

MATLAB[®] Coder[™]

Reference



MATLAB[®]

R2022a



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MATLAB® Coder™ Reference

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Revision History

| | | |
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Check Bug Reports for Issues and Fixes

Software is inherently complex and is not free of errors. The output of a code generator might contain bugs, some of which are not detected by a compiler. MathWorks reports critical known bugs brought to its attention on its Bug Report system at www.mathworks.com/support/bugreports/. In the search bar, type the phrase "Incorrect Code Generation" to obtain a report of known bugs that produce code that might compile and execute, but still produce wrong answers. To save a search, click Save Search.

The bug reports are an integral part of the documentation for each release. Examine periodically all bug reports for a release, as such reports may identify inconsistencies between the actual behavior of a release you are using and the behavior described in this documentation.

In addition to reviewing bug reports, you should implement a verification and validation strategy to identify potential bugs in your design, code, and tools.

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Apps

MATLAB Coder

Generate C code or MEX function from MATLAB code

Description

The **MATLAB Coder** app generates C or C++ code from MATLAB code. You can generate:

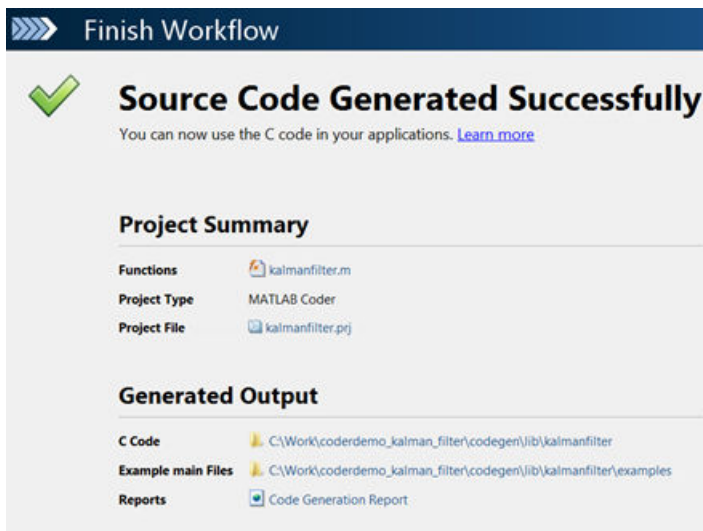
- C or C++ source code, static libraries, dynamically linked libraries, and executables that you can integrate into existing C or C++ applications outside of MATLAB.
- MEX functions for accelerated versions of your MATLAB functions.

The workflow-based user interface steps you through the code generation process. Using the app, you can:

- Create a project or open an existing project. The project specifies the input files, entry-point function input types, and build configuration.
- Review code generation readiness issues, including unsupported functions.
- Check your MATLAB function for run-time issues.
- Fix issues in your MATLAB code using the integrated editor.
- Convert floating-point MATLAB code to fixed-point C code (requires a Fixed-Point Designer™ license).
- Convert double-precision MATLAB code to single-precision C code (requires a Fixed-Point Designer license).
- Trace from MATLAB code to generated C or C++ source code through comments.
- See static code metrics (requires an Embedded Coder® license).
- Verify the numerical behavior of generated code using software-in-the-loop and processor-in-the-loop execution (requires an Embedded Coder license).
- Export project settings in the form of a MATLAB script.
- Access generated files.
- Package generated files as a single zip file for deployment outside of MATLAB.

When the app creates a project, if the Embedded Coder product is installed, the app enables Embedded Coder features. When Embedded Coder features are enabled, code generation requires an Embedded Coder license. To disable Embedded Coder features, in the project build settings, on the **All Settings** tab, under **Advanced**, set **Use Embedded Coder features** to No.

The **MATLAB Coder** app is not supported in MATLAB Online™.



Open the MATLAB Coder App

- MATLAB Toolstrip: On the **Apps** tab, under **Code Generation**, click the app icon.
- MATLAB command prompt: Enter coder.

Examples

- “Generate C Code by Using the MATLAB Coder App”

Programmatic Use

coder

See Also

Apps

Fixed-Point Converter

Functions

codegen

Topics

“Generate C Code by Using the MATLAB Coder App”

Simulation Data Inspector

Inspect and compare data and simulation results to validate and iterate model designs

Description

The Simulation Data Inspector visualizes and compares multiple kinds of data.

Using the Simulation Data Inspector, you can inspect and compare time series data at multiple stages of your workflow. This example workflow shows how the Simulation Data Inspector supports all stages of the design cycle:

1 “View Data in the Simulation Data Inspector” (Simulink).

Run a simulation in a model configured to log data to the Simulation Data Inspector, or import data from the workspace or a MAT-file. You can view and verify model input data or inspect logged simulation data while iteratively modifying your model diagram, parameter values, or model configuration.

2 “Inspect Simulation Data” (Simulink).

Plot signals on multiple subplots, zoom in and out on specified plot axes, and use data cursors to understand and evaluate the data. “Create Plots Using the Simulation Data Inspector” (Simulink) to tell your story.

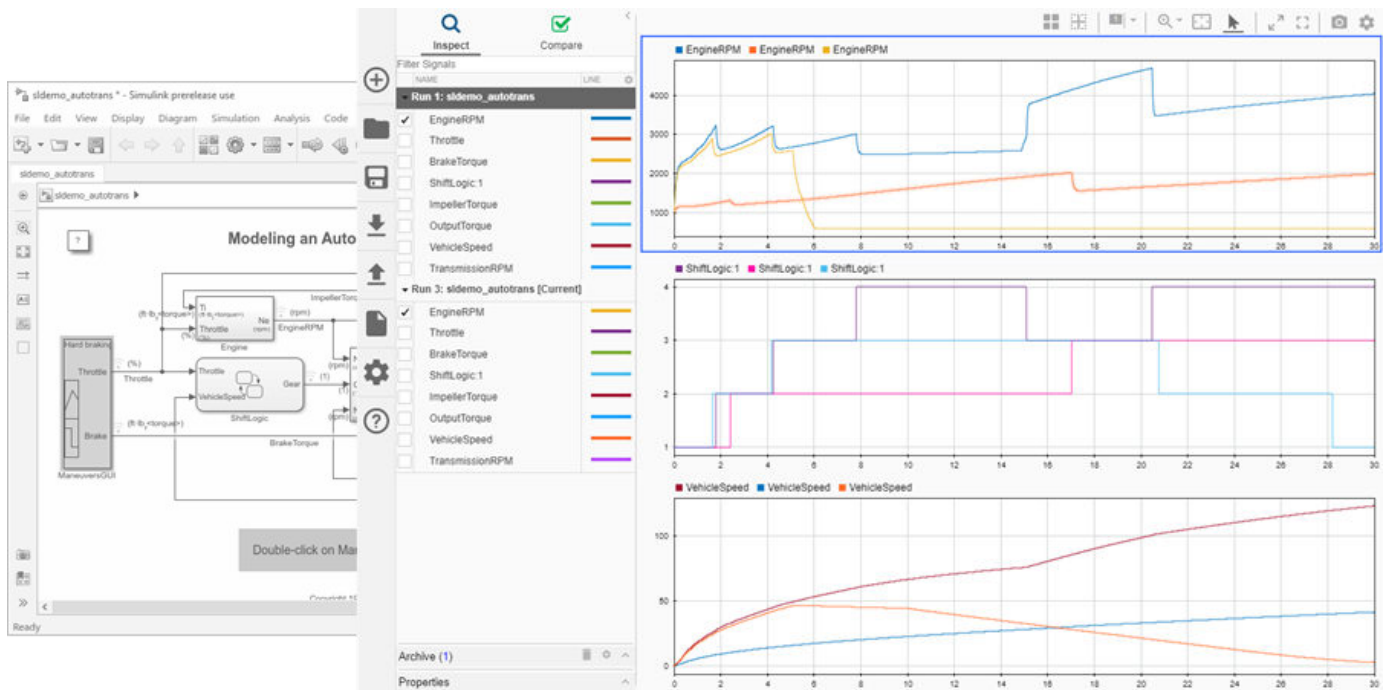
3 “Compare Simulation Data” (Simulink)

Compare individual signals or simulation runs and analyze your comparison results with relative, absolute, and time tolerances. The compare tools in the Simulation Data Inspector facilitate iterative design and allow you to highlight signals that do not meet your tolerance requirements. For more information about the comparison operation, see “How the Simulation Data Inspector Compares Data” (Simulink).

4 “Save and Share Simulation Data Inspector Data and Views” (Simulink).

Share your findings with others by saving Simulation Data Inspector data and views.

You can also harness the capabilities of the Simulation Data Inspector from the command line. For more information, see “Inspect and Compare Data Programmatically” (Simulink).



Open the Simulation Data Inspector

- Simulink® Toolstrip: On the **Simulation** tab, under **Review Results**, click **Data Inspector**.
- Click the streaming badge on a signal to open the Simulation Data Inspector and plot the signal.
- MATLAB command prompt: Enter `Simulink.sdi.view`.

Examples

Apply a Tolerance to a Signal in Multiple Runs

You can use the Simulation Data Inspector programmatic interface to modify a parameter for the same signal in multiple runs. This example adds an absolute tolerance of 0.1 to a signal in all four runs of data.

First, clear the workspace and load the Simulation Data Inspector session with the data. The session includes logged data from four simulations of a Simulink® model of a longitudinal controller for an aircraft.

```
Simulink.sdi.clear
Simulink.sdi.load('AircraftExample.mldatx');
```

Use the `Simulink.sdi.getRunCount` function to get the number of runs in the Simulation Data Inspector. You can use this number as the index for a for loop that operates on each run.

```
count = Simulink.sdi.getRunCount;
```

Then, use a for loop to assign the absolute tolerance of 0.1 to the first signal in each run.

```
for a = 1:count
    runID = Simulink.sdi.getRunIDByIndex(a);
    aircraftRun = Simulink.sdi.getRun(runID);
    sig = getSignalByIndex(aircraftRun,1);
    sig.AbsTol = 0.1;
end
```

- “View Data in the Simulation Data Inspector” (Simulink)
- “Inspect Simulation Data” (Simulink)
- “Compare Simulation Data” (Simulink)
- “Iterate Model Design Using the Simulation Data Inspector” (Simulink)

Programmatic Use

`Simulink.sdi.view` opens the Simulation Data Inspector from the MATLAB command line.

See Also

Functions

`Simulink.sdi.clear` | `Simulink.sdi.clearPreferences` | `Simulink.sdi.snapshot`

Topics

“View Data in the Simulation Data Inspector” (Simulink)

“Inspect Simulation Data” (Simulink)

“Compare Simulation Data” (Simulink)

“Iterate Model Design Using the Simulation Data Inspector” (Simulink)

Introduced in R2010b

Functions

addCompileFlags

Add compiler options to build information

Syntax

```
addCompileFlags(buildinfo,options,groups)
```

Description

`addCompileFlags(buildinfo,options,groups)` specifies the compiler options to add to the build information.

The function requires the *buildinfo* and *options* arguments. You can use an optional *groups* argument to group your options.

The code generator stores the compiler options in a build information object. The function adds options to the object based on the order in which you specify them.

Examples

Add Compiler Flags to OPTS Group

Add the compiler option `-O3` to the build information `myBuildInfo` and place the option in the group `OPTS`.

```
myBuildInfo = RTW.BuildInfo;  
addCompileFlags(myBuildInfo,'-O3','OPTS');
```

Add Compiler Flags to OPT_OPTS Group

Add the compiler options `-Zi` and `-Wall` to the build information `myBuildInfo` and place the options in the group `OPT_OPTS`.

```
myBuildInfo = RTW.BuildInfo;  
addCompileFlags(myBuildInfo,'-Zi -Wall','OPT_OPTS');
```

Add Compiler Flags to Build Information

For a non-makefile build environment, add the compiler options `-Zi`, `-Wall`, and `-O3` to the build information `myBuildInfo`. Place the options `-Zi` and `-Wall` in the group `Debug` and the option `-O3` in the group `MemOpt`.

```
myBuildInfo = RTW.BuildInfo;
addCompileFlags(myBuildInfo,{'-Zi -Wall' '-O3'}, ...
    {'Debug' 'MemOpt'});
```

Input Arguments

buildinfo — Build information object

object

RTW.BuildInfo object that contains information for compiling and linking generated code.

options — List of compiler options to add to build information

character vector | array of character vectors | string

You can specify the *options* argument as a character vector, as an array of character vectors, or as a string. You can specify the *options* argument as multiple compiler flags within a single character vector, for example `'-Zi -Wall'`. If you specify the *options* argument as multiple character vectors, for example, `'-Zi -Wall'` and `'-O3'`, the *options* argument is added to the build information as an array of character vectors.

Example: `{'-Zi -Wall' '-O3'}`

groups — Optional group name for the added compiler options

character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, `'Debug' 'MemOpt'`, the function relates the *groups* to the *options* in order of appearance. For example, the *options* argument `{'-Zi -Wall' '-O3'}` is an array of character vectors with two elements. The first element is in the `'Debug'` group and the second element is in the `'MemOpt'` group.

Note The template makefile-based build process considers only compiler flags in the `'OPTS'`, `'OPT_OPTS'`, and `'OPTIMIZATION_FLAGS'` groups when generating the makefile.

For the build process to consider compiler flags in other groups, the template makefile must contain the token `|>COMPILE_FLAGS_OTHER<|`.

Example: `{'Debug' 'MemOpt'}`

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

“Customize Template Makefiles” (Simulink Coder)

Introduced in R2006a

addDefines

Add preprocessor macro definitions to build information

Syntax

```
addDefines(buildinfo,macrodefs,groups)
```

Description

`addDefines(buildinfo,macrodefs,groups)` specifies the preprocessor macro definitions to add to the build information.

The function requires the *buildinfo* and *macrodefs* arguments. You can use an optional *groups* argument to group your options.

The code generator stores the definitions in a build information object. The function adds definitions to the object based on the order in which you specify them.

Examples

Add Macro Definitions to OPTS Group

Add the macro definition `-DPRODUCTION` to the build information `myBuildInfo` and place the definition in the group `OPTS`.

```
myBuildInfo = RTW.BuildInfo;  
addDefines(myBuildInfo, '-DPRODUCTION', 'OPTS');
```

Add Macro Definitions to OPT_OPTS Group

Add the macro definitions `-DPROTO` and `-DDEBUG` to the build information `myBuildInfo` and place the definitions in the group `OPT_OPTS`.

```
myBuildInfo = RTW.BuildInfo;  
addDefines(myBuildInfo, ...  
    '-DPROTO -DDEBUG', 'OPT_OPTS');
```

Add Macro Definitions to Build Information

For a non-makefile build environment, add the macro definitions `-DPROTO`, `-DDEBUG`, and `-DPRODUCTION` to the build information `myBuildInfo`. Place the definitions `-DPROTO` and `-DDEBUG` in the group `Debug` and the definition `-DPRODUCTION` in the group `Release`.

```
myBuildInfo = RTW.BuildInfo;  
addDefines(myBuildInfo, ...
```



```
{'-DPROTO -DDEBUG' '-DPRODUCTION'}, ...
{'Debug' 'Release'});
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo` object

Object contains information for compiling and linking generated code.

macrodefs — List of macro definitions to add to build information

character vector | array of character vectors | string

You can specify the *macrodefs* argument as a character vector, as an array of character vectors, or as a string. You can specify the *macrodefs* argument as multiple definitions within a single character vector, for example `'-DRT -DDEBUG'`. If you specify the *macrodefs* argument as multiple character vectors, for example `'-DPROTO -DDEBUG'` and `'-DPRODUCTION'`, the *macrodefs* argument is added to the build information as an array of character vectors.

Example: `{'-DPROTO -DDEBUG' '-DPRODUCTION'}`

groups — Optional group name for the added compiler options

character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example `'Debug' 'Release'`, the function relates the *groups* to the *macrodefs* in order of appearance. For example, the *macrodefs* argument `{'-DPROTO -DDEBUG' '-DPRODUCTION'}` is an array of character vectors with two elements. The first element is in the `'Debug'` group and the second element is in the `'Release'` group.

Note The template makefile-based build process considers only macro definitions in the `'OPTS'`, `'OPT_OPTS'`, `'OPTIMIZATION_FLAGS'`, and `'Custom'` groups when generating the makefile.

For the build process to consider definitions in other groups, the template makefile must contain the token `|>DEFINES_OTHER<|`.

Example: `{'Debug' 'Release'}`

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)
 “Customize Template Makefiles” (Simulink Coder)

Introduced in R2006a

addIncludeFiles

Add include files to build information

Syntax

```
addIncludeFiles(buildinfo,filenames,paths,groups)
```

Description

`addIncludeFiles(buildinfo,filenames,paths,groups)` specifies included files and paths to add to the build information.

The function requires the *buildinfo* and *filenames* arguments. You can use an optional *paths* argument to specify the included file paths and use an optional *groups* argument to group your options.

The code generator stores the included file and path options in a build information object. The function adds options to the object based on the order in which you specify them.

Note The function does **not**:

- Add the file paths to the compiler search path. See .
 - Produce `#include` directives in the generated code
-

Examples

Add Included File to SysFiles Group

Add the include file `mytypes.h` to the build information `myBuildInfo` and place the file in the group `SysFiles`.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo, ...
    'mytypes.h', '/proj/src', 'SysFiles');
```

Add Included Files to AppFiles Group

Add the include files `etc.h` and `etc_private.h` to the build information `myBuildInfo`, and place the files in the group `AppFiles`.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo, ...
    {'etc.h' 'etc_private.h'}, ...
    '/proj/src', 'AppFiles');
```

Add Included Files to SysFiles and AppFiles Groups

Add the include files `etc.h`, `etc_private.h`, and `mytypes.h` to the build information `myBuildInfo`. Group the files `etc.h` and `etc_private.h` with the character vector `AppFiles` and the file `mytypes.h` with the character vector `SysFiles`.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo, ...
{'etc.h' 'etc_private.h' 'mytypes.h'}, ...
 '/proj/src', ...
 {'AppFiles' 'AppFiles' 'SysFiles'});
```

Add Included Files with Wildcard to HFiles Group

Add the include files (.h files identified with a wildcard character) in a specified folder to the build information `myBuildInfo`, and place the files in the group `HFiles`.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo, ...
 '*.h', '/proj/src', 'HFiles');
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo`
object

Object provides information for compiling and linking generated code.

filenames — List of included files to add to build information
character vector | array of character vectors | string

You can specify the *filenames* argument as a character vector, as an array of character vectors, or as a string. If you specify the *filenames* argument as multiple character vectors, for example, `'etc.h' 'etc_private.h'`, the *filenames* argument is added to the build information as an array of character vectors.

If the dot delimiter (.) is present, the file name text can include wildcard characters. Examples are `*.*`, `*.h`, and `*.h*`.

The function removes duplicate included file entries with an exact match of a path and file name to a previously defined entry in the build information object.

Example: `*.h`

paths — List of included file paths to add to build information
character vector | array of character vectors | string

You can specify the *paths* argument as a character vector, as an array of character vectors, or as a string. If you specify a single path as a character vector, the function uses that path for all files. If you specify the *paths* argument as multiple character vectors, for example, `'/proj/src'` and `'/proj/inc'`, the *paths* argument is added to the build information as an array of character vectors.

Example: `'/proj/src'`

groups — Optional group name for the added included files

character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, 'AppFiles' 'AppFiles' 'SysFiles', the function relates the *groups* to the *filenames* in order of appearance. For example, the *filenames* argument 'etc.h' 'etc_private.h' 'mytypes.h' is an array of character vectors with three elements. The first element is in the 'AppFiles' group, the second element is in the 'AppFiles' group, and the third element is in the 'SysFiles' group.

Example: 'AppFiles' 'AppFiles' 'SysFiles'

See Also**Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2006a

addIncludePaths

Add include paths to build information

Syntax

```
addIncludePaths(buildinfo,paths,groups)
```

Description

`addIncludePaths(buildinfo,paths,groups)` specifies included file paths to add to the build information.

The function requires the *buildinfo* and *paths* arguments. You can use an optional *groups* argument to group your options.

The code generator stores the included file path options in a build information object. The function adds options to the object based on the order in which you specify them.

The function adds the file paths to the compiler search path.

The code generator does not check whether a specified path is valid.

Examples

Add Include File Path to Build Information

Add the include path `/etcproj/etc/etc_build` to the build information `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addIncludePaths(myBuildInfo,...
    '/etcproj/etc/etc_build');
```

Add Include File Paths to a Group

Add the include paths `/etcproj/etclib` and `/etcproj/etc/etc_build` to the build information `myBuildInfo` and place the files in the group `etc`.

```
myBuildInfo = RTW.BuildInfo;
addIncludePaths(myBuildInfo,...
    {'/etcproj/etclib' '/etcproj/etc/etc_build'}, 'etc');
```

Add Include File Paths to Groups

Add the include paths `/etcproj/etclib`, `/etcproj/etc/etc_build`, and `/common/lib` to the build information `myBuildInfo`. Group the paths `/etc/proj/etclib` and `/etcproj/etc/etc_build` with the character vector `etc` and the path `/common/lib` with the character vector `shared`.

```
myBuildInfo = RTW.BuildInfo;
addIncludePaths(myBuildInfo,...
    {'/etc/proj/etclib' '/etcproj/etc/etc_build'...
    '/common/lib'}, {'etc' 'etc' 'shared'});
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo`
object

paths — List of included file paths to add to build information
character vector | array of character vectors | string

You can specify the *paths* argument as a character vector, as an array of character vectors, or as a string. If you specify a single path as a character vector, the function uses that path for all files. If you specify the *paths* argument as multiple character vectors, for example, `'/proj/src'` and `'/proj/inc'`, the *paths* argument is added to the build information as an array of character vectors.

The function removes duplicate include file path entries with an exact match of a path and file name to a previously defined entry in the build information object.

Example: `'/proj/src'`

groups — Optional group name for the added included files
character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, `'etc' 'etc' 'shared'`, the function relates the *groups* to the *paths* in order of appearance. For example, the *paths* argument `'/etc/proj/etclib' '/etcproj/etc/etc_build' '/common/lib'` is an array of character vectors with three elements. The first element is in the `'etc'` group, the second element is in the `'etc'` group, and the third element is in the `'shared'` group.

Example: `'etc' 'etc' 'shared'`

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2006a

addLinkFlags

Add link options to build information

Syntax

```
addLinkFlags(buildinfo,options,groups)
```

Description

`addLinkFlags(buildinfo,options,groups)` specifies the linker options to add to the build information.

The function requires the *buildinfo* and *options* arguments. You can use an optional *groups* argument to group your options.

The code generator stores the linker options in a build information object. The function adds options to the object based on the order in which you specify them.

Examples

Add Linker Flags to OPTS Group

Add the linker -T option to the build information `myBuildInfo` and place the option in the group `OPTS`.

```
myBuildInfo = RTW.BuildInfo;  
addLinkFlags(myBuildInfo, '-T', 'OPTS');
```

Add Linker Flags to OPT_OPTS Group

Add the linker options -MD and -Gy to the build information `myBuildInfo` and place the options in the group `OPT_OPTS`.

```
myBuildInfo = RTW.BuildInfo;  
addLinkFlags(myBuildInfo, '-MD -Gy', 'OPT_OPTS');
```

Add Linker Flags to Build Information

For a non-makefile build environment, add the linker options -MD, -Gy, and -T to the build information `myBuildInfo`. Place the options -MD and -Gy in the group `Debug` and the option -T in the group `Temp`.

```
myBuildInfo = RTW.BuildInfo;  
addLinkFlags(myBuildInfo, {'-MD -Gy' '-T'}, ...  
    {'Debug' 'Temp'});
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo` object

options — List of linker options to add to build information

character vector | array of character vectors | string

You can specify the *options* argument as a character vector, as an array of character vectors, or as a string. You can specify the *options* argument as multiple compiler flags within a single character vector, for example `'-MD -Gy'`. If you specify the *options* argument as multiple character vectors, for example, `'-MD -Gy'` and `'-T'`, the *options* argument is added to the build information as an array of character vectors.

Example: `{'-MD -Gy' '-T'}`

groups — Optional group name for the added linker options

character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, `'Debug' 'Temp'`, the function relates the *groups* to the *options* in order of appearance. For example, the *options* argument `{'-MD -Gy' '-T'}` is an array of character vectors with two elements. The first element is in the `'Debug'` group and the second element is in the `Temp` group.

Example: `{'Debug' 'Temp'}`

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2006a

addLinkObjects

Add link objects to build information

Syntax

```
addLinkObjects(buildinfo,linkobjs,paths,priority,precompiled,linkonly,groups)
```

Description

`addLinkObjects(buildinfo,linkobjs,paths,priority,precompiled,linkonly,groups)` specifies included files and paths to add to the build information.

The function requires the *buildinfo*, *linkobjs*, and *paths* arguments. You can optionally select *priority* for link objects, select whether the objects are *precompiled*, select whether the objects are *linkonly* objects, and apply a *groups* argument to group your options.

The code generator stores the included link object and path options in a build information object. The function adds options to the object based on the order in which you specify them.

Examples

Add Link Objects to Build Information

Add the linkable objects `libobj1` and `libobj2` to the build information `myBuildInfo`. Mark both objects as link-only. Since individual priorities are not specified, the function adds the objects to the vector in the order specified.

```
myBuildInfo = RTW.BuildInfo;
addLinkObjects(myBuildInfo,{'libobj1' 'libobj2'}, ...
    {'/proj/lib/lib1' '/proj/lib/lib2'},1000, ...
    false,true);
```

Add Prioritized Link-Only Link Objects to Build Information

Add the linkable objects `libobj1` and `libobj2` to the build information `myBuildInfo`. Set the priorities of the objects to 26 and 10, respectively. Because `libobj2` is assigned the lower numeric priority value and has the higher priority, the function orders the objects such that `libobj2` precedes `libobj1` in the vector.

```
myBuildInfo = RTW.BuildInfo;
addLinkObjects(myBuildInfo, {'libobj1' 'libobj2'}, ...
    {'/proj/lib/lib1' '/proj/lib/lib2'},[26 10]);
```

Add Precompiled Link Objects to MyTest Group

Add the linkable objects `libobj1` and `libobj2` to the build information `myBuildInfo`. Set the priorities of the objects to 26 and 10, respectively. Mark both objects as precompiled. Group them under the name `MyTest`.

```
myBuildInfo = RTW.BuildInfo;
addLinkObjects(myBuildInfo,{'libobj1' 'libobj2'}, ...
    {'/proj/lib/lib1' '/proj/lib/lib2'},[26 10], ...
    true,false,'MyTest');
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo`
object

linkobjs — List of linkable object files to add to build information
character vector | array of character vectors | string

You can specify the *linkobjs* argument as a character vector, as an array of character vectors, or as a string. If you specify the *linkobjs* argument as multiple character vectors, for example, `'libobj1' 'libobj2'`, the *linkobjs* argument is added to the build information as an array of character vectors.

The function removes duplicate linkable object entries with an exact match of a path and file name to a previously defined entry in the build information object.

Example: `'libobj1'`

paths — List of included file paths to add to build information
character vector | array of character vectors | string

You can specify the *paths* argument as a character vector, as an array of character vectors, or as a string. If you specify a single path as a character vector, the function uses that path for all files. If you specify the *paths* argument as multiple character vectors, for example, `'/proj/lib/lib1' and '/proj/lib/lib2'`, the *paths* argument is added to the build information as an array of character vectors. The number of elements in *paths* must match the number of elements in the *linkobjs* argument.

Example: `'/proj/lib/lib1'`

priority — List of priority values for link objects to add to build information
1000 (default) | numeric value | array of numeric values

A numeric value or an array of numeric values that indicates the relative priority of each specified link object. Lower values have higher priority.

Example: `1000`

precompiled — List of precompiled indicators for link objects to add to build information
false (default) | true | array of logical values

A logical value or an array of logical values that indicates whether each specified link object is precompiled. The logical value `true` indicates precompiled.

Example: `false`

Linkonly — List of link-only indicators for link objects to add to build information`false` (default) | `true`

A logical value or an array of logical values that indicates whether each specified link object is link-only (not precompiled). The logical value `true` indicates link-only. If *linkonly* is `true`, the value of the *precompiled* argument is ignored.

Example: `false`

groups — Optional group name for the added link object files`character vector` | `array of character vectors` | `string`

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, `'MyTest1' 'MyTest2'`, the function relates the *groups* to the *linkobjs* in order of appearance. For example, the *linkobjs* argument `'libobj1' 'libobj2'` is an array of character vectors with two elements. The first element is in the `'MyTest1'` group, and the second element is in the `'MyTest2'` group.

Example: `'MyTest1' 'MyTest2'`

See Also**Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2006a

addNonBuildFiles

Add nonbuild-related files to build information

Syntax

```
addNonBuildFiles(buildinfo, filenames, paths, groups)
```

Description

`addNonBuildFiles(buildinfo, filenames, paths, groups)` specifies nonbuild-related files and paths to add to the build information.

The function requires the *buildinfo* and *filenames* arguments. You can use an optional *paths* argument to specify the included file paths and use an optional *groups* argument to group your options.

The code generator stores the nonbuild-related file and path options in a build information object. The function adds options to the object based on the order in which you specify them.

Examples

Add Nonbuild File to DocFiles Group

Add the nonbuild-related file `readme.txt` to the build information `myBuildInfo`, and place the file in the group `DocFiles`.

```
myBuildInfo = RTW.BuildInfo;
addNonBuildFiles(myBuildInfo, ...
    'readme.txt', '/proj/docs', 'DocFiles');
```

Add Nonbuild Files to DLLFiles Group

Add the nonbuild-related files `myutility1.dll` and `myutility2.dll` to the build information `myBuildInfo`, and place the files in the group `DLLFiles`.

```
myBuildInfo = RTW.BuildInfo;
addNonBuildFiles(myBuildInfo, ...
    {'myutility1.dll' 'myutility2.dll'}, ...
    '/proj/dlls', 'DLLFiles');
```

Add Nonbuild Files with Wildcard to DLLFiles Group

Add nonbuild-related files (`.dll` files identified with a wildcard character) in a specified folder to the build information `myBuildInfo`, and place the files in the group `DLLFiles`.

```
myBuildInfo = RTW.BuildInfo;
addNonBuildFiles(myBuildInfo, ...
    '*.dll', '/proj/dlls', 'DLLFiles');
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo` object

filenames — List of nonbuild-related files to add to build information
character vector | array of character vectors | string

You can specify the *filenames* argument as a character vector, as an array of character vectors, or as a string. If you specify the *filenames* argument as multiple character vectors, for example, 'etc.dll' 'etc_private.dll', the *filenames* argument is added to the build information as an array of character vectors.

If the dot delimiter (.) is present, the file name text can include wildcard characters. Examples are '*.*', '*.dll', and '*.d*'.

The function removes duplicate nonbuild-related file entries with an exact match of a path and file name to a previously defined entry in the build information object.

Example: '*.dll'

paths — List of nonbuild-related file paths to add to build information
character vector | array of character vectors | string

You can specify the *paths* argument as a character vector, as an array of character vectors, or as a string. If you specify a single path as a character vector, the function uses that path for all files. If you specify the *paths* argument as multiple character vectors, for example, '/proj/dll' and '/proj/docs', the *paths* argument is added to the build information as an array of character vectors.

Example: '/proj/dll'

groups — Optional group name for the added nonbuild-related files
character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, 'DLLFiles' 'DLLFiles' 'DocFiles', the function relates the *groups* to the *filenames* in order of appearance. For example, the *filenames* argument 'myutility1.dll' 'myutility2.dll' 'readme.txt' is an array of character vectors with three elements. The first element is in the 'DLLFiles' group, the second element is in the 'DLLFiles' group, and the third element is in the 'DocFiles' group.

Example: 'DLLFiles' 'DLLFiles' 'DocFiles'

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2008a

addSourceFiles

Add source files to build information

Syntax

```
addSourceFiles(buildinfo, filenames, paths, groups)
```

Description

`addSourceFiles(buildinfo, filenames, paths, groups)` specifies source files and paths to add to the build information.

The function requires the *buildinfo* and *filenames* arguments. You can use an optional *groups* argument to group your options.

The code generator stores the source file and path options in a build information object. The function adds options to the object based on the order in which you specify them.

Examples

Add Source File to Drivers Group

Add the source file `driver.c` to the build information `myBuildInfo` and place the file in the group `Drivers`.

```
myBuildInfo = RTW.BuildInfo;
addSourceFiles(myBuildInfo, 'driver.c', ...
    '/proj/src', 'Drivers');
```

Add Source Files to a Group

Add the source files `test1.c` and `test2.c` to the build information `myBuildInfo` and place the files in the group `Tests`.

```
myBuildInfo = RTW.BuildInfo;
addSourceFiles(myBuildInfo, ...
    {'test1.c' 'test2.c'}, ...
    '/proj/src', 'Tests');
```

Add Source Files to Groups

Add the source files `test1.c`, `test2.c`, and `driver.c` to the build information `myBuildInfo`. Group the files `test1.c` and `test2.c` with the character vector `Tests`. Group the file `driver.c` with the character vector `Drivers`.

```
myBuildInfo = RTW.BuildInfo;
addSourceFiles(myBuildInfo, ...
```

```
{'test1.c' 'test2.c' 'driver.c'}, ...
'/proj/src', ...
{'Tests' 'Tests' 'Drivers'});
```

Add Source Files with Wildcard to CFiles Group

Add the .c files in a specified folder to the build information myBuildInfo and place the files in the group CFiles.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo, ...
    '*.c', '/proj/src', 'CFiles');
```

Input Arguments

buildinfo — Build information object

object

RTW.BuildInfo object that holds information for compiling and linking generated code.

Example: myBuildInfo

filenames — List of source files to add to build information

character vector | array of character vectors | string

You can specify the *filenames* argument as a character vector, as an array of character vectors, or as a string. If you specify the *filenames* argument as multiple character vectors, for example, 'etc.c' 'etc_private.c', the *filenames* argument is added to the build information as an array of character vectors.

If the dot delimiter (.) is present, the file name text can include wildcard characters. Examples are '*.*', '*.c', and '*.c*'.

The function removes duplicate included file entries with an exact match of a path and file name to a previously defined entry in the build information object.

Example: '*.c'

paths — List of source file paths to add to build information

character vector | array of character vectors | string

You can specify the *paths* argument as a character vector, as an array of character vectors, or as a string. If you specify a single path as a character vector, the function uses that path for all files. If you specify the *paths* argument as multiple character vectors, for example, '/proj/src' and '/proj/inc', the *paths* argument is added to the build information as an array of character vectors.

Example: '/proj/src'

groups — Optional group name for the added source files

character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, 'Tests' 'Tests' 'Drivers', the function relates the *groups* to the *filenames* in order of appearance. For example, the *filenames*

argument `'test1.c' 'test2.c' 'driver.c'` is an array of character vectors with three elements. The first element is in the `'Tests'` group, and the second element is in the `'Tests'` group, and the third element is in the `'Drivers'` group.

Example: `'Tests' 'Tests' 'Drivers'`

See Also

[addIncludeFiles](#) | [addIncludePaths](#) | [addSourcePaths](#) | [getSourceFiles](#) | [removeSourceFiles](#) | [updateFilePathsAndExtensions](#) | [updateFileSeparator](#)

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2006a

addSourcePaths

Add source paths to build information

Syntax

```
addSourcePaths(buildinfo, paths, groups)
```

Description

`addSourcePaths(buildinfo, paths, groups)` specifies source file paths to add to the build information.

The function requires the *buildinfo* and *paths* arguments. You can use an optional *groups* argument to group your options.

The code generator stores the source file path options in a build information object. The function adds options to the object based on the order in which you specify them.

The code generator does not check whether a specified path is valid.

Note If you want to add source files and the corresponding file paths to build information, use the `addSourceFiles` function. Do not use `addSourcePaths`.

Examples

Add Source File Path to Build Information

Add the source path `/etcproj/etc/etc_build` to the build information `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo, ...
    '/etcproj/etc/etc_build');
```

Add Source File Paths to a Group

Add the source paths `/etcproj/etclib` and `/etcproj/etc/etc_build` to the build information `myBuildInfo` and place the files in the group `etc`.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo, ...
    {'/etcproj/etclib' '/etcproj/etc/etc_build'}, 'etc');
```

Add Source File Paths to Groups

Add the source paths `/etcproj/etclib`, `/etcproj/etc/etc_build`, and `/common/lib` to the build information `myBuildInfo`. Group the paths `/etcproj/etclib` and `/etcproj/etc/`

`etc_build` with the character vector `etc` and the path `/common/lib` with the character vector `shared`.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo,...
    {'/etc/proj/etclib' '/etcproj/etc/etc_build'...
    '/common/lib'}, {'etc' 'etc' 'shared'});
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo`
object

paths — List of source file paths to add to build information
character vector | array of character vectors | string

You can specify the *paths* argument as a character vector, as an array of character vectors, or as a string. If you specify a single path as a character vector, the function uses that path for all files. If you specify the *paths* argument as multiple character vectors, for example, `'/proj/src'` and `'/proj/inc'`, the *paths* argument is added to the build information as an array of character vectors.

The function removes duplicate source file path entries with an exact match of a path and file name to a previously defined entry in the build information object.

Example: `'/proj/src'`

groups — Optional group name for the added source files
character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, `'etc' 'etc' 'shared'`, the function relates the *groups* to the *paths* in order of appearance. For example, the *paths* argument `'/etc/proj/etclib' '/etcproj/etc/etc_build' '/common/lib'` is an array of character vectors with three elements. The first element is in the `'etc'` group, the second element is in the `'etc'` group, and the third element is in the `'shared'` group.

Example: `'etc' 'etc' 'shared'`

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2006a

addTMFTokens

Add template makefile (TMF) tokens to build information

Syntax

```
addTMFTokens(buildinfo, tokennames, tokenvalues, groups)
```

Description

`addTMFTokens(buildinfo, tokennames, tokenvalues, groups)` specifies TMF tokens and values to add to the build information.

To provide build-time information to help customize makefile generation, call the `addTMFTokens` function inside a post-code-generation command. The tokens specified in the `addTMFTokens` function call must be handled in the template makefile (TMF) for the target selected for your project. For example, you can call `addTMFTokens` in a post-code-generation command to add a TMF token named `|>CUSTOM_OUTNAME<|` with a token value that specifies an output file name for the build. To achieve the result you want, the TMF must apply an action with the value of `|>CUSTOM_OUTNAME<|`. (See “Examples” on page 2-0 .)

The `addTMFTokens` function adds specified TMF token names and values to the build information. The code generator stores the TMF tokens in a vector. The function adds the tokens to the end of the vector in the order that you specify them.

The function requires the *buildinfo*, *tokennames*, and *tokenvalues* arguments. You can use an optional *groups* argument to group your options. You can specify *groups* as a character vector or as an array of character vectors.

Examples

Add TMF Tokens to Build Information

Inside a post-code-generation command, add the TMF token `|>CUSTOM_OUTNAME<|` and its value to build information `myBuildInfo`, and place the token in the group `LINK_INFO`.

```
myBuildInfo = RTW.BuildInfo;
addTMFTokens(myBuildInfo, ...
    '|>CUSTOM_OUTNAME<|', 'foo.exe', 'LINK_INFO');
```

Apply Build Information as Tokens in TMF Build

In the TMF for the target selected for your project, this code uses the token value to achieve the result that you want:

```
CUSTOM_OUTNAME = |>CUSTOM_OUTNAME<|
...
```

```
target:  
$(LD) -o $(CUSTOM_OUTNAME) ...
```

Input Arguments

buildinfo — Name of build information object returned by `RTW.BuildInfo` object

tokennames — Specifies names of TMF tokens to add to the build information
character vector | array of character vectors | string

You can specify the *tokennames* argument as a character vector, as an array of character vectors, or as a string. If you specify the *tokennames* argument as multiple character vectors, for example, '|>CUSTOM_OUTNAME<|' '|>COMPUTER<|', the *tokennames* argument is added to the build information as an array of character vectors.

Example: '|>CUSTOM_OUTNAME<|' '|>COMPUTER<|'

tokenvalues — Specifies TMF token values (for the added tokens) to add to the build information

character vector | array of character vectors | string

You can specify the *tokenvalues* argument as a character vector, as an array of character vectors, or as a string. If you specify the *tokenvalues* argument as multiple character vectors, for example, '|>CUSTOM_OUTNAME<|' 'PCWIN64', the *tokennames* argument is added to the build information as an array of character vectors.

Example: 'foo.exe' 'PCWIN64'

groups — Optional group name for the added TMF tokens

character vector | array of character vectors | string

You can specify the *groups* argument as a character vector, as an array of character vectors, or as a string. If you specify multiple *groups*, for example, 'LINK_INFO' 'COMPUTER_INFO', the function relates the *groups* to the *tokennames* in order of appearance. For example, the *tokennames* argument '|>CUSTOM_OUTNAME<|' '|>COMPUTER<|' is an array of character vectors with two elements. The first element is in the 'LINK_INFO' group, and the second element is in the 'COMPUTER_INFO' group.

Example: 'LINK_INFO' 'COMPUTER_INFO'

See Also

Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

Introduced in R2009b

cnncodegen

Generate code for a deep learning network to target the ARM Mali GPU

Syntax

```
cnncodegen(net,'targetlib','arm-compute-mali')
cnncodegen(net,'targetlib','arm-compute-mali',targetparams)
```

Description

`cnncodegen(net,'targetlib','arm-compute-mali')` generates C++ code for the specified network object by using the ARM® Compute Library for Mali GPUs.

Requires the GPU Coder™ product and the GPU Coder Interface for Deep Learning Libraries.

`cnncodegen(net,'targetlib','arm-compute-mali',targetparams)` generates C++ code for the specified network object by using the ARM Compute Library for Mali GPUs with additional code generation options.

Examples

Generate C++ Code for a Pretrained Network to Run on an ARM Processor

Use `cnncodegen` to generate C++ code for a pretrained network for deployment to an ARM Mali graphics processor.

Get the pretrained GoogLeNet model by using the `googlenet` function. This function requires the Deep Learning Toolbox™ Model for GoogLeNet Network. If you have not installed this support package, the function provides a download link. Alternatively, see <https://www.mathworks.com/matlabcentral/fileexchange/64456-deep-learning-toolbox-model-for-googlenet-network>.

```
net = googlenet;
```

Generate code by using `cnncodegen` with `'targetlib'` set to `'arm-compute-mali'`. By default, the code generator targets version `'19.05'` of the ARM. To target a different version of the Compute Library, use the `'ArmComputeVersion'` parameter.

```
cnncodegen(net,'targetlib','arm-compute-mali'...
,'targetparams',struct('ArmComputeVersion','19.02'));
```

```
-----
Compilation suppressed: generating code only.
-----
```

```
### Codegen Successfully Generated for arm device
```

The code generator generates the `.cpp` and header files in the `'/pwd/codegen'` folder. The DAG network is generated as a C++ class called `CnnMain`, containing an array of 87 layer classes. The code generator reduces the number of layers by layer fusion optimization of convolutional and batch normalization layers. The `setup()` method of this class sets up handles and allocates resources for each layer object. The `predict()` method invokes prediction for each of the 87 layers

in the network. The `cleanup()` method releases all the memory and system resources allocated for each layer object. All the binary weights (`cnn_**_w`) and the bias files (`cnn_**_b`) for the convolution layers of the network are stored in the codegen folder.

To build the library, move the generated code to the ARM target platform and use the generated makefile `cnnbuild_rtw.mk`.

Input Arguments

net — Pretrained deep learning network object

character vector | string scalar

Pretrained `SeriesNetwork` or `DAGNetwork` object.

Note `cnncodegen` does not support `dlnetwork` objects.

targetparams — Library-specific parameters

structure

ARM Compute Library-specific parameters specified as a 1-by-1 structure containing the fields described in these tables.

| Field | Description |
|--------------------------------|--|
| <code>ArmComputeVersion</code> | Version of ARM Compute Library on the target hardware, specified as '19.02' or '19.05'. The default value is '19.05'. If you set <code>ArmComputeVersion</code> to a version later than '19.05', <code>ArmComputeVersion</code> is set to '19.05'. |

Compatibility Considerations

Changes to Target Library Support

From R2021b, the `cnncodegen` function generates C++ code and makefiles to build a static library for only the ARM Mali GPU processor by using the ARM Compute Library for computer vision and machine learning.

For all other targets, use the `codegen` command. Write an entry-point function in MATLAB that uses the `coder.loadDeepLearningNetwork` function to load a deep learning model and calls `predict` to predict the responses. For example,

```
function out = googlenet_predict(in) %#codegen
persistent mynet;
if isempty(mynet)
    mynet = coder.loadDeepLearningNetwork('googlenet');
end
% pass in input
out = predict(mynet,in);
```

This table shows some typical usages of `cnncodegen` and how to update your code to use `codegen` instead.

| Target workflow | Not recommended | Recommended |
|---|---|---|
| <p>ARM CPU processor supporting NEON instructions</p> | <p>Set the 'targetlib' parameter to 'arm-compute'. Specify the ARM Compute Library version to generate code for and the ARM architecture on the target hardware by using the 'targetparams' parameter.</p> <pre data-bbox="654 659 1049 772">cnncodegen(net, 'targetlib' ... , 'arm-compute', 'targetparams' ... , struct('ArmComputeVersion' ... , '19.02', 'ArmArchitecture' ... , 'armv8'))</pre> <p>Other supported versions of ARM Compute Library are '18.11', '19.02', '19.05', or '20.02.1'. The default value is '20.02.1'. If you set <code>ArmComputeVersion</code> to a version later than '20.02.1', <code>ArmComputeVersion</code> is set to '20.02.1'</p> <p>You can specify the ARM architecture as 'armv7' or 'armv8'. The specified architecture must be the same as the architecture for the ARM Compute Library on the target hardware.</p> | <p>Create a <code>coder.config</code> configuration object for generation of a static library.</p> <pre data-bbox="1065 506 1438 562">cfg = coder.config('lib'); cfg.TargetLang = 'C++';</pre> <p>Create a <code>coder.ARMNEONConfig</code> deep learning configuration object. Specify target library-specific properties of the deep learning configuration object. Assign it to the <code>DeepLearningConfig</code> property of the <code>cfg</code> configuration object.</p> <pre data-bbox="1065 894 1471 1010">dlcfg = coder.DeepLearningConfig ... ('arm-compute'); dlcfg.ArmArchitecture = 'armv8'; dlcfg.ArmComputeVersion = '19.02'; cfg.DeepLearningConfig = dlcfg;</pre> <p>Use the <code>-config</code> option of the <code>codegen</code> function to specify the <code>cfg</code> configuration object. The <code>codegen</code> function must determine the size, class, and complexity of MATLAB function inputs. Use the <code>-args</code> option to specify the size of the input to the entry-point function.</p> <pre data-bbox="1065 1339 1446 1409">arg = {ones(224,224,3, 'single')}; codegen -args arg ... -config cfg googlenet_predict</pre> <p>For more information, see “Code Generation for Deep Learning Networks with ARM Compute Library”.</p> |

| Target workflow | Not recommended | Recommended |
|--|--|--|
| <p>NVIDIA® GPUs by using the CUDA® Deep Neural Network library (cuDNN)</p> | <p>Set the 'targetlib' parameter to 'cudnn'. Specify cuDNN library-specific properties by using the 'targetparams' parameter.</p> <pre data-bbox="652 478 1050 640"> cnncodegen(net,'targetlib'... ,'cudnn','ComputeCapability'... ,'7.0','targetparams' ... ,struct('AutoTuning',true ... ,'DataType','INT8'... ,'CalibrationResultFile' ... ,'myInt8Cal.mat')) </pre> <p>The auto tuning feature allows the cuDNN library to find the fastest convolution algorithms.</p> <p>The 'DataType' parameter specifies the precision of the inference computations in supported layers. When performing inference in 32-bit floats, use 'FP32'.</p> | <p>Create a coder.gpuConfig configuration object for generation of a static library.</p> <pre data-bbox="1063 415 1396 462"> cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; </pre> <p>To set the minimum compute capability for code generation, use the ComputeCapability property of the GPU code configuration object.</p> <pre data-bbox="1063 661 1523 688"> cfg.GpuConfig.ComputeCapability = '7.0'; </pre> <p>Create a deep learning configuration object. Specify target library-specific properties of the deep learning configuration object. Assign it to the DeepLearningConfig property of the cfg configuration object.</p> <pre data-bbox="1063 991 1624 1134"> dlcfg = coder.DeepLearningConfig('cudnn'); dlcfg.AutoTuning = true; dlcfg.DataType = 'int8'; dlcfg.CalibrationResultFile = 'myInt8Ca...'; cfg.DeepLearningConfig = dlcfg; </pre> <p>Use the -config option of the codegen function to specify the cfg configuration object. The codegen function must determine the size, class, and complexity of MATLAB function inputs. Use the -args option to specify the size of the input to the entry-point function.</p> <pre data-bbox="1063 1465 1445 1533"> arg = {ones(224,224,3,'single')}; codegen -args arg ... -config cfg googlenet_predict </pre> <p>For more information, see “Code Generation for Deep Learning Networks by Using cuDNN” (GPU Coder).</p> |

| Target workflow | Not recommended | Recommended |
|----------------------|--|--|
| Intel® CPU processor | <p>To use the Intel Math Kernel Library for Deep Neural Networks (MKL-DNN) for Intel CPUs, set the 'targetlib' parameter to 'mklcnn'.</p> <pre>cnncodegen(net, 'targetlib'... , 'mklcnn');</pre> | <p>Create a <code>coder.config</code> configuration object for generation of a static library.</p> <pre>cfg = coder.config('lib'); cfg.TargetLang = 'C++';</pre> <p>Create a <code>coder.MkLDNNConfig</code> deep learning configuration object. Assign it to the <code>DeepLearningConfig</code> property of the <code>cfg</code> configuration object.</p> <pre>dldcfg = coder.DeepLearningConfig... ('mklcnn'); cfg.DeepLearningConfig = dldcfg;</pre> <p>Use the <code>-config</code> option of the <code>codegen</code> function to specify the <code>cfg</code> configuration object. The <code>codegen</code> function must determine the size, class, and complexity of MATLAB function inputs. Use the <code>-args</code> option to specify the size of the input to the entry-point function.</p> <pre>arg = {ones(224,224,3,'single')}; codegen -args arg ... -config cfg googlenet_predict</pre> <p>For more information, see “Code Generation for Deep Learning Networks with MKL-DNN”.</p> |

| Target workflow | Not recommended | Recommended |
|--|---|--|
| <p>NVIDIA GPUs by using NVIDIA TensorRT, a high performance deep learning inference optimizer and run-time library</p> | <p>Set the 'targetlib' parameter to 'tensorrt'. Specify TensorRT library-specific properties by using the 'targetparams' parameter.</p> <pre> cnncodegen(net,'targetlib'... ,'tensorrt','ComputeCapability'... ,'7.0','targetparams' ... ,struct('DataType','INT8' ... 'DataPath','image_dataset'... ,'NumCalibrationBatches',50)) </pre> | <p>Create a <code>coder.gpuConfig</code> configuration object for generation of a static library.</p> <pre> cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; </pre> <p>To set the minimum compute capability for code generation, use the <code>ComputeCapability</code> property of the GPU code configuration object.</p> <pre> cfg.GpuConfig.ComputeCapability = '7.0'; </pre> <p>Create a <code>coder.TensorRTConfig</code> deep learning configuration object. Specify target library-specific properties of the deep learning configuration object. Assign it to the <code>DeepLearningConfig</code> property of the <code>cfg</code> configuration object.</p> <pre> dlcfg = coder.DeepLearningConfig... ('cudnn'); dlcfg.DataType = 'int8'; dlcfg.DataPath = 'image_dataset'; dlcfg.NumCalibrationBatches = 50; cfg.DeepLearningConfig = dlcfg; </pre> <p>Use the <code>-config</code> option of the <code>codegen</code> function to specify the <code>cfg</code> configuration object. The <code>codegen</code> function must determine the size, class, and complexity of MATLAB function inputs. Use the <code>-args</code> option to specify the size of the input to the entry-point function.</p> <pre> arg = {ones(224,224,3,'single')}; codegen -args arg ... -config cfg googlenet_predict </pre> <p>For more information, see “Deep Learning Prediction by Using NVIDIA TensorRT” (GPU Coder).</p> |

| Target workflow | Not recommended | Recommended |
|-----------------|---|--|
| General options | Generate code without generating and building a makefile. For example, <pre>cnncodegen(net, 'targetlib' ... , 'mkl_dnn', 'codegenonly', 1);</pre> | To produce the source code without invoking the make command or build object code, use the <code>GenCodeOnly</code> property of the <code>coder.CodeConfig</code> or <code>coder.GPUCodeConfig</code> object. For example, <pre>cfg = coder.codeConfig('lib'); cfg.GenCodeOnly = true;</pre> |
| | Specifying the NVIDIA GPU compute capability to compile for. Argument takes the format of <code>major#.minor#</code> . <pre>cnncodegen(net, 'targetlib' ... , 'cudnn', 'ComputeCapability', '7.0');</pre> | To set the minimum compute capability for code generation, use the <code>ComputeCapability</code> property of the GPU code configuration object. <pre>cfg = coder.gpuConfig('lib'); cfg.GpuConfig.ComputeCapability = '7.0';</pre> |

See Also

Functions

`codegen` | `coder.loadDeepLearningNetwork`

Topics

“Code Generation for Deep Learning Networks with MKL-DNN”
 “Deep Learning Prediction with ARM Compute Using `codegen`”
 “Code Generation for Object Detection by Using YOLO v2” (GPU Coder)
 “Deep Learning Prediction by Using NVIDIA TensorRT” (GPU Coder)

Introduced in R2017b

codegen

Generate C/C++ code from MATLAB code

Syntax

```
codegen options function -args {func_inputs}
codegen options files function -args {func_inputs}
codegen options files function -args {func_inputs} -nargout number_args
codegen options files function1 -args {func1_inputs} ... functionN -args
{funcN_inputs}
codegen options files function -args {func_inputs1} ... -args {func_inputsN}

codegen project
```

Description

`codegen options function -args {func_inputs}` generates C or C++ code from a MATLAB function with inputs of type `func_inputs` and builds the generated code. Use the `options` argument to specify settings such as the code generation configuration object. The configuration object controls build type (MEX, lib, dll, or exe) and code generation parameters. For information on creating and using a configuration object, see “Configure Build Settings”, `coder.config`, and the configuration object reference pages: `coder.CodeConfig`, `coder.MexCodeConfig`, and `coder.EmbeddedCodeConfig`.

If the function does not have inputs, omit the function-specific `-args {func_inputs}` option.

`codegen options files function -args {func_inputs}` generates C/C++ code from a MATLAB function that uses custom source code specified in external files. For more information, see “Call Custom C/C++ Code from the Generated Code” and “Configure Build for External C/C++ Code”.

`codegen options files function -args {func_inputs} -nargout number_args` generates C/C++ code and controls the number of output arguments for the C/C++ function code generated from the MATLAB function. The files and options arguments are optional. Use the `-nargout` option when not all of the MATLAB function outputs are needed. For more information, see “Specify Number of Entry-Point Function Input or Output Arguments to Generate”.

`codegen options files function1 -args {func1_inputs} ... functionN -args {funcN_inputs}` generates C/C++ code from multiple MATLAB functions. Write the input arguments separately for each function following the function name. You can also use the `-nargout` option for each function. The functions that you generate code from are called *entry-point functions*. For more information, see “Generate Code for Multiple Entry-Point Functions”.

`codegen options files function -args {func_inputs1} ... -args {func_inputsN}` generates multisignature MEX function from a MATLAB function. Provide multiple `-args` specifications for input arguments of the same entry-point function. Use the `options` argument to specify settings such as the code generation configuration object and parameters. You must specify the build type as MEX function. Other build types (lib, dll, and exe) are not supported. For more information, see “Generate One MEX Function for Multiple Signatures”.

codegen project generates code from a MATLAB Coder project file, for example, test.prj.

Examples

Generate a MEX Function from a MATLAB Function

Write a MATLAB function mcadd that returns the sum of two values.

```
function y = mcadd(u,v) %#codegen
% The directive %#codegen indicates that the function
% is intended for code generation
y = u + v;
end
```

At the MATLAB command line, run this codegen command.

```
codegen mcadd -args {[0 0 0 0],0}
```

The code generator produces a MEX file mcadd_mex in the current working folder.

- If you do not specify a build target, code generation defaults to MEX code generation. By default, the code generator names the generated MEX function mcadd_mex.
- To allow the generation of MEX or C/C++ code with specific types, you must specify the properties (class, size, and complexity) of all input variables to the MATLAB entry-point functions. In this example, you use the -args option to provide example values for the inputs. The code generator uses these example values to determine that the first input is a 1-by-4 array of real double values and the second input is a real scalar double.

The actual values of these example inputs are not relevant for code generation. Any other pair of values with the same properties (class, size, and complexity) results in the same generated code. See “Specify Properties of Entry-Point Function Inputs”.

At the command line, call the generated MEX function mcadd_mex. Make sure that the class, size, and complexity of the values that you pass to mcadd_mex match the input properties that you specified in the codegen command.

```
mcadd_mex([1 1 1 1],5)
```

```
ans =
```

```
    6    6    6    6
```

Running the MATLAB function mcadd with these input values produces the same output. This test case verifies that mcadd and mcadd_mex have the same behavior.

Generate a MEX Function from a MATLAB Function That Has Multiple Signatures

Write a MATLAB function myAdd that returns the sum of two values.

```
function y = myAdd(u,v) %#codegen
y = u + v;
end
```

At the MATLAB command line, run this `codegen` command.

```
codegen -config:mex myAdd.m -args {1,2} -args {int8(2),int8(3)} -args {1:10,1:10} -report
```

The code generator creates a single MEX function `myAdd_mex` for the multiple signatures specified in the `codegen` command. For more information, see “Generate One MEX Function for Multiple Signatures”.

Generate C Static Library Files in a Custom Folder

Write a MATLAB function, `mcadd`, that returns the sum of two values.

```
function y = mcadd(u,v) %#codegen  
y = u + v;
```

Generate the C library files in a custom folder `mcaddlib` using the `-config:lib` option. Specify the first input type as a 1-by-4 vector of unsigned 16-bit integers. Specify the second input as a double-precision scalar.

```
codegen -d mcaddlib -config:lib mcadd -args {zeros(1,4,'uint16'),0}
```

Generate an Executable

Write a MATLAB function, `coderRand`, that generates a random scalar value from the standard uniform distribution on the open interval (0,1).

```
function r = coderRand() %#codegen  
r = rand();
```

Write a main C function, `c:\myfiles\main.c`, that calls `coderRand`.

```
/*  
** main.c  
*/  
#include <stdio.h>  
#include <stdlib.h>  
#include "coderRand.h"  
#include "coderRand_initialize.h"  
#include "coderRand_terminate.h"  
int main()  
{  
    coderRand_initialize();  
    printf("coderRand=%g\n", coderRand());  
    coderRand_terminate();  
  
    puts("Press enter to quit:");  
    getchar();  
  
    return 0;  
}
```

Configure your code generation parameters to include the main C function, then generate the C executable.

```
cfg = coder.config('exe')  
cfg.CustomSource = 'main.c'
```

```
cfg.CustomInclude = 'c:\myfiles'
codegen -config cfg coderRand
```

codegen generates a C executable, `coderRand.exe`, in the current folder, and supporting files in the default folder, `codegen\exe\coderRand`.

This example shows how to specify a main function as a parameter in the configuration object `coder.CodeConfig`. Alternatively, you can specify the file containing `main()` separately at the command line. You can use a source, object, or library file.

For a more detailed example, see “Use an Example C Main in an Application”.

Generate Code That Uses a Variable-Size Input

Write a MATLAB function that takes a single input.

```
function y = halfValue(vector) %codegen
    y = 0.5 * vector;
end
```

Use `coder.typeof` to define an input type as a row vector of doubles with a maximum size of 1-by-16, with the second dimension variable-size.

```
vectorType = coder.typeof(1, [1 16], [false true]);
```

Generate a C static library.

```
codegen -config:lib halfValue -args {vectorType}
```

Generate Code That Uses Global Data

Write a MATLAB function, `use_globals`, that takes one input parameter `u` and uses two global variables `AR` and `B`.

```
function y = use_globals(u)
%#codegen
% Turn off inlining to make
% generated code easier to read
coder.inline('never');
global AR;
global B;
AR(1) = u(1) + B(1);
y = AR * 2;
```

Generate a MEX function. By default, `codegen` generates a MEX function named `use_globals_mex` in the current folder. Specify the properties of the global variables at the command line by using the `-globals` option. Specify that input `u` is a real, scalar, double, by using the `-args` option.

```
codegen -globals {'AR', ones(4), 'B', [1 2 3 4]} use_globals -args {0}
```

Alternatively, you can initialize the global data in the MATLAB workspace. At the MATLAB prompt, enter:

```
global AR B;
AR = ones(4);
B = [1 2 3];
```

Generate the MEX function.

```
codegen use_globals -args {0}
```

Generate Code That Accepts an Enumerated Type Input

Write a function, `displayState`, that uses enumerated data to activate an LED display, based on the state of a device. It lights a green LED display to indicate the ON state. It lights a red LED display to indicate the OFF state.

```
function led = displayState(state)
%#codegen

if state == sysMode.ON
    led = LEDcolor.GREEN;
else
    led = LEDcolor.RED;
end
```

Define an enumeration `LEDcolor`. On the MATLAB path, create a file named 'LEDColor' containing:

```
classdef LEDcolor < int32
    enumeration
        GREEN(1),
        RED(2),
    end
end
```

Create a `coder.EnumType` object using a value from an existing MATLAB enumeration.

Define an enumeration `sysMode`. On the MATLAB path, create a file named 'sysMode' containing:

```
classdef sysMode < int32
    enumeration
        OFF(0)
        ON(1)
    end
end
```

Create a `coder.EnumType` object from this enumeration.

```
t = coder.typeof(sysMode.OFF);
```

Generate a MEX function for `displayState`.

```
codegen displayState -args {t}
```

Generate a Static Library That Accepts a Fixed-Point Input

Write a MATLAB language function, `mcsqrtfi`, that computes the square root of a fixed-point input.


```
function y = mcsqrtfi(x) %#codegen
y = sqrt(x);
```

Define `numericType` and `fimath` properties for the fixed-point input `x` and generate C library code for `mcsqrtfi` using the `-config:lib` option.

```
T = numericType('WordLength',32, ...
               'FractionLength',23, ...
               'Signed',true)
F = fimath('SumMode','SpecifyPrecision', ...
          'SumWordLength',32, ...
          'SumFractionLength',23, ...
          'ProductMode','SpecifyPrecision', ...
          'ProductWordLength',32, ...
          'ProductFractionLength',23)
% Define a fixed-point variable with these
% numericType and fimath properties
myfiprops = {fi(4.0,T,F)}
codegen -config:lib mcsqrtfi -args myfiprops
```

`codegen` generates C library and supporting files in the default folder, `codegen/lib/mcsqrtfi`.

Generate a Static C++ Library That Accepts Half-Precision Inputs

You can generate code for MATLAB code that accepts half-precision inputs. For more information, see `half`.

Write a MATLAB function `foo` that returns the sum of two values.

```
function y = foo(a,b)
y = a + b;
end
```

At the MATLAB command line, run this `codegen` command.

```
codegen -lang:c++ -config:lib foo -args {half(0),half(0)} -report
```

Code generation successful: [View report](#)

The code generator produces a static C++ library in `work\codegen\lib\foo`, where `work` is the current working folder.

To view the code generation report, click [View report](#). In the report viewer, inspect the generated C++ source code in the file `foo.cpp`.

```
real16_T foo(real16_T a, real16_T b)
{
    return a + b;
}
```

The generated function `foo` accepts and returns half-precision values. The C++ half-precision type `real16_T` is defined in the generated header file `rtw_half.h`. Inspect the definition of the `+` operator of the class `real16_T`.

The generated code in this example converts half-precision inputs to single-precision, performs the addition operation in single-precision, and converts the result back into half-precision.

Convert Floating-Point MATLAB Code to Fixed-Point C Code

This example requires Fixed-Point Designer.

Write a MATLAB function, `myadd`, that returns the sum of two values.

```
function y = myadd(u,v) %#codegen
    y = u + v;
end
```

Write a MATLAB function, `myadd_test`, to test `myadd`.

```
function y = myadd_test %#codegen
    y = myadd(10,20);
end
```

Create a `coder.FixptConfig` object, `fixptcfg`, with default settings.

```
fixptcfg = coder.config('fixpt');
```

Set the test bench name.

```
fixptcfg.TestBenchName = 'myadd_test';
```

Create a code generation configuration object to generate a standalone C static library.

```
cfg = coder.config('lib');
```

Generate the code using the `-float2fixed` option.

```
codegen -float2fixed fixptcfg -config cfg myadd
```

Convert codegen command to equivalent MATLAB Coder project

Define a MATLAB function, `myadd`, that returns the sum of two values.

```
function y = myadd(u,v) %#codegen
    y = u + v;
end
```

Create a `coder.CodeConfig` object for generating a static library. Set `TargetLang` to `'C++'`.

```
cfg = coder.config('lib');
cfg.TargetLang = 'C++';
```

At the MATLAB command line, create and run a `codegen` command. Specify `myadd` as the entry-point function. Specify the inputs to `myadd` to be variable-size matrices of type `double` whose dimensions are unbounded. Specify `cfg` as the code configuration object. Include the `-toproject` option to convert the `codegen` command to an equivalent MATLAB Coder project file with name `myadd_project.prj`.

```
codegen -config cfg myadd -args {coder.typeof(1,[Inf,Inf]),coder.typeof(1,[Inf,Inf])} -toproject
```

Project file 'myadd_project.prj' was successfully created.
Open Project

The code generator creates the project file `myadd_project.prj` in the current working folder. Running `codegen` with the `-toproject` option does not generate code. It only creates the project file.

Generate code from `myadd_project.prj` by using another `codegen` command.

```
codegen myadd_project.prj
```

The code generator produces a C++ static library function `myadd` in the `work\codegen\lib\myadd` folder, where `work` is your current working directory.

Input Arguments

options — Code generation options

option value | space delimited list of option values

The `codegen` command gives precedence to individual command-line options over options specified by a configuration object. If command-line options conflict, the rightmost option prevails. The order of the options and the other syntax elements is interchangeable.

Specified as one or more of these values:

| | |
|-----------------------------|---|
| <code>-c</code> | Generate C/C++ code, but do not invoke the <code>make</code> command. |
| <code>-config:dll</code> | Generate a dynamic C/C++ library using the default configuration parameters. |
| <code>-config:exe</code> | Generate a static C/C++ executable using the default configuration parameters. |
| <code>-config:lib</code> | Generate a static C/C++ library using the default configuration parameters. |
| <code>-config:mex</code> | Generate a MEX function using the default configuration parameters. |
| <code>-config:single</code> | Generate single-precision MATLAB code using the default configuration parameters. |
| | Requires Fixed-Point Designer. |

-config *config_object*

Specify the configuration object that contains the code generation parameters. *config_object* is one of the following configuration objects:

- `coder.CodeConfig` — Parameters for standalone C/C++ library or executable generation if Embedded Coder is not available.

```
% Configuration object for a dynamic linked library
cfg = coder.config('dll')
% Configuration object for an executable
cfg = coder.config('exe')
% Configuration object for a static standalone library
cfg = coder.config('lib')
```

- `coder.EmbeddedCodeConfig`— Parameters for a standalone C/C++ library or executable generation if Embedded Coder is available.

```
% Configuration object for a dynamic linked library
ec_cfg = coder.config('dll')
% Configuration object for an executable
ec_cfg = coder.config('exe')
% Configuration object for a static standalone library
ec_cfg = coder.config('lib')
```

- `coder.MexCodeConfig` — Parameters for MEX code generation.

```
mex_cfg = coder.config
% or
mex_cfg = coder.config('mex')
```

For more information, see “Configure Build Settings”.

-d *out_folder*

Store generated files in the absolute or relative path specified by *out_folder*. *out_folder* must not contain:

- Spaces, as spaces can lead to code generation failures in certain operating system configurations.
- Non 7-bit ASCII characters, such as Japanese characters,

If the folder specified by *out_folder* does not exist, `codegen` creates it.

If you do not specify the folder location, `codegen` generates files in the default folder:

codegen/target/fcn_name.

target can be:

- *mex* for MEX functions
- *exe* for embeddable C/C++ executables
- *lib* for embeddable C/C++ libraries
- *dll* for C/C++ dynamic libraries

fcn_name is the name of the first MATLAB function (alphabetically) at the command line.

The function does not support the following characters in folder names: asterisk (*), question-mark (?), dollar (\$), and pound (#).

Note Each time `codegen` generates the same type of output for the same code, it removes the files from the previous build. If you want to preserve files from a previous build, before starting another build, copy them to a different location.

`-double2single double2single_cfg_name`

Generates single-precision MATLAB code using the settings that the `coder.SingleConfig` object `double2single_cfg_name` specifies. `codegen` generates files in the folder `codegen/fcn_name/single`.

`fcn_name` is the name of the entry-point function.

When used with the `-config` option, also generates single-precision C/C++ code. `codegen` generates the single-precision files in the folder `codegen/target/folder_name`

`.target` can be:

- `mex` for MEX functions
- `exe` for embeddable C/C++ executables
- `lib` for embeddable C/C++ libraries
- `dll` for C/C++ dynamic libraries

`folder_name` is the concatenation of `fcn_name` and `singlesuffix`.

`singlesuffix` is the suffix that the `coder.SingleConfig` property `OutputFileNameSuffix` specifies. The single-precision files in this folder also have this suffix.

For more information, see “Generate Single-Precision MATLAB Code”. You must have Fixed-Point Designer to use this option.

`-float2fixed float2fixed_cfg_name`

When used with the `-config` option, generates fixed-point C/C++ code using the settings that the floating-point to fixed-point conversion configuration object *float2fixed_cfg_name* specifies.

codegen generates files in the folder `codegen/target/fcn_name_fixpt`. *target* can be:

- `mex` for MEX functions
- `exe` for embeddable C/C++ executables
- `lib` for embeddable C/C++ libraries
- `dll` for C/C++ dynamic libraries

fcn_name is the name of the entry-point function.

When used without the `-config` option, generates fixed-point MATLAB code using the settings that the floating-point to fixed-point conversion configuration object named *float2fixed_cfg_name* specifies. codegen generates files in the folder `codegen/fcn_name/fixpt`.

You must set the `TestBenchName` property of *float2fixed_cfg_name*. For example:

```
fixptcfg.TestBenchName = 'myadd_test';
```

This command specifies that `myadd_test` is the test file for the floating-point to fixed-point configuration object `fixptcfg`.

For more information, see “Convert MATLAB Code to Fixed-Point C Code”. You must have Fixed-Point Designer to use this option.

`-g`

Specify whether to use the debug option for the C compiler. If you enable debug mode, the C compiler disables some optimizations. The compilation is faster, but the execution is slower.

`-globals global_values`

Specify names and initial values for global variables in MATLAB files.

`global_values` is a cell array of global variable names and initial values. The format of `global_values` is:

```
{g1, init1, g2, init2, ..., gn, initn}
```

`gn` is the name of a global variable specified as a character vector. `initn` is the initial value. For example:

```
-globals {'g', 5}
```

Alternatively, use this format:

```
-globals {global_var, {type, initial_value}}
```

`type` is a type object. To create the type object, use `coder.typeof`. For global cell array variables, you must use this format.

Before generating code with `codegen`, initialize global variables. If you do not provide initial values for global variables using the `-globals` option, `codegen` checks for the variable in the MATLAB global workspace. If you do not supply an initial value, `codegen` generates an error.

MATLAB Coder and MATLAB each have their own copies of global data. For consistency, synchronize their global data whenever the two interact. If you do not synchronize the data, their global variables can differ.

To specify a constant value for a global variable, use `coder.Constant`. For example:

```
-globals {'g', coder.Constant(v)}
```

specifies that `g` is a global variable with constant value `v`.

For more information, see “Generate Code for Global Data”.

- `-I include_path` Add *include_path* to the beginning of the code generation path. When `codegen` searches for MATLAB functions and custom C/C++ files, it searches the code generation path first. It does not search for classes on the code generation path. Classes must be on the MATLAB search path. For more information, see “Paths and File Infrastructure Setup”.
- If the path contains characters that are not 7-bit ASCII, such as Japanese characters, it is possible that `codegen` does not find files on this path.
- If your *include_path* contains paths that contain spaces, enclose each instance in double quotes, for example:
- ```
'C:\Project "C:\Custom Files"'
```
- `-jit` Use just-in-time (JIT) compilation for generation of a MEX function. JIT compilation can speed up MEX function generation. This option applies only to MEX function generation. This option is not compatible with certain code generation features or options, such as custom code or using the OpenMP library.
- `-lang:c` Specify the language to use in the generated code as C.
- If you do not specify any target language, the code generator produces C code.
- `-lang:c++` Specify the language to use in the generated code as C++.
- `-launchreport` Generate and open a code generation report. If you do not specify this option, `codegen` generates a report only if error or warning messages occur or if you specify the `-report` option.

`-o output_file_name`

Generate the MEX function, C/C++ library, or C/C++ executable file with the base name *output\_file\_name* plus an extension:

- `.a` or `.lib` for C/C++ static libraries
- `.exe` or no extension for C/C++ executables
- `.dll` for C/C++ dynamic libraries on Microsoft® Windows® systems
- `.so` for C/C++ dynamic libraries on Linux® systems
- `.dylib` for C/C++ dynamic libraries on Mac systems
- Platform-dependent extension for generated MEX functions

*output\_file\_name* can be a file name or include an existing path. *output\_file\_name* must not contain spaces, as spaces can lead to code generation failures in certain operating system configurations.

For MEX functions, *output\_file\_name* must be a valid MATLAB function name.

If you do not specify an output file name for libraries and executables, the base name is *fcn\_1*. *fcn\_1* is the name of the first MATLAB function specified at the command line. For MEX functions, the base name is *fcn\_1\_mex*. You can run the original MATLAB function and the MEX function and compare the results.

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>-O optimization_option</code> | <p>Optimize generated code, based on the value of <i>optimization_option</i>:</p> <ul style="list-style-type: none"> <li>• <code>enable:inline</code> — Enable function inlining.</li> <li>• <code>disable:inline</code> — Disable function inlining. To learn more about function inlining, see “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.</li> <li>• <code>enable:openmp</code> — Use OpenMP library if available. Using the OpenMP library, the MEX functions or C/C++ code that codegen generates for <code>parfor</code>-loops can run on multiple threads.</li> <li>• <code>disable:openmp</code> — Disable OpenMP library. With OpenMP disabled, codegen treats <code>parfor</code>-loops as <code>for</code>-loops and generates a MEX function or C/C++ code that runs on a single thread. See “Control Compilation of <code>parfor</code>-Loops”.</li> </ul> <p>Specify <code>-O</code> at the command line once for each optimization.</p> <p>If not specified, codegen uses inlining and OpenMP for optimization.</p> |
| <code>-package zip_file_name</code> | <p>Package generated standalone code and its dependencies into a compressed ZIP file with name <i>zip_file_name</i>. You can then use the ZIP file to relocate, unpack, and rebuild the code files in another development environment.</p> <p>This packaging functionality is also provided by the <code>packNGo</code> function.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <code>-preservearraydims</code>     | <p>Generate code that uses N-dimensional indexing. For more information, see “Generate Code That Uses N-Dimensional Indexing”.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>-profile</code>               | <p>Enable profiling of generated MEX function by using the MATLAB Profiler. For more information, see “Profile MEX Functions by Using MATLAB Profiler”.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <code>-report</code>                | <p>Produce a code generation report. If you do not specify this option, codegen produces a report only if error or warning messages occur or if you specify the <code>-launchreport</code> option.</p> <p>If you have Embedded Coder, this option also enables production of the Code Replacements report.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <code>-reportinfo info</code>       | <p>Export information about code generation to the variable <i>info</i> in your base MATLAB workspace. See “Access Code Generation Report Information Programmatically”.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>-rowmajor</code>              | Generate code that uses row-major array layout. Column-major layout is the default. For more information, see “Generate Code That Uses Row-Major Array Layout”.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <code>-silent</code>                | If code generation succeeds without warning, suppress all messages, including when you generate a report.<br><br>Warning and error messages are displayed.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>-singleC</code>               | Generate single-precision C/C++ code. For more information, see “Generate Single-Precision C Code at the Command Line”.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <code>-std:c89/c90</code>           | You must have Fixed-Point Designer to use this option.<br>Use the C89/90 (ANSI) language standard for the generated code.                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <code>-std:c99</code>               | Use the C99 (ISO) language standard for the generated code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <code>-std:c++03</code>             | Use the C++03 (ISO) language standard for the generated code. You can use this library only if you generate C++ code.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <code>-std:c++11</code>             | Use the C++11 (ISO) language standard for the generated code. You can use this library only if you generate C++ code.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <code>-test <i>test_file</i></code> | Run <i>test_file</i> , replacing a call to the original MATLAB function with a call to the MEX function. Using this option is the same as running <code>coder.runTest</code> .<br><br>This option is supported only when generating MEX functions or when using a configuration object with <code>VerificationMode</code> set to 'SIL' or 'PIL'. Creation of a configuration object that has the <code>VerificationMode</code> parameter requires the Embedded Coder product.<br><br>This option is not supported with fixed-point conversion or single-precision conversion. |

`-toproject` *project\_file\_name*

Convert the `codegen` command to an equivalent MATLAB Coder project file named *project\_file\_name*. You can then generate code from the project file by using another `codegen` command or the MATLAB Coder app.

You can also use the `-toproject` option to convert an incomplete `codegen` command to a project file. For example, to create a project file `myProjectTemplate.prj` that contains only the code generation parameters stored in the configuration object `cfg`, run:

```
codegen -config cfg -toproject myProjectTemplate.prj
```

In this case, `myProjectTemplate.prj` does not contain specifications of entry-point functions or input types. So, you cannot generate code from this project file. You can open `myProjectTemplate.prj` in the MATLAB Coder app and use it as a template to create full project files that you can use to generate code.

Running `codegen` with the `-toproject` *project\_file\_name* option does not generate code. It creates only the project file.

See “Convert `codegen` Command to Equivalent MATLAB Coder Project”.

- `-v` Enable verbose mode to show code generation status and target build log messages.
- `-?` Display help for `codegen` command.

### **function** — Name of MATLAB function to generate code from

*function name*

Specified as a function existing in the current working folder or on the path. If the MATLAB file is on a path that contains non 7-bit ASCII characters, such as Japanese characters, the `codegen` command might not find the file.

If you are using the LCC compiler, do not name an entry-point function `main`.

Example: `codegen myAddFunction`

### **func\_inputs** — Example values for MATLAB function inputs

*expression* | *variable* | *literal value* | `coder.Type object`

Example values that define the size, class, and complexity of the inputs of the preceding MATLAB function. The position of the input in the cell array must correspond to the position of the input argument in the MATLAB function definition. Alternatively, instead of an example value, you can provide a `coder.Type` object. To create a `coder.Type` object, use `coder.typeof`.

To generate a function that has fewer input arguments than the function definition has, omit the example values for the arguments that you do not want.

For more information, see “Specify Properties of Entry-Point Function Inputs”.

Example: `codegen foo -args {1}`

Example: `codegen foo2 -args {1, ones(3,5)}`

Example: `codegen foo3 -args {1, ones(3,5), coder.typeof("hello")}`

### **files** — Names of custom source files

file name | space delimited list of file names

Space-separated list of custom files to include in generated code. The order of the options, external files, and function specifications is interchangeable. You can include these types of files:

- C file (.c)
- C++ file (.cpp)
- Header file (.h)
- Object file (.o or .obj)
- Library (.a, .so, .dylib, or .lib)
- Template makefile (.tmf)

---

**Note** Support for template makefiles (TMF) will be removed in a future release. Instead, use the toolchain approach for building the generated code.

---

If these files are on a path that contains non 7-bit ASCII characters, such as Japanese characters, the `codegen` command might not find the files.

Example: `codegen foo myLib.lib`

### **number\_args** — Number of output arguments in the generated entry-point function

integer

Number of output arguments in the C/C++ entry-point function generated for the preceding MATLAB function. The code generator produces the specified number of output arguments in the order in which they occur in the MATLAB function definition.

Example: `codegen myMLfnWithThreeOuts -nargout 2`

### **project** — Project file name

file name

Project file created from the MATLAB Coder app. The code generator uses the project file to set entry-point functions, input type definitions, and other options. To open the app and create or modify a project file, use the `coder` function.

Example: `codegen foo.prj`

## **Limitations**

- You cannot generate code for MATLAB scripts. Rewrite the script as a function to generate code.
- Generating code when the current folder is a private folder or an @ folder is not supported, because these folders have special meanings in MATLAB. You can generate code that invokes methods in @ folders and functions in private folders.

## Tips

- By default, code is generated in the folder `codegen/target/function`. MEX functions and executables are copied to the current working folder.
- To simplify your code generation process, you can write your code generation commands in a separate script. In the script, define your function input types and code generation options. To generate code, call the script.
- Each time `codegen` generates the same type of output for the same code or project, it removes the files from the previous build. If you want to preserve files from a previous build, before starting another build, copy the files to a different location.
- Use the `coder` function to open the MATLAB Coder app and create a MATLAB Coder project. The app provides a user interface that facilitates adding MATLAB files, defining input parameters, and specifying build parameters.
- You can call `codegen` by using function syntax. Specify the `codegen` arguments as character vectors or string scalars. For example:

```
codegen('myfunction', '-args', {2 3}, '-report')
```

- To provide a string scalar as an input or to specify a `codegen` argument as a string scalar, use the function syntax. For example:

```
codegen('myfunction', '-args', "mystring", '-report')
codegen("myfunction", "-args", "mystring", "-report")
```

Providing string scalar inputs to the command form of `codegen` can produce unexpected results. See “Choose Command Syntax or Function Syntax”.

- To perform programmatic `codegen` calls, use the function syntax. For example:

```
A = {'myfunction', '-args', {2 3}};
codegen(A{:})
```

## See Also

`coder` | `coder.typeof` | `fimath` | `numericType` | `mex` | `fi` | `coder.EnumType` | `coder.runTest` | `parfor` | `coder.FixptConfig` | `coder.config` | `packNGo`

## Topics

“Generate C Code at the Command Line”

“Generate C Code by Using the MATLAB Coder App”

“Build Process Customization”

## Introduced in R2011a


## coder

Open MATLAB Coder app

### Syntax

```
coder
coder projectname
coder -open projectname
coder -build projectname
coder -new projectname
coder -ecoder false -new projectname
coder -tocode projectname -script scriptname
coder -tocode projectname
coder -toconfig projectname
cfg = coder('-toconfig','projectname')
coder -typeEditor
```

### Description

`coder` opens the MATLAB Coder app. To create a project, on the **Select Source Files** page, provide the entry-point file names. The app creates a project with a default name that is the name of the first entry-point file. To open an existing project, on the app toolbar, click , and then click **Open existing project**.

If the Embedded Coder product is installed, when the app creates a project, it enables Embedded Coder features. When Embedded Coder features are enabled, code generation requires an Embedded Coder license. To disable Embedded Coder features, in the project build settings, on the **All Settings** tab, under **Advanced**, set **Use Embedded Coder features** to **No**.

`coder projectname` opens the MATLAB Coder app using the existing project named `projectname.prj`.

`coder -open projectname` opens the MATLAB Coder app using the existing project named `projectname.prj`.

`coder -build projectname` builds the existing project named `projectname.prj`.

`coder -new projectname` opens the MATLAB Coder app creating a project named `projectname.prj`. If the Embedded Coder product is installed, the app creates the project with Embedded Coder features enabled. To disable these features, in the project build settings, on the **All Settings** tab, under **Advanced**, set **Use Embedded Coder features** to **No**.

`coder -ecoder false -new projectname` opens the MATLAB Coder app creating a project named `projectname.prj`. The app creates the project with Embedded Coder features disabled even if the Embedded Coder product is installed.

`coder -tocode projectname -script scriptname` converts the existing project named `projectname.prj` to the equivalent script of MATLAB commands. The script is named `scriptname`.



- If `scriptname` exists, `coder` overwrites it.
- The script reproduces the project build configuration in a configuration object and builds the project. The script:
  - Creates a configuration object named `cfg`.
  - Defines the variable `ARGS` for function input types.
  - Defines the variable `GLOBALS` for global data initial values.
  - Runs the `codegen` command. When you run the script, the entry-point functions that are arguments to `codegen` must be on the search path.
- `cfg`, `ARGS`, and `GLOBALS` appear in the base workspace only after you run the script.

If the project includes automated fixed-point conversion, `coder` generates two scripts:

- A script `scriptname` that contains the MATLAB commands to:
  - Create a code configuration object that has the same settings as the project.
  - Run the `codegen` command to convert the fixed-point MATLAB function to a fixed-point C function.
- A script whose file name is a concatenation of the name specified by `scriptname` and the generated fixed-point file name suffix specified by the project file. If `scriptname` specifies a file extension, the script file name includes the file extension. For example, if `scriptname` is `myscript.m` and the suffix is the default value `_fixpt`, the script name is `myscript_fixpt.m`.

This script contains the MATLAB commands to:

- Create a floating-point to fixed-point conversion configuration object that has the same fixed-point conversion settings as the project.
- Run the `codegen` command to convert the floating-point MATLAB function to a fixed-point MATLAB function.

For a project that includes fixed-point conversion, before converting the project to scripts, complete the **Test Numerics** step of the fixed-point conversion process.

`coder -tocode projectname` converts the existing project named `projectname.prj` to the equivalent script of MATLAB commands. It writes the script to the Command Window.

`coder -toconfig projectname` exports the code configuration settings stored in a MATLAB Coder project file to a code configuration object. Executing this command returns a code configuration object corresponding to `projectname`. For more information on which code configuration object is returned for different project file settings, see “Share Build Configuration Settings”.

`cfg = coder('-toconfig','projectname')` returns a configuration object that contains the code configuration settings stored in a MATLAB Coder project file. Executing this command returns a code configuration object `cfg` corresponding to `projectname`. For more information on which code configuration object is returned for different project file settings, see “Share Build Configuration Settings”.

`coder -typeEditor` opens an empty Coder Type Editor dialog. If a dialog is already open, this command brings it to the front of the screen.

See “Create and Edit Input Types by Using the Coder Type Editor”.

## Examples

### Open an existing MATLAB Coder project

Open the MATLAB Coder app using the existing MATLAB Coder project named `my_coder_project`.

```
coder -open my_coder_project
```

### Build a MATLAB Coder project

Build the MATLAB Coder project named `my_coder_project`.

```
coder -build my_coder_project
```

### Create a MATLAB Coder project

Open the MATLAB Coder app and create a project named `my_coder_project`.

```
coder -new my_coder_project
```

### Convert a MATLAB Coder project to a MATLAB script

Convert the MATLAB Coder project named `my_coder_project.prj` to the MATLAB script named `myscript.m`.

```
coder -tocode my_coder_project -script my_script.m
```

### Create code configuration object from MATLAB Coder project

Define a MATLAB function, `myadd`, that returns the sum of two values.

```
function y = myadd(u,v) %#codegen
y = u + v;
end
```

Create a MATLAB Coder project `myadd.prj`:

- Open the MATLAB Coder app. Specify `myadd` as the entry point function.
- On the **Define Inputs Types** page, specify `u` and `v` as double scalars.
- On the **Generate Code** page, set **Build Type** to MEX. Leave other project file settings with their default values.

At the MATLAB command line, run this command:

```
cfg = coder('-toconfig', 'myadd.prj');
```

The code generator creates a `coder.MexCodeConfig` object `cfg` that contains the code configuration settings stored in `myadd.prj`.

Inspect the properties of `cfg`.

```

cfg =
 Description: 'class MexCodeConfig: MEX configuration objects with C code.'
 Name: 'MexCodeConfig'

----- Report -----
 GenerateReport: true
 LaunchReport: false
 ReportInfoVarName: ''
 ReportPotentialDifferences: false

----- Debugging -----
 EchoExpressions: true
 EnableDebugging: false
 EnableMexProfiling: false

----- Code Generation -----
 ConstantInputs: 'CheckValues'
 EnableJIT: false
 FilePartitionMethod: 'MapMFileToCFile'
 GenCodeOnly: false
 HighlightPotentialRowMajorIssues: true
 PostCodeGenCommand: ''
 PreserveArrayDimensions: false
 RowMajor: false
 TargetLang: 'C'

----- Language And Semantics -----
 CompileTimeRecursionLimit: 50
 ConstantFoldingTimeout: 40000
 DynamicMemoryAllocation: 'Threshold'
 DynamicMemoryAllocationThreshold: 65536
 EnableAutoExtrinsicCalls: true
 EnableRuntimeRecursion: true
 EnableVariableSizing: true
 ExtrinsicCalls: true
 GlobalDataSyncMethod: 'SyncAlways'
 InitFltsAndDblsToZero: true
 PreserveVariableNames: 'None'
 SaturateOnIntegerOverflow: true

----- C++ Language Features -----
 CppNamespace: ''

----- Safety (disable for faster execution) -----
 IntegrityChecks: true
 ResponsivenessChecks: true

----- Function Inlining and Stack Allocation -----

```

```
 InlineStackLimit: 4000
 InlineThreshold: 10
 InlineThresholdMax: 200
 StackUsageMax: 200000

----- Optimizations -----

 EnableMemcpy: true
 EnableOpenMP: true
 MemcpyThreshold: 64

----- Comments -----

 GenerateComments: true
 MATLABSourceComments: false

----- Custom Code -----

 CustomHeaderCode: ''
 CustomInclude: ''
 CustomInitializer: ''
 CustomLibrary: ''
 CustomSource: ''
 CustomSourceCode: ''
 CustomTerminator: ''
 ReservedNameArray: ''
```

## Input Arguments

### **projectname** — Name of MATLAB Coder project

project name

Name of MATLAB Coder project that you want to create, open, or build. The project name must not contain spaces.

### **scriptname** — Name of script file

script name

Name of script that you want to create when using the `-tocode` option with the `-script` option. The script name must not contain spaces.

## Output Arguments

### **cfg** — Code configuration object

`coder.MexCodeConfig` | `coder.CodeConfig` | `coder.EmbeddedCodeConfig`



Code configuration object that contains the configuration settings stored in a MATLAB Coder project file.

## Limitations

- The `coder` function is not supported in MATLAB Online.

## Tips

- If you are sharing an Embedded Coder license, use `coder -ecoder false -new projectname` to create a project that does not require this license. If the Embedded Coder product is installed, the app creates the project with Embedded Coder features disabled. When these features are disabled, code generation does not require an Embedded Coder license. To enable Embedded Coder features, in the project build settings, on the **All Settings** tab, under **Advanced**, set **Use Embedded Coder features** to Yes.
- Creating a project or opening an existing project causes other MATLAB Coder or Fixed-Point Converter projects to close.
- If your installation does not include the Embedded Coder product, the Embedded Coder settings do not show. However, values for these settings are saved in the project file. If you open the project in an installation that includes the Embedded Coder product, you see these settings.
- A Fixed-Point Converter project opens in the Fixed-Point Converter app. To convert the project to a MATLAB Coder project, in the Fixed-Point Converter app:

- 1  Click  and select **Reopen project as**.
- 2 Select MATLAB Coder.

## Alternatives

- On the **Apps** tab, in the **Code Generation** section, click **MATLAB Coder**.
- Use the `codegen` function to generate code at the command line.

## See Also

**MATLAB Coder** | `codegen` | `coder.MexCodeConfig` | `coder.CodeConfig` | `coder.EmbeddedCodeConfig`

## Topics

“Generate C Code by Using the MATLAB Coder App”  
 “Convert MATLAB Coder Project to MATLAB Script”  
 “Convert Fixed-Point Conversion Project to MATLAB Scripts”  
 “Share Build Configuration Settings”  
 “Convert MATLAB Code to Fixed-Point C Code”  
 “Create and Edit Input Types by Using the Coder Type Editor”

## Introduced in R2011a

## coder.allowpcode

**Package:** coder

Control code generation from protected MATLAB files

### Syntax

```
coder.allowpcode('plain')
```

### Description

`coder.allowpcode('plain')` allows you to generate protected MATLAB code (P-code) that you can then compile into optimized MEX functions or embeddable C/C++ code. This function does not obfuscate the generated MEX functions or embeddable C/C++ code.

With this capability, you can distribute algorithms as protected P-files that provide code generation optimizations.

Call this function in the top-level function before control-flow statements, such as `if`, `while`, `switch`, and function calls.

MATLAB functions can call P-code. When the `.m` and `.p` versions of a file exist in the same folder, the P-file takes precedence.

`coder.allowpcode` is ignored outside of code generation.

### Examples

Generate optimized embeddable code from protected MATLAB code:

- 1 Write an function `p_abs` that returns the absolute value of its input:

```
function out = p_abs(in) %#codegen
% The directive %#codegen indicates that the function
% is intended for code generation
coder.allowpcode('plain');
out = abs(in);
```

- 2 Generate protected P-code. At the MATLAB prompt, enter:

```
pcode p_abs
```

The P-file, `p_abs.p`, appears in the current folder.

- 3 Generate a MEX function for `p_abs.p`, using the `-args` option to specify the size, class, and complexity of the input parameter (requires a MATLAB Coder license). At the MATLAB prompt, enter:

```
codegen p_abs -args { int32(0) }
```

`codegen` generates a MEX function in the current folder.

- 4 Generate embeddable C code for `p_abs.p` (requires a MATLAB Coder license). At the MATLAB prompt, enter:

```
codegen p_abs -config:lib -args { int32(0) };
```

codegen generates C library code in the `codegen\lib\p_abs` folder.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

[pcode](#) | [codegen](#)

### Topics

“Compilation Directive %#codegen”

**Introduced in R2011a**

## coder.approximation

Create function replacement configuration object

### Syntax

```
q = coder.approximation(function_name)
q = coder.approximation('Function',function_name,Name,Value)
```

### Description

`q = coder.approximation(function_name)` creates a function replacement configuration object for use during code generation or fixed-point conversion. The configuration object specifies how to create a lookup table approximation for the MATLAB function specified by `function_name`. To associate this approximation with a `coder.FixptConfig` object for use with the `codegen` function, use the `coder.FixptConfig` configuration object `addApproximation` method.

Use this syntax only for the functions that `coder.approximation` can replace automatically. These functions are listed in the `function_name` argument description.

`q = coder.approximation('Function',function_name,Name,Value)` creates a function replacement configuration object using additional options specified by one or more name-value pair arguments.

### Examples

#### Replace Log Function with Default Lookup Table

Create a function replacement configuration object using the default settings. The resulting lookup table in the generated code uses 1000 points.

```
logAppx = coder.approximation('log');
```

#### Replace Log Function with Uniform Lookup Table

Create a function replacement configuration object. Specify the input range and prefix to add to the replacement function name. The resulting lookup table in the generated code uses 1000 points.

```
logAppx = coder.approximation('Function','log','InputRange',[0.1,1000],...
'FunctionNamePrefix','log_replace');
```

#### Replace Log Function with Optimized Lookup Table

Create a function replacement configuration object using the `'OptimizeLUTSize'` option to specify to replace the `log` function with an optimized lookup table. The resulting lookup table in the generated code uses less than the default number of points.



```
logAppx = coder.approximation('Function','log','OptimizeLUTSize',true,...
'InputRange',[0.1,1000],'InterpolationDegree',1,'ErrorThreshold',1e-3,...
'FunctionNamePrefix','log_optim_', 'OptimizeIterations',25);
```

## Replace Custom Function with Optimized Lookup Table

Create a function replacement configuration object that specifies to replace the custom function, `saturateExp`, with an optimized lookup table.

Create a custom function, `saturateExp`.

```
saturateExp = @(x) 1/(1+exp(-x));
```

Create a function replacement configuration object that specifies to replace the `saturateExp` function with an optimized lookup table. Because the `saturateExp` function is not listed as a function for which `coder.approximation` can generate an approximation automatically, you must specify the `CandidateFunction` property.

```
saturateExp = @(x) 1/(1+exp(-x));
custAppx = coder.approximation('Function','saturateExp',...
'CandidateFunction', saturateExp,...
'NumberOfPoints',50,'InputRange',[0,10]);
```

## Input Arguments

### function\_name — Name of the function to replace

'acos' | 'acosd' | 'acosh' | 'acoth' | 'asin' | 'asind' | 'asinh' | 'atan' | 'atand' | 'atanh' | 'cos' | 'cosd' | 'cosh' | 'erf' | 'erfc' | 'exp' | 'log' | 'normcdf' | 'reallog' | 'realsqrt' | 'reciprocal' | 'rsqrt' | 'sin' | 'sinc' | 'sind' | 'sinh' | 'sqrt' | 'tan' | 'tand'

Name of function to replace, specified as a string. The function must be one of the listed functions.

Example: 'sqrt'

Data Types: char

### Name-Value Pair Arguments

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: 'Function', 'log'

### Architecture — Architecture of lookup table approximation

'LookupTable' (default) | 'Flat'

Architecture of the lookup table approximation, specified as the comma-separated pair consisting of 'Architecture' and a string. Use this argument when you want to specify the architecture for the lookup table. The `Flat` architecture does not use interpolation.

Data Types: char

**CandidateFunction — Function handle of the replacement function**

function handle | string

Function handle of the replacement function, specified as the comma-separated pair consisting of 'CandidateFunction' and a function handle or string referring to a function handle. Use this argument when the function that you want to replace is not listed under `function_name`. Specify the function handle or string referring to a function handle of the function that you want to replace. You can define the function in a file or as an anonymous function.

If you do not specify a candidate function, then the function you chose to replace using the `Function` property is set as the `CandidateFunction`.

Example: 'CandidateFunction', @(x) (1./(1+x))

Data Types: `function_handle` | `char`

**ErrorThreshold — Error threshold value used to calculate optimal lookup table size**

0.001 (default) | nonnegative scalar

Error threshold value used to calculate optimal lookup table size, specified as the comma-separated pair consisting of 'ErrorThreshold' and a nonnegative scalar. If 'OptimizeLUTSize' is true, this argument is required.

**Function — Name of function to replace with a lookup table approximation**

function\_name

Name of function to replace with a lookup table approximation, specified as the comma-separated pair consisting of 'Function' and a string. The function must be continuous and stateless. If you specify one of the functions that is listed under `function_name`, the conversion process automatically provides a replacement function. Otherwise, you must also specify the 'CandidateFunction' argument for the function that you want to replace.

Example: 'Function','log'

Example: 'Function','my\_log','CandidateFunction',@my\_log

Data Types: `char`

**FunctionNamePrefix — Prefix for generated fixed-point function names**

'replacement\_' (default) | string

Prefix for generated fixed-point function names, specified as the comma-separated pair consisting of 'FunctionNamePrefix' and a string. The name of a generated function consists of this prefix, followed by the original MATLAB function name.

Example: 'log\_replace\_'

**InputRange — Range over which to replace the function**

[ ] (default) | 2x1 row vector | 2xN matrix

Range over which to replace the function, specified as the comma-separated pair consisting of 'InputRange' and a 2-by-1 row vector or a 2-by-N matrix.

Example: [-1 1]

**InterpolationDegree — Interpolation degree**

1 (default) | 0 | 2 | 3

Interpolation degree, specified as the comma-separated pair consisting of 'InterpolationDegree' and 1 (linear), 0 (none), 2 (quadratic), or 3 (cubic).

**NumberOfPoints — Number of points in lookup table**

1000 (default) | positive integer

Number of points in lookup table, specified as the comma-separated pair consisting of 'NumberOfPoints' and a positive integer.

**OptimizeIterations — Number of iterations**

25 (default) | positive integer

Number of iterations to run when optimizing the size of the lookup table, specified as the comma-separated pair consisting of 'OptimizeIterations' and a positive integer.

**OptimizeLUTSize — Optimize lookup table size**

false (default) | true

Optimize lookup table size, specified as the comma-separated pair consisting of 'OptimizeLUTSize' and a logical value. Setting this property to true generates an area-optimal lookup table, that is, the lookup table with the minimum possible number of points. This lookup table is optimized for size, but might not be speed efficient.

**PipelinedArchitecture — Option to enable pipelining**

false (default) | true

Option to enable pipelining, specified as the comma-separated pair consisting of 'PipelinedArchitecture' and a logical value.

**Output Arguments**

**q** — Function replacement configuration object, returned as a `coder.mathfcngenerator.LookupTable` or a `coder.mathfcngenerator.Flat` configuration object

`coder.mathfcngenerator.LookupTable` configuration object |  
`coder.mathfcngenerator.Flat` configuration object

Function replacement configuration object. Use the `coder.FixptConfig` configuration object `addApproximation` method to associate this configuration object with a `coder.FixptConfig` object. Then use the `codegen` function -float2fixed option with `coder.FixptConfig` to convert floating-point MATLAB code to fixed-point code.

| Property              | Default Value           |
|-----------------------|-------------------------|
| Auto-replace function | ''                      |
| InputRange            | []                      |
| FunctionNamePrefix    | 'replacement_'          |
| Architecture          | LookupTable (read only) |
| NumberOfPoints        | 1000                    |
| InterpolationDegree   | 1                       |
| ErrorThreshold        | 0.001                   |

| <b>Property</b>    | <b>Default Value</b> |
|--------------------|----------------------|
| OptimizeLUTSize    | false                |
| OptimizeIterations | 25                   |

## **See Also**

### **Classes**

`coder.FixPtConfig`

### **Functions**

`codegen`

### **Topics**

“Replace the exp Function with a Lookup Table”

“Replace a Custom Function with a Lookup Table”

“Replacing Functions Using Lookup Table Approximations”

**Introduced in R2014b**

## coder.ceval

Call external C/C++ function

### Syntax

```
coder.ceval(cfun_name)
coder.ceval(cfun_name,cfun_arguments)

coder.ceval('-global',cfun_name)
coder.ceval('-global',cfun_name,cfun_arguments)

coder.ceval('-gpudevicefcn',devicefun_name,devicefun_arguments)

coder.ceval('-layout:rowMajor',cfun_name,cfun_arguments)
coder.ceval('-layout:columnMajor',cfun_name,cfun_arguments)
coder.ceval('-layout:any',cfun_name,cfun_arguments)

cfun_return = coder.ceval(___)
```

### Description

`coder.ceval(cfun_name)` executes the external C/C++ function specified by `cfun_name`. Define `cfun_name` in an external C/C++ source file or library. Provide the external source, library, and header files to the code generator.

`coder.ceval(cfun_name,cfun_arguments)` executes `cfun_name` with arguments `cfun_arguments`. `cfun_arguments` is a comma-separated list of input arguments in the order that `cfun_name` requires.

By default, `coder.ceval` passes arguments by value to the C/C++ function whenever C/C++ supports passing arguments by value. To make `coder.ceval` pass arguments by reference, use the constructs `coder.ref`, `coder.rref`, and `coder.wref`. If C/C++ does not support passing arguments by value, for example, if the argument is an array, `coder.ceval` passes arguments by reference. If you do not use `coder.ref`, `coder.rref` or `coder.wref`, a copy of the argument can appear in the generated code to enforce MATLAB semantics for arrays.

`coder.ceval('-global',cfun_name)` executes `cfun_name` and indicates that `cfun_name` uses one or more MATLAB global variables. The code generator can then produce code that is consistent with this global variable usage.

---

**Note** The `-global` flag is only supported for code generation. You cannot include this flag while calling `coder.ceval` in MATLAB Function blocks.

---

`coder.ceval('-global',cfun_name,cfun_arguments)` executes `cfun_name` with arguments `cfun_arguments` and indicates that `cfun_name` uses one or more MATLAB global variables.

`coder.ceval('-gpudevicefcn',devicefun_name,devicefun_arguments)` allows you to call CUDA GPU `__device__` functions from within kernels. `'-gpudevicefcn'` indicates to `coder.ceval` that the target function is on the GPU device. `devicefun_name` is the name of the

`__device__` function and `devicefun_arguments` is a comma-separated list of input arguments in the order that `devicefun_name` requires. This option requires the GPU Coder product.

`coder.ceval('-layout:rowMajor', cfun_name, cfun_arguments)` executes `cfun_name` with arguments `cfun_arguments` and passes data stored in row-major layout. When called from a function that uses column-major layout, the code generator converts inputs to row-major layout and converts outputs back to column-major layout. For a shorter syntax, use `coder.ceval('row', ...)`.

`coder.ceval('-layout:columnMajor', cfun_name, cfun_arguments)` executes `cfun_name` with arguments `cfun_arguments` and passes data stored in column-major layout. When called from a function that uses row-major layout, the code generator converts inputs to column-major layout and converts outputs back to row-major layout. For a shorter syntax, use `coder.ceval('-col', ...)`.

`coder.ceval('-layout:any', cfun_name, cfun_arguments)` executes `cfun_name` with arguments `cfun_arguments` and passes data with its current array layout, even when array layouts do not match. The code generator does not convert the array layout of the input or output data.

`cfun_return = coder.ceval(____)` executes `cfun_name` and returns a single scalar value, `cfun_return`, corresponding to the value that the C/C++ function returns in the `return` statement. To be consistent with C/C++, `coder.ceval` can return only a scalar value. It cannot return an array. Use this option with any of the input argument combinations in the previous syntaxes.

## Examples

### Call External C Function

Call a C function `foo(u)` from a MATLAB function from which you intend to generate C code.

Create a C header file `foo.h` for a function `foo` that takes two input parameters of type `double` and returns a value of type `double`.

```
double foo(double in1, double in2);
```

Write the C function `foo.c`.

```
#include <stdio.h>
#include <stdlib.h>
#include "foo.h"

double foo(double in1, double in2)
{
 return in1 + in2;
}
```

Write a function `callfoo` that calls `foo` by using `coder.ceval`. Provide the source and header files to the code generator in the function.

```
function y = callfoo %#codegen
y = 0.0;
if coder.target('MATLAB')
 % Executing in MATLAB, call MATLAB equivalent of
 % C function foo
 y = 10 + 20;
```

```

else
 % Executing in generated code, call C function foo
 coder.updateBuildInfo('addSourceFiles','foo.c');
 coder.cinclude('foo.h');
 y = coder.ceval('foo', 10, 20);
end
end

```

Generate C library code for function `callfoo`. The `codegen` function generates C code in the `\codegen\lib\callfoo` subfolder.

```
codegen -config:lib callfoo -report
```

### Call a C Library Function

Call a C library function from MATLAB code.

Write a MATLAB function `myabsval`.

```

function y = myabsval(u)
%#codegen
y = abs(u);

```

Generate a C static library for `myabsval`, using the `-args` option to specify the size, type, and complexity of the input parameter.

```
codegen -config:lib myabsval -args {0.0}
```

The `codegen` function creates the library file `myabsval.lib` and header file `myabsval.h` in the folder `\codegen\lib\myabsval`. (The library file extension can change depending on your platform.) It generates the functions `myabsval_initialize` and `myabsval_terminate` in the same folder.

Write a MATLAB function to call the generated C library function using `coder.ceval`.

```

function y = callmyabsval(y)
%#codegen
% Check the target. Do not use coder.ceval if callmyabsval is
% executing in MATLAB
if coder.target('MATLAB')
 % Executing in MATLAB, call function myabsval
 y = myabsval(y);
else
 % add the required include statements to generated function code
 coder.updateBuildInfo('addIncludePaths','$(START_DIR)\codegen\lib\myabsval');
 coder.cinclude('myabsval_initialize.h');
 coder.cinclude('myabsval.h');
 coder.cinclude('myabsval_terminate.h');

 % Executing in the generated code.
 % Call the initialize function before calling the
 % C function for the first time
 coder.ceval('myabsval_initialize');

 % Call the generated C library function myabsval
 y = coder.ceval('myabsval',y);

```

```

 % Call the terminate function after
 % calling the C function for the last time
 coder.ceval('myabsval_terminate');
end

```

Generate the MEX function `callmyabsval_mex`. Provide the generated library file at the command line.

```
codegen -config:mex callmyabsval codegen\lib\myabsval\myabsval.lib -args {-2.75}
```

Rather than providing the library at the command line, you can use `coder.updateBuildInfo` to specify the library within the function. Use this option to preconfigure the build. Add this line to the `else` block:

```
coder.updateBuildInfo('addLinkObjects','myabsval.lib','$(START_DIR)\codegen\lib\myabsval',100, true);
```

---

**Note** The `START_DIR` macro is only supported for generating code with MATLAB Coder.

---

Run the MEX function `callmyabsval_mex` which calls the library function `myabsval`.

```
callmyabsval_mex(-2.75)
```

```
ans =
```

```
2.7500
```

Call the MATLAB function `callmyabsval`.

```
callmyabsval(-2.75)
```

```
ans =
```

```
2.7500
```

The `callmyabsval` function exhibits the desired behavior for execution in MATLAB and in code generation.

### Call C Function That Uses Global Variable

Use the `'-global'` flag when you call a C function that modifies a global variable.

Write a MATLAB function `useGlobal` that calls a C function `addGlobal`. Use the `'-global'` flag to indicate to the code generator that the C function uses a global variable.

```

function y = useGlobal()
global g;
t = g;
% compare execution with/without '-global' flag
coder.ceval('-global','addGlobal');
y = t;
end

```

Create a C header file `addGlobal.h` for the function `addGlobal`.



```
void addGlobal(void);
```

Write the C function `addGlobal` in the file `addGlobal.c`. This function includes the header file `useGlobal_data.h` that the code generator creates when you generate code for the function `useGlobal`. This header file contains the global variable declaration for `g`.

```
#include "addGlobal.h"
#include "useGlobal_data.h"
void addGlobal(void) {
 g++;
}
```

Generate the MEX function for `useGlobal`. To define the input to the code generator, declare the global variable in the workspace.

```
global g;
g = 1;
codegen useGlobal -report addGlobal.h addGlobal.c
y = useGlobal_mex();
```

With the `'-global'` flag, the MEX function produces the result `y = 1`. The `'-global'` flag indicates to the code generator that the C function possibly modifies the global variable. For `useGlobal`, the code generator produces this code:

```
real_T useGlobal(const emlrtStack *sp)
{
 real_T y;
 (void)sp;
 y = g;
 addGlobal();
 return y;
}
```

Without the `'-global'` flag, the MEX function produces `y = 2`. Because there is no indication that the C function modifies `g`, the code generator assumes that `y` and `g` are identical. This C code is generated:

```
real_T useGlobal(const emlrtStack *sp)
{
 (void)sp;
 addGlobal();
 return g;
}
```

## Call C Function That Uses Different Array Layout

Suppose that you have a C function `testRM` that is designed to use row-major layout. You want to integrate this function into a MATLAB function `bar` that operates on arrays. The function `bar` is designed to use column-major layout, employing the `coder.columnMajor` directive.

```
function out = bar(in)
%#codegen
coder.columnMajor;
coder.ceval('-layout:rowMajor','testRM', ...
 coder.rref(in),coder.wref(out));
end
```

In the generated code, the code generator inserts a layout conversion from column-major layout to row-major layout on the variable `in` before passing it to `testRM`. On the output variable `out`, the code generator inserts a layout conversion back to column-major.

In general, if you do not specify the `layout` option for `coder.ceval`, the external function arguments are assumed to use column-major.

### Call C Function That Takes Complex Number Inputs

Suppose you have a MATLAB function that calls custom C code that takes complex number inputs. You must define your C code input parameters so that the complex number inputs from your MATLAB function can map to your C code.

In generated code, complex numbers are defined as a `struct` that has two fields, `re` and `im`, which are the real and imaginary part of a complex number respectively. This `struct` is defined in the header file `rtwtypes.h`, which you can find in the `codegen\lib\functionName` folder of your current path. The `struct` is defined as follows:

```
typedef struct {
 real32_T re; /*Real Component*/
 real32_T im; /*Imaginary Component*/
} creal_T;
```

For more information, see “Mapping MATLAB Types to Types in Generated Code”.

The C code that you want to integrate must include the `rtwtypes.h` header file. An example C code `foo.c` is shown below:

```
#include "foo.h"
#include<stdio.h>
#include<stdlib.h>
#include "rtwtypes.h"

double foo(creal_T x) {
 double z = 0.0;
 z = x.re*x.re + x.im*x.im;
 return (z);
}
```

The `struct` is named `creal_T`. A header file `foo.h` must also be defined as:

```
#include "rtwtypes.h"
double foo(creal_T x);
```

The MATLAB code executes `foo.c` by using the `coder.ceval` function that has a complex numbers input:

```
function y = complexCeval %#codegen
y = 0.0;
coder.updateBuildInfo('addSourceFiles','foo.c');
coder.cinclude('foo.h');
y = coder.ceval('foo', 10+20i);
end
```

The `coder.ceval` command takes the complex number input. The code generator maps the complex number to the `struct creal_T` variable `x` and its fields `re` and `im`.

Generate code for the function `complexCeval` by running this command:

```
codegen -config:lib -report complexCeval
```

## Input Arguments

### **cfun\_name** — C/C++ function name

character vector | string scalar

Name of external C/C++ function to call.

Example: `coder.ceval('foo')`

Data Types: `char` | `string`

### **cfun\_arguments** — C/C++ function arguments

scalar variable | array | element of an array | structure | structure field | object property

Comma-separated list of input arguments in the order that `cfun_name` requires.

Example: `coder.ceval('foo', 10, 20);`

Example: `coder.ceval('myFunction', coder.ref(x));`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `struct`

Complex Number Support: Yes

## Limitations

- You cannot use `coder.ceval` on functions that you declare extrinsic with `coder.extrinsic`.
- When the LCC compiler creates a library, it adds a leading underscore to the library function names. If the compiler for the library was LCC and your code generation compiler is not LCC, you must add the leading underscore to the function name, for example, `coder.ceval('_mylibfun')`. If the compiler for a library was not LCC, you cannot use LCC to generate code from MATLAB code that calls functions from that library. Those library function names do not have the leading underscore that the LCC compiler requires.
- If a property has a get method, a set method, or validators, or is a System object™ property with certain attributes, then you cannot pass the property by reference to an external function. See “Passing By Reference Not Supported for Some Properties”.

## Tips

- For code generation, before calling `coder.ceval`, you must specify the type, size, and complexity data type of return values and output arguments.
- To apply `coder.ceval` to a function that accepts or returns variables that do not exist in MATLAB code, such as pointers, FILE types for file I/O, and C/C++ macros, use the `coder.opaque` function.
- Use `coder.ceval` only in MATLAB for code generation. `coder.ceval` generates an error in uncompiled MATLAB code. To determine if a MATLAB function is executing in MATLAB, use `coder.target`. If the function is executing in MATLAB, call the MATLAB version of the C/C++ function.

- External code called by using `coder.ceval` and the generated code run within the same process and share memory. If external code erroneously writes to the memory that contains data structures used by the generated code, it might cause the process to behave unexpectedly or crash. For example, if the external code attempts to write data to an array after its end point, the process might behave unexpectedly or crash.
- MATLAB uses UTF-8 as its system encoding on Windows platform. As a result, system calls made from within a generated MEX function accept and return UTF-8 encoded strings. By contrast, the code generated by MATLAB Coder encodes text data by using the encoding specified by the Windows locale. So, if your MATLAB entry-point function uses `coder.ceval` to call external C/C++ functions that assume a different system encoding, then the generated MEX function might produce garbled text. If this happens, you must update the external C/C++ functions to handle this situation.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ref` | `coder.rref` | `coder.wref` | `coder.target` | `codegen` | `coder.extrinsic` | `coder.opaque` | `coder.columnMajor` | `coder.rowMajor` | `coder.updateBuildInfo` | `coder.ExternalDependency` | `coder.reservedName`

## Topics

“External Code Integration”

“Generate Code That Uses Row-Major Array Layout”

“Interface with Row-Major Data in MATLAB Function Block” (Simulink)

“Unknown Output Type for `coder.ceval`”

## Introduced in R2011a

## coder.cinclude

Include header file in generated code

### Syntax

```
coder.cinclude(headerfile)
coder.cinclude(headerfile, 'InAllSourceFiles', allfiles)
```

### Description

`coder.cinclude(headerfile)` includes a header file in generated C/C++ source code.

MATLAB Coder generates the include statement in the C/C++ source files that are generated from the MATLAB code that contains the `coder.cinclude` call.

In a Simulink model, when a `coder.cinclude` call appears in a MATLAB Function block, the code generator puts the include statement in the model header file.

---

**Note** Place a `coder.cinclude` call as close as possible to the `coder.ceval` call that requires the header file.

---

`coder.cinclude(headerfile, 'InAllSourceFiles', allfiles)` uses the `allfiles` option to determine whether to include the header file in almost all C/C++ source files.

If `allfiles` is true, MATLAB Coder generates the include statement in almost all C/C++ source files, except for some utility files. This behavior is the `coder.cinclude` behavior from R2016a and earlier releases. The presence of the include statement in these additional files can increase compile time and make the generated code less readable. Use this option only if your code depends on the legacy behavior. If `allfiles` is false, the behavior is the same as the behavior of `coder.cinclude(headerfile)`.

In a MATLAB Function block, `coder.cinclude(headerfile, 'InAllSourceFiles', allfiles)` is the same as `coder.cinclude(headerfile)`.

### Examples

#### Include Header File in C/C++ Code Generated by Using the MATLAB Coder codegen Command

Generate code from a MATLAB function that calls an external C function. Use `coder.cinclude` to include the required header file in the generated C code.

In a writable folder, create a subfolder `mycfiles`.

Write a C function `myMult2.c` that doubles its input. Save it in `mycfiles`.

```
#include "myMult2.h"
double myMult2(double u)
```

```
{
 return 2 * u;
}
```

Write the header file `myMult2.h`. Save it in `mycfiles`.

```
#if !defined(MYMULT2)
#define MYMULT2
extern double myMult2(double);
#endif
```

Write a MATLAB function, `myfunc`, that includes `myMult2.h` and calls `myMult2` for code generation only.

```
function y = myfunc
%#codegen
y = 21;
if ~coder.target('MATLAB')
 % Running in generated code
 coder.cinclude('myMult2.h');
 y = coder.ceval('myMult2', y);
else
 % Running in MATLAB
 y = y * 2;
end
end
```

Create a code configuration object for a static library. Specify the locations of `myMult2.h` and `myMult2.c`.

```
cfg = coder.config('lib');
cfg.CustomInclude = fullfile(pwd, 'mycfiles');
cfg.CustomSource = fullfile(pwd, 'mycfiles', 'myMult2.c');
```

Generate the code.

```
codegen -config cfg myfunc -report
```

The file `myfunc.c` contains this statement:

```
#include "myMult2.h"
```

The include statement does not appear in any other file.

### **Include Header File in C/C++ Code Generated from a MATLAB Function Block in a Simulink Model**

Generate code from a MATLAB Function block that calls an external C function. Use `coder.cinclude` to include the required header file in the generated C code.

In a writable folder, create a subfolder `mycfiles`.

Write a C function `myMult2.c` that doubles its input. Save it in `mycfiles`.

```
#include "myMult2.h"
double myMult2(double u)
```

```
{
 return 2 * u;
}
```

Write the header file `myMult2.h`. Save it in `mycfiles`.

```
#if !defined(MYMULT2)
#define MYMULT2
extern double myMult2(double);
#endif
```

Create a Simulink model that contains a MATLAB Function block connected to an Outport block.



In the MATLAB Function block, add the function `myfunc` that includes `myMult2.h` and calls `myMult2`.

```
function y = myfunc
%#codegen
y = 21;
coder.cinclude('myMult2.h');
y = coder.ceval('myMult2', y);
% Specify the locations of myMult2.h and myMult2.c
coder.extrinsic('pwd', 'fullfile');
customDir = coder.const(fullfile(pwd, 'mycfiles'));
coder.updateBuildInfo('addIncludePaths', customDir);
coder.updateBuildInfo('addSourcePaths', customDir);
coder.updateBuildInfo('addSourceFiles', 'myMult2.c');
end
```

Open the Configuration Parameters dialog box.

On the **Solver** pane, select a fixed-step solver.

Save the model as `mymodel`.

Build the model.

The file `mymodel.h` contains this statement:

```
#include "myMult2.h"
```

To read more about integrating custom code in a MATLAB Function block, see “Integrate C Code by Using the MATLAB Function Block” (Simulink).

## Input Arguments

### **headerfile** — Name of header file

character vector | string scalar

Name of a header file specified as a character vector or string scalar. `headerfile` must be a compile-time constant.

Enclose a system header file name in angle brackets `< >`. The generated `#include` statement for a system header file has the format `#include <sysheader>`. A system header file must be in a standard location or on the include path. Specify the include path by using code generation custom code parameters.

Example: `coder.cinclude('<sysheader.h>')`

For a header file that is not a system header file, omit the angle brackets. The generated `#include` statement for a header file that is not a system header file has the format `#include "myHeader"`. The header file must be in the current folder or on the include path. Specify the include path by using code generation custom code parameters.

Example: `coder.cinclude('myheader.h')`

Data Types: `char`

### **allfiles — All source files option**

`true | false`

Option to include header file in all generated C/C++ source files. If `allfiles` is `true`, MATLAB Coder generates the include statement in almost all of the C/C++ source files, except for some utility files. If `allfiles` is `false`, the behavior is the same as the behavior of `coder.cinclude(headerfile)`.

In a MATLAB Function block, the code generator ignores the all source files option.

Data Types: `logical`

## **Limitations**

- Do not call `coder.cinclude` inside run-time conditional constructs such as `if` statements, `switch` statements, `while`-loops, and `for`-loops. You can call `coder.cinclude` inside compile-time conditional statements, such as `coder.target`. For example:

```
...
if ~coder.target('MATLAB')
 coder.cinclude('foo.h');
 coder.ceval('foo');
end
...
```

## **Tips**

- Before a `coder.ceval` call, call `coder.cinclude` to include the header file required by the external function that `coder.ceval` calls.
- Extraneous include statements in generated C/C++ code can increase compile time and reduce code readability. To avoid extraneous include statements in code generated by MATLAB Coder, follow these best practices:
  - Place a `coder.cinclude` call as close as possible to the `coder.ceval` call that requires the header file.
  - Do not set `allfiles` to `true`.

For the MATLAB Function block, the code generator generates the include statement in the model header file.



- In R2016a and earlier releases, for any `coder.cinclude` call, MATLAB Coder included the header file in almost all generated C/C++ source files, except for some utility files. If you have code that depends on this legacy behavior, you can preserve the legacy behavior by using this syntax:

```
coder.cinclude(headerfile,'InAllSourceFiles',true)
```

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`codegen` | `coder.ceval` | `coder.config` | `coder.target` | `coder.reservedName`

### Topics

“Configure Build for External C/C++ Code”

### Introduced in R2013a

## coder.columnMajor

Specify column-major array layout for a function or class

### Syntax

```
coder.columnMajor
```

### Description

`coder.columnMajor` specifies column-major array layout for the data used by the current function in generated code. When placed in a class constructor, `coder.columnMajor` specifies column-major layout for data used by the class.

---

**Note** By default, code generation uses column-major array layout.

---

### Examples

#### Specify Column-Major Array Layout for a Function

Specify column-major array layout for a function by inserting `coder.columnMajor` into the function body.

Suppose that `myFunction` is the top-level function of your code. Your application requires you to perform matrix addition with column-major array layout and matrix multiplication with row-major layout.

```
function S = myFunction(A,B)
%#codegen
% check to make sure inputs are valid
if size(A,1) ~= size(B,1) || size(A,2) ~= size(B,2)
 disp('Matrices must be same size.')
 return;
end
% make both matrices symmetric
B = B*B';
A = A*A';
% add matrices
S = addMatrix(A,B);
end
```

Write a function for matrix addition called `addMatrix`. Specify column-major for `addMatrix` by using `coder.columnMajor`.

```
function S = addMatrix(A,B)
%#codegen
S = zeros(size(A));
coder.columnMajor; % specify column-major array layout
S = A + B;
end
```

Generate code for `myFunction`. Use the `codegen` command.

```
codegen myFunction -args {ones(10,20),ones(10,20)} -config:lib -launchreport -rowmajor
```

Because of the `codegen -rowmajor` option, the matrix multiplication in `myFunction` uses row-major layout. However, the generated code for `addMatrix` uses column-major array layout due to the `coder.columnMajor` call.

## Tips

- The code generator uses column-major array layout by default.
- The specification of array layout inside a function supersedes the array layout specified with the `codegen` command. For example, if the function `foo` contains `coder.columnMajor`, and you generate code by using:

```
codegen foo -rowmajor
```

then the generated code still uses column-major layout.

- Other functions called from within a column-major function inherit the column-major specification. However, if one of the called functions has its own distinct `coder.rowMajor` call, the code generator changes the array layout accordingly. If a row-major function and a column-major function call the same function, which does not have its own array layout specification, the code generator produces a row-major version and column-major version of the function.
- `coder.columnMajor` is ignored outside of code generation and simulation.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `coder.rowMajor` | `coder.isRowMajor` | `coder.isColumnMajor`

### Topics

“Generate Code That Uses Row-Major Array Layout”

“Specify Array Layout in Functions and Classes”

“Generate Code That Uses N-Dimensional Indexing”

### Introduced in R2018a

## coder.config

**Package:** coder

Create MATLAB Coder code generation configuration objects

### Syntax

```
config_obj = coder.config
config_obj = coder.config(build_type)
config_obj = coder.config(build_type,'ecoder',ecoder_flag)
config_obj = coder.config(numeric_conversion_type)
```

### Description

`config_obj = coder.config` creates a `coder.MexCodeConfig` code generation configuration object for use with `codegen` when generating a MEX function. Use a `coder.MexCodeConfig` object with the `-config` option of the `codegen` command.

`config_obj = coder.config(build_type)` creates a code generation configuration object for use with `codegen` when generating a MEX function or standalone code (static library, dynamically linked library or executable program). Use the code generation configuration object with the `-config` option of the `codegen` command.

`config_obj = coder.config(build_type,'ecoder',ecoder_flag)` creates a `coder.EmbeddedCodeConfig` object or a `coder.CodeConfig` object depending on whether `ecoder_flag` is true or false. `build_type` is 'lib', 'dll', or 'exe'. Set the flag to true to use these features:

- Code verification through software-in-the-loop (SIL) and processor-in-the-loop (PIL) execution.
- Code tracing or bidirectional traceability.
- Hardware specific optimizations and custom replacement libraries.
- Customize the appearance of the generated code.

See “Embedded Coder Capabilities for Code Generation from MATLAB Code” (Embedded Coder).

`config_obj = coder.config(numeric_conversion_type)` creates these configuration objects for use with `codegen`:

- `coder.FixptConfig` when generating fixed-point MATLAB or C/C++ code from floating-point MATLAB code. Use with the `-float2fixed` option of the `codegen` command.
- `coder.SingleConfig` when generating single-precision MATLAB code from double-precision MATLAB code. Use with the `-double2single` option of the `codegen` command.

Fixed-point conversion or single-precision conversion requires Fixed-Point Designer.

---

**Note** Once you create a code configuration object by using the `coder.config` function, you can modify its properties programmatically at the command line or interactively by using the Configuration Parameter Dialog Box. See “Specify Configuration Parameters in Command-Line Workflow Interactively”.

---

## Examples

### Generate MEX Function from MATLAB Function

Generate a MEX function from a MATLAB function that is suitable for code generation and enable a code generation report.

Write a MATLAB function, `coderand`, that generates a random scalar value from the standard uniform distribution on the open interval (0,1).

```
function r = coderand() %#codegen
% The directive %#codegen declares that the function
% is intended for code generation
r = rand();
```

Create a code generation configuration object to generate a MEX function.

```
cfg = coder.config % or cfg = coder.config('mex')
```

Open the code generation report.

```
cfg.GenerateReport = true;
```

Generate a MEX function in the current folder that specifies the configuration object by using the `-config` option.

```
% Generate a MEX function and code generation report
codegen -config cfg coderand
```

### Generate Standalone C Static or Dynamic Library or Generate Standalone C Executable

Create a code generation configuration object for a standalone C static library.

```
cfg = coder.config('lib')
% Returns a coder.EmbeddedCodeConfig object if the Embedded
% Coder product is installed.
% Otherwise, returns a coder.CodeConfig object.
```

Create a code generation configuration object to generate a standalone C dynamic library.

```
cfg = coder.config('dll')
% Returns a coder.EmbeddedCodeConfig object if the Embedded
% Coder product is installed.
% Otherwise, returns a coder.CodeConfig object.
```

Create a code generation configuration object to generate a standalone C executable.

```
cfg = coder.config('exe')
% Returns a coder.EmbeddedCodeConfig object if the Embedded
% Coder product is installed.
% Otherwise, returns a coder.CodeConfig object.
```

### Create a coder.CodeConfig Object with Embedded Coder Installed

Create a coder.CodeConfig object even when the Embedded Coder product is installed on your system.

```
cfg = coder.config('lib','ecoder',false)
```

Create a coder.EmbeddedCodeConfig object without Embedded Coder.

```
cfg = coder.config('lib','ecoder',true)
```

### Create a Numeric Conversion Configuration Object

Create a coder.FixptConfig object.

```
fixptcfg = coder.config('fixpt');
```

Create a coder.SingleConfig object.

```
scfg = coder.config('single');
```

## Input Arguments

### build\_type — Type of code generation object to create

'mex' | 'lib' | 'dll' | 'exe'

| Configuration Object Type | Generated Code  | Code Generation Configuration Object (Embedded Coder installed) | Code Generation Configuration Object (Embedded Coder not installed) |
|---------------------------|-----------------|-----------------------------------------------------------------|---------------------------------------------------------------------|
| 'mex'                     | MEX function    | coder.MexCodeConfig                                             | coder.MexCodeConfig                                                 |
| 'lib'                     | Static library  | coder.EmbeddedCodeConfig                                        | coder.CodeConfig                                                    |
| 'dll'                     | Dynamic library | coder.EmbeddedCodeConfig                                        | coder.CodeConfig                                                    |
| 'exe'                     | Executable      | coder.EmbeddedCodeConfig                                        | coder.CodeConfig                                                    |

Example: `coder.config('mex');`

Data Types: char | string

### numeric\_conversion\_type — Numeric conversion object type

'fixpt' | 'single'

|         |                                                                                                                                                         |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'fixpt' | Creates a coder.FixptConfig configuration object for use with codegen when generating fixed-point MATLAB or C/C++ code from floating-point MATLAB code. |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------|

|          |                                                                                                                                                                                  |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'single' | Creates a <code>coder.SingleConfig</code> configuration object for use with <code>codegen</code> when generating single-precision MATLAB code from double-precision MATLAB code. |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Example: `coder.config('fixpt');`

Data Types: `char` | `string`

### **ecoder\_flag — Embedded Coder code configuration object flag**

false | true

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>Creates a <code>coder.EmbeddedCodeConfig</code> configuration object regardless of the presence of Embedded Coder to allow use of the following features:</p> <ul style="list-style-type: none"> <li>• Code verification through software-in-the-loop (SIL) and processor-in-the-loop (PIL) execution.</li> <li>• Code tracing or bidirectional traceability.</li> <li>• Hardware specific optimizations and custom replacement libraries.</li> <li>• Customize the appearance of the generated code</li> </ul> <p>See “Embedded Coder Capabilities for Code Generation from MATLAB Code” (Embedded Coder).</p> <p><code>build_type</code> must be 'lib', 'dll', or 'exe'.</p> <p>However, code generation by using a <code>coder.EmbeddedCodeConfig</code> object requires the Embedded Coder product.</p> |
| false | Creates a <code>coder.CodeConfig</code> configuration object even if the Embedded Coder product is installed. <code>build_type</code> must be 'lib', 'dll', or 'exe'.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

Example: `coder.config('lib','ecoder',false);`

Data Types: `logical`

## **Output Arguments**

### **config\_obj — Code generation configuration handle**

`coder.CodeConfig` | `coder.MexCodeConfig` | `coder.EmbeddedCodeConfig` | `coder.FixptConfig` | `coder.SingleConfig`

Handle to the MATLAB Coder code generation configuration object.

## **Alternatives**

Use the `coder` function to open the MATLAB Coder app and create a MATLAB Coder project. The app provides a user interface that facilitates adding MATLAB files, defining input parameters, and specifying build parameters.

## **See Also**

`coder.CodeConfig` | `coder.EmbeddedCodeConfig` | `coder.MexCodeConfig` |  
`coder.FixptConfig` | `codegen` | `coder.SingleConfig`

## **Topics**

*"Accelerate MATLAB Algorithm by Generating MEX Function"*

*"Generate C Code at the Command Line"*

*"Convert MATLAB Code to Fixed-Point C Code"*

*"Generate Single-Precision C Code at the Command Line"*

*"Specify Configuration Parameters in Command-Line Workflow Interactively"*

**Introduced in R2011a**



# coder.const

Fold expressions into constants in generated code

## Syntax

```
out = coder.const(expression)
[out1,...,outN] = coder.const(handle,arg1,...,argN)
```

## Description

`out = coder.const(expression)` evaluates `expression` and replaces `out` with the result of the evaluation in generated code.

`[out1,...,outN] = coder.const(handle,arg1,...,argN)` evaluates the multi-output function having handle `handle`. It then replaces `out1,...,outN` with the results of the evaluation in the generated code.

## Examples

### Specify Constants in Generated Code

This example shows how to specify constants in generated code using `coder.const`.

Write a function `AddShift` that takes an input `Shift` and adds it to the elements of a vector. The vector consists of the square of the first 10 natural numbers. `AddShift` generates this vector.

```
function y = AddShift(Shift) %#codegen
y = (1:10).^2+Shift;
```

Generate code for `AddShift` using the `codegen` command. Open the Code Generation Report.

```
codegen -config:lib -launchreport AddShift -args 0
```

The code generator produces code for creating the vector. It adds `Shift` to each element of the vector during vector creation. The definition of `AddShift` in generated code looks as follows:

```
void AddShift(double Shift, double y[10])
{
 int k;
 for (k = 0; k < 10; k++) {
 y[k] = (double)((1 + k) * (1 + k)) + Shift;
 }
}
```

Replace the expression `(1:10).^2` with `coder.const((1:10).^2)`, and then generate code for `AddShift` again using the `codegen` command. Open the Code Generation Report.

```
codegen -config:lib -launchreport AddShift -args 0
```

The code generator creates the vector containing the squares of the first 10 natural numbers. In the generated code, it adds `Shift` to each element of this vector. The definition of `AddShift` in generated code looks as follows:

```
void AddShift(double Shift, double y[10])
{
 int i;
 static const signed char iv[10] = { 1, 4, 9, 16, 25, 36,
 49, 64, 81, 100 };

 for (i = 0; i < 10; i++) {
 y[i] = (double)iv[i] + Shift;
 }
}
```

### Create Lookup Table in Generated Code

This example shows how to fold a user-written function into a constant in generated code.

Write a function `getsine` that takes an input `index` and returns the element referred to by `index` from a lookup table of sines. The function `getsine` creates the lookup table using another function `gettable`.

```
function y = getsine(index) %#codegen
 assert(isa(index, 'int32'));
 persistent tbl;
 if isempty(tbl)
 tbl = gettable(1024);
 end
 y = tbl(index);

function y = gettable(n)
 y = zeros(1,n);
 for i = 1:n
 y(i) = sin((i-1)/(2*pi*n));
 end
```

Generate code for `getsine` using an argument of type `int32`. Open the Code Generation Report.

```
codegen -config:lib -launchreport getsine -args int32(0)
```

The generated code contains instructions for creating the lookup table.

Replace the statement:

```
tbl = gettable(1024);
```

with:

```
tbl = coder.const(gettable(1024));
```

Generate code for `getsine` using an argument of type `int32`. Open the Code Generation Report.

The generated code contains the lookup table itself. `coder.const` forces the expression `gettable(1024)` to be evaluated during code generation. The generated code does not contain instructions for the evaluation. The generated code contains the result of the evaluation itself.

### Specify Constants in Generated Code Using Multi-Output Function

This example shows how to specify constants in generated code using a multi-output function in a `coder.const` statement.

Write a function `MultiplyConst` that takes an input `factor` and multiplies every element of two vectors `vec1` and `vec2` with `factor`. The function generates `vec1` and `vec2` using another function `EvalConsts`.

```
function [y1,y2] = MultiplyConst(factor) %#codegen
 [vec1,vec2]=EvalConsts(pi.*(1./2.^(1:10)),2);
 y1=vec1.*factor;
 y2=vec2.*factor;

function [f1,f2]=EvalConsts(z,n)
 f1=z.^(2*n)/factorial(2*n);
 f2=z.^(2*n+1)/factorial(2*n+1);
```

Generate code for `MultiplyConst` using the `codegen` command. Open the Code Generation Report.

```
codegen -config:lib -launchreport MultiplyConst -args 0
```

The code generator produces code for creating the vectors.

Replace the statement

```
[vec1,vec2]=EvalConsts(pi.*(1./2.^(1:10)),2);
```

with

```
[vec1,vec2]=coder.const(@EvalConsts,pi.*(1./2.^(1:10)),2);
```

Generate code for `MultiplyConst` using the `codegen` command. Open the Code Generation Report.

```
codegen -config:lib -launchreport MultiplyConst -args 0
```

The code generator does not generate code for creating the vectors. Instead, it calculates the vectors and specifies the calculated vectors in generated code.

### Read Constants by Processing XML File

This example shows how to call an extrinsic function using `coder.const`.

Write an XML file `MyParams.xml` containing the following statements:

```
<params>
 <param name="hello" value="17"/>
 <param name="world" value="42"/>
</params>
```

Save `MyParams.xml` in the current folder.

Write a MATLAB function `xml2struct` that reads an XML file. The function identifies the XML tag `param` inside another tag `params`.

After identifying `param`, the function assigns the value of its attribute `name` to the field name of a structure `s`. The function also assigns the value of attribute `value` to the value of the field.

```
function s = xml2struct(file)

s = struct();
doc = xmlread(file);
els = doc.getElementsByTagName('params');
for i = 0:els.getLength-1
 it = els.item(i);
 ps = it.getElementsByTagName('param');
 for j = 0:ps.getLength-1
 param = ps.item(j);
 paramName = char(param.getAttribute('name'));
 paramValue = char(param.getAttribute('value'));
 paramValue = evalin('base', paramValue);
 s.(paramName) = paramValue;
 end
end
```

Save `xml2struct` in the current folder.

Write a MATLAB function `MyFunc` that reads the XML file `MyParams.xml` into a structure `s` using the function `xml2struct`. Declare `xml2struct` as extrinsic using `coder.extrinsic` and call it in a `coder.const` statement.

```
function y = MyFunc(u) %#codegen
 assert(isa(u, 'double'));
 coder.extrinsic('xml2struct');
 s = coder.const(xml2struct('MyParams.xml'));
 y = s.hello + s.world + u;
```

Generate code for `MyFunc` using the `codegen` command. Open the Code Generation Report.

```
codegen -config:dll -launchreport MyFunc -args 0
```

The code generator executes the call to `xml2struct` during code generation. It replaces the structure fields `s.hello` and `s.world` with the values 17 and 42 in generated code.

## Input Arguments

### expression — MATLAB expression or user-written function

expression with constants | single-output function with constant arguments

MATLAB expression or user-defined single-output function.

The expression must have compile-time constants only. The function must take constant arguments only. For instance, the following code leads to a code generation error, because `x` is not a compile-time constant.

```
function y=func(x)
 y=coder.const(log10(x));
```

To fix the error, assign `x` to a constant in the MATLAB code. Alternatively, during code generation, you can use `coder.Constant` to define input type as follows:

```
codegen -config:lib func -args coder.Constant(10)
```

Example: `2*pi, factorial(10)`

### **handle** — Function handle

function handle

Handle to built-in or user-written function.

Example: `@log, @sin`

Data Types: `function_handle`

### **arg1, ..., argN** — Arguments to the function with handle handle

function arguments that are constants

Arguments to the function with handle `handle`.

The arguments must be compile-time constants. For instance, the following code leads to a code generation error, because `x` and `y` are not compile-time constants.

```
function y=func(x,y)
 y=coder.const(@choosek,x,y);
```

To fix the error, assign `x` and `y` to constants in the MATLAB code. Alternatively, during code generation, you can use `coder.Constant` to define input type as follows:

```
codegen -config:lib func -args {coder.Constant(10),coder.Constant(2)}
```

## **Output Arguments**

### **out** — Value of expression

value of the evaluated expression

Value of expression. In the generated code, MATLAB Coder replaces occurrences of `out` with the value of expression.

### **out1, ..., outN** — Outputs of the function with handle handle

values of the outputs of the function with handle `handle`

Outputs of the function with handle `handle`. MATLAB Coder evaluates the function and replaces occurrences of `out1, ..., outN` with constants in the generated code.

## **Tips**

- When possible, the code generator constant-folds expressions automatically. Typically, automatic constant-folding occurs for expressions with scalars only. Use `coder.const` when the code generator does not constant-fold expressions on its own.
- When constant-folding computationally intensive function calls, to reduce code generation time, make the function call extrinsic. The extrinsic function call causes evaluation of the function call by MATLAB instead of by the code generator. For example:

```
function j = fcn(z)
zTable = coder.const(0:0.01:100);
jTable = coder.const(feval('besselj',3,zTable));
j = interp1(zTable,jTable,z);
end
```

See “Use coder.const with Extrinsic Function Calls”.

- If `coder.const` is unable to constant-fold a function call, try to force constant-folding by making the function call extrinsic. The extrinsic function call causes evaluation of the function call by MATLAB instead of by the code generator. For example:

```
function yi = fcn(xi)
y = coder.const(feval('rand',1,100));
yi = interp1(y,xi);
end
```

See “Use coder.const with Extrinsic Function Calls”.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

### Topics

“Constant Folding”

“Fold Function Calls into Constants”

“Use coder.const with Extrinsic Function Calls”

### Introduced in R2013b

# coder.cstructname

**Package:** coder

Name C structure type in generated code

## Syntax

```
coder.cstructname(var,structName)
coder.cstructname(var,structName,'extern','HeaderFile',headerfile)
coder.cstructname(var,structName,'extern','HeaderFile',
headerfile,'Alignment',alignment)

outtype = coder.cstructname(intype,structName)
outtype = coder.cstructname(intype,structName,'extern','HeaderFile',
headerfile)
outtype = coder.cstructname(intype,structName,'extern','HeaderFile',
headerfile,'Alignment',alignment)
```

## Description

`coder.cstructname` names the generated or externally defined C structure type to use for MATLAB variables that are represented as structures in generated code.

`coder.cstructname(var,structName)` names the C structure type generated for the MATLAB variable `var`. The input `var` can be a structure or a cell array. Use this syntax in a function from which you generate code. Place `coder.cstructname` after the definition of `var` and before the first use of `var`. If `var` is an entry-point (top-level) function input argument, place `coder.cstructname` at the beginning of the function, before any control flow statements.

`coder.cstructname(var,structName,'extern','HeaderFile',headerfile)` specifies that the C structure type to use for `var` has the name `structName` and is defined in the external file, `headerfileName`.

It is possible to use the 'extern' option without specifying the header file. However, it is a best practice to specify the header file so that the code generator produces the `#include` statement in the correct location.

`coder.cstructname(var,structName,'extern','HeaderFile',headerfile,'Alignment',alignment)` also specifies the run-time memory alignment for the externally defined structure type `structName`. If you have Embedded Coder and use custom Code Replacement Libraries (CRLs), specify the alignment so that the code generator can match CRL functions that require alignment for structures. See “Data Alignment for Code Replacement” (Embedded Coder).

`outtype = coder.cstructname(intype,structName)` returns a structure or cell array type object `outtype` that specifies the name of the C structure type to generate. `coder.cstructname` creates `outtype` with the properties of the input type `intype`. Then, it sets the `TypeName` property to `structName`. Use this syntax to create a type object that you use with the `codegen -args` option. You cannot use this syntax in a function from which you generate code.

You cannot use this syntax in a MATLAB Function block.

`outtype = coder.cstructname(intype, structName, 'extern', 'HeaderFile', headerfile)` returns a type object `outtype` that specifies the name and location of an externally defined C structure type. The code generator uses the externally defined structure type for variables with type `outtype`.

You cannot use this syntax in a MATLAB Function block.

`outtype = coder.cstructname(intype, structName, 'extern', 'HeaderFile', headerfile, 'Alignment', alignment)` creates a type object `outtype` that also specifies the C structure type alignment.

You cannot use this syntax in a MATLAB Function block.

## Examples

### Name the C Structure Type for a Variable in a Function

In a MATLAB function, `myfun`, assign the name `MyStruct` to the generated C structure type for the variable `v`.

```
function y = myfun()
 %#codegen
 v = struct('a',1,'b',2);
 coder.cstructname(v, 'myStruct');
 y = v;
end
```

Generate standalone C code. For example, generate a static library.

```
codegen -config:lib myfun -report
```

To see the generated structure type, open `codegen/lib/myfun/myfun_types.h` or view `myfun_types.h` in the code generation report. The generated C structure type is:

```
typedef struct {
 double a;
 double b;
} myStruct;
```

### Name the C Structure Type Generated for a Substructure

In a MATLAB function, `myfun1`, assign the name `MyStruct` to the generated C structure type for the structure `v`. Assign the name `mysubStruct` to the structure type generated for the substructure `v.b`.

```
function y = myfun()
 %#codegen
 v = struct('a',1,'b',struct('f',3));
 coder.cstructname(v, 'myStruct');
 coder.cstructname(v.b, 'mysubStruct');
 y = v;
end
```



The generated C structure type `mysubStruct` is:

```
typedef struct {
 double f;
} mysubStruct;
```

The generated C structure type `myStruct` is:

```
typedef struct {
 double a;
 mysubStruct b;
} myStruct;
```

### Name the Structure Type Generated for a Cell Array

In a MATLAB function, `myfun2`, assign the name `myStruct` to the generated C structure type for the cell array `c`.

```
function z = myfun2()
c = {1 2 3};
coder.cstructname(c, 'myStruct')
z = c;
```

The generated C structure type for `c` is:

```
typedef struct {
 double f1;
 double f2;
 double f3;
} myStruct;
```

### Name an Externally Defined C Structure Type

Specify that a structure passed to a C function has a structure type defined in a C header file.

Create a C header file `mycadd.h` for the function `mycadd` that takes a parameter of type `mycstruct`. Define the type `mycstruct` in the header file.

```
#ifndef MYCADD_H
#define MYCADD_H

typedef struct {
 double f1;
 double f2;
} mycstruct;

double mycadd(mycstruct *s);
#endif
```

Write the C function `mycadd.c`.

```
#include <stdio.h>
#include <stdlib.h>
```

```
#include "mycadd.h"

double mycadd(mycstruct *s)
{
 return s->f1 + s->f2;
}
```

Write a MATLAB function `mymAdd` that passes a structure by reference to `mycadd`. Use `coder.cstructname` to specify that in the generated code, the structure has the C type `mycstruct`, which is defined in `mycadd.h`.

```
function y = mymAdd
%#codegen
s = struct('f1', 1, 'f2', 2);
coder.cstructname(s, 'mycstruct', 'extern', 'HeaderFile', 'mycadd.h');
y = 0;
y = coder.ceval('mycadd', coder.ref(s));
```

Generate a C static library for function `mymAdd`.

```
codegen -config:lib mymAdd mycadd.c
```

The generated header file `mymadd_types.h` does not contain a definition of the structure `mycstruct` because `mycstruct` is an external type.

### Create a Structure Type Object That Names the Generated C Structure Type

Suppose that the entry-point function `myFunction` takes a structure argument. To specify the type of the input argument at the command line:

- 1 Define an example structure `S`.
- 2 Create a type `T` from `S` by using `coder.typeof`.
- 3 Use `coder.cstructname` to create a type `T1` that:
  - Has the properties of `T`.
  - Names the generated C structure type `myStruct`.
- 4 Pass the type to `codegen` by using the `-args` option.

For example:

```
S = struct('a',double(0),'b',single(0));
T = coder.typeof(S);
T1 = coder.cstructname(T,'myStruct');
codegen -config:lib myFunction -args T1
```

Alternatively, you can create the structure type directly from the example structure.

```
S = struct('a',double(0),'b',single(0));
T1 = coder.cstructname(S,'myStruct');
codegen -config:lib myFunction -args T1
```

## Input Arguments

### var — MATLAB structure or cell array variable

structure | cell array

MATLAB structure or cell array variable that is represented as a structure in the generated code.

### structName — Name of C structure type

character vector | string scalar

Name of generated or externally defined C structure type, specified as a character vector or string scalar.

### headerfile — Header file that contains the C structure type definition

character vector | string scalar

Header file that contains the C structure type definition, specified as a character vector or string scalar.

To specify the path to the file:

- Use the `codegen -I` option or the **Additional include directories** parameter on the MATLAB Code app settings **Custom Code** tab.
- For a MATLAB Function block, on the **Simulation Target** and the **Code Generation > Custom Code** panes, under **Additional build information**, set the **Include directories** parameter.

Alternatively, use `coder.updateBuildInfo` with the `'addIncludePaths'` option.

Example: `'mystruct.h'`

### alignment — Run-time memory alignment for structure

-1 (default) | power of 2 not greater than 128

Run-time memory alignment for generated or externally defined structure.

### intype — Type object or variable for creation of new type object

`coder.StructType` | `coder.CellType` | structure | cell array

Structure type object, cell array type object, structure variable, or cell array variable from which to create a type object.

## Limitations

- You cannot apply `coder.cstructname` directly to a global variable. To name the structure type to use with a global variable, use `coder.cstructname` to create a type object that names the structure type. Then, when you run `codegen`, specify that the global variable has that type. See “Name the C Structure Type to Use With a Global Structure Variable”.
- For cell array inputs, the field names of externally defined structures must be `f1`, `f2`, and so on.
- You cannot apply `coder.cstructname` directly to a class property.

## Tips

- For information about how the code generator determines the C/C++ types of structure fields, see “Mapping MATLAB Types to Types in Generated Code”.
- Using `coder.cstructname` on a structure array sets the name of the structure type of the base element, not the name of the array. Therefore, you cannot apply `coder.cstructname` to a structure array element, and then apply it to the array with a different C structure type name. For example, the following code is not allowed. The second `coder.cstructname` attempts to set the name of the base type to `myStructArrayName`, which conflicts with the previously specified name, `myStructName`.

```
% Define scalar structure with field a
myStruct = struct('a', 0);
coder.cstructname(myStruct, 'myStructName');
% Define array of structure with field a
myStructArray = repmat(myStruct,4,6);
coder.cstructname(myStructArray, 'myStructArrayName');
```

- Applying `coder.cstructname` to an element of a structure array produces the same result as applying `coder.cstructname` to the entire structure array. If you apply `coder.cstructname` to an element of a structure array, you must refer to the element by using a single subscript. For example, you can use `var(1)`, but not `var(1,1)`. Applying `coder.cstructname` to `var(:)` produces the same result as applying `coder.cstructname` to `var` or `var(n)`.
- Heterogeneous cell arrays are represented as structures in the generated code. Here are considerations for using `coder.cstructname` with cell arrays:
  - In a function from which you generate code, using `coder.cstructname` with a cell array variable makes the cell array heterogeneous. Therefore, if a cell array is an entry-point function input and its type is permanently homogeneous, then you cannot use `coder.cstructname` with the cell array.
  - Using `coder.cstructname` with a homogeneous `coder.CellType` object `intype` makes the returned object heterogeneous. Therefore, you cannot use `coder.cstructname` with a permanently homogeneous `coder.CellType` object. For information about when a cell array is permanently homogeneous, see “Specify Cell Array Inputs at the Command Line”.
  - When used with a `coder.CellType` object, `coder.cstructname` creates a `coder.CellType` object that is permanently heterogeneous.
- When you use a structure named by `coder.cstructname` in a project with row-major and column-major array layouts, the code generator renames the structure in certain cases, appending `row_` or `col_` to the beginning of the structure name. This renaming provides unique type definitions for the types that are used in both array layouts.
- These tips apply only to MATLAB Function blocks:
  - MATLAB Function block input and output structures are associated with bus signals. The generated name for the structure type comes from the bus signal name. Do not use `coder.cstructname` to name the structure type for input or output signals. See “Create Structures in MATLAB Function Blocks” (Simulink).
  - The code generator produces structure type names according to identifier naming rules, even if you name the structure type with `coder.cstructname`. If you have Embedded Coder, you can customize the naming rules. See “Construction of Generated Identifiers” (Embedded Coder).

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `codegen` | `coder.StructType` | `coder.CellType`

### Topics

“Structure Definition for Code Generation”

“Code Generation for Cell Arrays”

“Specify Cell Array Inputs at the Command Line”

“Call Custom C/C++ Code from the Generated Code”

### Introduced in R2011a

## coder.DeepLearningConfig

Create deep learning code generation configuration objects

### Syntax

```
deepLearningCfg = coder.DeepLearningConfig(TargetLibrary = targetlib)
```

### Description

`deepLearningCfg = coder.DeepLearningConfig(TargetLibrary = targetlib)` creates a deep learning configuration object containing library-specific parameters that `codegen` uses to generate code for deep neural networks. Assign this deep learning configuration object to the `DeepLearningConfig` property of the code configuration object created by using `coder.config`. Pass the code configuration object to the `codegen` function by using the `-config` option.

### Examples

#### Generate Code for the ResNet-50 Network Using Intel MKL-DNN Library

Set the code configuration parameters and generate C++ code for an ResNet-50 series network. The generated code uses the Intel MKL-DNN deep learning libraries.

Create an entry-point function `resnet_predict` that uses the `coder.loadDeepLearningNetwork` function to load the `resnet50 SeriesNetwork` object.

```
function out = resnet_predict(in)

persistent mynet;
if isempty(mynet)
 mynet = coder.loadDeepLearningNetwork('resnet50', 'myresnet');
end

out = predict(mynet,in);
```

The persistent object avoids reconstructing and reloading the network object during subsequent calls to the function to invoke the `predict` method on the input.

The input layer of the pretrained ResNet-50 network accepts images of size 224x224x3. To read an input image from a graphics file and resize it to 224x224, use the following lines of code:

```
in = imread('peppers.png');
in = imresize(in,[224,224]);
```

Create a `coder.config` configuration object for MEX code generation and set the target language to C++. On the configuration object, set `DeepLearningConfig` with `targetlib` as `'mkl_dnn'`. Use the `-config` option of the `codegen` function to pass this code configuration object. The `codegen` function must determine the size, class, and complexity of MATLAB function inputs. Use the `-args` option to specify the size of the input to the entry-point function.

```
cfg = coder.config('mex');
cfg.TargetLang = 'C++';
```

```
cfg.DeepLearningConfig = coder.DeepLearningConfig(TargetLibrary = 'mkl_dnn');
codegen -args {ones(224,224,3,'single')} -config cfg resnet_predict;
```

The `codegen` command places all the generated files in the `codegen` folder. It contains the C++ code for the entry-point function `resnet_predict.cpp`, header and source files containing the C++ class definitions for the convoluted neural network (CNN), weight, and bias files.

## Input Arguments

### targetLib — Specify the target deep learning library

character vector | string scalar

Target library for deep learning code generation, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                       |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'none'        | For generating code that does not use any third-party library.                                                                                                                    |
| 'arm-compute' | For generating code that uses the ARM Compute Library.                                                                                                                            |
| 'mkl_dnn'     | For generating code that uses the Intel Math Kernel Library for Deep Neural Networks (Intel MKL-DNN).                                                                             |
| 'cmsis-nn'    | Common Microcontroller Software Interface Standard - Neural Network (CMSIS-NN) library.<br><br>Requires the MATLAB Coder Interface for Deep Learning Libraries.                   |
| 'cudnn'       | For generating code that uses the CUDA Deep Neural Network library (cuDNN).<br><br>This option requires GPU Coder.                                                                |
| 'tensorrt'    | For generating code that takes advantage of the NVIDIA TensorRT - high performance deep learning inference optimizer and run-time library.<br><br>This option requires GPU Coder. |

## Output Arguments

### deepLearningCfig — Deep learning configuration object

Configuration Object

Configuration object based on the target library specified in the input argument. This object contains library-specific parameters that are used during code generation.

| Target Library | Deep Learning Configuration Object                                   |
|----------------|----------------------------------------------------------------------|
| 'none'         | Creates an <code>DeepLearningConfigBase</code> configuration object. |
| 'arm-compute'  | Creates an <code>ARMNEONConfig</code> configuration object.          |

| <b>Target Library</b> | <b>Deep Learning Configuration Object</b>                   |
|-----------------------|-------------------------------------------------------------|
| 'mkl_dnn'             | Creates an <code>MklDnnConfig</code> configuration object.  |
| 'cmsis-nn'            | Creates a <code>CmsisNnConfig</code> configuration object.  |
| 'cudnn'               | Creates a <code>CuDnnConfig</code> configuration object.    |
| 'tensorrt'            | Creates a <code>TensorRTConfig</code> configuration object. |

## See Also

### Functions

`codegen` | `coder.loadDeepLearningNetwork`

### Objects

`coder.CodeConfig` | `coder.MklDnnConfig` | `coder.ARMNEONConfig` | `coder.CmsisNnConfig`

### Topics

"Code Generation for Deep Learning Networks with MKL-DNN"

"Code Generation for Deep Learning Networks with ARM Compute Library"

"Generate Generic C/C++ Code for Deep Learning Networks"

"Code Generation for Object Detection by Using YOLO v2" (GPU Coder)

"Code Generation for Deep Learning Networks by Using cuDNN" (GPU Coder)

"Code Generation for Deep Learning Networks by Using TensorRT" (GPU Coder)

### Introduced in R2018b



## coder.extrinsic

Declare a function as extrinsic and execute it in MATLAB

### Syntax

```
coder.extrinsic(function)
coder.extrinsic(function1, ... ,functionN)

coder.extrinsic('-sync:on', function1, ... ,functionN)
coder.extrinsic('-sync:off', function1, ... ,functionN)
```

### Description

`coder.extrinsic(function)` declares `function` as an extrinsic function. The code generator does not produce code for the body of the extrinsic function and instead uses the MATLAB engine to execute the call. This functionality is available only when the MATLAB engine is available during execution. Examples of situations where the MATLAB engine is available include execution of MEX functions, Simulink simulations, or function calls at the time of code generation (also known as compile time).

During standalone code generation, the code generator attempts to determine whether an extrinsic function only has a side effect (for example, by displaying a plot) or whether it affects the output of the function in which it is called (for example, by returning a value to an output variable). If there is no change to the output, the code generator proceeds with code generation, but excludes the extrinsic function from the generated code. Otherwise, the code generator produces a compilation error.

You cannot use `coder.ceval` on functions that you declare as extrinsic by using `coder.extrinsic`. Also, the `coder.extrinsic` directive is ignored outside of code generation.

See “Use MATLAB Engine to Execute a Function Call in Generated Code”.

---

**Note** The code generator automatically treats many common MATLAB visualization functions, such as `plot`, `disp`, and `figure`, as extrinsic. You do not have to explicitly declare them as extrinsic functions by using `coder.extrinsic`.

---

`coder.extrinsic(function1, ... ,functionN)` declares `function1` through `functionN` as extrinsic functions.

`coder.extrinsic('-sync:on', function1, ... ,functionN)` enables synchronization of global data between MATLAB execution and generated code execution or Simulink simulation before and after calls to the extrinsic functions `function1` through `functionN`. If only a few extrinsic calls use or modify global data, turn off synchronization before and after all extrinsic function calls by setting the global synchronization mode to `At MEX-function entry and exit`. Use the `'-sync:on'` option to turn on synchronization for only the extrinsic calls that do modify global data.

If you use MATLAB Coder to generate a MEX function, the `'-sync:on'` option enables verification of consistency of constant global data between MATLAB and MEX functions after calls to the extrinsic functions.

See “Generate Code for Global Data”.

`coder.extrinsic('-sync:off', function1, ... ,functionN)` disables synchronization of global data between MATLAB execution and generated code execution before and after calls to the extrinsic functions `function1` through `functionN`. If most extrinsic calls use or modify global data, but a few do not, use the `'-sync:off'` option to turn off synchronization for the extrinsic calls that do not modify global data.

If you use MATLAB Coder to generate a MEX function, the `'-sync:off'` option disables verification of consistency of constant global data between MATLAB and MEX functions after calls to the extrinsic functions.

See “Generate Code for Global Data”.

## Examples

### Declare a Function That Returns No Output as Extrinsic

The MATLAB function `patch` is not supported for code generation. This example shows how you can still use the functionality of `patch` in your generated MEX function by declaring `patch` as extrinsic your MATLAB function.

This MATLAB code declares `patch` as extrinsic in the local function `create_plot`. By declaring `patch` as extrinsic, you instruct the code generator not to produce code for `patch`. Instead, the code generator dispatches `patch` to MATLAB for execution.

The code generator automatically treats many common MATLAB visualization functions, such as the function `axis` this code uses, as extrinsic.

```
function c = pythagoras(a,b,color) %#codegen
% Calculate the hypotenuse of a right triangle
% and display the triangle as a patch object.
c = sqrt(a^2 + b^2);
create_plot(a, b, color);
end

function create_plot(a, b, color)
%Declare patch as extrinsic
coder.extrinsic('patch');
x = [0;a;a];
y = [0;0;b];
patch(x,y,color);
axis('equal');
end
```

---

**Note** This code calls `patch` without requesting any output arguments. When generating standalone code, the code generator ignores such calls.

---

Generate a MEX function for `pythagoras`. Also, generate the code generation report.

```
codegen pythagoras -args {1, 1, [.3 .3]} -report
```

In the report, view the MATLAB code for `create_plot`.

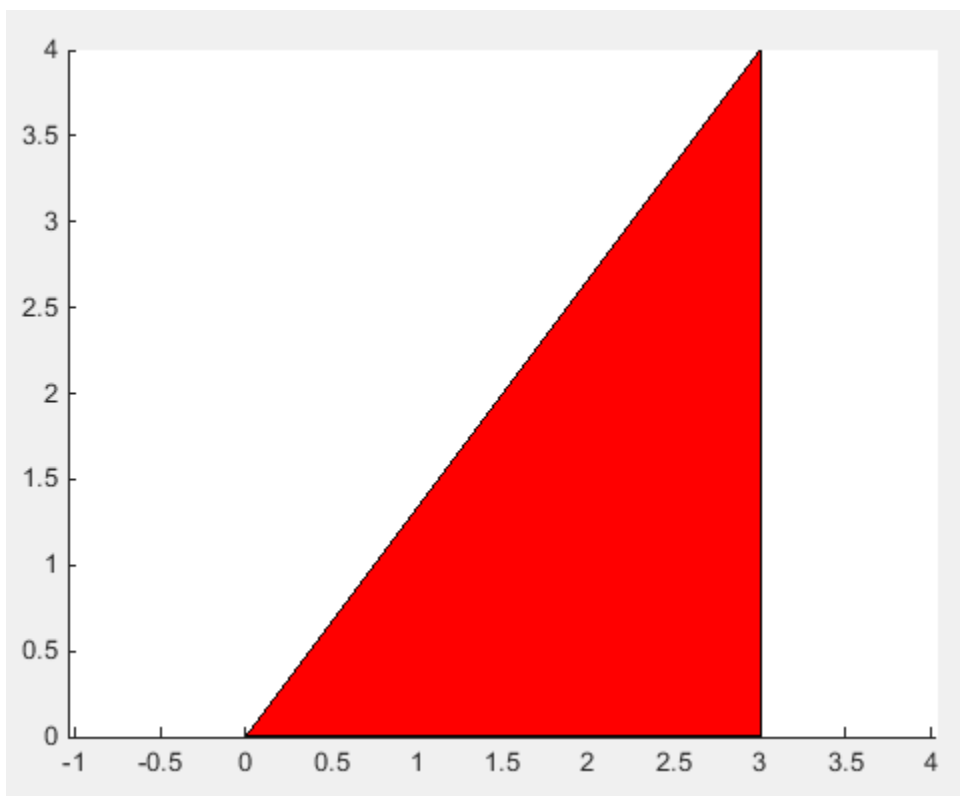
```
7 function create_plot(a, b, color)
8 coder.extrinsic('patch');
9 x = [0;a;a];
10 y = [0;0;b];
11 patch(x,y,color);
12 axis('equal');
13 end
```

The report highlights the `patch` and `axis` functions to indicate that they are treated as extrinsic functions.

Run the MEX function.

```
pythagoras_mex(3, 4, [1.0 0.0 0.0]);
```

MATLAB displays the plot of the right triangle as a red patch object.



---

**Note** Instead of generating a MEX file by using the `codegen` command, you can also place the function `pythagoras` inside a MATLAB Function block in a Simulink model. When you simulate the model, the MATLAB Function block has similar behavior as `pythagoras_mex`.

---

## Return Output of Extrinsic Function to MATLAB at Run Time

The output that an extrinsic function returns at run time is an mxArray, also known as a MATLAB array. The only valid operations for an mxArray are storing it in a variable, passing it to another extrinsic function, or returning it to MATLAB. To perform any other operation on an mxArray value, such as using it in an expression in your code, you must convert the mxArray to a known type at run time. To perform this action, assign the mxArray to a variable whose type is already defined by a prior assignment.

This example shows how to return an mxArray output from an extrinsic function directly to MATLAB. The next example shows how to convert the same mxArray output to a known type, and then use it in an expression inside your MATLAB function.

### Define Entry-Point Function

Define a MATLAB function `return_extrinsic_output` that accepts source and target node indices for a directed graph as inputs and determines if the graph is acyclic by using the `hascycles` function. The `hascycles` function is not supported for code generation and is declared as extrinsic.

```
type return_extrinsic_output.m

function hasCycles = return_extrinsic_output(source,target)
coder.extrinsic('hascycles');
assert(numel(source) == numel(target))
G = digraph(source,target);
hasCycles = hascycles(G);
end
```

### Generate and Call MEX Function

Generate MEX code for `return_extrinsic_output`. Specify the inputs to be unbounded vectors of type double.

```
codegen return_extrinsic_output -args {coder.typeof(0,[1 Inf]),coder.typeof(0,[1 Inf])} -report
```

Code generation successful: To view the report, open('codegen\mex\return\_extrinsic\_output\html\report.html')

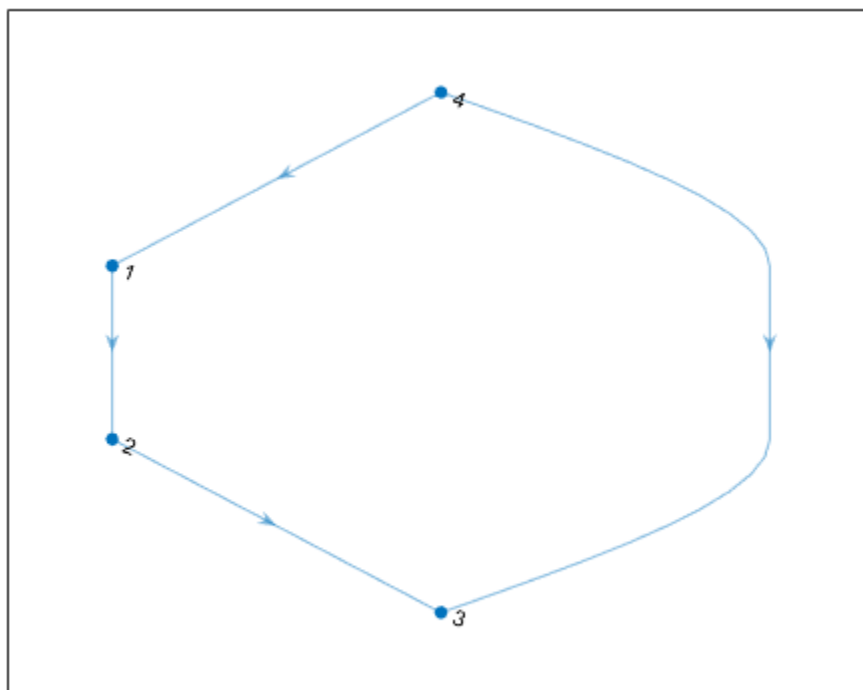
Call the generated MEX function `return_extrinsic_output_mex` with suitable inputs:

```
return_extrinsic_output([1 2 4 4],[2 3 3 1])
```

```
ans = logical
 0
```

To visually inspect if the directed graph has cycles, plot the directed graph in MATLAB.

```
plot(digraph([1 2 4 4],[2 3 3 1]))
```



### Use Output of Extrinsic Function in an Expression at Run Time

The output that an extrinsic function returns is an `mxAarray`, also known as a MATLAB array. The only valid operations for an `mxAarray` are storing it in a variable, passing it to another extrinsic function, or returning it to MATLAB. To perform any other operation on an `mxAarray` value, such as using it in an expression in your code, convert the `mxAarray` to a known type at run time. To perform this action, assign the `mxAarray` to a variable whose type is already defined by a prior assignment.

This example shows how to convert the `mxAarray` output of an extrinsic function to a known type, and then use the output in an expression inside your MATLAB function.

#### Define Entry-Point Function

Define a MATLAB function `use_extrinsic_output` that accepts source and target node indices for a directed graph as inputs and determines if the graph is acyclic by using the `hascycles` function. The `hascycles` function is not supported for code generation and is declared as extrinsic. The entry-point function displays a message based on the output of the `hascycles` function.

```

type use_extrinsic_output

function use_extrinsic_output(source,target) %#codegen
assert(numel(source) == numel(target))
G = digraph(source,target);

coder.extrinsic('hascycles');

```

```
hasCycles = true;

hasCycles = hascycles(G);
if hasCycles == true
 disp('The graph has cycles')
else
 disp('The graph does not have cycles')
end
end
```

The local variable `hasCycles` is first preassigned the Boolean value `true` before the assignment `hasCycles = hascycles(G)` occurs. This preassignment enables the code generator to convert the `mxAarray` that the extrinsic function `hascycles` returns to a Boolean before assigning it to the `hasCycles` variable. This conversion in turn enables you to compare `hasCycles` with the Boolean `true` in the condition of the `if` statement.

### **Generate and Call MEX Function**

Generate MEX code for `use_extrinsic_output`. Specify the inputs to be unbounded vectors of type `double`.

```
codegen use_extrinsic_output -args {coder.typeof(0,[1 Inf]),coder.typeof(0,[1 Inf])} -report
```

Code generation successful: To view the report, open('codegen\mex\use\_extrinsic\_output\html\report.html')

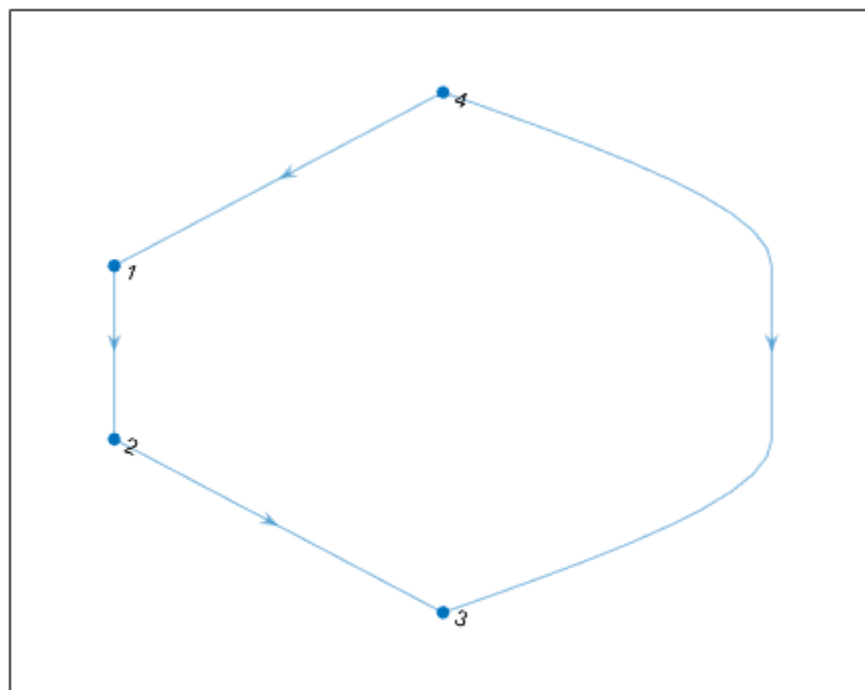
Call the generated MEX function `use_extrinsic_output_mex` with suitable inputs:

```
use_extrinsic_output_mex([1 2 4 4],[2 3 3 1])
```

```
The graph does not have cycles
```

To see if the directed graph has cycles, plot the graph in MATLAB.

```
plot(digraph([1 2 4 4],[2 3 3 1]))
```



### Evaluate Extrinsic Function Call at Compile Time by Using `coder.const`

This example shows how to call an extrinsic function at the time of code generation (also known as compile time) by using `coder.const`. Because the MATLAB engine is always available during the evaluation of the expression inside `coder.const`, you can use this coding pattern when generating either MEX or standalone code. Unlike the previous two examples that show run-time execution, you do not need to explicitly convert the output of the extrinsic function to a known type if its evaluation happens at compile time.

In this example, the entry-point function `rotate_complex` invokes another function `xml2struct` that uses the MATLAB API for XML processing. Because code generation does not support the MATLAB API for XML processing, the `xml2struct` function is declared as extrinsic in the body of the entry-point function. Also, the call to `xml2struct` inside the entry-point function returns a compile-time constant. So, this output is constant-folded by placing the function call inside the `coder.const` directive.

### Inspect XML File Containing Parameters

The supporting file `complex.xml` contains the values of real and imaginary parts of a complex number.

```
type complex.xml
```

```
<params>
 <param name="real" value="3"/>
```

```
<param name="imaginary" value="4"/>
</params>
```

### Define xml2struct Function

The MATLAB function `xml2struct` reads an XML file that uses the format of `complex.xml` to store parameter names and values, stores this information as structure fields, and returns this structure.

type `xml2struct.m`

```
function s = xml2struct(file)
s = struct();
doc = xmlread(file);
els = doc.getElementsByTagName("params");
for i = 0:els.getLength-1
 it = els.item(i);
 ps = it.getElementsByTagName("param");
 for j = 0:ps.getLength-1
 param = ps.item(j);
 paramName = char(param.getAttribute("name"));
 paramValue = char(param.getAttribute("value"));
 paramValue = evalin("base", paramValue);
 s.(paramName) = paramValue;
 end
end
```

### Define Entry-Point Function

Your MATLAB entry-point function `rotate_complex` first calls `xml2struct` to read the file `complex.xml`. It then rotates the complex number by an angle that is equal to the input argument `theta` in degrees and returns the resulting complex number.

type `rotate_complex.m`

```
function y = rotate_complex(theta) %#codegen
coder.extrinsic("xml2struct");
s = coder.const(xml2struct("complex.xml"));

comp = s.real + 1i * s.imaginary;
magnitude = abs(comp);
phase = angle(comp) + deg2rad(theta);
y = magnitude * cos(phase) + 1i * sin(phase);

end
```

The `xml2struct` function is declared as extrinsic and its output is constant-folded by placing the function inside the `coder.const` directive.

### Generate and Inspect Static Library

Generate a static library for `read_complex` by using the `codegen` command. Specify the input type to be a scalar double.

```
codegen -config:lib rotate_complex -args {0} -report
```

Code generation successful: To view the report, open('codegen\lib\rotate\_complex\html\report.mld

Inspect the generated C++ file `rotate_complex.c`. Observe that the output of the `xml2struct` function is hardcoded in the generated code.



```

type codegen/lib/rotate_complex/rotate_complex.c

/*
 * rotate_complex.c
 *
 * Code generation for function 'rotate_complex'
 *
 */

/* Include files */
#include "rotate_complex.h"
#include <math.h>

/* Function Definitions */
creal_T rotate_complex(double theta)
{
 creal_T y;
 double y_tmp;
 y_tmp = 0.017453292519943295 * theta + 0.92729521800161219;
 y.re = 5.0 * cos(y_tmp);
 y.im = sin(y_tmp);
 return y;
}

/* End of code generation (rotate_complex.c) */

```

## Input Arguments

### function — MATLAB function name

character vector

Name of the MATLAB function that is declared as extrinsic.

Example: `coder.extrinsic('patch')`

Data Types: `char`

## Limitations

- Extrinsic function calls have some overhead that can affect performance. Input data that is passed in an extrinsic function call must be provided to MATLAB, which requires making a copy of the data. If the function has any output data, this data must be transferred back into the MEX function environment, which also requires a copy.
- The code generator does not support the use of `coder.extrinsic` to call functions that are located in a private folder.
- The code generator does not support the use of `coder.extrinsic` to call local functions.

## Tips

- The code generator automatically treats many common MATLAB visualization functions, such as `plot`, `disp`, and `figure`, as extrinsic. You do not have to explicitly declare them as extrinsic functions by using `coder.extrinsic`.

- Use the `coder.screener` function to detect which functions you must declare as extrinsic. This function runs the Code Generation Readiness Tool that screens the MATLAB code for features and functions that are not supported for code generation.

## **Extended Capabilities**

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## **See Also**

`coder.ceval` | `coder.screener`

### **Topics**

“Use MATLAB Engine to Execute a Function Call in Generated Code”

“Generate Code for Global Data”

“Define Constant Global Data”

“Resolution of Function Calls for Code Generation”

### **Introduced in R2011a**

# coder.getArgTypes

**Package:** coder

Determine types of function input arguments by executing test file

## Syntax

```
types = coder.getArgTypes(test_fcn,fcn)
struct_of_types = coder.getArgTypes(test_fcn,{fcn_1,...,fcn_n})
struct_of_types = coder.getArgTypes(test_fcn,fcn, 'uniform',struct_flag)
```

## Description

`types = coder.getArgTypes(test_fcn,fcn)` returns a cell array of `coder.Type` objects determined by executing `test_fcn`. The function `test_fcn` must call the specified entry-point MATLAB function `fcn`. Input arguments to `fcn` construct the returned types.

`struct_of_types = coder.getArgTypes(test_fcn,{fcn_1,...,fcn_n})` returns a structure containing cell arrays of `coder.Type` objects determined by executing `test_fcn`. The function `test_fcn` must call the specified entry-point functions `fcn_1` through `fcn_n`. Input arguments to these functions construct the returned types. The returned structure contains one field for each function. The field name is the same as the name of the corresponding function.

`struct_of_types = coder.getArgTypes(test_fcn,fcn, 'uniform',struct_flag)` returns a structure even though there is only one entry-point function. The property `uniform` defines whether the output array type is a structure of cell arrays (`true`) or a cell array (`false`).

## Examples

### Get Input Parameter Types for Single Entry-Point Function

Get input parameter types for function `my_fun` by running test file `my_test`, which calls `my_fun`. Use these input types to generate code for `my_fun`.

In a local writable folder, create the MATLAB function `my_fun` and save it in the file `my_fun.m`.

```
function y = my_fun(u,v) %#codegen
 y = u+v;
end
```

Create the test function `my_test` and save it in the file `my_test.m`.

```
function y = my_test
 a = single(10);
 b = single(20);
 y = my_fun(a,b);
end
```

To get the input types for `my_fun`, run the test function.

```
types = coder.getArgTypes('my_test','my_fun')
types =
 1x2 cell array
 {1x1 coder.PrimitiveType} {1x1 coder.PrimitiveType}
```

Generate a MEX function for `my_fun` by using these input types as example inputs.

```
codegen my_fun -args types
```

In the current folder, `codegen` generates a MEX function, `my_fun_mex`, that accepts inputs of type `single`.

Test the MEX function. For example:

```
y = my_fun_mex(single(10),single(20))
```

### Get Input Parameter Types for Multiple Entry-Point Functions

Get input parameter types for functions `my_fun1` and `my_fun2` by running test file `my_test2`, which calls `my_fun1` and `my_fun2`. Use these input types to generate code for `my_fun1` and `my_fun2`.

In a local writable folder, create the MATLAB function `my_fun1`. Save it in the file `my_fun1.m`.

```
function y = my_fun1(u) %#codegen
 y = u;
```

Create the function `my_fun2`. Save it in the file `my_fun2.m`.

```
function y = my_fun2(u,v) %#codegen
 y = u + v;
```

Create the test function.

```
function [y1, y2] = my_test2
 a = 10;
 b = single(20);
 y1 = my_fun1(a);
 y2 = my_fun2(a,b);
end
```

To get the input types for `my_fun1` and `my_fun2`, run the test function.

```
types = coder.getArgTypes('my_test2',{'my_fun1','my_fun2'})
types =
 struct with fields:
 my_fun1: {[1x1 coder.PrimitiveType]}
 my_fun2: {[1x1 coder.PrimitiveType] [1x1 coder.PrimitiveType]}
```

Generate a MEX function for `my_fun1` and `my_fun2` by using these input types as example inputs.

```
codegen my_fun1 -args types.my_fun1 my_fun2 -args types.my_fun2
```

In the current folder, `codegen` generates a MEX function, `my_fun1_mex`, with two entry points, `my_fun1` and `my_fun2`, that accept inputs of type `double`.

Test each entry point in the MEX function. For example:

```
y1 = my_fun1_mex('my_fun1',10)
y2 = my_fun1_mex('my_fun2',10,20)
```

## Get Input Parameter Types as Structure for Single Entry-Point Function

Get input parameter types for function `my_fun` by running test file `my_test`, which calls `my_fun`. Use these input types to generate code for `my_fun`.

In a local writable folder, create the MATLAB function `my_fun` and save it in the file `my_fun.m`.

```
function y = my_fun(u,v) %#codegen
 y = u+v;
end
```

Create the test function `my_test` and save it in the file `my_test.m`.

```
function y = my_test
 a = single(10);
 b = single(20);
 y = my_fun(a,b);
end
```

To get the input types for `my_fun` as structure with fields, run the test function.

```
types = coder.getArgTypes('my_test','my_fun','uniform',true)
```

```
types =
```

```
 struct with fields:
```

```
 my_fun: {[1x1 coder.PrimitiveType] [1x1 coder.PrimitiveType]}
```

Generate a MEX function for `my_fun` by using these input types as example inputs.

```
codegen my_fun -args types.my_fun
```

In the current folder, `codegen` generates a MEX function, `my_fun_mex`, that accepts inputs of type `single`.

Test the MEX function. For example:

```
y = my_fun_mex(single(10),single(20))
```

## Input Arguments

### fcn — Name of function

character vector | string scalar

Name or handle of entry-point MATLAB function for which you want to determine input types. The function cannot be a local function. It must be on the MATLAB path in a writable folder.

Example: `types = coder.getArgTypes('my_test','my_fun');`

Example: `types = coder.getArgTypes(@my_test,@my_fun);`

Data Types: `char` | `string` | `function_handle`

**fcn\_1, ..., fcn\_n — List of names of functions**

character vector | string scalar

Comma-separated list of names or handles of entry-point MATLAB functions for which you want to determine input types. The functions cannot be local functions. They must be on the MATLAB path in a writable folder. The entry-point function names must be unique.

Example: `types = coder.getArgTypes('my_test',{'my_fun1','my_fun2'});`

Example: `types = coder.getArgTypes(@my_test,{@my_fun1,@my_fun2});`

Data Types: `char` | `string` | `function_handle`

**test\_fcn — Name of test function**

character vector | string scalar

Name or handle of test function or name of test script. The test function or script must be on the MATLAB path. `test_fcn` must call at least one of the specified entry-point functions. The input arguments to these functions construct the returned types.

Example: `types = coder.getArgTypes('my_test','my_fun');`

Data Types: `char` | `string` | `function_handle`

**struct\_flag — Output array type flag**

`true` | `false`

|                    |                                                                                                                                                                           |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | Returns a structure of cell arrays of <code>coder.Type</code> objects determined by executing <code>test_fcn</code> , even though there is only one entry-point function. |
| <code>false</code> | Returns a cell array of <code>coder.Type</code> objects determined by executing <code>test_fcn</code> .                                                                   |

Example: `coder.getArgTypes('my_test','my_fun','uniform',true);`

Data Types: `logical`

**Output Arguments**

**types — Cell array of `coder.Type` objects**

cell array

Cell array of `coder.Type` objects determined by executing the test function.

**struct\_of\_types — Structure containing cell arrays of `coder.Type` objects**

struct

Structure containing cell arrays of `coder.Type` objects determined by executing the `test_fcn` function. The structure contains one field for each function. The field name is the same as the name of the corresponding function.

## Tips

- Before using `coder.getArgTypes`, run the test function in MATLAB to verify that it provides the expected results.
- Verify that the test function calls the specified entry-point functions with input data types suitable for your run-time environment. If the test function does not call a specified function, `coder.getArgTypes` cannot determine the input types for this function.
- `coder.getArgTypes` might not compute the ideal type for your application. For example, you might want the size to be unbounded. The `coder.getArgTypes` function returns a bound based on the largest input. To adjust the sizes of the returned types, use `coder.resize`.
- For some combinations of inputs, `coder.getArgTypes` cannot produce a valid type. For example, if the test function calls the entry-point function with single inputs, and then calls it with double inputs, `coder.getArgTypes` generates an error because there is no single type that can represent both calls.
- When you generate code for the MATLAB function, use the returned types as example inputs by passing them to the `codegen` function using the `-args` option.

## Alternatives

- “Specify Properties of Entry-Point Function Inputs Using the App”
- “Define Input Properties Programmatically in the MATLAB File”

## See Also

`coder.typeof` | `coder.resize` | `coder.runTest` | `codegen`

## Topics

“Specify Properties of Entry-Point Function Inputs”

## Introduced in R2012a

## coder.getDeepLearningLayers

Get the list of layers supported for code generation for a specific deep learning library

### Syntax

```
coder.getDeepLearningLayers
coder.getDeepLearningLayers(TargetLibrary = libraryname)
```

### Description

`coder.getDeepLearningLayers` returns the layers supported for code generation that do not use any third-party libraries.

`coder.getDeepLearningLayers(TargetLibrary = libraryname)` returns the layers supported for code generation for a specific deep learning library.

---

**Note** To use `coder.getDeepLearningLayers`, you must install the support package that corresponds to `libraryname`:

- For 'none', 'arm-compute', 'cmsis-nn', and 'mkl-dnn', install MATLAB Coder Interface for Deep Learning Libraries.
  - For 'cudnn', 'tensorrt', or 'arm-compute-mali', install GPU Coder Interface for Deep Learning Libraries.
- 

---

**Note** The `coder.getDeepLearningLayers` function does not list certain custom layers if the associated support packages are not installed. For example, keras layers are not listed if the Deep Learning Toolbox Converter for TensorFlow™ Models support package is not installed.

---

### Examples

#### Get Layers Supported for Code Generation for a Specific Deep Learning Library

Get a list of layers supported for code generation for Intel Math Kernel Library for Deep Neural Networks.

```
coder.getDeepLearningLayers(TargetLibrary = 'mkl-dnn')
```

```
ans =
```

```
59x1 cell array
```

```
{'AdditionLayer' }
{'AnchorBoxLayer' }
{'AveragePooling2DLayer' }
{'BatchNormalizationLayer'}
{'BiLSTMLayer' }
```



```

{'ClassificationOutputLayer' }
{'ClippedReLULayer' }
{'ConcatenationLayer' }
{'Convolution2DLayer' }
{'Crop2DLayer' }
{'CrossChannelNormalizationLayer' }
{'DepthConcatenationLayer' }
{'DepthToSpace2DLayer' }
{'DicePixelClassificationLayer' }
{'DropoutLayer' }
{'ELULayer' }
{'FeatureInputLayer' }
{'FlattenLayer' }
{'FocalLossLayer' }
{'FullyConnectedLayer' }
{'GRULayer' }
{'GlobalAveragePooling2DLayer' }
{'GlobalMaxPooling2DLayer' }
{'GroupedConvolution2DLayer' }
{'ImageInputLayer' }
{'LSTMLayer' }
{'LeakyReLULayer' }
{'MaxPooling2DLayer' }
{'MaxUnpooling2DLayer' }
{'MultiplicationLayer' }
{'PixelClassificationLayer' }
{'RCNNBoxRegressionLayer' }
{'RPNClassificationLayer' }
{'ReLULayer' }
{'RegressionOutputLayer' }
{'Resize2DLayer' }
{'SSDMergeLayer' }
{'SequenceFoldingLayer' }
{'SequenceInputLayer' }
{'SequenceUnfoldingLayer' }
{'SigmoidLayer' }
{'SoftmaxLayer' }
{'SpaceToDepthLayer' }
{'TanhLayer' }
{'TransposedConvolution2DLayer' }
{'WordEmbeddingLayer' }
{'YOLOv2OutputLayer' }
{'YOLOv2ReorgLayer' }
{'YOLOv2TransformLayer' }
{'nnet.keras.layer.FlattenCStyleLayer' }
{'nnet.keras.layer.GlobalAveragePooling2dLayer' }
{'nnet.keras.layer.SigmoidLayer' }
{'nnet.keras.layer.TanhLayer' }
{'nnet.keras.layer.ZeroPadding2dLayer' }
{'nnet.onnx.layer.ElementwiseAffineLayer' }
{'nnet.onnx.layer.FlattenLayer' }
{'nnet.onnx.layer.IdentityLayer' }

```

```
{'ScalingLayer'
{'SoftplusLayer'}
```

## Input Arguments

### Libraryname — Name of deep learning library

character vector | string scalar

Name of deep learning library, specified as one of the values in this table.

| Value              | Description                                                                                                                                                                                                                                                                                                                         |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'arm-compute'      | ARM Compute Library for targeting ARM CPU processors.<br><br>Requires the MATLAB Coder Interface for Deep Learning Libraries.                                                                                                                                                                                                       |
| 'arm-compute-mali' | ARM Compute Library for targeting ARM GPU processors.<br><br>Requires the GPU Coder product and the GPU Coder Interface for Deep Learning Libraries.                                                                                                                                                                                |
| 'cmsis-nn'         | Common Microcontroller Software Interface Standard - Neural Network (CMSIS-NN) library.<br><br>Requires the MATLAB Coder Interface for Deep Learning Libraries.                                                                                                                                                                     |
| 'cudnn'            | NVIDIA CUDA Deep Neural Network library (cuDNN).<br><br>Requires the GPU Coder product and the GPU Coder Interface for Deep Learning Libraries.                                                                                                                                                                                     |
| 'mkl-dnn'          | Intel Math Kernel Library for Deep Neural Networks.<br><br>Requires the MATLAB Coder Interface for Deep Learning Libraries.                                                                                                                                                                                                         |
| 'none'             | <code>coder.getDeepLearningLayers(TargetLibrary = 'none')</code> returns the layers supported for code generation that do not use any third-party libraries. This is equivalent to calling <code>coder.getDeepLearningLayers</code> with no input argument.<br><br>Requires the MATLAB Coder Interface for Deep Learning Libraries. |
| 'tensorrt'         | NVIDIA TensorRT high performance deep learning inference optimizer and run-time library.<br><br>Requires the GPU Coder product and the GPU Coder Interface for Deep Learning Libraries.                                                                                                                                             |

## See Also

### Functions

codegen | coder.loadDeepLearningNetwork

### Topics

"Installing Prerequisite Products" (GPU Coder)

"Prerequisites for Deep Learning with MATLAB Coder"

"Supported Networks, Layers, and Classes" (GPU Coder)

"Networks and Layers Supported for Code Generation"

"Code Generation for Deep Learning Networks with MKL-DNN"

"Code Generation for Deep Learning Networks with ARM Compute Library"

"Generate Generic C/C++ Code for Deep Learning Networks"

"Code Generation for Deep Learning Networks by Using cuDNN" (GPU Coder)

"Code Generation for Deep Learning Networks by Using TensorRT" (GPU Coder)

### Introduced in R2018b

## coder.ignoreConst

Prevent use of constant value of expression for function specializations

### Syntax

```
coder.ignoreConst(expression)
```

### Description

`coder.ignoreConst(expression)` prevents the code generator from using the constant value of `expression` to create function specializations on page 2-122. `coder.ignoreConst(expression)` returns the value of `expression`.

### Examples

#### Prevent Function Specializations Based on Constant Input Values

Use `coder.ignoreConst` to prevent function specializations for a function that is called with constant values.

Write the function `call_myfcn`, which calls `myfcn`.

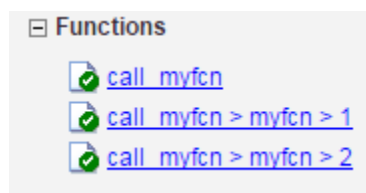
```
function [x, y] = call_myfcn(n)
 %#codegen
 x = myfcn(n, 'mode1');
 y = myfcn(n, 'mode2');
end

function y = myfcn(n,mode)
 coder.inline('never');
 if strcmp(mode, 'mode1')
 y = n;
 else
 y = -n;
 end
end
```

Generate standalone C code. For example, generate a static library. Enable the code generation report.

```
codegen -config:lib call_myfcn -args {1} -report
```

In the code generation report, you see two function specializations for `call_myfcn`.



The code generator creates `call_myfcn>myfcn>1` for `mode` with a value of `'mode1'`. It creates `call_myfcn>myfcn>2` for `mode` with a value of `'mode2'`.

In the generated C code, you see the specializations `my_fcn` and `b_my_fcn`.

```
static double b_myfcn(double n)
{
 return -n;
}

static double myfcn(double n)
{
 return n;
}
```

To prevent the function specializations, instruct the code generator to ignore that values of the `mode` argument are constant.

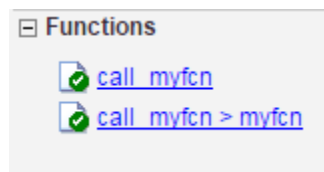
```
function [x, y] = call_myfcn(n)
%#codegen
x = myfcn(n, coder.ignoreConst('mode1'));
y = myfcn(n, coder.ignoreConst('mode2'));
end

function y = myfcn(n,mode)
coder.inline('never');
if strcmp(mode,'mode1')
 y = n;
else
 y = -n;
end
end
```

Generate the C code.

```
codegen -config:lib call_myfcn -args {1} -report
```

In the code generation report, you do not see multiple function specializations.



In the generated C code, you see one function for `my_fcn`.

## Input Arguments

**expression** — Expression whose value is to be treated as a nonconstant

MATLAB expression

Expression whose value is to be treated as a nonconstant, specified as a MATLAB expression.

## More About

### Function Specialization

Version of a function in which an input type, size, complexity, or value is customized for a particular invocation of the function.

Function specialization produces efficient C code at the expense of code duplication. The code generation report shows all MATLAB function specializations that the code generator creates. However, the specializations might not appear in the generated C/C++ code due to later transformations or optimizations.

### Tips

- For some recursive function calls, you can use `coder.ignoreConst` to force run-time recursion. See “Force Code Generator to Use Run-Time Recursion”.
- `coder.ignoreConst(expression)` prevents the code generator from using the constant value of `expression` to create function specializations. It does not prevent other uses of the constant value during code generation.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.inline` | `coder.ignoreSize`

### Topics

“Force Code Generator to Use Run-Time Recursion”

“Compile-Time Recursion Limit Reached”

“Avoid Duplicate Functions in Generated Code”

### Introduced in R2017a

# coder.ignoreSize

**Package:** coder

Prevent code generator from creating function specializations for constant-size expressions

## Syntax

```
coder.ignoreSize(expression)
```

## Description

`coder.ignoreSize(expression)` declares that the code generator must not use the constant size of an expression to create function specializations.

## Examples

### Duplicate Functions Generated for Multiple Input Sizes

If your MATLAB code calls a function multiple times and passes inputs of different sizes, the code generator can create function specializations for each size. To avoid this issue, use `coder.ignoreSize` on the function input. For example, this code uses `coder.ignoreSize` to avoid creating multiple copies of the function `indexOf`:

```
function [out1, out2] = test1(in)
 a = 1:10;
 b = 2:40;
 % Without coder.ignoreSize duplicate functions are generated
 out1 = indexOf(coder.ignoreSize(a), in);
 out2 = indexOf(coder.ignoreSize(b), in);
end

function index = indexOf(array, value)
 coder.inline('never');
 for i = 1:numel(array)
 if array(i) == value
 index = i;
 return
 end
 end
 index = -1;
 return
end
```

To generate code, enter:

```
codegen test1 -config:lib -report -args {1}
```

## Input Arguments

**expression** — Expression whose size is to be treated as nonconstant  
MATLAB expression

Example: `foo(coder.ignoreSize(1:10))`

## More About

### Function Specialization

Version of a function in which an input type, size, complexity, or value is customized for a particular invocation of the function.

Function specialization produces efficient C code at the expense of code duplication. The code generation report shows all MATLAB function specializations that the code generator creates. However, the specializations might not appear in the generated C/C++ code due to later transformations or optimizations.

### Tips

- If you assign an expression to a variable and declare the variable as variable-size by using `coder.varsize`, this declaration has the same effect as using `coder.ignoreSize` on the expression.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ignoreConst`

### Topics

“Avoid Duplicate Functions in Generated Code”

### Introduced in R2019b



# coder.inline

**Package:** coder

Control inlining of a specific function in generated code

## Syntax

```
coder.inline('always')
coder.inline('never')
coder.inline('default')
```

## Description

`coder.inline('always')` forces inlining on page 2-126 of the current function in the generated code. Place the `coder.inline` directive inside the function that you want to inline. The code generator does not inline entry-point functions and recursive functions. Also, the code generator does not inline functions into `parfor` loops, or inline functions called from `parfor` loops.

`coder.inline('never')` prevents inlining of the current function in the generated code. Prevent inlining when you want to simplify the mapping between the MATLAB source code and the generated code.

---

**Note** If you use the `codegen` or the `fiaccl` command, you can disable inlining for all functions by using the `-O disable:inline` option.

If you generate C/C++ code by using the `codegen` command or the MATLAB Coder app, you might have different speed and readability requirements for the code generated for functions that you write and the code generated for MathWorks® functions. Certain additional global settings enable you to separately control the inlining behavior for these two parts of the generated code base and at the boundary between them. See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

---

`coder.inline('default')` instructs the code generator to use internal heuristics to determine whether to inline the current function. Usually, the heuristics produce highly optimized code. Use `coder.inline` explicitly in your MATLAB functions only when you need to fine-tune these optimizations.

## Examples

### Prevent Function Inlining

In this example, function `foo` is not inlined in the generated code:

```
function y = foo(x)
 coder.inline('never');
```

```
 y = x;
end
```

### Use `coder.inline` in Control Flow Statements

You can use `coder.inline` in control flow code. If the software detects contradictory `coder.inline` directives, the generated code uses the default inlining heuristic and issues a warning.

Suppose that you want to generate code for a division function that runs on a system with limited memory. To optimize memory use in the generated code, the `inline_division` function manually controls inlining based on whether it performs scalar division or vector division:

```
function y = inline_division(dividend, divisor)

% For scalar division, inlining produces smaller code
% than the function call itself.
if isscalar(dividend) && isscalar(divisor)
 coder.inline('always');
else
% Vector division produces a for-loop.
% Prohibit inlining to reduce code size.
 coder.inline('never');
end

if any(divisor == 0)
 error('Cannot divide by 0');
end

y = dividend / divisor;
```

## More About

### Inlining

Technique that replaces a function call with the contents (body) of that function. Inlining eliminates the overhead of a function call, but can produce larger C/C++ code. Inlining can create opportunities for further optimization of the generated C/C++ code.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`codegen`

### Topics

“Control Inlining to Fine-Tune Performance and Readability of Generated Code”

“Optimization Strategies”

**Introduced in R2011a**

## coder.isColumnMajor

Determine whether the current function or variable uses column-major layout

### Syntax

```
coder.isColumnMajor
coder.isColumnMajor(arg)
```

### Description

`coder.isColumnMajor` resolves as true in the generated code if the current function uses column-major array layout. Use the function as the expression in control flow (`if`, `else`, `switch`) statements.

`coder.isColumnMajor(arg)` resolves as true if the current variable uses column-major array layout.

### Examples

#### Query Array Layout of a Function

To query the array layout of a function at compile time, use `coder.isColumnMajor` or `coder.isRowMajor`. This query can be useful for specializing your generated code when it involves row-major and column-major functions. For example, consider this function:

```
function S = addMatrixRouted(A,B)
 if coder.isRowMajor
 %execute this code if row major
 S = addMatrix_OptimizedForRowMajor(A,B);
 elseif coder.isColumnMajor
 %execute this code if column major
 S = addMatrix_OptimizedForColumnMajor(A,B);
 end
```

The function `addMatrixRouted` behaves differently depending on whether it uses row-major layout or column-major layout. The layout that the function uses, for example, can depend on whether it is called from a function that contains `coder.isRowMajor` or `coder.isColumnMajor`. When `addMatrixRouted` uses row-major layout, it calls the `addMatrix_OptimizedForRowMajor` function, which has efficient memory access for row-major data. When the function uses column-major layout, it calls a version of the `addMatrix` function optimized for column-major data.

By using the query functions, the generated code for `addMatrixRouted` provides efficient memory access for either choice of array layout.

#### Query Array Layout of a Variable

Consider the function `bar`:

```
function bar
 coder.columnMajor;
```

```
x = magic(3);
if coder.isColumnMajor(x)
 fprintf('This will always be displayed in generated code.\n');
else
 fprintf('This will never be displayed in generated code.\n');
end
end
```

Generate code:

```
codegen bar
```

To run the MEX function, enter:

```
bar_mex
```

## Input Arguments

**arg** — Variable name

array variable

Variable to query for array layout.

Example: `coder.isColumnMajor(x)`;

## Limitations

- You cannot query the array layout of a structure field or property.

## Tips

- The code generator uses column-major layout by default.
- Outside of code generation and simulation, `coder.isColumnMajor` is always true.
- If `coder.isColumnMajor` always resolves to true for your code, other branches in the `if` statement are ignored by the code generator. Otherwise, one instance of the current function is created for each array layout.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `coder.columnMajor` | `coder.rowMajor` | `coder.isRowMajor`

## Topics

“Generate Code That Uses Row-Major Array Layout”

“Specify Array Layout in Functions and Classes”

“Generate Code That Uses N-Dimensional Indexing”

**Introduced in R2018a**

## coder.isRowMajor

Determine whether the current function or variable uses row-major layout

### Syntax

```
coder.isRowMajor
coder.isRowMajor(arg)
```

### Description

`coder.isRowMajor` resolves as true in the generated code if the current function uses row-major array layout. Use the function as the expression in control flow (`if`, `else`, `switch`) statements.

`coder.isRowMajor(arg)` resolves as true if the current variable uses row-major array layout.

### Examples

#### Query Array Layout of a Function

To query the array layout of a function at compile time, use `coder.isRowMajor` or `coder.isColumnMajor`. This query can be useful for specializing your generated code when it involves row-major and column-major functions. For example, consider this function:

```
function S = addMatrixRouted(A,B)
 if coder.isRowMajor
 %execute this code if row major
 S = addMatrix_OptimizedForRowMajor(A,B);
 elseif coder.isColumnMajor
 %execute this code if column major
 S = addMatrix_OptimizedForColumnMajor(A,B);
 end
```

The function `addMatrixRouted` behaves differently depending on whether it uses row-major layout or column-major layout. The layout that the function uses, for example, can depend on whether it is called from a function that contains `coder.rowMajor` or `coder.columnMajor`. When `addMatrixRouted` uses row-major layout, it calls the `addMatrix_OptimizedForRowMajor` function, which has efficient memory access for row-major data. When the function uses column-major layout, it calls a version of the `addMatrix` function optimized for column-major data.

By using the query functions, the generated code for `addMatrixRouted` provides efficient memory access for either choice of array layout.

#### Query Array Layout of a Variable

Consider the function `foo`:

```
function foo
 coder.rowMajor;
```

```
x = magic(3);
if coder.isRowMajor(x)
 fprintf('This will always be displayed in generated code.\n');
else
 fprintf('This will never be displayed in generated code.\n');
end
end
```

Generate code:

```
codegen foo
```

To run the MEX function, enter:

```
foo_mex
```

## Input Arguments

### **arg** — Variable name

array variable

Variable to query for array layout.

Example: `coder.isRowMajor(x)`;

## Limitations

- You cannot query the array layout of a structure field or property.

## Tips

- Outside of code generation and simulation, `coder.isRowMajor` is always false.
- If `coder.isRowMajor` always resolves to true for your code, other branches in the `if` statement are ignored by the code generator. Otherwise, one instance of the current function is created for each array layout.

## Extended Capabilities

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `coder.columnMajor` | `coder.rowMajor` | `coder.isColumnMajor`

### Topics

“Generate Code That Uses Row-Major Array Layout”

“Specify Array Layout in Functions and Classes”

“Generate Code That Uses N-Dimensional Indexing”



**Introduced in R2018a**

## coder.load

Load compile-time constants from MAT-file or ASCII file into caller workspace

### Syntax

```
S = coder.load(filename)
S = coder.load(filename,var1,...,varN)
S = coder.load(filename,'-regex',expr1,...,exprN)
S = coder.load(filename,'-ascii')
S = coder.load(filename,'-mat')
S = coder.load(filename,'-mat',var1,...,varN)
S = coder.load(filename,'-mat','-regex', expr1,...,exprN)
```

### Description

`S = coder.load(filename)` loads compile-time constants from `filename`.

- If `filename` is a MAT-file, then `coder.load` loads variables from the MAT-file into a structure array.
- If `filename` is an ASCII file, then `coder.load` loads data into a double-precision array.

`coder.load` loads data at code generation time, also referred to as *compile time*. If you change the content of `filename` after you generate code, the change is not reflected in the behavior of the generated code.

`S = coder.load(filename,var1,...,varN)` loads only the specified variables from the MAT-file `filename`.

`S = coder.load(filename,'-regex',expr1,...,exprN)` loads only the variables that match the specified regular expressions.

`S = coder.load(filename,'-ascii')` treats `filename` as an ASCII file, regardless of the file extension.

`S = coder.load(filename,'-mat')` treats `filename` as a MAT-file, regardless of the file extension.

`S = coder.load(filename,'-mat',var1,...,varN)` treats `filename` as a MAT-file and loads only the specified variables from the file.

`S = coder.load(filename,'-mat','-regex', expr1,...,exprN)` treats `filename` as a MAT-file and loads only the variables that match the specified regular expressions.

### Examples

### Load compile-time constants from MAT-file

Generate code for a function `edgeDetect1` which given a normalized image, returns an image where the edges are detected with respect to the threshold value. `edgeDetect1` uses `coder.load` to load the edge detection kernel from a MAT-file at compile time.

Save the Sobel edge-detection kernel in a MAT-file.

```
k = [1 2 1; 0 0 0; -1 -2 -1];
```

```
save sobel.mat k
```

Write the function `edgeDetect1`.

```
function edgeImage = edgeDetect1(originalImage, threshold) %#codegen
assert(all(size(originalImage) <= [1024 1024]));
assert(isa(originalImage, 'double'));
assert(isa(threshold, 'double'));

S = coder.load('sobel.mat','k');
H = conv2(double(originalImage),S.k, 'same');
V = conv2(double(originalImage),S.k', 'same');
E = sqrt(H.*H + V.*V);
edgeImage = uint8((E > threshold) * 255);
```

Create a code generation configuration object for a static library.

```
cfg = coder.config('lib');
```

Generate a static library for `edgeDetect1`.

```
codegen -report -config cfg edgeDetect1
```

`codegen` generates C code in the `codegen\lib\edgeDetect1` folder.

### Load compile-time constants from ASCII file

Generate code for a function `edgeDetect2` which given a normalized image, returns an image where the edges are detected with respect to the threshold value. `edgeDetect2` uses `coder.load` to load the edge detection kernel from an ASCII file at compile time.

Save the Sobel edge-detection kernel in an ASCII file.

```
k = [1 2 1; 0 0 0; -1 -2 -1];
```

```
save sobel.dat k -ascii
```

Write the function `edgeDetect2`.

```
function edgeImage = edgeDetect2(originalImage, threshold) %#codegen
assert(all(size(originalImage) <= [1024 1024]));
assert(isa(originalImage, 'double'));
assert(isa(threshold, 'double'));

k = coder.load('sobel.dat');
H = conv2(double(originalImage),k, 'same');
V = conv2(double(originalImage),k', 'same');
```

```
E = sqrt(H.*H + V.*V);
edgeImage = uint8((E > threshold) * 255);
```

Create a code generation configuration object for a static library.

```
cfg = coder.config('lib');
```

Generate a static library for `edgeDetect2`.

```
codegen -report -config cfg edgeDetect2
```

`codegen` generates C code in the `codegen\lib\edgeDetect2` folder.

## Input Arguments

### **filename** — Name of file

character vector | string scalar

Name of file. `filename` must be a compile-time constant.

`filename` can include a file extension and a full or partial path. If `filename` has no extension, `load` looks for a file named `filename.mat`. If `filename` has an extension other than `.mat`, `load` treats the file as ASCII data.

ASCII files must contain a rectangular table of numbers, with an equal number of elements in each row. The file delimiter (the character between elements in each row) can be a blank, comma, semicolon, or tab character. The file can contain MATLAB comments (lines that begin with a percent sign, %).

Example: `'myFile.mat'`

### **var1, ..., varN** — Names of variables to load

character vector | string scalar

Names of variables, specified as one or more character vectors or string scalars. Each variable name must be a compile-time constant. Use the `*` wildcard to match patterns.

Example: `coder.load('myFile.mat', 'A*')` loads all variables in the file whose names start with `A`.

### **expr1, ..., exprN** — Regular expressions indicating which variables to load

character vector | string scalar

Regular expressions indicating which variables to load specified as one or more character vectors or string scalars. Each regular expression must be a compile-time constant.

Example: `coder.load('myFile.mat', '-regexp', '^A')` loads only variables whose names begin with `A`.

## Output Arguments

### **S** — Loaded variables or data

structure array | m-by-n array

If `filename` is a MAT-file, `S` is a structure array.

If `filename` is an ASCII file, `S` is an `m`-by-`n` array of type `double`. `m` is the number of lines in the file and `n` is the number of values on a line.

## Limitations

- Arguments to `coder.load` must be compile-time constants.
- The output `S` must be the name of a structure or array without any subscripting. For example, `S(i) = coder.load('myFile.mat')` is not allowed.
- You cannot use `save` to save workspace data to a file inside a function intended for code generation. The code generator does not support the `save` function. Furthermore, you cannot use `coder.extrinsic` with `save`. Prior to generating code, you can use `save` to save workspace data to a file.

## Tips

- `coder.load` loads data at compile time, not at run time. If you are generating MEX code or code for Simulink simulation, you can use the MATLAB function `load` to load run-time values.
- If the MAT-file contains unsupported constructs, use `coder.load(filename, var1, ..., varN)` to load only the supported constructs.
- If you generate code in a MATLAB Coder project, the code generator practices incremental code generation for the `coder.load` function. When the MAT-file or ASCII file used by `coder.load` changes, the software rebuilds the code.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`matfile` | `regexp` | `save`

## Topics

“Regular Expressions”

## Introduced in R2013a

## coder.loadDeepLearningNetwork

Load deep learning network model

### Syntax

```
net = coder.loadDeepLearningNetwork(filename)
net = coder.loadDeepLearningNetwork(functionname)
net = coder.loadDeepLearningNetwork(____, network_name)
```

### Description

`net = coder.loadDeepLearningNetwork(filename)` loads a pretrained deep learning `SeriesNetwork`, `DAGNetwork`, `yoloV2ObjectDetector`, or `ssdObjectDetector` object saved in the `filename` MAT-file. `filename` must be a valid MAT-file existing on the MATLAB path containing a single `SeriesNetwork`, `DAGNetwork`, `yoloV2ObjectDetector`, or `ssdObjectDetector` object. The MAT-file must contain only the network to be loaded.

`net = coder.loadDeepLearningNetwork(functionname)` calls a function that returns a pretrained deep learning `SeriesNetwork`, `DAGNetwork`, `yoloV2ObjectDetector`, or `ssdObjectDetector` object. `functionname` must be the name of a function existing on the MATLAB path that returns a `SeriesNetwork`, `DAGNetwork`, `yoloV2ObjectDetector`, or `ssdObjectDetector` object.

`net = coder.loadDeepLearningNetwork( ____, network_name)` is the same as `net = coder.loadDeepLearningNetwork(filename)` with the option to name the C++ class generated from the network. `network_name` is a descriptive name for the network object saved in the MAT-file or pointed to by the function. The network name must be a char type that is a valid identifier in C++.

Use this function when generating code from a network object inference. This function generates a C++ class from this network. The class name is derived from the MAT-file name or the function name.

---

**Note** The input argument of `coder.loadDeepLearningNetwork` must be a compile-time constant.

---

### Examples

#### Generate C++ Code from a MAT-File Containing the VGG-16 Network

Use of the `coder.loadDeepLearningNetwork` function to load an VGG-16 series network and generate C++ code for this network.

Get the MAT-file containing the pretrained VGG-16 network.

```
url = 'https://www.mathworks.com/supportfiles/gpuCoder/cnn_models/VGG/vgg16.mat';
websave('vgg16.mat',url);
```

Create an entry-point function `myVGG16` that uses the `coder.loadDeepLearningNetwork` function to load the `vgg16.mat` into the persistent `mynet` `SeriesNetwork` object.

```
function out = myVGG16(in)

persistent mynet;
if isempty(mynet)
 mynet = coder.loadDeepLearningNetwork('vgg16.mat', 'myVGGnet');
end

out = predict(mynet,in);
```

The persistent object avoids reconstructing and reloading the network object during subsequent calls to the function to invoke the `predict` method on the input.

The input layer of the pretrained VGG-16 network accepts images of size 224x224x3. Use the following lines of code to read an input image from a graphics file and resize it to 224x224.

```
in = imread('peppers.png');
in = imresize(in,[224,224]);
```

Create a `coder.config` configuration object for MEX code generation and set the target language to C++. On the configuration object, set `DeepLearningConfig` with `targetlib` as 'mkl\_dnn'. The `codegen` function must determine the size, class, and complexity of MATLAB function inputs. Use the `-args` option to specify the size of the input to the entry-point function. Use the `-config` option to pass the code configuration object.

```
cfg = coder.config('mex');
cfg.TargetLang = 'C++';
cfg.DeepLearningConfig = coder.DeepLearningConfig('mkl_dnn');
codegen -args {ones(224,224,3,'uint8')} -config cfg myVGG16 -report;
```

The `codegen` command places all the generated files in the `codegen` folder. The folder contains the C++ code for the entry-point function `myVGG16.cpp`, header and source files containing the C++ class definitions for the convoluted neural network (CNN), weight, and bias files.

Call VGG-16 `predict` on the input image and display the top five predicted labels.

```
predict_scores = myVGG16_mex(in);
[scores,indx] = sort(predict_scores, 'descend');
net = coder.loadDeepLearningNetwork('vgg16.mat');
classNames = net.Layers(end).Classes;
disp(classNames(indx(1:5)));
```

```
bell pepper
cucumber
grocery store
acorn squash
butternut squash
```

### Code Generation for a SeriesNetwork Inference Loaded from a MATLAB Function

Use of the `coder.loadDeepLearningNetwork` function to load an `resnet50` series network and generate CUDA code for this network.

Create an entry-point function `resnetFun` that uses the `coder.loadDeepLearningNetwork` function to call the Deep Learning Toolbox toolbox function `resnet50`. This function returns a pretrained ResNet-50 network.

```
function out = resnetFun(in)

persistent mynet;
if isempty(mynet)
 mynet = coder.loadDeepLearningNetwork('resnet50', 'myresnet');
end

out = predict(mynet,in);
```

The persistent object avoids reconstructing and reloading the network object during subsequent calls to the function to invoke the `predict` method on the input.

The input layer of the pretrained ResNet - 50 network accepts images of size 224x224x3. To read an input image from a graphics file and resize it to 224x224, use the following lines of code:

```
in = imread('peppers.png');
in = imresize(in,[224,224]);
```

Create a `coder.gpuConfig` configuration object for MEX code generation and set the target language to C++. The `codegen` function must determine the size, class, and complexity of MATLAB function inputs. Use the `-args` option to specify the size of the input to the entry-point function and the `-config` option to pass the code configuration object.

```
cfg = coder.gpuConfig('mex');
cfg.TargetLang = 'C++';
cfg.DeepLearningConfig = coder.DeepLearningConfig('cudnn');
codegen -args {ones(224,224,3,'uint8')} -config cfg resnetFun -report;
```

The `codegen` command places all the generated files in the `codegen` folder. It contains the CUDA code for the entry-point function `resnetFun.cu`, header, and source files containing the C++ class definitions for the convoluted neural network (CNN), weight, and bias files.

## Input Arguments

### **filename** — MAT file name

name

Specifies the name of the MAT-file containing the pretrained `SeriesNetwork`, `DAGNetwork`, `yolov2ObjectDetector`, or `ssdObjectDetector` object.

This input argument must be a compile-time constant.

Data Types: string

### **functionname** — MATLAB function name

name

Specifies the name of the function that returns a pretrained `SeriesNetwork`, `DAGNetwork`, `yolov2ObjectDetector`, or `ssdObjectDetector` object.

This input argument must be a compile-time constant.

Data Types: string

### **network\_name** — Descriptive name

name



Descriptive name for the network object saved in the MAT-file. It must be a char type that is a valid identifier in C++.

This input argument must be a compile-time constant.

Data Types: char

## Output Arguments

### **net** — Network object

SeriesNetwork object | DAGNetwork object | yolov2objectDetector object |  
ssdObjectDetector object

Network inference, returned as a SeriesNetwork, DAGNetwork, yolov2objectDetector, or ssdObjectDetector object.

## Limitations

- coder.loadDeepLearningNetwork does not support loading MAT-files with multiple networks.
- The MAT-file must contain only the network to be loaded.

## Extended Capabilities

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

### **Functions**

codegen

### **Objects**

SeriesNetwork | DAGNetwork | yolov2objectDetector | ssdObjectDetector

### **Topics**

“Load Pretrained Networks for Code Generation”

“Code Generation for Deep Learning Networks with MKL-DNN”

“Code Generation for Deep Learning Networks with ARM Compute Library”

### **Introduced in R2017b**

## coder.loop.parallelize

Disable automatic parallelization of a for loop

### Syntax

```
coder.loop.parallelize('never')
```

### Description

`coder.loop.parallelize('never')` disables automatic parallelization of the for loop placed immediately after it. This pragma overrides the `EnableAutoParallelization` configuration setting.

This pragma supports explicit for loops only. For more information on explicit and implicit loops, see “Parallelize Implicit for Loops”.

### Examples

#### Disable Automatic Parallelization of a Specific for loop

This example shows how to disable the automatic parallelization of a specific for loop in your MATLAB code by using the `coder.loop.parallelize('never')` directive.

Define the MATLAB function `autoparExample`:

```
function [x, y] = autoparExample(x, y) %#codegen
x = x * 17;
% Pragma to disable automatic parallelization of for-loops
coder.loop.parallelize('never');
for i = 10:numel(x)
 y(i) = sqrt(y(i));
end
end
```

This function contains two loops:

- The `mtimes` (matrix multiplication) function contains an implicit for loop that iterates over the elements of the matrix `x`.
- The explicit for loop that calculates the square root of a subset of the elements of the matrix `y`. The `coder.loop.parallelize('never')` directive disables automatic parallelization of this loop.

Create a code generation configuration object for a static library. Set the `EnableAutoParallelization` property to `true`. Specify the input types as 1-by-2000 row vectors of doubles and generate code.

```
cfg = coder.config('lib');
cfg.EnableAutoParallelization = 1;
codegen -config cfg autoparExample -args {rand(1,2000) rand(1,2000)} -report
```

Code generation successful: [View report](#)

Open the code generation report and inspect the generated `autoparExample` function:

- The generated code contains a parallel loop for the multiplication operation.
- The explicit `for` loop is converted to a serial loop in the generated code. This loop was preceded by the `coder.loop.parallelize('never')` directive in your MATLAB code. The code generator did not parallelize it.

```
void autoparExample(double x[2000], double y[2000])
{
 int b_i;
 int i;
 if (!isInitialized_autoparExample) {
 autoparExample_initialize();
 }
 #pragma omp parallel for num_threads(omp_get_max_threads()) private(i)

 for (i = 0; i < 2000; i++) {
 x[i] *= 17.0;
 }
 /* Pragma to disable automatic parallelization of for-loops */
 for (b_i = 0; b_i < 1991; b_i++) {
 y[b_i + 9] = sqrt(y[b_i + 9]);
 }
}
```

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`parfor` | `coder.config` | `coder.MexCodeConfig` | `coder.CodeConfig` | `coder.EmbeddedCodeConfig`

### Topics

“Automatically Parallelize for Loops in Generated Code”

### Introduced in R2021a

## coder.newtype

**Package:** coder

Create `coder.Type` object to represent type of an entry-point function input

### Syntax

```
t = coder.newtype(numeric_class,sz,variable_dims)
t = coder.newtype(numeric_class,sz,variable_dims, Name,Value)
t = coder.newtype('constant',value)
t = coder.newtype('struct',struct_fields,sz,variable_dims)
t = coder.newtype('cell',cells,sz,variable_dims)
t = coder.newtype('embedded.fi',numeric_type,sz,variable_dims, Name,Value)
t = coder.newtype(enum_value,sz,variable_dims)
t = coder.newtype('class_name')
t = coder.newtype('string')
```

### Description

The `coder.newtype` function is an advanced function that you can use to control the `coder.Type` object. Consider using `coder.typeof` instead of `coder.newtype`. The function `coder.typeof` creates a type from a MATLAB example. By default, `t = coder.newtype('class_name')` does not assign any properties of the class, `class_name` to the object `t`.

---

**Note** You can also create and edit `coder.Type` objects interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t = coder.newtype(numeric_class,sz,variable_dims)` creates a `coder.Type` object representing values of class `numeric_class`, sizes `sz` (upper bound), and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable-size. When `variable_dims` is not specified, the dimensions of the type are fixed except for those that are unbounded. When `variable_dims` is a scalar, it is applied to type dimensions that are not 1 or 0, which are fixed.

`t = coder.newtype(numeric_class,sz,variable_dims, Name,Value)` creates a `coder.Type` object by using additional options specified as one or more `Name, Value` pair arguments.

`t = coder.newtype('constant',value)` creates a `coder.Constant` object representing a single value. Use this type to specify a value that must be treated as a constant in the generated code.

`t = coder.newtype('struct',struct_fields,sz,variable_dims)` creates a `coder.StructType` object for an array of structures that has the same fields as the scalar structure `struct_fields`. The structure array type has the size specified by `sz` and variable-size dimensions specified by `variable_dims`.

`t = coder.newtype('cell',cells,sz,variable_dims)` creates a `coder.CellType` object for a cell array that has the cells and cell types specified by `cells`. The cell array type has the size

specified by `sz` and variable-size dimensions specified by `variable_dims`. You cannot change the number of cells or specify variable-size dimensions for a heterogeneous cell array.

`t = coder.newtype('embedded.fi', numeric_type, sz, variable_dims, Name, Value)` creates a `coder.FiType` object representing a set of fixed-point values that have `numeric_type` and additional options specified by one or more `Name, Value` pair arguments.

`t = coder.newtype(enum_value, sz, variable_dims)` creates a `coder.Type` object representing a set of enumeration values of class `enum_value`.

`t = coder.newtype('class_name')` creates a `coder.ClassType` object for an object of the class `class_name`. The new object does not have any properties of the class `class_name`.

`t = coder.newtype('string')` creates a type for a string scalar. A string scalar contains one piece of text represented as a character vector. To specify the size of the character vector and whether the second dimension is variable-size, create a type for the character vector and assign it to the `Value` property of the string scalar type. For example, `t.Properties.Value = coder.newtype('char', [1 10], [0 1])` specifies that the character vector inside the string scalar is variable-size with an upper bound of 10.

## Examples

### Create Type for a Matrix

Create a type for a variable-size matrix of doubles.

```
t = coder.newtype('double', [2 3 4], [1 1 0])
```

```
t =
```

```
coder.PrimitiveType
 :2x:3x4 double
% ':' indicates variable-size dimensions
```

Create a type for a matrix of doubles, first dimension unbounded, and second dimension with fixed size.

```
t = coder.newtype('double', [inf, 3])
```

```
t =
```

```
coder.PrimitiveType
 :infx3 double
```

```
t = coder.newtype('double', [inf, 3], [1 0])
```

```
% also returns
```

```
t =
```

```
coder.PrimitiveType
 :infx3 double
% ':' indicates variable-size dimensions
```

Create a type for a matrix of doubles, first dimension unbounded, and second dimension with variable-size that has an upper bound of 3.

```
t = coder.newtype('double',[inf,3],[0 1])
t =
coder.PrimitiveType
 :inf×3 double
% ':' indicates variable-size dimensions
```

### Create Type for a Structure

Create a type for a structure with a variable-size field.

```
ta = coder.newtype('int8',[1 1]);
tb = coder.newtype('double',[1 2],[1 1]);
t = coder.newtype('struct',struct('a',ta,'b',tb),[1 1],[1 1])
t =
coder.StructType
 :1×1 struct
 a: 1×1 int8
 b: :1×2 double
% ':' indicates variable-size dimensions
```

### Create Type for a Cell Array

Create a type for a heterogeneous cell array.

```
ta = coder.newtype('int8',[1 1]);
tb = coder.newtype('double',[1 2],[1 1]);
t = coder.newtype('cell',{ta, tb})
t =
coder.CellType
 1×2 heterogeneous cell
 f1: 1×1 int8
 f2: :1×2 double
% ':' indicates variable-size dimensions
```

Create a type for a homogeneous cell array.

```
ta = coder.newtype('int8',[1 1]);
tb = coder.newtype('int8',[1 2],[1 1]);
t = coder.newtype('cell',{ta, tb},[1,1],[1,1])
t =
coder.CellType
 :1×1 homogeneous cell
 base: :1×2 int8
% ':' indicates variable-size dimensions
```

### Create Type for a Constant

Create a new constant type to use in code generation.

```
t = coder.newtype('constant',42)
t =
coder.Constant
 42
```

### Create a coder.EnumType Object

Create a coder.EnumType object by using the name of an existing MATLAB enumeration.

1. Define an enumeration MyColors. On the MATLAB path, create a file named MyColors containing:

```
classdef MyColors < int32
 enumeration
 green(1),
 red(2),
 end
end
```

2. Create a coder.EnumType object from this enumeration.

```
t = coder.newtype('MyColors')
t =
coder.EnumType
 1x1 MyColors
```

### Create a Fixed-Point Type

Create a fixed-point type for use in code generation.

The fixed-point type uses default fimath values.

```
t = coder.newtype('embedded.fi',numerictype(1, 16, 15),[1 2])
t =
coder.FiType
 1x2 embedded.fi
 DataTypeMode: Fixed-point: binary point scaling
 Signedness: Signed
 WordLength: 16
 FractionLength: 15
```

### Create a Type for an Object

Create a type for an object to use in code generation.

1. Create this value class:

```
classdef mySquare
 properties
 side;
 end

 methods
 function obj = mySquare(val)
 if nargin > 0
 obj.side = val;
 end
 end

 function a = calcarea(obj)
 a = obj.side * obj.side;
 end
 end
end
```

2. Create a type for an object that has the same properties as mySquare.

```
t = coder.newtype('mySquare');
```

3. The previous step creates a `coder.ClassType` type for `t`, but does not assign any properties of `mySquare` to it. To ensure `t` has all the properties of `mySquare`, change the type of the property `side` by using `t.Properties`.

```
t.Properties.side = coder.typeof(int8(3))
```

```
t =
```

```
coder.ClassType
 1x1 mySquare
 side: 1x1 int8
```

### Create Type for a String Scalar

Create a type for a string scalar to use in code generation.

1. Create the string scalar type.

```
t = coder.newtype('string');
```

2. Specify the size.

```
t.Properties.Value = coder.newtype('char',[1,10]);
```

3. Make the string variable-size with an upper bound of 10.

```
t.Properties.Value = coder.newtype('char',[1,10],[0,1]);
```

4. Make the string variable-size with no upper bound.



```
t.Properties.Value = coder.newtype('char',[1,inf]);
```

## Input Arguments

### **numeric\_class** — Class of values of type object

numeric (default)

Class of the set of values represented by the type object.

Example: `coder.newtype('double',[6,3]);`

Data Types: `half | single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64 | logical | char | string | struct | table | cell | function_handle | categorical | datetime | duration | calendarDuration | fi`

Complex Number Support: Yes

### **struct\_fields** — Indicates fields in a new structure type

struct (default)

Scalar structure used to specify the fields in a new structure type.

Example: `coder.newtype('struct',struct('a',ta,'b',tb));`

Data Types: `struct`

### **cells** — Specify types of cells in a new cell array type

cell array (default)

Cell array of `coder.Type` objects that specify the types of the cells in a new cell array type.

Example: `coder.newtype('cell',{ta,tb});`

Data Types: `cell`

### **sz** — Dimension of type object

row vector of integer values

Size vector specifying each dimension of type object. The `sz` dimension cannot change the number of cells for a heterogeneous cell array.

Example: `coder.newtype('int8',[1 2]);`

Data Types: `single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64`

Complex Number Support: Yes

### **'class\_name'** — Name of the class

character vector | string scalar

Name of the class from which the `coder.ClassType` is created. Specify as a character vector or string scalar. `class_name` must be the name of a value class.

Example: `coder.newtype('mySquare')`

Data Types: `char | string`

### **variable\_dims** — Variable- or fixed-dimension

row vector of logical values

The value of `variable_dims` is `true` for dimensions for which `sz` specifies an upper bound of `inf`; `false` for all other dimensions.

Logical vector that specifies whether each dimension is variable size (`true`) or fixed size (`false`). You cannot specify variable-size dimensions for a heterogeneous cell array.

Example: `coder.newtype('char',[1,10],[0,1]);`

Data Types: `logical`

### **value — Value of the constant**

constant value (default)

Specifies the actual value of the constant.

Example: `coder.newtype('constant',41);`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell`

### **enum\_value — Enumeration values of class**

`enum` (default)

Enumeration values of a class.

Example: `coder.newtype('MyColors');`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

### **Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `coder.newtype('embedded.fi',numerictype(1,16,15),[1 2])`

### **complex — Type representing complex values**

`true`

Set `complex` to `true` to create a `coder.Type` object that can represent complex values. The type must support complex data.

### **fimath — Type representing fimath values**

`numeric` (default)

Specify local `fimath`. If you do not specify `fimath`, the code generator uses default `fimath` values.

Use with only

```
t = coder.newtype('embedded.fi',numerictype,sz,variable_dims,Name,Value)
```

### **sparse — Type representing sparse data**

`false` (default)

Set `sparse` to `true` to create a `coder.Type` object representing sparse data. The type must support sparse data.

Not for use with

```
t = coder.newtype('embedded.fi', numeric_type, sz, variable_dims, Name, Value)
```

### gpu — Type representing GPU inputs

false (default)

Set `gpu` to `true` to create a `coder.Type` object that can represent the GPU input type. This option requires GPU Coder.

## Output Arguments

### t — New type object

`coder.Type` object

A new `coder.Type` object.

## Limitations

- For sparse matrices, `coder.newtype` drops upper bounds for variable-size dimensions.
- For GPU input types, only bounded numeric and logical base types are supported. Scalar GPU arrays, structures, cell-arrays, classes, enumerated types, character, half-precision and fixed-point data types are not supported.
- When using `coder.newtype` to represent GPU inputs, the memory allocation (`malloc`) mode property of the GPU code configuration object to `'discrete'`.

## Tips

- The `coder.newtype` function fixes the size of a singleton dimension unless the `variable_dims` argument explicitly specifies that the singleton dimension has a variable size.

For example, this code specifies a 1-by-:10 double. The first dimension (the singleton dimension) has a fixed size. The second dimension has a variable size.

```
t = coder.newtype('double', [1 10], 1)
```

By contrast, this code specifies a :1-by-:10 double. Both dimensions have a variable size.

```
t = coder.newtype('double', [1 10], [1 1])
```

- For a MATLAB Function block, singleton dimensions of input or output signals cannot have a variable size.

## Alternatives

`coder.typeof`

**See Also**

`coder.resize` | `coder.Type` | `coder.ArrayType` | `coder.EnumType` | `coder.FiType` |  
`coder.PrimitiveType` | `coder.StructType` | `coder.CellType` | `coder.ClassType` | `codegen`  
| `coder.OutputType`

**Topics**

“Create and Edit Input Types by Using the Coder Type Editor”

**Introduced in R2011a**

# coder.noImplicitExpansionInFunction

**Package:** coder

Disable implicit expansion within the specified function in the generated code

## Syntax

```
coder.noImplicitExpansionInFunction
```

## Description

`coder.noImplicitExpansionInFunction` disables implicit expansion in the code generated for the MATLAB function within which it is called.

Disable implicit expansion to apply binary operations and functions in the generated code without automatic size change to the operands, additional code generation, and performance variations. See “Generate Code With Implicit Expansion Enabled”, “Optimize Implicit Expansion in Generated Code” and “Compatible Array Sizes for Basic Operations”.

`coder.noImplicitExpansionInFunction` only affects binary operations in the generated code. This function does not disable implicit expansion in MATLAB code. To apply specific binary operations and functions in MATLAB without implicit expansion, use `coder.sameSizeBinaryOp`.

## Examples

### Disable Implicit Expansion Within a Function

Use `coder.noImplicitExpansionInFunction` to disable implicit expansion in the code generated for a MATLAB function by calling it in within the required function. Disable implicit expansion to apply binary operations and functions without:

- Automatic size change of compatible size operands
- Additional code generation
- Performance variations

In this example, the functions `DisableImpExpinFunction` and `ImpExpinFunction` add two operands of compatible sizes with identical code but the former disables implicit expansion. The code generated for `DisableImpExpinFunction` does not contain additional code to apply implicit expansion. The code generated for `ImpExpinFunction` contains loops that must be executed if the operands are of compatible size and can be implicitly expanded at run-time.

In the code generation report for the two functions, the sizes of the expression assigning the out values are different.

Define a function `DisableImpExpinFunction` that calculates the addition of two operands without implicit expansion by calling `coder.noImplicitExpansionInFunction` within the required function.

type `DisableImpExpinFunction.m`

```
function out = DisableImpExpinFunction(a,b)
coder.noImplicitExpansionInFunction;
out = a + b;
end
```

Define a function `ImpExpinFunction` that calculates the addition of two operands with implicit expansion enabled.

type `ImpExpinFunction.m`

```
function out = ImpExpinFunction(a,b)
out = a + b;
end
```

Define a fixed-size and variable-size input type for these functions.

```
a = coder.typeof(1,[2 1]);
b = coder.typeof(1,[2 inf]);
```

Generate code for the functions by using these commands:

```
codegen DisableImpExpinFunction -args {a,b} -config:lib -lang:c++ -report
```

Code generation successful: To view the report, open('codegen\lib\DisableImpExpinFunction\html\report.m')

```
codegen ImpExpinFunction.m -args {a,b} -config:lib -lang:c++ -report
```

Code generation successful: To view the report, open('codegen\lib\ImpExpinFunction\html\report.m')

### Compare Generated Code for Functions

To apply implicit expansion, the generated code introduces additional code to automatically expand the operands. The difference between the generated code for the two functions is shown in this code.

type `codegen/lib/DisableImpExpinFunction/DisableImpExpinFunction.cpp`

```
//
// File: DisableImpExpinFunction.cpp
//
// MATLAB Coder version : 5.4
// C/C++ source code generated on : 26-Feb-2022 13:01:50
//

// Include Files
#include "DisableImpExpinFunction.h"
#include "coder_array.h"

// Function Definitions
//
// Arguments : const double a[2]
// const coder::array<double, 2U> &b
// double out[2]
// Return Type : void
//
void DisableImpExpinFunction(const double a[2],
 const coder::array<double, 2U> &b, double out[2])
{
 out[0] = a[0] + b[0];
 out[1] = a[1] + b[1];
}
```

```

}

//
// File trailer for DisableImpExpinFunction.cpp
//
// [EOF]
//

type codegen/lib/ImpExpinFunction/ImpExpinFunction.cpp

//
// File: ImpExpinFunction.cpp
//
// MATLAB Coder version : 5.4
// C/C++ source code generated on : 26-Feb-2022 13:01:59
//

// Include Files
#include "ImpExpinFunction.h"
#include "coder_array.h"

// Function Definitions
//
// Arguments : const double a[2]
// const coder::array<double, 2U> &b
// coder::array<double, 2U> &out
// Return Type : void
//
void ImpExpinFunction(const double a[2], const coder::array<double, 2U> &b,
 coder::array<double, 2U> &out)
{
 int loop_ub;
 out.set_size(2, b.size(1));
 loop_ub = b.size(1);
 for (int i{0}; i < loop_ub; i++) {
 out[2 * i] = a[0] + b[2 * i];
 out[2 * i + 1] = a[1] + b[2 * i + 1];
 }
}

//
// File trailer for ImpExpinFunction.cpp
//
// [EOF]
//

```

When implicit expansion is enabled, the generated code includes additional code to change the size of the operands, as seen in `ImpExpinFunction`. If implicit expansion is disabled, the generated code does not include additional code to apply any size changes to the operands, as seen in `DisableImpExpinFunction`.

Compare the size of the output variables in the code generation report. The expression assigning the `out` variable in `DisableImpExpinFunction` is of the size `2x1`.

The expression assigning the out variable in `ImpExpinFunction` is of the size `2x:?`.

### **See Also**

`coder.sameSizeBinaryOp`

### **Topics**

“Compatible Array Sizes for Basic Operations”  
“Generate Code With Implicit Expansion Enabled”  
“Optimize Implicit Expansion in Generated Code”

**Introduced in R2021b**



# coder.nullcopy

**Package:** coder

Declare uninitialized variables in code generation

## Syntax

```
X = coder.nullcopy(A)
```

## Description

`X = coder.nullcopy(A)` copies type, size, and complexity of `A` to `X`, but does not copy element values. The function preallocates memory for `X` without incurring the overhead of initializing memory. In code generation, the `coder.nullcopy` function declares uninitialized variables. In MATLAB, `coder.nullcopy` returns the input such that `X` is equal to `A`.

If `X` is a structure or a class containing variable-sized arrays, then you must assign the size of each array. `coder.nullcopy` does not copy sizes of arrays or nested arrays from its argument to its result.

---

**Note** Before you use `X` in a function or a program, ensure that the data in `X` is completely initialized. Declaring a variable through `coder.nullcopy` without assigning all the elements of the variable results in nondeterministic program behavior. For more information, see “How to Eliminate Redundant Copies by Defining Uninitialized Variables”.

---

## Examples

### Declare Variables for Optimized Initialization

Declare variable `X` as a 1-by-5 vector of real doubles without performing an unnecessary initialization:

```
function X = foo %#codegen

N = 5;
X = coder.nullcopy(zeros(1,N));
for i = 1:N
 if mod(i,2) == 0
 X(i) = i;
 else
 X(i) = 0;
 end
end
```

Using `coder.nullcopy` with `zeros` lets you specify the size of vector `X` without initializing each element to zero.

## Input Arguments

### **A** — Variable to copy

scalar | vector | matrix | class | multidimensional array

Variable to copy, specified as a scalar, vector, matrix, or multidimensional array.

Example: `coder.nullcopy(A)`;

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `class`

Complex Number Support: Yes

## Limitations

- You cannot use `coder.nullcopy` on sparse matrices.
- You cannot use `coder.nullcopy` with classes that support overloaded parentheses or require indexing methods to access their data, such as `table`.

## Extended Capabilities

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

### **Topics**

“Eliminate Redundant Copies of Variables in Generated Code”

### **Introduced in R2011a**

# coder.opaque

Declare variable in generated code

## Syntax

```
y = coder.opaque(type)
y = coder.opaque(type,value)
y = coder.opaque(____, 'Size',Size)
y = coder.opaque(____, 'HeaderFile',HeaderFile)
```

## Description

`y = coder.opaque(type)` declares a variable `y` with the specified type and no initial value in the generated code.

- `y` can be a variable or a structure field.
- MATLAB code cannot set or access `y`, but external C functions can accept `y` as an argument.
- `y` can be an:
  - Argument to `coder.rref`, `coder.wref`, or `coder.ref`
  - Input or output argument to `coder.ceval`
  - Input or output argument to a user-written MATLAB function
  - Input to a subset of MATLAB toolbox functions supported for code generation
- Assignment from `y` declares another variable with the same type in the generated code. For example:

```
y = coder.opaque('int');
z = y;
```

declares a variable `z` of type `int` in the generated code.

- You can assign `y` from another variable declared using either `coder.opaque` or assignment from a variable declared using `coder.opaque`. The variables must have identical types.
- You can compare `y` to another variable declared using either `coder.opaque` or assignment from a variable declared using `coder.opaque`. The variables must have identical types.

`y = coder.opaque(type,value)` specifies the type and initial value of `y`.

`y = coder.opaque( ____, 'Size',Size)` specifies the size, in bytes, of `y`. You can specify the size with any of the previous syntaxes.

`y = coder.opaque( ____, 'HeaderFile',HeaderFile)` specifies the header file that contains the type definition. The code generator produces the `#include` statement for the header file where the statement is required in the generated code. You can specify the header file with any of the previous syntaxes.

## Examples

### Declare Variable Specifying Initial Value

Generate code for a function `valtest` which returns 1 if the call to `myfun` is successful. This function uses `coder.opaque` to declare a variable `x1` with type `int` and initial value 0. The assignment `x2 = x1` declares `x2` to be a variable with the type and initial value of `x1`.

Write a function `valtest`.

```
function y = valtest
%codegen
%declare x1 to be an integer with initial value '0'
x1 = coder.opaque('int','0');
%Declare x2 to have same type and initial value as x1
x2 = x1;
x2 = coder.ceval('myfun');
%test the result of call to 'myfun' by comparing to value of x1
if x2 == x1
 y = 0;
else
 y = 1;
end
end
```

### Declare Variable Specifying Initial Value and Header File

Generate code for a MATLAB function `filetest` which returns its own source code using `fopen/fread/fclose`. This function uses `coder.opaque` to declare the variable that stores the file pointer used by `fopen/fread/fclose`. The call to `coder.opaque` declares the variable `f` with type `FILE *`, initial value `NULL`, and header file `<stdio.h>`.

Write a MATLAB function `filetest`.

```
function buffer = filetest
%#codegen

% Declare 'f' as an opaque type 'FILE *' with initial value 'NULL'
%Specify the header file that contains the type definition of 'FILE *';

f = coder.opaque('FILE *', 'NULL', 'HeaderFile', '<stdio.h>');
% Open file in binary mode
f = coder.ceval('fopen', cstring('filetest.m'), cstring('rb'));

% Read from file until end of file is reached and put
% contents into buffer
n = int32(1);
i = int32(1);
buffer = char(zeros(1,8192));
while n > 0
 % By default, MATLAB converts constant values
 % to doubles in generated code
 % so explicit type conversion to int32 is inserted.
 n = coder.ceval('fread', coder.ref(buffer(i)), int32(1), ...
 int32(numel(buffer)), f);
 i = i + n;
end
coder.ceval('fclose', f);

buffer = strip_cr(buffer);

% Put a C termination character '\0' at the end of MATLAB character vector
```

```

function y = cstring(x)
 y = [x char(0)];

% Remove all character 13 (CR) but keep character 10 (LF)
function buffer = strip_cr(buffer)
 j = 1;
 for i = 1:numel(buffer)
 if buffer(i) ~= char(13)
 buffer(j) = buffer(i);
 j = j + 1;
 end
 end
 buffer(i) = 0;

```

### Compare Variables Declared Using coder.opaque

Compare variables declared using `coder.opaque` to test for successfully opening a file.

Use `coder.opaque` to declare a variable `null` with type `FILE *` and initial value `NULL`.

```
null = coder.opaque('FILE *', 'NULL', 'HeaderFile', '<stdio.h>');
```

Use assignment to declare another variable `ftmp` with the same type and value as `null`.

```
ftmp = null;
ftmp = coder.ceval('fopen', ['testfile.txt', char(0)], ['r', char(0)]);
```

Compare the variables.

```
if ftmp == null
 %error condition
end
```

### Cast to and from Types of Variables Declared Using coder.opaque

This example shows how to cast to and from types of variables that are declared using `coder.opaque`. The function `castopaque` calls the C run-time function `strncmp` to compare at most `n` characters of the strings `s1` and `s2`. `n` is the number of characters in the shorter of the strings. To generate the correct C type for the `strncmp` input `nsizet`, the function casts `n` to the C type `size_t` and assigns the result to `nsizet`. The function uses `coder.opaque` to declare `nsizet`. Before using the output `retval` from `strncmp`, the function casts `retval` to the MATLAB type `int32` and stores the results in `y`.

Write this MATLAB function:

```

function y = castopaque(s1,s2)

% <0 - the first character that does not match has a lower value in s1 than in s2
% 0 - the contents of both strings are equal
% >0 - the first character that does not match has a greater value in s1 than in s2
%
%#codegen

coder.cinclude('<string.h>');
n = min(numel(s1), numel(s2));

% Convert the number of characters to compare to a size_t
nsizet = cast(n,'like',coder.opaque('size_t','0'));

```

```

% The return value is an int
retval = coder.opaque('int');
retval = coder.ceval('strcmp', cstr(s1), cstr(s2), nsizet);

% Convert the opaque return value to a MATLAB value
y = cast(retval, 'int32');

%-----
function sc = cstr(s)
% NULL terminate a MATLAB character vector for C
sc = [s, char(0)];

```

Generate the MEX function.

```
codegen castopaque -args {blanks(3), blanks(3)} -report
```

Call the MEX function with inputs 'abc' and 'abc'.

```
castopaque_mex('abc', 'abc')
```

ans =

0

The output is 0 because the strings are equal.

Call the MEX function with inputs 'abc' and 'abd'.

```
castopaque_mex('abc', 'abd')
```

ans =

-1

The output is -1 because the third character d in the second string is greater than the third character c in the first string.

Call the MEX function with inputs 'abd' and 'abc'.

```
castopaque_mex('abd', 'abc')
```

ans =

1

The output is 1 because the third character d in the first string is greater than the third character c in the second string.

In the MATLAB workspace, you can see that the type of y is int32.

### Declare Variable Specifying Initial Value and Size

Declare y to be a 4-byte integer with initial value 0.

```
y = coder.opaque('int', '0', 'Size', 4);
```

## Input Arguments

### **type** — Type of variable

character vector | string scalar

Type of variable in generated code. `type` must be a compile-time constant. The type must be a:

- Built-in C data type or a type defined in a header file
- C type that supports copy by assignment
- Legal prefix in a C declaration

Example: `'FILE *'`

### **value** — Initial value of variable

character vector | string scalar

Initial value of variable in generated code. `value` must be a compile-time constant. Specify a C expression not dependent on MATLAB variables or functions.

If you do not provide the initial value in `value`, initialize the value of the variable before using it. To initialize a variable declared using `coder.opaque`:

- Assign a value from another variable with the same type declared using either `coder.opaque` or assignment from a variable declared using `coder.opaque`.
- Assign a value from an external C function.
- Pass the address of the variable to an external function using `coder.wref`.

Specify a `value` that has the type that `type` specifies. Otherwise, the generated code can produce unexpected results.

Example: `'NULL'`

### **Size** — Size of variable

integer

Number of bytes for the variable in the generated code, specified as an integer. If you do not specify the size, the size of the variable is 8 bytes.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64`

### **HeaderFile** — Name of header file

character vector | string scalar

Name of header file that contains the definition of `type`. `HeaderFile` must be a compile-time constant.

For a system header file, use angle brackets.

Example: `'<stdio.h>'` generates `#include <stdio.h>`

For an application header file, use double quotes.

Example: `'"foo.h"'` generates `#include "foo.h"`

If you omit the angle brackets or double quotes, the code generator produces double quotes.

Example: 'foo.h' generates #include "foo.h"

Specify the include path in the build configuration parameters.

Example: `cfg.CustomInclude = 'c:\myincludes'`

## Tips

- Specify a value that has the type that type specifies. Otherwise, the generated code can produce unexpected results. For example, the following `coder.opaque` declaration can produce unexpected results.

```
y = coder.opaque('int', '0.2')
```

- `coder.opaque` declares the type of a variable. It does not instantiate the variable. You can instantiate a variable by using it later in the MATLAB code. In the following example, assignment of `fp1` from `coder.ceval` instantiates `fp1`.

```
% Declare fp1 of type FILE *
fp1 = coder.opaque('FILE *');
%Create the variable fp1
fp1 = coder.ceval('fopen', ['testfile.txt', char(0)], ['r', char(0)]);
```

- In the MATLAB environment, `coder.opaque` returns the value specified in `value`. If `value` is not provided, it returns an empty character vector.
- You can compare variables declared using either `coder.opaque` or assignment from a variable declared using `coder.opaque`. The variables must have identical types. The following example demonstrates how to compare these variables. “Compare Variables Declared Using `coder.opaque`” on page 2-161
- To avoid multiple inclusions of the same header file in generated code, enclose the header file in the conditional preprocessor statements `#ifndef` and `#endif`. For example:

```
#ifndef MyHeader_h
#define MyHeader_h
<body of header file>
#endif
```

- You can use the MATLAB `cast` function to cast a variable to or from a variable that is declared using `coder.opaque`. Use `cast` with `coder.opaque` only for numeric types.

To cast a variable declared by `coder.opaque` to a MATLAB type, you can use the `B = cast(A, type)` syntax. For example:

```
x = coder.opaque('size_t', '0');
x1 = cast(x, 'int32');
```

You can also use the `B = cast(A, 'like', p)` syntax. For example:

```
x = coder.opaque('size_t', '0');
x1 = cast(x, 'like', int32(0));
```

To cast a MATLAB variable to the type of a variable declared by `coder.opaque`, you must use the `B = cast(A, 'like', p)` syntax. For example:

```
x = int32(12);
x1 = coder.opaque('size_t', '0');
x2 = cast(x, 'like', x1);
```

Use `cast` with `coder.opaque` to generate the correct data types for:



- Inputs to C/C++ functions that you call using `coder.ceval`.
- Variables that you assign to outputs from C/C++ functions that you call using `coder.ceval`.

Without this casting, it is possible to receive compiler warnings during code generation.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `coder.ref` | `coder.rref` | `coder.wref`

## Topics

“Specify Build Configuration Parameters”

“Call Custom C/C++ Code from the Generated Code”

## Introduced in R2011a

## **coder.ref**

Indicate data to pass by reference

### **Syntax**

```
coder.ref(arg)
```

### **Description**

`coder.ref(arg)` indicates that `arg` is an expression or variable to pass by reference to an external C/C++ function. Use `coder.ref` inside a `coder.ceval` call only. The C/C++ function can read from or write to the variable passed by reference. Use a separate `coder.ref` construct for each argument that you pass by reference to the function.

See also `coder.rref` and `coder.wref`.

### **Examples**

#### **Pass Scalar Variable by Reference**

Consider the C function `addone` that returns the value of an input plus one:

```
double addone(double* p) {
 return *p + 1;
}
```

The C function defines the input variable `p` as a pointer to a double.

Pass the input by reference to `addone`:

```
...
y = 0;
u = 42;
y = coder.ceval('addone', coder.ref(u));
...
```

#### **Pass Multiple Arguments by Reference**

```
...
u = 1;
v = 2;
y = coder.ceval('my_fcn', coder.ref(u), coder.ref(v));
...
```

#### **Pass Class Property by Reference**

```
...
x = myClass;
x.prop = 1;
coder.ceval('foo', coder.ref(x.prop));
...
```

## Pass a Structure by Reference

To indicate that the structure type is defined in a C header file, use `coder.cstructname`.

Suppose that you have the C function `incr_struct`. This function reads from and writes to the input argument.

```
#include "MyStruct.h"

void incr_struct(struct MyStruct *my_struct)
{
 my_struct->f1 = my_struct->f1 + 1;
 my_struct->f2 = my_struct->f2 + 1;
}
```

The C header file, `MyStruct.h`, defines a structure type named `MyStruct`:

```
#ifndef MYSTRUCT
#define MYSTRUCT

typedef struct MyStruct
{
 double f1;
 double f2;
} MyStruct;

void incr_struct(struct MyStruct *my_struct);

#endif
```

In your MATLAB function, pass a structure by reference to `incr_struct`. To indicate that the structure type for `s` has the name `MyStruct` that is defined in the C header file `MyStruct.h`, use `coder.cstructname`.

```
function y = foo
%#codegen
y = 0;
coder.updateBuildInfo('addSourceFiles','incr_struct.c');

s = struct('f1',1,'f2',2);
coder.cstructname(s,'MyStruct','extern','HeaderFile','MyStruct.h');
coder.ceval('incr_struct', coder.ref(s));
```

To generate standalone library code, enter:

```
codegen -config:lib foo -report
```

## Pass Structure Field by Reference

```
...
s = struct('s1', struct('a', [0 1]));
coder.ceval('foo', coder.ref(s.s1.a));
...
```

You can also pass an element of an array of structures:

```
...
c = repmat(struct('u',magic(2)),1,10);
```

```
b = repmat(struct('c',c),3,6);
a = struct('b',b);
coder.ceval('foo', coder.ref(a.b(3,4).c(2).u));
...
```

## Input Arguments

### arg — Argument to pass by reference

scalar variable | array | element of an array | structure | structure field | object property

Argument to pass by reference to an external C/C++ function. The argument cannot be a class, a System object, a cell array, or an index into a cell array.

Data Types: single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64 | logical | char | struct  
Complex Number Support: Yes

## Limitations

- You cannot pass these data types by reference:
  - Class or System object
  - Cell array or index into a cell array
- If a property has a get method, a set method, or validators, or is a System object property with certain attributes, then you cannot pass the property by reference to an external function. See “Passing By Reference Not Supported for Some Properties”.

## Tips

- If `arg` is an array, then `coder.ref(arg)` provides the address of the first element of the array. The `coder.ref(arg)` function does not contain information about the size of the array. If the C function must know the number of elements of your data, pass that information as a separate argument. For example:

```
coder.ceval('myFun',coder.ref(arg),int32(numel(arg)));
```
- When you pass a structure by reference to an external C/C++ function, use `coder.cstructname` to provide the name of a C structure type that is defined in a C header file.
- In MATLAB, `coder.ref` results in an error. To parameterize your MATLAB code so that it can run in MATLAB and in generated code, use `coder.target`.
- You can use `coder.opaque` to declare variables that you pass to and from an external C/C++ function.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

**See Also**

`coder.rref` | `coder.wref` | `coder.ceval` | `coder.opaque` | `coder.cstructname` | `numel`

**Topics**

“Call Custom C/C++ Code from the Generated Code”

**Introduced in R2011a**

## coder.regenerateDeepLearningParameters

Regenerate files containing network learnables and states parameters

### Syntax

```
networkFileNames = coder.regenerateDeepLearningParameters(net,parameterFile)
networkFileNames = coder.regenerateDeepLearningParameters(dlnet,
parameterFile)
networkFileNames = coder.regenerateDeepLearningParameters(___,Name,Value)
```

### Description

`networkFileNames = coder.regenerateDeepLearningParameters(net,parameterFile)` returns a cell array of the file names containing the regenerated network learnables and states parameters. `coder.regenerateDeepLearningParameters` regenerates these files based on the learnables and states of the input `SeriesNetwork` or `DAGNetwork` object.

`networkFileNames = coder.regenerateDeepLearningParameters(dlnet,parameterFile)` returns a cell array of the file names containing the regenerated network learnables and states parameters. `coder.regenerateDeepLearningParameters` regenerates these files based on the learnables and states of the input `dlnetwork` object.

`networkFileNames = coder.regenerateDeepLearningParameters( ___,Name,Value)` returns a cell array of the file names containing the regenerated network learnables and states parameters by using the options specified by one or more `Name,Value` pair arguments.

### Examples

#### Post-Code-Generation Update of Network Learnable and State Parameters

This example shows how to update learnable and state parameters of deep learning networks without regenerating code for the network.

Write an entry-point function in MATLAB that:

- 1 Uses the `coder.loadDeepLearningNetwork` function to construct and set up a CNN network object. For more information, see “Load Pretrained Networks for Code Generation”.
- 2 Calls `predict` to predict the responses.

```
function out = mLayer(in,matFile)
myNet = coder.loadDeepLearningNetwork(coder.const(matFile));
out = predict(myNet,in);
```

Create a simple network that requires input images of size 4-by-5-by-3.

```
inputSize = [4 5 3];
im = dlarray(rand(inputSize, 'single'), 'SSCB');

outSize = 6;
```

```

layers = [
 imageInputLayer(inputSize, 'Name', 'input', 'Normalization', 'none')
 convolution2dLayer([3 3], 5, 'Name', 'conv-1')
 batchNormalizationLayer('Name', 'batchNorm')
 reluLayer('Name', 'relu1')
 transposedConv2dLayer([2 2], 5, 'Name', 'transconv')
 convolution2dLayer([2 2], 5, 'Name', 'conv2')
 reluLayer('Name', 'relu2')
 fullyConnectedLayer(outSize, 'Name', 'fc3')
];

```

Create an initialized dlnetwork object from the layer graph.

```

rng(0);
dlnet1 = dlnetwork(layers);
save('trainedNet.mat', 'dlnet1');

```

To specify code generation parameters for MKL-DNN, set the DeepLearningConfig property to a coder.MklDNNConfig object that you create with coder.DeepLearningConfig

```

cfg = coder.CodeConfig('mex');
cfg.TargetLang = 'C++';
cfg.DeepLearningConfig = coder.DeepLearningConfig('TargetLibrary', 'mklDnn')

```

Run the codegen command. The codegen command generates CUDA code from the mLayers.m MATLAB entry-point function.

```

cnnMatFile = fullfile(pwd, 'trainedNet.mat');
inputArgs = {im, coder.Constant(cnnMatFile)};

codegen -config cfg mLayers -args inputArgs -report

```

Call predict on the input image and compare the results with MATLAB.

```

out = mLayer_mex(im, cnnMatFile)
out_MATLAB = mLayer(im, cnnMatFile)

```

out1 =

6(C) x 1(B) single dlarray

```

-0.0064
-0.1422
-0.0897
0.2223
0.0329
0.0365

```

out\_MATLAB =

6(C) x 1(B) single dlarray

```

-0.0064
-0.1422
-0.0897
0.2223
0.0329
0.0365

```

Re-initialize `dlnetwork` to update learnables to different values.

```
rng(10);
dlnet2 = dlnetwork(layers);
save('trainedNet.mat', 'dlnet2');
```

Use the `coder.regenerateDeepLearningParameters` function to regenerate the bias files based on the new learnables and states of the network.

```
codegenDir = fullfile(pwd, 'codegen/mex/mLayer');
networkFileNames = (coder.regenerateDeepLearningParameters(dlnet2, codegenDir))'
```

```
networkFileNames =

8×1 cell array

{'cnn_trainedNet0_0_conv-1_b.bin' }
{'cnn_trainedNet0_0_conv-1_w.bin' }
{'cnn_trainedNet0_0_conv2_b.bin' }
{'cnn_trainedNet0_0_conv2_w.bin' }
{'cnn_trainedNet0_0_fc3_b.bin' }
{'cnn_trainedNet0_0_fc3_w.bin' }
{'cnn_trainedNet0_0_transconv_b.bin'}
{'cnn_trainedNet0_0_transconv_w.bin'}
```

Call `predict` on the input image and compare the results with MATLAB.

```
clear mLayer_mex;
outNew = mLayer_mex(im,cnnMatFile)
outNew_MATLAB = mLayer(im,cnnMatFile)
```

```
outNew =

6(C) x 1(B) single dlarray

0.1408
-0.0080
0.0342
-0.0065
0.1843
0.0799
```

```
outNew_MATLAB =

6(C) x 1(B) single dlarray

0.1408
-0.0080
0.0342
-0.0065
0.1843
0.0799
```

## Input Arguments

### **net** — Trained network

DAGNetwork object | SeriesNetwork object



Trained network used during code generation, specified as a `SeriesNetwork` or a `DAGNetwork` object. You can use a pretrained network (for example, by using the `googlenet` function) or by training your own network using `trainNetwork`.

### **dlnet — Network for custom training loops**

`dlnetwork` object

Network for custom training loops used during code generation, specified as a `dlnetwork` object.

### **parameterFile — Location of generated network parameter file**

character vector | string

Path to the folder containing the generated network parameter information file. During code generation, the software creates the `networkParamsInfo_*.bin` binary file that contains the network parameter information. By default, the code generator creates this file in the `codegen` folder.

### **Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `networkFileNames = coder.regenerateDeepLearningParameters(dlnet, "codegen", NetworkName="fooDL");`

### **NetworkName — C++ class name**

' ' (default) | character vector | string

Name of the C++ class for the network in the generated code, specified as a character vector or string.

### **OverrideParameterFiles — Use original code generation folder for regenerating network parameters**

false (default) | true

For MEX workflows, when the generated MEX and the associated `codegen` folder is moved from one location to another, `coder.regenerateDeepLearningParameters` cannot regenerate files containing network learnables and states parameters in the new location. Set the `'OverrideParameterFiles'` parameter to true to allow the `coder.regenerateDeepLearningParameters` function to regenerate files containing network learnables and states parameters in the original `codegen` location.

This parameter has no effect for non-MEX workflows.

## **Output Arguments**

### **networkFileNames — File names of network learnables and states parameters**

cell array

File names of the regenerated network learnables and states parameters, returned as a cell array.

## Limitations

Only the network learnables and states can be updated by using the `coder.regenerateDeepLearningParameters` function. For modifications that the code generator does not support, an error message is thrown. For example, using `coder.regenerateDeepLearningParameters` after changing the scale factor of a leaky ReLU layer throws the following error message as scale factor is not a network learnable.

```
Network architecture has been modified since the last code generation. Unable to accommodate the provided network in the generated code. Regenerate code for the provided network to reflect changes in the network. For more information, see Limitations to Regenerating Network Parameters After Code Generation.
```

## See Also

### Functions

`codegen` | `coder.loadDeepLearningNetwork`

### Objects

`SeriesNetwork` | `DAGNetwork` | `dlarray` | `dlnetwork`

### Topics

“Post-Code-Generation Update of Deep Learning Network Parameters”

“Load Pretrained Networks for Code Generation”

“Code Generation for Deep Learning Networks with MKL-DNN”

“Update Network Parameters After Code Generation”

### Introduced in R2021b

# coder.reservedName

**Package:** coder

Generate code that does not use specified identifier names

## Syntax

```
coder.reservedName(name1,name2,...,nameN)
```

## Description

`coder.reservedName(name1,name2,...,nameN)` reserves the identifiers `name1`, `name2`, ..., `nameN` for use in your custom C/C++ code to integrate with your generated code. If you place this directive in your MATLAB code intended for code generation, the generated code does not contain the identifiers `name1`, `name2`, ..., `nameN`, thereby preventing name collision with your custom code.

## Examples

### Generate Code That Does Not Use an Identifier Used by External C Code

Suppose that the identifier `g` denotes both a global variable in your MATLAB code and a local variable in your custom C code, which you call by using `coder.ceval`. By default, the generated code uses the same identifier that MATLAB uses for the global variable. But, in this case, such usage in the generated code can cause a name collision with the local variable `g` in the custom code. This example shows how to instruct the code generator to not use the identifier `g` in the generated code.

Define the MATLAB function `callfoo` that declares a global variable `g`, calls an external C function `foo`, and returns the sum of `g` and the value that `foo` returns. Insert the `coder.reservedName('g')` directive to instruct the code generator to not use the identifier `g` in the generated code.

```
function u = callfoo(n) %#codegen
% Reserve 'g' for use in the C function foo
coder.reservedName('g');

global g
u = int32(0);

coder.updateBuildInfo('addSourceFiles','foo.c');
coder.cinclude('foo.h');

u = coder.ceval('foo', n);
u = u + g;
end
```

Declare the function `foo` in the C header file `foo.h`:

```
int foo(int x);
```

Define the function `foo` in the C source file `foo.c`. This function accepts an integer input and returns the factorial of that integer.

```
#include <stdio.h>
#include <stdlib.h>
#include "foo.h"

int foo(int x)
{
 int count;
 int g = 1;
 for (count = 1; count <= x; count++)
 {
 g = g*count;
 }

 return (g);
}
```

Generate a static library for `callfoo`. Specify the input as a scalar 32-bit integer.

```
codegen -config:lib -global {'g', int32(2)} callfoo -args {int32(0)} -report
```

Inspect the generated header file `callfoo_data.h`. The name of the global variable has been changed to `b_g`.

```
extern int b_g;
```

## Input Arguments

**name1, name2, . . . , nameN** — Identifier names that you want to reserve for use in your custom C/C++ code

character vectors

Identifier names that generated code does not use, specified as character vectors.

Example: 'myname1', 'myname2', 'myname3'

Data Types: char

## Tips

- The following code generation setting provides the same functionality as `coder.reservedName`. To specify identifier names that the generated code does not use:
  - In a code configuration object, set the `ReservedNameArray` property
  - Alternatively, in the MATLAB Coder app, on the **Code Appearance** tab, set the **Reserved names** parameter

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## **See Also**

`coder.CodeConfig` | `coder.EmbeddedCodeConfig` | `coder.MexCodeConfig` | `coder.ceval` | `coder.cinclude`

## **Topics**

“Call Custom C/C++ Code from the Generated Code”

## **Introduced in R2020b**

## coder.resize

**Package:** coder

Resize coder.Type object

### Syntax

```
t_out = coder.resize(t,sz)
t_out = coder.resize(t,sz,variable_dims)
t_out = coder.resize(t,[],variable_dims)
t_out = coder.resize(t,sz,variable_dims,Name,Value)
t_out = coder.resize(t,'sizelimits',limits)
```

### Description

`t_out = coder.resize(t,sz)` resizes `t` to have size `sz`.

`t_out = coder.resize(t,sz,variable_dims)` returns a modified copy of `coder.Type` `t` with (upper-bound) size `sz` and variable dimensions `variable_dims`. If `variable_dims` or `sz` are scalars, the function applies the scalars to all dimensions of `t`. By default, `variable_dims` does not apply to dimensions where `sz` is 0 or 1, which are fixed. Use the 'uniform' option to override this special case. The `coder.resize` function ignores `variable_dims` for dimensions with size `inf`. These dimensions are variable size. `t` can be a cell array of types, in which case, `coder.resize` resizes all elements of the cell array.

`t_out = coder.resize(t,[],variable_dims)` changes `t` to have variable dimensions `variable_dims` while leaving the size unchanged.

`t_out = coder.resize(t,sz,variable_dims,Name,Value)` resizes `t` by using additional options specified by one or more `Name, Value` pair arguments.

`t_out = coder.resize(t,'sizelimits',limits)` resizes the individual dimensions of `t` based on the threshold values in the `limits` vector. The `limits` vector is a row vector containing two positive integer elements. Each dimension of `t` is individually resized according to the thresholds in the `limits` vector.

- When the size `S` of a dimension is lesser than both thresholds defined in `limits`, the dimension remains the same.
- When the size `S` of a dimension is greater than or equal to the first threshold and less than the second threshold defined in `limits`, the dimension becomes variable size with upper bound `S`.
- However, when the size `S` of a dimension is also greater than or equal to the second threshold defined in `limits`, the dimension becomes an unbounded variable size.

If the value of `limits` is scalar, the threshold gets scalar-expanded to represent both thresholds. For example, if `limits` is defined as 4, it is interpreted as [4 4].

The 'sizelimits' option allows you to dynamically allocate memory to large arrays in your generated code.

## Examples

### Change Fixed-Size Array to an Unbounded, Variable-Size Array

Change a fixed-size array to an unbounded, variable-size array.

```
t = coder.typeof(ones(3,3))
t =
coder.PrimitiveType
 3x3 double
coder.resize(t,inf)
ans =
coder.PrimitiveType
 :infx:inf double
% ':' indicates variable-size dimensions
```

### Change Fixed-Size Array to a Bounded, Variable-Size Array

Change a fixed-size array to a bounded, variable-size array.

```
t = coder.typeof(ones(3,3))
t =
coder.PrimitiveType
 3x3 double
coder.resize(t,[4 5],1)
ans =
coder.PrimitiveType
 :4x:5 double
% ':' indicates variable-size dimensions
```

### Resize Structure Field

Resize a structure field.

```
ts = coder.typeof(struct('a',ones(3, 3)))
ts =
coder.StructType
 1x1 struct
 a: 3x3 double
coder.resize(ts,[5, 5], 'recursive',1)
```

```
ans =

coder.StructType
 5×5 struct
 a: 5×5 double
```

### Resize Cell Array

Resize a cell array.

```
tc = coder.typeof({1 2 3})

tc =

coder.CellType
 1×3 homogeneous cell
 base: 1×1 double

coder.resize(tc,[5, 5], 'recursive',1)

ans =

coder.CellType
 5×5 homogeneous cell
 base: 1×1 double
```

### Change Fixed-Sized Array to Variable-Size Based on Bounded and Unbounded Thresholds

Change a fixed-sized array to a variable size based on bounded and unbounded thresholds.

```
t = coder.typeof(ones(100,200))

t =

coder.PrimitiveType
 100×200 double

coder.resize(t, 'sizelimits',[99 199])

ans =

coder.PrimitiveType
 :100×:inf double
% ':' indicates variable-size dimensions
```

### Input Arguments

#### **limits** — Vector that defines the threshold

row vector of integer values

A row vector of variable-size thresholds. If the value of `limits` is scalar, the threshold gets scalar-expanded. If the size `sz` of a dimension of `t` is greater than or equal to the first threshold and less than the second threshold defined in `limits`, the dimension becomes variable size with upper bound



**sz**. If the size **sz** of a dimension of **t** is also greater than or equal to the second threshold, the dimension becomes an unbounded variable size.

However, if the size **sz** is lesser than both thresholds, the dimension remains the same.

Example: `coder.resize(t, 'sizelimits', [99 199]);`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64`

### **sz — New size for object type**

row vector of integer values

New size for `coder.Type` object, **t\_out**

Example: `coder.resize(t, [3,4]);`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64`

### **t — coder.Type object that you want to resize**

`coder.Type` object

If **t** is a `coder.CellType` object, the `coder.CellType` object must be homogeneous.

Example: `coder.resize(t, inf);`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

### **variable\_dims — Variable or fixed dimension**

row vector of logical values

Specify whether each dimension of **t\_out** is fixed size or variable size.

Example: `coder.resize(t, [4 5], 1);`

Data Types: `logical`

### **Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `coder.resize(t, [5, 5], 'recursive', 1);`

### **recursive — Resize t and all types contained within it**

false (default) | true

Setting `recursive` to true resizes **t** and all types contained within it.

Data Types: `logical`

### **uniform — Resize t by applying the heuristic for dimensions of size one**

false (default) | true

Setting `uniform` to true resizes **t** and applies the heuristic for dimensions of size one.

The heuristic works in the following manner:

- If `variable_dims` is a scalar `true`, all dimensions are resized to upper bound variable sizes specified in `sz`. This includes dimensions of size one. For example:

```
t = coder.typeof(1, [1 5]);
tResize = coder.resize(t,[1 7],true,'uniform',true);
```

This generates an object `tResize` as shown:

```
tResize =

coder.PrimitiveType
 :1x:7 double

 Edit Type Object
```

- If you set `uniform` to `true` with the `'sizelimits'` option, the dimensions of size one are also resized to variable size, according to the `'sizelimits'` heuristics. For example:

```
t = coder.typeof(1, [1 5]);
tResize = coder.resize(t,[],'sizelimits',[0 6],'uniform',true);
```

These commands generate an object `tResize` as shown:

```
tResize =

coder.PrimitiveType
 :1x:5 double

 Edit Type Object
```

- If `variable_dims` is specified as a non-scalar logical, the `uniform` setting has no effect. However, if `variable_dims` is scalar and `uniform` is set to `false`, only dimensions of size greater than one are resized.

Data Types: `logical`

### **sizelimits** — Resize individual dimensions of `t` according to thresholds provided in the **limits** vector

`limits` (default)

Using the `sizelimits` options with `limits` vector resizes individual dimensions of `t`.

```
t = coder.typeof(1, [1 5]);
tResize = coder.resize(t,[],'sizelimits',[0 6],'uniform',true);
```

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64`

## **Output Arguments**

### **t\_out** — Resized type object

`coder.Type` object

Resized `coder.Type` object

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

## Limitations

- For sparse matrices, `coder.resize` drops the upper bounds for variable-size dimensions.

## See Also

`coder.typeof` | `coder.newtype` | `codegen`

**Introduced in R2011a**

## coder.rowMajor

Specify row-major array layout for a function or class

### Syntax

```
coder.rowMajor
```

### Description

`coder.rowMajor` specifies row-major array layout for the data used by the current function in generated code. When placed in a class constructor, `coder.rowMajor` specifies row-major layout for data used by the class.

---

**Note** By default, code generation uses column-major array layout.

---

## Examples

### Specify Row-Major Array Layout for a Function

Specify row-major array layout for a function by inserting `coder.rowMajor` into the function body.

Suppose that `myFunction` is the top-level function of your code. Your application requires you to perform matrix addition with row-major array layout and matrix multiplication with column-major layout.

```
function S = myFunction(A,B)
%#codegen
% check to make sure inputs are valid
if size(A,1) ~= size(B,1) || size(A,2) ~= size(B,2)
 disp('Matrices must be same size.');
```

return;

```
end
% make both matrices symmetric
B = B*B';
A = A*A';
% add matrices
S = addMatrix(A,B);
end
```

Write a function for matrix addition called `addMatrix`. Specify row-major layout for `addMatrix` by using `coder.rowMajor`.

```
function S = addMatrix(A,B)
%#codegen
S = zeros(size(A));
coder.rowMajor; % specify row-major array layout
S = A + B;
end
```

Generate code for `myFunction`. Use the `codegen` command.

```
codegen myFunction -args {ones(10,20),ones(10,20)} -config:lib -launchreport
```

The code generator produces code for `addMatrix` that uses row-major array layout. However, the matrix multiplication from the top-level function uses the default layout, column-major.

## Tips

- To specify row-major array layout for all the functions in your generated code, use the `codegen -rowmajor` option.
- Other functions called from within a row-major function inherit the row-major specification. However, if one of the called functions has its own distinct `coder.columnMajor` call, the code generator changes the array layout accordingly. If a row-major function and a column-major function call the same function, which does not have its own array layout specification, the code generator produces a row-major version and column-major version of the function.
- `coder.rowMajor` is ignored outside of code generation and simulation.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `coder.columnMajor` | `coder.isRowMajor` | `coder.isColumnMajor`

### Topics

“Generate Code That Uses Row-Major Array Layout”

“Specify Array Layout in Functions and Classes”

“Generate Code That Uses N-Dimensional Indexing”

### Introduced in R2018a

## coder.rref

Indicate read-only data to pass by reference

### Syntax

```
coder.rref(arg)
```

### Description

`coder.rref(arg)` indicates that `arg` is a read-only expression or variable to pass by reference to an external C/C++ function. Use `coder.rref` only inside a `coder.ceval` call.

The `coder.rref` function can enable the code generator to optimize the generated code. Because the external function is assumed to not write to `coder.rref(arg)`, the code generator can perform optimizations such as expression folding on assignments to `arg` that occur before and after the `coder.ceval` call. Expression folding is the combining of multiple operations into one statement to avoid the use of temporary variables and improve code performance.

---

**Note** The code generator assumes that the memory that you pass with `coder.rref(arg)` is read-only. To avoid unpredictable results, the C/C++ function must not write to this variable.

---

See also `coder.ref` and `coder.wref`.

## Examples

### Pass Scalar Variable as a Read-Only Reference

Consider the C function `addone` that returns the value of a constant input plus one:

```
double addone(const double* p) {
 return *p + 1;
}
```

The C function defines the input variable `p` as a pointer to a constant double.

Pass the input by reference to `addone`:

```
...
y = 0;
u = 42;
y = coder.ceval('addone', coder.rref(u));
...
```

### Pass Multiple Arguments as a Read-Only Reference

```
...
u = 1;
v = 2;
y = coder.ceval('my_fcn', coder.rref(u), coder.rref(v));
...
```

## Pass Class Property as a Read-Only Reference

```
...
x = myClass;
x.prop = 1;
y = coder.ceval('foo', coder.rref(x.prop));
...
```

## Pass Structure as a Read-Only Reference

To indicate that the structure type is defined in a C header file, use `coder.cstructname`.

Suppose that you have the C function `use_struct`. This function reads from the input argument but does not write to it.

```
#include "MyStruct.h"

double use_struct(const struct MyStruct *my_struct)
{
 return my_struct->f1 + my_struct->f2;
}
```

The C header file, `MyStruct.h`, defines a structure type named `MyStruct`:

```
#ifndef MYSTRUCT
#define MYSTRUCT

typedef struct MyStruct
{
 double f1;
 double f2;
} MyStruct;

double use_struct(const struct MyStruct *my_struct);

#endif
```

In your MATLAB function, pass a structure as a read-only reference to `use_struct`. To indicate that the structure type for `s` has the name `MyStruct` that is defined in the C header file `MyStruct.h`, use `coder.cstructname`.

```
function y = foo
%#codegen
y = 0;
coder.updateBuildInfo('addSourceFiles','use_struct.c');

s = struct('f1',1,'f2',2);
coder.cstructname(s,'MyStruct','extern','HeaderFile','MyStruct.h');
y = coder.ceval('use_struct', coder.rref(s));
```

To generate standalone library code, enter:

```
codegen -config:lib foo -report
```

## Pass Structure Field as a Read-Only Reference

```
...
s = struct('s1', struct('a', [0 1]));
```

```
y = coder.ceval('foo', coder.rref(s.s1.a));
...
```

You can also pass an element of an array of structures:

```
...
c = repmat(struct('u',magic(2)),1,10);
b = repmat(struct('c',c),3,6);
a = struct('b',b);
coder.ceval('foo', coder.rref(a.b(3,4).c(2).u));
...
```

## Input Arguments

### arg — Argument to pass by reference

scalar variable | array | element of an array | structure | structure field | object property

Argument to pass by reference to an external C/C++ function. The argument cannot be a class, a System object, a cell array, or an index into a cell array.

Data Types: single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64 | logical | char | struct

Complex Number Support: Yes

## Limitations

- You cannot pass these data types by reference:
  - Class or System object
  - Cell array or index into a cell array
- If a property has a get method, a set method, or validators, or is a System object property with certain attributes, then you cannot pass the property by reference to an external function. See “Passing By Reference Not Supported for Some Properties”.

## Tips

- If `arg` is an array, then `coder.rref(arg)` provides the address of the first element of the array. The `coder.rref(arg)` function does not contain information about the size of the array. If the C function must know the number of elements of your data, pass that information as a separate argument. For example:

```
coder.ceval('myFun', coder.rref(arg), int32(numel(arg)));
```

- When you pass a structure by reference to an external C/C++ function, use `coder.cstructname` to provide the name of a C structure type that is defined in a C header file.
- In MATLAB, `coder.rref` results in an error. To parametrize your MATLAB code so that it can run in MATLAB and in generated code, use `coder.target`.
- You can use `coder.opaque` to declare variables that you pass to and from an external C/C++ function.



## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

[coder.ref](#) | [coder.wref](#) | [coder.ceval](#) | [coder.opaque](#) | [coder.cstructname](#)

### Topics

“Call Custom C/C++ Code from the Generated Code”

**Introduced in R2011a**

## coder.runTest

Run test replacing calls to MATLAB functions with calls to MEX functions

### Syntax

```
coder.runTest(test,fcn)
coder.runTest(test,fcns,mexfcn)
coder.runTest(test,mexfile)
```

### Description

`coder.runTest(test,fcn)` runs `test` replacing calls to `fcn` with calls to the compiled version of `fcn`. `test` is the file name for a MATLAB function, script, or class-based unit test that calls the MATLAB function `fcn`. The compiled version of `fcn` must be in a MEX function that has the default name. The default name is the name specified by `fcn` followed by `_mex`.

`coder.runTest(test,fcns,mexfcn)` replaces calls to the specified MATLAB functions with calls to the compiled versions of the functions. The MEX function `mexfcn` must contain the compiled versions of all of the specified MATLAB functions.

`coder.runTest(test,mexfile)` replaces a call to a MATLAB function with a call to the compiled version of the function when the compiled version of the function is in `mexfile`. `mexfile` includes the platform-specific file extension. If `mexfile` does not contain the compiled version of a function, `coder.runTest` runs the original MATLAB function. If you do not want to specify the individual MATLAB functions to replace, use this syntax.

### Examples

#### Run Test File Replacing One Function

Use `coder.runTest` to run a test file. Specify replacement of one MATLAB function with the compiled version. You do not provide the name of the MEX function that contains the compiled version. Therefore, `coder.runTest` looks for a MEX function that has the default name.

In a local, writable folder, create a MATLAB function, `myfun`.

```
function y = myfun(u,v) %#codegen
y = u+v;
end
```

In the same folder, create a test function, `mytest1`, that calls `myfun`.

```
function mytest1
c = myfun(10,20);
disp(c);
end
```

Run the test function in MATLAB.

```
mytest1
```

30

Generate a MEX function for myfun.

```
codegen myfun -args {0,0}
```

In the current folder, codegen generates a MEX function that has the default name, myfun\_mex.

Run coder.runTest. Specify that you want to run the test file mytest1. Specify replacement of myfun with the compiled version in myfun\_mex.

```
coder.runTest('mytest1','myfun')
```

30

The results are the same as when you run mytest1 at the MATLAB command line.

### Replace Multiple Functions That You Specify

Use coder.runTest to run a test file. Specify replacement of two functions with calls to the compiled versions. Specify the MEX function that contains the compiled versions of the functions.

In a local writable folder, create a MATLAB function, myfun1.

```
function y = myfun1(u) %#codegen
y = u;
end
```

In the same folder, create another MATLAB function, myfun2.

```
function y = myfun2(u, v) %#codegen
y = u + v;
end
```

In the same folder, create a test function that calls myfun1 and myfun2.

```
function mytest2
c1 = myfun1(10);
disp(c1)
c2 = myfun2(10,20);
disp(c2)
end
```

Run the test function.

```
mytest2
```

10

30

Generate a MEX function for myfun1 and myfun2. Use the -o option to specify the name of the generated MEX function.

```
codegen -o mymex myfun1 -args {0} myfun2 -args {0,0}
```

Run `coder.runTest`. Specify that you want to run `mytest2`. Specify that you want to replace the calls to `myfun1` and `myfun2` with calls to the compiled versions in the MEX function `mymex`.

```
coder.runTest('mytest2',{'myfun1','myfun2'},'mymex')
```

```
10
```

```
30
```

The results are the same as when you run `mytest2` at the MATLAB command line.

### Replace Functions That Have Compiled Versions in Specified MEX File

Use `coder.runTest` to run a test that replaces calls to MATLAB functions in the test with calls to the compiled versions. Specify the file name for the MEX function that contains the compiled versions of the functions.

In a local writable folder, create a MATLAB function, `myfun1`.

```
function y = myfun1(u) %#codegen
y = u;
end
```

In the same folder, create another MATLAB function, `myfun2`.

```
function y = myfun2(u, v) %#codegen
y = u + v;
end
```

In the same folder, create a test function that calls `myfun1` and `myfun2`.

```
function mytest2
c1 = myfun1(10);
disp(c1)
c2 = myfun2(10,20);
disp(c2)
end
```

Run the test.

```
mytest2
```

```
10
```

```
30
```

Generate a MEX function for `myfun1` and `myfun2`. Use the `-o` option to specify the name of the generated MEX function.

```
codegen -o mymex myfun1 -args {0} myfun2 -args {0,0}
```

Run `coder.runTest`. Specify that you want to run `mytest2`. Specify that you want to replace calls to functions called by `mytest2` with calls to the compiled versions in `mymex`. Specify the complete MEX file name including the platform-specific extension. Use `mexext` to get the platform-specific extension.

```
coder.runTest('mytest2',['mymex.', mexext])
```

```
10
```

```
30
```

The results are the same as when you run `mytest2` at the MATLAB command line.

### Run Class-Based Unit Test

Run `coder.runTest` with a class-based unit test.

Write the function `addOne`, which adds 1 to the input.

```
function y = addOne(x)
%#codegen
y = x + 1;
end
```

Write a class-based unit test that verifies the value returned by `addOne` when the input is 1 and when the input is `pi`.

```
classdef TestAddOne < matlab.unittest.TestCase
 methods (Test)
 function reallyAddsOne(testCase)
 x = 1;
 y = addOne(x);
 testCase.verifyEqual(y,2);
 end
 function addsFraction(testCase)
 x = pi;
 y = addOne(x);
 testCase.verifyEqual(y,x+1);
 end
 end
end
```

Run the class-based unit test, replacing calls to `addOne` with calls to `addOne_mex`.

```
coder.runTest('TestAddOne', 'addOne')
```

```
Running TestAddOne
```

```
..
```

```
Done TestAddOne
```

```

```

```
testbenchResult =
```

```
1x2 TestResult array with properties:
```

```
Name
Passed
Failed
Incomplete
```

Duration  
Details

Totals:  
2 Passed, 0 Failed, 0 Incomplete.  
0.28516 seconds testing time.

## Input Arguments

### **test** — File name for test function, script, or class-based unit test

character vector | string scalar

File name for MATLAB function, script, or class-based unit test that calls the MATLAB functions for which you want to test the generated MEX. `coder.runTest` replaces the calls to the functions with calls to the generated MEX.

Example: 'mytest'

### **fcn** — Name of MATLAB function to replace

character vector | string scalar

Name of MATLAB function to replace when running test. `coder.runTest` replaces calls to this function with calls to the compiled version of this function.

Example: 'myfun'

### **fcns** — Names of MATLAB functions to replace

character vector | string scalar | cell array of character vectors

Names of MATLAB functions to replace when running test. `coder.runTest` replaces calls to these functions with calls to the compiled versions of these functions.

Specify one function as a character vector or a string scalar.

Example: 'myfun'

Example: "myfun"

Specify multiple functions as a cell array of character vectors. Before using `coder.runTest`, compile these functions into a single MEX function.

Example: {'myfun1', 'myfun2', 'myfun3'}

### **mexfcn** — MEX function name

character vector | string scalar

Name of a MEX function generated for one or more functions.

Generate this MEX function using the MATLAB Coder app or the `codegen` function.

Example: 'mymex'

### **mexfile** — MEX file name with extension

character vector

The file name and platform-specific extension of a MEX file for one or more functions. Use `mexext` to get the platform-specific MEX file extension.

Generate this MEX file using the MATLAB Coder app or the `codegen` function.

Example: `['myfunmex.', mexext]`

Data Types: `char`

## Tips

- `coder.runTest` does not return outputs. To see test results, in the test, include code that displays the results.
- To compare MEX and MATLAB function behavior:
  - Run the test in MATLAB.
  - Use `codegen` to generate a MEX function.
  - Use `coder.runTest` to run the test replacing the call to the original function with a call to the compiled version in the MEX function.
- Before using `coder.runTest` to test multiple functions, compile the MATLAB functions into a single MEX function.
- If you use the syntax `coder.runTest(test, mexfile)`, use `mexext` to get the platform-specific MEX file name extension. For example:

```
coder.runTest('my_test', ['mymexfun.', mexext])
```

- If errors occur during the test, you can debug the code using call stack information.
- You can combine MEX generation and testing in one step by running `codegen` with the `-test` option. For example, the following code generates a MEX function for `myfunction` and calls the test file `myfunction_test`, replacing calls to `myfunction` with calls to `myfunction_mex`.

```
codegen myfunction -test myfunction_test
```

## See Also

`codegen` | `coder` | `coder.getArgTypes`

### Topics

“MATLAB Code Analysis”

“Author Class-Based Unit Tests in MATLAB”

“Unit Test Generated Code with MATLAB Coder”

**Introduced in R2012a**

## coder.sameSizeBinaryOp

Apply element-wise binary operations without implicit expansion

### Syntax

```
result = coder.sameSizeBinaryOp(func_handle,u,v)
```

### Description

`result = coder.sameSizeBinaryOp(func_handle,u,v)` performs an error check that the operands are of the same size and applies the binary operation or function specified by the function handle `func_handle` on the operands `u` and `v` without implicitly expanding them. The operands must be of the same size because this function does not allow scalar expansion.

Use `coder.sameSizeBinaryOp` to disable implicit expansion for a specific binary operation or function. Disable implicit expansion to avoid automatic size change of output sizes, additional code generation, and performance variation. See “Generate Code With Implicit Expansion Enabled”, “Optimize Implicit Expansion in Generated Code” and “Compatible Array Sizes for Basic Operations”.

To disable implicit expansion for all binary operations and functions within a specific function in the generated code, call `coder.noImplicitExpansionInFunction` within that function.

### Examples

#### Apply Operations and Functions Without Implicit Expansion

Use `coder.sameSizeBinaryOp` to apply binary operations and functions where implicit expansion is not required.

Using `coder.sameSizeBinaryOp` ensures that any variable-size operands of compatible sizes are not expanded automatically. The generated code does not include additional code to enable the automatic expansion of the operands.

In this example, the `plus` function applies the operation with implicit expansion. The `coder.sameSizeBinaryOp` function applies the operation without implicit expansion.

```
type addExample.m

function [out1,out2] = addExample(a,b)
out1 = coder.sameSizeBinaryOp(@plus,a,b);
out2 = plus(a,b);
end
```

Define the input types.

```
a_type = coder.typeof(1,[5 1]);
b_type = coder.typeof(1,[5 inf]);
```

Generate code for the function `addExample` by using this command.

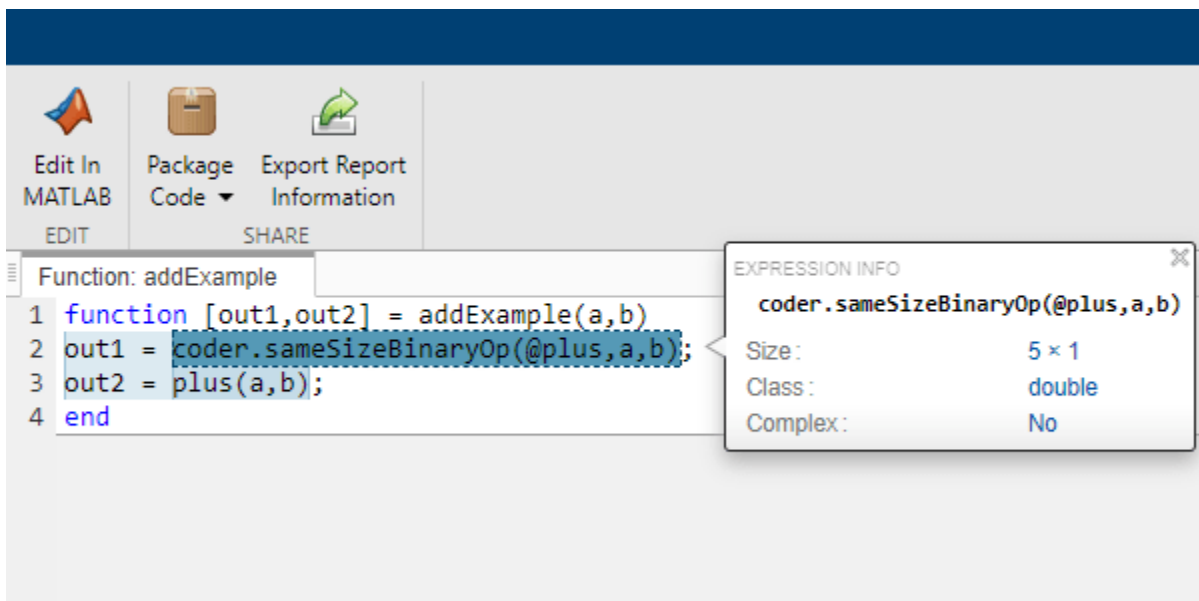
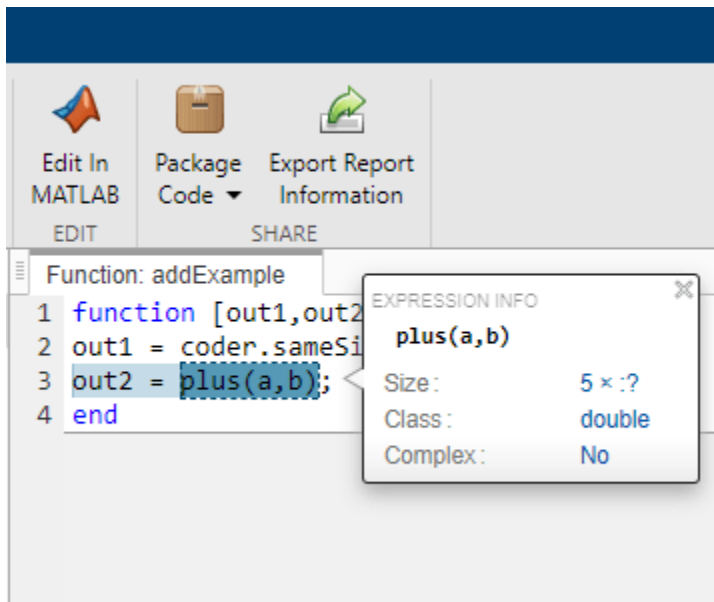
```
codegen addExample -args {a_type, b_type} -config:lib -report
```



Code generation successful: To view the report, open('codegen\lib\addExample\html\report.mldatx')

## Compare Output Sizes

In the code generation report created in the previous step, place your cursor over the two operations.



The size of the output from the `plus` operation is  $5 \times ?$  whereas the size of the output of `coder.sameSizeBinaryOp` is  $5 \times 1$ .

The `plus` function implicitly expands its operands to the output size.

The `coder.sameSizeBinaryOp` function disables implicit expansion to prevent the automatic expansion of the operands.

**Examine the Generated Code**

```
type codegen/lib/addExample/addExample.c

/*
 * File: addExample.c
 *
 * MATLAB Coder version : 5.4
 * C/C++ source code generated on : 26-Feb-2022 13:00:27
 */

/* Include Files */
#include "addExample.h"
#include "addExample_emxutil.h"
#include "addExample_types.h"

/* Function Definitions */
/*
 * Arguments : const double a[5]
 * const mxArray_real_T *b
 * double out1[5]
 * mxArray_real_T *out2
 * Return Type : void
 */
void addExample(const double a[5], const mxArray_real_T *b, double out1[5],
 mxArray_real_T *out2)
{
 const double *b_data;
 double *out2_data;
 int i;
 int i1;
 int loop_ub;
 b_data = b->data;
 for (i = 0; i < 5; i++) {
 out1[i] = a[i] + b_data[i];
 }
 i = out2->size[0] * out2->size[1];
 out2->size[0] = 5;
 out2->size[1] = b->size[1];
 emxEnsureCapacity_real_T(out2, i);
 out2_data = out2->data;
 loop_ub = b->size[1];
 for (i = 0; i < loop_ub; i++) {
 for (i1 = 0; i1 < 5; i1++) {
 int i2;
 i2 = i1 + 5 * i;
 out2_data[i2] = a[i1] + b_data[i2];
 }
 }
}

/*
 * File trailer for addExample.c
 *
 * [EOF]
 */
```

The code generated to calculate `out1` by using `coder.sameSizeBinaryOp` is seen in the first `for` loop in the function `addExample`. The code generated to calculate `out2` is seen below the first `for` loop. The generated code for `out1` is much smaller, as compared to the code generated to calculate `out2`.

The code generated for the `plus` function needs additional code to expand its operands.

### Generate Code for Binary Operations and Functions Without Implicit Expansion

This example shows how to generate code for binary operations and functions without implicitly expanding its operands.

The `coder.sameSizeBinaryOp` function applies the required operation and bypasses additional code generation and change in output size associated with implicit expansion.

This example highlights the difference between the code generated for `coder.sameSizeBinaryOp` and the code generated for the `minus` function.

### Subtracting Two Operands With Implicit Expansion

For this code snippet, the generated code implicitly expands the output.

```
type fooImpEx.m

function out = fooImpEx(a,b)
out = b - a;
end
```

Define the operand types.

```
a = coder.typeof(1,[2 1])
```

```
a =
coder.PrimitiveType
 2×1 double
```

Edit Type Object

```
b = coder.typeof(1,[2 inf])
```

```
b =
coder.PrimitiveType
 2×:inf double
```

Edit Type Object

Generate code for the function by running this command:

```
codegen fooImpEx -config:lib -args {a,b}
```

Code generation successful.

The code generated for the function `fooImpEx` is shown here.

```
type codegen/lib/fooImpEx/fooImpEx.c
```

```
/*
 * File: fooImpEx.c
```

```

*
* MATLAB Coder version : 5.4
* C/C++ source code generated on : 26-Feb-2022 13:03:41
*/

/* Include Files */
#include "fooImpEx.h"
#include "fooImpEx_emxutil.h"
#include "fooImpEx_types.h"

/* Function Definitions */
/*
* Arguments : const double a[2]
* const emxArray_real_T *b
* emxArray_real_T *out
* Return Type : void
*/
void fooImpEx(const double a[2], const emxArray_real_T *b, emxArray_real_T *out)
{
 const double *b_data;
 double *out_data;
 int i;
 int loop_ub;
 b_data = b->data;
 i = out->size[0] * out->size[1];
 out->size[0] = 2;
 out->size[1] = b->size[1];
 emxEnsureCapacity_real_T(out, i);
 out_data = out->data;
 loop_ub = b->size[1];
 for (i = 0; i < loop_ub; i++) {
 int i1;
 out_data[2 * i] = b_data[2 * i] - a[0];
 i1 = 2 * i + 1;
 out_data[i1] = b_data[i1] - a[1];
 }
}

/*
* File trailer for fooImpEx.c
*
* [EOF]
*/

```

The generated code includes code to automatically expand the size of compatible operands.

### Subtracting Two Same-Size Operands Without Implicit Expansion

This code snippet uses `coder.sameSizeBinaryOp` to apply the operation without using implicit expansion.

type `fooSameSize.m`

```

function out = fooSameSize(a,b)
out = coder.sameSizeBinaryOp(@minus,b,a);
end

```

Generate code for the function by running this command:

```
codegen fooSameSize -config:lib -args {a,b}
```

Code generation successful.

The code generated for the function `fooImpEx` is shown here.

```
type codegen/lib/fooSameSize/fooSameSize.c
```

```
/*
 * File: fooSameSize.c
 *
 * MATLAB Coder version : 5.4
 * C/C++ source code generated on : 26-Feb-2022 13:03:46
 */

/* Include Files */
#include "fooSameSize.h"
#include "fooSameSize_types.h"

/* Function Definitions */
/*
 * Arguments : const double a[2]
 * const mxArray_real_T *b
 * double out[2]
 * Return Type : void
 */
void fooSameSize(const double a[2], const mxArray_real_T *b, double out[2])
{
 const double *b_data;
 b_data = b->data;
 out[0] = b_data[0] - a[0];
 out[1] = b_data[1] - a[1];
}

/*
 * File trailer for fooSameSize.c
 *
 * [EOF]
 */
```

In this case, the variable `out` is fixed-size and the code generated for the operation applied by the `coder.sameSizeBinaryOp` function does not expand the operands. The generated function `fooSameSize` does not contain additional loops to increase the size of the operands.

## Input Arguments

### **func\_handle** — Binary function to apply

function handle

Binary function to apply, specified as a function handle, `func_handle` must be a binary (two-input) element-wise function of the form `C = func_handle(u,v)` that accepts arrays `u` and `v` with the same-size. Apply these binary functions without implicit expansion by using `coder.sameSizeBinaryOp`:

| Function | Symbol | Description                                      |
|----------|--------|--------------------------------------------------|
| plus     | +      | Plus                                             |
| minus    | -      | Minus                                            |
| times    | .*     | Array multiply                                   |
| rdivide  | ./     | Right array divide                               |
| ldivide  | .\     | Left array divide                                |
| power    | .^     | Array power                                      |
| eq       | ==     | Equal                                            |
| ne       | ~=     | Not equal                                        |
| gt       | >      | Greater than                                     |
| ge       | >=     | Greater than equal to                            |
| lt       | <      | Less than                                        |
| le       | <=     | Less than equal to                               |
| and      | &      | Element-wise logical AND                         |
| or       |        | Element-wise logical OR                          |
| xor      | N/A    | Logical exclusive OR                             |
| bitand   | N/A    | Bit-wise AND                                     |
| bitor    | N/A    | Bit-wise OR                                      |
| bitxor   | N/A    | Bit-wise XOR                                     |
| max      | N/A    | Binary maximum                                   |
| min      | N/A    | Binary minimum                                   |
| mod      | N/A    | Modulus after division                           |
| rem      | N/A    | Remainder after division                         |
| atan2    | N/A    | Four-quadrant inverse tangent; result in radians |
| atan2d   | N/A    | Four-quadrant inverse tangent; result in degrees |
| hypot    | N/A    | Square root of sum of squares                    |

Example: `result = coder.sameSizeBinaryOp(@plus, u, v);`

Data Types: `function_handle`

**u – Input array**

scalars | vectors | matrices | multidimensional arrays

Input array, specified as scalar, vector, matrix, or multidimensional array. Inputs `u` and `v` must be of the same sizes.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

**v – Input array**

scalars | vectors | matrices | multidimensional arrays

Input array, specified as scalar, vector, matrix, or multidimensional array. Inputs `u` and `v` must be of the same sizes.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

**See Also**

`bsxfun` | `coder.noImplicitExpansionInFunction`

**Topics**

“Compatible Array Sizes for Basic Operations”

“Generate Code With Implicit Expansion Enabled”

“Optimize Implicit Expansion in Generated Code”

**Introduced in R2021b**

## coder.screener

**Package:** coder

Determine if function is suitable for code generation

### Syntax

```
coder.screener(fcn)
coder.screener(fcn, '-gpu')
coder.screener(fcn_1, ..., fcn_n)
info = coder.screener(___)
```

### Description

`coder.screener(fcn)` analyzes the entry-point MATLAB function `fcn` to identify unsupported functions and language features as code generation compliance issues. The code generation compliance issues are displayed in the readiness report.

If `fcn` calls other functions directly or indirectly that are not MathWorks functions (MATLAB built-in functions and toolbox functions), `coder.screener` analyzes these functions. It does not analyze the MathWorks functions.

It is possible that `coder.screener` does not detect all code generation issues. Under certain circumstances, it is possible that `coder.screener` reports false errors.

To avoid undetected code generation issues and false errors, before generating code, verify that your MATLAB code is suitable for code generation by performing these additional checks:

- Before using `coder.screener`, fix issues that the Code Analyzer identifies.
- After using `coder.screener`, and before generating C/C++ code, verify that your MATLAB code is suitable for code generation by generating and verifying a MEX function.

The `coder.screener` function does not report functions that the code generator treats as extrinsic. Examples of such functions are `plot`, `disp`, and `figure`. See “Use MATLAB Engine to Execute a Function Call in Generated Code”.

`coder.screener(fcn, '-gpu')` analyzes the entry-point MATLAB function `fcn` to identify unsupported functions and language features for GPU code generation.

`coder.screener(fcn_1, ..., fcn_n)` analyzes multiple entry-point MATLAB functions.

`info = coder.screener( ___ )` returns a `coder.ScreenerInfo` object. The properties of this object contain the code generation readiness analysis results. Use `info` to access the code generation readiness results programmatically. For a list of properties, see `coder.ScreenerInfo` Properties.

### Examples



## Identify Unsupported Functions

The `coder.screener` function identifies calls to functions that are not supported for code generation. It checks the entry-point function, `foo1`, and the function, `foo2`, that `foo1` calls.

Write the function `foo2` and save it in the file `foo2.m`.

```
function [tf1,tf2] = foo2(source,target)
G = digraph(source,target);
tf1 = hascycles(G);
tf2 = isdag(G);
end
```

Write the function `foo1` that calls `foo2`. Save `foo1` in the file `foo1.m`.

```
function [tf1,tf2] = foo1(source,target)
assert(numel(source)==numel(target))
[tf1,tf2] = foo2(source,target);
end
```

Analyze `foo1`.

```
coder.screener('foo1')
```

The Code Generation Readiness report displays a summary of the unsupported MATLAB function calls. The report **Issues** tab indicates that `foo2.m` contains one call to the `isdag` function and one call to the `hascycles`, which are not supported for code generation.



**2 Code generation readiness issues - Code might require changes** Language C/C++ (MATLAB Coder) [Refresh](#) [Edit](#)

2 Unsupported functions  
2 Files analyzed

Issues Files Group by: Issue

- Unsupported function: `hascycles` (1)
- Unsupported function: `isdag` (1)

Unsupported function: `hascycles`

```
foo2.m
1 function [tf1,tf2] = foo2(source,target)
2 G = digraph(source,target);
3 tf1 = hascycles(G);
4 tf2 = isdag(G);
5 end
6
```

The function `foo2` calls two unsupported MATLAB functions. To generate a MEX function, modify the code to make the calls to `hascycles` and `isdag` extrinsic by using the `coder.extrinsic` directive, and then rerun the code generation readiness tool.

```
function [tf1,tf2] = foo2(source,target)
coder.extrinsic('hascycles','isdag');
G = digraph(source,target);
tf1 = hascycles(G);
tf2 = isdag(G);
end
```

Rerun `coder.screener` on the entry-point function `foo1`.

```
coder.screener('foo1')
```

The report no longer flags that code generation does not support the `hascycles` and `isdag` functions. When you generate a MEX function for `foo1`, the code generator dispatches these two functions to MATLAB for execution.

### Access Code Generation Readiness Results Programmatically

You can call the `coder.screener` function with an optional output argument. If you use this syntax, the `coder.screener` function returns a `coder.ScreenerInfo` object that contains the results of

the code generation readiness analysis for your MATLAB code base. See `coder.ScreenerInfo` Properties.

This example uses the files `foo1.m` and `foo2.m` defined in the previous example. Call the `coder.screener` function:

```
info = coder.screener('foo1.m')
info =
 ScreenerInfo with properties:
 Files: [2x1 coder.CodeFile]
 Messages: [2x1 coder.Message]
 UnsupportedCalls: [2x1 coder.CallSite]
 View Screener Report
```

To access information about the first unsupported call, index into the `UnsupportedCalls` property,

```
firstCall = info.UnsupportedCalls(1)
firstCall =
```

```
CallSite with properties:
 CalleeName: 'hascycles'
 File: [1x1 coder.CodeFile]
 StartIndex: 78
 EndIndex: 86
```

View the text of the file that contains this unsupported call to `hascycles`.

```
firstCall.File.Text
ans =
 'function [tf1,tf2] = foo2(source,target)
 G = digraph(source,target);
 tf1 = hascycles(G);
 tf2 = isdag(G);
 end
 '
```

To export the entire code generation readiness report to a MATLAB string, use the `textReport` function.

```
reportString = textReport(info)
reportString =
 'Code Generation Readiness (Text Report)
 =====
 2 Code generation readiness issues
 2 Unsupported functions
 2 Files analyzed
 Configuration
```

```
=====
Language: C/C++ (MATLAB Coder)

Code Generation Issues
=====

Unsupported function: digraph (2)
- foo2.m (Line 3)
- foo2.m (Line 4)

,
```

### Identify Unsupported Data Types

The `coder.screener` function identifies MATLAB data types that code generation does not support.

Write the function `myfun1` that contains a MATLAB calendar duration array data type.

```
function out = myfun1(A)
out = calyears(A);
end
```

Analyze `myfun1`.

```
coder.screener('myfun1');
```

The code generation readiness report indicates that the `calyears` data type is not supported for code generation. Before generating code, fix the reported issue.

## Input Arguments

### **fcn** — Name of entry-point function

character vector | string scalar

Name of entry-point MATLAB function for analysis. Specify as a character vector or a string scalar.

Example: `coder.screener('myfun');`

Data Types: `char` | `string`

### **fcn\_1, ..., fcn\_n** — List of entry-point function names

character vector | string scalar

Comma-separated list of entry-point MATLAB function names for analysis. Specify as character vectors or string scalars.

Example: `coder.screener('myfun1','myfun2');`

Data Types: `char` | `string`

## Alternatives

- “Run Code Generation Readiness Tool from the Current Folder Browser”

- “Run the Code Generation Readiness Tool Using the MATLAB Coder App”

## **See Also**

`codegen` | `coder.extrinsic`

## **Topics**

“MATLAB Language Features Supported for C/C++ Code Generation”

“Functions and Objects Supported for C/C++ Code Generation”

“Code Generation Readiness Tool”

## **Introduced in R2012b**

## coder.target

Determine if code generation target is specified target

### Syntax

```
tf = coder.target(target)
```

### Description

`tf = coder.target(target)` returns true (1) if the code generation target is `target`. Otherwise, it returns false (0).

If you generate code for MATLAB classes, MATLAB computes class initial values at class loading time before code generation. If you use `coder.target` in MATLAB class property initialization, `coder.target('MATLAB')` returns true.

### Examples

#### Use coder.target to Parametrize a MATLAB Function

Parametrize a MATLAB function so that it works in MATLAB or in generated code. When the function runs in MATLAB, it calls the MATLAB function `myabsval`. The generated code, however, calls a C library function `myabsval`.

Write a MATLAB function `myabsval`.

```
function y = myabsval(u)
%#codegen
y = abs(u);
```

Generate a C static library for `myabsval`, using the `-args` option to specify the size, type, and complexity of the input parameter.

```
codegen -config:lib myabsval -args {0.0}
```

The `codegen` function creates the library file `myabsval.lib` and header file `myabsval.h` in the folder `\codegen\lib\myabsval`. (The library file extension can change depending on your platform.) It generates the functions `myabsval_initialize` and `myabsval_terminate` in the same folder.

Write a MATLAB function to call the generated C library function using `coder.ceval`.

```
function y = callmyabsval(y)
%#codegen
% Check the target. Do not use coder.ceval if callmyabsval is
% executing in MATLAB
if coder.target('MATLAB')
 % Executing in MATLAB, call function myabsval
 y = myabsval(y);
else
```

```

% add the required include statements to generated function code
coder.updateBuildInfo('addIncludePaths','$(START_DIR)\codegen\lib\myabsval');
coder.cinclude('myabsval_initialize.h');
coder.cinclude('myabsval.h');
coder.cinclude('myabsval_terminate.h');

% Executing in the generated code.
% Call the initialize function before calling the
% C function for the first time
coder.ceval('myabsval_initialize');

% Call the generated C library function myabsval
y = coder.ceval('myabsval',y);

% Call the terminate function after
% calling the C function for the last time
coder.ceval('myabsval_terminate');
end

```

Generate the MEX function `callmyabsval_mex`. Provide the generated library file at the command line.

```
codegen -config:mex callmyabsval codegen\lib\myabsval\myabsval.lib -args {-2.75}
```

Rather than providing the library at the command line, you can use `coder.updateBuildInfo` to specify the library within the function. Use this option to preconfigure the build. Add this line to the `else` block:

```
coder.updateBuildInfo('addLinkObjects','myabsval.lib','$(START_DIR)\codegen\lib\myabsval',100, true);
```

---

**Note** The `START_DIR` macro is only supported for generating code with MATLAB Coder.

---

Run the MEX function `callmyabsval_mex` which calls the library function `myabsval`.

```
callmyabsval_mex(-2.75)
```

```
ans =
```

```
2.7500
```

Call the MATLAB function `callmyabsval`.

```
callmyabsval(-2.75)
```

```
ans =
```

```
2.7500
```

The `callmyabsval` function exhibits the desired behavior for execution in MATLAB and in code generation.

## Input Arguments

**target** — code generation target

'MATLAB' | 'MEX' | 'Sfun' | 'Rtw' | 'HDL' | 'Custom'

Code generation target, specified as a character vector or a string scalar. Specify one of these targets.

|          |                                                                                                           |
|----------|-----------------------------------------------------------------------------------------------------------|
| 'MATLAB' | Running in MATLAB (not generating code)                                                                   |
| 'MEX'    | Generating a MEX function                                                                                 |
| 'Sfun'   | Simulating a Simulink model. Also used for running in Accelerator mode.                                   |
| 'Rtw'    | Generating a LIB, DLL, or EXE target. Also used for running in Simulink Coder and Rapid Accelerator mode. |
| 'HDL'    | Generating an HDL target                                                                                  |
| 'Custom' | Generating a custom target                                                                                |

Example: `tf = coder.target('MATLAB')`

Example: `tf = coder.target("MATLAB")`

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## See Also

`coder.ceval` | `coder.cinclude` | `coder.updateBuildInfo` | `coder.BuildConfig` | `coder.ExternalDependency`

## Topics

“Call Custom C/C++ Code from the Generated Code”

## Introduced in R2011a



# coder.typeof

**Package:** coder

Create `coder.Type` object to represent the type of an entry-point function input

## Syntax

```
type_obj = coder.typeof(v)
type_obj = coder.typeof(v,sz,variable_dims)
type_obj = coder.typeof(v,'Gpu', true)
type_obj = coder.typeof(type_obj)
```

## Description

---

**Note** You can also create and edit `coder.Type` objects interactively by using the `Coder Type Editor`. See “Create and Edit Input Types by Using the `Coder Type Editor`”.

---

`type_obj = coder.typeof(v)` creates an object that is derived from `coder.Type` to represent the type of `v` for code generation. Use `coder.typeof` to specify only input parameter types. Use it with the `codegen` function `-args` option or in a MATLAB Coder project when you are defining an input type by providing a sample code. Do not use it in MATLAB code from which you intend to generate code.

`type_obj = coder.typeof(v,sz,variable_dims)` returns a modified copy of `type_obj = coder.typeof(v)` with upper bound size specified by `sz` and variable dimensions specified by `variable_dims`.

`type_obj = coder.typeof(v,'Gpu', true)` creates an object that is derived from `coder.Type` to represent `v` as a GPU input type for code generation. This option requires a valid GPU Coder license.

`type_obj = coder.typeof(type_obj)` returns `type_obj` itself.

## Examples

### Create Type for a Matrix

Create a type for a simple fixed-size 5x6 matrix of doubles.

```
coder.typeof(ones(5,6))

ans =

coder.PrimitiveType
 5x6 double

coder.typeof(0,[5 6])
```

```
ans =
coder.PrimitiveType
 5×6 double
```

Create a type for a variable-size matrix of doubles.

```
coder.typeof(ones(3,3), [], 1)
```

```
ans =
coder.PrimitiveType
 :3×:3 double
% ':' indicates variable-size dimensions
```

Create a type for a matrix with fixed-size and variable-size dimensions.

```
coder.typeof(0, [2,3,4], [1 0 1])
```

```
ans =
coder.PrimitiveType
 :2×3×:4 double
coder.typeof(10, [1 5], 1)
```

```
ans =
coder.PrimitiveType
 1×:5 double
% ':' indicates variable-size dimensions
```

Create a type for a matrix of doubles, first dimension unbounded, second dimension with fixed size.

```
coder.typeof(10, [inf, 3])
```

```
ans =
coder.PrimitiveType
 :inf×3 double
% ':' indicates variable-size dimensions
```

Create a type for a matrix of doubles, first dimension unbounded, second dimension with variable size that has an upper bound of 3.

```
coder.typeof(10, [inf, 3], [0 1])
```

```
ans =
coder.PrimitiveType
 :inf×:3 double
```

Convert a fixed-size matrix to a variable-size matrix.

```
coder.typeof(ones(5,5), [], 1)
```

```
ans =
coder.PrimitiveType
```

```

:5x:5 double
% ':' indicates variable-size dimensions

```

### Create Type for a Structure

Create a type for a structure with a variable-size field.

```

x.a = coder.typeof(0,[3 5],1);
x.b = magic(3);
coder.typeof(x)

ans =

coder.StructType
 1x1 struct
 a: :3x:5 double
 b: 3x3 double
% ':' indicates variable-size dimensions

```

Create a nested structure (a structure as a field of another structure).

```

S = struct('a',double(0),'b',single(0));
SuperS.x = coder.typeof(S);
SuperS.y = single(0);
coder.typeof(SuperS)

ans =

coder.StructType
 1x1 struct
 x: 1x1 struct
 a: 1x1 double
 b: 1x1 single
 y: 1x1 single

```

Create a structure containing a variable-size array of structures as a field.

```

S = struct('a',double(0),'b',single(0));
SuperS.x = coder.typeof(S,[1 inf],[0 1]);
SuperS.y = single(0);
coder.typeof(SuperS)

ans =

coder.StructType
 1x1 struct
 x: 1x:inf struct
 a: 1x1 double
 b: 1x1 single
 y: 1x1 single
% ':' indicates variable-size dimensions

```

### Create Type for a Cell Array

Create a type for a homogeneous cell array with a variable-size field.

```
a = coder.typeof(0,[3 5],1);
b = magic(3);
coder.typeof({a b})

ans =

coder.CellType
 1x2 homogeneous cell
 base: :3x:5 double
% ':' indicates variable-size dimensions
```

Create a type for a heterogeneous cell array.

```
a = coder.typeof('a');
b = coder.typeof(1);
coder.typeof({a b})
```

```
ans =

coder.CellType
 1x2 heterogeneous cell
 f1: 1x1 char
 f2: 1x1 double
```

Create a variable-size homogeneous cell array type from a cell array that has the same class but different sizes.

1. Create a type for a cell array that contains two character vectors with different sizes. The cell array type is heterogeneous.

```
coder.typeof({'aa','bbb'})
```

```
ans =

coder.CellType
 1x2 heterogeneous cell
 f1: 1x2 char
 f2: 1x3 char
```

2. Create a type by using the same cell array input. This time, specify that the cell array type has variable-size dimensions. The cell array type is homogeneous.

```
coder.typeof({'aa','bbb'},[1,10],[0,1])
```

```
ans =

coder.CellType
 1x:10 locked homogeneous cell
 base: 1x:3 char
% ':' indicates variable-size dimensions
```

### **Create Type for a Value Class Object**

Change a fixed-size array to a bounded, variable-size array.

Create a type for a value class object.

1. Create this value class:

```
classdef mySquare
 properties
 side;
 end
 methods
 function obj = mySquare(val)
 if nargin > 0
 obj.side = val;
 end
 end
 function a = calcarea(obj)
 a = obj.side * obj.side;
 end
 end
end
```

2. Create an object of mySquare.

```
sq_obj = coder.typeof(mySquare(4))
sq_obj =
coder.ClassType
 1x1 mySquare
 side: 1x1 double
```

3. Create a type for an object that has the same properties as sq\_obj.

```
t = coder.typeof(sq_obj)
t =
coder.ClassType
 1x1 mySquare
 side: 1x1 double
```

Alternatively, you can create the type from the class definition:

```
t = coder.typeof(mySquare(4))
t =
coder.ClassType
 1x1 mySquare
 side: 1x1 double
```

### Create Type for a String Scalar

Define a string scalar. For example:

```
s = "mystring";
```

Create a type from s.

```
t = coder.typeof(s);
```

To make `t` variable-size, assign the `Value` property of `t` to a type for a variable-size character vector that has the upper bound that you want. For example, specify that type `t` is variable-size with an upper bound of 10.

```
t.Properties.Value = coder.typeof('a',[1 10],[0 1]);
```

To specify that `t` is variable-size and does not have an upper bound:

```
t.Properties.Value = coder.typeof('a',[1 inf]);
```

Pass the type to `codegen` by using the `-args` option.

```
codegen myFunction -args {t}
```

## Input Arguments

### **v** — Set of values representing input parameter types

numeric array | character vector | string | struct | cell array

`v` can be a MATLAB numeric, logical, char, enumeration, or fixed-point array. `v` can also be a cell array, structure, or value class that contains the previous types.

When `v` is a cell array whose elements have the same classes but different sizes, if you specify variable-size dimensions, `coder.typeof` creates a homogeneous cell array type. If the elements have different classes, `coder.typeof` reports an error.

Example: `coder.typeof(ones(5,6));`

Data Types: half | single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64 | logical | char | string | struct | table | cell | function\_handle | categorical | datetime | duration | calendarDuration | fi  
Complex Number Support: Yes

### **sz** — Dimension of type object

row vector of integer values

Size vector specifying each dimension of type object.

If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. When `sz` is `[]`, the upper bounds of `v` do not change.

If size is not specified, `sz` takes the default dimension of `v`.

Example: `coder.typeof(0,[5,6]);`

Data Types: single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64

### **variable\_dims** — Variable or fixed dimension

row vector of logical values

Logical vector that specifies whether each dimension is variable size (`true`) or fixed size (`false`). For a cell array, if the elements have different classes, you cannot specify variable-size dimensions.

If you do not specify the `variable_dims` input parameter, the bounded dimensions of the type are fixed.

A scalar `variable_dims` applies to all dimensions. However, if `variable_dims` is 1, the size of a singleton dimension remains fixed.

Example: `coder.typeof(0,[2,3,4],[1 0 1]);`

Data Types: `logical`

### **type\_obj — Type object**

`coder.Type` object

`coder.Type` object to represent the type of `v` for code generation.

Example: `type_obj = coder.typeof(ones(5,6));`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

## **Output Arguments**

### **type\_obj — Type object**

`coder.Type` object

`coder.Type` object to represent the type of `v` for code generation.

Example: `type_obj = coder.typeof(ones(5,6));`

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `function_handle` | `categorical` | `datetime` | `duration` | `calendarDuration` | `fi`

Complex Number Support: Yes

## **Limitations**

- For sparse matrices, `coder.typeof` drops upper bounds for variable-size dimensions.
- For representing GPU arrays, only bounded numeric and logical base types are supported. Scalar GPU arrays, structures, cell-arrays, classes, enumerated types, character, half-precision and fixed-point data types are not supported.
- When using `coder.typeof` to represent GPU arrays, the memory allocation (`malloc`) mode property of the GPU code configuration object must be set to be `'discrete'`.

## **Tips**

- `coder.typeof` fixes the size of a singleton dimension unless the `variable_dims` argument explicitly specifies that the singleton dimension has a variable size.

For example, the following code specifies a 1-by-:10 double. The first dimension (the singleton dimension) has a fixed size. The second dimension has a variable size.

```
t = coder.typeof(5,[1 10],1)
```

By contrast, this code specifies a :1-by-:10 double. Both dimensions have a variable size.

```
t = coder.typeof(5,[1 10],[1 1])
```

**Note** For a MATLAB Function block, singleton dimensions of input or output signals cannot have a variable size.

- If you are already specifying the type of an input variable by using a type function, do not use `coder.typeof` unless you also want to specify the size. For instance, instead of `coder.typeof(single(0))`, use the syntax `single(0)`.
- For cell array types, `coder.typeof` determines whether the cell array type is homogeneous or heterogeneous.

If the cell array elements have the same class and size, `coder.typeof` returns a homogeneous cell array type.

If the elements have different classes, `coder.typeof` returns a heterogeneous cell array type.

For some cell arrays, classification as homogeneous or heterogeneous is ambiguous. For example, the type for `{1 [2 3]}` can be a 1x2 heterogeneous type where the first element is double and the second element is 1x2 double. The type can also be a 1x3 homogeneous type in which the elements have class double and size 1x2. For these ambiguous cases, `coder.typeof` uses heuristics to classify the type as homogeneous or heterogeneous. If you want a different classification, use the `coder.CellType` `makeHomogeneous` or `makeHeterogeneous` methods to make a type with the classification that you want. The `makeHomogeneous` method makes a homogeneous copy of a type. The `makeHeterogeneous` method makes a heterogeneous copy of a type.

The `makeHomogeneous` and `makeHeterogeneous` methods permanently assign the classification as heterogeneous and homogeneous. You cannot later use one of these methods to create a copy that has a different classification.

- During code generation with GPU array types, if one input to the entry-point function is of the GPU array type, then the output variables are all GPU array types, provided they are supported for GPU code generation. For example, if the entry-point function returns a `struct` and because `struct` is not supported, the generated code returns a CPU output. However, if a supported matrix type is returned, then the generated code returns a GPU output.

## See Also

`coder.newtype` | `coder.resize` | `coder.Type` | `coder.ArrayType` | `coder.EnumType` | `coder.FiType` | `coder.PrimitiveType` | `coder.StructType` | `coder.CellType` | `coder.ClassType` | `codegen` | `coder.OutputType`

## Topics

“Define Input Properties by Example at the Command Line”  
“Specify Cell Array Inputs at the Command Line”  
“Specify Objects as Inputs at the Command Line”  
“Define String Scalar Inputs”  
“Create and Edit Input Types by Using the Coder Type Editor”

## Introduced in R2011a



# coder.unroll

Unroll for-loop by making a copy of the loop body for each loop iteration

## Syntax

```
coder.unroll()
coder.unroll(flag)
```

## Description

`coder.unroll()` unrolls a for-loop. The `coder.unroll` call must be on a line by itself immediately preceding the for-loop that it unrolls.

Instead of producing a for-loop in the generated code, loop unrolling produces a copy of the for-loop body for each loop iteration. In each iteration, the loop index becomes constant. To unroll a loop, the code generator must be able to determine the bounds of the for-loop.

For small, tight loops, unrolling can improve performance. However, for large loops, unrolling can increase code generation time significantly and generate inefficient code.

`coder.unroll` is ignored outside of code generation.

`coder.unroll(flag)` unrolls a for-loop if `flag` is `true`. `flag` is evaluated at code generation time. The `coder.unroll` call must be on a line by itself immediately preceding the for-loop that it unrolls.

## Examples

### Unroll a for-loop

To produce copies of a for-loop body in the generated code, use `coder.unroll`.

In one file, write the entry-point function `call_getrand` and a local function `getrand`. `getrand` unrolls a for-loop that assigns random numbers to an n-by-1 array. `call_getrand` calls `getrand` with the value 3.

```
function z = call_getrand
%#codegen
z = getrand(3);
end
```

```
function y = getrand(n)
coder.inline('never');
y = zeros(n, 1);
coder.unroll();
for i = 1:n
 y(i) = rand();
end
end
```

Generate a static library.

```
codegen -config:lib call_getrand -report
```

In the generated code, the code generator produces a copy of the for-loop body for each of the three loop iterations.

```
static void getrand(double y[3])
{
 y[0] = b_rand();
 y[1] = b_rand();
 y[2] = b_rand();
}
```

### Control for-loop Unrolling with Flag

Control loop unrolling by using `coder.unroll` with the `flag` argument.

In one file, write the entry-point function `call_getrand_unrollflag` and a local function `getrand_unrollflag`. When the number of loop iterations is less than 10, `getrand_unrollflag` unrolls the for-loop. `call_getrand` calls `getrand` with the value 50.

```
function z = call_getrand_unrollflag
 %#codegen
 z = getrand_unrollflag(50);
end
```

```
function y = getrand_unrollflag(n)
 coder.inline('never');
 unrollflag = n < 10;
 y = zeros(n, 1);
 coder.unroll(unrollflag)
 for i = 1:n
 y(i) = rand();
 end
end
```

Generate a static library.

```
codegen -config:lib call_getrand_unrollflag -report
```

```
static void getrand_unrollflag(double y[50])
{
 int i;
 for (i = 0; i < 50; i++) {
 y[i] = b_rand();
 }
}
```

The number of iterations is not less than 10. Therefore, the code generator does not unroll the for-loop. It produces a for-loop in the generated code.

## Use Legacy Syntax to Unroll for-Loop

- ```
function z = call_getrand
    %#codegen
    z = getrand(3);
end

function y = getrand(n)
    coder.inline('never');
    y = zeros(n, 1);
    for i = coder.unroll(1:n)
        y(i) = rand();
    end
end
```

Use Legacy Syntax to Control for-Loop Unrolling

- ```
function z = call_getrand_unrollflag
 %#codegen
 z = getrand_unrollflag(50);
end

function y = getrand_unrollflag(n)
 coder.inline('never');
 unrollflag = n < 10;
 y = zeros(n, 1);
 for i = coder.unroll(1:n, unrollflag)
 y(i) = rand();
 end
end
```

## Input Arguments

### flag — Indicates whether to unroll the for-loop

true (default) | false

When `flag` is `true`, the code generator unrolls the `for`-loop. When `flag` is `false`, the code generator produces a `for`-loop in the generated code. `flag` is evaluated at code generation time.

## Tips

- Sometimes, the code generator unrolls a `for`-loop even though you do not use `coder.unroll`. For example, if a `for`-loop indexes into a heterogeneous cell array or into `varargin` or `varargout`, the code generator unrolls the loop. By unrolling the loop, the code generator can determine the value of the index for each loop iteration. The code generator uses heuristics to determine when to unroll a `for`-loop. If the heuristics fail to identify that unrolling is warranted, or if the number of loop iterations exceeds a limit, code generation fails. In these cases, you can force loop unrolling by using `coder.unroll`. See “Nonconstant Index into `varargin` or `varargout` in a `for`-Loop”.
- If a `for`-loop is not preceded by `coder.unroll`, the code generator uses a loop unrolling threshold to determine whether to automatically unroll the loop. If the number of loop iterations is less than the threshold, the code generator unrolls the loop. If the number of iterations is greater than or equal to the threshold, the code generator produces a `for`-loop. The default value of the

threshold is 5. By modifying this threshold, you can fine-tune loop unrolling. For more details, see “Unroll for-Loops and parfor-Loops”.

## **Extended Capabilities**

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## **See Also**

`coder.inline`

### **Topics**

“Unroll for-Loops and parfor-Loops”

“Nonconstant Index into varargin or varargout in a for-Loop”

### **Introduced in R2011a**

## coder.updateBuildInfo

Update build information object RTW.BuildInfo

### Syntax

```
coder.updateBuildInfo('addCompileFlags',options)
coder.updateBuildInfo('addLinkFlags',options)
coder.updateBuildInfo('addDefines',options)
coder.updateBuildInfo(__ ,group)
```

```
coder.updateBuildInfo('addLinkObjects',filename,path)
coder.updateBuildInfo('addLinkObjects',filename,path,priority,precompiled)
coder.updateBuildInfo('addLinkObjects',filename,path,priority,precompiled,
linkonly)
coder.updateBuildInfo(__ ,group)
```

```
coder.updateBuildInfo('addNonBuildFiles',filename)
coder.updateBuildInfo('addSourceFiles',filename)
coder.updateBuildInfo('addIncludeFiles',filename)
coder.updateBuildInfo(__ ,path)
coder.updateBuildInfo(__ ,path,group)
```

```
coder.updateBuildInfo('addSourcePaths',path)
coder.updateBuildInfo('addIncludePaths',path)
coder.updateBuildInfo(__ ,group)
```

### Description

`coder.updateBuildInfo('addCompileFlags',options)` adds compiler options to the build information object.

`coder.updateBuildInfo('addLinkFlags',options)` adds link options to the build information object.

`coder.updateBuildInfo('addDefines',options)` adds preprocessor macro definitions to the build information object.

`coder.updateBuildInfo( __ ,group)` assigns a group name to options for later reference.

`coder.updateBuildInfo('addLinkObjects',filename,path)` adds a link object from a file to the build information object.

`coder.updateBuildInfo('addLinkObjects',filename,path,priority,precompiled)` specifies if the link object is precompiled.

`coder.updateBuildInfo('addLinkObjects',filename,path,priority,precompiled,linkonly)` specifies if the object is to be built before being linked or used for linking alone. If the object is to be built, it specifies if the object is precompiled.

`coder.updateBuildInfo( __ ,group)` assigns a group name to the link object for later reference.

`coder.updateBuildInfo('addNonBuildFiles', filename)` adds a nonbuild-related file to the build information object.

`coder.updateBuildInfo('addSourceFiles', filename)` adds a source file to the build information object.

`coder.updateBuildInfo('addIncludeFiles', filename)` adds an include file to the build information object.

`coder.updateBuildInfo( ____, path)` adds the file from specified path.

`coder.updateBuildInfo( ____, path, group)` assigns a group name to the file for later reference.

`coder.updateBuildInfo('addSourcePaths', path)` adds a source file path to the build information object.

`coder.updateBuildInfo('addIncludePaths', path)` adds an include file path to the build information object.

`coder.updateBuildInfo( ____, group)` assigns a group name to the path for later reference.

## Examples

### Add Multiple Compiler Options

Add the compiler options `-Zi` and `-Wall` during code generation for function, `func`.

Anywhere in the MATLAB code for `func`, add the following line:

```
coder.updateBuildInfo('addCompileFlags', '-Zi -Wall');
```

Generate code for `func` using the `codegen` command. Open the Code Generation Report.

```
codegen -config:lib -launchreport func
```

You can see the added compiler options under the **Build Logs** tab in the Code Generation Report.

### Add Source File Name

Add a source file to the project build information while generating code for a function, `calc_factorial`.

- 1 Write a header file `fact.h` that declares a C function `factorial`.

```
double factorial(double x);
```

`fact.h` will be included as a header file in generated code. This inclusion ensures that the function is declared before it is called.

Save the file in the current folder.

- 2 Write a C file `fact.c` that contains the definition of `factorial`. `factorial` calculates the factorial of its input.

```
#include "fact.h"

double factorial(double x)
{
 int i;
 double fact = 1.0;
 if (x == 0 || x == 1) {
 return 1.0;
 } else {
 for (i = 1; i <= x; i++) {
 fact *= (double)i;
 }
 return fact;
 }
}
```

`fact.c` is used as a source file during code generation.

Save the file in the current folder.

- 3 Write a MATLAB function `calc_factorial` that uses `coder.ceval` to call the external C function `factorial`.

Use `coder.updateBuildInfo` with option `'addSourceFiles'` to add the source file `fact.c` to the build information. Use `coder.cinclude` to include the header file `fact.h` in the generated code.

```
function y = calc_factorial(x) %#codegen

 coder.cinclude('fact.h');
 coder.updateBuildInfo('addSourceFiles', 'fact.c');

 y = 0;
 y = coder.ceval('factorial', x);
```

- 4 Generate code for `calc_factorial` using the `codegen` command.

```
codegen -config:dll -launchreport calc_factorial -args 0
```

In the Code Generation Report, on the **C Code** tab, you can see the added source file `fact.c`.

## Add Link Object

Add a link object `LinkObj.lib` to the build information while generating code for a function `func`. For this example, you must have a link object `LinkObj.lib` saved in a local folder, for example, `c:\Link_Objects`.

Anywhere in the MATLAB code for `func`, add the following lines:

```
libPriority = '';
libPreCompiled = true;
libLinkOnly = true;
libName = 'LinkObj.lib';
libPath = 'c:\Link_Objects';
coder.updateBuildInfo('addLinkObjects', libName, libPath, ...
 libPriority, libPreCompiled, libLinkOnly);
```

Generate a MEX function for `func` using the `codegen` command. Open the Code Generation Report.

```
codegen -launchreport func
```

You can see the added link object under the **Build Logs** tab in the Code Generation Report.

### Add Include Paths

Add an include path to the build information while generating code for a function, `adder`. Include a header file, `adder.h`, existing on the path.

When header files do not reside in the current folder, to include them, use this method:

- 1 Write a header file `mysum.h` that contains the declaration for a C function `mysum`.

```
double mysum(double, double);
```

Save it in a local folder, for example `c:\coder\myheaders`.

- 2 Write a C file `mysum.c` that contains the definition of the function `mysum`.

```
#include "mysum.h"

double mysum(double x, double y)
{
 return(x+y);
}
```

Save it in the current folder.

- 3 Write a MATLAB function `adder` that adds the path `c:\coder\myheaders` to the build information.

Use `coder.cinclude` to include the header file `mysum.h` in the generated code.

```
function y = adder(x1, x2) %#codegen
 coder.updateBuildInfo('addIncludePaths','c:\coder\myheaders');
 coder.updateBuildInfo('addSourceFiles','mysum.c');
 %Include the source file containing C function definition
 coder.cinclude('mysum.h');
 y = 0;
 if coder.target('MATLAB')
 % This line ensures that the function works in MATLAB
 y = x1 + x2;
 else
 y = coder.ceval('mysum', x1, x2);
 end
end
```

- 4 Generate code for `adder` using the `codegen` command.

```
codegen -config:lib -launchreport adder -args {0,0}
```



Open the Code Generation Report. The header file `adder.h` is included in the generated code.

## Input Arguments

### options — Build options

character vector | string scalar

Build options, specified as a character vector or string scalar. The value must be a compile-time constant.

Depending on the leading argument, `options` specifies the relevant build options to be added to the project's build information.

| Leading Argument  | Values in options              |
|-------------------|--------------------------------|
| 'addCompileFlags' | Compiler options               |
| 'addLinkFlags'    | Link options                   |
| 'addDefines'      | Preprocessor macro definitions |

The function adds the options to the end of an option vector.

Example: `coder.updateBuildInfo('addCompileFlags','-Zi -Wall')`

### group — Group name

character vector | string scalar

Name of user-defined group, specified as a character vector or string scalar. The value must be a compile-time constant.

The group option assigns a group name to the parameters in the second argument.

| Leading Argument   | Second Argument | Parameters Named by group                |
|--------------------|-----------------|------------------------------------------|
| 'addCompileFlags'  | options         | Compiler options                         |
| 'addLinkFlags'     | options         | Link options                             |
| 'addLinkObjects'   | filename        | Name of file containing linkable objects |
| 'addNonBuildFiles' | filename        | Name of nonbuild-related file            |
| 'addSourceFiles'   | filename        | Name of source file                      |
| 'addSourcePaths'   | path            | Name of source file path                 |

You can use `group` to:

- Document the use of specific parameters.
- Retrieve or apply multiple parameters together as one group.

### filename — File name

character vector | string scalar

File name, specified as a character vector or string scalar. The value must be a compile-time constant.

Depending on the leading argument, `filename` specifies the relevant file to be added to the project's build information.

| Leading Argument   | File Specified by filename       |
|--------------------|----------------------------------|
| 'addLinkObjects'   | File containing linkable objects |
| 'addNonBuildFiles' | Nonbuild-related file            |
| 'addSourceFiles'   | Source file                      |

The function adds the file name to the end of a file name vector.

Example: `coder.updateBuildInfo('addSourceFiles', 'fact.c')`

### path — Path name

character vector | string scalar

Relative path name, specified as a character vector or string scalar. The value must be a compile-time constant.

Depending on the leading argument, `path` specifies the relevant path name to be added to the project's build information. The function adds the path to the end of a path name vector.

| Leading Argument                   | Path Specified by path         |
|------------------------------------|--------------------------------|
| 'addLinkObjects'                   | Path to linkable objects       |
| 'addNonBuildFiles'                 | Path to nonbuild-related files |
| 'addSourceFiles', 'addSourcePaths' | Path to source files           |

The relative path starts from the *current working folder* in which you generate code. In the relative path name, reference the current working folder by using the `START_DIR` macro. For example, suppose that your source file `fact.c` is contained in `C:\myCode\mySrcDir`, and you generate code from `C:\myCode`. Write the path as in this example:

Example: `coder.updateBuildInfo('addSourceFiles', 'fact.c', '$(START_DIR)\mySrcDir')`

---

**Note** The `START_DIR` macro is only supported for generating code with MATLAB Coder.

---

### priority — Relative priority of link object

''

Priority of link objects.

This feature applies only when several link objects are added. Currently, only a single link object file can be added for every `coder.updateBuildInfo` statement. Therefore, this feature is not available for use.

To use the succeeding arguments, include '' as a placeholder argument.

### precompiled — Variable indicating if link objects are precompiled

logical value

Variable indicating if the link objects are precompiled, specified as a logical value. The value must be a compile-time constant.

If the link object has been prebuilt for faster compiling and linking and exists in a specified location, specify `true`. Otherwise, the MATLAB Coder build process creates the link object in the build folder.

If `linkonly` is set to `true`, this argument is ignored.

Data Types: `logical`

### **linkonly** — Variable indicating if objects must be used for linking only

logical value

Variable indicating if objects must be used for linking only, specified as a logical value. The value must be a compile-time constant.

If you want that the MATLAB Coder build process must not build or generate rules in the makefile for building the specified link object, specify `true`. Instead, when linking the final executable, the process should just include the object. Otherwise, rules for building the link object are added to the makefile.

You can use this argument to incorporate link objects for which source files are not available.

If `linkonly` is set to `true`, the value of `precompiled` is ignored.

Data Types: `logical`

## **Extended Capabilities**

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## **See Also**

`coder.ref` | `coder.rref` | `coder.wref` | `coder.target` | `codegen` | `coder.ceval` | `coder.cinclude` | `coder.ExternalDependency`

### **Topics**

“Build Process Customization”

“Call Custom C/C++ Code from the Generated Code”

“Configure Build for External C/C++ Code”

“Configure Build Settings”

### **Introduced in R2013b**

## coder.versize

**Package:** coder

Declare variable-size data

### Syntax

```
coder.versize(varName1,...,varNameN)
coder.versize(varName1,...,varNameN,ubounds)
coder.versize(varName1,...,varNameN,ubounds,dims)
```

### Description

`coder.versize(varName1,...,varNameN)` declares that the variables named `varName1,...,varNameN` have a variable size. The declaration instructs the code generator to allow the variables to change size during execution of the generated code. With this syntax, you do not specify the upper bounds of the dimensions of the variables or which dimensions can change size. The code generator computes the upper bounds. All dimensions, except singleton dimensions on page 2-237, are allowed to change size.

Use `coder.versize` according to these restrictions and guidelines:

- Use `coder.versize` inside a MATLAB function intended for code generation.
- The `coder.versize` declaration must precede the first use of a variable. For example:

```
...
x = 1;
coder.versize('x');
disp(size(x));
...
```

- Use `coder.versize` to declare that an output argument has a variable size or to address size mismatch errors. Otherwise, to define variable-size data, use the methods described in “Define Variable-Size Data for Code Generation”.

---

**Note** For MATLAB Function blocks, to declare variable-size output variables, use the **Symbols** pane and Property Inspector. See “Declare Variable-Size Outputs” (Simulink). If you provide upper bounds in a `coder.versize` declaration, the upper bounds must match the upper bounds in the Property Inspector.

---

For more restrictions and guidelines, see “Limitations” on page 2-235 and “Tips” on page 2-237.

`coder.versize(varName1,...,varNameN,ubounds)` also specifies an upper bound for each dimension of the variables. All variables must have the same number of dimensions. All dimensions, except singleton dimensions on page 2-237, are allowed to change size.

`coder.versize(varName1,...,varNameN,ubounds,dims)` also specifies an upper bound for each dimension of the variables and whether each dimension has a fixed size or a variable size. If a dimension has a fixed size, then the corresponding `ubound` element specifies the fixed size of the dimension. All variables have the same fixed-size dimensions and the same variable-size dimensions.

## Examples

### Address Size Mismatch Error by Using `coder.varsize`

After a variable is used (read), changing the size of the variable can cause a size mismatch error. Use `coder.varsize` to specify that the size of the variable can change.

Code generation for the following function produces a size mismatch error because `x = 1:10` changes the size of the second dimension of `x` after the line `y = size(x)` that uses `x`.

```
function [x,y] = usevarsize(n)
%#codegen
x = 1;
y = size(x);
if n > 10
 x = 1:10;
end
```

To declare that `x` can change size, use `coder.varsize`.

```
function [x,y] = usevarsize(n)
%#codegen
x = 1;
coder.varsize('x');
y = size(x);
if n > 10
 x = 1:10;
end
```

If you remove the line `y = size(x)`, you no longer need the `coder.varsize` declaration because `x` is not used before its size changes.

### Declare Variable-Size Array with Upper Bounds

Specify that `A` is a row vector whose second dimension has a variable size with an upper bound of 20.

```
function fcn()
...
coder.varsize('A',[1 20]);
...
end
```

When you do not provide `dims`, all dimensions, except singleton dimensions, have a variable size.

### Declare Variable-Size Array with a Mix of Fixed and Variable Dimensions

Specify that `A` is an array whose first dimension has a fixed size of three and whose second dimension has a variable size with an upper bound of 20.

```
function fcn()
...
coder.varsize('A',[3 20], [0 1]);
```

```
...
end
```

### Declare Variable-Size Structure Fields

In this function, the statement `coder. varsize('data.values')` declares that the field values inside each element of `data` has a variable size.

```
function y = varsize_field()
%#codegen

d = struct('values', zeros(1,0), 'color', 0);
data = repmat(d, [3 3]);
coder. varsize('data.values');

for i = 1:numel(data)
 data(i).color = rand-0.5;
 data(i).values = 1:i;
end

y = 0;
for i = 1:numel(data)
 if data(i).color > 0
 y = y + sum(data(i).values);
 end
end
```

### Declare Variable-Size Cell Array

Specify that cell array `C` has a fixed-size first dimension and variable-size second dimension with an upper bound of three. The `coder. varsize` declaration must precede the first use of `C`.

```
...
C = {1 [1 2]};
coder. varsize('C', [1 3], [0 1]);
y = C{1};
...
end
```

Without the `coder. varsize` declaration, `C` is a heterogeneous cell array whose elements have the same class and different sizes. With the `coder. varsize` declaration, `C` is a homogeneous cell array whose elements have the same class and maximum size. The first dimension of each element is fixed at 1. The second dimension of each element has a variable size with an upper bound of 3.

### Declare That a Cell Array Has Variable-Size Elements

Specify that the elements of cell array `C` are vectors with a fixed-size first dimension and variable-size second dimension with an upper bound of 5.

```
...
C = {1 2 3};
coder. varsize('C{:}', [1 5], [0 1]);
```

```
C = {1, 1:5, 2:3};
...
```

## Input Arguments

**varName1, ..., varNameN** — Names of variables to declare as having a variable size  
character vectors | string scalars

Names of variables to declare as having a variable size, specified as one or more character vectors or string scalars.

Example: `coder.varsize('x','y')`

**ubounds** — Upper bounds for array dimensions  
[] (default) | vector of integer constants

Upper bounds for array dimensions, specified as a vector of integer constants.

When you do not specify `ubounds`, the code generator computes the upper bound for each variable. If the `ubounds` element corresponds to a fixed-size dimension, the value is the fixed size of the dimension.

Example: `coder.varsize('x','y',[1 2])`

**dims** — Indication of whether each dimension has a fixed size or a variable size  
logical vector

Indication of whether each dimension has a fixed size or a variable size, specified as a logical vector. Dimensions that correspond to 0 or `false` in `dims` have a fixed size. Dimensions that correspond to 1 or `true` have a variable size.

When you do not specify `dims`, the dimensions have a variable size, except for the singleton dimensions.

Example: `coder.varsize('x','y',[1 2], [0 1])`

## Limitations

- The `coder.varsize` declaration instructs the code generator to allow the size of a variable to change. It does not change the size of the variable. Consider this code:

```
...
x = 7;
coder.varsize('x', [1,5]);
disp(size(x));
...
```

After the `coder.varsize` declaration, `x` is still a 1-by-1 array. You cannot assign a value to an element beyond the current size of `x`. For example, this code produces a run-time error because the index 3 exceeds the dimensions of `x`.

```
...
x = 7;
coder.varsize('x', [1,5]);
x(3) = 1;
...
```

- `coder.versize` is not supported for a function input argument. Instead:
  - If the function is an entry-point function, specify that an input argument has a variable size by using `coder.typeof` at the command line. Alternatively, specify that an entry-point function input argument has a variable size by using the **Define Input Types** step of the app.
  - If the function is not an entry-point function, use `coder.versize` in the calling function with the variable that is the input to the called function.
- For sparse matrices, `coder.versize` drops upper bounds for variable-size dimensions.
- Limitations for using `coder.versize` with cell arrays:
  - A cell array can have a variable size only if it is homogeneous. When you use `coder.versize` with a heterogeneous cell array, the code generator tries to make the cell array homogeneous. The code generator tries to find a class and maximum size that apply to all elements of the cell array. For example, consider the cell array `c = {1, [2 3]}`. Both elements can be represented by a double type whose first dimension has a fixed size of 1 and whose second dimension has a variable size with an upper bound of 2. If the code generator cannot find a common class and a maximum size, code generation fails. For example, consider the cell array `c = {'a', [2 3]}`. The code generator cannot find a class that can represent both elements because the first element is `char` and the second element is `double`.
  - If you use the `cell` function to define a fixed-size cell array, you cannot use `coder.versize` to specify that the cell array has a variable size. For example, this code causes a code generation error because `x = cell(1,3)` makes `x` a fixed-size,1-by-3 cell array.

```
...
x = cell(1,3);
coder.versize('x',[1 5])
...
```

You can use `coder.versize` with a cell array that you define by using curly braces. For example:

```
...
x = {1 2 3};
coder.versize('x',[1 5])
...
```

- To create a variable-size cell array by using the `cell` function, use this code pattern:

```
function mycell(n)
%#codegen
x = cell(1,n);
for i = 1:n
 x{i} = i;
end
end
```

See “Definition of Variable-Size Cell Array by Using `cell`”.

To specify upper bounds for the cell array, use `coder.versize`.

```
function mycell(n)
%#codegen
x = cell(1,n);
for i = 1:n
 x{i} = i;
coder.versize('x',[1,20]);
end
end
```



```
end
end
```

- `coder.versize` is not supported for:
  - Global variables
  - MATLAB classes or class properties
  - String scalars

## More About

### Singleton Dimension

Dimension for which `size(A,dim) = 1`.

### Tips

- In a code generation report or a MATLAB Function report, a colon (:) indicates that a dimension has a variable size. For example, a size of `1x:2` indicates that the first dimension has a fixed size of one and the second dimension has a variable size with an upper bound of two.
- If you use `coder.versize` to specify that the upper bound of a dimension is 1, by default, the dimension has a fixed size of 1. To specify that the dimension can be 0 (empty array) or 1, set the corresponding element of the `dims` argument to `true`. For example, this code specifies that the first dimension of `x` has a fixed size of 1 and the other dimensions have a variable size of 5.

```
coder.versize('x',[1,5,5])
```

In contrast, this code specifies that the first dimension of `x` has an upper bound of 1 and has a variable size (can be 0 or 1).

```
coder.versize('x',[1,5,5],[1,1,1])
```

---

**Note** For a MATLAB Function block, you cannot specify that an output signal with size 1 has a variable size.

---

- If you use input variables or the result of a computation using input variables to specify the size of an array, it is declared as variable-size in the generated code. Do not re-use `coder.versize` on the array, unless you also want to specify an upper bound for its size.
- If you do not specify upper bounds with a `coder.versize` declaration and the code generator is unable to determine the upper bounds, the generated code uses dynamic memory allocation. Dynamic memory allocation can reduce the speed of generated code. To avoid dynamic memory allocation, specify the upper bounds by providing the `ubounds` argument.

## See Also

`coder.typeof`

### Topics

“Code Generation for Variable-Size Arrays”

“Incompatibilities with MATLAB in Variable-Size Support for Code Generation”

“Avoid Duplicate Functions in Generated Code”

**Introduced in R2011a**

## coder.wref

Indicate write-only data to pass by reference

### Syntax

```
coder.wref(arg)
```

### Description

`coder.wref(arg)` indicates that `arg` is a write-only expression or variable to pass by reference to an external C/C++ function. Use `coder.wref` only inside a `coder.ceval` call. This function enables the code generator to optimize the generated code by ignoring prior assignments to `arg` in your MATLAB code, because the external function is assumed to not read from the data. Write to all the elements of `arg` in your external code to fully initialize the memory.

---

**Note** The C/C++ function must fully initialize the memory referenced by `coder.wref(arg)`. Initialize the memory by assigning values to every element of `arg` in your C/C++ code. If the generated code tries to read from uninitialized memory, it can cause undefined run-time behavior.

---

See also `coder.ref` and `coder.rref`.

### Examples

#### Pass Array by Reference as Write-Only

Suppose that you have a C function `init_array`.

```
void init_array(double* array, int numel) {
 for(int i = 0; i < numel; i++) {
 array[i] = 42;
 }
}
```

The C function defines the input variable `array` as a pointer to a double.

Call the C function `init_array` to initialize all elements of `y` to 42:

```
...
Y = zeros(5, 10);
coder.ceval('init_array', coder.wref(Y), int32(numel(Y)));
...
```

#### Pass Multiple Arguments as a Write-Only Reference

```
...
U = zeros(5, 10);
V = zeros(5, 10);
coder.ceval('my_fcn', coder.wref(U), int32(numel(U)), coder.wref(V), int32(numel(V)));
...
```

**Pass Class Property as a Write-Only Reference**

```

...
x = myClass;
x.prop = 1;
coder.ceval('foo', coder.wref(x.prop));
...

```

**Pass Structure as a Write-Only Reference**

To indicate that the structure type is defined in a C header file, use `coder.cstructname`.

Suppose that you have the C function `init_struct`. This function writes to the input argument but does not read from it.

```

#include "MyStruct.h"

void init_struct(struct MyStruct *my_struct)
{
 my_struct->f1 = 1;
 my_struct->f2 = 2;
}

```

The C header file, `MyStruct.h`, defines a structure type named `MyStruct`:

```

#ifndef MYSTRUCT
#define MYSTRUCT

typedef struct MyStruct
{
 double f1;
 double f2;
} MyStruct;

void init_struct(struct MyStruct *my_struct);

#endif

```

In your MATLAB function, pass a structure as a write-only reference to `init_struct`. Use `coder.cstructname` to indicate that the structure type for `s` has the name `MyStruct` that is defined in the C header file `MyStruct.h`.

```

function y = foo
%#codegen
y = 0;
coder.updateBuildInfo('addSourceFiles','init_struct.c');

s = struct('f1',1,'f2',2);
coder.cstructname(s,'MyStruct','extern','HeaderFile','MyStruct.h');
coder.ceval('init_struct', coder.wref(s));

```

To generate standalone library code, enter:

```
codegen -config:lib foo -report
```

**Pass Structure Field as a Write-Only Reference**

```

...
s = struct('s1', struct('a', [0 1]));

```

```
coder.ceval('foo', coder.wref(s.s1.a));
...
```

You can also pass an element of an array of structures:

```
...
c = repmat(struct('u',magic(2)),1,10);
b = repmat(struct('c',c),3,6);
a = struct('b',b);
coder.ceval('foo', coder.wref(a.b(3,4).c(2).u));
...
```

## Input Arguments

### arg — Argument to pass by reference

scalar variable | array | element of an array | structure | structure field | object property

Argument to pass by reference to an external C/C++ function. The argument cannot be a class, a System object, a cell array, or an index into a cell array.

Data Types: single | double | int8 | int16 | int32 | int64 | uint8 | uint16 | uint32 | uint64 | logical | char | struct

Complex Number Support: Yes

## Limitations

- You cannot pass these data types by reference:
  - Class or System object
  - Cell array or index into a cell array
- If a property has a get method, a set method, or validators, or is a System object property with certain attributes, then you cannot pass the property by reference to an external function. See “Passing By Reference Not Supported for Some Properties”.

## Tips

- If `arg` is an array, then `coder.wref(arg)` provides the address of the first element of the array. The `coder.wref(arg)` function does not contain information about the size of the array. If the C function must know the number of elements of your data, pass that information as a separate argument. For example:

```
coder.ceval('myFun',coder.wref(arg),int32(numel(arg)));
```

- When you pass a structure by reference to an external C/C++ function, use `coder.cstructname` to provide the name of a C structure type that is defined in a C header file.
- In MATLAB, `coder.wref` results in an error. To parametrize your MATLAB code so that it can run in MATLAB and in generated code, use `coder.target`.
- You can use `coder.opaque` to declare variables that you pass to and from an external C/C++ function.

## **Extended Capabilities**

### **C/C++ Code Generation**

Generate C and C++ code using MATLAB® Coder™.

### **GPU Code Generation**

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

## **See Also**

`coder.ref` | `coder.rref` | `coder.ceval` | `coder.opaque` | `coder.cstructname`

### **Topics**

“Call Custom C/C++ Code from the Generated Code”

**Introduced in R2011a**

# parfor

Parallel for-loop

## Syntax

```
parfor LoopVar = InitVal:EndVal; Statements; end
parfor (LoopVar = InitVal:EndVal, NumThreads); Statements; end
```

## Description

`parfor LoopVar = InitVal:EndVal; Statements; end` creates a loop in a generated MEX function or in C/C++ code that runs in parallel on shared-memory multicore platforms.

The `parfor`-loop executes the `Statements` for values of `LoopVar` between `InitVal` and `EndVal`. `LoopVar` specifies a vector of integer values increasing by 1.

`parfor (LoopVar = InitVal:EndVal, NumThreads); Statements; end` uses a maximum of `NumThreads` threads when creating a parallel for-loop.

## Examples

### Generate MEX for parfor

Generate a MEX function for a `parfor`-loop to execute on the maximum number of cores available.

Write a MATLAB function, `test_parfor`, that calls the fast Fourier transform function, `fft`, in a `parfor`-loop. Because the loop iterations run in parallel, this evaluation can be completed much faster than an analogous `for`-loop.

```
function a = test_parfor %#codegen
 a = ones(10,256);
 r = rand(10,256);
 parfor i = 1:10
 a(i,:) = real(fft(r(i)));
 end
end
```

Generate a MEX function for `test_parfor`. At the MATLAB command line, enter:

```
codegen test_parfor
```

`codegen` generates a MEX function, `test_parfor_mex`, in the current folder.

Run the MEX function. At the MATLAB command line, enter:

```
test_parfor_mex
```

The MEX function runs using the available cores.

### Specify Maximum Number of Threads for parfor

Specify the maximum number of threads when generating a MEX function for a parfor-loop.

Write a MATLAB function, `specify_num_threads`, that uses input, `u`, to specify the maximum number of threads in the parfor-loop.

```
function y = specify_num_threads(u) %#codegen
 y = ones(1,100);
 % u specifies maximum number of threads
 parfor (i = 1:100,u)
 y(i) = i;
 end
end
```

Generate a MEX function for `specify_num_threads`. Use `-args 0` to specify the type of the input. At the MATLAB command line, enter:

```
% -args 0 specifies that input u is a scalar double
% u is typecast to an integer by the code generator
codegen -report specify_num_threads -args 0
```

codegen generates a MEX function, `specify_num_threads_mex`, in the current folder.

Run the MEX function, specifying that it run in parallel on at most four threads. At the MATLAB command line, enter:

```
specify_num_threads_mex(4)
```

The generated MEX function runs on up to four cores. If fewer than four cores are available, the MEX function runs on the maximum number of cores available at the time of the call.

### Generate MEX for parfor Without Parallelization

Disable parallelization before generating a MEX function for a parfor-loop.

Write a MATLAB function, `test_parfor`, that calls the fast Fourier transform function, `fft`, in a parfor-loop.

```
function a = test_parfor %#codegen
 a = ones(10,256);
 r = rand(10,256);
 parfor i = 1:10
 a(i,:) = real(fft(r(i)));
 end
end
```

Generate a MEX function for `test_parfor`. Disable the use of OpenMP so that codegen does not generate a MEX function that can run on multiple threads.

```
codegen -0 disable:OpenMP test_parfor
```

codegen generates a MEX function, `test_parfor_mex`, in the current folder.

Run the MEX function.



```
test_parfor_mex
```

The MEX function runs on a single thread.

If you disable parallelization, MATLAB Coder treats `parfor`-loops as `for`-loops. The software generates a MEX function that runs on a single thread. Disable parallelization to compare performance of the serial and parallel versions of the generated MEX function or C/C++ code. You can also disable parallelization to debug issues with the parallel version.

## Input Arguments

### LoopVar — Loop index

integer

Loop index variable whose initial value is `InitVal` and final value is `EndVal`.

### InitVal — Initial value of loop index

integer

Initial value for loop index variable, `LoopVar`. With `EndVal`, specifies the `parfor` range vector, which must be of the form `M:N`.

### EndVal — Final value of loop index

integer

Final value for loop index variable, `LoopVar`. With `InitVal`, specifies the `parfor` range vector, which must be of the form `M:N`.

### Statements — Loop body

text

The series of MATLAB commands to execute in the `parfor`-loop.

If you put more than one statement on the same line, separate the statements with semicolons. For example:

```
parfor i = 1:10
 arr(i) = rand(); arr(i) = 2*arr(i)-1;
end
```

### NumThreads — Maximum number of threads running in parallel

number of available cores (default) | nonnegative integer

Maximum number of threads to use. If you specify the upper limit, MATLAB Coder uses no more than this number, even if additional cores are available. If you request more threads than the number of available cores, MATLAB Coder uses the maximum number of cores available at the time of the call. If the loop iterations are fewer than the threads, some threads perform no work.

If the `parfor`-loop cannot run on multiple threads (for example, if only one core is available or `NumThreads` is 0), MATLAB Coder executes the loop in a serial manner.

## Limitations

- You must use a compiler that supports the Open Multiprocessing (OpenMP) application interface. See [https://www.mathworks.com/support/compilers/current\\_release/](https://www.mathworks.com/support/compilers/current_release/). If you use a

compiler that does not support OpenMP, MATLAB Coder treats the `parfor`-loops as `for`-loops. In the generated MEX function or C/C++ code, the loop iterations run on a single thread.

- The OpenMP application interface is not compatible with JIT MEX compilation. See “JIT Compilation Does Not Support OpenMP”.
- Do not use the following constructs inside `parfor`-loops:
  - You cannot call extrinsic functions using `coder.extrinsic` in the body of a `parfor`-loop.
  - You cannot write to a global variable inside a `parfor`-loop.
  - MATLAB Coder does not support the use of `coder.ceval` in reductions. For example, you cannot generate code for the following `parfor`-loop:

```
parfor i = 1:4
 y = coder.ceval('myCFcn',y,i);
end
```

Instead, write a local function that calls the C code using `coder.ceval` and call this function in the `parfor`-loop. For example:

```
parfor i = 1:4
 y = callMyCFcn(y,i);
end
function y = callMyCFcn(y,i)
 y = coder.ceval('mCyFcn', y , i);
end
```

- You cannot use `varargin` or `varargout` in `parfor`-loops.
- The type of the loop index must be representable by an integer type on the target hardware. Use a type that does not require a multiword type in the generated code.
- `parfor` for standalone code generation requires the toolchain approach for building executables or libraries. Do not change settings that cause the code generator to use the template makefile approach. See “Project or Configuration Is Using the Template Makefile”.
- To use `parfor` in your MATLAB code, you require a Parallel Computing Toolbox™ license.

For a comprehensive list of restrictions, see “`parfor` Restrictions”.

## Tips

- Use a `parfor`-loop when:
  - You need many loop iterations of a simple calculation. `parfor` divides the loop iterations into groups so that each thread can execute one group of iterations.
  - You have loop iterations that take a long time to execute.
- Do not use a `parfor`-loop when an iteration in your loop depends on the results of other iterations.

Reductions are one exception to this rule. A reduction variable accumulates a value that depends on all the iterations together, but is independent of the iteration order.

- The input argument `NumThreads` sets the OpenMP `num_threads()` clause in the generated code. OpenMP also supports globally limiting the number of threads in C/C++ by setting the environment variable `OMP_NUM_THREADS` or by using `omp_set_num_threads()`. For more information, see the openMP specifications. <https://www.openmp.org/specifications/>

## See Also

### Functions

codegen

### Topics

“Generate Code with Parallel for-Loops (parfor)”

“Algorithm Acceleration Using Parallel for-Loops (parfor)”

“Control Compilation of parfor-Loops”

“When to Use parfor-Loops”

“When Not to Use parfor-Loops”

“Classification of Variables in parfor-Loops”

“Automatically Parallelize for Loops in Generated Code”

### Introduced in R2012b

## addOption

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Add new option

### Syntax

```
h.addOption(OptionName, buildItemHandle)
```

### Description

`h.addOption(OptionName, buildItemHandle)` adds an option to `coder.make.BuildConfiguration.Options`.

### Tips

Before using `addOption`, create a `coder.make.BuildItem` object to use as the second argument.

### Input Arguments

#### **h — BuildConfiguration handle**

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: `h`

#### **OptionName — Name of option**

new option name

Name of option, specified as a character vector. Choose a new option name.

Example: `'faster2'`

Data Types: `char`

#### **buildItemHandle — BuildItem handle**

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

### Examples

#### **Using the Option-related methods interactively**

```
tc = coder.make.ToolchainInfo;
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.isOption('X Compiler')
```

```
ans =
 0
bi = coder.make.BuildItem('WV','wrongvalue')
bi =
 Macro : WV
 Value : wrongvalue
cfg.addOption('X Compiler',bi);
value = cfg.getOption('X Compiler')
value =
 Macro : WV
 Value : wrongvalue
cfg.setOption('X Compiler','rightvalue');
value = cfg.getOption('X Compiler')
value =
 Macro : WV
 Value : rightvalue
```

## See Also

[getOption](#) | [isOption](#) | [setOption](#) | [coder.make.BuildItem](#)

## getOption

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Get value of option

### Syntax

```
OptionValue = h.getOption(OptionName)
```

### Description

`OptionValue = h.getOption(OptionName)` returns the value and optional macro name of a build configuration option.

### Input Arguments

**h — BuildConfiguration handle**

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: `h`

**OptionName — Name of option**

new option name

Name of option, specified as a character vector. Choose a new option name.

Example: `'faster2'`

Data Types: `char`

### Output Arguments

**OptionValue — Value of option**

`coder.make.BuildItem` object

Value of the option, returned as a `coder.make.BuildItem` object that contains a value and an optional macro name.

### Examples

**Using the Option-related methods interactively**

```
tc = coder.make.ToolchainInfo;
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.isOption('X Compiler')
```

```
ans =
 0
bi = coder.make.BuildItem('WV','wrongvalue')
bi =
 Macro : WV
 Value : wrongvalue
cfg.addOption('X Compiler',bi);
value = cfg.getOption('X Compiler')
value =
 Macro : WV
 Value : wrongvalue
cfg.setOption('X Compiler','rightvalue');
value = cfg.getOption('X Compiler')
value =
 Macro : WV
 Value : rightvalue
```

## See Also

[addOption](#) | [isOption](#) | [setOption](#)

## info

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Get information about build configuration

### Syntax

```
h.info
OutputInfo = h.info
```

### Description

`h.info` displays information about the `coder.make.BuildConfiguration` object in the MATLAB Command Window.

`OutputInfo = h.info` returns information about the `coder.make.BuildConfiguration` object

### Input Arguments

**h — BuildConfiguration handle**

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: `h`

### Output Arguments

**OutputInfo — Build configuration information**

character vector

Build configuration information, returned as a character vector.

### Examples

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to display information about the `BuildConfiguration` property:

```
tc = intel_tc
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.info

#####
Build Configuration : Faster Builds
Description : Default settings for faster compile/link of code
#####
ARFLAGS = /nologo
CFLAGS = $(cflags) $(CVARSFLAG) $(CFLAGS_ADDITIONAL) /c /Od
CPPFLAGS = $(cflags) $(CVARSFLAG) $(CPPFLAGS_ADDITIONAL) /c /Od
DOWNLOAD_FLAGS =
EXECUTE_FLAGS =
```



---

```
LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN)
MEX_CFLAGS =
MEX_LDFLAGS =
MAKE_FLAGS = -f $(MAKEFILE)
SHAREDLIB_LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) -dll -def:$(DEF_FILE)
```

## isOption

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Determine if option exists

### Syntax

```
OutputValue = isOption(OptionName)
```

### Description

`OutputValue = isOption(OptionName)` returns '1' (true) if the specified option exists. Otherwise, it returns '0' (false).

### Input Arguments

**h — BuildConfiguration handle**

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: h

**OptionName — Name of option**

new option name

Name of option, specified as a character vector. Choose a new option name.

Example: 'faster2'

Data Types: char

### Output Arguments

**OutputValue — Option exists**

0 | 1

Option exists, returned as a logical value. If the option exists, the value is '1' (true). Otherwise, the output is '0' (false).

### Examples

**Using the Option-related methods interactively**

```
tc = coder.make.ToolchainInfo;
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.isOption('X Compiler')
```

```
ans =
 0
bi = coder.make.BuildItem('WV','wrongvalue')
bi =
 Macro : WV
 Value : wrongvalue
cfg.addOption('X Compiler',bi);
value = cfg.getOption('X Compiler')
value =
 Macro : WV
 Value : wrongvalue
cfg.setOption('X Compiler','rightvalue');
value = cfg.getOption('X Compiler')
value =
 Macro : WV
 Value : rightvalue
```

## See Also

[addOption](#) | [getOption](#) | [setOption](#) | [coder.make.BuildItem](#)

## keys

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Get all option names

### Syntax

```
Out = h.keys
```

### Description

`Out = h.keys` returns a list of all option names or keys in the build configuration.

### Input Arguments

**h — BuildConfiguration handle**

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: `h`

### Output Arguments

**Output — List of all option names or keys in build configuration**

cell array of character vectors

List of all option names or keys in build configuration, returned as a cell array of character vectors.

### Examples

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to display keys from the `BuildConfiguration` property:

```
tc = intel_tc
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.keys
```

# setOption

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Set value of option

## Syntax

```
h.setOption(OptionName, OptionValue)
```

## Description

`h.setOption(OptionName, OptionValue)` updates the values within a `coder.make.BuildConfiguration` object.

## Input Arguments

### **h** — BuildConfiguration handle

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: `h`

### **OptionName** — Name of option

new option name

Name of option, specified as a character vector. Choose a new option name.

Example: `'faster2'`

Data Types: `char`

### **OptionValue** — Value of option

character vector or object handle

Value of option, specified as a character vector, or as the handle of a `coder.make.BuildItem` object that contains an option value.

Example: `linkerOpts`

## Examples

### The setOption method in intel\_tc

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, gets a default `BuildConfiguration` object and then uses `setOption` to update the values in that object:

```
% -----
% BUILD CONFIGURATIONS
% -----

optimsoffOpts = {'/c /Od'};
```

```

optimsOn0pts = {'/c /O2'};
cCompiler0pts = '$(cflags) $(CVARSFLAG) $(CFLAGS_ADDITIONAL)';
cppCompiler0pts = '$(cflags) $(CVARSFLAG) $(CPPFLAGS_ADDITIONAL)';
linker0pts = {'$(ldebug) $(conflags) $(LIBS_TOOLCHAIN)'};
sharedLinker0pts = horzcat(linker0pts, '-dll -def:$(DEF_FILE)');
archiver0pts = {'/nologo'};

% Get the debug flag per build tool
debugFlag.CCompiler = '$(CDEBUG)';
debugFlag.CppCompiler = '$(CPPDEBUG)';
debugFlag.Linker = '$(LDDEBUG)';
debugFlag.Archiver = '$(ARDEBUG)';

cfg = tc.getBuildConfiguration('Faster Builds');
cfg.setOption('C Compiler', horzcat(cCompiler0pts, optimsOff0pts));
cfg.setOption('C++ Compiler', horzcat(cppCompiler0pts, optimsOff0pts));
cfg.setOption('Linker', linker0pts);
cfg.setOption('Shared Library Linker', sharedLinker0pts);
cfg.setOption('Archiver', archiver0pts);

cfg = tc.getBuildConfiguration('Faster Runs');
cfg.setOption('C Compiler', horzcat(cCompiler0pts, optimsOn0pts));
cfg.setOption('C++ Compiler', horzcat(cppCompiler0pts, optimsOn0pts));
cfg.setOption('Linker', linker0pts);
cfg.setOption('Shared Library Linker', sharedLinker0pts);
cfg.setOption('Archiver', archiver0pts);

cfg = tc.getBuildConfiguration('Debug');
cfg.setOption('C Compiler', horzcat(cCompiler0pts, optimsOff0pts, debugFlag.CCompiler));
cfg.setOption('C++ Compiler', horzcat(cppCompiler0pts, optimsOff0pts, debugFlag.CppCompiler));
cfg.setOption('Linker', horzcat(linker0pts, debugFlag.Linker));
cfg.setOption('Shared Library Linker', horzcat(sharedLinker0pts, debugFlag.Linker));
cfg.setOption('Archiver', horzcat(archiver0pts, debugFlag.Archiver));

tc.setBuildConfigurationOption('all', 'Make Tool', '-f $(MAKEFILE)');

```

## Using the Option-related methods interactively

```

tc = coder.make.ToolchainInfo;
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.isOption('X Compiler')

```

```
ans =
```

```
0
```

```
bi = coder.make.BuildItem('WV', 'wrongvalue')
```

```
bi =
```

```
Macro : WV
Value : wrongvalue
```

```
cfg.addOption('X Compiler', bi);
value = cfg.getOption('X Compiler')
```

```
value =
```

```
Macro : WV
Value : wrongvalue
```

```
cfg.setOption('X Compiler', 'rightvalue');
value = cfg.getOption('X Compiler')
```

```
value =
```

```
Macro : WV
Value : rightvalue
```

**See Also**

`addOption` | `getOption` | `isOption` | `coder.make.BuildItem`

**Topics**

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)

## values

**Class:** `coder.make.BuildConfiguration`

**Package:** `coder.make`

Get all option values

### Syntax

```
Out = h.values
```

### Description

`Out = h.values` returns a list of all option values in the build configuration.

### Input Arguments

**h — BuildConfiguration handle**

object handle

BuildConfiguration handle, specified as a `coder.make.BuildConfiguration` object.

Example: `h`

### Output Arguments

**Out — List of all option values in build configuration**

character vector or object handle

List of all option values in the build configuration, returned as a cell array of character vectors.

### Examples

Starting from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example, enter the following lines:

```
tc = intel_tc
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.values
```

```
ans =
```

```
Columns 1 through 2
```

```
 [1x1 coder.make.BuildItem] [1x1 coder.make.BuildItem]
```

```
Columns 3 through 4
```

```
 [1x1 coder.make.BuildItem] [1x1 coder.make.BuildItem]
```

```
Columns 5 through 6
```



[1x1 coder.make.BuildItem] [1x1 coder.make.BuildItem]

Columns 7 through 8

[1x1 coder.make.BuildItem] [1x1 coder.make.BuildItem]

Columns 9 through 10

[1x1 coder.make.BuildItem] [1x1 coder.make.BuildItem]

## getMacro

**Class:** `coder.make.BuildItem`

**Package:** `coder.make`

Get macro name of build item

### Syntax

```
h.getMacro
```

### Description

`h.getMacro` returns the macro name of an existing build item.

### Input Arguments

**buildItemHandle** — BuildItem handle

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

### Examples

```
bi = coder.make.BuildItem('bldtmvalue')
```

```
bi =
```

```
Macro : (empty)
Value : bldtmvalue
```

```
bi.setMacro('BIMV2');
bi.getMacro
```

```
ans =
```

```
BIMV2
```

### See Also

`getMacro` | `getValue` | `setMacro` | `setValue`

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

# getValue

**Class:** `coder.make.BuildItem`

**Package:** `coder.make`

Get value of build item

## Syntax

```
h.getValue
```

## Description

`h.getValue` returns the value of an existing build item.

## Input Arguments

**buildItemHandle** — BuildItem handle

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

## Examples

```
bi = coder.make.BuildItem('wrongvalue')
```

```
bi =
```

```
Macro : (empty)
Value : wrongvalue
```

```
bi.setValue('rightvalue')
```

```
bi.getValue
```

```
ans =
```

```
rightvalue
```

## See Also

`getMacro` | `getValue` | `setMacro` | `setValue`

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

## setMacro

**Class:** `coder.make.BuildItem`

**Package:** `coder.make`

Set macro name of build item

### Syntax

```
h.setMacro(blditm_macroname)
```

### Description

`h.setMacro(blditm_macroname)` sets the macro name of an existing build item.

### Input Arguments

**buildItemHandle — BuildItem handle**

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

**blditm\_macroname — Macro name of build item**

character vector

Macro name of build item, specified as a character vector.

Data Types: `char`

### Examples

```
bi = coder.make.BuildItem('bldtmvalue')
```

```
bi =
```

```
Macro : (empty)
Value : bldtmvalue
```

```
bi.setMacro('BIMV2');
bi.getMacro
```

```
ans =
```

```
BIMV2
```

### See Also

[getMacro](#) | [getValue](#) | [setMacro](#) | [setValue](#)

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## setValue

**Class:** `coder.make.BuildItem`

**Package:** `coder.make`

Set value of build item

### Syntax

```
h.setValue(blditm_value)
```

### Description

`h.setValue(blditm_value)` sets the value of an existing build item macro.

### Input Arguments

**buildItemHandle** — BuildItem handle

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

**blditm\_value** — Value of build item

character vector

Value of build item

Data Types: `char`

### Examples

```
bi = coder.make.BuildItem('wrongvalue')
```

```
bi =
```

```
Macro : (empty)
Value : wrongvalue
```

```
bi.setValue('rightvalue')
```

```
bi.getValue
```

```
ans =
```

```
rightvalue
```

### See Also

[getMacro](#) | [getValue](#) | [setMacro](#) | [setValue](#)

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## addDirective

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Add directive to Directives

### Syntax

```
h.addDirective(name,value)
```

### Description

`h.addDirective(name,value)` creates a named directive, assigns a value to it, and adds it to `coder.make.BuildTool.Directives`.

### Input Arguments

#### **h** — Object handle

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

#### **name** — Name of directive

character vector

Name of directive, specified as a character vector.

Data Types: `char`

#### **value** — Value of directive

character vector

Value of directive, specified as a character vector.

Data Types: `char`

### Examples

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.addDirective('IncludeSearchPath','-O');
tool.setDirective('IncludeSearchPath','-I');
tool.getDirective('IncludeSearchPath')
```

```
ans =
```

```
-I
```



## **See Also**

“Properties” on page 3-66 | [getDirective](#) | [setDirective](#)

## **Topics**

“Example” on page 3-69

## addFileExtension

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Add new file extension entry to `FileExtensions`

### Syntax

```
h.addFileExtension(name,buildItemHandle)
```

### Description

`h.addFileExtension(name,buildItemHandle)` creates a named extension, assigns a `coder.make.BuildItem` object to it, and adds it to `coder.make.BuildTool.FileExtensions`.

### Input Arguments

#### **h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

#### **name — Name of file type.**

character vector

Name of file type, specified as a character vector.

Data Types: `char`

#### **buildItemHandle — BuildItem handle**

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

### Examples

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
blditm = coder.make.BuildItem('CD', '.cd')

bldtm =

 Macro : CD
 Value : .cd

tool.addFileExtension('SourceX',blditm)
value = tool.getFileExtension('SourceX')
```

```
value =
.cd
tool.setFileExtension('SourceX', '.ef')
value = tool.getFileExtension('SourceX')
value =
.ef
```

**See Also**

“Properties” on page 3-66 | [getFileExtension](#) | [setFileExtension](#)

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## getCommand

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Get build tool command

### Syntax

```
c_out = h.getCommand
c_out = h.getCommand('value')
c_out = h.getCommand('macro')
```

### Description

`c_out = h.getCommand` returns the value of the `coder.make.BuildTool.Command` property.

`c_out = h.getCommand('value')` also returns the value of `coder.make.BuildTool.Command`.

`c_out = h.getCommand('macro')` returns the macro name of `coder.make.BuildTool.Command`.

### Input Arguments

#### **h** — Object handle

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

#### **'value'** — Get command value

character vector

Gets the command value.

#### **'macro'** — Get command macro

character vector

Gets the command macro.

### Output Arguments

#### **c\_out** — Command value or macro

variable

The command value or macro of the build tool, returned as a scalar.

Data Types: `char`

## Examples

```
tc = coder.make.ToolchainInfo;
btl = tc.getBuildTool('C Compiler');
btl.getCommand
```

```
ans =
```

```
icl
```

```
btl.getCommand('value')
```

```
ans =
```

```
icl
```

```
c_out = btl.getCommand('macro')
```

```
c_out =
```

```
CC
```

## See Also

setCommand

## getDirective

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Get value of named directive from `Directives`

### Syntax

```
value = h.getDirective(name)
```

### Description

`value = h.getDirective(name)` gets the value of the named directive from `Directives`

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

**name — Name of directive**

character vector

Name of directive, specified as a character vector.

Data Types: `char`

### Output Arguments

**value — Value of directive**

character vector

Value of directive, specified as a character vector.

Data Types: `char`

### Examples

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.addDirective('IncludeSearchPath', '-O');
tool.setDirective('IncludeSearchPath', '-I');
tool.getDirective('IncludeSearchPath')
```

```
ans =
```

```
-I
```

## **See Also**

“Properties” on page 3-66 | `addDirective` | `setDirective`

## **Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## getFileExtension

**Class:** coder.make.BuildTool

**Package:** coder.make

Get file extension for named file type in FileExtensions

### Syntax

```
value = h.getFileExtension(name)
```

### Description

`value = h.getFileExtension(name)` gets the file extension of the named file type from `coder.make.BuildTool.FileExtensions`.

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

**name — Name of file type.**

character vector

Name of file type, specified as a character vector.

Data Types: `char`

### Output Arguments

**value — Value of file extension**

character vector

Value of file extension, specified as a character vector.

Data Types: `char`

### Examples

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
blditm = coder.make.BuildItem('CD', '.cd')
```

```
bldtm =
```

```
Macro : CD
Value : .cd
```



```
tool.addFileExtension('SourceX',blditm)
value = tool.getFileExtension('SourceX')

value =

.cd

tool.setFileExtension('SourceX','.ef')
value = tool.getFileExtension('SourceX')

value =

.ef
```

## See Also

“Properties” on page 3-66 | [addFileExtension](#) | [setFileExtension](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## getName

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Get build tool name

### Syntax

```
toolname = h.getName
```

### Description

`toolname = h.getName` returns the name of the `coder.make.BuildTool` object.

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

### Output Arguments

**toolname — Name of BuildTool object**

The name of the `coder.make.BuildTool` object

### Examples

#### Using the `getName` and `setName` methods interactively

Starting from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example, enter the following lines:

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.getName
```

```
ans =
```

```
C Compiler
```

```
tool.setName('X Compiler')
tool.getName
```

```
ans =
```

```
X Compiler
```

**See Also**

setName

## getPath

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Get path and macro of build tool in Path

### Syntax

```
btpath = h.getPath
btmacro = h.getPath('macro')
```

### Description

`btpath = h.getPath` returns the path of the build tool from **`coder.make.BuildTool.Paths`**.

`btmacro = h.getPath('macro')` returns the macro for the path of the build tool from **`coder.make.BuildTool.Paths`**

### Tips

If the system command environment specifies a path variable for the build tool, the value of the path does not need to be specified by the `BuildTool` object.

### Input Arguments

**h — Object handle**  
variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

### Output Arguments

**btpath — Path of build tool object**  
character vector

The path of `BuildTool` object, returned as a scalar.

Data Types: `char`

**btmacro — Macro for path of build tool object**  
character vector

Macro for path of `BuildTool` object, returned as a scalar.

Data Types: `char`

## Examples

Enter the following lines:

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.getPath
```

```
ans =
```

```
''
```

```
tool.getPath('macro')
```

```
ans =
```

```
CC_PATH
```

```
tool.setPath('/gcc')
tool.Path
```

```
ans =
```

```
Macro : CC_PATH
Value : /gcc
```

## See Also

“Properties” on page 3-66 | [setPath](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## info

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Display build tool properties and values

## Syntax

`h.info`

## Description

`h.info` returns information about the `coder.make.BuildTool` object.

## Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

## Examples

Starting from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example, enter the following lines:

```
tc = intel_tc;
tool = tc.getBuildTool('C Compiler');
tool.info

#####
Build Tool: Intel C Compiler
#####

Language : 'C'
OptionsRegistry : {'C Compiler','CFLAGS'}
InputFileExtensions : {'Source'}
OutputFileExtensions : {'Object'}
DerivedFileExtensions : {'|>OBJ_EXT<|'}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<| '

Command

CC = icl
CC_PATH =

Directives

Debug = -Zi
Include =
IncludeSearchPath = -I
OutputFlag = -Fo
PreprocessorDefine = -D

File Extensions
```

---

```

Header = .h
Object = .obj
Source = .c
```

## See Also

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## setCommand

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set build tool command

### Syntax

```
h.setCommand(commandvalueinput)
```

### Description

`h.setCommand(commandvalueinput)` sets the value of the `coder.make.BuildTool.Command` property.

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

**commandvalueinput — Value of `coder.make.BuildTool.Command` property**

character vector

Value of the `coder.make.BuildTool.Command` property. Enter a character vector, or the handle of a `coder.make.BuildItem` object that contains an option value.

### Examples

#### Get a default build tool and set its properties

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to set the command of a default build tool, C Compiler, from a `ToolchainInfo` object called `tc`, and then sets its properties.

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');
```



```
tool.setCommandPattern(' |>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<| ');
```

## See Also

`getCommand`

## Topics

“Toolchain Definition File with Commentary”

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## setCommandPattern

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set pattern of commands for build tools

### Syntax

```
h.setCommandPattern(commandpattern);
```

### Description

`h.setCommandPattern(commandpattern)`; sets the command pattern of a specific `coder.make.BuildTool` object in `coder.make.ToolchainInfo.BuildTools`.

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

**commandpattern — Pattern of commands and options**

character vector

Pattern of commands and options that a `BuildTool` can use to run a build tool, specified as a character vector.

Use `|>` and `<|` as the left and right delimiters of a command element. Use a space character between the `<|` and `|>` delimiters to require a space between two command elements. For example:

- `|>TOOL<| |>TOOL_OPTIONS<|` requires a space between the two command elements.
- `|>OUTPUT_FLAG<| |>OUTPUT<|` requires no space between the two command elements.

Data Types: `char`

### Examples

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to get and update one of the `BuildTool` objects, including the command pattern:

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
```

```
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');

tool.setCommandPattern('|>T00L<| |>T00L_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<|');
```

## See Also

[addBuildTool](#) | [setCommandPattern](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## setCompilerOptionMap

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set C/C++ language standard and compiler options for selected build tool (compiler)

### Syntax

```
h.setCompilerOptionMap(std,opts);
```

### Description

`h.setCompilerOptionMap(std,opts);` sets the C/C++ language standard and corresponding compiler options of a specific `coder.make.BuildTool` object in `coder.make.ToolchainInfo.BuildTools`.

### Input Arguments

#### **h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

#### **std — C/C++ language standard**

character vector

The C/C++ language standard for the compiler in the `BuildTool` definition, specified as a character vector.

Use one of the following for the `std` value:

- `'C89/C90 (ANSI)'`
- `'C99 (ISO)'`
- `'C++03 (ISO)'`

Data Types: `char`

#### **opts — Compiler options**

character vector

The compiler options correspond to specific `BuildTool` name and C/C++ language standard selections, specified as a character vector. The table provides example value combinations for an Intel toolchain.

| Build Tool Name (Compiler) | std Value     | opts Value                                         |
|----------------------------|---------------|----------------------------------------------------|
| 'Intel C Compiler'         | 'C99 (ISO)'   | '/Qstd=c99' for Windows<br>'-std=c99' for UNIX®    |
| 'Intel C++ Compiler'       | 'C++03 (ISO)' | '/Qstd=c++0x' for Windows<br>'-std=c++0x' for UNIX |

For more Intel-related options, visit <https://software.intel.com/en-us/articles/iso-iec-standards-language-conformance-for-intel-c-compiler>:

Data Types: char

## Examples

The following version of the `intel_tc.m` file differs from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example. This example shows how to define the `C_STANDARD_OPTS` and `CPP_STANDARD_OPTS` macros, set values for the macros with the `setCompilerOptionMap` method, and apply the macros in build configurations.

### Define C/C++ STANDARD\_OPTS Macros

```

%%
% Adding a build tool to ToolchainInfo
%%

function tc = intel_tc
%INTEL_TC Creates an Intel v14 ToolchainInfo object.
% This file can be used as a template to define other toolchains on Windows.

% Copyright 2012-2016 The MathWorks, Inc.

tc = coder.make.ToolchainInfo('BuildArtifact', 'nmake makefile');
tc.Name = 'Intel v14 | nmake makefile (64-bit Windows)';
tc.Platform = 'win64';
tc.SupportedVersion = '14';

tc.addAttribute('TransformPathsWithSpaces');
tc.addAttribute('RequiresCommandFile');
tc.addAttribute('RequiresBatchFile');

% -----
% Setup
% -----
% Below we are using %ICPP_COMPILER14% as root folder where Intel Compiler is installed.
% You can either set an environment variable or give full path to the
% compilervars.bat file
tc.ShellSetup{1} = 'call %ICPP_COMPILER14%\bin\compilervars.bat intel64';

% -----
% Macros
% -----
tc.addMacro('MW_EXTERNLIB_DIR', ['$ (MATLAB_ROOT)\extern\lib\' tc.Platform '\microsoft']);
tc.addMacro('MW_LIB_DIR', ['$ (MATLAB_ROOT)\lib\' tc.Platform]);
tc.addMacro('CFLAGS_ADDITIONAL', '-D_CRT_SECURE_NO_WARNINGS');
tc.addMacro('CPPFLAGS_ADDITIONAL', '-Ehs -D_CRT_SECURE_NO_WARNINGS');
tc.addMacro('LIBS_TOOLCHAIN', '$(conlibs)');
tc.addMacro('CVARSFLAG', '');

tc.addIntrinsicMacros({'ldebug', 'conflags', 'cflags'});
tc.addIntrinsicMacros({'C_STANDARD_OPTS', 'CPP_STANDARD_OPTS'});

```

```

% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');

tool.setCommandPattern('>TOOL<| >TOOL_OPTIONS<| >OUTPUT_FLAG<||>OUTPUT<|');

tool.setCompilerOptionMap('C99 (ISO)', '/Qstd=c99');

% -----
% C++ Compiler
% -----

tool = tc.getBuildTool('C++ Compiler');

tool.setName('Intel C++ Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.cpp');
tool.setFileExtension('Header', '.hpp');
tool.setFileExtension('Object', '.obj');

tool.setCommandPattern('>TOOL<| >TOOL_OPTIONS<| >OUTPUT_FLAG<||>OUTPUT<|');

tool.setCompilerOptionMap('C99 (ISO)', '/Qstd=c++0x');

% -----
% Linker
% -----

tool = tc.getBuildTool('Linker');

tool.setName('Intel C/C++ Linker');
tool.setCommand('xilink');
tool.setPath('');

tool.setDirective('Library', '-L');
tool.setDirective('LibrarySearchPath', '-I');
tool.setDirective('OutputFlag', '-out:');
tool.setDirective('Debug', '');

tool.setFileExtension('Executable', '.exe');
tool.setFileExtension('Shared Library', '.dll');

tool.setCommandPattern('>TOOL<| >TOOL_OPTIONS<| >OUTPUT_FLAG<||>OUTPUT<|');

% -----
% C++ Linker
% -----

tool = tc.getBuildTool('C++ Linker');

```

```

tool.setName('Intel C/C++ Linker');
tool.setCommand('xilink');
tool.setPath('');

tool.setDirective('Library', '-L');
tool.setDirective('LibrarySearchPath', '-I');
tool.setDirective('OutputFlag', '-out:');
tool.setDirective('Debug', '');

tool.setFileExtension('Executable', '.exe');
tool.setFileExtension('Shared Library', '.dll');

tool.setCommandPattern('>TOOL<| >TOOL_OPTIONS<| >OUTPUT_FLAG<|>OUTPUT<|');

% -----
% Archiver
% -----

tool = tc.getBuildTool('Archiver');

tool.setName('Intel C/C++ Archiver');
tool.setCommand('xilib');
tool.setPath('');
tool.setDirective('OutputFlag', '-out:');
tool.setFileExtension('Static Library', '.lib');
tool.setCommandPattern('>TOOL<| >TOOL_OPTIONS<| >OUTPUT_FLAG<|>OUTPUT<|');

% -----
% Builder
% -----

tc.setBuilderApplication(tc.Platform);

% -----
% BUILD CONFIGURATIONS
% -----

optimsOff0pts = {'/c /Od'};
optimsOn0pts = {'/c /O2'};
cCompilerOpts = '$(cflags) $(CVARSFLAG) $(CFLAGS_ADDITIONAL) $(C_STANDARD_OPTS) ';
cppCompilerOpts = '$(cflags) $(CVARSFLAG) $(CPPFLAGS_ADDITIONAL) $(CPP_STANDARD_OPTS)';
linkerOpts = {'$(ldebug) $(conflags) $(LIBS_TOOLCHAIN)'};
sharedLinkerOpts = horzcat(linkerOpts, '-dll -def:$(DEF_FILE)');
archiverOpts = {'/nologo'};

% Get the debug flag per build tool
debugFlag.CCompiler = '$(CDEBUG)';
debugFlag.CppCompiler = '$(CPPDEBUG)';
debugFlag.Linker = '$(LDDEBUG)';
debugFlag.CppLinker = '$(CPPLDDEBUG)';
debugFlag.Archiver = '$(ARDEBUG)';

% Set the toolchain flags for 'Faster Builds' build configuration

cfg = tc.getBuildConfiguration('Faster Builds');
cfg.setOption('C Compiler', horzcat(cCompilerOpts, optimsOff0pts));
cfg.setOption('C++ Compiler', horzcat(cppCompilerOpts, optimsOff0pts));
cfg.setOption('Linker', linkerOpts);
cfg.setOption('C++ Linker', linkerOpts);
cfg.setOption('Shared Library Linker', sharedLinkerOpts);
cfg.setOption('Archiver', archiverOpts);

% Set the toolchain flags for 'Faster Runs' build configuration

cfg = tc.getBuildConfiguration('Faster Runs');
cfg.setOption('C Compiler', horzcat(cCompilerOpts, optimsOn0pts));
cfg.setOption('C++ Compiler', horzcat(cppCompilerOpts, optimsOn0pts));
cfg.setOption('Linker', linkerOpts);
cfg.setOption('C++ Linker', linkerOpts);
cfg.setOption('Shared Library Linker', sharedLinkerOpts);
cfg.setOption('Archiver', archiverOpts);

```

```
% Set the toolchain flags for 'Debug' build configuration

cfg = tc.getBuildConfiguration('Debug');
cfg.setOption('C Compiler', horzcat(cCompilerOpts, optimsOff0pts, debugFlag.CCompiler));
cfg.setOption('C++ Compiler', horzcat(cppCompilerOpts, optimsOff0pts, debugFlag.CppCompiler));
cfg.setOption('Linker', horzcat(linkerOpts, debugFlag.Linker));
cfg.setOption('C++ Linker', horzcat(linkerOpts, debugFlag.CppLinker));
cfg.setOption('Shared Library Linker', horzcat(sharedLinkerOpts, debugFlag.Linker));
cfg.setOption('Archiver', horzcat(archiverOpts, debugFlag.Archiver));

tc.setBuildConfigurationOption('all', 'Download', '');
tc.setBuildConfigurationOption('all', 'Execute', '');
tc.setBuildConfigurationOption('all', 'Make Tool', '-f $(MAKEFILE)');
```

### See Also

`coder.make.BuildTool`

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”



# setDirective

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set value of directive in `Directives`

## Syntax

```
h.setDirective(name,value)
```

## Description

`h.setDirective(name,value)` assigns a value to the named directive in `coder.make.Directives`.

## Input Arguments

### **h** — Object handle

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

### **name** — Name of directive

character vector

Name of directive, specified as a character vector.

Data Types: `char`

### **value** — Value of directive

character vector

Value of directive, specified as a character vector.

Data Types: `char`

## Examples

### Get a default build tool and set its properties

The following example code shows `setDirective` in a portion of the `intel_tc.m` file from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” tutorial.

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');
```

```

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');

tool.setCommandPattern('>TOOL<| >TOOL_OPTIONS<| >OUTPUT_FLAG<|>OUTPUT<|');

```

### Use the setDirective method interactively

```

tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.addDirective('IncludeSearchPath', '-O');
tool.setDirective('IncludeSearchPath', '-I');
tool.getDirective('IncludeSearchPath')

```

```
ans =
```

```
-I
```

### Specify Custom Toolchain Directives for Building PIL Target Application

If you use a custom toolchain for building a processor-in-the-loop (PIL) target application that supports Simulink Coverage™ analysis or Embedded Coder code execution profiling, in the toolchain definition file, you must provide these compiler directives:

- **CompileFlag** — Specify the flag that C or C++ compiler uses to compile source files without linking. For example, if the compiler in the toolchain is GNU® C or C++, set the directive to `-c`.
- **PreprocessFile** — Specify the flag that C or C++ compiler uses to preprocess the source files without running other compiler stages. For example, if the compiler in the toolchain is GNU C or C++, set the directive to `-E`.

This section from a toolchain definition file example shows how you can use the `setDirective` method to provide the directives.

```

tc = coder.make.ToolchainInfo('BuildArtifact', 'nmake makefile');
tc.Name = 'My Toolchain Name';
tc.Platform = 'win64';
tc.SupportedVersion = '14';
...
% -----
% C Compiler
% -----
tool = tc.getBuildTool('C Compiler');
tool.setName('My C Compiler');
...
tool.setDirective('CompileFlag', '-c');
tool.setDirective('PreprocessFile', '-E');
...

```

### See Also

“Properties” on page 3-66 | `addDirective` | `getDirective`

### Topics

“Custom Toolchain Registration”

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## setFileExtension

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set file extension for named file type in `FileExtensions`

### Syntax

```
h.setFileExtension(name,value)
```

### Description

`h.setFileExtension(name,value)` sets the extension value of the named file type in `coder.make.BuildTool.FileExtensions`.

### Input Arguments

#### **h** — Object handle

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

#### **name** — Name of file type.

character vector

Name of file type, specified as a character vector.

Data Types: `char`

#### **value** — Value of file extension

character vector

Value of file extension, specified as a character vector.

Data Types: `char`

### Examples

#### **Get a default build tool and set its properties**

The following example code shows `setFileExtension` in a portion of the `intel_tc.m` file from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” tutorial.

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');
```

```

tool.setDirective('IncludeSearchPath','-I');
tool.setDirective('PreprocessorDefine','-D');
tool.setDirective('OutputFlag','-Fo');
tool.setDirective('Debug','-Zi');

tool.setFileExtension('Source','.c');
tool.setFileExtension('Header','.h');
tool.setFileExtension('Object','.obj');

tool.setCommandPattern('|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<||>OUTPUT<|');

```

### Use the setFileExtension interactively

```

tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
blditm = coder.make.BuildItem('CD', '.cd')

blditm =

 Macro : CD
 Value : .cd

tool.addFileExtension('SourceX', blditm)
value = tool.getFileExtension('SourceX')

value =

 .cd

tool.setFileExtension('SourceX', '.ef')
value = tool.getFileExtension('SourceX')

value =

 .ef

```

### See Also

“Properties” on page 3-66 | [addFileExtension](#) | [getFileExtension](#)

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## setName

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set build tool name

### Syntax

```
h.setName(name)
```

### Description

`h.setName(name)` sets the name of the `coder.make.BuildTool.Name` property.

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

**name — Name of build tool**

character vector

The name of the build tool, specified as a character vector.

Example: `'Intel C Compiler'`

Data Types: `char`

### Examples

#### Get a default build tool and set its properties

The following example code shows `setName` in a portion of the `intel_tc.m` file from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” tutorial:

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');
```

```
tool.setCommandPattern('|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<|>OUTPUT<|');
```

### Using the getName and setName methods interactively

Starting from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example, enter the following lines:

```
tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.getName
```

```
ans =
```

```
C Compiler
```

```
tool.setName('X Compiler')
tool.getName
```

```
ans =
```

```
X Compiler
```

## See Also

### Topics

“Toolchain Definition File with Commentary”

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## setPath

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Set path and macro of build tool in Path

### Syntax

```
h.setPath(btpath,btmacro)
```

### Description

`h.setPath(btpath,btmacro)` sets the path and macro of the build tool in **`coder.make.BuildTool.Paths`**.

### Input Arguments

#### **h** — Object handle

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

#### **btpath** — Path of build tool object

character vector

The path of `BuildTool` object, returned as a scalar.

Data Types: `char`

#### **btmacro** — Macro for path of build tool object

character vector

Macro for path of `BuildTool` object, returned as a scalar.

Data Types: `char`

### Examples

#### **Get a default build tool and set its properties**

The following example code shows `setPath` in a portion of the `intel_tc.m` file from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” tutorial.

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');
```



```

tool.setDirective('IncludeSearchPath','-I');
tool.setDirective('PreprocessorDefine','-D');
tool.setDirective('OutputFlag','-Fo');
tool.setDirective('Debug','-Zi');

tool.setFileExtension('Source','.c');
tool.setFileExtension('Header','.h');
tool.setFileExtension('Object','.obj');

tool.setCommandPattern('|>T00L<| |>T00L_OPTIONS<| |>OUTPUT_FLAG<||>OUTPUT<|');

```

## Use the getPath and setPath methods interactively

This example shows example inputs and outputs for the methods in a MATLAB Command Window:

Enter the following lines:

```

tc = coder.make.ToolchainInfo;
tool = tc.getBuildTool('C Compiler');
tool.getPath

```

```
ans =
```

```
''
```

```
tool.getPath('macro')
```

```
ans =
```

```
CC_PATH
```

```
tool.setPath('/gcc')
tool.Path
```

```
ans =
```

```
Macro : CC_PATH
Value : /gcc
```

## See Also

“Properties” on page 3-66 | [getPath](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## validate

**Class:** `coder.make.BuildTool`

**Package:** `coder.make`

Validate build tool properties

### Syntax

```
validtool = h.validate
```

### Description

`validtool = h.validate` validates the `coder.make.BuildTool` object, and generates errors if any properties are incorrectly defined.

### Input Arguments

**h — Object handle**

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

### Output Arguments

**validtool — Validity of `coder.make.BuildTool` object**

The validity of the `coder.make.BuildTool` object. If the method detects a problem it returns '0' or an error message.

### Examples

The `coder.make.BuildTool.validate` method returns warning and error messages if you try to validate a build tool before you have installed the build tool software (compiler, linker, archiver).

Starting from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example, enter the following lines:

```
tc = intel_tc;
tool = tc.getBuildTool('C Compiler');
tool.validate
```

If your host computer does not have the Intel toolchain installed, `validate` displays the following messages:

```
Warning: Validation of build tool 'Intel C Compiler' may require the toolchain
to be set up first. The setup information is registered in the toolchain
this build tool belong to. Pass the parent ToolchainInfo object to VALIDATE
in order for any toolchain setup to be done before validation.
> In C:\Program Files\MATLAB\R2013a\toolbox\coder\foundation\build\+coder\+make\
BuildTool.p>BuildTool.checkForPresence at 634
```

```
In C:\Program Files\MATLAB\R2013a\toolbox\coder\foundation\build\+coder\+make\
BuildTool.p>BuildTool.validate at 430
Error using message
In 'CoderFoundation:toolchain:ValidateBuildToolError',data type supplied is
incorrect for parameter {1}.
```

```
Error in C:\Program
Files\MATLAB\R2013a\toolbox\coder\foundation\build\+coder\+make\
BuildTool.p>BuildTool.checkForPresence
(line 664)
```

```
Error in C:\Program
Files\MATLAB\R2013a\toolbox\coder\foundation\build\+coder\+make\
BuildTool.p>BuildTool.validate
(line 430)
```

```
Trial>>
```

For more information, see “Troubleshooting Custom Toolchain Validation”.

## See Also

validate

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“Troubleshooting Custom Toolchain Validation”

## addAttribute

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Add custom attribute to `Attributes`

### Syntax

```
h.addAttribute(Name,Value)
```

### Description

`h.addAttribute(Name,Value)` adds a custom attribute with the specified name and value to `coder.make.ToolchainInfo.Attributes`. If you do not specify a value, the function initializes the attribute to `true` (default).

All attributes are optional. The toolchain uses the attributes during the build process.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**Name-Value Pair Argument**

Specify a `Name, Value` pair argument. `Name` is the argument name and `Value` is the corresponding value.

**TransformPathsWithSpaces — Path spaces**

`true` (default) | `false`

Look for spaces in paths to source files, include files, include paths, additional source paths, object paths, and prebuild object paths, library paths, and within `MACROS` used in any of the stated paths. If any path contains spaces, an alternate version of the path is returned. For long path names or paths with spaces, the method returns the '~' version on Windows when 8.3 name creation is enabled. On Linux platforms, paths with spaces are returned with the spaces escaped.

**RequiresBatchFile — Batch file**

`true` (default) | `false`

Create a batch file that runs the generated makefile.

You can run the created batch file only on a Windows operating system. On an operating system that is not Windows, to avoid running the batch file, set `RequiresBatchFile` to `false` or set the `GenCodeOnly` configuration parameter to `true`.

**SupportsUNCPaths — UNC paths**

`true` (default) | `false`

Looks in the same locations for UNC paths (Windows only, ignored on Linux/Mac platforms). If there is a drive mapped to the UNC the path is pointing to, then paths that are UNC paths will have a mapped drive letter put in place.

### **SupportsDoubleQuotes — Double quotes**

true (default) | false

Wrap each path in double quotes if they contain spaces.

### **RequiresCommandFile — Long compiler or archiver/linker lines**

true (default) | false

For handling long compiler or archiver/linker lines (typically in Windows). If specified:

- In the compiler command line, the makefile replaces a long list of include paths with a call to the command file
- In the linker/archiver command line, the makefile replaces a long object file list with a call to a command file.

### **NoCompilerCommandFile — No compiler command file**

true (default) | false

Build process does not create a response file for the header file paths in the model reference hierarchy, which modifies the behaviour specified by `RequiresCommandFile`. Set `NoCompilerCommandFile` to `true` only if you need to avoid long compiler command lines and your compiler does not support compiler command files. Use with the `CopyReferencedModelHeaders` attribute.

### **CopyReferencedModelHeaders — Copy model reference header files**

true (default) | false

Copy model reference header files to the `referenced_model_includes` subfolder in the top model build folder. Set `CopyReferencedModelHeaders` to `true` only if you need to avoid long compiler command lines and your compiler does not support compiler command files. Use with the `NoCompilerCommandFile` attribute.

### **LinkerLibraryPrefix — Linker library prefix**

character vector | string

Append prefix to the linker libraries specified on the command line. Applies only if toolchain has a `gmake` build artifact.

Example: `tc.addAttribute('LinkerLibraryPrefix', '--library=')`

## **Examples**

### **Add an attribute and initialize its value, overriding the default value**

```
h.Attribute
```

```
ans =
```

```

"Attribute" List
```

```

(empty)

h.addAttribute('TransformPathsWithSpaces',false)
h.getAttribute('TransformPathsWithSpaces')

ans =

 0
```

### Add attribute without overriding its default value

```
h.addAttribute('CustomAttribute')
h.Attributes

ans =
```

```

"Attributes" List

CustomAttribute = true
```

### Add attribute using toolchain definition file

The `intel_tc.m` file from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example defines the following custom attributes:

```
tc.addAttribute('TransformPathsWithSpaces');
tc.addAttribute('RequiresCommandFile');
tc.addAttribute('RequiresBatchFile');
```

To see the property values from that example in the MATLAB Command Window, enter:

```
h = intel_tc;
h.Attributes
```

```
ans =

"Attributes" List

RequiresBatchFile = true
RequiresCommandFile = true
TransformPathsWithSpaces = true
```

## See Also

[addAttribute](#) | [getAttribute](#) | [getAttributes](#) | [isAttribute](#) | [removeAttribute](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”  
“About coder.make.ToolchainInfo”

# addBuildConfiguration

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Add build configuration

## Syntax

```
h.addBuildConfiguration(blldcfg_name)
h.addBuildConfiguration(blldcfg_name, blldcfg_desc)
h.addBuildConfiguration(blldcfg_handle)
```

## Description

`h.addBuildConfiguration(blldcfg_name)` creates a `coder.make.BuildConfiguration` object, assigns the value of `blldcfg_name` to Name property of the object, and adds the object to `coder.make.ToolchainInfo.BuildConfigurations` on page 3-79.

`h.addBuildConfiguration(blldcfg_name, blldcfg_desc)` assigns the value of `blldcfg_desc` to Description property of the object.

`h.addBuildConfiguration(blldcfg_handle)` adds an existing build configuration object to `coder.make.ToolchainInfo.BuildConfigurations` on page 3-79. The build configuration must have a name that is unique within `coder.make.ToolchainInfo.BuildConfigurations` on page 3-79.

## Input Arguments

### **h** — ToolchainInfo object handle

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

### **blldcfg\_name** — Build configuration name

character vector | string scalar

Build configuration name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### **blldcfg\_handle** — BuildConfiguration object handle

variable

Handle of `coder.make.BuildConfiguration` object

### **blldcfg\_desc** — Build configuration description

character vector | string scalar

Build configuration description, specified as a character vector or string scalar.

Data Types: `char` | `string`

## Examples

```
h.getBuildConfigurations
```

```
ans =
```

```
 'Faster Builds'
 'Faster Runs'
 'Debug'
```

```
bldcfg_handle = h.getBuildConfiguration('Debug')
```

```
bldcfg_handle =
```

```

Build Configuration : Debug
Description : Default debug settings for compiling/linking code

ARFLAGS = /nologo $(ARDEBUG)
CFLAGS = $(cflags) $(CVARSFLAG) $(CFLAGS_ADDITIONAL) /c /Od $(CDEBUG)
CPPFLAGS = $(cflags) $(CVARSFLAG) $(CPPFLAGS_ADDITIONAL) /c /Od $(CPPDEBUG)
DOWNLOAD_FLAGS =
EXECUTE_FLAGS =
LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) $(LDDEBUG)
MEX_CFLAGS =
MEX_LDFLAGS =
MAKE_FLAGS = -f $(MAKEFILE)
SHAREDLIB_LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) -dll -def:$(DEF_FILE) $(LDDEBUG)
```

```
h.addBuildConfiguration('Debug2','Variant debugging configuration')
h.setBuildConfiguration('Debug2',bldcfg_handle)
h.getBuildConfigurations
```

```
ans =
```

```
 'Faster Builds'
 'Faster Runs'
 'Debug'
 'Debug2'
```

## See Also

[coder.make.BuildConfiguration](#) | [coder.make.BuildItem](#) | [coder.make.BuildTool](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”



# addBuildTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Add BuildTool object to BuildTools

## Syntax

```
tool = h.addBuildTool(bldtl_name)
tool = h.addBuildTool(bldtl_name, bldtl_handle)
```

## Description

`tool = h.addBuildTool(bldtl_name)` creates and adds a named `BuildTool` object to `coder.make.ToolchainInfo.BuildTools`.

`tool = h.addBuildTool(bldtl_name, bldtl_handle)` adds an existing `BuildTool` object to `coder.make.ToolchainInfo.BuildTools`. The `bldtl_name` argument overrides the `Name` property of the existing `BuildTool` object.

## Tips

Refer to the “Example” on page 3-69 for `coder.make.BuildTool` for an example of how to create a `BuildTool` object.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

## Output Arguments

**tool — BuildTool object handle**

variable

Handle of `coder.make.BuildTool` object.

## Examples

Refer to the `coder.make.BuildTool` “Example” on page 3-69 for a complete example of how to create a `addBuildTool`.

### Create a build tool and specify its name

```
h.addBuildTool('ExampleBuildTool')
```

```
ans =

Build Tool: Build Tool

Language : 'C'
OptionsRegistry : {}
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<|'

Command

Directives

(none)

File Extensions

(none)
```

## See Also

`coder.make.BuildTool` | `addBuildTool` | `getBuildTool` | `removeBuildTool` | `setBuildTool`

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

# addIntrinsicMacros

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Add intrinsic macro to Macros

## Syntax

```
h.addIntrinsicMacros(intrnsc_macroname)
```

## Description

`h.addIntrinsicMacros(intrnsc_macroname)` adds an intrinsic macro to `Macros`. The value of the intrinsic macro is defined by a build tool, not by `ToolchainInfo` or your MathWorks software.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**intrnsc\_macronames — Intrinsic macro name or names**

character vector or cell array of character vectors | string or string array

Intrinsic macro name or names, specified as a character vector, cell array of character vectors, string, or string array.

## Examples

```
h.addIntrinsicMacros('GCCROOT')
h.getMacro('GCCROOT')
```

```
ans =
```

```
 []
```

```
h.removeIntrinsicMacros('GCCROOT')
h.getMacro('GCCROOT')
```

## Tips

The value of intrinsic macros are intentionally not declared in `ToolchainInfo`. The value of the intrinsic macro is defined by the build tools in the toolchain, outside the scope of your MathWorks software.

During the software build process, your MathWorks software inserts intrinsic macros into a build artifact, such as a makefile, without altering their form. During the build process, the build artifact

passes the intrinsic macros to the build tools in the toolchain. The build tools interpret the macros based on their own internal definitions.

The `validate` method does not validate the intrinsic macros.

Because intrinsic macros have undeclared values, they remain unchanged in the generated code, where they can be used and interpreted by the software build toolchain. In contrast, ordinary macros are replaced by their assigned values when you create them.

### **See Also**

`addMacro` | `getMacro` | `removeMacro` | `setMacro` | `addIntrinsicMacros` | `removeIntrinsicMacros`

### **Topics**

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)

[“About `coder.make.ToolchainInfo`”](#)

# addMacro

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Add macro to Macros

## Syntax

```
h.addMacro(macroname)
h.addMacro(macroname, macrovalue)
```

## Description

`h.addMacro(macroname)` adds a macro to `coder.make.ToolchainInfo.Macros` without initializing the value of the Macro.

`h.addMacro(macroname, macrovalue)` adds a macro and initializes the value of the macro.

## Input Arguments

**h** — ToolchainInfo object handle

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**macroname** — Name of macro

character vector | string scalar

Name of macro.

**macrovalue** — Value of macro

character vector | string scalar | cell

Value of the macro, specified as a character vector, string scalar, or cell array.

If the value contains MATLAB functions or other macros, `ToolchainInfo` on page 3-74 interprets the value of functions and macros.

Data Types: `cell` | `char` | `string`

## Examples

```
h.setMacro('CYGWIN','C:\cygwin\');
h.getMacro('CYGWIN')
```

```
ans =
```

```
C:\cygwin\bin\
```

```
h.removeMacro('CYGWIN')
```

## Tips

Use `setMacro` to update the value of a macro in `coder.make.ToolchainInfo.Macros`.

## See Also

`addMacro` | `getMacro` | `removeMacro` | `setMacro` | `addIntrinsicMacros` | `removeIntrinsicMacros`

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”  
“About `coder.make.ToolchainInfo`”

# addPostbuildTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Add postbuild tool to PostbuildTools

## Syntax

```
h.addPostbuildTool(bldtl_name)
h.addPostbuildTool(bldtl_name, bldtl_handle)
```

## Description

`h.addPostbuildTool(bldtl_name)` adds a `BuildTool` object to `PostbuildTools`.

`h.addPostbuildTool(bldtl_name, bldtl_handle)` adds a postbuild tool to `PostbuildTools` and assigns a `BuildTool` object to it.

## Tips

Refer to the “Example” on page 3-69 for `coder.make.BuildTool` for an example of how to create a `BuildTool` object.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

## Examples

```
h = coder.make.ToolchainInfo;
bt = coder.make.BuildTool('postbuildtoolname');
h.addPostbuildTool('exemplename',bt)
```

ans =

```

Build Tool: postbuildtoolname

Language : 'C'
OptionsRegistry : {}
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<|'

Command

Directives

(none)

File Extensions

(none)
```

### See Also

[addPostbuildTool](#) | [getPostbuildTool](#) | [removePostbuildTool](#) | [setPostbuildTool](#) | [addPostDownloadTool](#) | [addPostExecuteTool](#)

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”  
“About coder.make.ToolchainInfo”



# addPostDownloadTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Add post-download tool to PostDownloadTool

## Syntax

```
h.addPostDownloadTool(bldtl_name,bldtl_handle)
```

## Description

`h.addPostDownloadTool(bldtl_name,bldtl_handle)` adds a `BuildTool` object between the download tool and the execute tool specified by the `PostbuildTools` property.

## Tips

Refer to the “Example” on page 3-69 for `coder.make.BuildTool` for an example of how to create a `BuildTool` object.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

## Examples

```
h = coder.make.ToolchainInfo;
bt = coder.make.BuildTool('toolname');
h.addPostDownloadTool('examplename',bt)

ans =

#####
Build Tool: toolname
```

```


Language : 'C'
OptionsRegistry : {}
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<|'

Command

Directives

(none)

File Extensions

(none)
```

### References

“About coder.make.ToolchainInfo”

### See Also

[addPostbuildTool](#) | [getPostbuildTool](#) | [removePostbuildTool](#) | [setPostbuildTool](#) | [addPostDownloadTool](#) | [addPostExecuteTool](#)

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”  
“About coder.make.ToolchainInfo”

# addPostExecuteTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Add post-execute tool to PostbuildTools

## Syntax

```
h.addPostExecuteTool(name,bldtl_handle)
```

## Description

`h.addPostExecuteTool(name,bldtl_handle)` adds a named build tool to `PostbuildTools` after the `Execute` tool.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**name — Name of post execute tool**

character vector | string scalar

Name of post execute tool, specified as a character vector or string scalar.

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

## Examples

Refer to the `coder.make.BuildTool` “Example” on page 3-69 for an example of to create a `BuildTool`.

To use `addPostExecuteTool`, enter the following commands:

```
h = coder.make.ToolchainInfo;
bt = coder.make.BuildTool('toolname');
h.addPostExecuteTool('ExampleName',bt)
```

ans =

```
#####
Build Tool: toolname
#####
```

```
Language : 'C'
OptionsRegistry : {}
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<|'
```

```

Command

```

```

Directives

(none)
```

```

File Extensions

(none)
```

## See Also

[addPostbuildTool](#) | [addPostDownloadTool](#)

## Topics

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)

[“About coder.make.ToolchainInfo”](#)

# addPrebuildTool

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Add prebuild tool to `PrebuildTools`

## Syntax

```
h.addPrebuildTool(bldtl_name)
h.addPrebuildTool(bldtl_name, bldtl_handle)
```

## Description

`h.addPrebuildTool(bldtl_name)` creates a `BuildTool` object and adds it to the `PrebuildTools` property.

`h.addPrebuildTool(bldtl_name, bldtl_handle)` adds an existing `BuildTool` object to the `PrebuildTools` property.

## Input Arguments

**h** — **ToolchainInfo** object handle

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name** — **Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

**bldtl\_handle** — **BuildTool** object handle

variable

`coder.make.BuildTool` object handle.

## See Also

`addPrebuildTool` | `getPrebuildTool` | `removePrebuildTool` | `setPrebuildTool`

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

## cleanup

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Run cleanup commands

### Syntax

```
h.cleanup
```

### Description

`h.cleanup` runs cleanup commands after completing the software build process. First, it runs the commands specified by `coder.make.ToolchainInfo.ShellCleanup`, and then it runs the commands specified by `coder.make.ToolchainInfo.MATLABCleanup`.

The commands in `ShellCleanup` run as system calls to the standard input of the operating system on your host computer. These commands are similar to what you enter when you use the command line.

The commands in `MATLABCleanup` run in your MATLAB software.

### Input Arguments

**h** — **ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

### Output Arguments

**success** — **Indication whether cleanup completed**

Indication whether cleanup completed (0 = false, 1 = true), returned as a scalar.

Data Types: `double`

**report** — **Information generated by the cleanup commands**

Detailed information generated by the cleanup commands, returned as a character vector.

Data Types: `double`

### Examples

```
[success,report] = h.cleanup
```

```
success =
```

---

1

report =

''

## **See Also**

setup | validate

## **Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## getAttribute

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Get value of attribute

### Syntax

```
att_value = h.getAttribute(att_name)
```

### Description

`att_value = h.getAttribute(att_name)` returns the value of a specific attribute in `coder.make.ToolchainInfo.Attributes`.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**att\_name — Name of attribute**

character vector | string scalar

Name of attribute, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Output Arguments

**att\_value — Value of attribute**

true (default)

Attribute value. Any data type.

### Examples

```
h.Attribute
```

```
ans =
```

```

"Attribute" List

(empty)
```

```
h.addAttribute('TransformPathsWithSpaces', false)
h.getAttribute('TransformPathsWithSpaces')
```



```
ans =
```

```
0
```

## See Also

[addAttribute](#) | [getAttribute](#) | [getAttributes](#) | [isAttribute](#) | [removeAttribute](#)

## Topics

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)

[“About coder.make.ToolchainInfo”](#)

## getAttributes

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Get list of attribute names

### Syntax

```
names = h.getAttributes
```

### Description

`names = h.getAttributes` returns the list of attribute names in `coder.make.ToolchainInfo.Attributes`.

### Input Arguments

**h** — **ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

### Output Arguments

**names** — **List of names**

cell array of character vectors

A list of the names, returned as a cell array.

Data Types: `cell`

### Examples

```
h.addAttribute('FirstAttribute')
h.addAttribute('SecondAttribute')
h.addAttribute('ThirdAttribute')
names = h.getAttributes
```

```
names =
```

```
 'FirstAttribute' 'SecondAttribute' 'ThirdAttribute'
```

### See Also

[addAttribute](#) | [getAttribute](#) | [getAttributes](#) | [isAttribute](#) | [removeAttribute](#)

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## getBuildConfiguration

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Get handle for build configuration object

### Syntax

```
bldcfg_handle = h.getBuildConfiguration(bldcfg_name)
```

### Description

`bldcfg_handle = h.getBuildConfiguration(bldcfg_name)` returns a handle for the specified `coder.make.BuildConfig` object.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldcfg\_name — Build configuration name**

character vector | string scalar

Build configuration name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Output Arguments

**bldcfg\_handle — BuildConfiguration object handle**

variable

Handle of `coder.make.BuildConfiguration` object

### Examples

```
bldcfg_handle = h.getBuildConfiguration('Debug')
```

```
bldcfg_handle =
#####
Build Configuration : Debug
Description : Default debug settings for compiling/linking code
#####
ARFLAGS = /nologo $(ARDEBUG)
CFLAGS = $(cflags) $(CVARSFLAG) $(CFLAGS_ADDITIONAL) /c /Od $(CDEBUG)
CPPFLAGS = $(cflags) $(CVARSFLAG) $(CPPFLAGS_ADDITIONAL) /c /Od $(CPPDEBUG)
DOWNLOAD_FLAGS =
EXECUTE_FLAGS =
```

```
LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) $(LDDEBUG)
MEX_CFLAGS =
MEX_LDFLAGS =
MAKE_FLAGS = -f $(MAKEFILE)
SHAREDLIB_LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) -dll -def:$(DEF_FILE) $(LDDEBUG)
```

## See Also

[getBuildConfiguration](#) | [removeBuildConfiguration](#) | [setBuildConfiguration](#) | [setBuildConfigurationOption](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## getBuildTool

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Get `BuildTool` object

### Syntax

```
bldtl_handle = h.getBuildTool(bldtl_name)
```

### Description

`bldtl_handle = h.getBuildTool(bldtl_name)` returns the `BuildTool` object that has the specified name.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Output Arguments

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

### Examples

```
bldtl_handle = h.getBuildTool('C Compiler')
```

```
bldtl_handle =
```

```
#####
Build Tool: Intel C Compiler
#####
```

```
Language : 'C'
OptionsRegistry : {'C Compiler','CFLAGS'}
```

```
InputFileExtensions : {'Source'}
OutputFileExtensions : {'Object'}
DerivedFileExtensions : {'|>OBJ_EXT<|'}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<| '

Command

CC = icl
CC_PATH =

Directives

Debug = -Zi
Include =
IncludeSearchPath = -I
OutputFlag = -Fo
PreprocessorDefine = -D

File Extensions

Header = .h
Object = .obj
Source = .c
```

## See Also

[coder.make.BuildTool](#) | [addBuildTool](#) | [getBuildTool](#) | [removeBuildTool](#) | [setBuildTool](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”





**See Also**

[addMacro](#) | [getMacro](#) | [removeMacro](#) | [setMacro](#) | [addIntrinsicMacros](#) | [removeIntrinsicMacros](#)

**Topics**

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)

[“About coder.make.ToolchainInfo”](#)

## getPostbuildTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Get postbuild BuildTool object

### Syntax

```
bldtl_handle = h.getPostbuildTool(bldtl_name)
```

### Description

`bldtl_handle = h.getPostbuildTool(bldtl_name)` gets the named BuildTool object from PostbuildTool and returns a handle to the object.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A coder.make.ToolchainInfo on page 3-74 object, specified using an object handle, such as h. To create h, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: char | string

### Output Arguments

**bldtl\_handle — BuildTool object handle**

variable

coder.make.BuildTool object handle.

### Examples

```
h.getPostbuildTool('Download')
```

```
ans =
```

```
#####
Build Tool: Download
#####
```

```
Language : ''
OptionsRegistry : {'Download','DOWNLOAD_FLAGS'}
```

```
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {coder.make.enum.BuildOutput.EXECUTABLE}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<|'
```

```

Command

DOWNLOAD =
DOWNLOAD_PATH =
```

```

Directives

(none)
```

```

File Extensions

(none)
```

## See Also

[addPostbuildTool](#) | [getPostbuildTool](#) | [removePostbuildTool](#) | [setPostbuildTool](#) | [addPostDownloadTool](#) | [addPostExecuteTool](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## getPrebuildTool

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Get prebuild `BuildTool` object

### Syntax

```
bldtl_handle = tc.getPrebuildTool(bldtl_name)
```

### Description

`bldtl_handle = tc.getPrebuildTool(bldtl_name)` gets the named `BuildTool` object from `PrebuildTool` and assigns it to a handle.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Output Arguments

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

### Examples

```
h.getPrebuildTool('Copy Tool')
```

```
ans =
```

```
#####
Build Tool: Copy Tool
#####
```

```
Language : ''
OptionsRegistry : {'Copy', 'COPY_FLAGS'}
```

```
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {coder.make.enum.BuildOutput.EXECUTABLE}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<|'
```

```

Command

COPY =
COPY_PATH =
```

```

Directives

(none)
```

```

File Extensions

(none)
```

## See Also

[addPrebuildTool](#) | [getPrebuildTool](#) | [removePrebuildTool](#) | [setPrebuildTool](#)

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## **coder.make.ToolchainInfo.getSupportedLanguages**

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Get list of supported languages

### **Syntax**

```
lng_list = h.getSupportedLanguages
```

### **Description**

`lng_list = h.getSupportedLanguages` returns the list of supported code generation languages for the current toolchain.

### **Input Arguments**

**h** — ToolchainInfo object handle

variable

A coder.make.ToolchainInfo on page 3-74 object, specified using an object handle, such as h. To create h, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

### **Output Arguments**

**lng\_list** — List of supported languages

cell

List of supported languages, returned as a cell.

### **Attributes**

Static true

To learn about attributes of methods, see Method Attributes.

### **Examples**

```
ans = h.getSupportedLanguages
```

```
ans =
```

```
 'Asm/C' 'Asm/C++' 'Asm/C/C++' 'C' 'C++' 'C/C++'
```

### **See Also**

coder.make.ToolchainInfo

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## isAttribute

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Determine if attribute exists

### Syntax

```
truefalse = h.isAttribute(att_name)
```

### Description

`truefalse = h.isAttribute(att_name)` returns a logical value that indicates whether the specified attribute is a member of `coder.make.ToolchainInfo.Attributes`.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**att\_name — Name of attribute**

character vector | string scalar

Name of attribute, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Output Arguments

**truefalse — Logical value**

boolean

Logical value: 0 = false, 1 = true, specified as a logical value.

Data Types: `logical`

### Examples

```
h.addAttribute('FirstAttribute')
truefalse = h.isAttribute('FirstAttribute')
```

```
truefalse =
```

```
1
```



**See Also**

`addAttribute` | `getAttribute` | `getAttributes` | `isAttribute` | `removeAttribute`

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

## removeAttribute

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Remove attribute

### Syntax

```
h.removeAttribute(att_name)
```

### Description

`h.removeAttribute(att_name)` removes the named attribute from `coder.make.ToolchainInfo.Attributes`.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**att\_name — Name of attribute**

character vector | string scalar

Name of attribute, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Examples

```
h.addAttribute('FirstAttribute')
h.isAttribute('FirstAttribute')
```

```
ans =

 1
```

```
h.removeAttribute('FirstAttribute')
h.isAttribute('FirstAttribute')
```

```
ans =

 0
```

### See Also

`addAttribute` | `getAttribute` | `getAttributes` | `isAttribute` | `removeAttribute`

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## removeBuildConfiguration

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Remove build configuration

### Syntax

```
h.removeBuildConfiguration(blldcfg_name)
```

### Description

`h.removeBuildConfiguration(blldcfg_name)` removes the specified build configuration object from `coder.make.ToolchainInfo.BuildConfiguration`.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**blldcfg\_name — Build configuration name**

character vector | string scalar

Build configuration name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Examples

```
h.BuildConfigurations
```

```
ans =
```

```

"BuildConfigurations" List

Debug = <coder.make.BuildConfiguration>
ExampleName = <coder.make.BuildConfiguration>
Faster Builds = <coder.make.BuildConfiguration>
Faster Runs = <coder.make.BuildConfiguration>
```

```
h.removeBuildConfiguration('ExampleName')
h.BuildConfigurations
```

```
ans =
```

```

"BuildConfigurations" List

Debug = <coder.make.BuildConfiguration>
Faster Builds = <coder.make.BuildConfiguration>
Faster Runs = <coder.make.BuildConfiguration>
```

## See Also

[getBuildConfiguration](#) | [removeBuildConfiguration](#) | [setBuildConfiguration](#) | [setBuildConfigurationOption](#)

## Topics

["Add Custom Toolchains to MATLAB® Coder™ Build Process"](#)  
["About coder.make.ToolchainInfo"](#)

## removeBuildTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Remove BuildTool object from BuildTools

### Syntax

```
h.removeBuildTool(bldtl_name)
```

### Description

h.removeBuildTool(bldtl\_name) removes the named build tool from BuildTools.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A coder.make.ToolchainInfo on page 3-74 object, specified using an object handle, such as h. To create h, enter h = coder.make.ToolchainInfo in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: char | string

### Examples

```
h.addBuildTool('ExampleBuildTool');
h.BuildTools
```

```
ans =
```

```

"BuildTools" List

C Compiler = <coder.make.BuildTool>
C++ Compiler = <coder.make.BuildTool>
Archiver = <coder.make.BuildTool>
Linker = <coder.make.BuildTool>
ExampleBuildTool = <coder.make.BuildTool>
```

```
h.removeBuildTool('ExampleBuildTool')
h.BuildTools
```

```
ans =
```

```

"BuildTools" List

C Compiler = <coder.make.BuildTool>
C++ Compiler = <coder.make.BuildTool>
Archiver = <coder.make.BuildTool>
Linker = <coder.make.BuildTool>
```

## See Also

[coder.make.BuildTool](#) | [addBuildTool](#) | [getBuildTool](#) | [removeBuildTool](#) | [setBuildTool](#)

## Topics

["Add Custom Toolchains to MATLAB® Coder™ Build Process"](#)

["About coder.make.ToolchainInfo"](#)

## removeIntrinsicMacros

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Remove intrinsic macro

### Syntax

```
h.removeIntrinsicMacros(intrnsc_macronames)
```

### Description

`h.removeIntrinsicMacros(intrnsc_macronames)` removes the named intrinsic macro from `Macros`.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**intrnsc\_macronames — Intrinsic macro name or names**

character vector or cell array of character vectors | string or string array

Intrinsic macro name or names, specified as a character vector, cell array of character vectors, string, or string array.

### Examples

```
h.addIntrinsicMacros('GCCROOT')
h.getMacro('GCCROOT')
```

```
ans =
```

```
 []
```

```
h.removeIntrinsicMacros('GCCROOT')
h.getMacro('GCCROOT')
```

### See Also

`addMacro` | `getMacro` | `removeMacro` | `setMacro` | `addIntrinsicMacros` | `removeIntrinsicMacros`

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”



“About coder.make.ToolchainInfo”



# removePostbuildTool

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Remove postbuild build tool

## Syntax

```
h.removePostbuildTool(bldtl_name)
```

## Description

`h.removePostbuildTool(bldtl_name)` removes the named build tool from `PostbuildTools`.

## Input Arguments

**h** — **ToolchainInfo** object handle

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name** — **Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

## Examples

```
h.addPostbuildTool('copier');
h.PostbuildTools
```

```
ans =
```

```

"PostbuildTools" List

copier = <coder.make.BuildTool>
Download = <coder.make.BuildTool>
Execute = <coder.make.BuildTool>
```

```
h.removePostbuildTool('copier')
```

## See Also

`addPostbuildTool` | `getPostbuildTool` | `removePostbuildTool` | `setPostbuildTool` | `addPostDownloadTool` | `addPostExecuteTool`

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

# removePrebuildTool

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Remove prebuild build tool

## Syntax

```
h.removePrebuildTool(bldtl_name)
```

## Description

`h.removePrebuildTool(bldtl_name)` removes the named build tool from `PrebuildTools`.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

## Examples

If you have an example `coder.make.ToolchainInfo.PrebuildTools` object that contains a `BuildTool` object such as `copyFiles`:

```
h.PrebuildTools
```

```
ans =
```

```

"PrebuildTools" List

copyFiles = <coder.make.BuildTool>
h.removePrebuildTool('copyFiles')
```

## See Also

`addPrebuildTool` | `getPrebuildTool` | `removePrebuildTool` | `setPrebuildTool`

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

# setBuildConfiguration

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Set value of specified build configuration

## Syntax

```
h.setBuildConfiguration(blldcfg_name, blldcfg_handle)
```

## Description

`h.setBuildConfiguration(blldcfg_name, blldcfg_handle)` assigns a build configuration object to a build configuration in `coder.make.ToolchainInfo.BuildConfigurations`.

## Tips

Before you can use this method, add a build configuration to `BuildConfigurations` using `coder.make.ToolchainInfo.addBuildConfiguration` with a `blldcfg_name` argument.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**blldcfg\_name — Build configuration name**

character vector | string scalar

Build configuration name, specified as a character vector or string scalar.

Data Types: `char` | `string`

**blldcfg\_handle — BuildConfiguration object handle**

variable

Handle of `coder.make.BuildConfiguration` object

## Examples

```
h.getBuildConfigurations
```

```
ans =
```

```
 'Faster Builds'
 'Faster Runs'
 'Debug'
```

```

bldcfg_handle = h.getBuildConfiguration('Debug')

bldcfg_handle =

#####
Build Configuration : Debug
Description : Default debug settings for compiling/linking code
#####

ARFLAGS = /nologo $(ARDEBUG)
CFLAGS = $(cflags) $(CVARSFLAG) $(CFLAGS_ADDITIONAL) /c /Od $(CDEBUG)
CPPFLAGS = $(cflags) $(CVARSFLAG) $(CPPFLAGS_ADDITIONAL) /c /Od $(CPPDEBUG)
DOWNLOAD_FLAGS =
EXECUTE_FLAGS =
LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) $(LDDEBUG)
MEX_CFLAGS =
MEX_LDFLAGS =
MAKE_FLAGS = -f $(MAKEFILE)
SHAREDLIB_LDFLAGS = $(ldebug) $(conflags) $(LIBS_TOOLCHAIN) -dll -def:$(DEF_FILE) $(LDDEBUG)

h.addBuildConfiguration('Debug2','Variant debugging configuration')
h.setBuildConfiguration('Debug2',bldcfg_handle)
h.getBuildConfigurations

ans =

 'Faster Builds'
 'Faster Runs'
 'Debug'
 'Debug2'

```

## See Also

[getBuildConfiguration](#) | [removeBuildConfiguration](#) | [setBuildConfiguration](#) | [setBuildConfigurationOption](#)

## Topics

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)  
[“About coder.make.ToolchainInfo”](#)



# setBuildConfigurationOption

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Sets value of build tool options for build configuration

## Syntax

```
h.setBuildConfigurationOption(buildconfignames, buildobjectname, options)
```

## Description

`h.setBuildConfigurationOption(buildconfignames, buildobjectname, options)` sets option values for the named `coder.make.BuildConfiguration` objects in `coder.make.ToolchainInfo.BuildConfigurations`.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**buildconfignames — Build configuration names**

character vector | string scalar

Build configuration name or 'all', specified as a character vector.

**buildobjectname — BuildTool object name**

character vector | string scalar

BuildTool object name, specified as a character vector.

**options — Build configuration options**

character vector | string scalar

Build configuration options, specified as a character vector.

## Examples

To update a specific BuildConfiguration object or objects:

```
h = coder.make.ToolchainInfo
h.setBuildConfigurationOption('Faster Runs','C Compiler','-c -g')
```

To update all BuildConfiguration objects:

```
h = coder.make.ToolchainInfo
tc.setBuildConfigurationOption('all','C Compiler','-c -g')
```

**See Also**

`getBuildConfiguration` | `removeBuildConfiguration` | `setBuildConfiguration` | `setBuildConfigurationOption`

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”  
“About `coder.make.ToolchainInfo`”

# setBuilderApplication

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Update builder application to work on specific platform

## Syntax

`h.setBuilderApplication(platform)`

## Description

`h.setBuilderApplication(platform)` updates options in the `coder.make.BuildTool` object in `coder.make.ToolchainInfo.BuilderApplication` to work on a specific platform.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**platform — Development computer**

character vector | string scalar

To specify development computer, use one of these values:

- WIN32
- WIN64
- MACI64
- GLNXA64

Data Types: `char` | `string`

## Examples

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to update the `BuilderApplication` property:

```
% -----
% Builder
% -----

tc.setBuilderApplication(tc.Platform);
```

### Tips

- You must use this method you if you plan to use the custom toolchain on a computer running Windows and the value of `coder.make.ToolchainInfo.BuildArtifact` is `gmake makefile`.

### See Also

#### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

# setBuildTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Assign BuildTool object to named build tool in BuildTools

## Syntax

```
h.setBuildTool(bldtl_name, bldtl_handle)
```

## Description

h.setBuildTool(bldtl\_name, bldtl\_handle) assigns a BuildTool object to the named build tool in coder.make.ToolchainInfo.BuildTools.

## Tips

Refer to the “Example” on page 3-69 for coder.make.BuildTool for an example of how to create a BuildTool object.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A coder.make.ToolchainInfo on page 3-74 object, specified using an object handle, such as h. To create h, enter h = coder.make.ToolchainInfo in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: char | string

**bldtl\_handle — BuildTool object handle**

variable

coder.make.BuildTool object handle.

## Examples

```
h = coder.make.ToolchainInfo;
bt = coder.make.BuildTool('exemplename')
h.setBuildTool('Archiver',bt)
```

## See Also

coder.make.BuildTool | addBuildTool | getBuildTool | removeBuildTool | setBuildTool

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

# setMacro

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Set value of macro

## Syntax

```
h.setMacro(macroname, value)
```

## Description

`h.setMacro(macroname, value)` sets the value of a macro.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**macroname — Name of macro**

character vector | string scalar

Name of macro.

**macrovalue — Value of macro**

character vector | string scalar | cell

Value of the macro, specified as a character vector, string scalar, or cell array.

If the value contains MATLAB functions or other macros, `ToolchainInfo` on page 3-74 interprets the value of functions and macros.

Data Types: `cell` | `char` | `string`

## Examples

```
h.setMacro('CYGWIN','C:\cygwin\');
h.getMacro('CYGWIN')
```

```
ans =
```

```
C:\cygwin\bin\
```

```
h.removeMacro('CYGWIN')
```

**See Also**

`addMacro` | `getMacro` | `removeMacro` | `setMacro` | `addIntrinsicMacros` | `removeIntrinsicMacros`

**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”  
“About `coder.make.ToolchainInfo`”



# setPostbuildTool

**Class:** coder.make.ToolchainInfo

**Package:** coder.make

Assign BuildTool object to PostbuildTool tool in PostbuildTools

## Syntax

```
h.setPostbuildTool(bldtl_name, bldtl_handle)
```

## Description

`h.setPostbuildTool(bldtl_name, bldtl_handle)` assigns a BuildTool object to the named build tool in `coder.make.ToolchainInfo.PostbuildTools` on page 3-86.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

**bldtl\_handle — BuildTool object handle**

variable

`coder.make.BuildTool` object handle.

## Examples

```
h = coder.make.ToolchainInfo;
bt = coder.make.BuildTool('exampleName')
h.addPostbuildTool('toolName')
h.setPostbuildTool('toolName',bt)
```

## See Also

`addPostbuildTool` | `getPostbuildTool` | `removePostbuildTool` | `setPostbuildTool` | `addPostDownloadTool` | `addPostExecuteTool`

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

## setPrebuildTool

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Assign `BuildTool` object to named `PrebuildTool` in `PrebuildTools`

### Syntax

```
h.setPrebuildTool(bldtl_name, bldtl_handle)
```

### Description

`h.setPrebuildTool(bldtl_name, bldtl_handle)` assigns a `BuildTool` object to the named build tool in `coder.make.ToolchainInfo.PrebuildTools` on page 3-87.

### Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**bldtl\_name — Build tool name**

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Examples

```
h = coder.make.ToolchainInfo;
bt = coder.make.BuildTool('examplename');
h.addPrebuildTool('toolname');
h.setPrebuildTool('toolname',bt)
```

### See Also

`addPrebuildTool` | `getPrebuildTool` | `removePrebuildTool` | `setPrebuildTool`

### Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

# setup

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Invoke toolchain setup commands specified by `MATLABSetup` and `ShellSetup`

## Syntax

```
h.setup
```

## Description

`h.setup` runs setup commands before starting the software build process. First, it runs the commands specified by `coder.make.ToolchainInfo.MATLABSetup`, and then it runs the commands specified by `coder.make.ToolchainInfo.ShellSetup`.

The commands in `MATLABSetup` run in your MATLAB software.

The commands in `ShellSetup` run as system calls to the standard input of the operating system on your host computer. These commands are similar to what you enter when you use the command line.

## Input Arguments

**h** — **ToolchainInfo** object handle

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

## Output Arguments

**success** — **Response indicating whether setup completed**

double

Response indicating whether setup completed (0 = false, 1 = true), returned as a double.

**report** — **Detailed information generated by setup commands**

character vector

Detailed information generated by the setup commands, returned as a character vector.

## Examples

```
[success,report] = h.setup
```

```
success =
```

```
1
```

```
report =
 ''
```

### **See Also**

`cleanup` | `validate`

### **Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About `coder.make.ToolchainInfo`”

# validate

**Class:** `coder.make.ToolchainInfo`

**Package:** `coder.make`

Validate toolchain

## Syntax

```
h.validate
h.validate('setup','cleanup')
[sflag, report] = h.validate (___)
```

## Description

`h.validate` validates the toolchain object and generates errors if properties are incorrectly defined.

`h.validate('setup','cleanup')` evaluates the setup callbacks (`ShellSetup` and `MATLABSetup`) of the toolchain object before validation and evaluates the cleanup callbacks (`ShellCleanup` and `MATLABCleanup`) of the toolchain object after validation. The Configuration Parameters dialog box executes this version of `validate` when validating the toolchain.

`[sflag, report] = h.validate (___)` validates the toolchain object, generates errors if properties are incorrectly defined, and returns optional output arguments.

## Input Arguments

**h — ToolchainInfo object handle**

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**'setup' — Setup argument for validate operation.**

character vector | string scalar

Evaluates setup for the toolchain.

**'cleanup' — Cleanup argument for validate operation.**

character vector | string scalar

Evaluates cleanup for the toolchain.

## Output Arguments

**sflag — Validation response**

double

Validation response, returned as a numeric value. If any of the property values that the method checks are invalid, the method returns 0. Otherwise, it returns 1.

**report — Invalid property information**

character vector

Information about properties that are invalid. Only available when the method returns 0.

**Examples****Validation Response for Undefined Toolchain**

If you try to validate a toolchain before build tools are defined, `validate` produces an error.

```
h = coder.make.ToolchainInfo;
[sflag,report] = h.validate
```

```
Error using coder.make.ToolchainInfo/validate
Validation error(s):
The 'Command' parameter for the build tool named 'C Compiler'
in the toolchain '' cannot be an empty character vector.
The 'Command' parameter for the build tool named 'Linker'
in the toolchain '' cannot be an empty character vector.
The 'Command' parameter for the build tool named 'C++ Compiler'
in the toolchain '' cannot be an empty character vector.
The 'Command' parameter for the build tool named 'C++ Linker'
in the toolchain '' cannot be an empty character vector.
```

**Validation Response for Uninstalled Toolchain**

If you try to validate a toolchain before defined build tools are installed, `validate` produces an error.

```
[sflag,report] = tc.validate
```

```
Error using ToolchainInfo.validate (line 270)
Validation error(s):
Validating other build tools ...

Unable to locate build tool "Intel C Compiler": icl
Unable to locate build tool "Intel C++ Compiler": icl
Unable to locate build tool "Intel C/C++ Archiver": xilib
Unable to locate build tool "Intel C/C++ Linker": xilink
Unable to locate build tool "NMAKE Utility": nmake
```

**See Also**[cleanup](#) | [setup](#)**Topics**[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)[“Troubleshooting Custom Toolchain Validation”](#)[“About coder.make.ToolchainInfo”](#)

# coder.make.getDefaultToolchain

**Package:** coder.make

Get DefaultToolchain name from registry

## Syntax

```
tc_name = coder.make.getDefaultToolchain()
```

## Description

`tc_name = coder.make.getDefaultToolchain()` returns the name of the default host toolchain based on the toolchain indicated by `mex -setup`.

## Examples

### Retrieve Name of Default Toolchain

To get the name of the default toolchain, run:

```
tc_name = coder.make.getDefaultToolchain()
```

## Output Arguments

### **tc\_name** — Toolchain name

character vector

Toolchain name, specified as a character vector.

Data Types: char

## See Also

`getToolchainInfoFromRegistry` | `coder.make.BuildTool` | `addBuildTool` | `getBuildTool` | `removeBuildTool` | `setBuildTool`

## Topics

"About coder.make.ToolchainInfo"

**Introduced in R2016b**

## coder.make.getToolchainInfoFromRegistry

**Package:** coder.make

Get copy of selected ToolchainInfo object from registry

### Syntax

```
h = coder.make.getToolchainInfoFromRegistry(tc_name)
```

### Description

`h = coder.make.getToolchainInfoFromRegistry(tc_name)` returns a copy of the toolchain information object that is registered with the specified name.

### Examples

#### Retrieve Information About Default Toolchain

To retrieve information about the default toolchain, run:

```
tc_name=coder.make.getDefaultToolchain();
h=coder.make.getToolchainInfoFromRegistry(tc_name)
```

### Input Arguments

#### **tc\_name** — Toolchain name

character vector

Toolchain name, specified as a character vector.

Data Types: char

### Output Arguments

#### **h** — ToolchainInfo object handle

variable

A `coder.make.ToolchainInfo` on page 3-74 object, specified using an object handle, such as `h`. To create `h`, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

### See Also

`getDefaultToolchain` | `coder.make.BuildTool` | `addBuildTool` | `getBuildTool` | `removeBuildTool` | `setBuildTool`

### Topics

“About `coder.make.ToolchainInfo`”



**Introduced in R2016b**

## **getHardwareImplementation**

**Class:** `coder.BuildConfig`

**Package:** `coder`

Get handle of copy of hardware implementation object

### **Syntax**

```
hw = bldcfg.getHardwareImplementation()
```

### **Description**

`hw = bldcfg.getHardwareImplementation()` returns the handle of a copy of the hardware implementation object.

### **Input Arguments**

**bldcfg**

`coder.BuildConfig` object.

### **Output Arguments**

**hw**

Handle of copy of hardware implementation object.

### **See Also**

`coder.HardwareImplementation`

# getStdLibInfo

**Class:** coder.BuildConfig

**Package:** coder

Get standard library information

## Syntax

```
[linkLibPath,linkLibExt,execLibExt,libPrefix]= bldcfg.getStdLibInfo()
```

## Description

[linkLibPath,linkLibExt,execLibExt,libPrefix]= bldcfg.getStdLibInfo() returns character vectors representing the:

- Standard MATLAB architecture-specific library path
- Platform-specific library file extension for use at link time
- Platform-specific library file extension for use at run time
- Standard architecture-specific library name prefix

## Input Arguments

### bldcfg

coder.BuildConfig object.

## Output Arguments

### linkLibPath

Standard MATLAB architecture-specific library path specified as a character vector. The character vector can be empty.

### linkLibExt

Platform-specific library file extension for use at link time, specified as a character vector. The value is one of '.lib', '.dylib', '.so', ''.

### execLibExt

Platform-specific library file extension for use at run time, specified as a character vector. The value is one of '.dll', '.dylib', '.so', ''.

### linkPrefix

Standard architecture-specific library name prefix, specified as a character vector. The character vector can be empty.

## getTargetLang

**Class:** coder.BuildConfig

**Package:** coder

Get target code generation language

### Syntax

```
lang = bldcfg.getTargetLang()
```

### Description

`lang = bldcfg.getTargetLang()` returns a character vector containing the target code generation language.

### Input Arguments

**bldcfg**

coder.BuildConfig object.

### Output Arguments

**lang**

A character vector containing the target code generation language. The value is 'C' or 'C++'.

## getToolchainInfo

**Class:** `coder.BuildConfig`

**Package:** `coder`

Returns handle of copy of toolchain information object

### Syntax

```
tc = bldcfg.getToolchainInfo()
```

### Description

`tc = bldcfg.getToolchainInfo()` returns a handle of a copy of the toolchain information object.

### Input Arguments

**bldcfg**

`coder.BuildConfig` object.

### Output Arguments

**tc**

Handle of copy of toolchain information object.

### See Also

`coder.make.ToolchainInfo`

## isCodeGenTarget

**Class:** `coder.BuildConfig`

**Package:** `coder`

Determine if build configuration represents specified target

### Syntax

```
tf = bldcfg.isCodeGenTarget(target)
```

### Description

`tf = bldcfg.isCodeGenTarget(target)` returns true (1) if the code generation target of the current build configuration represents the code generation target specified by `target`. Otherwise, it returns false (0).

### Input Arguments

#### **bldcfg**

`coder.BuildConfig` object.

#### **target**

Code generation target specified as a character vector or cell array of character vectors.

| Specify | For code generation target                                       |
|---------|------------------------------------------------------------------|
| 'rtw'   | C/C++ dynamic Library, C/C++ static library, or C/C++ executable |
| 'sfun'  | S-function (Simulation)                                          |
| 'mex'   | MEX-function                                                     |

Specify `target` as a cell array of character vectors to test if the code generation target of the build configuration represents one of the targets specified in the cell array.

For example:

```
...
mytarget = {'sfun','mex'};
tf = bldcfg.isCodeGenTarget(mytarget);
...
```

tests whether the build context represents an S-function target or a MEX-function target.

## Output Arguments

**tf**

The value is true (1) if the code generation target of the build configuration represents the code generation target specified by `target`. Otherwise, the value is false (0).

## See Also

`coder.target`

## isMatlabHostTarget

**Class:** coder.BuildConfig

**Package:** coder

Determine if hardware implementation object target is MATLAB host computer

### Syntax

```
tf = bldcfg.isMatlabHostTarget()
```

### Description

`tf = bldcfg.isMatlabHostTarget()` returns true (1) if the current hardware implementation object targets the MATLAB host computer. Otherwise, it returns false (0).

### Input Arguments

**bldcfg**

coder.BuildConfig object.

### Output Arguments

**tf**

Value is true (1) if the current hardware implementation object targets the MATLAB host computer. Otherwise, the value is false (0).

### See Also

coder.HardwareImplementation



# isHeterogeneous

**Class:** coder.CellType

**Package:** coder

Determine whether cell array type represents a heterogeneous cell array

## Syntax

```
tf = isHeterogeneous(t)
```

## Description

`tf = isHeterogeneous(t)` returns true if the `coder.CellType` object `t` is heterogeneous. Otherwise, it returns false.

## Examples

### Determine Whether Cell Array Type Is Heterogeneous

Create a `coder.CellType` object for a cell array whose elements have different classes.

```
t = coder.typeof({'a', 1})
```

```
t =
```

```
coder.CellType
 1x2 heterogeneous cell
 f0: 1x1 char
 f1: 1x1 double
```

Determine whether the `coder.CellType` object represents a heterogeneous cell array.

```
isHeterogeneous(t)
```

```
ans =
```

```
1
```

### Test for Heterogeneous Cell Array Type Before Executing Code

Write a function `assign_name`. If the input type `t` is heterogeneous, the function returns a copy of `t`. The copy specifies the name for the structure type that represents the cell array type in the generated code.

```
function ts = assign_name(t, str_name)
assert(isHeterogeneous(t));
ts = coder.cstructname(t, str_name);
disp ts
end
```

Create a homogeneous type `tc`.

```
tc = coder.typeof({1 2 3});
```

Pass `tc` to `make_varsize`.

```
tc1 = assign_name(tc, 'myname')
```

The assertions fails because `tc` is not heterogeneous.

Create a heterogeneous type `tc`.

```
tc = coder.typeof({'a' 1});
```

Pass `tc` to `make_varsize`.

```
tc1 = assign_name(tc, 'myname')
```

```
tc1 =
```

```
coder.CellType
 1x2 heterogeneous cell myname
 f0: 1x1 char
 f1: 1x1 double
```

## Tips

- `coder.typeof` determines whether the cell array type is homogeneous or heterogeneous. If the cell array elements have the same class and size, `coder.typeof` returns a homogeneous cell array type. If the elements have different classes, `coder.typeof` returns a heterogeneous cell array type. For some cell arrays, the classification as homogeneous or heterogeneous is ambiguous. For example, the type for `{1 [2 3]}` can be a 1x2 heterogeneous type. The first element is double and the second element is 1x2 double. The type can also be a 1x3 homogeneous type in which the elements have class double and size 1x:2. For these ambiguous cases, `coder.typeof` uses heuristics to classify the type as homogeneous or heterogeneous. If you want a different classification, use the `makeHomogeneous` or `makeHeterogeneous` methods. The `makeHomogeneous` method makes a homogeneous copy of a type. The `makeHeterogeneous` method makes a heterogeneous copy of a type.

The `makeHomogeneous` and `makeHeterogeneous` methods permanently assign the classification as homogeneous and heterogeneous, respectively. You cannot later use one of these methods to create a copy that has a different classification.

## See Also

`coder.typeof` | `coder.newtype`

## Topics

“Code Generation for Cell Arrays”

“Specify Cell Array Inputs at the Command Line”

**Introduced in R2015b**

## isHomogeneous

**Class:** coder.CellType

**Package:** coder

Determine whether cell array type represents a homogeneous cell array

### Syntax

```
tf = isHomogeneous(t)
```

### Description

`tf = isHomogeneous(t)` returns `true` if the `coder.CellType` object `t` represents a homogeneous cell array. Otherwise, it returns `false`.

### Examples

#### Determine Whether Cell Array Type Is Homogeneous.

Create a `coder.CellType` object for a cell array whose elements have the same class and size.

```
t = coder.typeof({1 2 3})
t =
```

```
coder.CellType
 1x3 homogeneous cell
 base: 1x1 double
```

Determine whether the `coder.CellType` object represents a homogeneous cell array.

```
isHomogeneous(t)
ans =
 1
```

#### Test for a Homogeneous Cell Array Type Before Executing Code

Write a function `make_varsize`. If the input type `t` is homogeneous, the function returns a variable-size copy of `t`.

```
function c = make_varsize(t, n)
assert(isHomogeneous(t));
c = coder.typeof(t, [n n], [1 1]);
end
```

Create a heterogeneous type `tc`.

```
tc = coder.typeof({'a', 1});
```

Pass `tc` to `make_varsize`.

```
tc1 = make_varsize(tc, 5)
```

The assertion fails because `tc` is heterogeneous.

Create a homogeneous type `tc`.

```
tc = coder.typeof({1 2 3});
```

Pass `tc` to `make_varsize`.

```
tc1 = make_varsize(tc, 5)
```

```
tc1 =
```

```
coder.CellType
 :5x:5 homogeneous cell
 base: 1x1 double
```

## Tips

- `coder.typeof` determines whether the cell array type is homogeneous or heterogeneous. If the cell array elements have the same class and size, `coder.typeof` returns a homogeneous cell array type. If the elements have different classes, `coder.typeof` returns a heterogeneous cell array type. For some cell arrays, the classification as homogeneous or heterogeneous is ambiguous. For example, the type for `{1 [2 3]}` can be a 1x2 heterogeneous type. The first element is double and the second element is 1x2 double. The type can also be a 1x3 homogeneous type in which the elements have class double and size 1x:2. For these ambiguous cases, `coder.typeof` uses heuristics to classify the type as homogeneous or heterogeneous. If you want a different classification, use the `makeHomogeneous` or `makeHeterogeneous` methods. The `makeHomogeneous` method makes a homogeneous copy of a type. The `makeHeterogeneous` method makes a heterogeneous copy of a type.

The `makeHomogeneous` and `makeHeterogeneous` methods permanently assign the classification as homogeneous and heterogeneous, respectively. You cannot later use one of these methods to create a copy that has a different classification.

## See Also

`coder.typeof` | `coder.newtype`

### Topics

“Code Generation for Cell Arrays”

“Specify Cell Array Inputs at the Command Line”

### Introduced in R2015b

# makeHeterogeneous

**Class:** `coder.CellType`

**Package:** `coder`

Make a heterogeneous copy of a cell array type

## Syntax

```
newt = makeHeterogeneous(t)
t = makeHeterogeneous(t)
```

## Description

`newt = makeHeterogeneous(t)` creates a `coder.CellType` object for a heterogeneous cell array from the `coder.CellType` object `t`. `t` cannot represent a variable-size cell array.

The classification as heterogeneous is permanent. You cannot later create a homogeneous `coder.CellType` object from `newt`.

`t = makeHeterogeneous(t)` creates a heterogeneous `coder.CellType` object from `t` and replaces `t` with the new object.

## Examples

### Replace a Homogeneous Cell Array Type with a Heterogeneous Cell Array Type

Create a cell array type `t` whose elements have the same class and size.

```
t = coder.typeof({1 2 3})
```

```
t =
```

```
coder.CellType
 1x3 homogeneous cell
 base: 1x1 double
```

The cell array type is homogeneous.

Replace `t` with a cell array type for a heterogeneous cell array.

```
t = makeHeterogeneous(t)
```

```
t =
```

```
coder.CellType
 1x3 locked heterogeneous cell
 f1: 1x1 double
 f2: 1x1 double
 f3: 1x1 doublee
```

The cell array type is heterogeneous. The elements have the size and class of the original homogeneous cell array type.

## Tips

- In the display of a `coder.CellType` object, the terms `locked heterogeneous` or `locked homogeneous` indicate that the classification as homogeneous or heterogeneous is permanent. You cannot later change the classification by using the `makeHomogeneous` or `makeHeterogeneous` methods.
- `coder.typeof` determines whether the cell array type is homogeneous or heterogeneous. If the cell array elements have the same class and size, `coder.typeof` returns a homogeneous cell array type. If the elements have different classes, `coder.typeof` returns a heterogeneous cell array type. For some cell arrays, the classification as homogeneous or heterogeneous is ambiguous. For example, the type for `{1 [2 3]}` can be a 1x2 heterogeneous type. The first element is double and the second element is 1x2 double. The type can also be a 1x3 homogeneous type in which the elements have class double and size 1x2. For these ambiguous cases, `coder.typeof` uses heuristics to classify the type as homogeneous or heterogeneous. If you want a different classification, use the `makeHomogeneous` or `makeHeterogeneous` methods.

## See Also

`coder.typeof` | `coder.newtype`

## Topics

“Code Generation for Cell Arrays”

“Specify Cell Array Inputs at the Command Line”

**Introduced in R2015b**

# makeHomogeneous

**Class:** `coder.CellType`

**Package:** `coder`

Create a homogeneous copy of a cell array type

## Syntax

```
newt = makeHomogeneous(t)
t = makeHomogeneous(t)
```

## Description

`newt = makeHomogeneous(t)` creates a `coder.CellType` object for a homogeneous cell array `newt` from the `coder.CellType` object `t`.

To create `newt`, the `makeHomogeneous` method must determine a size and class that represent all elements of `t`:

- If the elements of `t` have the same class, but different sizes, the elements of `newt` are variable size with upper bounds that accommodate the elements of `t`.
- If the elements of `t` have different classes, for example, `char` and `double`, the `makeHomogeneous` method cannot create a `coder.CellType` object for a homogeneous cell array.

If you use `coder.cstructname` to specify a name for the structure type that represents `t` in the generated code, you cannot create a homogeneous `coder.CellType` object from `t`.

The classification as homogeneous is permanent. You cannot later create a heterogeneous `coder.CellType` object from `newt`.

`t = makeHomogeneous(t)` creates a homogeneous `coder.CellType` object from `t` and replaces `t` with the new object.

## Examples

### Replace a Heterogeneous Cell Array Type with a Homogeneous Cell Array Type

Create a cell array type `t` whose elements have the same class, but different sizes.

```
t = coder.typeof({1 [2 3]})
t =
coder.CellType
 1x2 heterogeneous cell
 f0: 1x1 double
 f1: 1x2 double
```

The cell array type is heterogeneous.

Replace `t` with a cell array type for a homogeneous cell array.

```
t = makeHomogeneous(t)
t =
coder.CellType
 1x2 locked homogeneous cell
 base: 1x2 double
```

The new cell array type is homogeneous.

## Tips

- In the display of a `coder.CellType` object, the terms `locked heterogeneous` or `locked homogeneous` indicate that the classification as homogeneous or heterogeneous is permanent. You cannot later change the classification by using the `makeHomogeneous` or `makeHeterogeneous` methods.
- `coder.typeof` determines whether the cell array type is homogeneous or heterogeneous. If the cell array elements have the same class and size, `coder.typeof` returns a homogeneous cell array type. If the elements have different classes, `coder.typeof` returns a heterogeneous cell array type. For some cell arrays, the classification as homogeneous or heterogeneous is ambiguous. For example, the type for `{1 [2 3]}` can be a 1x2 heterogeneous type. The first element is `double` and the second element is `1x2 double`. The type can also be a 1x3 homogeneous type in which the elements have class `double` and size `1x2`. For these ambiguous cases, `coder.typeof` uses heuristics to classify the type as homogeneous or heterogeneous. If you want a different classification, use the `makeHomogeneous` or `makeHeterogeneous` methods.

## See Also

`coder.typeof` | `coder.newtype` | `coder.cstructname`

## Topics

“Code Generation for Cell Arrays”

“Specify Cell Array Inputs at the Command Line”

**Introduced in R2015b**



# coder.ExternalDependency.getDescriptiveName

**Class:** coder.ExternalDependency

**Package:** coder

Return descriptive name for external dependency

## Syntax

```
extname = coder.ExternalDependency.getDescriptiveName(bldcfg)
```

## Description

`extname = coder.ExternalDependency.getDescriptiveName(bldcfg)` returns the name that you want to associate with an “external dependency” on page 2-390. The code generator uses the external dependency name for error messages.

## Input Arguments

### **bldcfg**

`coder.BuildConfig` object. Use `coder.BuildConfig` methods to get information about the “build context” on page 2-390

You can use this information when you want to return different names based on the build context.

## Output Arguments

### **extname**

External dependency name returned as a character vector.

## Examples

### **Return external dependency name**

Define a method that always returns the same name.

```
function myextname = getDescriptiveName(~)
 myextname = 'MyLibrary'
end
```

### **Return external library name based on the code generation target**

Define a method that uses the build context to determine the name.

```
function myextname = getDescriptiveName(context)
 if context.isMatlabHostTarget()
```

```
 myextname = 'MyLibrary_MatlabHost';
 else
 myextname = 'MyLibrary_Local';
 end
end
```

## More About

### external dependency

External code interface represented by a class derived from a `coder.ExternalDependency` class. The external code can be a library, object files, or C/C++ source.

### build context

Information used by the build process including:

- Target language
- Code generation target
- Target hardware
- Build toolchain

## See Also

`coder.updateBuildInfo` | `coder.BuildConfig` | `coder.ceval` | `coder.ExternalDependency`

### Topics

“Develop Interface for External C/C++ Code”

“Build Process Customization”

“Integrate External/Custom Code”

# coder.ExternalDependency.isSupportedContext

**Class:** coder.ExternalDependency

**Package:** coder

Determine if build context supports external dependency

## Syntax

```
tf = coder.ExternalDependency.isSupportedContext(blcfg)
```

## Description

`tf = coder.ExternalDependency.isSupportedContext(blcfg)` returns true (1) if you can use the “external dependency” on page 2-392 in the current “build context” on page 2-392 . You must provide this method in the class definition for a class that derives from `coder.ExternalDependency`.

If you cannot use the “external dependency” on page 2-392 in the current “build context” on page 2-392, display an error message and stop code generation. The error message must describe why you cannot use the external dependency in this build context. If the method returns false (0), the code generator uses a default error message. The default error message uses the name returned by the `getDescriptiveName` method of the `coder.ExternalDependency` class.

Use `coder.BuildConfig` methods to determine if you can use the external dependency in the current build context.

## Input Arguments

### **blcfg**

`coder.BuildConfig` object. Use `coder.BuildConfig` methods to get information about the “build context” on page 2-392.

## Output Arguments

### **tf**

Value is true (1) if the build context supports the external dependency.

## Examples

### **Report error when build context does not support external library**

This method returns true(1) if the code generation target is a MATLAB host target. Otherwise, the method reports an error and stops code generation.

Write `isSupportedContext` method.

```
function tf = isSupportedContext(ctx)
 if ctx.isMatlabHostTarget()
 tf = true;
 else
 error('adder library not available for this target');
 end
end
```

## More About

### external dependency

External code interface represented by a class derived from `coder.ExternalDependency` class. The external code can be a library, object file, or C/C++ source.

### build context

Information used by the build process including:

- Target language
- Code generation target
- Target hardware
- Build toolchain

## See Also

`coder.updateBuildInfo` | `coder.BuildConfig` | `coder.ceval` | `coder.ExternalDependency`

### Topics

“Develop Interface for External C/C++ Code”

“Build Process Customization”

“Integrate External/Custom Code”

# coder.ExternalDependency.updateBuildInfo

**Class:** coder.ExternalDependency

**Package:** coder

Update build information

## Syntax

```
coder.ExternalDependency.updateBuildInfo(buildInfo, bldcfg)
```

## Description

`coder.ExternalDependency.updateBuildInfo(buildInfo, bldcfg)` updates the build information object whose handle is `buildInfo`. After code generation, the build information object has standard information. Use this method to provide additional information required to link to external code. Use `coder.BuildConfig` methods to get information about the “build context” on page 2-393.

You must implement this method in a subclass of `coder.ExternalDependency`. For an example, see `coder.ExternalDependency`.

## Input Arguments

### **buildInfo**

Handle of build information object.

### **bldcfg**

`coder.BuildConfig` object. Use `coder.BuildConfig` methods to get information about the “build context” on page 2-393.

## Limitations

- The build information method `AddIncludeFiles` has no effect in a `coder.ExternalDependency.updateBuildInfo` method.

## More About

### **build context**

Information used by the build process including:

- Target language
- Code generation target
- Target hardware
- Build toolchain

**See Also**

`coder.updateBuildInfo` | `coder.BuildConfig` | `coder.ceval` | `coder.ExternalDependency`

**Topics**

“Develop Interface for External C/C++ Code”

“Build Process Customization”

“Integrate External/Custom Code”

# addDesignRangeSpecification

Add design range specification to parameter

## Syntax

```
addDesignRangeSpecification(fcnName,paramName,designMin, designMax)
```

## Description

`addDesignRangeSpecification(fcnName,paramName,designMin, designMax)` specifies the minimum and maximum values allowed for the parameter, `paramName`, in function, `fcnName`. The fixed-point conversion process uses this design range information to derive ranges for downstream variables in the code.

## Input Arguments

### **fcnName** — Function name

string

Function name, specified as a string.

Data Types: char

### **paramName** — Parameter name

string

Parameter name, specified as a string.

Data Types: char

### **designMin** — Minimum value allowed for this parameter

scalar

Minimum value allowed for this parameter, specified as a scalar double.

Data Types: double

### **designMax** — Maximum value allowed for this parameter

scalar

Maximum value allowed for this parameter, specified as a scalar double.

Data Types: double

## Examples

### Add a Design Range Specification

```
% Set up the fixed-point configuration object
fixptcfg = coder.config('fixpt');
fixptcfg.TestBenchName = 'dti_test';
fixptcfg.addDesignRangeSpecification('dti', 'u_in', -1.0, 1.0)
```

```
fixptcfg.ComputeDerivedRanges = true;

%Set up C code configuration object
cfg = coder.config('lib');
% Derive ranges and generate fixed-point C code
codegen -config cfg -float2fixed fixptcfg dti -report
```

### See Also

[coder.FixPtConfig](#) | [codegen](#) | [hasDesignRangeSpecification](#) | [removeDesignRangeSpecification](#) | [clearDesignRangeSpecifications](#) | [getDesignRangeSpecification](#)



# addFunctionReplacement

Replace floating-point function with fixed-point function during fixed-point conversion

## Syntax

```
addFunctionReplacement(floatFn, fixedFn)
```

## Description

`addFunctionReplacement(floatFn, fixedFn)` specifies a function replacement in a `coder.FixptConfig` object. During floating-point to fixed-point conversion, the conversion process replaces the specified floating-point function with the specified fixed-point function. The fixed-point function must be in the same folder as the floating-point function or on the MATLAB path.

## Input Arguments

### **floatFn** — Name of floating-point function

' ' (default) | string

Name of floating-point function, specified as a string.

### **fixedFn** — Name of fixed-point function

' ' (default) | string

Name of fixed-point function, specified as a string.

## Examples

### Specify Function Replacement in Fixed-Point Conversion Configuration Object

Suppose that:

- The function `myfunc` calls a local function `myadd`.
- The test function `mytest` calls `myfunc`.
- You want to replace calls to `myadd` with the fixed-point function `fi_myadd`.

Create a `coder.FixptConfig` object, `fixptcfg`, with default settings.

```
fixptcfg = coder.config('fixpt');
```

Set the test bench name. In this example, the test bench function name is `mytest`.

```
fixptcfg.TestBenchName = 'mytest';
```

Specify that the floating-point function, `myadd`, should be replaced with the fixed-point function, `fi_myadd`.

```
fixptcfg.addFunctionReplacement('myadd', 'fi_myadd');
```

Create a code generation configuration object to generate a standalone C static library.

```
cfg = coder.config('lib');
```

Convert the floating-point MATLAB function, `myfunc`, to fixed-point, and generate C code.

```
codegen -float2fixed fixptcfg -config cfg myfunc
```

When you generate code, the code generator replaces instances of `myadd` with `fi_myadd` during floating-point to fixed-point conversion.

### **See Also**

`coder.FixPtConfig` | `coder.config` | `codegen`

# clearDesignRangeSpecifications

Clear all design range specifications

## Syntax

```
clearDesignRangeSpecifications()
```

## Description

`clearDesignRangeSpecifications()` clears all design range specifications.

## Examples

### Clear a Design Range Specification

```
% Set up the fixed-point configuration object
cfg = coder.config('fixpt');
cfg.TestBenchName = 'dti_test';
cfg.addDesignRangeSpecification('dti', 'u_in', -1.0, 1.0)
cfg.ComputeDerivedRanges = true;
% Verify that the 'dti' function parameter 'u_in' has design range
hasDesignRanges = cfg.hasDesignRangeSpecification('dti','u_in')
% Now remove the design range
cfg.clearDesignRangeSpecifications()
hasDesignRanges = cfg.hasDesignRangeSpecification('dti','u_in')
```

## See Also

`coder.FixPtConfig` | `codegen` | `addDesignRangeSpecification` | `removeDesignRangeSpecification` | `hasDesignRangeSpecification` | `getDesignRangeSpecification`

## getDesignRangeSpecification

Get design range specifications for parameter

### Syntax

```
[designMin, designMax] = getDesignRangeSpecification(fcnName,paramName)
```

### Description

[designMin, designMax] = getDesignRangeSpecification(fcnName,paramName) gets the minimum and maximum values specified for the parameter, paramName, in function, fcnName.

### Input Arguments

**fcnName — Function name**

string

Function name, specified as a string.

Data Types: char

**paramName — Parameter name**

string

Parameter name, specified as a string.

Data Types: char

### Output Arguments

**designMin — Minimum value allowed for this parameter**

scalar

Minimum value allowed for this parameter, specified as a scalar double.

Data Types: double

**designMax — Maximum value allowed for this parameter**

scalar

Maximum value allowed for this parameter, specified as a scalar double.

Data Types: double

### Examples

**Get Design Range Specifications**

```
% Set up the fixed-point configuration object
cfg = coder.config('fixpt');
cfg.TestBenchName = 'dti_test';
```

```
cfg.addDesignRangeSpecification('dti', 'u_in', -1.0, 1.0)
cfg.ComputeDerivedRanges = true;
% Get the design range for the 'dti' function parameter 'u_in'
[designMin, designMax] = cfg.getDesignRangeSpecification('dti','u_in')

designMin =

 -1

designMax =

 1
```

### See Also

[coder.FixPtConfig](#) | [codegen](#) | [addDesignRangeSpecification](#) | [hasDesignRangeSpecification](#) | [removeDesignRangeSpecification](#) | [clearDesignRangeSpecifications](#)

## hasDesignRangeSpecification

Determine whether parameter has design range

### Syntax

```
hasDesignRange = hasDesignRangeSpecification(fcnName,paramName)
```

### Description

`hasDesignRange = hasDesignRangeSpecification(fcnName,paramName)` returns true if the parameter, `param_name` in function, `fcn`, has a design range specified.

### Input Arguments

#### **fcnName — Name of function**

string

Function name, specified as a string.

Example: 'dti'

Data Types: char

#### **paramName — Parameter name**

string

Parameter name, specified as a string.

Example: 'dti'

Data Types: char

### Output Arguments

#### **hasDesignRange — Parameter has design range**

true | false

Parameter has design range, returned as a boolean.

Data Types: logical

### Examples

#### **Verify That a Parameter Has a Design Range Specification**

```
% Set up the fixed-point configuration object
cfg = coder.config('fixpt');
cfg.TestBenchName = 'dti_test';
cfg.addDesignRangeSpecification('dti', 'u_in', -1.0, 1.0);
cfg.ComputeDerivedRanges = true;
% Verify that the 'dti' function parameter 'u_in' has design range
hasDesignRanges = cfg.hasDesignRangeSpecification('dti','u_in')
```

hasDesignRanges =

1

### **See Also**

coder.FixPtConfig | codegen | addDesignRangeSpecification |  
removeDesignRangeSpecification | clearDesignRangeSpecifications |  
getDesignRangeSpecification

# removeDesignRangeSpecification

Remove design range specification from parameter

## Syntax

```
removeDesignRangeSpecification(fcnName,paramName)
```

## Description

`removeDesignRangeSpecification(fcnName,paramName)` removes the design range information specified for parameter, `paramName`, in function, `fcnName`.

## Input Arguments

### **fcnName** — Name of function

string

Function name, specified as a string.

Data Types: char

### **paramName** — Parameter name

string

Parameter name, specified as a string.

Data Types: char

## Examples

### Remove Design Range Specifications

```
% Set up the fixed-point configuration object
cfg = coder.config('fixpt');
cfg.TestBenchName = 'dti_test';
cfg.addDesignRangeSpecification('dti', 'u_in', -1.0, 1.0)
cfg.ComputeDerivedRanges = true;
% Verify that the 'dti' function parameter 'u_in' has design range
hasDesignRanges = cfg.hasDesignRangeSpecification('dti','u_in')
% Now clear the design ranges and verify that
% hasDesignRangeSpecification returns false
cfg.removeDesignRangeSpecification('dti', 'u_in')
hasDesignRanges = cfg.hasDesignRangeSpecification('dti','u_in')
```

## See Also

`coder.FixPtConfig` | `codegen` | `addDesignRangeSpecification` | `clearDesignRangeSpecifications` | `hasDesignRangeSpecification` | `getDesignRangeSpecification`



# addApproximation

Replace floating-point function with lookup table during fixed-point conversion

## Syntax

```
addApproximation(approximationObject)
```

## Description

`addApproximation(approximationObject)` specifies a lookup table replacement in a `coder.FixptConfig` object. During floating-point to fixed-point conversion, the conversion process generates a lookup table approximation for the function specified in the `approximationObject`.

## Input Arguments

### **approximationObject** — Function replacement configuration object

`coder.mathfcngenerator.LookupTable` configuration object

Function replacement configuration object. Use the `coder.FixptConfig` configuration object `addApproximation` method to associate this configuration object with a `coder.FixptConfig` object. Then use the `codegen` function - `float2fixed` option with `coder.FixptConfig` to convert floating-point MATLAB code to fixed-point code.

## Examples

### **Replace log function with an optimized lookup table replacement**

Create a function replacement configuration object that specifies to replace the log function with an optimized lookup table.

```
logAppx = coder.approximation('Function','log','OptimizeLUTSize',...
 true,'InputRange',[0.1,1000],'InterpolationDegree',1,...
 'ErrorThreshold',1e-3,...
 'FunctionNamePrefix','log_optim_','OptimizeIterations',25);
```

Create a fixed-point configuration object and associate the function replacement configuration object with it.

```
fixptcfg = coder.config('fixpt');
fixptcfg.addApproximation(logAppx);
```

You can now generate fixed-point code using the `codegen` function.

## See Also

`coder.FixPtConfig` | `coder.config` | `codegen`

## Topics

“Replace the exp Function with a Lookup Table”

“Replace a Custom Function with a Lookup Table”  
“Replacing Functions Using Lookup Table Approximations”

# addFunctionReplacement

**Class:** `coder.SingleConfig`

**Package:** `coder`

Replace double-precision function with single-precision function during single-precision conversion

## Syntax

```
addFunctionReplacement(doubleFn, singleFn)
```

## Description

`addFunctionReplacement(doubleFn, singleFn)` specifies a function replacement in a `coder.SingleConfig` object. During double-precision to single-precision conversion, the conversion process replaces the specified double-precision function with the specified single-precision function. The single-precision function must be in the same folder as the double-precision function or on the MATLAB path. It is a best practice to provide unique names to local functions that a replacement function calls. If a replacement function calls a local function, do not give that local function the same name as a local function in a different replacement function file.

## Input Arguments

**doubleFn — Name of double-precision function**

' ' (default) | string

Name of double-precision function, specified as a string.

**singleFn — Name of single-precision function**

' ' (default) | string

Name of single-precision function, specified as a string.

## Examples

### Specify Function Replacement in Single-Precision Conversion Configuration Object

Suppose that:

- The function `myfunc` calls a local function `myadd`.
- The test function `mytest` calls `myfunc`.
- You want to replace calls to `myadd` with the single-precision function `single_myadd`.

Create a `coder.SingleConfig` object, `scfg`, with default settings.

```
scfg = coder.config('single');
```

Set the test file name. In this example, the test file function name is `mytest`.

```
scfg.TestBenchName = 'mytest';
```

Specify that you want to replace the double-precision function, `myadd`, with the single-precision function, `single_myadd`.

```
scfg.addFunctionReplacement('myadd', 'single_myadd');
```

Convert the double-precision MATLAB function, `myfunc`, to a single-precision MATLAB function.

```
codegen -double2single scfg myfunc
```

The double-precision to single-precision conversion replaces instances of `myadd` with `single_myadd`.

### **See Also**

`coder.config` | `codegen`

**Introduced in R2015b**

## coder.LAPACKCallback.getHeaderFilename

**Class:** coder.LAPACKCallback

**Package:** coder

Return file name of LAPACKE header file

### Syntax

```
coder.LAPACKCallback.getHeaderFilename()
```

### Description

`coder.LAPACKCallback.getHeaderFilename()` returns the file name of the LAPACKE header file that defines the C interface to a specific LAPACK library.

`coder.LAPACKCallback` is an abstract class for defining a LAPACK callback class. A LAPACK callback class specifies the LAPACK library and LAPACKE header file to use for LAPACK calls in code generated from MATLAB code. At code generation time, if you specify a LAPACK callback class, for certain linear algebra function calls, the code generator produces LAPACK calls in standalone code.

The code generator uses the LAPACKE header file name to generate a `#include` statement.

### Examples

#### Return LAPACKE Header File Name

This example shows how to write a `getHeaderFilename` method to return the name of the LAPACKE header file.

In a class that derives from `coder.LAPACKCallback`, write a method `getHeaderFilename` that returns the name of the LAPACKE header file as a character vector. For example, in this class definition, `getHeaderFilename` returns `'mylapacke_custom.h'`.

```
classdef useMyLAPACK < coder.LAPACKCallback
 methods (Static)
 function hn = getHeaderFilename()
 hn = 'mylapacke_custom.h';
 end
 function updateBuildInfo(buildInfo, buildctx)
 buildInfo.addIncludePaths(fullfile(pwd,'include'));
 libName = 'mylapack';
 libPath = fullfile(pwd,'lib');
 [~,linkLibExt] = buildctx.getStdLibInfo();
 buildInfo.addLinkObjects([libName linkLibExt], libPath, ...
 '', true, true);
 buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
 buildInfo.addDefines('LAPACK_COMPLEX_STRUCTURE');
 buildInfo.addDefines('LAPACK_ILP64');
 end
 end
end
```

```
end
end
```

## See Also

### Topics

“Speed Up Linear Algebra in Generated Standalone Code by Using LAPACK Calls”

“Speed Up Linear Algebra in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.netlib.org/lapack](http://www.netlib.org/lapack)

# coder.LAPACKCallback.updateBuildInfo

**Class:** coder.LAPACKCallback

**Package:** coder

Update build information for linking to a specific LAPACK library

## Syntax

```
coder.LAPACKCallback.updateBuildInfo(buildInfo, buildctx)
```

## Description

`coder.LAPACKCallback.updateBuildInfo(buildInfo, buildctx)` updates the build information object `buildInfo` with the information required for the build process to link to a specific LAPACK library.

`coder.LAPACKCallback` is an abstract class for defining a LAPACK callback class. A LAPACK callback class specifies the LAPACK library and LAPACKE header file to use for LAPACK calls in code generated from MATLAB code. At code generation time, if you specify a LAPACK callback class, for certain linear algebra function calls, the code generator produces LAPACK calls in standalone code.

## Input Arguments

### buildInfo

Build information object. After code generation, this object contains standard project, build option, and dependency information. In the `updateBuildInfo` method, to add the information for linking to the LAPACK library, use build information methods.

### buildctx

`coder.BuildConfig` object. Use the `coder.BuildConfig.getStdLibInfo` method to get the platform-specific file extension to use at link time.

## Examples

### Link to a Specific LAPACK Library

This example shows how to write an `updateBuildInfo` method to update the build information object with the information required to link to a specific LAPACK library.

In a class that derives from `coder.LAPACKCallback`, write a method `updateBuildInfo`. Use this example LAPACK callback class as a template.

```
classdef useMyLAPACK < coder.LAPACKCallback
 methods (Static)
 function hn = getHeaderFilename()
 hn = 'mylapacke_custom.h';
 end
 end
end
```

```

function updateBuildInfo(buildInfo, buildctx)
 buildInfo.addIncludePaths(fullfile(pwd,'include'));
 libName = 'mylapack';
 libPath = fullfile(pwd,'lib');
 [~,linkLibExt] = buildctx.getStdLibInfo();
 buildInfo.addLinkObjects([libName linkLibExt], libPath, ...
 '', true, true);
 buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
 buildInfo.addDefines('LAPACK_COMPLEX_STRUCTURE');
 buildInfo.addDefines('LAPACK_ILP64');
end
end
end

```

Replace `mylapack` with the name of your LAPACK library. Modify the include and library paths as necessary.

To update the build information with the location of the header files, use the build information `addIncludePaths` method.

To access the platform-specific library extension, use the `coder.BuildConfig` `getStdLibInfo` method.

To update the build information with the name and location of your LAPACK library, use the build information `addLinkObjects` method.

If your compiler supports only complex data types that are represented as structures, include these lines.

```

buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
buildInfo.addDefines('LAPACK_COMPLEX_STRUCTURE');

```

You must specify the integer type that your LAPACK library uses. Not specifying this integer type can result in incorrect behaviors or crashes. Do one of the following:

- Include these lines in the `updateBuildInfo` method.

```

buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
buildInfo.addDefines('LAPACK_ILP64');

```

- Alternatively, you can directly specify the integer type that your LAPACK library uses. For example, if the integer type is `long long`, include this line in the `updateBuildInfo` method.

```

buildInfo.addDefines('lapack_int=long long');

```

## See Also

`coder.BuildConfig` | `coder.ExternalDependency`

## Topics

“Speed Up Linear Algebra in Generated Standalone Code by Using LAPACK Calls”

“Speed Up Linear Algebra in Code Generated from a MATLAB Function Block” (Simulink Coder)

“RTW.BuildInfo Methods”

## External Websites

[www.netlib.org/lapack](http://www.netlib.org/lapack)



# coder.BLASCallback.updateBuildInfo

**Class:** coder.BLASCallback

**Package:** coder

Update build information for linking to a specific BLAS library

## Syntax

```
coder.BLASCallback.updateBuildInfo(buildInfo, buildctx)
```

## Description

`coder.BLASCallback.updateBuildInfo(buildInfo, buildctx)` updates the build information object `buildInfo` with the information required for the build process to link to a specific BLAS library.

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. At code generation time, if you specify a BLAS callback class, for certain vector and matrix function calls, the code generator produces BLAS calls in standalone code.

`updateBuildInfo` is an abstract method. You must implement it in the definition of your callback class that derives from `coder.BLASCallback`.

## Input Arguments

### **buildInfo** — Build information object

value object (default)

After code generation, this object contains standard project, build option, and dependency information. In the `updateBuildInfo` method, to add the information for linking to the BLAS library, use build information methods.

### **buildctx** — `coder.BuildConfig` object

value object (default)

Use the `coder.BuildConfig` methods to access the build context settings such as target language and platform-specific library file extensions.

## Attributes

|          |      |
|----------|------|
| Abstract | true |
| Static   | true |

To learn about attributes of methods, see [Method Attributes](#).

## Examples

## Link to the Intel MKL BLAS Library

This example shows how to write an `updateBuildInfo` method to update the build information object with the information required to link to a specific BLAS library.

In a class that derives from `coder.BLASCallback`, write a method `updateBuildInfo`. This example is an implementation of the callback class `mklcallback` for integration with the Intel MKL BLAS library on a Windows platform. Use this example BLAS callback class as a template.

```
classdef mklcallback < coder.BLASCallback
 methods (Static)
 function updateBuildInfo(buildInfo, ~)
 libPath = fullfile(pwd, 'mkl', 'WIN', 'lib', 'intel64');
 libPriority = '';
 libPreCompiled = true;
 libLinkOnly = true;
 libs = {'mkl_intel_ilp64.lib' 'mkl_intel_thread.lib' 'mkl_core.lib'};
 buildInfo.addLinkObjects(libs, libPath, libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addLinkObjects('libiomp5md.lib', fullfile(matlabroot, 'bin', 'win64'), ...
 libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addIncludePaths(fullfile(pwd, 'mkl', 'WIN', 'include'));
 buildInfo.addDefines('-DMKL_ILP64');
 end
 function headerName = getHeaderFilename()
 headerName = 'mkl_cblas.h';
 end
 function intTypeName = getBLASIntTypeName()
 intTypeName = 'MKL_INT';
 end
 end
end
```

To update the build information with the name and location of your BLAS library, use the build information `addLinkObjects` method. If you use the Intel MKL BLAS library, use the link line advisor to see which libraries and compiler options are recommended for your use case.

To update the build information with the location of the header files, use the build information `addIncludePaths` method.

To add preprocessor macro definitions to the build information in `updateBuildInfo`, use the build information `addDefines` method.

To specify the compiler options in `updateBuildInfo`, use the build information `addCompileFlags` method.

To specify the linker options, use the build information `addLinkFlags` method.

## See Also

`coder.BuildConfig` | `coder.ExternalDependency`

## Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

“Build Process Customization”

**External Websites**

<https://www.netlib.org/blas/>

<https://www.openblas.net/>

<https://www.intel.com/content/www/us/en/documentation-resources/developer.html>

<https://software.intel.com/content/www/us/en/develop/tools/oneapi/components/onemkl/link-line-advisor.html>

**Introduced in R2018b**

## **coder.BLASCallback.getHeaderFilename**

**Class:** `coder.BLASCallback`

**Package:** `coder`

Return the file name of CBLAS header file

### **Syntax**

```
headerName = coder.BLASCallback.getHeaderFilename()
```

### **Description**

`headerName = coder.BLASCallback.getHeaderFilename()` returns the name of the CBLAS header file that defines the C interface to a specific BLAS library.

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. At code generation time, if you specify a BLAS callback class, for certain vector and matrix function calls, the code generator produces BLAS calls in standalone code.

`getHeaderFilename` is an abstract method. You must implement it in the definition of your callback class that derives from `coder.BLASCallback`. The code generator uses the CBLAS header file name returned by `getHeaderFilename` to produce a `#include` statement in the generated code.

### **Output Arguments**

**headerName — CBLAS header file name**

character vector

Character vector that specifies the name of the CBLAS header file that defines the C interface to a specific BLAS library.

### **Attributes**

|          |      |
|----------|------|
| Abstract | true |
| Static   | true |

To learn about attributes of methods, see [Method Attributes](#).

### **Examples**

#### **Return CBLAS Header File Name**

This example shows how to write a `getHeaderFilename` method to return the name of the CBLAS header file.

In a class that derives from `coder.BLASCallback`, write a method `getHeaderFilename` that returns the name of the CBLAS header file as a character vector. This example is an implementation

of the callback class `mklcallback` for integration with the Intel MKL BLAS library on a Windows platform. In this class, `getHeaderFilename` returns `'mkl_cblas.h'`, which is the CBLAS header file for the Intel MKL BLAS library.

```
classdef mklcallback < coder.BLASCallback
 methods (Static)
 function updateBuildInfo(buildInfo, ~)
 libPath = fullfile(pwd, 'mkl', 'WIN', 'lib', 'intel64');
 libPriority = '';
 libPreCompiled = true;
 libLinkOnly = true;
 libs = {'mkl_intel_ilp64.lib' 'mkl_intel_thread.lib' 'mkl_core.lib'};
 buildInfo.addLinkObjects(libs, libPath, libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addLinkObjects('libiomp5md.lib', fullfile(matlabroot, 'bin', 'win64'), ...
 libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addIncludePaths(fullfile(pwd, 'mkl', 'WIN', 'include'));
 buildInfo.addDefines('-DMKL_ILP64');
 end
 function headerName = getHeaderFilename()
 headerName = 'mkl_cblas.h';
 end
 function intTypeName = getBLASIntTypeName()
 intTypeName = 'MKL_INT';
 end
 end
end
```

If you are using a different BLAS library, replace `'mkl_cblas.h'` with the name of your CBLAS header file.

## See Also

### Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

<https://www.netlib.org/blas/>

<https://software.intel.com/content/www/us/en/develop/documentation/onemkl-developer-reference-c/top.html>

### Introduced in R2018b

## **coder.BLASCallback.getBLASIntTypeName**

**Class:** `coder.BLASCallback`

**Package:** `coder`

Return name of integer data type used by CBLAS interface

### **Syntax**

```
intTypeName = coder.BLASCallback.getBLASIntTypeName()
```

### **Description**

`intTypeName = coder.BLASCallback.getBLASIntTypeName()` returns the name of the integer data type that is used by the CBLAS interface to a specific BLAS library.

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. At code generation time, if you specify a BLAS callback class, for certain vector and matrix function calls, the code generator produces BLAS calls in standalone code.

`getBLASIntTypeName` is an abstract method. You must implement it in the definition of your callback class that derives from `coder.BLASCallback`. The generated code uses the integer data type name to specify types of variables in the generated code that produces BLAS calls.

### **Output Arguments**

**intTypeName** — CBLAS integer data type name

character vector

Character vector that specifies the name of the integer data type that the CBLAS interface to a specific BLAS library uses.

### **Attributes**

|          |      |
|----------|------|
| Abstract | true |
| Static   | true |

To learn about attributes of methods, see [Method Attributes](#).

### **Examples**

#### **Return CBLAS Integer Data Type Name**

This example shows how to write a `getBLASIntTypeName` method to return the name of the CBLAS integer data type.

In a class that derives from `coder.BLASCallback`, write a method `getBLASIntTypeName` that returns the name of the CBLAS integer data type as a character vector. This example is an

implementation of the callback class `mklcallback` for integration with the Intel MKL BLAS library on a Windows platform. In this class, `getBLASIntTypeName` returns `'MKL_INT'`, which is the CBLAS integer data type for the Intel MKL BLAS library.

```
classdef mklcallback < coder.BLASCallback
 methods (Static)
 function updateBuildInfo(buildInfo, ~)
 libPath = fullfile(pwd, 'mkl', 'WIN', 'lib', 'intel64');
 libPriority = '';
 libPreCompiled = true;
 libLinkOnly = true;
 libs = {'mkl_intel_ilp64.lib' 'mkl_intel_thread.lib' 'mkl_core.lib'};
 buildInfo.addLinkObjects(libs, libPath, libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addLinkObjects('libiomp5md.lib', fullfile(matlabroot, 'bin', 'win64'), ...
 libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addIncludePaths(fullfile(pwd, 'mkl', 'WIN', 'include'));
 buildInfo.addDefines('-DMKL_ILP64');
 end
 function headerName = getHeaderFilename()
 headerName = 'mkl_cblas.h';
 end
 function intTypeName = getBLASIntTypeName()
 intTypeName = 'MKL_INT';
 end
 end
end
```

If you are using a different BLAS library, replace `'MKL_INT'` with the name of your CBLAS integer data type.

## See Also

### Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

<https://www.netlib.org/blas/>

<https://www.intel.com/content/www/us/en/documentation-resources/developer.html>

### Introduced in R2018b

## **coder.BLASCallback.getBLASDoubleComplexTypeName**

**Class:** `coder.BLASCallback`

**Package:** `coder`

Return name of double-precision complex data type used by CBLAS interface

### **Syntax**

```
doubleComplexTypeName = coder.BLASCallback.getBLASDoubleComplexTypeName()
```

### **Description**

`doubleComplexTypeName = coder.BLASCallback.getBLASDoubleComplexTypeName()` returns the name of the double-precision complex data type that is used by the CBLAS interface to a specific BLAS library.

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. At code generation time, if you specify a BLAS callback class, for certain vector and matrix function calls, the code generator produces BLAS calls in standalone code.

By default, the callback class that you define inherits the `getBLASDoubleComplexTypeName` method from `coder.BLASCallback`. If your BLAS library takes a type other than `double*` and `void*` for double-precision complex array arguments, you must override the inherited `getBLASDoubleComplexTypeName` method with your own implementation in your callback class definition.

The generated code uses the double-precision complex data type name to specify types of variables in the generated code that produces BLAS calls.

### **Output Arguments**

**doubleComplexTypeName** — CBLAS double-precision complex data type name

character vector

Character vector that specifies the name of the double-precision complex data type that the CBLAS interface to a specific BLAS library uses.

### **Attributes**

Static true

To learn about attributes of methods, see [Method Attributes](#).

### **Examples**



## Return Double Complex Type Name

If your BLAS library takes a type other than `double*` and `void*` for double-precision complex array arguments, you must include this `Static` method in your callback class definition.

```
function doubleComplexTypeName = getBLASDoubleComplexTypeName()
doubleComplexTypeName = 'my_double_complex_type';
end
```

Replace `my_double_complex_type` with the type that your BLAS library takes for double-precision complex array arguments.

## See Also

### Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

<https://www.netlib.org/blas/>

### Introduced in R2018b

## **coder.BLASCallback.getBLASSingleComplexTypeName**

**Class:** `coder.BLASCallback`

**Package:** `coder`

Return name of single-precision complex data type used by CBLAS interface

### **Syntax**

```
singleComplexTypeName = coder.BLASCallback.getBLASSingleComplexTypeName()
```

### **Description**

`singleComplexTypeName = coder.BLASCallback.getBLASSingleComplexTypeName()` returns the name of the single-precision complex data type that is used by the CBLAS interface to a specific BLAS library.

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. At code generation time, if you specify a BLAS callback class, for certain vector and matrix function calls, the code generator produces BLAS calls in standalone code.

By default, the callback class that you define inherits the `getBLASSingleComplexTypeName` method from `coder.BLASCallback`. If your BLAS library takes a type other than `float*` and `void*` for single-precision complex array arguments, you must override the inherited `getBLASSingleComplexTypeName` method with your own implementation in your callback class definition.

The generated code uses the single-precision complex data type name to specify types of variables in the generated code that produces BLAS calls.

### **Output Arguments**

**singleComplexTypeName** — CBLAS single-precision complex data type name

character vector

Character vector that specifies the name of the single-precision complex data type that the CBLAS interface to a specific BLAS library uses.

### **Attributes**

Static true

To learn about attributes of methods, see [Method Attributes](#).

### **Examples**

## Return Single Complex Type Name

If your BLAS library takes a type other than `float*` and `void*` for single-precision complex array arguments, you must include this `Static` method in your callback class definition.

```
function singleComplexTypeName = getBLASSingleComplexTypeName()
doubleComplexTypeName = 'my_single_complex_type';
end
```

Replace `my_single_complex_type` with the type that your BLAS library takes for single-precision complex array arguments.

## See Also

### Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

<https://www.netlib.org/blas/>

### Introduced in R2018b

## **coder.BLASCallback.useEnumNameRatherThanTypedef**

**Class:** `coder.BLASCallback`

**Package:** `coder`

Specify whether types for enumerations in a BLAS library include the `enum` keyword

### **Syntax**

```
p = coder.BLASCallback.useEnumNameRatherThanTypedef()
```

### **Description**

`p = coder.BLASCallback.useEnumNameRatherThanTypedef()` returns `true` if types for enumerations in your BLAS library include the `enum` keyword. Otherwise it returns `false`.

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. At code generation time, if you specify a BLAS callback class, for certain vector and matrix function calls, the code generator produces BLAS calls in standalone code.

By default, the callback class that you define inherits the `useEnumNameRatherThanTypedef` method from `coder.BLASCallback` and returns `false`. If types for enumerations in your BLAS library include the `enum` keyword, you must override the inherited `useEnumNameRatherThanTypedef` method with your own implementation in your callback class definition. In such cases, the `useEnumNameRatherThanTypedef` method must return `true`.

The generated code uses the output of `useEnumNameRatherThanTypedef` to specify types of variables in the generated code that produces BLAS calls.

### **Output Arguments**

**p** — Specify whether types for enumerations in BLAS library include the `enum` keyword

`false` | `true`

Logical variable that is `true` if types for enumerations in the BLAS library include the `enum` keyword, otherwise it is `false`.

### **Attributes**

Static true

To learn about attributes of methods, see [Method Attributes](#).

### **Examples**

## Specify Whether Types for Enumerations Include the enum Keyword

If types for enumerations in your BLAS library use the `enum` keyword, you must include this `Static` method in your callback class definition.

```
function p = useEnumNameRatherThanTypedef()
p = true;
end
```

## See Also

### Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

<https://www.netlib.org/blas/>

### Introduced in R2018b

## coder.fftw.StandaloneFFTW3Interface.getNumThreads

**Class:** coder.fftw.StandaloneFFTW3Interface

**Package:** coder.fftw

Return number of threads to use for FFTW library calls

### Syntax

```
coder.fftw.StandaloneFFTW3Interface.getNumThreads()
```

### Description

coder.fftw.StandaloneFFTW3Interface.getNumThreads() returns the number of threads to use for calls to a specific FFTW library.

An FFT library callback class that derives from a coder.fftw.StandaloneFFTW3Interface class specifies the FFTW library to use.

### Examples

#### Return Number of Threads to Use for FFTW Library Calls

In a class that derives from coder.fftw.StandaloneFFTW3Interface, implement a method getNumThreads that returns the number of threads for the FFTW library to use.

Use the getNumThreads method in this example coder.fftw.StandaloneFFTW3Interface class as a template.

```
% copyright 2017 The MathWorks, Inc.
classdef useMyFFTW < coder.fftw.StandaloneFFTW3Interface
 methods (Static)
 function th = getNumThreads
 coder.inline('always');
 th = int32(coder.const(1));
 end

 function updateBuildInfo(buildInfo, ctx)
 fftwLocation = '/usr/lib/fftw';
 includePath = fullfile(fftwLocation, 'include');
 buildInfo.addIncludePaths(includePath);
 libPath = fullfile(fftwLocation, 'lib');

 %Double
 libName1 = 'libfftw3-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName1 = [libName1 libExt];
 addLinkObjects(buildInfo, libName1, libPath, 1000, true, true);

 %Single
 libName2 = 'libfftw3f-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName2 = [libName2 libExt];
 addLinkObjects(buildInfo, libName2, libPath, 1000, true, true);
 end
 end
end
```

```
end
end
end
```

In your `getNumThreads` method, set `th` to the number of threads that you want to use. For example, this code specifies three threads:

```
th = int32(coder.const(3))
```

## See Also

### Topics

“Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”

“Speed Up Fast Fourier Transforms in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.fftw.org](http://www.fftw.org)

### Introduced in R2017b

## coder.fftw.StandaloneFFTW3Interface.getPlanMethod

**Class:** coder.fftw.StandaloneFFTW3Interface

**Package:** coder.fftw

Return FFTW planning method

### Syntax

```
coder.fftw.StandaloneFFTW3Interface.getPlanMethod()
```

### Description

`coder.fftw.StandaloneFFTW3Interface.getPlanMethod()` returns the FFTW planning method for FFTW library calls in generated standalone code.

When you define an FFTW library callback class that derives from a `coder.fftw.StandaloneFFTW3Interface` class, you do not have to implement a `getPlanMethod` method. By default, the planning method is `FFTW_ESTIMATE`. To use a different method, implement the `getPlanMethod` method. Specify one of the planning methods described in the planning section of the FFTW website.

### Examples

#### Specify FFTW Planning Method

Specify the `FFTW_MEASURE` planning method in a `getPlanMethod` method in an FFTW library callback class that derives from `coder.fftw.StandaloneFFTW3Interface`.

```
% copyright 2017 The MathWorks, Inc.
```

```
classdef useMyFFTW < coder.fftw.StandaloneFFTW3Interface
 methods (Static)
 function th = getNumThreads
 coder.inline('always');
 th = int32(coder.const(1));
 end

 function me = getPlanMethod
 coder.inline('always');
 me = coder.const(coder.opaque('int', 'FFTW_MEASURE'));
 end

 function updateBuildInfo(buildInfo, ctx)
 fftwLocation = '/usr/lib/fftw';
 includePath = fullfile(fftwLocation, 'include');
 buildInfo.addIncludePaths(includePath);
 libPath = fullfile(fftwLocation, 'lib');
```



```
%Double
libName1 = 'libfftw3-3';
[~, libExt] = ctx.getStdLibInfo();
libName1 = [libName1 libExt];
addLinkObjects(buildInfo, libName1, libPath, 1000, true, true);

%Single
libName2 = 'libfftw3f-3';
[~, libExt] = ctx.getStdLibInfo();
libName2 = [libName2 libExt];
addLinkObjects(buildInfo, libName2, libPath, 1000, true, true);
end
end
end
```

## See Also

### Topics

“Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”  
“Speed Up Fast Fourier Transforms in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.fftw.org](http://www.fftw.org)

### Introduced in R2017b

## **coder.fftw.StandaloneFFTW3Interface.lock**

**Class:** `coder.fftw.StandaloneFFTW3Interface`

**Package:** `coder.fftw`

Lock access to FFTW planning

### **Syntax**

```
coder.fftw.StandaloneFFTW3Interface.lock()
```

### **Description**

`coder.fftw.StandaloneFFTW3Interface.lock()` locks access to the planning process for FFTW library calls in generated standalone code.

When multiple threads call an FFTW library, implement this method in an FFT library callback class that derives from `coder.fftw.StandaloneFFTW3Interface`.

### **Examples**

#### **Synchronize Multithreaded Access to FFTW Planning in Generated Code**

In a class that derives from `coder.fft.StandaloneFFTW3Interface`, implement `lock` and `unlock` methods that call C code to manage a lock.

Write C functions that initialize, set, and unset a lock. To manage the lock, this example uses the OpenMP library. For a different library, modify the code accordingly.

- Create a file `mylock.c` that contains this C code:

```
#include "mylock.h"
#include "omp.h"

static omp_nest_lock_t lockVar;

void mylock_initialize(void)
{
 omp_init_nest_lock(&lockVar);
}

void mylock(void)
{
 omp_set_nest_lock(&lockVar);
}

void myunlock(void)
{
 omp_unset_nest_lock(&lockVar);
}
```

- Create a header file `mylock.h` that contains:

```

#ifndef MYLOCK_H
#define MYLOCK_H

void mylock_initialize(void);
void mylock(void);
void myunlock(void);

#endif

```

Write an FFT callback class `myfftc` that:

- Specifies the FFTW library.
- Implements `lock` and `unlock` methods that call the supporting C code to control access to the FFTW planning.

Use this class as a template. Replace `fftwLocation` with the location of your FFTW library installation.

```

classdef myfftc < coder.fftw.StandaloneFFTW3Interface

 methods (Static)
 function th = getNumThreads
 coder.inline('always');
 th = int32(coder.const(1));
 end

 function lock()
 coder.cinclude('mylock.h', 'InAllSourceFiles', true);
 coder.inline('always');
 coder.ceval('mylock');
 end

 function unlock()
 coder.cinclude('mylock.h', 'InAllSourceFiles', true);
 coder.inline('always');
 coder.ceval('myunlock');
 end

 function updateBuildInfo(buildInfo, ctx)
 fftwLocation = '\usr\lib\fftw';
 includePath = fullfile(fftwLocation, 'include');
 buildInfo.addIncludePaths(includePath);
 libPath = fullfile(fftwLocation, 'lib');

 %Double
 libName1 = 'libfftw3-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName1 = [libName1 libExt];
 addLinkObjects(buildInfo, libName1, libPath, 1000, true, true);

 %Single
 libName2 = 'libfftw3f-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName2 = [libName2 libExt];
 addLinkObjects(buildInfo, libName2, libPath, 1000, true, true);
 end
 end
end

```

end

Set the code generation configuration parameters.

- For code generation with the MATLAB Coder `codegen` command, set:
  - `CustomFFTCallback` to `'myfftcallback'`.
  - `CustomSource` to `'mylock.c'`.
  - `CustomInitializer` to `'mylock_initialize()'`.
- For code generation with the MATLAB Coder app, set:
  - **Custom FFT library callback** to `myfftcallback`.
  - **Additional source files** to `mylock.c`.
  - **Initialize function** to `mylock_initialize()`.
- For code generation from a MATLAB Function block by using Simulink Coder, set these parameters:
  - **Custom FFT library callback** to `myfftcallback`.
  - In **Code Generation > Custom Code**, under **Additional build information**, set **Source files** to `mylock.c`.
  - In **Code Generation > Custom Code**, under **Insert custom C code in generated**, set **Initialize function** to `mylock_initialize()`.

Generate code.

## See Also

### Topics

“Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”

“Synchronize Multithreaded Access to FFTW Planning in Generated Standalone Code”

“Speed Up Fast Fourier Transforms in Code Generated from a MATLAB Function Block” (Simulink Coder)

“Synchronize Multithreaded FFTW Planning in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.fftw.org](http://www.fftw.org)

**Introduced in R2017b**

# coder.fftw.StandaloneFFTW3Interface.unlock

**Class:** `coder.fftw.StandaloneFFTW3Interface`

**Package:** `coder.fftw`

Unlock access to FFTW planning

## Syntax

```
coder.fftw.StandaloneFFTW3Interface.unlock()
```

## Description

`coder.fftw.StandaloneFFTW3Interface.unlock()` unlocks access to planning for FFTW library calls in generated standalone code.

When multiple threads call an FFTW library, implement this method in an FFT library callback class that derives from `coder.fftw.StandaloneFFTW3Interface`.

## Examples

### Synchronize Multithreaded Access to FFTW Planning in Generated Code

In a class that derives from `coder.fft.StandaloneFFTW3Interface`, implement `lock` and `unlock` methods that call C code to manage a lock.

Write C functions that initialize, set, and unset a lock. To manage the lock, this example uses the OpenMP library. For a different library, modify the code accordingly.

- Create a file `mylock.c` that contains this C code:

```
#include "mylock.h"
#include "omp.h"

static omp_nest_lock_t lockVar;

void mylock_initialize(void)
{
 omp_init_nest_lock(&lockVar);
}

void mylock(void)
{
 omp_set_nest_lock(&lockVar);
}

void myunlock(void)
{
 omp_unset_nest_lock(&lockVar);
}
```

- Create a header file `mylock.h` that contains:

```

#ifndef MYLOCK_H
#define MYLOCK_H

void mylock_initialize(void);
void mylock(void);
void myunlock(void);

#endif

```

Write an FFT callback class `myfftc` that:

- Specifies the FFTW library.
- Implements `lock` and `unlock` methods that call the supporting C code to control access to the FFTW planning.

Use this class as a template. Replace `fftwLocation` with the location of your FFTW library installation.

```

classdef myfftc < coder.fftw.StandaloneFFTW3Interface

 methods (Static)
 function th = getNumThreads
 coder.inline('always');
 th = int32(coder.const(1));
 end

 function lock()
 coder.cinclude('mylock.h', 'InAllSourceFiles', true);
 coder.inline('always');
 coder.ceval('mylock');
 end

 function unlock()
 coder.cinclude('mylock.h', 'InAllSourceFiles', true);
 coder.inline('always');
 coder.ceval('myunlock');
 end

 function updateBuildInfo(buildInfo, ctx)
 fftwLocation = '\usr\lib\fftw';
 includePath = fullfile(fftwLocation, 'include');
 buildInfo.addIncludePaths(includePath);
 libPath = fullfile(fftwLocation, 'lib');

 %Double
 libName1 = 'libfftw3-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName1 = [libName1 libExt];
 addLinkObjects(buildInfo, libName1, libPath, 1000, true, true);

 %Single
 libName2 = 'libfftw3f-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName2 = [libName2 libExt];
 addLinkObjects(buildInfo, libName2, libPath, 1000, true, true);
 end
 end
end

```

end

Set the code generation configuration parameters.

- For code generation with the MATLAB Coder `codegen` command, set:
  - `CustomFFTCallback` to `'myfftcallback'`.
  - `CustomSource` to `'mylock.c'`.
  - `CustomInitializer` to `'mylock_initialize()'`.
- For code generation with the MATLAB Coder app, set:
  - **Custom FFT library callback** to `myfftcallback`.
  - **Additional source files** to `mylock.c`.
  - **Initialize function** to `mylock_initialize()`.
- For code generation from a MATLAB Function block by using Simulink Coder, set these parameters:
  - **Custom FFT library callback** to `myfftcallback`.
  - In **Code Generation > Custom Code**, under **Additional build information**, set **Source files** to `mylock.c`.
  - In **Code Generation > Custom Code**, under **Insert custom C code in generated**, set **Initialize function** to `mylock_initialize()`.

Generate code.

## See Also

### Topics

“Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”

“Synchronize Multithreaded Access to FFTW Planning in Generated Standalone Code”

“Speed Up Fast Fourier Transforms in Code Generated from a MATLAB Function Block” (Simulink Coder)

“Synchronize Multithreaded FFTW Planning in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.fftw.org](http://www.fftw.org)

**Introduced in R2017b**

## coder.fftw.StandaloneFFTW3Interface.updateBuildInfo

**Class:** coder.fftw.StandaloneFFTW3Interface

**Package:** coder.fftw

Update the build information for linking to a specific FFTW library

### Syntax

```
coder.fftw.StandaloneFFTW3Interface.updateBuildInfo(buildInfo, ctx)
```

### Description

coder.fftw.StandaloneFFTW3Interface.updateBuildInfo(buildInfo, ctx) updates the build information to link to a specific FFTW library.

An FFT library callback class that derives from a coder.fftw.StandaloneFFTW3Interface class specifies the FFTW library.

### Input Arguments

#### buildInfo — Build information object

build information object

After code generation, the build information object contains standard project, build option, and dependency information. In the updateBuildInfo method, to add the information for linking to a specific FFTW library, use build information methods.

#### ctx — coder.BuildConfig object

coder.BuildConfig object

Implement the coder.BuildConfig getStdLibInfo method to get the platform-specific file extension to use at link time.

### Examples

#### Link to a Specific FFTW Library

In a class that derives from coder.fft.StandaloneFFTW3Interface, implement a method updateBuildInfo that updates the build information to link to a specific FFTW library.

Use the updateBuildInfo method in this example coder.fftw.StandaloneFFTW3Interface class as a template.

```
% copyright 2017 The MathWorks, Inc.
classdef useMyFFTW < coder.fftw.StandaloneFFTW3Interface
 methods (Static)
 function th = getNumThreads
```



```

 coder.inline('always');
 th = int32(coder.const(1));
 end

 function updateBuildInfo(buildInfo, ctx)
 fftwLocation = '/usr/lib/fftw';
 includePath = fullfile(fftwLocation, 'include');
 buildInfo.addIncludePaths(includePath);
 libPath = fullfile(fftwLocation, 'lib');

 %Double
 libName1 = 'libfftw3-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName1 = [libName1 libExt];
 addLinkObjects(buildInfo, libName1, libPath, 1000, true, true);

 %Single
 libName2 = 'libfftw3f-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName2 = [libName2 libExt];
 addLinkObjects(buildInfo, libName2, libPath, 1000, true, true);
 end
end
end

```

In your `updateBuildInfo` method, set:

- `fftwLocation` to the full path for your installation of the library.
- `includePath` to the full path of the folder that contains the FFTW library header file.
- `libPath` to the full path of the folder that contains the library files.

## See Also

### Topics

“Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”  
 “Speed Up Fast Fourier Transforms in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.fftw.org](http://www.fftw.org)

### Introduced in R2017b

## coder.mfunctionname

**Package:** coder

Name of calling function or method

### Syntax

```
name = coder.mfunctionname
```

### Description

`name = coder.mfunctionname` returns the name of the function or method in whose body this function call is placed. For anonymous functions, `name` contains the function definition.

When debugging your MATLAB code or the generated code, use this function to access the name of the currently running function or method.

### Examples

#### Access Name of Function

Use `coder.mfunctionname` to access the name of the currently running function.

Define the MATLAB function `sumOfDeviations`:

```
function y = sumOfDeviations(x)
y = sum(x - mean(x), 'all');
fprintf('%s returned the value: %f\n', coder.mfunctionname, y);
end
```

Call `sumOfDeviations` with a 4-by-4 input:

```
sumOfDeviations(magic(4));

sumOfDeviations returned the value: 0.000000
```

Generate a MEX function for the `sumOfDeviations` function. Specify the input as a 4-by-4 double.

```
codegen sumOfDeviations -args {zeros(4)}
```

Code generation successful.

Call the generated MEX function `sumOfDeviations_mex` with the same 4-by-4 input:

```
sumOfDeviations_mex(magic(4));

sumOfDeviations returned the value: 0.000000
```

## Access Text of Anonymous Function

Use `coder.mfunctionname` to access the text of the currently running anonymous function.

Define the MATLAB function `foo` that both defines and calls an anonymous function. The anonymous function calls `coder.mfunctionname` inside its body.

```
function foo
z = @(~) fprintf('Currently running: %s\n',coder.mfunctionname);
z();
end
```

Call `foo` at the MATLAB command line:

```
foo
```

```
Currently running: @(~)fprintf('Currently running: %s\n',coder.mfunctionname)
```

Generate a MEX function for `foo`.

```
codegen foo
```

```
Code generation successful.
```

Call the generated MEX function.

```
foo_mex
```

```
Currently running: foo/ @(~)fprintf('Currently running: %s\n',coder.mfunctionname)
```

## Output Arguments

**name** — Name of the currently running function or method

character vector

Name of the function or method that called the `coder.mfunctionname` function, returned as a character vector.

In certain special cases, the output of `coder.mfunctionname` in the generated code might be different from MATLAB execution:

| Context of calling <code>coder.mfunctionname</code>                                                                 | Output in MATLAB  | Output in Generated Code |
|---------------------------------------------------------------------------------------------------------------------|-------------------|--------------------------|
| Inside a method placed in a class folder (@-folder)<br>For example, <code>MyMethod</code> of <code>MyClass</code> . | 'MyMethod'        | 'MyClass.MyMethod'       |
| Inside a class constructor.<br>For example, constructor of <code>MyClass</code> .                                   | 'MyClass.MyClass' | 'MyClass (constructor)'  |

| Context of calling<br><code>coder.mfunctionname</code> | Output in MATLAB                | Output in Generated Code                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inside an anonymous function.                          | Text of the anonymous function. | Concatenation of these two character vectors, separated by a forward slash character: <ul style="list-style-type: none"> <li>• Output of <code>coder.mfunctionname</code> for the function enclosing the anonymous function</li> <li>• Text of the anonymous function</li> </ul> See “Access Text of Anonymous Function” on page 2-438. |

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

Usage notes and limitations:

See “Output Arguments” on page 2-439.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

Usage notes and limitations:

See “Output Arguments” on page 2-439.

## See Also

`mfilename`

**Introduced in R2021b**

# findBuildArg

Find a specific build argument in build information

## Syntax

```
[identifier,value] = findBuildArg(buildinfo,buildArgName)
```

## Description

[identifier,value] = findBuildArg(buildinfo,buildArgName) searches for a build argument from the build information.

If the build argument is present in the build information, the function returns the name and value.

## Examples

### Find Build Argument in Build Information

Find a build argument and its value stored in build information myBuildInfo. Then, view the argument identifier and value.

```
load buildInfo.mat
myBuildInfo = buildInfo;
myBuildArgExtmodeStaticAlloc = 'EXTMODE_STATIC_ALLOC';
[buildArgId buildArgValue] = findBuildArg(buildInfo, ...
 myBuildArgExtmodeStaticAlloc);
```

```
>> buildArgId
```

```
buildArgId =
```

```
 'EXTMODE_STATIC_ALLOC'
```

```
>> buildArgValue
```

```
buildArgValue =
```

```
 '0'
```

## Input Arguments

**buildinfo** — Name of build information object returned by RTW.BuildInfo object

**buildArgName** — Name of build argument to find in build information  
character vector | string scalar

To get the build argument identifiers from the build information, use the getBuildArgs function.

## **Output Arguments**

**identifier** — Name of the build argument

character vector | string scalar

**value** — Value of the build argument

character vector | string scalar

## **See Also**

### **Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2014a**

# findIncludeFiles

Find and add include (header) files to build information

## Syntax

```
findIncludeFiles(buildinfo,extPatterns,Name,Value)
```

## Description

`findIncludeFiles(buildinfo,extPatterns,Name,Value)` searches for and adds include files to the build information.

Use the `findIncludeFiles` function to:

- Search for include files in source and include paths from the build information.
- Apply the optional *extPatterns* argument to specify file name extension patterns for search.
- Add the found files with their full paths to the build information.
- Delete duplicate include file entries from the build information.

To ensure that `findIncludeFiles` finds header files, add their paths to `buildInfo` by using the `addIncludePaths` function.

## Examples

### Find and Add Include Files to Build Information

Find include files with file name extension `.h` that are in the build information, `myBuildInfo`. Add the full paths for these files to the build information. View the include files from the build information.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo,{fullfile(pwd,...
 'mycustomheaders')},'myheaders');
findIncludeFiles(myBuildInfo);
headerfiles = getIncludeFiles(myBuildInfo,true,false);
```

```
>> headerfiles
```

```
headerfiles =
```

```
 'W:\work\mycustomheaders\myheader.h'
```

## Input Arguments

**buildinfo** — Name of build information object returned by `RTW.BuildInfo` object

Object provides information for compiling and linking generated code.

**extPatterns — Patterns of file name extensions that specify files for the search**`'*.h'` (default) | cell array of character vectors | string array

To specify files for the search, the character vectors or strings in the *extPatterns* argument:

- Must start with an asterisk immediately followed by a period (\*.)
- Can include a combination of alphanumeric and underscore (\_) characters

Example: `'*.h' '*.hpp' '*.x*'`

**Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `minimalHeaders=false,ignoreParseError=true`

**minimalHeaders — Specifies whether to include only the minimal header files**`true` (default) | `false`

If `true`, include only the minimal header files required to build the code.

If `false`, include header files found on the include path.

Example: `minimalHeaders=false`

**ignoreParseError — Response to parse errors**`false` (default) | `true`

If `false`, terminate on parse errors.

If `true`, do not terminate on parse errors.

Example: `ignoreParseError=true`

**See Also****Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006b**



# getBuildArgs

Get build arguments from build information

## Syntax

```
[identifiers,values] = getBuildArgs(buildinfo,includeGroupIDs,
excludeGroupIDs)
```

## Description

[*identifiers*,*values*] = `getBuildArgs`(*buildinfo*,*includeGroupIDs*,*excludeGroupIDs*) returns build argument identifiers and values from build information.

The function requires the *buildinfo*, *identifiers*, and *values* arguments. You can use optional *includeGroupIDs* and *excludeGroupIDs* arguments. These optional arguments let you include or exclude groups selectively from the build arguments returned by the function.

If you choose to specify *excludeGroupIDs* and omit *includeGroupIDs*, specify a null character vector ( ' ') for *includeGroupIDs*.

## Examples

### Get Build Arguments from Build Information

After you build a project, the build information is available in the `buildInfo.mat` file. Retrieve the build arguments from the build information object.

```
load buildInfo.mat
[buildArgIds,buildArgValues] = getBuildArgs(buildInfo);
```

To get the value of a single build argument from the build information, you can use the `findBuildArg` function.

To view the build argument identifiers, enter:

```
buildArgIds
```

To view the build argument values, enter:

```
buildArgValues
```

## Input Arguments

**buildinfo** — Name of build information object returned by `RTW.BuildInfo`  
object

**includeGroupIDs** — Group identifiers of build arguments to include in the return from the function

cell array of character vectors | string

To use the *includeGroupIDs* argument, view available build argument identifier groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

### **excludeGroupIDs – Group identifiers of build arguments to exclude from the return from the function**

cell array of character vectors | string

To use the *excludeGroupIDs* argument, view available build argument identifier groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

## **Output Arguments**

### **identifiers – Names of the build arguments**

cell array of character vectors

### **values – Values of the build arguments**

cell array of character vectors

## **See Also**

### **Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2014a**

# getCompileFlags

Get compiler options from build information

## Syntax

```
options = getCompileFlags(buildinfo,includeGroups,excludeGroups)
```

## Description

`options = getCompileFlags(buildinfo,includeGroups,excludeGroups)` returns compiler options from the build information.

The function requires the *buildinfo* argument. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the compiler options returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( `' '`) for *includeGroups*.

## Examples

### Get Compiler Options from Build Information

Get the compiler options stored in the build information `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addCompileFlags(myBuildInfo,{'-Zi -Wall' '-O3'}, ...
 'OPTS');
compflags = getCompileFlags(myBuildInfo);
```

```
>> compflags
```

```
compflags =
```

```
 '-Zi -Wall' '-O3'
```

### Get Compiler Options with Include Group Argument

Get the compiler options stored with the group name `Debug` in the build information `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addCompileFlags(myBuildInfo,{'-Zi -Wall' '-O3'}, ...
 {'Debug' 'MemOpt'});
compflags = getCompileFlags(myBuildInfo,'Debug');
```

```
>> compflags
```

```
compflags =
 '-Zi -Wall'
```

### Get Compiler Options with Exclude Group Argument

Get the compiler options stored in the build information `myBuildInfo`, except those options with the group name `Debug`.

```
myBuildInfo = RTW.BuildInfo;
addCompileFlags(myBuildInfo,{'-Zi -Wall' '-03'}, ...
 {'Debug' 'MemOpt'});
compflags = getCompileFlags(myBuildInfo, '', 'Debug');
```

```
>> compflags

compflags =
 '-03'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo`  
object

**includeGroups** — Group names of compiler options to include in the return from the function

cell array of character vectors | string

To use the *includeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**excludeGroups** — Group names of compiler options to exclude from the return from the function

cell array of character vectors | string

To use the *excludeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

## Output Arguments

**options** — Compiler options from the build information

cell array of character vectors

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**

## getDefines

Get preprocessor macro definitions from build information

### Syntax

```
[macrodefs,identifiers,values] = getDefines(buildinfo,includeGroups,excludeGroups)
```

### Description

[macrodefs,identifiers,values] = getDefines(buildinfo,includeGroups,excludeGroups) returns preprocessor macro definitions from the build information.

The function requires the *buildinfo*, *macrodefs*, *identifiers*, and *values* arguments. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the preprocessor macro definitions returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( ' ') for *includeGroups*.

### Examples

#### Get Macro Definitions from Build Information

Get the preprocessor macro definitions stored in the build information `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addDefines(myBuildInfo, ...
 {'PROTO=first' '-DDEBUG' 'test' '-dPRODUCTION'}, 'OPTS');
[defs,names,values] = getDefines(myBuildInfo);
```

```
>> defs
```

```
defs =
```

```
 '-DPROTO=first' '-DDEBUG' '-Dtest' '-DPRODUCTION'
```

```
>> names
```

```
names =
```

```
 'PROTO'
 'DEBUG'
 'test'
 'PRODUCTION'
```

```
>> values
```

```
values =
```

```
'first'
''
''
''
```

### Get Macro Definitions with Include Group Argument

Get the preprocessor macro definitions stored with the group name `Debug` in the build information `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addDefines(myBuildInfo, ...
 {'PROTO=first' '-DDEBUG' 'test' '-dPRODUCTION'}, ...
 {'Debug' 'Debug' 'Debug' 'Release'});
[defs,names,values] = getDefines(myBuildInfo,'Debug');
```

```
>> defs
```

```
defs =
```

```
 '-DPROTO=first' '-DDEBUG' '-Dtest'
```

### Get Macro Definitions with Exclude Group Argument

Get the preprocessor macro definitions stored in the build information `myBuildInfo`, except those definitions with the group name `Debug`.

```
myBuildInfo = RTW.BuildInfo;
addDefines(myBuildInfo, ...
 {'PROTO=first' '-DDEBUG' 'test' '-dPRODUCTION'}, ...
 {'Debug' 'Debug' 'Debug' 'Release'});
[defs,names,values] = getDefines(myBuildInfo,'','Debug');
```

```
>> defs
```

```
defs =
```

```
 '-DPRODUCTION'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo` object

**includeGroups** — Group names of macro definitions to include in the return from the function

cell array of character vectors | string

To use the *includeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**excludeGroups** — Group names of macro definitions to exclude from the return from the function

cell array of character vectors | string

To use the *excludeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

## Output Arguments

**macrodefs** — Macro definitions from the build information

cell array of character vectors

The *macrodefs* provide the complete macro definitions with a -D prefix. When the function returns a definition:

- If the -D was not specified when the definition was added to the build information, prepends a -D to the definition.
- Changes a lowercase -d to -D.

**identifiers** — Names of the macros from the build information

cell array of character vectors

**values** — Values assigned to the macros from the build information

cell array of character vectors

The *values* provide anything specified to the right of the first equal sign in the macro definition. The default is an empty character vector ('').

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**



# getFullFileList

Get list of files from build information

## Syntax

```
[fPathNames, names] = getFullFileList(buildinfo, fcase)
```

## Description

`[fPathNames, names] = getFullFileList(buildinfo, fcase)` returns the fully qualified paths and names of files, or files of a selected type (source, include, or nonbuild), from the build information.

The function requires the *buildinfo*, *fPathNames*, and *names* arguments. You can use the optional *fcase* argument. This optional argument lets you include or exclude file cases selectively from file list returned by the function.

To ensure that header files are added to the file list (for example, header files in the `_sharedutils` (Simulink Coder) folder), run `before` `getFullFileList`.

The `packNGo` function calls `getFullFileList` to return a list of files in the build information before processing files for packaging.

The makefile for the build resolves file locations based on source paths and rules. The build process does not require you to resolve the path of every file in the build information. The `getFullFileList` function returns the path for each file:

- If a path was explicitly associated with the file when it was added.
- If you called `updateFilePathsAndExtensions` to resolve file paths and extensions before calling `getFullFileList`.

## Examples

### Get Full List of Files

After building a project and loading the generated `buildInfo.mat` file, you can list the files stored in the build information object, `buildInfo`. This example returns information for the current project and its submodels.

From the code generation folder that contains the `buildInfo.mat` file, run:

```
bi = load('buildInfo.mat');
findIncludeFiles(bi.buildInfo);
[fPathNames, names] = getFullFileList(bi.buildInfo);
```

## Get List of Source Files

If you use an *fcase* option, you limit the listing to the files stored in the build information object for the current project. This example returns information for the current project only (not for submodels).

```
[fPathNames,names] = getFullFileList(bi.buildInfo,'source');
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo`  
object

**fcase** — File case to return from the build information

' ' (default) | 'source' | 'include' | 'nonbuild'

The *fcase* argument selects whether the function returns the full list for files in the build information or returns selected cases of files. If you omit the argument or specify a null character vector ( ' '), the function returns the files from the build information.

| Specify    | Function Action                                    |
|------------|----------------------------------------------------|
| 'source'   | Returns source files from the build information.   |
| 'include'  | Returns include files from the build information.  |
| 'nonbuild' | Returns nonbuild files from the build information. |

Example: 'source'

## Output Arguments

**fPathNames** — Fully qualified file paths from the build information

cell array of character vectors

**names** — File names from the build information

cell array of character vectors

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2008a**

# getIncludeFiles

Get include files from build information

## Syntax

```
files = getIncludeFiles(buildinfo,concatenatePaths,replaceMatlabroot,
includeGroups,excludeGroups)
```

## Description

`files = getIncludeFiles(buildinfo,concatenatePaths,replaceMatlabroot,includeGroups,excludeGroups)` returns the names of include files from the build information.

The function requires the *buildinfo*, *concatenatePaths*, and *replaceMatlabroot* arguments. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the include files returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( ' ') for *includeGroups*.

The makefile for the build resolves file locations based on source paths and rules. The build process does not require you to resolve the path of every file in the build information. If you specify `true` for the *concatenatePaths* argument, the `getIncludeFiles` function returns the path for each file:

- If a path was explicitly associated with the file when it was added.
- If you called `updateFilePathsAndExtensions` to resolve file paths and extensions before calling `getIncludeFiles`.

## Examples

### Get Include Paths and Files from Build Information

Get the include paths and file names from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo,{'etc.h' 'etc_private.h' ...
 'mytypes.h'},{'/etc/proj/etclib' '/etcproj/etc/etc_build' ...
 '/common/lib'},{'etc' 'etc' 'shared'});
incfiles=getIncludeFiles(myBuildInfo,true,false);
```

```
>> incfiles
```

```
incfiles =
```

```
 [1x22 char] [1x36 char] [1x21 char]
```

## Get Include Paths and Files with Include Group Argument

Get the names of include files in group `etc` from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addIncludeFiles(myBuildInfo,{'etc.h' 'etc_private.h' ...
 'mytypes.h'},{'/etc/proj/etclib' '/etcproj/etc/etc_build' ...
 '/common/lib'},{'etc' 'etc' 'shared'});
incfiles = getIncludeFiles(myBuildInfo,false,false, ...
 'etc');
```

```
>> incfiles
```

```
incfiles =
 'etc.h' 'etc_private.h'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo`  
object

**concatenatePaths** — Choice of whether to concatenate paths and file names in return  
`false` | `true`

| Specify            | Function Action                                                      |
|--------------------|----------------------------------------------------------------------|
| <code>true</code>  | Concatenates and returns each file name with its corresponding path. |
| <code>false</code> | Returns only file names.                                             |

Example: `true`

**replaceMatlabroot** — Choice of whether to replace the `$(MATLAB_ROOT)` token with absolute paths in return  
`false` | `true`

Use the `replaceMatlabroot` argument to control whether the function includes the MATLAB root definition in the output it returns.

| Specify            | Function Action                                                                                             |
|--------------------|-------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | Replaces the token <code>\$(MATLAB_ROOT)</code> with the absolute path for your MATLAB installation folder. |
| <code>false</code> | Does not replace the token <code>\$(MATLAB_ROOT)</code> .                                                   |

Example: `true`

**includeGroups** — Group names of include paths and files to include in the return from the function

cell array of character vectors | string

To use the `includeGroups` argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: `' '`

**excludeGroups** — Group names of include paths and files to exclude from the return from the function

cell array of character vectors | string

To use the *excludeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**Output Arguments****files** — Names of include files from the build information

cell array of character vectors

The names of include files that you add with the `addIncludeFiles` function. If you call the `packNGo` function, the names include files that `packNGo` found and added while packaging code.

**See Also****Topics**

"Customize Post-Code-Generation Build Processing" (Simulink Coder)

**Introduced in R2006a**

## getIncludePaths

Get include paths from build information

### Syntax

```
paths = getIncludePaths(buildinfo,replaceMatlabroot,includeGroups,
excludeGroups)
```

### Description

`paths = getIncludePaths(buildinfo,replaceMatlabroot,includeGroups,excludeGroups)` returns the names of include file paths from the build information.

The function requires the *buildinfo* and *replaceMatlabroot* arguments. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the include paths returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector (' ') for *includeGroups*.

### Examples

#### Get Include Paths from Build Information

Get the include paths from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addIncludePaths(myBuildInfo,{'/etc/proj/etclib' ...
 '/etcproj/etc/etc_build' '/common/lib'}, ...
 {'etc' 'etc' 'shared'});
incpaths = getIncludePaths(myBuildInfo,false);
```

```
>> incpaths
```

```
incpaths =
```

```
 '\etc\proj\etclib' [1x22 char] '\common\lib'
```

#### Get Include Paths with Include Group Argument

Get the paths in group `shared` from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addIncludePaths(myBuildInfo,{'/etc/proj/etclib' ...
 '/etcproj/etc/etc_build' '/common/lib'}, ...
 {'etc' 'etc' 'shared'});
incpaths = getIncludePaths(myBuildInfo,false,'shared');
```

```
>> incpaths
incpaths =
 '\common\lib'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo` object

**replaceMatlabroot** — Choice of whether to replace the `$(MATLAB_ROOT)` token with absolute paths in return from the function  
false | true

Use the *replaceMatlabroot* argument to control whether the function includes the MATLAB root definition in the output that it returns.

| Specify | Function Action                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------|
| true    | Replaces the token <code>\$(MATLAB_ROOT)</code> with the absolute path for your MATLAB installation folder. |
| false   | Does not replace the token <code>\$(MATLAB_ROOT)</code> .                                                   |

Example: true

**includeGroups** — Group names of include paths to include in the return from the function  
cell array of character vectors | string

To use the *includeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**excludeGroups** — Group names of include paths to exclude from the return from the function

cell array of character vectors | string

To use the *excludeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

## Output Arguments

**paths** — Paths of include files from the build information  
cell array of character vectors

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**



# getLinkFlags

Get link options from build information

## Syntax

```
options = getLinkFlags(buildinfo,includeGroups,excludeGroups)
```

## Description

`options = getLinkFlags(buildinfo,includeGroups,excludeGroups)` returns linker options from the build information.

The function requires the *buildinfo* argument. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the compiler options returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( `' '`) for *includeGroups*.

## Examples

### Get Linker Options from Build Information

Get the linker options from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addLinkFlags(myBuildInfo,{'-MD -Gy' '-T'},'OPTS');
linkflags = getLinkFlags(myBuildInfo);
```

```
>> linkflags
```

```
linkflags =
```

```
 '-MD -Gy' '-T'
```

### Get Linker Options with Include Group Argument

Get the linker options with the group name `Debug` from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addLinkFlags(myBuildInfo,{'-MD -Gy' '-T'}, ...
 {'Debug' 'MemOpt'});
linkflags = getLinkFlags(myBuildInfo,{'Debug'});
```

```
>> linkflags
```

```
linkflags =
```

```
'-MD -Gy'
```

### Get Linker Options with Exclude Group Argument

Get the linker options from the build information `myBuildInfo`, except those options with the group name `Debug`.

```
myBuildInfo = RTW.BuildInfo;
addLinkFlags(myBuildInfo,{'-MD -Gy' '-T'}, ...
 {'Debug' 'MemOpt'});
linkflags = getLinkFlags(myBuildInfo, '', {'Debug'});
```

```
>> linkflags
```

```
linkflags =
```

```
'-T'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo`  
object

**includeGroups** — Group names of linker options to include in the return from the function  
cell array of character vectors | string

To use the *includeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**excludeGroups** — Group names of linker options to exclude from the return from the function  
cell array of character vectors | string

To use the *excludeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

## Output Arguments

**options** — Linker options from the build information  
cell array of character vectors

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**

## getNonBuildFiles

Get nonbuild-related files from build information

### Syntax

```
files = getNonBuildFiles(buildinfo, concatenatePaths, replaceMatlabroot,
includeGroups, excludeGroups)
```

### Description

`files = getNonBuildFiles(buildinfo, concatenatePaths, replaceMatlabroot, includeGroups, excludeGroups)` returns the names of non-build files from the build information, such as DLL files required for a final executable or a README file.

The function requires the *buildinfo*, *concatenatePaths*, and *replaceMatlabroot* arguments. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the non-build files returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( ' ') for *includeGroups*.

The makefile for the build resolves file locations based on source paths and rules. The build process does not require you to resolve the path of every file in the build information. If you specify `true` for the *concatenatePaths* argument, the `getNonBuildFiles` function returns the path for each file:

- If a path was explicitly associated with the file when it was added.
- If you called `updateFilePathsAndExtensions` to resolve file paths and extensions before calling `getIncludeFiles`.

### Examples

#### Get Nonbuild Files from Build Information

Get the nonbuild file names stored in the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addNonBuildFiles(myBuildInfo, {'readme.txt' 'myutility1.dll' ...
 'myutility2.dll'});
nonbuildfiles = getNonBuildFiles(myBuildInfo, false, false);
```

```
>> nonbuildfiles
```

```
nonbuildfiles =
```

```
'readme.txt' 'myutility1.dll' 'myutility2.dll'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo` object

**concatenatePaths** — Choice of whether to concatenate paths and file names in return from function

false | true

| Specify | Function Action                                                      |
|---------|----------------------------------------------------------------------|
| true    | Concatenates and returns each file name with its corresponding path. |
| false   | Returns only file names.                                             |

Example: true

**replaceMatlabroot** — Choice of whether to replace the `$(MATLAB_ROOT)` token with absolute paths in return from function

false | true

Use the `replaceMatlabroot` argument to control whether the function includes the MATLAB root definition in the output that it returns.

| Specify | Function Action                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------|
| true    | Replaces the token <code>\$(MATLAB_ROOT)</code> with the absolute path for your MATLAB installation folder. |
| false   | Does not replace the token <code>\$(MATLAB_ROOT)</code> .                                                   |

Example: true

**includeGroups** — Group names of non-build files to include in the return from the function

cell array of character vectors | string

To use the `includeGroups` argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**excludeGroups** — Group names of non-build files to exclude from the return from the function

cell array of character vectors | string

To use the `excludeGroups` argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

## Output Arguments

**files** — Names of non-build files from the build information

cell array of character vectors

## **See Also**

### **Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2008a**

# getSourceFiles

Get source files from build information

## Syntax

```
srcfiles = getSourceFiles(buildinfo,concatenatePaths,replaceMatlabroot,
includeGroups,excludeGroups)
```

## Description

`srcfiles = getSourceFiles(buildinfo,concatenatePaths,replaceMatlabroot,includeGroups,excludeGroups)` returns the names of source files from the build information.

The function requires the *buildinfo*, *concatenatePaths*, and *replaceMatlabroot* arguments. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the source files returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( ' ') for *includeGroups*.

The makefile for the build resolves file locations based on source paths and rules. The build process does not require you to resolve the path of every file in the build information. If you specify `true` for the *concatenatePaths* argument, the `getSourceFiles` function returns the path for each file:

- If a path was explicitly associated with the file when it was added.
- If you called `updateFilePathsAndExtensions` to resolve file paths and extensions before calling `getSourceFiles`.

## Examples

### Get Source Files from Build Information

Get the source paths and file names from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addSourceFiles(myBuildInfo, ...
 {'test1.c' 'test2.c' 'driver.c'},'', ...
 {'Tests' 'Tests' 'Drivers'});
srcfiles = getSourceFiles(myBuildInfo,false,false);
```

```
>> srcfiles
```

```
srcfiles =
```

```
 'test1.c' 'test2.c' 'driver.c'
```

### Get Source Files with Include Group Argument

Get the names of source files in group `tests` from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addSourceFiles(myBuildInfo,{'test1.c' 'test2.c'...
 'driver.c'}, {'/proj/test1' '/proj/test2'...
 '/drivers/src'}, {'tests', 'tests', 'drivers'});
incfiles = getSourceFiles(myBuildInfo,false,false,...
 'tests');
```

```
>> incfiles
```

```
incfiles =
```

```
 'test1.c' 'test2.c'
```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo` object

**concatenatePaths** — Choice of whether to concatenate paths and file names in return  
false | true

| Specify | Function Action                                                      |
|---------|----------------------------------------------------------------------|
| true    | Concatenates and returns each file name with its corresponding path. |
| false   | Returns only file names.                                             |

Example: true

**replaceMatlabroot** — Choice of whether to replace the `$(MATLAB_ROOT)` token with absolute paths in return  
false | true

Use the `replaceMatlabroot` argument to control whether the function includes the MATLAB root definition in the output it returns.

| Specify | Function Action                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------|
| true    | Replaces the token <code>\$(MATLAB_ROOT)</code> with the absolute path for your MATLAB installation folder. |
| false   | Does not replace the token <code>\$(MATLAB_ROOT)</code> .                                                   |

Example: true

**includeGroups** — Group names of source files to include in the return from the function  
cell array of character vectors | string

To use the `includeGroups` argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''



**excludeGroups** — Group names of source files to exclude from the return from the function

cell array of character vectors | string

To use the *excludeGroups* argument, view available groups by using `myGroups = getGroups(buildInfo)`.

Example: ''

**Output Arguments****srcfiles** — Names of source files from the build information

cell array of character vectors

The names of source files that you add with the `addIncludeFiles` function. If you call the `packNGo` function, the names include files that `packNGo` found and added while packaging code.

**See Also****Topics**

"Customize Post-Code-Generation Build Processing" (Simulink Coder)

**Introduced in R2006a**

## getSourcePaths

Get source paths from build information

### Syntax

```
srcpaths = getSourcePaths(buildinfo,replaceMatlabroot,includeGroups,
excludeGroups)
```

### Description

`srcpaths = getSourcePaths(buildinfo,replaceMatlabroot,includeGroups,excludeGroups)` returns the names of source file paths from the build information. The function returns only the file paths that were added to the build information by using `.`. The build process uses build information source paths to locate source files that were specified without an explicit path.

The function requires the *buildinfo* and *replaceMatlabroot* arguments. You can use optional *includeGroups* and *excludeGroups* arguments. These optional arguments let you include or exclude groups selectively from the source paths returned by the function.

If you choose to specify *excludeGroups* and omit *includeGroups*, specify a null character vector ( `' '`) for *includeGroups*.

### Examples

#### Get Source Paths from Build Information

Get the source paths from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo,{'/proj/test1' ...
 '/proj/test2' '/drivers/src'}, {'tests' 'tests' ...
 'drivers'});
srcpaths = getSourcePaths(myBuildInfo,false);
```

```
>> srcpaths
```

```
srcpaths =
```

```
 '\proj\test1' '\proj\test2' '\drivers\src'
```

#### Get Source Paths with Include Group Argument

Get the paths in group `tests` from the build information, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo,{'/proj/test1' ...
 '/proj/test2' '/drivers/src'}, {'tests' 'tests' ...
```

```

 'drivers'});
srcpaths = getSourcePaths(myBuildInfo,true,'tests');

>> srcpaths

srcpaths =

 '\proj\test1' '\proj\test2'

```

## Get Source Paths from Build Information

Get a source path from the build information, `myBuildInfo`. First, get the path without replacing `$(MATLAB_ROOT)` with an absolute path. Then, get it with replacement. Here, the MATLAB root folder is `\\myserver\myworkspace\matlab`.

```

myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo, fullfile(matlabroot, ...
 'rtw', 'c', 'src'));
srcpaths = getSourcePaths(myBuildInfo,false);

>> srcpaths{:}

ans =

$(MATLAB_ROOT)\rtw\c\src

>> srcpaths = getSourcePaths(myBuildInfo,true);
>> srcpaths{:}

ans =

\\myserver\myworkspace\matlab\rtw\c\src

```

## Input Arguments

**buildinfo** — Name of the build information object returned by `RTW.BuildInfo` object

`RTW.BuildInfo` object that contains information for compiling and linking generated code.

**replaceMatlabroot** — Choice of whether to replace the `$(MATLAB_ROOT)` token with absolute paths in return

false | true

Use the `replaceMatlabroot` argument to control whether the function includes the MATLAB root definition in the output it returns.

| Specify | Function Action                                                                                             |
|---------|-------------------------------------------------------------------------------------------------------------|
| true    | Replaces the token <code>\$(MATLAB_ROOT)</code> with the absolute path for your MATLAB installation folder. |
| false   | Does not replace the token <code>\$(MATLAB_ROOT)</code> .                                                   |

Example: `true`

**includeGroups** — Group names of source paths to include in the return from the function

cell array of character vectors | string

To use the *includeGroups* argument, view available groups with `myGroups = getGroups(buildInfo)`.

Example: ''

**excludeGroups** — Group names of source paths to exclude from the return from the function

cell array of character vectors | string

To use the *excludeGroups* argument, view available groups with `myGroups = getGroups(buildInfo)`.

Example: ''

## Output Arguments

**srcpaths** — Source file paths

cell array of character vectors

Paths of source files from the build information.

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**

# half

Construct half-precision numeric object

## Description

Use the `half` constructor to assign a half-precision data type to a number or variable. A half-precision data type occupies 16 bits of memory, but its floating-point representation enables it to handle wider dynamic ranges than integer or fixed-point data types of the same size. For more information, see “Floating-Point Numbers” (Fixed-Point Designer) and “What is Half Precision?” (Fixed-Point Designer).

For a list of functions that support code generation with half-precision inputs, see “Half Precision Code Generation Support”.

## Creation

### Syntax

```
a = half(v)
```

### Description

`a = half(v)` converts the values in `v` to half-precision.

### Input Arguments

#### **v** — Input array

scalar | vector | matrix | multidimensional array

Input array, specified as a scalar, vector, matrix, or multidimensional array.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical`

## Object Functions

These functions are supported for simulation with half-precision inputs in MATLAB. For a list of functions that support code generation with half-precision inputs, see “Half Precision Code Generation Support” (Fixed-Point Designer).

## Math and Arithmetic

|                    |                                      |
|--------------------|--------------------------------------|
| <code>abs</code>   | Absolute value and complex magnitude |
| <code>acos</code>  | Inverse cosine in radians            |
| <code>acosh</code> | Inverse hyperbolic cosine            |
| <code>asin</code>  | Inverse sine in radians              |
| <code>asinh</code> | Inverse hyperbolic sine              |

|           |                                                             |
|-----------|-------------------------------------------------------------|
| atan      | Inverse tangent in radians                                  |
| atan2     | Four-quadrant inverse tangent                               |
| atanh     | Inverse hyperbolic tangent                                  |
| ceil      | Round toward positive infinity                              |
| conj      | Complex conjugate                                           |
| conv      | Convolution and polynomial multiplication                   |
| conv2     | 2-D convolution                                             |
| cos       | Cosine of argument in radians                               |
| cosh      | Hyperbolic cosine                                           |
| cospi     | Compute $\cos(X*\pi)$ accurately                            |
| cumsum    | Cumulative sum                                              |
| dot       | Dot product                                                 |
| exp       | Exponential                                                 |
| expm1     | Compute $\exp(x)-1$ accurately for small values of $x$      |
| fft       | Fast Fourier transform                                      |
| fft2      | 2-D fast Fourier transform                                  |
| fftn      | N-D fast Fourier transform                                  |
| fftshift  | Shift zero-frequency component to center of spectrum        |
| fix       | Round toward zero                                           |
| floor     | Round toward negative infinity                              |
| fma       | Multiply and add using fused multiply add approach          |
| hypot     | Square root of sum of squares (hypotenuse)                  |
| ifft      | Inverse fast Fourier transform                              |
| ifft2     | 2-D inverse fast Fourier transform                          |
| ifftn     | Multidimensional inverse fast Fourier transform             |
| ifftshift | Inverse zero-frequency shift                                |
| imag      | Imaginary part of complex number                            |
| ldivide   | Left array division                                         |
| log       | Natural logarithm                                           |
| log10     | Common logarithm (base 10)                                  |
| log1p     | Compute $\log(1+x)$ accurately for small values of $x$      |
| log2      | Base 2 logarithm and floating-point number dissection       |
| mean      | Average or mean value of array                              |
| minus     | Subtraction                                                 |
| mldivide  | Solve systems of linear equations $Ax = B$ for $x$          |
| mod       | Remainder after division (modulo operation)                 |
| mrdivide  | Solve systems of linear equations $xA = B$ for $x$          |
| mtimes    | Matrix multiplication                                       |
| plus      | Add numbers, append strings                                 |
| pow10     | Base 10 power and scale half-precision numbers              |
| pow2      | Base 2 exponentiation and scaling of floating-point numbers |
| power     | Element-wise power                                          |
| prod      | Product of array elements                                   |
| rdivide   | Right array division                                        |
| real      | Real part of complex number                                 |
| rem       | Remainder after division                                    |
| round     | Round to nearest decimal or integer                         |
| rsqrt     | Reciprocal square root                                      |
| sign      | Sign function (signum function)                             |
| sin       | Sine of argument in radians                                 |
| sinh      | Hyperbolic sine                                             |
| sinpi     | Compute $\sin(X*\pi)$ accurately                            |

|        |                                |
|--------|--------------------------------|
| sqrt   | Square root                    |
| sum    | Sum of array elements          |
| tan    | Tangent of argument in radians |
| tanh   | Hyperbolic tangent             |
| times  | Multiplication                 |
| uminus | Unary minus                    |
| uplus  | Unary plus                     |

## Data Types

|               |                                                      |
|---------------|------------------------------------------------------|
| cast          | Convert variable to different data type              |
| cell          | Cell array                                           |
| double        | Double-precision arrays                              |
| eps           | Floating-point relative accuracy                     |
| flintmax      | Largest consecutive integer in floating-point format |
| Inf           | Create array of all Inf values                       |
| int16         | 16-bit signed integer arrays                         |
| int32         | 32-bit signed integer arrays                         |
| int64         | 64-bit signed integer arrays                         |
| int8          | 8-bit signed integer arrays                          |
| isa           | Determine if input has specified data type           |
| isfloat       | Determine whether input is floating-point data type  |
| isinteger     | Determine whether input is integer array             |
| islogical     | Determine if input is logical array                  |
| isnan         | Determine which array elements are NaN               |
| isnumeric     | Determine whether input is numeric array             |
| isobject      | Determine if input is MATLAB object                  |
| isreal        | Determine whether array uses complex storage         |
| logical       | Convert numeric values to logicals                   |
| NaN           | Create array of all NaN values                       |
| realmax       | Largest positive floating-point number               |
| realmin       | Smallest normalized floating-point number            |
| single        | Single-precision arrays                              |
| storedInteger | Stored integer value of fi object                    |
| typecast      | Convert data type without changing underlying data   |
| uint16        | 16-bit unsigned integer arrays                       |
| uint32        | 32-bit unsigned integer arrays                       |
| uint64        | 64-bit unsigned integer arrays                       |
| uint8         | 8-bit unsigned integer arrays                        |

## Relational and Logical Operators

|                                     |                                                        |
|-------------------------------------|--------------------------------------------------------|
| all                                 | Determine if all array elements are nonzero or true    |
| and                                 | Find logical AND                                       |
| any                                 | Determine if any array elements are nonzero            |
| eq                                  | Determine equality                                     |
| ge                                  | Determine greater than or equal to                     |
| gt                                  | Determine greater than                                 |
| isequal                             | Determine array equality                               |
| isequaln                            | Determine array equality, treating NaN values as equal |
| le                                  | Determine less than or equal to                        |
| Logical Operators: Short-Circuit && | Logical operations with short-circuiting               |
| lt                                  | Determine less than                                    |

|     |                      |
|-----|----------------------|
| ne  | Determine inequality |
| not | Find logical NOT     |
| or  | Find logical OR      |

## **Array and Matrix Operations**

|            |                                                             |
|------------|-------------------------------------------------------------|
| cat        | Concatenate arrays                                          |
| circshift  | Shift array circularly                                      |
| colon      | Vector creation, array subscripting, and for-loop iteration |
| complex    | Create complex array                                        |
| ctranspose | Complex conjugate transpose                                 |
| empty      | Create empty array of specified class                       |
| eye        | Identity matrix                                             |
| flip       | Flip order of elements                                      |
| fliplr     | Flip array left to right                                    |
| flipud     | Flip array up to down                                       |
| horzcat    | Horizontal concatenation for heterogeneous arrays           |
| iscolumn   | Determine whether input is column vector                    |
| isempty    | Determine whether array is empty                            |
| isfinite   | Determine which array elements are finite                   |
| isinf      | Determine which array elements are infinite                 |
| ismatrix   | Determine whether input is matrix                           |
| isrow      | Determine whether input is row vector                       |
| isscalar   | Determine whether input is scalar                           |
| issorted   | Determine if array is sorted                                |
| isvector   | Determine whether input is vector                           |
| length     | Length of largest array dimension                           |
| max        | Maximum elements of an array                                |
| min        | Minimum elements of an array                                |
| ndims      | Number of array dimensions                                  |
| numel      | Number of array elements                                    |
| ones       | Create array of all ones                                    |
| permute    | Permute array dimensions                                    |
| repelem    | Repeat copies of array elements                             |
| repmat     | Repeat copies of array                                      |
| reshape    | Reshape array                                               |
| size       | Array size                                                  |
| sort       | Sort array elements                                         |
| squeeze    | Remove dimensions of length 1                               |
| transpose  | Transpose vector or matrix                                  |
| vertcat    | Vertical concatenation for heterogeneous arrays             |
| zeros      | Create array of all zeros                                   |

## **Graphics**

|            |                             |
|------------|-----------------------------|
| area       | Area of 2-D alpha shape     |
| bar        | Bar graph                   |
| barh       | Horizontal bar graph        |
| fplot      | Plot expression or function |
| line       | Create primitive line       |
| plot       | 2-D line plot               |
| plot3      | 3-D point or line plot      |
| plotmatrix | Scatter plot matrix         |



|          |                            |
|----------|----------------------------|
| rgbplot  | Plot colormap              |
| scatter  | Scatter plot               |
| scatter3 | 3-D scatter plot           |
| xlim     | Set or query x-axis limits |
| ylim     | Set or query y-axis limits |
| zlim     | Set or query z-axis limits |

## Deep Learning

|                       |                                                                                         |
|-----------------------|-----------------------------------------------------------------------------------------|
| activations           | Compute deep learning network layer activations                                         |
| classify              | Classify data using trained deep learning neural network                                |
| predict               | Reconstruct the inputs using trained autoencoder                                        |
| predictAndUpdateState | Predict responses using a trained recurrent neural network and update the network state |

To display a list of supported functions, at the MATLAB Command Window, enter:

```
methods(half(1))
```

## Examples

### Convert Value to Half Precision

To cast a double-precision number to half precision, use the `half` function.

```
a = half(pi)
```

```
a =
```

```
half
```

```
3.1406
```

You can also use the `half` function to cast an existing variable to half precision.

```
v = single(magic(3))
```

```
v = 3x3 single matrix
```

```
8 1 6
3 5 7
4 9 2
```

```
a = half(v)
```

```
a =
```

```
3x3 half matrix
```

```
8 1 6
3 5 7
4 9 2
```

## Limitations

- Arithmetic operations which combine half-precision and logical types are not supported.
- For additional usage notes and limitations, see “Half Precision Code Generation Support”.

## Extended Capabilities

### C/C++ Code Generation

Generate C and C++ code using MATLAB® Coder™.

- For a list of functions that support code generation with half-precision inputs and any associated limitations, see “Half Precision Code Generation Support”.
- If your target hardware does not have native support for half-precision, then `half` is used as a storage type, with arithmetic operations performed in single-precision.
- Some functions use `half` only as a storage type and the arithmetic is performed in single-precision, regardless of the target hardware.
- For deep learning code generation, half inputs are cast to single precision and computations are performed in single precision.
- In MATLAB, the `isobject` function returns true with a half-precision input. In generated code, this function returns false.

### GPU Code Generation

Generate CUDA® code for NVIDIA® GPUs using GPU Coder™.

- For a list of functions that support code generation with half-precision inputs and any associated limitations, see “Half Precision Code Generation Support”.
- CUDA compute capability of 5.3 or higher is required for generating and executing code with half-precision data types.
- CUDA toolkit version of 10.0 or later is required for generating and executing code with half-precision data types.
- You must set the memory allocation (`malloc`) mode to 'Discrete' for generating CUDA code.
- Half-precision complex data types are not supported for GPU code generation.
- If your target hardware does not have native support for half-precision, then `half` is used as a storage type, with arithmetic operations performed in single-precision.
- Some functions use `half` only as a storage type and the arithmetic is performed in single-precision, regardless of the target hardware.
- For deep learning code generation, half inputs are cast to single precision and computations are performed in single precision. To perform computations in half, set the library target to 'tensorrt' and set the data type to 'FP16' in `coder.DeepLearningConfig`.
- In MATLAB, the `isobject` function returns true with a half-precision input. In generated code, this function returns false.

## See Also

`single` | `double`

### Topics

“Half Precision Code Generation Support”

“Floating-Point Numbers” (Fixed-Point Designer)

“What is Half Precision?” (Fixed-Point Designer)

“Generate Code for Sobel Edge Detection That Uses Half-Precision Data Type”

**Introduced in R2018b**

## packNGo

Package generated code in ZIP file for relocation

### Syntax

```
packNGo(buildInfo,Name,Value)
```

### Description

`packNGo(buildInfo,Name,Value)` packages the code files in a compressed ZIP file so that you can relocate, unpack, and rebuild them in another development environment. The list of name-value pairs is optional.

The ZIP file can include these types of files:

- Source files (for example, `.c`, `.cu`, and `.cpp` files)
- Header files (for example, `.h`, `.cuh`, and `.hpp` files)
- MAT-file that contains the build information object (`.mat` file)
- Nonbuild-related files (for example, `.dll` files and `.txt` informational files) required for a final executable
- Build-generated binary files (for example, executable `.exe` file or dynamic link library `.dll`).

The code generator includes the build-generated binary files (if present) in the ZIP file. The **ignoreFileMissing** property does not apply to build-generated binary files.

- CMake configuration files (`CMakeLists.txt`) that you use to generate makefiles or projects for a compiler environment.

Use this function to relocate files. You can then recompile the files for a specific target environment or rebuild them in a development environment in which MATLAB is not installed. By default, the function packages the files as a flat folder structure in a ZIP file within the code generation folder. You can customize the output by specifying name-value pairs. After relocating the ZIP file, use a standard ZIP utility to unpack the compressed file.

The `packNGo` function can potentially modify the build information passed in the first `packNGo` argument. As part of code packaging, `packNGo` can find additional files from source and include paths recorded in the build information. When these files are found, `packNGo` adds them to the build information.

To ensure that `packNGo` finds header files, add their paths to `buildInfo` by using the `addIncludePaths` function.

---

**Note** When generating standalone code by using the `codegen` command, you can use the `-package` option to both generate code and package the code in a ZIP file in a single step.

---

### Examples

## Run packNGo from Command Window

After the build process is complete, you can run packNGo from the Command Window. Use packNGo for ZIP file packaging of generated code in the file portzingbit.zip. Maintain the relative file hierarchy.

- 1 Change folders to the code generation folder. For example, using MATLAB Coder, codegen/dll/zingbit or for Simulink code generation, zingbit\_grt\_rtw.
- 2 Load the buildInfo object that describes the build.
- 3 Run packNGo with property settings for packType and fileName.

```
cd codegen/dll/zingbit;
load buildInfo.mat
packNGo(buildInfo,'packType', 'hierarchical', ...
 'fileName','portzingbit');
```

## Configure packNGo in the Simulink Editor

If you configure ZIP file packaging from the code generation pane, the code generator uses packNGo to output a ZIP file during the build process.

- 1 Select **Code Generation > Package code and artifacts**. Optionally, provide a **Zip file name**. To apply the changes, click **OK**.
- 2 Build the model. At the end of the build process, the code generator outputs the ZIP file. The folder structure in the ZIP file is hierarchical.

## Configure packNGo for Simulink from the Command Line

If you configure ZIP file packaging by using the set\_param function, the code generator uses packNGo to output a ZIP file during the build process.

To configure ZIP file packaging for the model zingbit in the file zingbit.zip, use the set\_param function.

```
set_param('zingbit','PostCodeGenCommand', ...
 'packNGo(buildInfo);');
```

## Input Arguments

### buildInfo — Object that provides build information

buildInfo object | path to buildInfo.mat

During the build process, the code generator places buildInfo.mat in the code generation folder. This MAT-file contains the buildInfo object. The object provides information that packNGo uses to produce the ZIP file.

You can specify the argument as a buildInfo object:

```
load buildInfo.mat
packNGo(buildInfo,'packType', 'hierarchical', ...
 'fileName','portzingbit');
```

Or, you can specify the argument as the path to the `buildInfo.mat` file:

```
buildInfoFile = fullfile(pathToBuildFolder, 'buildInfo.mat');
packNGo(buildInfoFile,'packType', 'hierarchical', ...
 'fileName','portzingbit');
```

Or, you can specify the argument as the path to the folder that contains `buildInfo.mat`:

```
packNGo(pathToBuildFolder,'packType', 'hierarchical', ...
 'fileName','portzingbit');
```

### Name-Value Pair Arguments

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `'packType','flat','nestedZipFiles',true`

#### **packType** — Specify structure type of ZIP file

`'flat'` (default) | `'hierarchical'`

If `'flat'`, package the generated code files in a ZIP file as a single, flat folder. The function does *not* package:

- Child `buildInfo.mat` files.
- `CMakeLists.txt` files.

If `'hierarchical'`, package the generated code files hierarchically in a primary ZIP file. The hierarchy contains top model, referenced model, and shared utility folders. The function also packages:

- The corresponding `buildInfo.mat` files for the folders.
- `CMakeLists.txt` files in the build folder.

Example: `'packType','flat'`

#### **nestedZipFiles** — Determines whether the paths for files in the secondary ZIP files are relative to the root folder of the primary ZIP file

`true` (default) | `false`

If `true`, create a primary ZIP file that contains three secondary ZIP files:

- `mlrFiles.zip` — Files in your `matlabroot` folder tree
- `sDirFiles.zip` — Files in and under your code generation folder
- `otherFiles.zip` — Required files not in the `matlabroot` or `start` folder trees

If `false`, create a primary ZIP file that contains folders, for example, your code generation folder and `matlabroot`.

Example: `'nestedZipFiles',true`

#### **fileName** — Specifies a file name for the primary ZIP file

`'modelOrFunctionName.zip'` (default) | `'myName'`

If you do not specify the `'fileName'`-value pair, the function packages the files in a ZIP file named `modelOrFunctionName.zip` and places the ZIP file in the code generation folder.

If you specify `'fileName'` with the value, `'myName'`, the function creates `myName.zip` in the code generation folder.

To specify another location for the primary ZIP file, provide the absolute path to the location, `fullPath/myName.zip`

Example: `'fileName','/home/user/myModel.zip'`

### **minimalHeaders — Selects whether to include only the minimal header files**

`true` (default) | `false`

If `true`, include only the minimal header files required to build the code in the ZIP file.

If `false`, include header files found on the include path in the ZIP file.

Example: `'minimalHeaders',true`

### **includeReport — Selects whether to include the html folder for your code generation report**

`false` (default) | `true`

If `false`, do not include the `html` folder in the ZIP file.

If `true`, include the `html` folder in the ZIP file.

Example: `'includeReport',false`

### **ignoreParseError — Instruct packNGo not to terminate on parse errors**

`false` (default) | `true`

If `false`, terminate on parse errors.

If `true`, do not terminate on parse errors.

Example: `'ignoreParseError',false`

### **ignoreFileMissing — Instruct packNGo not to terminate if files are missing**

`false` (default) | `true`

If `false`, terminate on missing file errors.

If `true`, do not terminate on missing files errors.

Example: `'ignoreFileMissing',false`

## **Limitations**

- The function operates on source files only, such as `*.c`, `*.cpp`, `.cuh`, and `*.h` files. The function does not support compile flags, defines, or makefiles.
- The function does not package source files for reusable library subsystems.
- Unnecessary files might be included. The function might find additional files from source paths and include paths recorded in the build information, even if those files are not used.

- For MATLAB Coder, the function does not package example main source and header files that you generate with the default configuration settings. To package the example main files, configure code generation to generate and compile the example main function, generate your code, and then package the build files.
- packNGo does not package the code generated for MEX targets.

### **See Also**

#### **Topics**

“Build Process Customization”

“Package Code for Other Development Environments”

#### **Introduced in R2006b**



# getLineColumn

**Package:** coder

Find locations of beginning and end of MATLAB code involved in code generation

## Syntax

```
[startLoc,endLoc] = getLineColumn(obj)
[startLoc,endLoc] = getLineColumn(obj_message)
[startLoc,endLoc] = getLineColumn(obj_callsite)
```

## Description

`[startLoc,endLoc] = getLineColumn(obj)` returns the line and column indices of the first and last character of the MATLAB code described by `obj` in the text of the file containing the code. The code described by `obj` is a MATLAB function or method that is involved in code generation.

`[startLoc,endLoc] = getLineColumn(obj_message)` returns the line and column indices of the first and last character of the MATLAB code that caused the code generation message described by `obj_message`.

`[startLoc,endLoc] = getLineColumn(obj_callsite)` returns the line and column indices of the first and last character of the function call site described by `obj_callsite` in the text of the file containing the call.

## Examples

### Locate a MATLAB Function in File

Create a report information object for a code generation process. You then locate a MATLAB function involved in code generation in the file containing that function.

Define the MATLAB function `foo`:

```
function [b,c] = foo(a)
b = svd(a,0);
c = bar(a);
end
```

```
function c = bar(a)
c = inv(a);
end
```

Generate a static C library for `foo`. Specify the input as a string scalar. Export the code generation report information to the variable `info` in your base MATLAB workspace.

```
codegen -config:lib foo -args {"A string scalar"} -reportinfo info
```

Code generation fails because a string scalar is not a valid input for the MATLAB functions `svd` and `inv`. The code generator creates a report information object `info` in the base MATLAB workspace.

The property `info.Functions` is a two-dimensional array. `info.Functions(1)` contains the description of the MATLAB function `foo`. `info.Functions(2)` contains the description of the MATLAB function `bar`.

To manually inspect the function `bar`, first display the text of the file containing `bar`.

```
info.Functions(2).File.Text
```

```
'function [b,c] = foo(a)
b = svd(a,0);
c = bar(a);
end

function c = bar(a)
c = inv(a);
end
'
```

Use `getLineColumn` to locate the beginning and end of the function `bar` in this text. The output `startLoc` contains the line and column indices of the first character of `bar`. The output `endLoc` contains the line and column indices of the last character of `bar`.

```
[startLoc,endLoc]=getLineColumn(info.Functions(2))
```

```
startLoc =
```

```
struct with fields:
```

```
Line: 6
Column: 1
```

```
endLoc =
```

```
struct with fields:
```

```
Line: 8
Column: 3
```

### Locate MATLAB Code That Causes a Code Generation Error Message

Create a report information object for a code generation process that fails. You then locate the part of MATLAB code that caused an error message.

Define the MATLAB function `foo`:

```
function b = foo(a)
b = svd(a,0);
end
```

Generate a static C library for `foo`. Specify the input as a string scalar. Export the code generation report information to the variable `info` in your base MATLAB workspace.

```
codegen -config:lib foo -args {"A string scalar"} -reportinfo info
```

Code generation fails because a string scalar is not a valid input for the MATLAB function `svd`. The code generator creates a report information object `info` in the base MATLAB workspace.

The property `info.Messages` is a two-dimensional array containing descriptions of two code generation messages. Inspect the description of the first message.

```
info.Messages(1)
```

```
Message with properties:
```

```
Identifier: 'Coder:toolbox:unsupportedClass'
Type: 'Error'
Text: 'Function 'svd' is not defined for values of class 'string'.'
File: [1x1 coder.CodeFile]
StartIndex: 26
EndIndex: 33
```

To manually inspect the segment of MATLAB code that caused this error message, first display the text of the file associated with this error message.

```
info.Messages(1).File.Text
```

```
'function b = foo(a)
b = svd(a,0);
end
'
```

Use `getLineColumn` to locate the beginning and end of the part of the code that caused the error message. The output `startLoc` contains the line and column indices of the first character of the code segment. The output `endLoc` contains the line and column indices of the last character of the code segment.

```
[startLoc,endLoc] = getLineColumn(info.messages(1))
```

```
startLoc =
```

```
struct with fields:
```

```
Line: 2
Column: 5
```

```
endLoc =
```

```
struct with fields:
```

```
Line: 2
Column: 12
```

These locations correspond to the beginning and the end of the function call `'svd(a,0)'` in the text of `foo.m`.

## Input Arguments

**obj** — Object describing MATLAB function or method involved in code generation

handle object

Object describing a MATLAB function or a method in a MATLAB class that is involved in code generation, specified as one of the following:

- A `coder.Function` object for the description of a function. See `coder.Function` Properties.
- A `coder.Method` object for the description of a method. See `coder.Method` Properties.

**obj\_message — Object describing code generation error message**

`coder.Message` object

A `coder.Message` object describing an error, warning, or informational message produced during code generation from MATLAB code. See `coder.Message` Properties.

**obj\_callsite — Object describing function call site**

`coder.CallSite` object

A `coder.CallSite` object describing a function call site in your MATLAB code. See `coder.CallSite` Properties.

## Output Arguments

**startLoc — Line and column indices of the first character of MATLAB code**

structure array

Structure array with two fields: `Line` and `Column`.

- `startLoc.Line` is the line index of the first character of the MATLAB code in the text of the file containing the code.
- `startLoc.Column` is the column index of the first character of the MATLAB code in the text of the file containing the code.

**endLoc — Line and column indices of the last character of MATLAB code**

structure array

Structure array with two fields: `Line` and `Column`.

- `endLoc.Line` is the line index of the last character of the MATLAB code in the text of the file containing the code.
- `endLoc.Column` is the column index of the last character of the MATLAB code in the text of the file containing the code.

## See Also

`coder.Function` Properties | `coder.Method` Properties | `coder.Message` Properties

### Topics

“Access Code Generation Report Information Programmatically”

**Introduced in R2019a**

# coderTypeEditor

Launch the Coder Type Editor dialog

## Syntax

```
coderTypeEditor
coderTypeEditor var1 ... varN
coderTypeEditor -all
coderTypeEditor -close
```

## Description

`coderTypeEditor` opens an empty Coder Type Editor dialog. If a dialog is already open, this command brings it to the front of the screen.

You can use the Coder Type Editor to create and edit `coder.Type` objects interactively. See “Create and Edit Input Types by Using the Coder Type Editor”.

`coderTypeEditor var1 ... varN` opens a Coder Type Editor dialog pre-populated with `coder.Type` objects corresponding to the workspace variables `var1` through `varN`. For a variable `var`, the name of the generated `coder.Type` object is `varType`.

`coderTypeEditor -all` opens a Coder Type Editor dialog pre-populated with `coder.Type` objects corresponding to all compatible variables in the current workspace.

`coderTypeEditor -close` closes an open Coder Type Editor dialog.

## Examples

### Open Coder Type Editor Populated with Types for Existing Variables

In your MATLAB workspace, define variables `var1`, `var2`, and `var3`.

```
myArray = magic(4);
myCharVector = 'Hello, World!';
myStruct = struct('a',5,'b','mystring');
```

Open the type editor pre-populated with types for `var1`, `var2`, and `var3`.

```
coderTypeEditor myArray myCharVector myStruct
```

The Coder Type Editor dialog opens. The **Type Browser** pane displays the name, class (data type), and size for `coder.Type` objects `myArrayType`, `myCharVectorType`, and `myStructType` for the three workspace variables.

Inspect the created types and check that they are consistent with the variables in the workspace.

- `myArrayType` represents a 4-by-4 array of type double.
- `myCharVectorType` represents a 1-by-13 character row vector.

- `myStructType` represents a scalar of type `struct`. Expand the tree corresponding to `myStructType` in the **Type Browser**. The field `a` represents a scalar double. The field `b` represents a 1-by-8 character vector.

To save these types in the base workspace, in the Coder Type Editor toolstrip, click **Save**. The variables `myArrayType`, `myCharVectorType`, and `myStructType` appear in the base workspace.

## Input Arguments

**var1 ... varN — Workspace variables whose types you intend to view in the type editor**

value belonging to a fundamental MATLAB class that supports code generation | value object | handle object | `coder.Type` object

Workspace variables whose types you intend to view in the type editors. They can store any value that is compatible with code generation.

The value can also be a `coder.Type` object. In that case, the `coder.Type` object itself opens in the type editor.

Data Types: `single` | `double` | `int8` | `int16` | `int32` | `int64` | `uint8` | `uint16` | `uint32` | `uint64` | `logical` | `char` | `string` | `struct` | `table` | `cell` | `categorical` | `datetime` | `duration` | `t timetable` | `fi` | value object | `coder.Type` object

Complex Number Support: Yes

## See Also

`coder` | `coder.typeof` | `coder.newtype`

## Topics

“Create and Edit Input Types by Using the Coder Type Editor”

**Introduced in R2020a**

# removeSourceFiles

Remove source files from build information object

## Syntax

```
removeSourceFiles(buildInfo,filenames,groups)
```

## Description

`removeSourceFiles(buildInfo,filenames,groups)` removes source file names from build information that is stored in an `RTW.BuildInfo` object.

## Examples

### Remove Source File Names from Build Information

Suppose you add a list of source files to an `RTW.BuildInfo` object, `myBuildInfo`.

```
myBuildInfo = RTW.BuildInfo;
addSourceFiles(myBuildInfo, ...
 {'test1.c' 'test2.c' 'driver1.c' 'driver2.c'}, ...
 '/proj/src', ...
 {'Tests' 'Tests' 'Drivers' 'Drivers'});
```

To remove `test1.c` from the object, run:

```
removeSourceFiles(myBuildInfo, 'test1.c');
```

To remove `test2.c` and `driver1.c`, run:

```
removeSourceFiles(myBuildInfo, {'test2.c' 'driver1.c'});
```

To remove the names of files that belong to the `'Drivers'` group, run:

```
removeSourceFiles(myBuildInfo, '', 'Drivers');
```

## Input Arguments

### **buildInfo** — Build information object

object

`RTW.BuildInfo` object that contains information for compiling and linking generated code.

Example: `myBuildInfo`

### **filenames** — Source files to remove

character vector | array of character vectors | string

Specify source files that you want to remove from the build information object.

Example: `'test1.c'`

**groups – File groups to remove**

character vector | array of character vectors | string

Specify groups of source files that you want to remove from the build information object.

Example: {'Tests' 'Drivers'}

**See Also**

addSourceFiles

**Topics**

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2021b**



# setTargetProvidesMain

Disable inclusion of code generator provided (generated or static) `main.c` source file during build

## Syntax

```
setTargetProvidesMain(buildInfo,providesMain)
```

## Description

`setTargetProvidesMain(buildInfo,providesMain)` disables the code generator from including a sample `main.c` source file.

To replace the sample `main.c` file from the code generator with a custom `main.c` file, call the `setTargetProvidesMain` function during the 'after\_tlc' case in the `ert_make_rtw_hook.m` or `grt_make_rtw_hook.m` file.

## Examples

### Workflow for setTargetProvidesMain

To apply the `setTargetProvidesMain` function:

Add `buildInfo` to the arguments in the function call.

```
function ert_make_rtw_hook(hookMethod,Name,rtwroot, ...
 templateMakefile,buildOpts,buildArgs,buildInfo)
```

Add the `setTargetProvidesMain` function to the 'after\_tlc' stage.

```
case 'after_tlc'
% Called just after to invoking TLC Compiler (actual code generation.)
% Valid arguments at this stage are hookMethod, Name, and
% buildArgs, buildInfo
%
 setTargetProvidesMain(buildInfo,true);
```

Use the **Configuration Parameters > Code Generation > Custom Code > Source Files** field to add your custom `main.c` to the project. When you indicate that the target provides `main.c`, the project requires this file to build without errors.

## Input Arguments

**buildInfo** — Name of build information object returned by `RTW.BuildInfo` object

**providesMain** — Logical value that specifies whether the code generator includes the target provided `main.c` file

false (default) | true

The *providesmain* argument specifies whether the code generator includes a (generated or static) `main.c` source file.

- `false` — The code generator includes a sample `main.obj` object file.
- `true` — The target provides the `main.c` source file.

### See Also

#### Topics

“Customize Build Process with `STF_make_rtw_hook` File” (Simulink Coder)

**Introduced in R2009a**

# Simulink.sdi.compareRuns

**Package:** Simulink.sdi

Compare data in two simulation runs

## Syntax

```
diffResult = Simulink.sdi.compareRuns(runID1,runID2)
diffResult = Simulink.sdi.compareRuns(runID1,runID2,Name=Value)
```

## Description

`diffResult = Simulink.sdi.compareRuns(runID1,runID2)` compares the data in the runs that correspond to `runID1` and `runID2` and returns the result in the `Simulink.sdi.DiffRunResult` object `diffResult`. For more information about the comparison algorithm, see “How the Simulation Data Inspector Compares Data” (Simulink).

`diffResult = Simulink.sdi.compareRuns(runID1,runID2,Name=Value)` compares the simulation runs that correspond to `runID1` and `runID2` using the options specified by one or more name-value arguments. For more information about comparison options, see “How the Simulation Data Inspector Compares Data” (Simulink).

## Examples

### Compare Runs with Global Tolerance

You can specify global tolerance values to use when comparing two simulation runs. Global tolerance values are applied to all signals within the run. This example shows how to specify global tolerance values for a run comparison and how to analyze and save the comparison results.

First, load the session file that contains the data to compare. The session file contains data for four simulations of an aircraft longitudinal controller. This example compares data from two runs that use different input filter time constants.

```
Simulink.sdi.load('AircraftExample.mldatx');
```

To access the run data to compare, use the `Simulink.sdi.getAllRunIDs` (Simulink) function to get the run IDs that correspond to the last two simulation runs.

```
runIDs = Simulink.sdi.getAllRunIDs;
runID1 = runIDs(end - 1);
runID2 = runIDs(end);
```

Use the `Simulink.sdi.compareRuns` (Simulink) function to compare the runs. Specify a global relative tolerance value of 0.2 and a global time tolerance value of 0.5.

```
runResult = Simulink.sdi.compareRuns(runID1,runID2,'reltol',0.2,'timetol',0.5);
```

Check the `Summary` property of the returned `Simulink.sdi.DiffRunResult` object to see whether signals were within the tolerance values or out of tolerance.

```
runResult.Summary
ans = struct with fields:
 OutOfTolerance: 0
 WithinTolerance: 3
 Unaligned: 0
 UnitsMismatch: 0
 Empty: 0
 Canceled: 0
 EmptySynced: 0
 DataTypeMismatch: 0
 TimeMismatch: 0
 StartStopMismatch: 0
 Unsupported: 0
```

All three signal comparison results fell within the specified global tolerance.

You can save the comparison results to an MLDATX file using the `saveResult` (Simulink) function.

```
saveResult(runResult, 'InputFilterComparison');
```

### Analyze Simulation Data Using Signal Tolerances

You can programmatically specify signal tolerance values to use in comparisons performed using the Simulation Data Inspector. In this example, you compare data collected by simulating a model of an aircraft longitudinal flight control system. Each simulation uses a different value for the input filter time constant and logs the input and output signals. You analyze the effect of the time constant change by comparing results using the Simulation Data Inspector and signal tolerances.

First, load the session file that contains the simulation data.

```
Simulink.sdi.load('AircraftExample.mldatx');
```

The session file contains four runs. In this example, you compare data from the first two runs in the file. Access the `Simulink.sdi.Run` objects for the first two runs loaded from the file.

```
runIDs = Simulink.sdi.getAllRunIDs;
runIDTs1 = runIDs(end-3);
runIDTs2 = runIDs(end-2);
```

Now, compare the two runs without specifying any tolerances.

```
noTolDiffResult = Simulink.sdi.compareRuns(runIDTs1, runIDTs2);
```

Use the `getResultByIndex` function to access the comparison results for the `q` and `alpha` signals.

```
qResult = getResultByIndex(noTolDiffResult, 1);
alphaResult = getResultByIndex(noTolDiffResult, 2);
```

Check the `Status` of each signal result to see whether the comparison result fell within our out of tolerance.

```
qResult.Status
ans =
 ComparisonSignalStatus enumeration
```

```
 OutOfTolerance
```

```
alphaResult.Status
```

```
ans =
 ComparisonSignalStatus enumeration

 OutOfTolerance
```

The comparison used a value of 0 for all tolerances, so the `OutOfTolerance` result means the signals are not identical.

You can further analyze the effect of the time constant by specifying tolerance values for the signals. Specify the tolerances by setting the properties for the `Simulink.sdi.Signal` objects that correspond to the signals being compared. Comparisons use tolerances specified for the baseline signals. This example specifies a time tolerance and an absolute tolerance.

To specify a tolerance, first access the `Signal` objects from the baseline run.

```
runTs1 = Simulink.sdi.getRun(runIDTs1);
qSig = getSignalsByName(runTs1,'q, rad/sec');
alphaSig = getSignalsByName(runTs1,'alpha, rad');
```

Specify an absolute tolerance of 0.1 and a time tolerance of 0.6 for the `q` signal using the `AbsTol` and `TimeTol` properties.

```
qSig.AbsTol = 0.1;
qSig.TimeTol = 0.6;
```

Specify an absolute tolerance of 0.2 and a time tolerance of 0.8 for the `alpha` signal.

```
alphaSig.AbsTol = 0.2;
alphaSig.TimeTol = 0.8;
```

Compare the results again. Access the results from the comparison and check the `Status` property for each signal.

```
tolDiffResult = Simulink.sdi.compareRuns(runIDTs1,runIDTs2);
qResult2 = getResultByIndex(tolDiffResult,1);
alphaResult2 = getResultByIndex(tolDiffResult,2);
```

```
qResult2.Status
```

```
ans =
 ComparisonSignalStatus enumeration

 WithinTolerance
```

```
alphaResult2.Status
```

```
ans =
 ComparisonSignalStatus enumeration

 WithinTolerance
```

## Configure Comparisons to Check Metadata

You can use the `Simulink.sdi.compareRuns` function to compare signal data and metadata, including data type and start and stop times. A single comparison may check for mismatches in one or more pieces of metadata. When you check for mismatches in signal metadata, the `Summary` property of the `Simulink.sdi.DiffRunResult` object may differ from a basic comparison because the `Status` property for a `Simulink.sdi.DiffSignalResult` object can indicate the metadata mismatch. You can configure comparisons using the `Simulink.sdi.compareRuns` function for imported data and for data logged from a simulation.

This example configures a comparison of runs created from workspace data three ways to show how the `Summary` of the `DiffSignalResult` object can provide specific information about signal mismatches.

### Create Workspace Data

The `Simulink.sdi.compareRuns` function compares time series data. Create data for a sine wave to use as the baseline signal, using the `timeseries` format. Give the `timeseries` the name `Wave Data`.

```
time = 0:0.1:20;
sig1vals = sin(2*pi/5*time);
sig1_ts = timeseries(sig1vals,time);
sig1_ts.Name = 'Wave Data';
```

Create a second sine wave to compare against the baseline signal. Use a slightly different time vector and attenuate the signal so the two signals are not identical. Cast the signal data to the `single` data type. Also name this `timeseries` object `Wave Data`. The Simulation Data Inspector comparison algorithm will align these signals for comparison using the name.

```
time2 = 0:0.1:22;
sig2vals = single(0.98*sin(2*pi/5*time2));
sig2_ts = timeseries(sig2vals,time2);
sig2_ts.Name = 'Wave Data';
```

### Create and Compare Runs in the Simulation Data Inspector

The `Simulink.sdi.compareRuns` function compares data contained in `Simulink.sdi.Run` objects. Use the `Simulink.sdi.createRun` function to create runs in the Simulation Data Inspector for the data. The `Simulink.sdi.createRun` function returns the run ID for each created run.

```
runID1 = Simulink.sdi.createRun('Baseline Run','vars',sig1_ts);
runID2 = Simulink.sdi.createRun('Compare to Run','vars',sig2_ts);
```

You can use the `Simulink.sdi.compareRuns` function to compare the runs. The comparison algorithm converts the signal data to the `double` data type and synchronizes the signal data before computing the difference signal.

```
basic_DRR = Simulink.sdi.compareRuns(runID1,runID2);
```

Check the `Summary` property of the returned `Simulink.sdi.DiffRunResult` object to see the result of the comparison.

```
basic_DRR.Summary
ans = struct with fields:
 OutOfTolerance: 1
 WithinTolerance: 0
 Unaligned: 0
 UnitsMismatch: 0
 Empty: 0
 Canceled: 0
 EmptySynced: 0
 DataTypeMismatch: 0
 TimeMismatch: 0
 StartStopMismatch: 0
 Unsupported: 0
```

The difference between the signals is out of tolerance.

### Compare Runs and Check for Data Type Match

Depending on your system requirements, you may want the data types for signals you compare to match. You can use the `Simulink.sdi.compareRuns` function to configure the comparison algorithm to check for and report data type mismatches.

```
dataType_DRR = Simulink.sdi.compareRuns(runID1,runID2,'DataType','MustMatch');
dataType_DRR.Summary
```

```
ans = struct with fields:
 OutOfTolerance: 0
 WithinTolerance: 0
 Unaligned: 0
 UnitsMismatch: 0
 Empty: 0
 Canceled: 0
 EmptySynced: 0
 DataTypeMismatch: 1
 TimeMismatch: 0
 StartStopMismatch: 0
 Unsupported: 0
```

The result of the signal comparison is now `DataTypeMismatch` because the data for the baseline signal is double data type, while the data for the signal compared to the baseline is single data type.

### Compare Runs and Check for Start and Stop Time Match

You can use the `Simulink.sdi.compareRuns` function to configure the comparison algorithm to check whether the aligned signals have the same start and stop times.

```
startStop_DRR = Simulink.sdi.compareRuns(runID1,runID2,'StartStop','MustMatch');
startStop_DRR.Summary
```

```
ans = struct with fields:
 OutOfTolerance: 0
 WithinTolerance: 0
 Unaligned: 0
 UnitsMismatch: 0
```

```

 Empty: 0
 Canceled: 0
 EmptySynced: 0
 DataTypeMismatch: 0
 TimeMismatch: 0
 StartStopMismatch: 1
 Unsupported: 0

```

The signal comparison result is now `StartStopMismatch` because the signals created in the workspace have different stop times.

### Compare Runs with Alignment Criteria

When you compare runs using the Simulation Data Inspector, you can specify alignment criteria that determine how signals are paired with each other for comparison. This example compares data from simulations of a model of an aircraft longitudinal control system. The simulations used a square wave input. The first simulation used an input filter time constant of `0.1s` and the second simulation used an input filter time constant of `0.5s`.

First, load the simulation data from the session file that contains the data for this example.

```
Simulink.sdi.load('AircraftExample.mldatx');
```

The session file contains data for four simulations. This example compares data from the first two runs. Access the run IDs for the first two runs loaded from the session file.

```
runIDs = Simulink.sdi.getAllRunIDs;
runIDTs1 = runIDs(end-3);
runIDTs2 = runIDs(end-2);
```

Before running the comparison, define how you want the Simulation Data Inspector to align the signals between the runs. This example aligns signals by their name, then by their block path, and then by their Simulink identifier.

```
alignMethods = [Simulink.sdi.AlignType.SignalName
 Simulink.sdi.AlignType.BlockPath
 Simulink.sdi.AlignType.SID];
```

Compare the simulation data in your two runs, using the alignment criteria you specified. The comparison uses a small time tolerance to account for the effect of differences in the step size used by the solver on the transition of the square wave input.

```
diffResults = Simulink.sdi.compareRuns(runIDTs1,runIDTs2,'align',alignMethods,...
 'timetol',0.005);
```

You can use the `getResultByIndex` function to access the comparison results for the aligned signals in the runs you compared. You can use the `Count` property of the `Simulink.sdi.DiffRunResult` object to set up a `for` loop to check the `Status` property for each `Simulink.sdi.DiffSignalResult` object.

```
numComparisons = diffResults.count;
for k = 1:numComparisons
 resultAtIdx = getResultByIndex(diffResults,k);
```



```

sigID1 = resultAtIdx.signalID1;
sigID2 = resultAtIdx.signalID2;

sig1 = Simulink.sdi.getSignal(sigID1);
sig2 = Simulink.sdi.getSignal(sigID2);

displayStr = 'Signals %s and %s: %s \n';
fprintf(displayStr,sig1.Name,sig2.Name,resultAtIdx.Status);
end

```

```

Signals q, rad/sec and q, rad/sec: OutOfTolerance
Signals alpha, rad and alpha, rad: OutOfTolerance
Signals Stick and Stick: WithinTolerance

```

## Input Arguments

### runID1 — Baseline run identifier

integer

Numeric identifier for the baseline run in the comparison, specified as a run ID that corresponds to a run in the Simulation Data Inspector. The Simulation Data Inspector assigns run IDs when runs are created. You can get the run ID for a run by using the ID property of the `Simulink.sdi.Run` object, the `Simulink.sdi.getAllRunIDs` function, or the `Simulink.sdi.getRunIDByIndex` function.

### runID2 — Identifier for run to compare

integer

Numeric identifier for the run to compare, specified as a run ID that corresponds to a run in the Simulation Data Inspector. The Simulation Data Inspector assigns run IDs when runs are created. You can get the run ID for a run by using the ID property of the `Simulink.sdi.Run` object, the `Simulink.sdi.getAllRunIDs` function, or the `Simulink.sdi.getRunIDByIndex` function.

## Name-Value Pair Arguments

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `AbsTol=x,Align=alignOpts`

### Align — Signal alignment options

`Simulink.sdi.AlignType` scalar | `Simulink.sdi.AlignType` vector

Signal alignment options, specified as a `Simulink.sdi.AlignType` scalar or vector. The `Simulink.sdi.AlignType` enumeration includes a value for each option available for pairing each signal in the baseline run with a signal in the comparison run. You can specify one or more alignment options for the comparison. To use more than one alignment option, specify an array. When you specify multiple alignment options, the Simulation Data Inspector aligns signals first by the option in the first element of the array, then by the option in the second element array, and so on. For more information, see “Signal Alignment” (Simulink).

| Value                                          | Aligns By                                                                               |
|------------------------------------------------|-----------------------------------------------------------------------------------------|
| <code>Simulink.sdi.AlignType.BlockPath</code>  | Path to the source block for the signal                                                 |
| <code>Simulink.sdi.AlignType.SID</code>        | Simulink identifier<br><br>For more information, see “Simulink Identifiers” (Simulink). |
| <code>Simulink.sdi.AlignType.SignalName</code> | Signal name                                                                             |
| <code>Simulink.sdi.AlignType.DataSource</code> | Path of the variable in the MATLAB workspace                                            |

Example: `[Simulink.sdi.AlignType.SignalName, Simulink.sdi.AlignType.BlockPath]` specifies signal alignment by signal name and then by block path.

### **AbsTol — Global absolute tolerance for comparison**

0 (default) | positive-valued scalar

Global absolute tolerance for comparison, specified as a positive-valued scalar.

Global tolerances apply to all signals in the run comparison. To use a different tolerance value for a signal in the comparison, specify the tolerance you want to use on the `Simulink.sdi.Signal` object in the baseline run and set the `OverrideGlobalTol` property for that signal to `true`.

For more information about how tolerances are used in comparisons, see “Tolerance Specification” (Simulink).

Example: `0.5`

Data Types: `double`

### **RelTol — Global relative tolerance for comparison**

0 (default) | positive-valued scalar

Global relative tolerance for comparison, specified as a positive-valued scalar. The relative tolerance is expressed as a fractional multiplier. For example, `0.1` specifies a 10 percent tolerance.

Global tolerances apply to all signals in the run comparison. To use a different tolerance value for a signal in the comparison, specify the tolerance you want to use on the `Simulink.sdi.Signal` object in the baseline run and set the `OverrideGlobalTol` property for that signal to `true`.

For more information about how tolerances are used in comparisons, see “Tolerance Specification” (Simulink).

Example: `0.1`

Data Types: `double`

### **TimeTol — Global time tolerance for comparison**

0 (default) | positive-valued scalar

Global time tolerance for comparison, specified as a positive-valued scalar, using units of seconds.

Global tolerances apply to all signals in the run comparison. To use a different tolerance value for a signal in the comparison, specify the tolerance you want to use on the `Simulink.sdi.Signal` object in the baseline run and set the `OverrideGlobalTol` property for that signal to `true`.

For more information about tolerances in the Simulation Data Inspector, see “Tolerance Specification” (Simulink).

Example: 0.2

Data Types: double

### **Data Type — Comparison sensitivity to signal data types**

"MustMatch"

Comparison sensitivity to signal data types, specified as "MustMatch". Specify `DataType="MustMatch"` when you want the comparison to be sensitive to data type mismatches in compared signals. When you specify this name-value argument, the algorithm compares the data types for aligned signals before synchronizing and comparing the signal data.

When signal data types do not match, the `Status` property of the `Simulink.sdi.DiffSignalResult` object for the result is set to `DataTypeMismatch`.

The `Simulink.sdi.compareRuns` function does not compare the data types of aligned signals unless you specify this name-value argument. When you do not specify this name-value argument, the comparison does compute results for signals with different data types.

When you specify that data types must match and configure the comparison to stop on the first mismatch, a data type mismatch stops the comparison. A stopped comparison may not compute results for all signals.

### **Time — Comparison sensitivity to signal time vectors**

"MustMatch"

Comparison sensitivity to signal time vectors, specified as "MustMatch". Specify `Time="MustMatch"` when you want the comparison to be sensitive to mismatches in the time vectors of compared signals. When you specify this name-value argument, the algorithm compares the time vectors of aligned signals before synchronizing and comparing the signal data.

When the time vectors for signals do not match, the `Status` property of the `Simulink.sdi.DiffSignalResult` object for the result is set to `TimeMismatch`.

Comparisons are not sensitive to differences in signal time vectors unless you specify this name-value argument. For comparisons that are not sensitive to differences in the time vectors, the comparison algorithm synchronizes the signals prior to the comparison. For more information about how synchronization works, see “How the Simulation Data Inspector Compares Data” (Simulink).

When you specify that time vectors must match and configure the comparison to stop on the first mismatch, a time vector mismatch stops the comparison. A stopped comparison may not compute results for all signals.

### **StartStop — Comparison sensitivity to signal start and stop times**

"MustMatch"

Comparison sensitivity to signal start and stop times, specified as "MustMatch". Specify `StartStop="MustMatch"` when you want the comparison to be sensitive to mismatches in signal start and stop times. When you specify this name-value argument, the algorithm compares the start and stop times for aligned signals before synchronizing and comparing the signal data.

When the start times and stop times do not match, the `Status` property of the `Simulink.sdi.DiffSignalResult` object for the result is set to `StartStopMismatch`.

When you specify that start and stop times must match and configure the comparison to stop on the first mismatch, a start or stop time mismatch stops the comparison. A stopped comparison may not compute results for all signals.

### **StopOnFirstMismatch — Whether comparison stops on first detected mismatch**

"Metadata" | "Any"

Whether comparison stops on first detected mismatch without comparing remaining signals, specified as "Metadata" or "Any". A stopped comparison may not compute results for all signals, and can return a mismatched result more quickly.

- **Metadata** — A mismatch in metadata for aligned signals causes the comparison to stop. Metadata comparisons happen before comparing signal data.

The Simulation Data Inspector always aligns signals and compares signal units. When you configure the comparison to stop on the first mismatch, an unaligned signal or mismatched units always causes the comparison to stop. You can specify additional name-value arguments to configure the comparison to check and stop on the first mismatch for additional metadata, such as signal data type, start and stop times, and time vectors.

- **Any** — A mismatch in metadata or signal data for aligned signals causes the comparison to stop.

### **ExpandChannels — Whether to compute comparison results for each channel in multidimensional signals**

true or 1 (default) | false or 0

Whether to compute comparison results for each channel in multidimensional signals, specified as logical true (1) or false (0).

- **true or 1** — Comparison expands multidimensional signals represented as a single signal with nonscalar sample values to a set of signals with scalar sample values and computes a comparison result for each of these signals.

The representation of the multidimensional signal in the Simulation Data Inspector as a single signal with nonscalar sample values does not change.

- **false or 0** — Comparison does not compute results for multidimensional signals represented as a single signal with nonscalar sample values.

## **Output Arguments**

### **diffResult — Comparison results**

Simulink.sdi.DiffRunResult object

Comparison results, returned as a Simulink.sdi.DiffRunResult object.

## **Limitations**

The Simulation Data Inspector does not support comparing:

- Signals of data types int64 or uint64.
- Variable-size signals.

## See Also

### Functions

`Simulink.sdi.compareSignals` | `Simulink.sdi.getRunIDByIndex` |  
`Simulink.sdi.getRunCount` | `getResultByIndex`

### Objects

`Simulink.sdi.DiffRunResult` | `Simulink.sdi.DiffSignalResult`

### Topics

“Inspect and Compare Data Programmatically” (Simulink)

“Compare Simulation Data” (Simulink)

“How the Simulation Data Inspector Compares Data” (Simulink)

### Introduced in R2011b

## textReport

**Package:** coder

Export code generation readiness report to base workspace as a character vector

### Syntax

```
myreport = textReport(info)
```

### Description

`myreport = textReport(info)` returns a character vector `myreport` that contains the code generation readiness report described by the `coder.ScreenerInfo` object `info`.

The object `info` and the character vector `myreport` contain two different representations of the code generation readiness report. If you want to display the entire report at the command line for manual inspection, use the character vector representation. If you want to programmatically retrieve information from specific parts of the report (for example, to create your own customized report), use the object representation. See `coder.ScreenerInfo` Properties.

### Examples

#### Export code generation readiness report as a character vector

This example shows how to export the code generation readiness report that a `coder.ScreenerInfo` object contains to the base workspace as a character vector.

Write the function `foo2` and save it in the file `foo2.m`.

```
function [tf1,tf2] = foo2(source,target)
G = digraph(source,target);
tf1 = hascycles(G);
tf2 = isdag(G);
end
```

Write the function `foo1` that calls `foo2`. Save `foo1` in the file `foo1.m`.

```
function [tf1,tf2] = foo1(source,target)
assert(numel(source)==numel(target))
[tf1,tf2] = foo2(source,target);
end
```

Analyze code generation readiness of `foo1` by using `coder.screener` and export the report to the object `info`.

```
info = coder.screener('foo1')
```

```
info =
```

```
 ScreenerInfo with properties:
```

```

 Files: [2x1 coder.CodeFile]
 Messages: [2x1 coder.Message]
 UnsupportedCalls: [2x1 coder.CallSite]

```

View Screener Report

The function `foo2` contains calls to two MATLAB functions `hascycles` and `isdag` that are not supported for code generation.

Export the code generation readiness report to the character vector `myreport`.

```

myreport = textReport(info)

myreport =

 'Code Generation Readiness (Text Report)
 =====
 2 Code generation readiness issues
 2 Unsupported functions
 2 Files analyzed

 Configuration
 =====

 Language: C/C++ (MATLAB Coder)

 Code Generation Issues
 =====

 Unsupported function: digraph (2)
 - foo2.m (Line 3)
 - foo2.m (Line 4)
 '

```

## Input Arguments

**info** — Object representation of a code generation readiness report

`coder.ScreenerInfo` object

`coder.ScreenerInfo` object containing a representation of the code generation readiness report.  
`coder.ScreenerInfo` Properties.

## Output Arguments

**myreport** — Character vector representation of a code generation readiness report

character vector

Character vector containing a code generation readiness report.

## See Also

`coder.screener` | `coder.ScreenerInfo` Properties

**Introduced in R2022a**



# updateFileSeparator

Update file separator character for file lists in build information

## Syntax

```
updateFileSeparator(buildinfo,separator)
```

## Description

`updateFileSeparator(buildinfo,separator)` changes instances of the current file separator (/ or \) in the build information to the specified file separator.

The default value for the file separator matches the value returned by the MATLAB command `filesep`. For template makefile (TMF) approach builds, you can override the default by defining a separator with the `MAKEFILE_FILESEP` macro in the template makefile. If the `GenerateMakefile` parameter is set, the code generator overrides the default separator and updates the build information after evaluating the `PostCodeGenCommand` configuration parameter.

## Examples

### Update File Separator in Build Information

Update object `myBuildInfo` to apply the Windows file separator.

```
myBuildInfo = RTW.BuildInfo;
updateFileSeparator(myBuildInfo, '\');
```

## Input Arguments

### **buildinfo** — RTW.BuildInfo object

object

RTW.BuildInfo object that contains information for compiling and linking generated code.

### **separator** — File separator character for path specifications in the build information

'\ ' | '/'

The separator argument specifies the file separator \ (Windows) or / (UNIX) to use in file path specifications in the build information.

Example: '\'

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**

# updateFilePathsAndExtensions

Update files in build information with missing paths and file extensions

## Syntax

```
updateFilePathsAndExtensions(buildinfo,extensions)
```

## Description

`updateFilePathsAndExtensions(buildinfo,extensions)` specifies the file name extensions (file types) to include in search and update processing.

Using paths from the build information, the `updateFilePathsAndExtensions` function checks whether file references in the build information require an updated path or file extension. Use this function to:

- Maintain build information for a toolchain that requires the use of file extensions.
- Update multiple customized instances of build information for a given model.

If you use `updateFilePathsAndExtensions`, you call it after you add files to the build information. This approach minimizes the potential performance impact of the required disk I/O.

## Examples

### Update File Paths and Extensions in Build Information

In your working folder, create the folder path `etcproj/etc`, add files `etc.c`, `test1.c`, and `test2.c` to the folder `etc`. For this example, the working folder is `w:\work\BuildInfo`. From the working folder, update build information `myBuildInfo` with missing paths or file extensions.

```
myBuildInfo = RTW.BuildInfo;
addSourcePaths(myBuildInfo,fullfile(pwd, ...
 'etcproj','/etc'),'test');
addSourceFiles(myBuildInfo,{'etc' 'test1' ...
 'test2'},',' 'test');
before = getSourceFiles(myBuildInfo,true,true);
```

```
>> before
```

```
before =
```

```
 '\etc' '\test1' '\test2'
```

```
updateFilePathsAndExtensions(myBuildInfo);
after = getSourceFiles(myBuildInfo,true,true);
```

```
>> after{:}
```

```
ans =
 'w:\work\BuildInfo\etcproj\etc\etc.c'

ans =
 'w:\work\BuildInfo\etcproj\etc\test1.c'

ans =
 'w:\work\BuildInfo\etcproj\etc\test2.c'
```

## Input Arguments

**buildinfo** — Name of build information object returned by `RTW.BuildInfo` object

**extensions** — File name extensions to include in search and update processing

' .c ' (default) | cell array of character vectors | string

The *extensions* argument specifies the file name extensions (file types) to include in search and update processing. The function checks files and updates paths and extensions based on the order in which you list the extensions in the cell array. For example, if you specify {'.c' '.cpp'} and a folder contains `myfile.c` and `myfile.cpp`, an instance of `myfile` is updated to `myfile.c`.

Example: '.c' '.cpp'

## See Also

### Topics

“Customize Post-Code-Generation Build Processing” (Simulink Coder)

**Introduced in R2006a**

# Classes

---

## **coder.ArrayType class**

**Package:** coder

**Superclasses:** coder.Type

Represent set of MATLAB arrays

### **Description**

Specifies the set of arrays that the generated code accepts. Use only with the `codegen -args` option. Do not pass as an input to a generated MEX function.

### **Construction**

---

**Note** You can also create and edit `coder.Type` objects interactively by using the `Coder Type Editor`. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`coder.ArrayType` is an abstract class. You cannot create instances of it directly. You can create `coder.EnumType`, `coder.FiType`, `coder.PrimitiveType`, and `coder.StructType` objects that derive from this class.

### **Properties**

#### **ClassName**

Class of values in this set

#### **SizeVector**

The upper-bound size of arrays in this set.

#### **VariableDims**

A vector specifying whether each dimension of the array is fixed or variable size. If a vector element is `true`, the corresponding dimension is variable size.

### **Copy Semantics**

Value. To learn how value classes affect copy operations, see `Copying Objects`.

### **See Also**

`coder.Type` | `coder.EnumType` | `coder.FiType` | `coder.PrimitiveType` | `coder.StructType` | `coder.CellType` | `coder.ClassType` | `coder.newtype` | `coder.typeof` | `coder.resize` | `codegen`

### **Topics**

“Create and Edit Input Types by Using the Coder Type Editor”

**Introduced in R2011a**

## coder.BuildConfig class

**Package:** coder

Build context during code generation

### Description

The code generator creates an object of this class to facilitate access to the build context. The build context encapsulates the settings used by the code generator including:

- Target language
- Code generation target
- Target hardware
- Build toolchain

Use `coder.BuildConfig` methods in the methods that you write for the `coder.ExternalDependency` class.

### Construction

The code generator creates objects of this class.

### Methods

|                                        |                                                                            |
|----------------------------------------|----------------------------------------------------------------------------|
| <code>getHardwareImplementation</code> | Get handle of copy of hardware implementation object                       |
| <code>getStdLibInfo</code>             | Get standard library information                                           |
| <code>getTargetLang</code>             | Get target code generation language                                        |
| <code>getToolchainInfo</code>          | Returns handle of copy of toolchain information object                     |
| <code>isCodeGenTarget</code>           | Determine if build configuration represents specified target               |
| <code>isMatlabHostTarget</code>        | Determine if hardware implementation object target is MATLAB host computer |

### Copy Semantics

Value. To learn how value classes affect copy operations, see [Copying Objects](#).

### Examples

#### Use `coder.BuildConfig` methods to access the build context in `coder.ExternalDependency` methods

This example shows how to use `coder.BuildConfig` methods to access the build context in `coder.ExternalDependency` methods. In this example, you use:



- `coder.BuildConfig.isMatlabHostTarget` to verify that the code generation target is the MATLAB host. If the host is not MATLAB report an error.
- `coder.BuildConfig.getStdLibInfo` to get the link-time and run-time library file extensions. Use this information to update the build information.

Write a class definition file for an external library that contains the function `adder`.

```

=====
% This class abstracts the API to an external Adder library.
% It implements static methods for updating the build information
% at compile time and build time.
=====

classdef AdderAPI < coder.ExternalDependency
 %#codegen

 methods (Static)

 function bName = getDescriptiveName(~)
 bName = 'AdderAPI';
 end

 function tf = isSupportedContext(buildContext)
 if buildContext.isMatlabHostTarget()
 tf = true;
 else
 error('adder library not available for this target');
 end
 end

 function updateBuildInfo(buildInfo, buildContext)
 % Get file extensions for the current platform
 [~, linkLibExt, execLibExt, ~] = buildContext.getStdLibInfo();

 % Add file paths
 hdrFilePath = fullfile(pwd, 'codegen', 'dll', 'adder');
 buildInfo.addIncludePaths(hdrFilePath);

 % Link files
 linkFiles = strcat('adder', linkLibExt);
 linkPath = hdrFilePath;
 linkPriority = '';
 linkPrecompiled = true;
 linkLinkOnly = true;
 group = '';
 buildInfo.addLinkObjects(linkFiles, linkPath, ...
 linkPriority, linkPrecompiled, linkLinkOnly, group);

 % Non-build files for packaging
 nbFiles = 'adder';
 nbFiles = strcat(nbFiles, execLibExt);
 buildInfo.addNonBuildFiles(nbFiles, '', '');
 end

 %API for library function 'adder'
 function c = adder(a, b)
 if coder.target('MATLAB')

```

```
 % running in MATLAB, use built-in addition
 c = a + b;
 else
 % Add the required include statements to the generated function code
 coder.cinclude('adder.h');
 coder.cinclude('adder_initialize.h');
 coder.cinclude('adder_terminate.h');
 c = 0;

 % Because MATLAB Coder generated adder, use the
 % housekeeping functions before and after calling
 % adder with coder.ceval.

 coder.ceval('adder_initialize');
 c = coder.ceval('adder', a, b);
 coder.ceval('adder_terminate');
 end
end
end
end
```

## See Also

`coder.target` | `coder.ExternalDependency` | `coder.HardwareImplementation` |  
`coder.make.ToolchainInfo`

## Topics

“Develop Interface for External C/C++ Code”  
“Build Process Customization”

**Introduced in R2013b**

# coder.CellType class

**Package:** coder

**Superclasses:** coder.ArrayType

Represent set of MATLAB cell arrays

## Description

Specifies the set of cell arrays that the generated code accepts. Use only with the codegen `-args` option. Do not pass as an input to a generated MEX function.

## Construction

---

**Note** You can also create and edit `coder.Type` objects interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t = coder.typeof(cells)` creates a `coder.CellType` object for a cell array that has the same cells and cell types as `cells`. The cells in `cells` are type objects or example values.

`t = coder.typeof(cells,sz,variable_dims)` creates a `coder.CellType` object that has upper bounds specified by `sz` and variable dimensions specified by `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. When `sz` is `[]`, the upper bounds do not change. If you do not specify the `variable_dims` input parameter, except for the unbounded dimensions, the dimensions of the type are fixed. A scalar `variable_dims` applies to the bounded dimensions that are not 1 or 0.

When `cells` specifies a cell array whose elements have different classes, you cannot use `coder.typeof` to create a `coder.CellType` object for a variable-size cell array.

`t = coder.newtype('cell',cells)` creates a `coder.CellType` object for a cell array that has the cells and cell types specified by `cells`. The cells in `cells` must be type objects.

`t = coder.newtype('cell',cells,sz,variable_dims)` creates a `coder.CellType` that has upper bounds specified by `sz` and variable dimensions specified by `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. When `sz` is `[]`, the upper bounds do not change. If you do not specify the `variable_dims` input parameter, except for the unbounded dimensions, the dimensions of the type are fixed. A scalar `variable_dims` applies to the bounded dimensions that are not 1 or 0.

When `cells` specifies a cell array whose elements have different classes, you cannot use `coder.newtype` to create a `coder.CellType` object for a variable-size cell array.

## Input Arguments

**cells — Specification of cell types**

cell array

Cell array that specifies the cells and cell types for the output `coder.CellType` object. For `coder.typeof`, `cells` can contain type objects or example values. For `coder.newtype`, `cells` must contain type objects.

**sz — Size of cell array**

row vector of integer values

Specifies the upper bound for each dimension of the cell array type object. For `coder.newtype`, `sz` cannot change the number of cells for a heterogeneous cell array.

For `coder.newtype`, the default is `[1 1]`.

**variable\_dims — Dimensions that are variable size**

row vector of logical values

Specifies whether each dimension is variable size (`true`) or fixed size (`false`).

For `coder.newtype`, the default is `true` for dimensions for which `sz` specifies an upper bound of `inf` and `false` for all other dimensions.

When `cells` specifies a cell array whose elements have different classes, you cannot create a `coder.CellType` object for a variable-size cell array.

## Properties

**Alignment — Run-time memory alignment**

-1 | power of 2 that is less than or equal to 128

The run-time memory alignment of structures of this type in bytes. If you have an Embedded Coder license and use Code Replacement Libraries (CRLs), the CRLs provide the ability to align data objects passed into a replacement function to a specified boundary. You can take advantage of target-specific function implementations that require data to be aligned. By default, the structure is not aligned on a specific boundary, so it is not matched by CRL functions that require alignment.

**Cells — Types of cells**

cell array

A cell array that specifies the `coder.Type` of each cell.

**ClassName — Name of class**

character vector or string scalar

Class of values in this set.

**Extern — External definition**

logical scalar

Specifies whether the cell array type is externally defined.

**HeaderFile — Name of header file**

nonempty character vector or string scalar

If the cell array type is externally defined, the name of the header file that contains the external definition of the type, for example, `'mytype.h'`. If you use the `codegen` command to specify the

path to the file, use the `-I` option. If you use the MATLAB Coder app to specify the path to the file, use the **Additional include directories** setting in the **Custom Code** tab in the project settings dialog box.

By default, the generated code contains `#include` statements for custom header files after the standard header files. If a standard header file refers to the custom structure type, then the compilation fails. If you specify the `HeaderFile` option, the code generator includes the custom header file where it is required.

### **SizeVector — Size of cell array**

row vector of integer values

The upper bounds of dimensions of the cell array.

### **TypeName — Name of generated structure type**

character vector

The name to use in the generated code for the structure type that represents this cell array type. `TypeName` applies only to heterogeneous cell arrays types.

### **VariableDims — Dimensions that are variable size**

row vector of logical values

A vector that specifies whether each dimension of the array is fixed or variable size. If a vector element is `true`, the corresponding dimension is variable size.

## **Methods**

|                                |                                                                         |
|--------------------------------|-------------------------------------------------------------------------|
| <code>isHeterogeneous</code>   | Determine whether cell array type represents a heterogeneous cell array |
| <code>isHomogeneous</code>     | Determine whether cell array type represents a homogeneous cell array   |
| <code>makeHeterogeneous</code> | Make a heterogeneous copy of a cell array type                          |
| <code>makeHomogeneous</code>   | Create a homogeneous copy of a cell array type                          |

## **Copy Semantics**

Value. To learn how value classes affect copy operations, see [Copying Objects](#).

## **Examples**

### **Create a Type for a Cell Array Whose Elements Have the Same Class**

Create a type for a cell array whose first element has class `char` and whose second element has class `double`.

```
t = coder.typeof({1 2 3})
```

```
t =
```

```
coder.CellType
 1x3 homogeneous cell
 base: 1x1 double
```

The type is homogeneous.

### Create a Heterogeneous Type for a Cell Array Whose Elements Have the Same Class

To create a heterogeneous type when the elements of the example cell array type have the same class, use the `makeHeterogeneous` method.

```
t = makeHeterogeneous(coder.typeof({1 2 3}))
```

```
t =
```

```
coder.CellType
 1x3 locked heterogeneous cell
 f1: 1x1 double
 f2: 1x1 double
 f3: 1x1 double
```

The cell array type is heterogeneous. It is represented as a structure in the generated code.

### Create a Cell Array Type for a Cell Array Whose Elements Have Different Classes

Define variables that are example cell values.

```
a = 'a';
b = 1;
```

Pass the example cell values to `coder.typeof`.

```
t = coder.typeof({a, b})
```

```
t =
```

```
coder.CellType
 1x2 heterogeneous cell
 f0: 1x1 char
 f1: 1x1 double
```

### Create a Type for a Variable-Size Homogeneous Cell Array from an Example Cell Array Whose Elements Have Different Classes

Create a type for a cell array that contains two character vectors that have different sizes.

```
t = coder.typeof({'aa', 'bbb'})
```

```
t =
```

```
coder.CellType
 1x2 heterogeneous cell
 f0: 1x2 char
 f1: 1x3 char
```

The cell array type is heterogeneous.

Create a type using the same cell array input. This time, specify that the cell array type has variable-size dimensions.

```
t = coder.typeof({'aa', 'bbb'}, [1,10], [0,1])
t =
coder.CellType
 1x:10 locked homogeneous cell
 base: 1x:3 char
```

The cell array type is homogeneous. `coder.typeof` determined that the base type `1x:3 char` can represent `'aa'`, and `'bbb'`.

### Create a New Cell Array Type from a Cell Array of Types

Create a type for a scalar `int8`.

```
ta = coder.newtype('int8', [1 1]);
```

Create a type for a `:1x:2` double row vector.

```
tb = coder.newtype('double', [1 2], [1 1]);
```

Create a cell array type whose cells have the types specified by `ta` and `tb`.

```
t = coder.newtype('cell', {ta, tb})
t =
coder.CellType
 1x2 heterogeneous cell
 f0: 1x1 int8
 f1: :1x:2 double
```

### Create a coder.CellType That Uses an Externally Defined Type

Create a cell type for a heterogeneous cell array.

```
ca = coder.typeof(double(0));
cb = coder.typeof(single(0));
t = coder.typeof({ca cb})
```

```
coder.CellType
 1x2 heterogeneous cell
 f0: 1x1 double
 f1: 1x1 single
```

Use `coder.cstructname` to specify the name for the type and that the type is defined in an external file.

```
t = coder.cstructname(t, 'mytype', 'extern', 'HeaderFile', 'myheader.h')
t =
```

```
coder.CellType
 1x2 extern locked heterogeneous cell mytype(myheader.h) [-1]
 f1: 1x1 double
 f2: 1x1 single
```

## Tips

- In the display of a `coder.CellType` object, the terms `locked heterogeneous` or `locked homogeneous` indicate that the classification as homogeneous or heterogeneous is permanent. You cannot later change the classification by using the `makeHomogeneous` or `makeHeterogeneous` methods.
- `coder.typeof` determines whether the cell array type is homogeneous or heterogeneous. If the cell array elements have the same class and size, `coder.typeof` returns a homogeneous cell array type. If the elements have different classes, `coder.typeof` returns a heterogeneous cell array type. For some cell arrays, the classification as homogeneous or heterogeneous is ambiguous. For example, the type for `{1 [2 3]}` can be a `1x2` heterogeneous type. The first element is `double` and the second element is `1x2 double`. The type can also be a `1x3` homogeneous type in which the elements have class `double` and size `1x:2`. For these ambiguous cases, `coder.typeof` uses heuristics to classify the type as homogeneous or heterogeneous. If you want a different classification, use the `makeHomogeneous` or `makeHeterogeneous` methods. The `makeHomogeneous` method makes a homogeneous copy of a type. The `makeHeterogeneous` method makes a heterogeneous copy of a type.

The `makeHomogeneous` and `makeHeterogeneous` methods permanently assign the classification as homogeneous and heterogeneous, respectively. You cannot later use one of these methods to create a copy that has a different classification.

## See Also

`coder.ArrayType` | `coder.Constant` | `coder.EnumType` | `coder.FiType` |  
`coder.PrimitiveType` | `coder.StructType` | `coder.ClassType` | `coder.Type` |  
`coder.newtype` | `coder.resize` | `coder.typeof` | `codegen`

## Topics

“Code Generation for Cell Arrays”

“Create and Edit Input Types by Using the Coder Type Editor”

## Introduced in R2015b



## coder.ClassType class

**Package:** coder

**Superclasses:** coder.ArrayType

Represent set of MATLAB classes

### Description

Specifies the set of value class objects that the generated code can accept. Use only with the `codegen -args` option. Do not pass as an input to a generated MEX function.

### Construction

---

**Note** You can also create and edit `coder.Type` objects interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t = coder.typeof(value_class_object)` creates a `coder.ClassType` object for the object `value_class_object`.

`t = coder.newtype(value_class_name)` creates a `coder.ClassType` object for an object of the class `value_class_name`.

### Input Arguments

#### `value_class_object`

Value class object from which to create the `coder.ClassType` object. `value_class_object` is an expression that evaluates to an object of a value class. For example:

```
v = myValueClass;
t = coder.typeof(v);

t = coder.typeof(myValueClass(2,3));
```

#### `value_class_name`

Name of a value class definition file on the MATLAB path. Specify as a character vector or string scalar. For example:

```
t = coder.newtype('myValueClass');
```

### Properties

When you create a `coder.ClassType` object `t` from a value class object `v` by using `coder.typeof`, the properties of `t` are the same as the properties of `v` with the attribute `Constant` set to `false`.

### Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects.

## Examples

### Create Type Based on Example Object

Create a type based on an example object in the workspace.

Create a value class myRectangle.

```
classdef myRectangle
 properties
 length;
 width;
 end
 methods
 function obj = myRectangle(l,w)
 if nargin > 0
 obj.length = l;
 obj.width = w;
 end
 end
 function area = calcarea(obj)
 area = obj.length * obj.width;
 end
 end
end
```

Create a function that takes an object of myRectangle as an input.

```
function z = getarea(r)
 %#codegen
 z = calcarea(r);
end
```

Create an object of myRectangle.

```
v = myRectangle(1,2)

v =

 myRectangle with properties:

 length: 1
 width: 2
```

Create a coder.ClassType object based on v.

```
t = coder.typeof(v)

t =

 coder.ClassType
 1x1 myRectangle
 length: 1x1 double
 width : 1x1 double
```

coder.typeof creates a coder.ClassType object that has the same properties names and types as v has.

Generate code for `getarea`. Specify the input type by passing the `coder.ClassType` object, `t`, to the `-args` option.

```
codegen getarea -args {t} -report
```

### Create Type by Using `coder.newtype`

Create a `coder.ClassType` object for an object of the value class `mySquare` by using `coder.newtype`.

Create value class `mySquare` that has one property, `side`.

```
classdef mySquare
 properties
 side;
 end
 methods
 function obj = mySquare(val)
 if nargin > 0
 obj.side = val;
 end
 end
 function a = calcarea(obj)
 a = obj.side * obj.side;
 end
 end
end
```

Create a `coder.ClassType` type for `mySquare`.

```
t = coder.newtype('mySquare')
```

The previous step creates a `coder.ClassType` type for `t`, but does not assign any properties of `mySquare` to it. To ensure `t` has all the properties of `mySquare`, specify the type of `side` by using `t.Properties`.

```
t.Properties.side = coder.typeof(2)
```

### Tips

- After you create a `coder.ClassType`, you can modify the types of the properties. For example:

```
t = coder.typeof(myClass)
t.Properties.prop1 = coder.typeof(int16(2));
t.Properties.prop2 = coder.typeof([1 2 3]);
```

- After you create a `coder.ClassType`, you can add properties. For example:

```
t = coder.typeof(myClass)
t.Properties.newprop1 = coder.typeof(int8(2));
t.Properties.newprop2 = coder.typeof([1 2 3]);
```

- When you generate code, the properties of the `coder.ClassType` object that you pass to `codegen` must be consistent with the properties in the class definition file. However, if the class definition file has properties that your code does not use, the `coder.ClassType` object does not have to include those properties. The code generator removes properties that you do not use.

**See Also**

`coder.Type` | `coder.PrimitiveType` | `coder.EnumType` | `coder.CellType` | `coder.FiType` | `coder.Constant` | `coder.ArrayType` | `coder.newtype` | `coder.typeof` | `coder.resize` | `codegen` | `coder` | `coder.cstructname`

**Topics**

“Create and Edit Input Types by Using the Coder Type Editor”

**Introduced in R2017a**

# coder.Constant class

**Package:** coder

**Superclasses:** coder.Type

Specification of constant value for code generation

## Description

Use a `coder.Constant` object to define input values that are constant during code generation. Use this object with the `codegen -args` and `-globals` options to specify the properties of the input arguments and the global variables, respectively. Do not pass it as an input to a generated MEX function.

You can use a `coder.Constant` object in place of a `coder.Type` object to specify a given constant value in an entry-point input or global variable.

## Creation

`const_type = coder.Constant(v)` creates a `coder.Constant` type from the value `v`.

`const_type = coder.newtype('constant', v)` creates a `coder.Constant` type from the value `v`.

---

**Note** After you have created a `coder.Constant` object, you can create a constant global variable `g` that has the value `v` by using the `codegen` command: `codegen -globals {'g'}, coder.Constant(v)`.

---

## Properties

### Value — Actual value of constant

`constant`

The actual value of the constant. Also indicates the input argument value `v` that is used to construct the input argument type.

Here, in the first example, when `k` is passed in `codegen` with value `v` as 42, the corresponding input type is inferred as `double`. Similarly, in the second example, when `k` is passed in `codegen` with value `v` as 42, the corresponding input type is inferred as `uint8`.

Example: `k = coder.Constant(42);`

Example: `k = coder.Constant(uint8(42));`

## Examples

### Generate a MEX Function from a MATLAB Function by Using Different Input Types

Write a MATLAB function `myAdd` that returns the sum of two values.

```
function c = myAdd(a,b) %#codegen
c = a + b;
end
```

Generate a MEX function `myAdd_mex`. Specify the input arguments as constant with values 1 and 3.

```
codegen myAdd -args {1,3} -report
```

Call `myAdd_mex` with constant input values other than 1 and 3, for example, 2 and 5.

```
myAdd_mex(2,5)
```

```
ans =
```

```
7
```

The generated MEX function accepts any constant value of the type that you specified in the input argument within the `codegen` command.

Generate a MEX function `myAdd_mex` by specifying `coder.Constant` object as one of the input arguments. Specify the first input argument as double scalar and the second input argument as a constant with value 1.

```
codegen myAdd -args {1, coder.Constant(3)} -report
```

Call `myAdd_mex` with constant input values 2 and 5.

```
myAdd_mex(2,5)
```

```
Constant function parameter 'b' has a different run-time value than the compile-time value.
```

```
Error in myAdd_mex
```

The MEX function displays an error for the input value 5. To fix the error, assign the constant value 3, which is the value you passed during compile time.

### Generate a MEX Function from a MATLAB Function by Using a Constant Input

Generate MEX code for a MATLAB function that has a constant input. Use the `ConstantInputs` configuration parameter to control whether the MEX function signature includes constant inputs and whether the constant input values must match the compile-time values.

Write a MATLAB function `myAdd` that returns the sum of two values.

```
function c = myAdd(a,b) %#codegen
c = a + b;
end
```

Create a configuration object for MEX code generation.

```
mexcfg = coder.config('mex');
```

Review the value of the constant input checking configuration parameter.

```
mexcfg.ConstantInputs
```

```
ans =
 'CheckValues'
```

It has the default value.

Generate a MEX function `myAdd_mex`. Specify that the first argument is a double scalar and the second argument is a constant with value 3.

```
codegen myAdd -config mexcfg -args {1, coder.Constant(3)}
```

Call `myAdd_mex`. Provide the input 3 for the second argument.

```
myadd_mex(1,3)

ans =
 4
```

Modify `ConstantInputs` so that the MEX function does not check that the input value matches the value specified at code generation time.

```
mexcfg.ConstantInputs = 'IgnoreValues';
```

Generate `myAdd_mex`.

```
codegen myAdd -config mexcfg -args {1, coder.Constant(3)}
```

Call `myAdd_mex` with a constant input value other than 3, for example 5.

```
myadd_mex(1,5)

ans =
 4
```

The MEX function ignores the input value 5. It uses the value 3, which is the value that you specified for the constant argument `b` when you generated `myAdd_mex`.

Modify `ConstantInputs` so that the MEX function signature does not include the constant input argument.

```
mexcfg.ConstantInputs = 'Remove';
```

Generate `myAdd_mex`.

```
codegen myAdd -config mexcfg -args {1, coder.Constant(3)}
```

Call `myAdd_mex`. Provide the value 1 for `a`. Do not provide a value for the constant argument `b`.

```
myAdd_mex(1)

ans =
 4
```

### Generate C Code from a MATLAB Function That Has Constant Input

Generate C code for a function specialized for the case where an input has a constant value.

Write a MATLAB function `identity` that copies its input to its output.

```
function y = identity(u) %#codegen
y = u;
```

Create a code configuration object for C code generation.

```
cfg = coder.config('lib');
```

Generate C code for `identity` with the constant input 42, and then generate a report.

```
codegen identity -config cfg -args {coder.Constant(42)} -report
```

In the report, on the **C code** tab, click `identity.c`.

The function signature for `identity` is:

```
double identity(void)
```

### Generate a MEX Function from a MATLAB Function That Uses Constant Global Data

Specify a constant value for a global variable at compile time.

Write a MATLAB function `myFunction` that returns the value of the global constant `g`.

```
function y = myFunction() %#codegen
global g;

y = g;

end
```

Create a configuration object for MEX code generation.

```
cfg = coder.config('mex');
```

Define a cell array `globals` that declares that `g` is a constant global variable with value 5.

```
globals = {'g', coder.Constant(5)};
```

Generate a MEX function for `myFunction` by using the `-globals` option to specify the global data.

```
codegen -config cfg -globals globals myFunction
```

Run the generated MEX function.

```
myFunction_mex
```



```
ans =
 5
```

## Limitations

- You cannot use `coder.Constant` on sparse matrices, or on structures, cell arrays, or classes that contain sparse matrices.

## See Also

`coder.Type` | `coder.newtype` | `codegen` | `coder.Constant`

## Topics

“Specify Constant Inputs at the Command Line”

“Constant Input Checking in MEX Functions”

“Define Constant Global Data”

## Introduced in R2011a

## coder.EnumType class

**Package:** coder

**Superclasses:** coder.ArrayType

Represent set of MATLAB enumerations

### Description

Specifies the set of MATLAB enumerations that the generated code should accept. Use only with the `codegen -args` options. Do not pass as an input to a generated MEX function.

### Construction

---

**Note** You can also create and edit `coder.Type` objects interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`enum_type = coder.typeof(enum_value)` creates a `coder.EnumType` object representing a set of enumeration values of class (`enum_value`).

`enum_type = coder.typeof(enum_value, sz, variable_dims)` returns a modified copy of `coder.typeof(enum_value)` with (upper bound) size specified by `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. When `sz` is `[]`, the (upper bound) sizes of `v` do not change. If you do not specify `variable_dims`, the bounded dimensions of the type are fixed; the unbounded dimensions are variable size. When `variable_dims` is a scalar, it applies to bounded dimensions that are not 1 or 0 (which are fixed).

`enum_type = coder.newtype(enum_name, sz, variable_dims)` creates a `coder.EnumType` object that has variable size with (upper bound) sizes `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. If you do not specify `variable_dims`, the bounded dimensions of the type are fixed. When `variable_dims` is a scalar, it applies to bounded dimensions that are not 1 or 0 (which are fixed).

### Input Arguments

#### **enum\_value**

Enumeration value defined in a file on the MATLAB path.

#### **sz**

Size vector specifying each dimension of type object.

**Default:** [1 1] for `coder.newtype`

#### **variable\_dims**

Logical vector that specifies whether each dimension is variable size (true) or fixed size (false).

**Default:** false(size(sz)) | sz==Inf for coder.newtype

### enum\_name

Name of enumeration defined in a file on the MATLAB path.

## Properties

### ClassName

Class of values in the set.

### SizeVector

The upper-bound size of arrays in the set.

### VariableDims

A vector specifying whether each dimension of the array is fixed or variable size. If a vector element is true, the corresponding dimension is variable size.

## Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects.

## Examples

Create a coder.EnumType object using a value from an existing MATLAB enumeration.

- 1 Define an enumeration MyColors. On the MATLAB path, create a file named 'MyColors' containing:

```
classdef MyColors < int32
 enumeration
 green(1),
 red(2),
 end
end
```

- 2 Create a coder.EnumType object from this enumeration.

```
t = coder.typeof(MyColors.red);
```

Create a coder.EnumType object using the name of an existing MATLAB enumeration.

- 1 Define an enumeration MyColors. On the MATLAB path, create a file named 'MyColors' containing:

```
classdef MyColors < int32
 enumeration
 green(1),
 red(2),
 end
end
```

- 2 Create a coder.EnumType object from this enumeration.

```
t = coder.newtype('MyColors');
```

**See Also**

[coder.Type](#) | [coder.ArrayType](#) | [coder.ClassType](#) | [coder.typeof](#) | [coder.newtype](#) | [coder.resize](#) | [codegen](#)

**Topics**

[“Enumerations”](#)

[“Create and Edit Input Types by Using the Coder Type Editor”](#)

**Introduced in R2011a**

# coder.ExternalDependency class

**Package:** coder

Interface to external code

## Description

`coder.ExternalDependency` is an abstract class for developing an interface between external code and MATLAB code intended for code generation. You can define classes that derive from `coder.ExternalDependency` to encapsulate the interface to external libraries, object files, and C/C++ source code. This encapsulation allows you to separate the details of the interface from your MATLAB code.

To define a class derived from `coder.ExternalDependency`, create a subclass. For example:

```
classdef myClass < coder.ExternalDependency
```

You must define all of the methods listed in “Methods” on page 3-25. These methods are static and are not compiled. The code generator invokes these methods in MATLAB after code generation is complete to configure the build for the generated code. The `RTW.BuildInfo` and `coder.BuildConfig` objects that describe the build information and build context are automatically created during the build process. The `updateBuildInfo` method provides access to these objects. For more information on build information customization, see “Build Process Customization”.

You also define methods that call the external code. These methods are compiled. For each external function that you want to call, write a method to define the programming interface to the function. In the method, use `coder.ceval` to call the external function.

## Methods

|                                 |                                                         |
|---------------------------------|---------------------------------------------------------|
| <code>getDescriptiveName</code> | Return descriptive name for external dependency         |
| <code>isSupportedContext</code> | Determine if build context supports external dependency |
| <code>updateBuildInfo</code>    | Update build information                                |

## Examples

### Encapsulate the Interface to an External C Dynamic Library

This example shows how to encapsulate the interface to an external C dynamic linked library using `coder.ExternalDependency`.

Write a function `adder` that returns the sum of its inputs.

```
function c = adder(a,b)
%#codegen
c = a + b;
end
```

Generate a library that contains `adder`.

```
codegen('adderr', '-args', {-2,5}, '-config:dll', '-report')
```

Write the class definition file `AdderAPI.m` to encapsulate the library interface.

```

=====
% This class abstracts the API to an external Adder library.
% It implements static methods for updating the build information
% at compile time and build time.
=====

classdef AdderAPI < coder.ExternalDependency
 %#codegen

 methods (Static)

 function bName = getDescriptiveName(~)
 bName = 'AdderAPI';
 end

 function tf = isSupportedContext(buildContext)
 if buildContext.isMatlabHostTarget()
 tf = true;
 else
 error('adderr library not available for this target');
 end
 end

 function updateBuildInfo(buildInfo, buildContext)
 % Get file extensions for the current platform
 [~, linkLibExt, execLibExt, ~] = buildContext.getStdLibInfo();

 % Add file paths
 hdrFilePath = fullfile(pwd, 'codegen', 'dll', 'adderr');
 buildInfo.addIncludePaths(hdrFilePath);

 % Link files
 linkFiles = strcat('adderr', linkLibExt);
 linkPath = hdrFilePath;
 linkPriority = '';
 linkPrecompiled = true;
 linkLinkOnly = true;
 group = '';
 buildInfo.addLinkObjects(linkFiles, linkPath, ...
 linkPriority, linkPrecompiled, linkLinkOnly, group);

 % Non-build files for packaging
 nbFiles = 'adderr';
 nbFiles = strcat(nbFiles, execLibExt);
 buildInfo.addNonBuildFiles(nbFiles, '', '');
 end

 %API for library function 'adderr'
 function c = adderr(a, b)
 if coder.target('MATLAB')
 % running in MATLAB, use built-in addition
 c = a + b;
 else
 % Add the required include statements to the generated function code

```

```

 coder.cinclude('adder.h');
 coder.cinclude('adder_initialize.h');
 coder.cinclude('adder_terminate.h');
 c = 0;

 % Because MATLAB Coder generated adder, use the
 % housekeeping functions before and after calling
 % adder with coder.ceval.

 coder.ceval('adder_initialize');
 c = coder.ceval('adder', a, b);
 coder.ceval('adder_terminate');
 end
end
end
end
end

```

Write a function `adder_main` that calls the external library function `adder`.

```

function y = adder_main(x1, x2)
 %#codegen
 y = AdderAPI.adder(x1, x2);
end

```

Generate a MEX function for `adder_main`. The MEX Function exercises the `coder.ExternalDependency` methods.

```
codegen('adder_main', '-args', {7,9}, '-report')
```

Copy the library to the current folder using the file extension for your platform. For Windows, use:

```
copyfile(fullfile(pwd, 'codegen', 'dll', 'adder', 'adder.dll'));
```

For Linux, use:

```
copyfile(fullfile(pwd, 'codegen', 'dll', 'adder', 'adder.so'));
```

Run the MEX function and verify the result.

```
adder_main_mex(2,3)
```

## See Also

[coder.ceval](#) | [coder.cinclude](#) | [coder.updateBuildInfo](#) | [coder.BuildConfig](#)

## Topics

“Develop Interface for External C/C++ Code”

“Build Process Customization”

“Integrate External/Custom Code”

## Introduced in R2013b

## coder.fftw.StandaloneFFTW3Interface class

**Package:** `coder.fftw`

Abstract class for specifying an FFTW library for FFTW calls in generated code

### Description

`coder.fftw.StandaloneFFTW3Interface` is an abstract class for defining an FFT library callback class. An FFT library callback class specifies an FFT library to use for C/C++ code generated for MATLAB fast Fourier transform functions. To define an FFT callback class for the FFTW library, version 3.2 or later, use the `coder.fftw.StandaloneFFTW3Interface` class. For example, to define an FFT library callback class with the name `useMyFFTW`, make this line the first line of your class definition file:

```
classdef useMyFFTW < coder.fftw.StandaloneFFTW3Interface
```

For information about the FFTW library, see [www.fftw.org](http://www.fftw.org).

MATLAB fast Fourier transform functions include `fft`, `fft2`, `fftn`, `ifft`, `ifft2`, and `ifftn`. The code generator produces FFTW library calls for these functions when all of these conditions are true:

- You generate standalone C/C++ code (static library, dynamically linked library, or executable program) with MATLAB Coder or generate C/C++ code from a MATLAB Function block with Simulink Coder.
- You have access to an FFTW library installation, version 3.2 or later.
- You specify the FFTW library installation in an FFT library callback class that derives from `coder.fftw.StandaloneFFTW3Interface`.
- You set the appropriate configuration parameter to the name of the callback class.
  - For code generation with the MATLAB Coder `codegen` command, set `CustomFFTCallback`.
  - For code generation with the MATLAB Coder app, set **Custom FFT library callback**.
  - For code generation for a MATLAB Function block by using Simulink Coder, set **Custom FFT library callback**.

You must implement the `updateBuildInfo` and `getNumThreads` methods.

Optionally, you can implement these methods:

- `getPlanMethod`
- `lock` and `unlock`

All methods are static.



## Methods

|                 |                                                                     |
|-----------------|---------------------------------------------------------------------|
| getNumThreads   | Return number of threads to use for FFTW library calls              |
| getPlanMethod   | Return FFTW planning method                                         |
| lock            | Lock access to FFTW planning                                        |
| unlock          | Unlock access to FFTW planning                                      |
| updateBuildInfo | Update the build information for linking to a specific FFTW library |

## Examples

### Write an FFT Library Callback Class for an FFTW Library

Specify a specific installed FFTW library in an FFT library callback class.

Use this example FFT library callback class as a template.

```
% copyright 2017 The MathWorks, Inc.
classdef useMyFFTW < coder.fftw.StandaloneFFTW3Interface
 methods (Static)
 function th = getNumThreads
 coder.inline('always');
 th = int32(coder.const(1));
 end

 function updateBuildInfo(buildInfo, ctx)
 fftwLocation = '/usr/lib/fftw';
 includePath = fullfile(fftwLocation, 'include');
 buildInfo.addIncludePaths(includePath);
 libPath = fullfile(fftwLocation, 'lib');

 %Double
 libName1 = 'libfftw3-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName1 = [libName1 libExt];
 addLinkObjects(buildInfo, libName1, libPath, 1000, true, true);

 %Single
 libName2 = 'libfftw3f-3';
 [~, libExt] = ctx.getStdLibInfo();
 libName2 = [libName2 libExt];
 addLinkObjects(buildInfo, libName2, libPath, 1000, true, true);
 end
 end
end
```

Modify the template.

- Replace `useMyFFTW` with the name of your callback class.
- If your FFTW installation uses multiple threads, modify the `getNumThreads` method to return the number of threads that you want to use.
- In the `updateBuildInfo` method, set:
  - `fftwLocation` to the full path for your installation of the library.
  - `includePath` to the full path of the folder that contains `fftw3.h`.

- `libPath` to the full path of the folder that contains the library files.

## See Also

### Topics

“Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”

“Synchronize Multithreaded Access to FFTW Planning in Generated Standalone Code”

“Speed Up Fast Fourier Transforms in Code Generated from a MATLAB Function Block” (Simulink Coder)

“Synchronize Multithreaded FFTW Planning in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.fftw.org](http://www.fftw.org)

**Introduced in R2017b**

## coder.FiType class

**Package:** coder

**Superclasses:** coder.ArrayType

Represent set of MATLAB fixed-point arrays

### Description

Specifies the set of fixed-point array values that the generated code should accept. Use only with the `codegen -args` options. Do not pass as an input to the generated MEX function.

### Construction

---

**Note** You can also create and edit `coder.Type` objects interactively by using the `Coder Type Editor`. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t=coder.typeof(v)` creates a `coder.FiType` object representing a set of fixed-point values whose properties are based on the fixed-point input `v`.

`t=coder.typeof(v, sz, variable_dims)` returns a modified copy of `coder.typeof(v)` with (upper bound) size specified by `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. When `sz` is `[]`, the (upper bound) sizes of `v` do not change. If you do not specify the `variable_dims` input parameter, the bounded dimensions of the type are fixed. When `variable_dims` is a scalar, it applies to the bounded dimensions that are not 1 or 0 (which are fixed).

`t=coder.newtype('embedded.fi', numerictype, sz, variable_dims)` creates a `coder.Type` object representing a set of fixed-point values with `numerictype` and (upper bound) sizes `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is unbounded and the dimension is variable size. When you do not specify `variable_dims`, the bounded dimensions of the type are fixed. When `variable_dims` is a scalar, it applies to the bounded dimensions that are not 1 or 0 (which are fixed).

`t=coder.newtype('embedded.fi', numerictype, sz, variable_dims, Name, Value)` creates a `coder.Type` object representing a set of fixed-point values with `numerictype` and additional options specified by one or more `Name, Value` pair arguments. `Name` can also be a property name and `Value` is the corresponding value. Specify `Name` as a character vector or string scalar. You can specify several name-value pair arguments in any order as `Name1, Value1, ..., NameN, ValueN`.

### Input Arguments

**v**

Fixed-point value used to create new `coder.FiType` object.

**sz**

Size vector specifying each dimension of type object.

**Default:** [1 1] for `coder.newtype`

### **variable\_dims**

Logical vector that specifies whether each dimension is variable size (`true`) or fixed size (`false`).

**Default:** `false(size(sz)) | sz == Inf` for `coder.newtype`

### **Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

### **complex**

Set `complex` to `true` to create a `coder.Type` object that can represent complex values. The type must support complex data.

**Default:** `false`

### **fimath**

Specify local `fimath`. If not, uses default `fimath`.

## **Properties**

### **ClassName**

Class of values in the set.

### **Complex**

Indicates whether fixed-point arrays in the set are real (`false`) or complex (`true`).

### **Fimath**

Local `fimath` that the fixed-point arrays in the set use.

### **NumericType**

`numericType` that the fixed-point arrays in the set use.

### **SizeVector**

The upper-bound size of arrays in the set.

### **VariableDims**

A vector specifying whether each dimension of the array is fixed or variable size. If a vector element is `true`, the corresponding dimension is variable size.

## Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects.

## Examples

Create a new fixed-point type `t`.

```
t = coder.typeof(fi(1));
% Returns
% coder.FiType
% 1x1 embedded.fi
% DataTypeMode:Fixed-point: binary point scaling
% Signedness:Signed
% WordLength:16
% FractionLength:14
```

Create a new fixed-point type for use in code generation. The fixed-point type uses the default `fimath`.

```
t = coder.newtype('embedded.fi',numerictype(1, 16, 15), [1 2])

t =
% Returns
% coder.FiType
% 1x2 embedded.fi
% DataTypeMode: Fixed-point: binary point scaling
% Signedness: Signed
% WordLength: 16
% FractionLength: 15
```

This new type uses the default `fimath`.

## See Also

`coder.Type` | `coder.ArrayType` | `coder.ClassType` | `coder.typeof` | `coder.resize` | `coder.newtype` | `codegen`

## Topics

“Create and Edit Input Types by Using the Coder Type Editor”

## Introduced in R2011a

## **coder.FixPtConfig class**

**Package:** coder

Floating-point to fixed-point conversion configuration object

### **Description**

A `coder.FixPtConfig` object contains the configuration parameters that the MATLAB Coder `codegen` function requires to convert floating-point MATLAB code to fixed-point MATLAB code during code generation. Use the `-float2fixed` option to pass this object to the `codegen` function.

### **Construction**

`fixptcfg = coder.config('fixpt')` creates a `coder.FixPtConfig` object for floating-point to fixed-point conversion.

### **Properties**

#### **ComputeDerivedRanges**

Enable derived range analysis.

Values: `true|false` (default)

#### **ComputeSimulationRanges**

Enable collection and reporting of simulation range data. If you need to run a long simulation to cover the complete dynamic range of your design, consider disabling simulation range collection and running derived range analysis instead.

Values: `true` (default)|`false`

#### **DefaultFractionLength**

Default fixed-point fraction length.

Values: 4 (default) | positive integer

#### **DefaultSignedness**

Default signedness of variables in the generated code.

Values: 'Automatic' (default) | 'Signed' | 'Unsigned'

#### **DefaultWordLength**

Default fixed-point word length.

Values: 14 (default) | positive integer

**DetectFixptOverflows**

Enable detection of overflows using scaled doubles.

Values: true| false (default)

**fimath**

fimath properties to use for conversion.

Values: fimath('RoundingMethod', 'Floor', 'OverflowAction', 'Wrap', 'ProductMode', 'FullPrecision', 'SumMode', 'FullPrecision') (default) | string

**FixPtFileNameSuffix**

Suffix for fixed-point file names.

Values: '\_fixpt' | string

**LaunchNumericTypesReport**

View the numeric types report after the software has proposed fixed-point types.

Values: true (default) | false

**LogIOForComparisonPlotting**

Enable simulation data logging to plot the data differences introduced by fixed-point conversion.

Values: true (default) | false

**OptimizeWholeNumber**

Optimize the word lengths of variables whose simulation min/max logs indicate that they are always whole numbers.

Values: true (default) | false

**PlotFunction**

Name of function to use for comparison plots.

LogIOForComparisonPlotting must be set to true to enable comparison plotting. This option takes precedence over PlotWithSimulationDataInspector.

The plot function should accept three inputs:

- A structure that holds the name of the variable and the function that uses it.
- A cell array to hold the logged floating-point values for the variable.
- A cell array to hold the logged values for the variable after fixed-point conversion.

Values: '' (default) | string

**PlotWithSimulationDataInspector**

Use Simulation Data Inspector for comparison plots.

`LogIOForComparisonPlotting` must be set to true to enable comparison plotting. The `PlotFunction` option takes precedence over `PlotWithSimulationDataInspector`.

Values: true| false (default)

### **ProposeFractionLengthsForDefaultWordLength**

Propose fixed-point types based on `DefaultWordLength`.

Values: true (default) | false

### **ProposeTargetContainerTypes**

By default (false), propose data types with the minimum word length needed to represent the value. When set to true, propose data type with the smallest word length that can represent the range and is suitable for C code generation ( 8,16,32, 64 ... ). For example, for a variable with range [0..7], propose a word length of 8 rather than 3.

Values: true| false (default)

### **ProposeWordLengthsForDefaultFractionLength**

Propose fixed-point types based on `DefaultFractionLength`.

Values: false (default) | true

### **ProposeTypesUsing**

Propose data types based on simulation range data, derived ranges, or both.

Values: 'BothSimulationAndDerivedRanges' (default) |  
'SimulationRanges'|'DerivedRanges'

### **SafetyMargin**

Safety margin percentage by which to increase the simulation range when proposing fixed-point types. The specified safety margin must be a real number greater than -100.

Values: 0 (default) | double

### **StaticAnalysisQuickMode**

Perform faster static analysis.

Values: true | false (default)

### **StaticAnalysisTimeoutMinutes**

Abort analysis if timeout is reached.

Values: '' (default) | positive integer

### **TestBenchName**

Test bench function name or names, specified as a string or cell array of strings. You must specify at least one test bench.



If you do not explicitly specify input parameter data types, the conversion uses the first test bench function to infer these data types.

Values: '' (default) | string | cell array of strings

### TestNumerics

Enable numerics testing.

Values: true| false (default)

## Methods

|                                |                                                                                         |
|--------------------------------|-----------------------------------------------------------------------------------------|
| addDesignRangeSpecification    | Add design range specification to parameter                                             |
| addFunctionReplacement         | Replace floating-point function with fixed-point function during fixed-point conversion |
| clearDesignRangeSpecifications | Clear all design range specifications                                                   |
| getDesignRangeSpecification    | Get design range specifications for parameter                                           |
| hasDesignRangeSpecification    | Determine whether parameter has design range                                            |
| removeDesignRangeSpecification | Remove design range specification from parameter                                        |
| addApproximation               | Replace floating-point function with lookup table during fixed-point conversion         |

## Examples

### Generate Fixed-Point C Code from Floating-Point MATLAB Code

Create a `coder.FixPtConfig` object, `fixptcfg`, with default settings.

```
fixptcfg = coder.config('fixpt');
```

Set the test bench name. In this example, the test bench function name is `dti_test`.

```
fixptcfg.TestBenchName = 'dti_test';
```

Create a code generation configuration object to generate a standalone C static library.

```
cfg = coder.config('lib');
```

Convert a floating-point MATLAB function to fixed-point C code. In this example, the MATLAB function name is `dti`.

```
codegen -float2fixed fixptcfg -config cfg dti
```

### Convert Floating-Point MATLAB Code to Fixed Point Based On Derived Ranges

Create a `coder.FixPtConfig` object, `fixptcfg`, with default settings.

```
fixptcfg = coder.config('fixpt');
```

Set the name of the test bench to use to infer input data types. In this example, the test bench function name is `dti_test`. The conversion process uses the test bench to infer input data types.

```
fixptcfg.TestBenchName = 'dti_test';
```

Select to propose data types based on derived ranges.

```
fixptcfg.ProposeTypesUsing = 'DerivedRanges';
fixptcfg.ComputeDerivedRanges = true;
```

Add design ranges. In this example, the `dti` function has one scalar double input, `u_in`. Set the design minimum value for `u_in` to -1 and the design maximum to 1.

```
fixptcfg.addDesignRangeSpecification('dti', 'u_in', -1.0, 1.0);
```

Convert the floating-point MATLAB function, `dti`, to fixed-point MATLAB code.

```
codegen -float2fixed fixptcfg dti
```

### Enable Overflow Detection

When you select to detect potential overflows, `codegen` generates a scaled double version of the generated fixed-point MEX function. Scaled doubles store their data in double-precision floating-point, so they carry out arithmetic in full range. They also retain their fixed-point settings, so they are able to report when a computation goes out of the range of the fixed-point type.

This example requires MATLAB Coder and Fixed-Point Designer licenses.

Create a `coder.FixPtConfig` object, `fixptcfg`, with default settings.

```
fixptcfg = coder.config('fixpt');
```

Set the test bench name. In this example, the test bench function name is `dti_test`.

```
fixptcfg.TestBenchName = 'dti_test';
```

Enable numerics testing with overflow detection.

```
fixptcfg.TestNumerics = true;
fixptcfg.DetectFixptOverflows = true;
```

Create a code generation configuration object to generate a standalone C static library.

```
cfg = coder.config('lib');
```

Convert a floating-point MATLAB function to fixed-point C code. In this example, the MATLAB function name is `dti`.

```
codegen -float2fixed fixptcfg -config cfg dti
```

### Alternatives

You can convert floating-point MATLAB code to fixed-point code using the MATLAB Coder app. Open the app using one of these methods:

- On the **Apps** tab, in the **Code Generation** section, click **MATLAB Coder**.
- Use the `coder` command.

See “Convert MATLAB Code to Fixed-Point C Code”.

### **See Also**

`coder.HdlConfig` | `coder.CodeConfig` | `coder.config` | `codegen` | `coder`

### **Topics**

“Generate HDL Code from MATLAB Code Using the Command Line Interface” (HDL Coder)

“Generate C Code at the Command Line”

## coder.LAPACKCallback class

**Package:** coder

Abstract class for specifying the LAPACK library and LAPACKE header file for LAPACK calls in generated code

### Description

`coder.LAPACKCallback` is an abstract class for defining a LAPACK callback class. A LAPACK callback class specifies the LAPACK library and LAPACKE header file to use for LAPACK calls in code generated from MATLAB code. If you use MATLAB Coder to generate standalone code or generate code for the MATLAB Function block, for certain linear algebra function calls, you can generate LAPACK calls. To generate LAPACK calls, set the appropriate configuration parameter to the name of the LAPACK callback class.

- For code generation with MATLAB Coder `codegen` command, set `CustomLAPACKCallback`.
- For code generation with MATLAB Coder app, set **Custom LAPACK library callback**.
- For code generation for a MATLAB Function block with Simulink Coder, set **Custom LAPACK library callback**.

To define a LAPACK callback class with the name `useMyLAPACK`, make the following line the first line of your class definition file.

```
classdef useMyLAPACK < coder.LAPACKCallback
```

You must define all of the methods listed in “Methods” on page 3-40. These methods are static and are not compiled.

### Methods

|                                |                                                                   |
|--------------------------------|-------------------------------------------------------------------|
| <code>getHeaderFilename</code> | Return file name of LAPACKE header file                           |
| <code>updateBuildInfo</code>   | Update build information for linking to a specific LAPACK library |

### Examples

#### Write a LAPACK Callback Class

This example shows how to write a LAPACK callback class.

Use this example LAPACK callback class as a template.

```
classdef useMyLAPACK < coder.LAPACKCallback
 methods (Static)
 function hn = getHeaderFilename()
 hn = 'mylapacke_custom.h';
 end
 function updateBuildInfo(buildInfo, buildctx)
 buildInfo.addIncludePaths(fullfile(pwd, 'include'));
 end
 end
end
```

```

 libName = 'mylapack';
 libPath = fullfile(pwd, 'lib');
 [~,linkLibExt] = buildctx.getStdLibInfo();
 buildInfo.addLinkObjects([libName linkLibExt], libPath, ...
 '', true, true);
 buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
 buildInfo.addDefines('LAPACK_COMPLEX_STRUCTURE');
 buildInfo.addDefines('LAPACK_ILP64');
 end
end
end

```

Replace useMyLAPACK with the name of your callback class.

The `getHeaderFilename` method returns the name of the header file for the LAPACKE C interface to the LAPACK library. Replace `mylapack_custom.h` with the name of your LAPACKE header file.

The `updateBuildInfo` method updates the build information with the locations of the header files and the name and location of the LAPACK library. Replace `mylapack` with the name of your LAPACK library.

If your compiler supports only complex data types that are represented as structures, include these lines in the `updateBuildInfo` method.

```

buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
buildInfo.addDefines('LAPACK_COMPLEX_STRUCTURE');

```

You must specify the integer type that your LAPACK library uses. Not specifying this integer type can result in incorrect behaviors or crashes. Do one of the following:

- Include these lines in the `updateBuildInfo` method.

```

buildInfo.addDefines('HAVE_LAPACK_CONFIG_H');
buildInfo.addDefines('LAPACK_ILP64');

```

- Alternatively, you can directly specify the integer type that your LAPACK library uses. For example, if the integer type is `long long`, include this line in the `updateBuildInfo` method.

```

buildInfo.addDefines('lapack_int=long long');

```

## See Also

[coder.BuildConfig](#) | [coder.ExternalDependency](#)

### Topics

“Speed Up Linear Algebra in Generated Standalone Code by Using LAPACK Calls”

“Speed Up Linear Algebra in Code Generated from a MATLAB Function Block” (Simulink Coder)

### External Websites

[www.netlib.org/lapack](http://www.netlib.org/lapack)

### Introduced in R2016a

## coder.BLASCallback class

**Package:** coder

Abstract class for specifying the BLAS library and CBLAS header and data type information for BLAS calls in generated code

### Description

`coder.BLASCallback` is an abstract class for defining a BLAS callback class. A BLAS callback class specifies the BLAS library and CBLAS header and data type information to use for BLAS calls in code generated from MATLAB code. If you use MATLAB Coder to generate standalone code or generate code for the MATLAB Function block, for certain vector and matrix function calls, you can generate BLAS calls. To generate BLAS calls, set the appropriate configuration parameter to the name of the BLAS callback class.

- For code generation by using the MATLAB Coder `codegen` command, set `CustomBLASCallback`.
- For code generation by using the MATLAB Coder app, set **Custom BLAS library callback**.
- For code generation for a MATLAB Function block by using Simulink Coder, set **Custom BLAS library callback**.

To define a BLAS callback class with the name `useMyBLAS`, make the following line the first line of your class definition file.

```
classdef useMyBLAS < coder.BLASCallback
```

You must define the `updateBuildInfo`, `getHeaderFileName`, and `getBLASIntTypeName` methods. The other methods, `getBLASDoubleComplexTypeName`, `getBLASSingleComplexTypeName`, and `useEnumNameRatherThanTypedef`, are already implemented in `coder.BLASCallback`. In certain situations, you must override these methods with your own definitions when you define your callback class. All methods are static and are not compiled.

### Class Attributes

Abstract true

For information on class attributes, see “Class Attributes”.

### Methods

#### Public Methods

|                                           |                                                                           |
|-------------------------------------------|---------------------------------------------------------------------------|
| <code>updateBuildInfo</code>              | Update build information for linking to a specific BLAS library           |
| <code>getHeaderFilename</code>            | Return the file name of CBLAS header file                                 |
| <code>getBLASIntTypeName</code>           | Return name of integer data type used by CBLAS interface                  |
| <code>getBLASDoubleComplexTypeName</code> | Return name of double-precision complex data type used by CBLAS interface |
| <code>getBLASSingleComplexTypeName</code> | Return name of single-precision complex data type used by CBLAS interface |

`useEnumNameRatherThanTypedef` Specify whether types for enumerations in a BLAS library include the enum keyword

## Examples

### Callback Class for Intel MKL BLAS

This example is an implementation of the BLAS callback class `mklcallback` for linking to the Intel MKL BLAS library on a Windows platform. `mklcallback` does not include explicit implementations of `getBLASDoubleComplexTypeName`, `getBLASSingleComplexTypeName`, and `useEnumNameRatherThanTypedef`. It inherits these methods from `coder.BLASCallback`.

```
classdef mklcallback < coder.BLASCallback
 methods (Static)
 function updateBuildInfo(buildInfo, ~)
 libPath = fullfile(pwd, 'mkl', 'WIN', 'lib', 'intel64');
 libPriority = '';
 libPreCompiled = true;
 libLinkOnly = true;
 libs = {'mkl_intel_ilp64.lib' 'mkl_intel_thread.lib' 'mkl_core.lib'};
 buildInfo.addLinkObjects(libs, libPath, libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addLinkObjects('libiomp5md.lib', fullfile(matlabroot, 'bin', 'win64'), ...
 libPriority, libPreCompiled, libLinkOnly);
 buildInfo.addIncludePaths(fullfile(pwd, 'mkl', 'WIN', 'include'));
 buildInfo.addDefines('-DMKL_ILP64');
 end
 function headerName = getHeaderFilename()
 headerName = 'mkl_cblas.h';
 end
 function intTypeName = getBLASIntTypeName()
 intTypeName = 'MKL_INT';
 end
 end
end
```

Use this example class as a template for writing your own BLAS callback class.

If you are using a different BLAS library, replace `'mkl_cblas.h'` with the name of your CBLAS header file.

If you are using a different BLAS library, replace `'MKL_INT'` with the name of your CBLAS integer data type.

To update the build information in `updateBuildInfo` with the name and location of your BLAS library, use the build information `addLinkObjects` method. If you use the Intel MKL BLAS library, use the link line advisor to see which libraries and compiler options are recommended for your use case.

To update the build information in `updateBuildInfo` with the location of the CBLAS header files, use the build information `addIncludePaths` method.

To add preprocessor macro definitions to the build information in `updateBuildInfo`, use the build information `addDefines` method.

To specify the compiler options in `updateBuildInfo`, use the build information `addCompileFlags` method.

To specify the linker options in `updateBuildInfo`, use the build information `addLinkFlags` method.

The `getBLASDoubleComplexTypeName` method returns the type used for double-precision complex variables in the generated code. If your BLAS library takes a type other than `double*` and `void*` for double-precision complex array arguments, include this method in your callback class definition.

```
function doubleComplexTypeName = getBLASDoubleComplexTypeName()
doubleComplexTypeName = 'my_double_complex_type';
end
```

Replace `my_double_complex_type` with the type that your BLAS library takes for double-precision complex array arguments.

The `getBLASSingleComplexTypeName` method returns the type used for single-precision complex variables in the generated code. If your BLAS library takes a type other than `float*` and `void*` for single-precision complex array arguments, include this method in your callback class definition.

```
function singleComplexTypeName = getBLASSingleComplexTypeName()
doubleComplexTypeName = 'my_single_complex_type';
end
```

Replace `my_single_complex_type` with the type that your BLAS library takes for single-precision complex array arguments.

The `useEnumNameRatherThanTypedef` method returns `false` by default. If types for enumerations in your BLAS library include the `enum` keyword, redefine this method to return `true` in your callback class definition.

```
function p = useEnumNameRatherThanTypedef()
p = true;
end
```

### Callback Class for OpenBLAS

This example is an implementation of the BLAS callback class `openblascallback` for linking to the OpenBLAS library on a Linux platform. `openblascallback` does not have explicit implementations of `getBLASDoubleComplexTypeName`, `getBLASSingleComplexTypeName`, and `useEnumNameRatherThanTypedef`. It inherits these methods from `coder.BLASCallback`.

```
classdef openblascallback < coder.BLASCallback
 methods (Static)
 function updateBuildInfo(buildInfo, buildctx)
 libPriority = '';
 libPreCompiled = true;
 libLinkOnly = true;
 libName = 'libopenblas.a';
 libPath = fullfile(pwd, 'openblas');
 incPath = fullfile(pwd, 'openblas');
 buildInfo.addLinkFlags('-lpthread');
 buildInfo.addLinkObjects(libName, libPath, ...
 libPriority, libPreCompiled, libLinkOnly);
 end
 end
end
```



```

 buildInfo.addIncludePaths(incPath);
 end
 function headerName = getHeaderFilename()
 headerName = 'cblas.h';
 end
 function intTypeName = getBLASIntTypeName()
 intTypeName = 'blasint';
 end
end
end
end

```

If you generate C++ code that includes calls to OpenBLAS library functions, compiling it with the `-pedantic` option produces warnings. To disable the `-pedantic` compiler option, in the `updateBuildInfo` method, include these lines:

```

if buildctx.getTargetLang() == 'C++'
 buildInfo.addCompileFlags('-Wno-pedantic');
end

```

OpenBLAS does not support the C89/C90 standard.

## See Also

`coder.BuildConfig` | `coder.ExternalDependency`

## Topics

“Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”

“Speed Up Matrix Operations in Code Generated from a MATLAB Function Block” (Simulink Coder)

“Build Process Customization”

## External Websites

<https://www.netlib.org/blas/>

<https://www.openblas.net/>

<https://www.intel.com/content/www/us/en/documentation-resources/developer.html>

<https://software.intel.com/content/www/us/en/develop/tools/oneapi/components/onemkl/link-line-advisor.html>

## Introduced in R2018b

## coder.PrimitiveType class

**Package:** coder

**Superclasses:** coder.ArrayType

Represent set of logical, numeric, or char arrays

### Description

Specifies the set of logical, numeric, or char values that the generated code should accept. Supported classes are `half`, `double`, `single`, `int8`, `uint8`, `int16`, `uint16`, `int32`, `uint32`, `int64`, `uint64`, `char`, and `logical`. Use only with the `codegen -args` option. Do not pass as an input to a generated MEX function.

### Construction

---

**Note** You can also create and edit `coder.Type` objects interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t=coder.typeof(v)` creates a `coder.PrimitiveType` object denoting the smallest non-constant type that contains `v`. `v` must be a MATLAB numeric, logical or char.

`t=coder.typeof(v, sz, variable_dims)` returns a modified copy of `coder.typeof(v)` with (upper bound) size specified by `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is assumed to be unbounded and the dimension is assumed to be variable sized. When `sz` is `[]`, the (upper bound) sizes of `v` remain unchanged. When `variable_dims` is not specified, the dimensions of the type are assumed to be fixed except for those that are unbounded. When `variable_dims` is a scalar, it is applied to bounded dimensions that are not 1 or 0 (which are assumed to be fixed).

`t=coder.newtype(numeric_class, sz, variable_dims)` creates a `coder.PrimitiveType` object representing values of class `numeric_class` with (upper bound) sizes `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is assumed to be unbounded and the dimension is assumed to be variable sized. When `variable_dims` is not specified, the dimensions of the type are assumed to be fixed except for those that are unbounded. When `variable_dims` is a scalar, it is applied to the dimensions of the type that are not 1 or 0 (which are assumed to be fixed).

`t=coder.newtype(numeric_class, sz, variable_dims, Name, Value)` creates a `coder.PrimitiveType` object with additional options specified by one or more `Name, Value` pair arguments. `Name` can also be a property name and `Value` is the corresponding value. Specify `Name` as character vector or string scalar. You can specify several name-value pair arguments in any order as `Name1, Value1, ..., NameN, ValueN`.

### Input Arguments

**v**

Input that is not a `coder.Type` object

**sz**

Size for corresponding dimension of type object. Size must be a valid size vector.

**Default:** [1 1] for `coder.newtype`

**variable\_dims**

Logical vector that specifies whether each dimension is variable size (true) or fixed size (false).

**Default:** `false(size(sz)) | sz==Inf` for `coder.newtype`

**numeric\_class**

Class of type object.

**Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

**complex**

Set `complex` to `true` to create a `coder.PrimitiveType` object that can represent complex values. The type must support complex data.

Character arrays do not support complex data.

**Default:** `false`

**sparse**

Set `sparse` to `true` to create a `coder.PrimitiveType` object representing sparse data. The type must support sparse data.

Character and half-precision data types do not support sparse data.

**Default:** `false`

**gpu**

Set `gpu` to `true` to create a `coder.PrimitiveType` object that can represent GPU input type. This option requires a valid GPU Coder license.

Character and half-precision data types do not support GPU Arrays.

**Default:** `false`

**Properties****ClassName**

Class of values in this set

**Complex**

Indicates whether the values in this set are real (`false`) or complex (`true`)

**SizeVector**

The upper-bound size of arrays in this set.

**Sparse**

Indicates whether the values in this set are sparse arrays (`true`)

**VariableDims**

A vector used to specify whether each dimension of the array is fixed or variable size. If a vector element is `true`, the corresponding dimension is variable size.

**Copy Semantics**

Value. To learn how value classes affect copy operations, see [Copying Objects](#).

**Examples**

Create a `coder.PrimitiveType` object.

```
z = coder.typeof(0,[2 3 4],[1 1 0]) % returns double :2x:3x4
% ':' indicates variable-size dimensions
```

Create a `coder.PrimitiveType` object then call `codegen` to generate a C library for a function `fcn.m` that has one input parameter of this type.

- 1 Create a `coder.PrimitiveType` object.

```
z = coder.typeof(0,[2 3 4],[1 1 0]) % returns double :2x:3x4
% ':' indicates variable-size dimensions
```

- 2 Call `codegen` to generate a C library for a MATLAB function `fcn.m` that has one input parameter type `z`.

```
% Use the config:lib option to generate a C library
codegen -config:lib fcn -args {z}
```

**See Also**

[coder.Type](#) | [coder.ArrayType](#) | [coder.ClassType](#) | [coder.newtype](#) | [coder.typeof](#) | [coder.resize](#) | [codegen](#)

**Topics**

“Create and Edit Input Types by Using the Coder Type Editor”

**Introduced in R2011a**

## coder.StructType class

**Package:** coder

**Superclasses:** coder.ArrayType

Represent set of MATLAB structure arrays

### Description

Specifies the set of structure arrays that the generated code should accept. Use only with the `codegen -args` option. Do not pass as an input to a generated MEX function.

### Construction

---

**Note** You can also create and edit `coder.Type` objects interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t=coder.typeof(struct_v)` creates a `coder.StructType` object for a structure with the same fields as the scalar structure `struct_v`.

`t=coder.typeof(struct_v, sz, variable_dims)` returns a modified copy of `coder.typeof(struct_v)` with (upper bound) size specified by `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is assumed to be unbounded and the dimension is assumed to be variable sized. When `sz` is `[]`, the (upper bound) sizes of `struct_v` remain unchanged. If the `variable_dims` input parameter is not specified, the dimensions of the type are assumed to be fixed except for those that are unbounded. When `variable_dims` is a scalar, it is applied to the bounded dimensions that are not 1 or 0 (which are assumed to be fixed).

`t=coder.newtype('struct', struct_v, sz, variable_dims)` creates a `coder.StructType` object for an array of structures with the same fields as the scalar structure `struct_v` and (upper bound) size `sz` and variable dimensions `variable_dims`. If `sz` specifies `inf` for a dimension, then the size of the dimension is assumed to be unbounded and the dimension is assumed to be variable sized. When `variable_dims` is not specified, the dimensions of the type are assumed to be fixed except for those that are unbounded. When `variable_dims` is a scalar, it is applied to the dimensions of the type, except if the dimension is 1 or 0, which is assumed to be fixed.

### Input Arguments

#### **struct\_v**

Scalar structure used to specify the fields in a new structure type.

#### **sz**

Size vector specifying each dimension of type object.

**Default:** [1 1] for `coder.newtype`

**variable\_dims**

Logical vector that specifies whether each dimension is variable size (`true`) or fixed size (`false`).

**Default:** `false(size(sz)) | sz==Inf` for `coder.newtype`

**Properties****Alignment**

The run-time memory alignment of structures of this type in bytes. If you have an Embedded Coder license and use Code Replacement Libraries (CRLs), the CRLs provide the ability to align data objects passed into a replacement function to a specified boundary. This capability allows you to take advantage of target-specific function implementations that require data to be aligned. By default, the structure is not aligned on a specific boundary so it will not be matched by CRL functions that require alignment.

Alignment must be either `-1` or a power of 2 that is no more than 128.

**ClassName**

Class of values in this set.

**Extern**

Whether the structure type is externally defined.

**Fields**

A structure giving the `coder.Type` of each field in the structure.

**HeaderFile**

If the structure type is externally defined, name of the header file that contains the external definition of the structure, for example, `"mystruct.h"`. Specify the path to the file using the `codegen -I` option or the **Additional include directories** parameter in the MATLAB Coder project settings dialog box **Custom Code** tab.

By default, the generated code contains `#include` statements for custom header files after the standard header files. If a standard header file refers to the custom structure type, then the compilation fails. By specifying the `HeaderFile` option, MATLAB Coder includes that header file exactly at the point where it is required.

Must be a non-empty character vector or string scalar.

**SizeVector**

The upper-bound size of arrays in this set.

**VariableDims**

A vector used to specify whether each dimension of the array is fixed or variable size. If a vector element is `true`, the corresponding dimension is variable size.

## Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects.

## Examples

Create a type for a structure with a variable-size field.

```
x.a = coder.typeof(0,[3 5],1);
x.b = magic(3);
coder.typeof(x)
% Returns
% coder.StructType
% 1x1 struct
% a: :3x:5 double
% b: 3x3 double
% ':' indicates variable-size dimensions
```

Create a `coder.StructType` object then call `codegen` to generate a C library for a function `fcn.m` that has one input parameter of this type

- 1 Create a new structure type.

```
ta = coder.newtype('int8',[1 1]);
tb = coder.newtype('double',[1 2],[1 1]);
z = coder.newtype('struct',struct('a',ta,'b',tb))
% Returns
% coder.StructType
% 1x1 struct
% a: 1x1 int8
% b: :1x:2 double
```

- 2 Call `codegen` to generate a C library for a MATLAB function `fcn.m` that has one input parameter of this type.

```
% Use the -config:lib option to generate a C library
codegen -config:lib fcn -args {z}
```

Create a `coder.StructType` object that uses an externally-defined structure type.

- 1 Create a type that uses an externally-defined structure type.

```
S.a = coder.typeof(double(0));
S.b = coder.typeof(single(0));
T = coder.typeof(S);
T = coder.cstructname(T,'mytype','extern','HeaderFile','myheader.h');
```

```
T =
```

```
coder.StructType
 1x1 extern mytype (myheader.h) struct
 a: 1x1 double
 b: 1x1 single
```

- 2 View the types of the structure fields.

```
T.Fields
```

```
ans =
 a: [1x1 coder.PrimitiveType]
 b: [1x1 coder.PrimitiveType]
```

**See Also**

[coder.Type](#) | [coder.PrimitiveType](#) | [coder.EnumType](#) | [coder.FiType](#) | [coder.ClassType](#) | [coder.Constant](#) | [coder.ArrayType](#) | [coder.newtype](#) | [coder.typeof](#) | [coder.resize](#) | [codegen](#) | [coder](#) | [coder.cstructname](#)

**Topics**

[“Create and Edit Input Types by Using the Coder Type Editor”](#)

**Introduced in R2011a**



# coder.SingleConfig class

**Package:** coder

Double-precision to single-precision conversion configuration object

## Description

A `coder.SingleConfig` object contains the configuration parameters that the MATLAB Coder `codegen` function requires to convert double-precision code to single-precision MATLAB code. To pass this object to the `codegen` function, use the `-double2single` option.

## Construction

`scfg = coder.config('single')` creates a `coder.SingleConfig` object for double-precision to single-precision conversion.

## Properties

### OutputFileNameSuffix — Suffix for single-precision file name

'\_single' (default) | character vector

Suffix that the single-conversion process uses for generated single-precision files.

### LogIOForComparisonPlotting — Enable simulation data logging for comparison plotting of input and output variables

false (default) | true

Enable simulation data logging to plot the data differences introduced by single-precision conversion.

### PlotFunction — Name of function for comparison plots

' ' (default) | character vector

Name of function to use for comparison plots.

To enable comparison plotting, set `LogIOForComparisonPlotting` to true. This option takes precedence over `PlotWithSimulationDataInspector`.

The plot function must accept three inputs:

- A structure that holds the name of the variable and the function that uses it.
- A cell array to hold the logged floating-point values for the variable.
- A cell array to hold the logged values for the variable after fixed-point conversion.

### PlotWithSimulationDataInspector — Specify use of Simulation Data Inspector for comparison plots

false (default) | true

Use Simulation Data Inspector for comparison plots.

`LogIOForComparisonPlotting` must be set to `true` to enable comparison plotting. The `PlotFunction` option takes precedence over `PlotWithSimulationDataInspector`.

**TestBenchName — Name of test file**

' ' (default) | character vector | cell array of character vectors

Test file name or names, specified as a character vector or cell array of character vectors. Specify at least one test file.

If you do not explicitly specify input parameter data types, the conversion uses the first file to infer these data types.

**TestNumerics — Enable numerics testing**

false (default) | true

Enable numerics testing to verify the generated single-precision code. The test file runs the single-precision code.

**Methods**

`addFunctionReplacement` Replace double-precision function with single-precision function during single-precision conversion

**Examples****Generate Single-Precision MATLAB Code**

Create a `coder.SingleConfig` object.

```
scfg= coder.config('single');
```

Set the properties of the doubles-to-singles configuration object. Specify the test file. In this example, the name of the test file is `myfunction_test`. The conversion process uses the test file to infer input data types and collect simulation range data. Enable numerics testing and generation of comparison plots.

```
scfg.TestBenchName = 'myfunction_test';
scfg.TestNumerics = true;
scfg.LogIOForComparisonPlotting = true;
```

Run `codegen`. Use the `-double2single` option to specify the `coder.SingleConfig` that you want to use. In this example, the MATLAB function name is `myfunction`.

```
codegen -double2single scfg myfunction
```

**Alternatives**

You can convert double-precision MATLAB code to single-precision C/C++ code by using the `'singleC'` option of the `codegen` function.

You can convert double-precision MATLAB code to single-precision code using the MATLAB Coder app. Open the app using one of these methods:

- On the **Apps** tab, in the **Code Generation** section, click **MATLAB Coder**.
- Use the `coder` command.

## See Also

`coder.config` | `codegen`

## Topics

“Generate Single-Precision MATLAB Code”

“Generate Single-Precision C Code at the Command Line”

## Introduced in R2015b

## **coder.Type class**

**Package:** coder

Represent set of MATLAB values

### **Description**

Specifies the set of values that the generated code should accept. Use only with the `codegen -args` option. Do not pass as an input to a generated MEX function.

### **Construction**

---

**Note** You can also create and edit `coder.Type` objects interactively by using the `Coder Type Editor`. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`coder.Type` is an abstract class. To create instances of `coder.Type` class, you can use `coder.typeof`, and `coder.newtype` functions.

The following are the instances of `coder.Type` class.

- `coder.CellType`
- `coder.ClassType`
- `coder.Constant`
- `coder.EnumType`
- `coder.FiType`
- `coder.OutputType`
- `coder.PrimitiveType`
- `coder.StructType`

### **Properties**

#### **ClassName**

Class of values in this set

### **Copy Semantics**

Value. To learn how value classes affect copy operations, see `Copying Objects`.

### **See Also**

`coder.ArrayType` | `coder.resize` | `codegen` | `coder`

#### **Topics**

“Create and Edit Input Types by Using the Coder Type Editor”

**Introduced in R2011a**

## coder.make.BuildConfiguration class

**Package:** coder.make

Represent build configuration

### Description

A build configuration contains information on how to build source code and binaries.

Give each build configuration a unique name that you can use to reference or access it, such as 'Faster Builds'.

A build configuration contains options with values. Each option maps to a build tool in the ToolchainInfo object that uses the build configuration.

For example, a build configuration can contain options for the following build tools in coder.make.ToolchainInfo:

- C Compiler
- C++ Compiler'
- Linker
- Shared Library Linker
- Archiver

The value of each option can vary from one build configuration to another. For example, the "Faster Runs" build configuration can have compiler options that include optimization flags, while the "Debug" build configuration can have compiler options that include a symbolic debug flag.

### Construction

```
ConfigObj = coder.make.BuildConfiguration(ConfigName, {Name, Value, ...})
```

#### Input Arguments

##### **ConfigName — Name of build configuration**

character vector

Name of build configuration, specified as a character vector.

Example: 'Faster Builds II'

Data Types: char

##### **Name-Value Pair Arguments**

Specify optional pairs of arguments as Name1=Value1, ..., NameN=ValueN, where Name is the argument name and Value is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

**Name — Name of option**

character vector

Name of option, specified as a character vector.

Data Types: char

**Value — Value of option**

character vector

Value of option, specified as a character vector.

Data Types: char

**Output Arguments****ConfigObj — Object handle for configuration**

variable

Object handle for configuration, returned as a variable.

Data Types: char

**Properties****Description — Brief description of build configuration**

A brief description of the build configuration. The MATLAB Coder software displays this description in the project build settings, on the **Hardware** tab, below the **Build Configuration** parameter.

You can assign a description to this property after you create the `BuildConfiguration` object.

```
config.Description = 'BldConfigDescription'
```

```
config =
#####
Build Configuration : BldConfigName
Description : BldConfigDescription
#####
```

Data type: char

**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

**Name — Name of build configuration**

The name of the build configuration.

You can assign a name to this property when you create a `BuildConfiguration` object.

```
config = coder.make.BuildConfiguration ...
('BldConfigName',{'optiona','1','optionb','2','optionc','3'})
```

You can also assign a name to this property after you create a `BuildConfiguration` object.

```
config.Name = 'BldConfigName'
```

Both approaches produce the same result

```
config =

Build Configuration : BldConfigName
Description :
#####
```

Data type: char

#### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

#### Options — List of options or settings for specific build configuration

A list of options or settings for a specific build configuration. This list contains name-value pairs. The `Options` property has an option for each `coder.make.BuildTool` object in `coder.make.Toolchain.BuildTools`. For example, `Options` has a `C Compiler` option for the `C Compiler` build tool.

Data type: `coder.make.UnorderedList`

#### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

#### Methods

|                        |                                           |
|------------------------|-------------------------------------------|
| <code>addOption</code> | Add new option                            |
| <code>getOption</code> | Get value of option                       |
| <code>info</code>      | Get information about build configuration |
| <code>isOption</code>  | Determine if option exists                |
| <code>keys</code>      | Get all option names                      |
| <code>setOption</code> | Set value of option                       |
| <code>values</code>    | Get all option values                     |

#### Copy Semantics

Handle. To learn how handle classes affect copy operations, see [Copying Objects](#).

#### See Also

`coder.make.BuildItem` | `coder.make.BuildTool` | `coder.make.ToolchainInfo` |  
`getBuildConfiguration` | `removeBuildConfiguration` | `setBuildConfiguration` |  
`setBuildConfigurationOption`



**Topics**

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“Toolchain Definition File with Commentary”

## **coder.make.BuildItem class**

**Package:** `coder.make`

Represent build item

### **Description**

Create a `coder.make.BuildItem` object that can have macro name and value. Then, use the `BuildItem` object as an argument for one of the following `coder.make.BuildTool` methods:

- `coder.make.BuildTool.getCommand`
- `coder.make.BuildTool.setCommand`
- `coder.make.BuildTool.setPath`
- `coder.make.BuildTool.addFileExtension`

---

**Note** What is a macro? The term has a different meaning depending on the context:

- In this context, a macro is a variable that the makefile can use to refer to a given value, such as a build tool's command, path, or file extension.
  - In topics for the `coder.make.ToolchainInfo.Macros` and related methods, a macro is a variable that the makefile can use to refer to arbitrary or predefined value.
- 

### **Construction**

`h = coder.make.BuildItem(blditm_macrovalue)` creates a `coder.make.BuildItem` object that has a value.

`h = coder.make.BuildItem(blditm_macroname,blditm_value)` creates a `coder.make.BuildItem` object that has a macro name and value.

### **Input Arguments**

#### **blditm\_macroname — Macro name of build item**

character vector

Macro name of build item, specified as a character vector.

Data Types: `char`

#### **blditm\_value — Value of build item**

character vector

Value of build item

Data Types: `char`

## Output Arguments

### buildItemHandle — BuildItem handle

object handle

BuildItem handle, specified as a `coder.make.BuildItem` object that contains an option value.

Example: `bi`

## Methods

|                       |                              |
|-----------------------|------------------------------|
| <code>getMacro</code> | Get macro name of build item |
| <code>getValue</code> | Get value of build item      |
| <code>setMacro</code> | Set macro name of build item |
| <code>setValue</code> | Set value of build item      |

## Copy Semantics

Handle. To learn how handle classes affect copy operations, see Copying Objects.

## Example

```
bi1 = coder.make.BuildItem('BuildItemMacroValue')

bi1 =
 Macro : (empty)
 Value : BuildItemMacroValue

bi2 = coder.make.BuildItem('BIMV','BuildItemMacroValue')

bi2 =
 Macro : BIMV
 Value : BuildItemMacroValue
```

## See Also

`coder.make.ToolchainInfo` | `coder.make.BuildTool` | `coder.make.ToolchainInfo` | `getCommand` | `setCommand` | `setPath` | `addFileExtension`

## Topics

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

## **coder.make.BuildTool class**

**Package:** `coder.make`

Represent build tool

### **Description**

Use `coder.make.BuildTool` to get and define an existing default `coder.make.BuildTool` object, or to create a `coder.make.BuildTool` object.

To work with default `BuildTool` objects, use the get and define approach from the `ToolchainInfo` properties:

- `coder.make.ToolchainInfo.BuildTools`
- `coder.make.ToolchainInfo.PostbuildTools`

Examples showing the get and define approach are:

- “Toolchain Definition File with Commentary”
- Tutorial example: “Add Custom Toolchains to MATLAB® Coder™ Build Process” tutorial

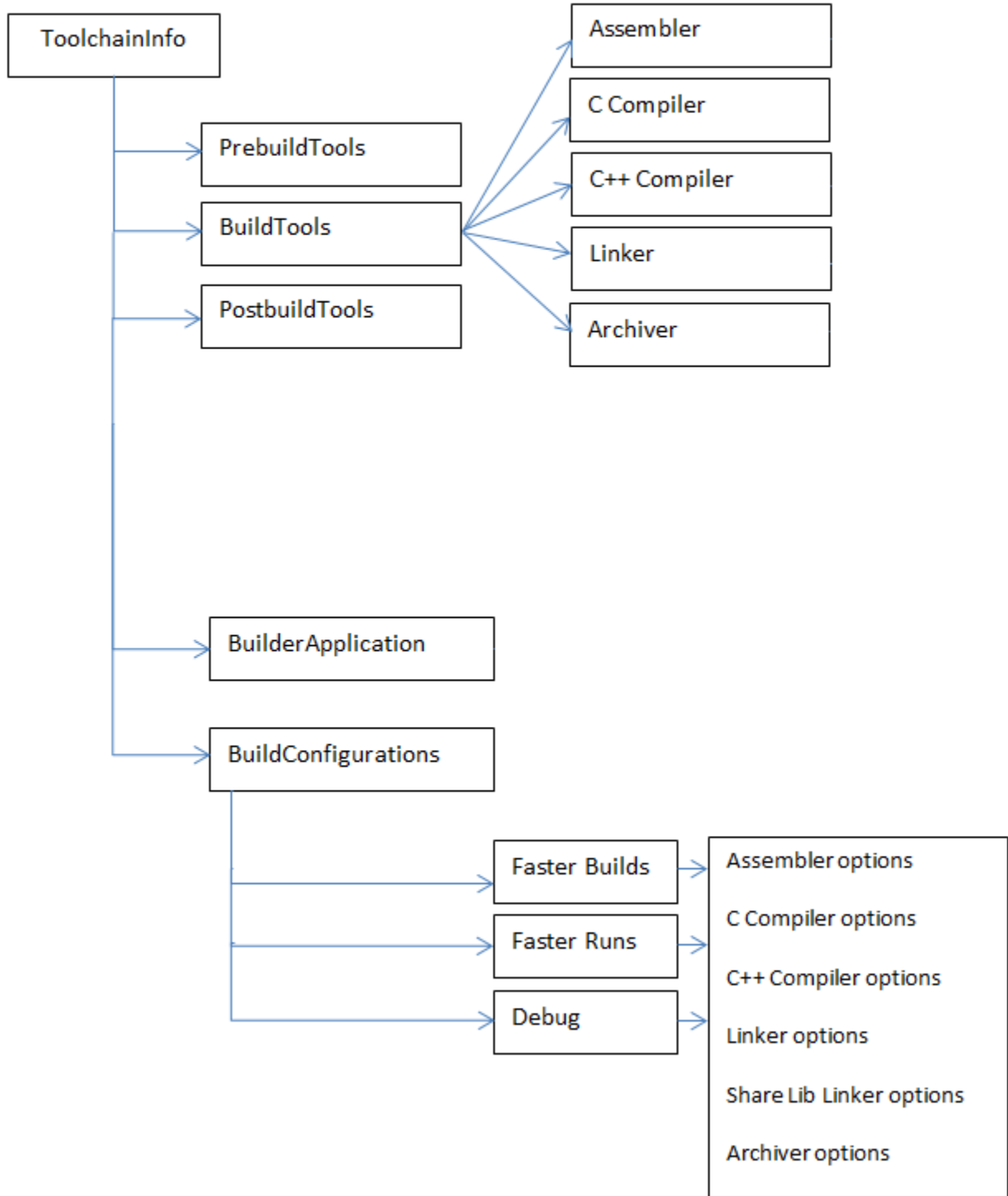
An alternative to the get and define approach is the create new approach. An example showing the create new approach appears in “Create a Non-Default BuildTool” on page 3-69.

The illustration shows the relationship between the default `BuildTool` objects and `ToolchainInfo`. When you examine the `PHONY TARGETS` section of the generated makefile, the difference between the `BuildTools`, `PostbuildTools`, and `PrebuildTools` becomes clearer.

- `prebuild` - runs only the prebuild tool.
- `build` - runs the build tools after running prebuild. The `build` generates the build `PRODUCT`.
- `postbuild` - runs the postbuild tool after running build.
- `all` - runs prebuild, build, and postbuild. The build process uses this rule on a Ctrl+B build.
- `clean` - cleans up all output file extensions and derived file extensions of all the tools in the toolchain.
- `info` - expands and prints all macros used in the makefile.

**ToolchainInfo class & key properties**

**Default build tools and options**



## Construction

`h = coder.make.BuildTool(bldtl_name)` creates a `coder.make.BuildTool` object and sets its `Name` property.

### Input Arguments

#### **bldtl\_name** — Build tool name

character vector | string scalar

Build tool name, specified as a character vector or string scalar.

Data Types: `char` | `string`

### Output Arguments

#### **h** — Object handle

variable

Object handle for a `coder.make.BuildTool` object, specified as a variable.

Example: `tool`

## Properties

### **Command** — Build tool command or command macro

Represents the build tool command using:

- An optional macro name, such as: `CC`.
- The system call (command) that starts the build tool, such as: `gcc`.

The macro name and system call appear together in the generated makefile. For example: `CC = gcc`

Assigning a value to this property is optional.

You can use the following methods with `Command`:

- `getCommand`
- `setCommand`

### **Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

### **Directives** — Tool-specific directives

Defines any tool-specific directives, such as `-D` for preprocessor defines. Assigning a value to this property is optional.

You can use the following methods with `Directives`:

- `addDirective`

- `getDirective`
- `setDirective`

**Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

**FileExtensions — Tool-specific file extensions**

Defines any tool-specific file extensions. This value is optional.

You can use the following methods with `FileExtensions`:

- `addFileExtension`
- `getFileExtension`
- `setFileExtension`

**Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

**Name — Name of build tool**

Defines the name of the build tool.

You can use the following methods with `Name`.

- `getName`
- `setName`

**Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

**Path — Tool-specific paths**

Defines any tool-specific paths. If the command is on the system path, this value is optional.

You can use the following methods with `Path`:

- `getPath`
- `setPath`

**Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

### SupportedOutputs — Tool-specific output formats

Defines any tool-specific output formats. If the tool supports all available formats, this value is optional.

The default value is { '\*' }, which indicates support for all available formats.

The datatype is cell array. The contents of the cell array must be either `coder.make.BuildOutput` enumeration values, or '\*'.

This property does not have any associated methods. Assign the value directly to the `SupportedOutputs`. See the `addPrebuildToolToToolchainInfo.m` example or the `addPostbuildToolToToolchainInfo.m` example. Valid enumeration values are:

|                                                    |                                                                               |
|----------------------------------------------------|-------------------------------------------------------------------------------|
| <code>coder.make.BuildOutput.STATIC_LIBRARY</code> | applies for pre-build tools, build tools, and post-build tools                |
| <code>coder.make.BuildOutput.SHARED_LIBRARY</code> | applies for build tools and post-build tools; requires Embedded Coder license |
| <code>coder.make.BuildOutput.EXECUTABLE</code>     | applies for build tools and post-build tools                                  |

#### Attributes:

|                        |        |
|------------------------|--------|
| <code>GetAccess</code> | public |
| <code>SetAccess</code> | public |

### Methods

|                                   |                                                                                     |
|-----------------------------------|-------------------------------------------------------------------------------------|
| <code>addDirective</code>         | Add directive to <code>Directives</code>                                            |
| <code>addFileExtension</code>     | Add new file extension entry to <code>FileExtensions</code>                         |
| <code>getCommand</code>           | Get build tool command                                                              |
| <code>getDirective</code>         | Get value of named directive from <code>Directives</code>                           |
| <code>getFileExtension</code>     | Get file extension for named file type in <code>FileExtensions</code>               |
| <code>getName</code>              | Get build tool name                                                                 |
| <code>getPath</code>              | Get path and macro of build tool in <code>Path</code>                               |
| <code>info</code>                 | Display build tool properties and values                                            |
| <code>setCommand</code>           | Set build tool command                                                              |
| <code>setCommandPattern</code>    | Set pattern of commands for build tools                                             |
| <code>setCompilerOptionMap</code> | Set C/C++ language standard and compiler options for selected build tool (compiler) |
| <code>setDirective</code>         | Set value of directive in <code>Directives</code>                                   |
| <code>setFileExtension</code>     | Set file extension for named file type in <code>FileExtensions</code>               |
| <code>setName</code>              | Set build tool name                                                                 |
| <code>setPath</code>              | Set path and macro of build tool in <code>Path</code>                               |
| <code>validate</code>             | Validate build tool properties                                                      |



## Copy Semantics

Handle. To learn how handle classes affect copy operations, see Copying Objects.

### Example

- “Get a Default Build Tool and Set Its Properties” on page 3-69
- “Create a Non-Default BuildTool” on page 3-69
- “Add Prebuild and Postbuild Tools to Toolchain” on page 3-72

#### Get a Default Build Tool and Set Its Properties

The `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process” uses the following lines to get a default build tool, C Compiler, from a `ToolchainInfo` object called `tc`, and then sets its properties.

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');

tool.setCommandPattern('|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<| |>OUTPUT<|');
```

The following examples show the same “get and define” approach in more detail:

- “Toolchain Definition File with Commentary”
- Tutorial example: “Add Custom Toolchains to MATLAB® Coder™ Build Process” tutorial

#### Create a Non-Default BuildTool

To create a build tool:

- 1 Create a file that defines a `BuildTool` object, such as `createBuildTool_1.m` or `createBuildTool_2`.
- 2 Create a file like `addBuildToolToToolchainInfo.m`, that:
  - Creates a `ToolchainInfo` object, or uses an existing one.
  - Creates a `BuildTool` object from `createBuildTool_1.m` or `createBuildTool_2`.
  - Adds the `BuildTool` object to the `ToolchainInfo` object.
- 3 Run `addBuildToolToToolchainInfo.m`.

Refer to the following examples of `addBuildToolToToolchainInfo.m`, `createBuildTool_1.m`, and `createBuildTool_2.m`.

**addBuildToolToToolchainInfo.m**

```

%%
% Adding a build tool to ToolchainInfo
%%

% Create a toolchain object
h = coder.make.ToolchainInfo();

% User function for creating and populating a build tool
tool = createBuildTool_1();
% or tool = createBuildTool_2();

% Add the build tool to ToolchainInfo
h.addBuildTool('My C Compiler',tool);

```

**createBuildTool\_1.m**

```

function buildToolObj = createBuildTool_1()

toolinfo.Name = 'My GNU C Compiler';
toolinfo.Language = 'C';

toolinfo.Command.Macro = 'CC';
toolinfo.Command.Value = 'gcc';

toolinfo.Path.Macro = 'CC_PATH';
toolinfo.Path.Value = '';

toolinfo.OptionsRegistry = {'My C Compiler','MY_CFLAGS'};

% Key name of this directive
toolinfo.Directives(1).Key = 'IncludeSearchPath';

% Macro of this directive (directives can have empty macros)
toolinfo.Directives(1).Macro = '';

% Value of this directive
toolinfo.Directives(1).Value = '-I';

toolinfo.Directives(2).Key = 'PreprocessorDefine';
toolinfo.Directives(2).Macro = '';
toolinfo.Directives(2).Value = '-D';

toolinfo.Directives(3).Key = 'Debug';
toolinfo.Directives(3).Macro = 'CDEBUG';
toolinfo.Directives(3).Value = '-g';

toolinfo.Directives(4).Key = 'OutputFlag';
toolinfo.Directives(4).Macro = 'C_OUTPUT_FLAG';
toolinfo.Directives(4).Value = '-o';

% Key name of this file extension
toolinfo.FileExtensions(1).Key = 'Source';

% Macro of this file extension
toolinfo.FileExtensions(1).Macro = 'C_EXT';

% Value of this file extension
toolinfo.FileExtensions(1).Value = '.c';

toolinfo.FileExtensions(2).Key = 'Header';
toolinfo.FileExtensions(2).Macro = 'H_EXT';
toolinfo.FileExtensions(2).Value = '.h';

toolinfo.FileExtensions(3).Key = 'Object';
toolinfo.FileExtensions(3).Macro = 'OBJ_EXT';
toolinfo.FileExtensions(3).Value = '.obj';

toolinfo.DerivedFileExtensions = {'$(OBJ_EXT)'};
% '*' means all outputs are supported
toolinfo.SupportedOutputs = {'*'};

% put actual extension (e.g. '.c') or keyname if already registered

```

```

% under 'FileExtensions'
toolinfo.InputFileExtensions = {'Source'};
toolinfo.OutputFileExtensions = {'Object'};

% Create a build tool object and populate it with the above data
buildToolObj = createAndpopulateBuildTool(toolinfo);

function buildToolObj = createAndpopulateBuildTool(toolinfo)

% -----
% Construct a BuildTool
% -----
buildToolObj = coder.make.BuildTool();

% -----
% Set general properties
% -----
buildToolObj.Name = toolinfo.Name;
buildToolObj.Language = toolinfo.Language;
buildToolObj.Command = coder.make.BuildItem ...
 (toolinfo.Command.Macro,toolinfo.Command.Value);
buildToolObj.Path = coder.make.BuildItem ...
 (toolinfo.Path.Macro,toolinfo.Path.Value);
buildToolObj.OptionsRegistry = toolinfo.OptionsRegistry;
buildToolObj.SupportedOutputs = toolinfo.SupportedOutputs;

% -----
% Directives
% -----
for i = 1:numel(toolinfo.Directives)
 directiveBuildItem = coder.make.BuildItem(...
 toolinfo.Directives(i).Macro,toolinfo.Directives(i).Value);
 buildToolObj.addDirective(toolinfo.Directives(i).Key,directiveBuildItem);
end

% -----
% File extensions
% -----
for i = 1:numel(toolinfo.FileExtensions)
 fileExtBuildItem = coder.make.BuildItem(...
 toolinfo.FileExtensions(i).Macro,toolinfo.FileExtensions(i).Value);
 buildToolObj.addFileExtension(toolinfo.FileExtensions(i).Key,fileExtBuildItem);
end

% -----
% Derived file extensions
% -----
for i = 1:numel(toolinfo.DerivedFileExtensions)
 if buildToolObj.FileExtensions.isKey(toolinfo.DerivedFileExtensions{i})
 buildToolObj.DerivedFileExtensions{end+1} = ...
 ['$(buildToolObj.getFileExtension
 (toolinfo.DerivedFileExtensions{i}) ')'];
 else
 buildToolObj.DerivedFileExtensions{end+1} = toolinfo.DerivedFileExtensions{i};
 end
end

% -----
% Command pattern
% -----
if isfield(toolinfo,'CommandPattern')
 buildToolObj.CommandPattern = toolinfo.CommandPattern;
end

% -----
% [Input/Output]FileExtensions
% -----
if isfield(toolinfo,'InputFileExtensions')
 buildToolObj.InputFileExtensions = toolinfo.InputFileExtensions;
end
if isfield(toolinfo,'OutputFileExtensions')
 buildToolObj.OutputFileExtensions = toolinfo.OutputFileExtensions;
end
end

```

### createBuildTool\_2.m

```

function buildToolObj = createBuildTool_2()

% -----
% Construct a BuildTool
% -----

```

```

buildToolObj = coder.make.BuildTool();

% -----
% Set general properties
% -----
buildToolObj.Name = 'My GNU C Compiler';
buildToolObj.Language = 'C';
buildToolObj.Command = coder.make.BuildItem('CC','gcc');
buildToolObj.Path = coder.make.BuildItem('CC_PATH','');
buildToolObj.OptionsRegistry = {'My C Compiler','MY_CFLAGS'};
buildToolObj.SupportedOutputs = {'*'}; % '*' means all outputs are supported

% -----
% Directives
% -----

directiveBuildItem = coder.make.BuildItem('','-I');
buildToolObj.addDirective('IncludeSearchPath',directiveBuildItem);

directiveBuildItem = coder.make.BuildItem('','-D');
buildToolObj.addDirective('PreprocessorDefine',directiveBuildItem);

directiveBuildItem = coder.make.BuildItem('CDEBUG','-g');
buildToolObj.addDirective('Debug',directiveBuildItem);

directiveBuildItem = coder.make.BuildItem('C_OUTPUT_FLAG','-o');
buildToolObj.addDirective('OutputFlag',directiveBuildItem);

% -----
% File Extensions
% -----

fileExtBuildItem = coder.make.BuildItem('C_EXT','.c');
buildToolObj.addFileExtension('Source',fileExtBuildItem);

fileExtBuildItem = coder.make.BuildItem('H_EXT','.h');
buildToolObj.addFileExtension('Header',fileExtBuildItem);

fileExtBuildItem = coder.make.BuildItem('OBJ_EXT','.obj');
buildToolObj.addFileExtension('Object',fileExtBuildItem);

% -----
% Others
% -----

buildToolObj.DerivedFileExtensions = {'$(OBJ_EXT)'};
buildToolObj.InputFileExtensions = {'Source'};
% put actual extension (e.g. '.c')
% or keyname if already registered under 'FileExtensions'
buildToolObj.OutputFileExtensions = {'Object'};
% put actual extension (e.g. '.c')
% or keyname if already registered under 'FileExtensions'

```

### Add Prebuild and Postbuild Tools to Toolchain

The code in the `addPrebuildToolToToolchainInfo.m` and the `addPostbuildToolToToolchainInfo.m` examples show how to add prebuild and postbuild tools to a toolchain.

#### addPrebuildToolToToolchainInfo.m

```

%%
% Adding a pre-build tool with selected SupportedOutputs to ToolchainInfo
%%

% Create a toolchain object
tc = coder.make.ToolchainInfo(coder.make.getToolchainInfoFromRegistry(coder.make.getDefaultToolchain));
% Set inlined commands for source to dependency tool
tc.InlinedCommands = ['define sourceToDep=', 10, ...
'$(foreach source, $(1), $(CC) $(CFLAGS) -E -MMD -MP -MF"$(notdir $(source:%.c=%d))" -MT"$(notdir $(source:%.c=%o))" $
'endef'];
% Set makefile includes
make = tc.BuilderApplication();
make.IncludeFiles = {'*.d'};
% Dependency File Generator for GCC-based toolchain
prebuildToolName = 'Dependency File Generator';

```

```

prebuildTool = tc.addPrebuildTool(prebuildToolName);
% Set command macro and value
prebuildTool.setCommand('SRC2DEP', '${call sourceToDep, $(SRCS)}');
% Set tool options macro
prebuildTool.OptionsRegistry = {prebuildToolName, 'SRC2DEP_OPTS'};
% Set output type from tool
prebuildTool.SupportedOutputs = {'*'};
tc.addBuildConfigurationOption(prebuildToolName, prebuildTool);
tc.setBuildConfigurationOption('all', prebuildToolName, '');

% displays pre-build tool properties
tc.getPrebuildTool('Dependency File Generator')

```

### addPostbuildToolToToolchainInfo.m

```

%%
% Adding a post-build tool to ToolchainInfo
%%

% ELF (executable and linkable format) to hexadecimal converter
postbuildToolName = 'elf2hex converter';
% Create and populate a post-build tool
tc = coder.make.ToolchainInfo;
postbuild = tc.addPostbuildTool(postbuildToolName);
% Set command macro and value for tool
postbuild.setCommand('OBJCOPY', 'arm-none-eabi-objcopy');
% Set path for tool
postbuild.setPath('OBJCOPYPATH', '${MW_GNU_ARM_TOOLS_PATH}');
% Set options for tool
postbuild.OptionsRegistry = {postbuildToolName, 'OBJCOPYFLAGS_HEX'};
% Set output type from tool
postbuild.SupportedOutputs = {coder.make.enum.BuildOutput.EXECUTABLE};
% Create build configuration for tool
tc.addBuildConfigurationOption(postbuildToolName, postbuild);
% Set build configuration for tool
tc.setBuildConfigurationOption('all', postbuildToolName, '-O ihex $(PRODUCT) $(PRODUCT_HEX)');

% displays post-build tool properties
tc.getPostbuildTool('elf2hex converter')

```

### See Also

[coder.make.ToolchainInfo](#) | [coder.make.BuildTool](#) | [addBuildTool](#) | [getBuildTool](#) | [removeBuildTool](#) | [setBuildTool](#)

### Topics

“Toolchain Definition File with Commentary”

“Add Custom Toolchains to MATLAB® Coder™ Build Process”

“About coder.make.ToolchainInfo”

## **coder.make.ToolchainInfo class**

**Package:** `coder.make`

Represent custom toolchain

### **Description**

Use `coder.make.ToolchainInfo` to define and register a new set of software build tools (toolchain) with MathWorks code generation products.

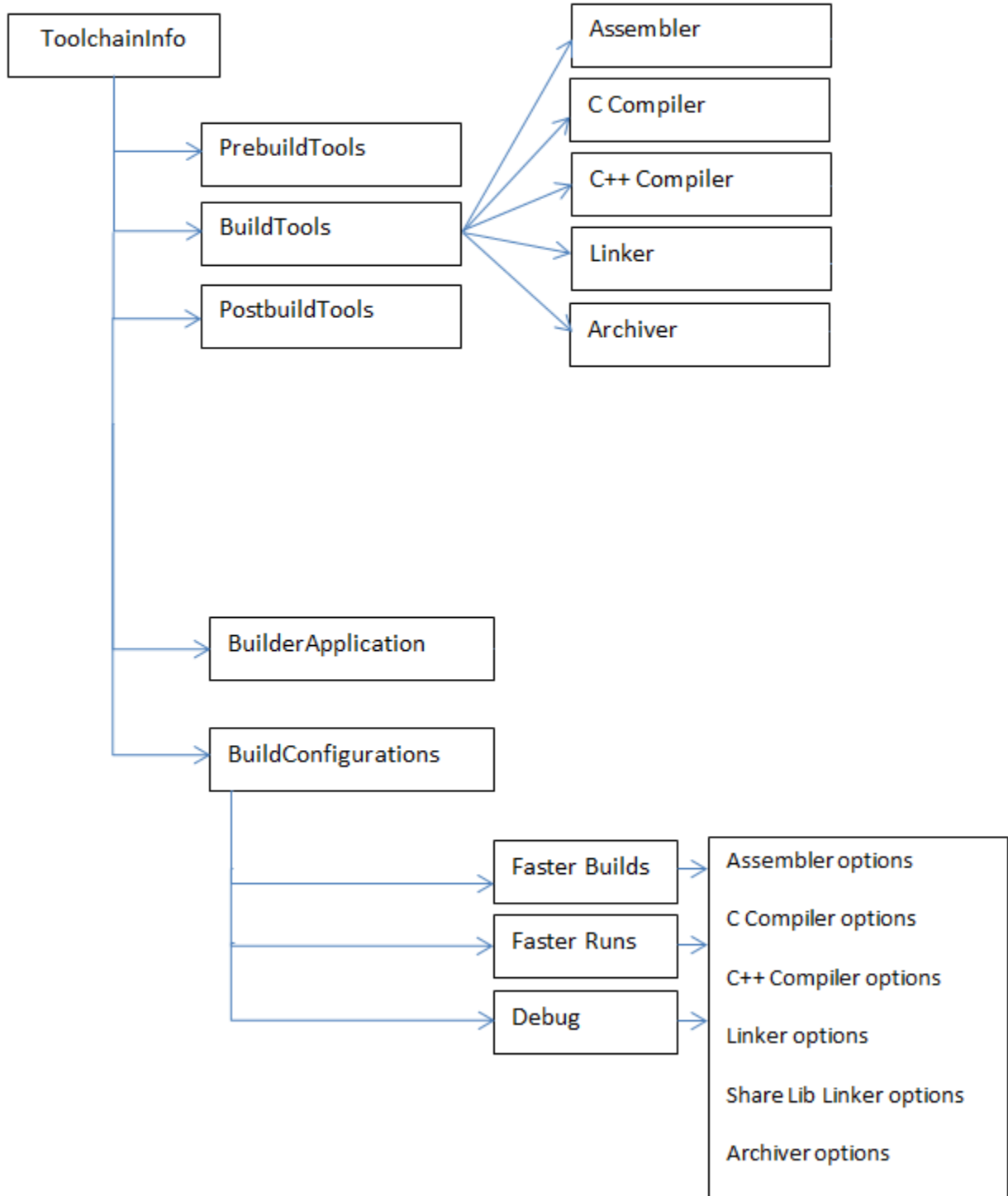
To get toolchain information about defined toolchains, use `coder.make.getDefaultToolchain` and `coder.make.getToolchainInfoFromRegistry`.

A `coder.make.ToolchainInfo` object contains:

- `coder.make.BuildTool` objects that can describe each build tool
- `coder.make.BuildConfiguration` objects that can apply sets of options to the build tools

**ToolchainInfo class & key properties**

**Default build tools and options**



## Construction

`h = coder.make.ToolchainInfo` creates a default `ToolchainInfo` on page 3-74 object and assigns it to a handle, `h`.

The default `ToolchainInfo` object includes `BuildTool` objects and configurations for C, C++, and `gmake`:

- The default value of `SupportedLanguages`, C/C++, adds `BuildTool` and `BuildConfiguration` objects for C and C++ compilers to `ToolchainInfo`.
- The default value of `BuildArtifact`, `gmake`, adds a `BuildTool` object for `gmake` to `ToolchainInfo.BuilderApplication`.

You can use the input arguments (name-value pairs) to override these defaults when you create the `ToolchainInfo` object. Each property is optional. Each property requires a corresponding value. This example overrides the `SupportedLanguages` or `BuildArtifact` defaults.

```
h = coder.make.ToolchainInfo('SupportedLanguages',vLanguages,'BuildArtifact',vArtifact)
```

The default property values for `SupportedLanguages` or `BuildArtifact` can be overridden only during the creation of the toolchain information object. These properties are read-only after object creation.

### Input Arguments

#### **BuildArtifact** — Name of `BuildArtifact` property

The property name. For more information, see the “Properties” on page 3-77 description for `BuildArtifact`.

#### **vArtifact** — Value of `BuildArtifact` property

`gmake` (default) | `gmake makefile` | `nmake` | `nmake makefile`

Values for the `BuildArtifact` property, specified as a character vector.

#### **Name** — Name of `Name` property

The property name. For more information, see the “Properties” on page 3-77 description for `Name`.

#### **vName** — Value of `Name` property

Unique name for the toolchain definition, specified as a character vector. The default value is empty.

#### **Platform** — Name of `Platform` property

The property name. For more information, see the “Properties” on page 3-77 description for `Platform`.

#### **vPlatform** — Value of `Platform` property

`win32` | `glnx86` | `win64` | `glnxa64` | `maci64`

The supported platform, specified as a character vector. The default value is the current platform.



**Revision — Name of Revision property**

The property name. For more information, see the “Properties” on page 3-77 description for Revision.

**vRevision — Value of Revision property**

1.0 (default)

Revision number for ToolchainInfo, specified as a character vector.

**SupportedLanguages — Name of SupportedLanguages property**

The property name. For more information, see the “Properties” on page 3-77 description for SupportedLanguages.

**vLanguages — Value of SupportedLanguages property**

C/C++ (default) | C | C++ | Asm/C | Asm/C/C++ | Asm/C++

Supported language or languages, specified as a character vector.

**SupportedVersion — Name of SupportedVersion property**

The property name. For more information, see the “Properties” on page 3-77 description for SupportedVersion.

**vVersion — Value of SupportedVersion property**

Version of software build tools that ToolchainInfo supports, specified as a character vector. The default value is empty

**Output Arguments****h — ToolchainInfo object handle**

variable

A coder.make.ToolchainInfo on page 3-74 object, specified using an object handle, such as h. To create h, enter `h = coder.make.ToolchainInfo` in a MATLAB Command Window.

**Properties****Attributes — Custom attributes of toolchain**

Custom attributes of the toolchain

Add custom attributes required by the toolchain and specify their default values.

By default, the list of custom attributes is empty.

Attributes returns a `coder.make.util.UnorderedList`.

For example, the `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, defines the following custom attributes:

```
tc.addAttribute('TransformPathsWithSpaces');
tc.addAttribute('RequiresCommandFile');
tc.addAttribute('RequiresBatchFile');
```

To display the `Attributes` list from that example in a MATLAB Command Window, enter:

```
h = intel_tc;
h.Attributes
```

```
ans =
```

```

"Attributes" List

RequiresBatchFile = true
RequiresCommandFile = true
TransformPathsWithSpaces = true
```

Use the following methods with `Attributes`:

- `addAttribute`
- `getAttribute`
- `getAttributes`
- `isAttribute`
- `removeAttribute`

**Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

**BuildArtifact — Type of makefile or build artifact**

The type of makefile (build artifact) MATLAB Coder uses during the software build process.

Initialize this property when you create `coder.make.ToolchainInfo`. Use the default value, `gmake makefile`, or override the default value using a name-value pair argument, as described in “Construction” on page 3-76.

For example:

```
h = coder.make.ToolchainInfo('BuildArtifact', 'nmake');
```

The values can be:

- `'gmake'` or `'gmake makefile'` — The GNU make utility
- `'nmake'` or `'nmake makefile'` — The Windows make utility

For example, to display the value of `BuildArtifact` in a MATLAB Command Window, enter:

```
h = coder.make.ToolchainInfo;
h.BuildArtifact
```

```
ans =
```

```
gmake makefile
```

ToolchainInfo uses the value of the BuildArtifact property to create a BuildTool object for the build artifact in coder.make.ToolchainInfo.BuilderApplication.

The intel\_tc.m file from the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example uses the following line to set the value of BuildArtifact:

```
tc = coder.make.ToolchainInfo('BuildArtifact','nmake makefile');
```

There are no methods to use with BuildArtifact.

### Attributes:

|           |           |
|-----------|-----------|
| GetAccess | public    |
| SetAccess | protected |

### BuildConfigurations — List of build configurations

List of build configurations

Each entry in this list is a coder.make.BuildConfiguration object.

For example, the intel\_tc.m file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to define the build configurations:

```
cfg = tc.getBuildConfiguration('Faster Builds');
cfg.setOption('C Compiler',horzcat(cCompilerOpts,optimsOff0pts));
cfg.setOption('C++ Compiler',horzcat(cppCompilerOpts,optimsOff0pts));
cfg.setOption('Linker',linkerOpts);
cfg.setOption('Shared Library Linker',sharedLinkerOpts);
cfg.setOption('Archiver',archiverOpts);

cfg = tc.getBuildConfiguration('Faster Runs');
cfg.setOption('C Compiler',horzcat(cCompilerOpts,optimsOn0pts));
cfg.setOption('C++ Compiler',horzcat(cppCompilerOpts,optimsOn0pts));
cfg.setOption('Linker',linkerOpts);
cfg.setOption('Shared Library Linker',sharedLinkerOpts);
cfg.setOption('Archiver',archiverOpts);

cfg = tc.getBuildConfiguration('Debug');
cfg.setOption('C Compiler',horzcat(cCompilerOpts,optimsOff0pts,debugFlag.CCompiler));
cfg.setOption('C++ Compiler',horzcat(cppCompilerOpts,optimsOff0pts,debugFlag.CppCompiler));
cfg.setOption('Linker',horzcat(linkerOpts,debugFlag.Linker));
cfg.setOption('Shared Library Linker',horzcat(sharedLinkerOpts,debugFlag.Linker));
cfg.setOption('Archiver',horzcat(archiverOpts,debugFlag.Archiver));

tc.setBuildConfigurationOption('all','Make Tool','-f $(MAKEFILE)');
```

To display the BuildConfigurations list from that example in a MATLAB Command Window, enter:

```
h = intel_tc;
h.BuildConfigurations

ans =

"BuildConfigurations" List

Debug = <coder.make.BuildConfiguration>
Faster Builds = <coder.make.BuildConfiguration>
Faster Runs = <coder.make.BuildConfiguration>
```

Use the following methods with BuildConfigurations:

- `getBuildConfiguration`
- `removeBuildConfiguration`
- `setBuildConfiguration`

**Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

**BuildTools — List of build tools in toolchain**

The list of build tools in the toolchain.

Each entry in this list is a `coder.make.BuildTool` object.

When you initialize `ToolchainInfo`, the `SupportedLanguages` property determines which build tools are created in `BuildTools`. For more information, see `SupportedLanguages` or “Construction” on page 3-76.

The `BuildTool` objects `ToolchainInfo` can create based on the `SupportedLanguages` are:

- Assembler
- C Compiler
- C++ Compiler
- Linker
- Archiver

For example, the `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to get and update one of the `BuildTool` objects:

```
% -----
% C Compiler
% -----

tool = tc.getBuildTool('C Compiler');

tool.setName('Intel C Compiler');
tool.setCommand('icl');
tool.setPath('');

tool.setDirective('IncludeSearchPath', '-I');
tool.setDirective('PreprocessorDefine', '-D');
tool.setDirective('OutputFlag', '-Fo');
tool.setDirective('Debug', '-Zi');

tool.setFileExtension('Source', '.c');
tool.setFileExtension('Header', '.h');
tool.setFileExtension('Object', '.obj');

tool.setCommandPattern('|>TOOL<| |>TOOL_OPTIONS<| |>OUTPUT_FLAG<|>OUTPUT<|');
```

To display the `BuildTools` list from that example in a MATLAB Command Window, enter:

```
h = intel_tc;
h.BuildTools
```

```
ans =
```

```

"BuildTools" List

C Compiler = <coder.make.BuildTool>
C++ Compiler = <coder.make.BuildTool>
Archiver = <coder.make.BuildTool>
Linker = <coder.make.BuildTool>
MEX Tool = <coder.make.BuildTool>
```

Use the following methods with `BuildTools`:

- `addBuildTool`
- `getBuildTool`
- `removeBuildTool`
- `setBuildTool`

#### Attributes:

```
GetAccess public
SetAccess public
```

#### BuilderApplication — Properties of build tool

Properties of the build tool that runs the makefile or build artifact

`ToolchainInfo` uses the value of the `BuildArtifact` property to create a `BuildTool` object for `coder.make.ToolchainInfo.BuilderApplication`, as described in “Construction” on page 3-76.

For example, the `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process”, uses the following lines to set the `BuildArtifact` and update `BuilderApplication` objects:

```
h = coder.make.ToolchainInfo('BuildArtifact','nmake');
```

To display the value of `BuilderApplication` from that example in a MATLAB Command Window, enter:

```
h.BuilderApplication
```

```
ans =
#####
Build Tool: NMAKE Utility
#####
Language : ''
OptionsRegistry : {'Make Tool','MAKE_FLAGS'}
InputFileExtensions : {}
OutputFileExtensions : {}
DerivedFileExtensions : {}
SupportedOutputs : {'*'}
CommandPattern : '|>TOOL<| |>TOOL_OPTIONS<|'

Command

MAKE = nmake
MAKE_PATH =

Directives
```

```

Comment = #
DeleteCommand = @del
DisplayCommand = @echo
FileSeparator = \
ImpliedFirstDependency = $<
ImpliedTarget = $@
IncludeFile = !include
LineContinuation = \
MoveCommand = @mv
ReferencePattern = \$\($1\)
RunScriptCommand = @cmd /C

File Extensions

Makefile = .mk

```

Use the `setBuilderApplication` method with `BuilderApplication`.

#### Attributes:

```

GetAccess public
SetAccess public

```

#### InlinedCommands — Commands toolchain needs to inline within generated makefile

Commands the toolchain needs to inline within the generated makefile

Specify inlined commands to insert verbatim into the makefile. The default value is empty.

The datatype is character vector.

For example, to display and then update the value of the `InlinedCommands` property, use the MATLAB Command Window to enter:

```

h.InlinedCommands

ans =

 ''

h.InlinedCommands = '!include <ntwin32.mak>';
h.InlinedCommands

!include <ntwin32.mak>

```

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the `InlinedCommands` property.

There are no methods to use with `InlinedCommands`.

#### Attributes:

```

GetAccess public
SetAccess public

```

#### MATLABCleanup — MATLAB cleanup commands

MATLAB cleanup commands

Specify MATLAB commands or scripts to perform cleanup routines specific to this toolchain. Use commands or scripts that can be invoked from the MATLAB Command Window. The default value is empty.

The datatype is a cell array of character vectors.

For example, to display and then update the value of the `MATLABSetup` and `MATLABCleanup` properties, use the MATLAB Command Window to enter:

```
h = coder.make.ToolchainInfo;
h.MATLABSetup;
h.MATLABCleanup;
h.MATLABSetup{1} = sprintf('if ispc \n origTMP=getenv(''TMP''); \n setenv(''TMP'', 'C:\\TEMP');\nend');
h.MATLABCleanup{1} = sprintf('if ispc \n setenv(''TMP'',origTMP); \nend');
```

The following list illustrates where this property fits in the sequence of operations :

- 1 MATLAB Setup
- 2 Shell Setup
- 3 Prebuild
- 4 Build (assembler, compilers, linker, archiver)
- 5 Postbuild
- 6 Shell Cleanup
- 7 MATLAB Cleanup

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the `MATLABCleanup` property.

There are no methods to use with `MATLABCleanup`.

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

#### MATLABSetup — MATLAB setup commands

MATLAB setup commands

Specify MATLAB commands or scripts to perform setup routines specific to this toolchain. Use commands or scripts that can be invoked from the MATLAB Command Window. The default value is empty.

The datatype is a cell array of character vectors.

For example, to display and then update the value of the `MATLABSetup` and `MATLABCleanup` properties, use the MATLAB Command Window to enter:

```
h = coder.make.ToolchainInfo;
h.MATLABSetup;
h.MATLABCleanup;
h.MATLABSetup{1} = sprintf('if ispc \n origTMP=getenv(''TMP''); \n setenv(''TMP'', 'C:\\TEMP');\nend');
h.MATLABCleanup{1} = sprintf('if ispc \n setenv(''TMP'',origTMP); \nend');
```

The following list illustrates where this property fits in the sequence of operations :

- 1 MATLAB Setup
- 2 Shell Setup
- 3 Prebuild
- 4 Build (assembler, compilers, linker, archiver)
- 5 Postbuild
- 6 Shell Cleanup
- 7 MATLAB Cleanup

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the `MATLABSetup` property.

There are no methods to use with `MATLABCleanup`.

#### Attributes:

```
GetAccess public
SetAccess public
```

#### Macros — List of custom macros

List of custom macros that contains macro names and values

The list is a `coder.make.util.OrderedList` of `coder.make.BuildItem` objects.

By default this list is empty. For example:

```
h = coder.make.ToolchainInfo;
h.Macros
```

```
ans =
```

```

"Macros" List

(empty)
```

`ToolchainInfo` uses macros in two ways:

- It writes macros that are used by the current build to the makefile as variables. For example:

```
TI_INSTALL = C:\Program Files\CCSv4
TI_C2000_TOOLS = $(TI_INSTALL)\tools\compiler\c2000\bin
```

- When the custom toolchain has been registered, `validate` expands the complete path provided by a macro, including macros contained within macros. For example, when `ToolchainInfo` validates the path in the following compiler information, it expands both `TI_C2000_TOOLS` and `TI_INSTALL`:

```
Command = 'cl2000'
Path = '$(TI_C2000_TOOLS)'
```

The default value of `Macros` is an empty list.

The datatype is `coder.make.util.OrderedList` of `coder.make.BuildItem` objects.



For example, the `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process” uses the following lines to add macros to `Macros`:

```
% -----
% Macros
% -----
tc.addMacro('MW_EXTERNLIB_DIR', ['$ (MATLAB_ROOT)\extern\lib\' tc.Platform \'microsoft']);
tc.addMacro('MW_LIB_DIR', ['$ (MATLAB_ROOT)\lib\' tc.Platform]);
tc.addMacro('CFLAGS_ADDITIONAL', '-D_CRT_SECURE_NO_WARNINGS');
tc.addMacro('CPPFLAGS_ADDITIONAL', '-EHs -D_CRT_SECURE_NO_WARNINGS');
tc.addMacro('LIBS_TOOLCHAIN', '$(conlibs)');
tc.addMacro('CVARSFLAG', '');

tc.addIntrinsicMacros({'ldebug', 'conflags', 'cflags'});
```

With that example, to see the corresponding property values in a MATLAB command window, enter:

```
h = intel_tc;
h.Macros
```

```
ans =
```

```

"Macros" List

MW_EXTERNLIB_DIR = $(MATLAB_ROOT)\extern\lib\win64\microsoft
MW_LIB_DIR = $(MATLAB_ROOT)\lib\win64
CFLAGS_ADDITIONAL = -D_CRT_SECURE_NO_WARNINGS
CPPFLAGS_ADDITIONAL = -EHs -D_CRT_SECURE_NO_WARNINGS
LIBS_TOOLCHAIN = $(conlibs)
CVARSFLAG =
ldebug =
conflags =
cflags =
```

Use the following methods with this property:

- `addMacro`
- `getMacro`
- `removeMacro`
- `setMacro`
- `addIntrinsicMacros`
- `removeIntrinsicMacros`

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

#### Name — Unique name for toolchain definition

Unique name for the toolchain definition

Specify the full name of the toolchain. This name also appears as one of the **Toolchain** parameter options on the **Hardware** tab of the project build settings. The default value is empty. The recommended format is:

```
name version | build artifact (platform)
```

The data type is character vector.

For example, the `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process” provides a line that defines the value of `Name`. To see the property value, in the Command Window, enter:

```
h = intel_tc;
h.Name
```

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

#### Platform — Specify supported platform

Specify the supported platform

Specify the platform upon which the toolchain will be used. The default value is the current platform. Supported values are `win32`, `win64`, `maci64`, and `glnxa64`.

Create a separate `ToolchainInfo` for each platform.

The datatype is character vector.

This property does not have any associated methods. Assign the value directly to the `Platform`.

For example, the `intel_tc.m` file from “Add Custom Toolchains to MATLAB® Coder™ Build Process” uses the following line to define the value of `Platform`:

```
tc.Platform = 'win64';
```

With that example, to see the corresponding property values in a MATLAB Command Window, enter:

```
h = intel_tc;
h.Platform
```

```
ans =
```

```
win64
```

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

#### PostbuildTools — List of tools used after linker archiver

The list of tools used after the linker/archiver are invoked.

The list is a `coder.make.util.OrderedList` of `coder.make.BuildTool` objects.

To see the corresponding property values in the MATLAB Command Window, enter:

```
h = coder.make.ToolchainInfo;
h.PostbuildTools
```

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the `PostbuildTools` property.

Use the following methods with this property:

- `addPostbuildTool`
- `getPostbuildTool`
- `removePostbuildTool`
- `setPostbuildTool`

### **PrebuildTools — List of tools used before compiling source files**

The list of tools used before compiling the source files into object files.

The list is a `coder.make.util.OrderedList` of `coder.make.BuildTool` objects.

By default this list is empty. For example:

```
h.PrebuildTools
```

```
ans =
```

```

"PrebuildTools" List

(empty)
```

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the `PrebuildTools` property.

Use the following methods with this property:

- `addPrebuildTool`
- `getPrebuildTool`
- `removePrebuildTool`
- `setPrebuildTool`

### **Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

### **Revision — Assign revision number to ToolchainInfo**

Assign revision number to `ToolchainInfo` on page 3-74

The author of the toolchain definition file can use this information to differentiate one version of the file from another. The default value is `1.0`.

The datatype is character vector.

This property does not have any associated methods. Assign the value directly to the `Revision`.

For example:

```
h.Revision
```

```
ans =
```

```
1.0
```

```
h.Revision = '2.0';
h.Revision
```

```
ans =
```

```
2.0
```

#### **Attributes:**

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

#### **ShellCleanup — Shell scripts that clean up toolchain**

Shell scripts that clean up the toolchain

Specify shell commands or scripts to perform cleanup routines specific to this toolchain. Use commands or scripts that can be invoked from the system command environment. The default value is empty.

The datatype is a cell array of character vectors. Each character vector is a shell cleanup command.

If `ToolchainInfo` invokes a setup routine, you can use a corresponding set of cleanup routines to restore the system environment to its original settings. For example, if a setup routine added environment variables and folders to the system path, you can use a cleanup routine to remove them.

For example:

```
>> h.ShellCleanup
```

```
ans =
```

```
 []
```

```
>> h.ShellCleanup = 'call "cleanup_mssdk71.bat"';
```

```
>> h.ShellCleanup
```

```
ans =
```

```
 'call "cleanup_mssdk71.bat"'
```

The following list illustrates where this property fits in the sequence of operations :

- 1 MATLAB Setup
- 2 Shell Setup
- 3 Prebuild
- 4 Build (assembler, compilers, linker, archiver)
- 5 Postbuild
- 6 Shell Cleanup
- 7 MATLAB Cleanup

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the `ShellCleanup` property.

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

#### ShellSetup — Shell scripts that set up toolchain

Shell scripts that set up the toolchain

Specify shell commands or scripts to perform setup routines specific to this toolchain. Use commands or scripts that can be invoked from the system command environment. The default value is empty.

The datatype is a cell array of character vectors. Each character vector is a shell setup command.

If `ToolchainInfo` invokes a setup routine, you can use a corresponding set of cleanup routines to restore the system environment to its original settings. For example, if a setup routine added environment variables and folders to the system path, you can use a cleanup routine to remove them.

For example:

```
>> h.ShellSetup

ans =

 []

>> h.ShellSetup = 'call "setup_mssdk71.bat"';

>> h.ShellSetup

ans =

 'call "setup_mssdk71.bat"'
```

The `intel_tc.m` file in “Add Custom Toolchains to MATLAB® Coder™ Build Process” uses the following lines to set the value of `ShellSetup`:

```
% -----
% Setup
% -----
% Below we are using %ICPP_COMPILER12% as root folder where Intel Compiler is
% installed. You can either set an environment variable or give full path to the
```

```
% compilervars.bat file
tc.ShellSetup{1} = 'call %ICPP_COMPILER12%\bin\compilervars.bat intel64';
```

With that example, to see the corresponding property values in the MATLAB Command Window, enter:

```
h = intel_tc;
h.ShellSetup
```

```
ans =
```

```
'call %ICPP_COMPILER12%\bin\compilervars.bat intel64'
```

The following list illustrates where this property fits in the sequence of operations :

- 1 MATLAB Setup
- 2 Shell Setup
- 3 Prebuild
- 4 Build (assembler, compilers, linker, archiver)
- 5 Postbuild
- 6 Shell Cleanup
- 7 MATLAB Cleanup

#### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

#### SupportedLanguages — Create BuildTool objects for specific languages

Create BuildTool objects for specific languages

Initializing ToolchainInfo creates BuildTool objects for the language or set of languages specified by SupportedLanguages on page 3-90.

If you do not specify a value for SupportedLanguages on page 3-90, the default value is 'C/C++'. This adds BuildTool objects for a C compiler and a C++ compiler to the other BuildTool objects in ToolchainInfo on page 3-74.

To override the default, use a name-value pair to specify a value for SupportedLanguages on page 3-90 when you initialize ToolchainInfo on page 3-74. For example:

```
h = coder.make.ToolchainInfo('SupportedLanguages', 'C');
```

The value can be: 'C', 'C++', 'C/C++', 'Asm/C', 'Asm/C++', or 'Asm/C/C++'.

The SupportedLanguages on page 3-90 property does not have any related methods.

The “Add Custom Toolchains to MATLAB® Coder™ Build Process” example does not include the SupportedLanguages on page 3-90 property.

#### Attributes:

|           |           |
|-----------|-----------|
| GetAccess | public    |
| SetAccess | protected |

### **SupportedVersion — Version of software build tools that ToolchainInfo supports**

The version of the software build tools ToolchainInfo supports.

The default value is empty.

The datatype is character vector.

This property does not have any associated methods. Assign the value directly to the **SupportedVersion**.

With the “Add Custom Toolchains to MATLAB® Coder™ Build Process” example, the value of **SupportedVersion** is defined in the `intel_tc.m` toolchain definition file:

```
tc.SupportedVersion = '12.1';
```

With that example, to see the corresponding property values in the MATLAB command window, enter:

```
h = intel_tc;
h.SupportedVersion
```

```
ans =
```

```
12.1
```

### **Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

## Methods

|                                          |                                                                                                        |
|------------------------------------------|--------------------------------------------------------------------------------------------------------|
| <code>addAttribute</code>                | Add custom attribute to <code>Attributes</code>                                                        |
| <code>addBuildConfiguration</code>       | Add build configuration                                                                                |
| <code>addBuildTool</code>                | Add <code>BuildTool</code> object to <code>BuildTools</code>                                           |
| <code>addIntrinsicMacros</code>          | Add intrinsic macro to <code>Macros</code>                                                             |
| <code>addMacro</code>                    | Add macro to <code>Macros</code>                                                                       |
| <code>addPostbuildTool</code>            | Add postbuild tool to <code>PostbuildTools</code>                                                      |
| <code>addPostDownloadTool</code>         | Add post-download tool to <code>PostDownloadTool</code>                                                |
| <code>addPostExecuteTool</code>          | Add post-execute tool to <code>PostbuildTools</code>                                                   |
| <code>addPrebuildTool</code>             | Add prebuild tool to <code>PrebuildTools</code>                                                        |
| <code>cleanup</code>                     | Run cleanup commands                                                                                   |
| <code>getAttribute</code>                | Get value of attribute                                                                                 |
| <code>getAttributes</code>               | Get list of attribute names                                                                            |
| <code>getBuildConfiguration</code>       | Get handle for build configuration object                                                              |
| <code>getBuildTool</code>                | Get <code>BuildTool</code> object                                                                      |
| <code>getMacro</code>                    | Get value of macro                                                                                     |
| <code>getPostbuildTool</code>            | Get postbuild <code>BuildTool</code> object                                                            |
| <code>getPrebuildTool</code>             | Get prebuild <code>BuildTool</code> object                                                             |
| <code>getSupportedLanguages</code>       | Get list of supported languages                                                                        |
| <code>isAttribute</code>                 | Determine if attribute exists                                                                          |
| <code>removeAttribute</code>             | Remove attribute                                                                                       |
| <code>removeBuildConfiguration</code>    | Remove build configuration                                                                             |
| <code>removeBuildTool</code>             | Remove <code>BuildTool</code> object from <code>BuildTools</code>                                      |
| <code>removeIntrinsicMacros</code>       | Remove intrinsic macro                                                                                 |
| <code>removeMacro</code>                 | Remove macro from <code>Macros</code>                                                                  |
| <code>removePostbuildTool</code>         | Remove postbuild build tool                                                                            |
| <code>removePrebuildTool</code>          | Remove prebuild build tool                                                                             |
| <code>setBuildConfiguration</code>       | Set value of specified build configuration                                                             |
| <code>setBuildConfigurationOption</code> | Sets value of build tool options for build configuration                                               |
| <code>setBuilderApplication</code>       | Update builder application to work on specific platform                                                |
| <code>setBuildTool</code>                | Assign <code>BuildTool</code> object to named build tool in <code>BuildTools</code>                    |
| <code>setMacro</code>                    | Set value of macro                                                                                     |
| <code>setPostbuildTool</code>            | Assign <code>BuildTool</code> object to <code>PostbuildTool</code> tool in <code>PostbuildTools</code> |
| <code>setPrebuildTool</code>             | Assign <code>BuildTool</code> object to named <code>PrebuildTool</code> in <code>PrebuildTools</code>  |
| <code>setup</code>                       | Invoke toolchain setup commands specified by <code>MATLABSetup</code> and <code>ShellSetup</code>      |
| <code>validate</code>                    | Validate toolchain                                                                                     |



## See Also

[coder.make.getDefaultToolchain](#) | [coder.make.getToolchainInfoFromRegistry](#) | [coder.make.BuildConfiguration](#) | [coder.make.BuildItem](#) | [coder.make.BuildTool](#)

## Topics

[“Add Custom Toolchains to MATLAB® Coder™ Build Process”](#)  
[“About coder.make.ToolchainInfo”](#)

## target Package

Manage target hardware information

### Description

Use these classes to manage target hardware information. For example, register new target hardware for code generation or set up target connectivity for external mode and processor-in-the-loop (PIL) simulations.

### Classes

|                               |                                                   |
|-------------------------------|---------------------------------------------------|
| target.Alias                  | Create alternative identifier for target object   |
| target.LanguageImplementation | Provide C and C++ compiler implementation details |
| target.Object                 | Base class for target types                       |
| target.Processor              | Provide target processor information              |

### Functions

|                |                                                  |
|----------------|--------------------------------------------------|
| target.add     | Add target object to internal database           |
| target.create  | Create target object                             |
| target.export  | Export target object data                        |
| target.get     | Retrieve target objects from internal database   |
| target.remove  | Remove target object from internal database      |
| target.upgrade | Upgrade existing definitions of hardware devices |

### See Also

#### Topics

“Register New Hardware Devices”

**Introduced in R2019a**

# target.add

**Package:** target

Add target object to internal database

## Syntax

```
objectsAdded = target.add(targetObject)
objectsAdded = target.add(targetObject, Name, Value)
```

## Description

`objectsAdded = target.add(targetObject)` adds the specified target object to an internal database and returns a vector that contains the added objects. By default, the target data is available only for the current MATLAB session.

`objectsAdded = target.add(targetObject, Name, Value)` uses name-value arguments to controls persistence over MATLAB sessions and command-line output.

## Examples

### Specify Hardware Implementation

To specify a hardware implementation that persists over MATLAB sessions, use the `target.create` and `target.add` functions.

```
myLangImp = target.create('LanguageImplementation', ...
 'Name', 'MyLanguageImplementation', ...
 'Copy', 'ARM Compatible-ARM Cortex');

myProc = target.create('Processor', 'Name', 'MyProcessor');
myProc.LanguageImplementations = myLangImp;
objectsAdded = target.add(myProc, ...
 'UserInstall', true, ...
 'SuppressOutput', true);
```

## Input Arguments

### targetObject — Target object

object

Specify the target object that you want to add to the internal database.

Example: `target.add(myTargetObject)`;

### Name-Value Pair Arguments

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `target.add(myTargetObject, 'UserInstall', true);`

### **UserInstall — Target data persistence**

false (default) | true

Control persistence of target data in an internal database:

- `true` -- Target data persists in internal database over multiple MATLAB sessions.
- `false` -- Target data is in internal database only for the current MATLAB session.

Example: `target.add(myTargetObject, 'UserInstall', true);`

Data Types: `logical`

### **SuppressOutput — Control command-line output**

false (default) | true

Control command-line output of function:

- `true` -- Suppress command-line output from the function.
- `false` -- Provide information about the objects that the function adds to internal database.

Example: `target.add(myTargetObject, 'SuppressOutput', true);`

Data Types: `logical`

## **Output Arguments**

### **objectsAdded — Objects added**

object vector

Target objects that the function adds to internal database.

## **See Also**

`target.create` | `target.get` | `target.remove`

### **Topics**

“Register New Hardware Devices”

**Introduced in R2019a**

# target.Alias class

**Package:** target

Create alternative identifier for target object

## Description

Use the `target.Alias` class to create alternative identifiers for target objects. For example, if a target object has a long class identifier, you can create a `target.Alias` object that provides a short identifier for the target object.

To create a `target.Alias` object, use the `target.create` function.

## Properties

### Name — Alternative identifier

character vector | string

Alternative identifier for target object.

#### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

### For — Target object

object

Original target object.

#### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

## Examples

### Create Short Identifier for Target Object

For an example that uses this class, see “Create Alternative Identifier for Target Object”.

## See Also

`target.create`

## Topics

“Register New Hardware Devices”

**Introduced in R2019a**

## target.create

**Package:** target

Create target object

### Syntax

```
targetObject = target.create(targetType)
targetObject = target.create(targetType,Name,Value)
```

### Description

`targetObject = target.create(targetType)` creates and returns an object of the specified class.

`targetObject = target.create(targetType,Name,Value)` configures the object using one or more name-value arguments.

### Examples

#### Create New Hardware Implementation

For workflow examples that use this function, see:

- “Specify Hardware Implementation for New Device”
- “Create Hardware Implementation by Modifying Existing Implementation”
- “Create Hardware Implementation by Reusing Existing Implementation”

### Input Arguments

#### targetType — Target type

character vector | string

Specify class of object. For example, specifying:

- 'Processor' creates a `target.Processor` object.
- 'LanguageImplementation' creates a `target.LanguageImplementation` object.
- 'Alias' creates a `target.Alias` object.

For the full list of supported types, see `target`.

Example: 'Processor'

#### Name-Value Pair Arguments

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

```
Example: myProc = target.create('Processor', 'Name', 'myProcessor',
 'Manufacturer', 'myProcessorManufacturer');
```

### **Copy – Copy existing target feature object**

character vector | string

Create a target object by copying values from an existing target object. For example:

```
myLangImp = target.create('LanguageImplementation', ...
 'Name', 'myLanguageImplementation', ...
 'Copy', 'ARM Compatible-ARM Cortex');
```

### **propertyName – Property name**

character vector | string

Create the target object with properties that are set to values that you specify.

## **Output Arguments**

### **targetObject – Target object**

object

The object that is created and returned. For example, the object is a:

- `target.Processor` object if `targetType` is `'Processor'`
- `target.LanguageImplementation` object if `targetType` is `'LanguageImplementation'`
- `target.Alias` object if `targetType` is `'Alias'`

## **See Also**

`target.add` | `target.get` | `target.remove`

### **Topics**

“Register New Hardware Devices”

### **Introduced in R2019a**

## target.export

**Package:** target

Export target object data

### Syntax

```
target.export(targetObject)
target.export(targetObject,Name,Value)
```

### Description

`target.export(targetObject)` exports the specified target object data to a MATLAB function, `registerTargets.m`. Use the generated file to share target feature data between sessions and computers. When you run `registerTargets.m`, it recreates the target object and adds the object to an internal database.

`target.export(targetObject,Name,Value)` exports the specified target object data using one or more name-value pair arguments.

### Examples

#### Share Hardware Device Data

You can share hardware device data across computers and users.

Specify two hardware devices.

```
langImp1 = target.create('LanguageImplementation', ...
 'Name', 'MyLanguageImplementation1', ...
 'Copy', 'ARM Compatible-ARM Cortex');
```

```
langImp2 = target.create('LanguageImplementation', ...
 'Name', 'MyLanguageImplementation2', ...
 'Copy', 'Atmel-AVR');
```

```
myProc1 = target.create('Processor','Name','MyProcessor1');
myProc1.LanguageImplementations = [langImp1, langImp2];
objectsAdded1 = target.add(myProc1, ...
 'UserInstall',true, ...
 'SuppressOutput',true);
```

```
myProc2 = target.create('Processor','Name','MyProcessor2');
objectsAdded2 = target.add(myProc2, ...
 'UserInstall',true, ...
 'SuppressOutput',true);
```

Run the `target.export` function.

```
target.export([myProc1, myProc2], 'FileName', 'exportMyProcFunction')
```



The function generates `exportMyProcFunction.m` in the current working folder. Use the generated function to share hardware device data across computers and users. For example, on another computer, run this command:

```
addedObjects = exportMyProcFunction;
```

The generated function recreates and adds the objects to an internal database.

If you want the hardware device data to persist over MATLAB sessions, run:

```
addedObjects = exportMyProcFunction('UserInstall',true);
```

## Input Arguments

### **targetObject** – Target object

object vector

Specify the target objects that you want to export.

Example: `target.export(myTargetObject);`

### **Name-Value Pair Arguments**

Specify optional comma-separated pairs of **Name**, **Value** arguments. **Name** is the argument name and **Value** is the corresponding value. **Name** must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1, Value1, ..., NameN, ValueN`.

Example: `target.export(myTargetObject, 'FileName', 'exportMyTargetFn');`

### **FileName** – File name

character vector | string

Specify name of MATLAB function file that contains exported target data.

### **Overwrite** – Overwrite flag

false (default) | true

- `true` -- Overwrite MATLAB function file if it exists.
- `false` -- Generate error if MATLAB function file exists. File is not overwritten.

## See Also

`target.add` | `target.create`

## Topics

“Register New Hardware Devices”

## Introduced in R2019b

## target.get

**Package:** target

Retrieve target objects from internal database

### Syntax

```
targetObject = target.get(targetType, targetObjectId)
tFOList = target.get(targetType)
tFOList = target.get(targetType, Name, Value)
```

### Description

`targetObject = target.get(targetType, targetObjectId)` retrieves a target object from an internal database.

`tFOList = target.get(targetType)` returns a list of *targetType* objects that are stored in the internal database.

`tFOList = target.get(targetType, Name, Value)` returns a list of *targetType* objects that have properties that match the name-value pairs.

### Examples

#### Remove Target Object

This example shows how you can remove a `target.LanguageImplementation` object associated with an object identifier, *myLanguageImplementationID*.

Retrieve the object from the internal database.

```
objectToRemove = target.get('LanguageImplementation', myLanguageImplementationID);
```

Remove the object.

```
target.remove(objectToRemove);
```

#### Create Board Description

This example shows how to create a `target.Board` object that provides MATLAB with a description of processor attributes. It uses `target.get` to retrieve the description of a supported processor.

Create a board object.

```
hostTarget = target.create('Board', 'Name', 'Host Intel processor');
```

Specify the processor for the board by reusing a supported processor.

```
hostTarget.Processors = target.get('Processor', ...
 'Intel-x86-64 (Linux 64)');
```

## Input Arguments

### targetType — Target type

character vector | string

Specify the class of the object that you want to retrieve. For example, to retrieve:

- A `target.Processor` object, specify `'Processor'`.
- A `target.LanguageImplementation` object, specify `'LanguageImplementation'`.

For the list of supported classes, see `target` Package.

### targetObjectId — Target object identifier

character vector | string

Specify the unique identifier of the object that you want to retrieve, that is, the `Id` property value of the object.

## Output Arguments

### targetObject — Target object

object

Retrieved target object. For example:

- If `targetType` is `'Processor'`, the returned object is a `target.Processor` object.
- If `targetType` is `'LanguageImplementation'`, the returned object is a `target.LanguageImplementation` object.

For the list of supported classes, see `target` Package.

### tF0List — Target object list

object vector

List of retrieved target objects.

## See Also

`target.add` | `target.create` | `target.remove`

### Topics

“Register New Hardware Devices”

### Introduced in R2019a

## target.LanguageImplementation class

**Package:** target

Provide C and C++ compiler implementation details

### Description

Use the `target.LanguageImplementation` class to provide implementation details about the C and C++ compiler for your target hardware. For example, byte ordering.

To create a `target.LanguageImplementation` object, use the `target.create` function.

### Properties

#### AtomicFloatSize — Largest atomic float size

integer

Size in bits of the largest floating-point data type that you can atomically load and store on the hardware

##### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

Data Types: int32

#### AtomicIntegerSize — Largest atomic integer size

integer

Size in bits of the largest integer that you can atomically load and store on the hardware

##### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

Data Types: int32

#### Endianness — Byte ordering

'Little' (default) | 'Big' | 'Unspecified'

Byte ordering implemented by target hardware.

##### Attributes:

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

#### DataTypes — Data type definitions

target.DataTypes object

Provides C and C++ data type definitions through properties described in this table.



**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

Data Types: int32

**Examples****Create New Hardware Implementation**

For examples that use this class, see:

- “Specify Hardware Implementation for New Device”
- “Create Hardware Implementation by Modifying Existing Implementation”
- “Create Hardware Implementation by Reusing Existing Implementation”

**See Also**

target.Processor | target.create

**Topics**

“Register New Hardware Devices”

**Introduced in R2019a**

# target.Object class

**Package:** target

Base class for target types

## Description

target.Object is an abstract base class that enables target types to inherit common functionality.

### Class Attributes

|                  |      |
|------------------|------|
| Abstract         | true |
| HandleCompatible | true |

For information on class attributes, see “Class Attributes”.

## Properties

### IsValid — Data validity

true | false

- true if object passes validation procedure.
- false otherwise.

### Attributes:

|           |         |
|-----------|---------|
| GetAccess | public  |
| SetAccess | private |

Data Types: logical

## Methods

### Public Methods

validate Validate data integrity of target feature object

## Examples

### Validate Hardware Device Data

For an example that uses this class, see “Validate Hardware Device Data”.

## See Also

### Topics

“Register New Hardware Devices”

**Introduced in R2019b**

## validate

**Class:** target.Object

**Package:** target

Validate data integrity of target feature object

### Syntax

```
myTargetFeature.validate()
```

### Description

`myTargetFeature.validate()` runs a procedure to validate the data integrity of the object *myTargetFeature*. If the validation procedure fails, the method produces an error.

### Examples

#### Validate Hardware Device Data

For an example that uses this method, see “Validate Hardware Device Data”.

### See Also

#### Topics

“Register New Hardware Devices”

#### Introduced in R2019b



# target.Processor class

**Package:** target

Provide target processor information

## Description

Use the `target.Processor` class to provide information about your target processor. For example, name, manufacturer, and language implementation.

To create a `target.Processor` object, use the `target.create` function.

## Properties

### Id — Object identifier

character vector | string

The object identifier is the hyphenated combination of the `Manufacturer` and `Name` property values. If the `Manufacturer` property is empty, the object identifier is the `Name` property value.

#### Attributes:

|                        |                      |
|------------------------|----------------------|
| <code>GetAccess</code> | <code>public</code>  |
| <code>SetAccess</code> | <code>private</code> |

### LanguageImplementations — Language implementation

object

Associated `target.LanguageImplementation` object.

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

### Name — Processor name

character vector | string

Name of the target processor.

Example: 'Cortex-A53'

#### Attributes:

|                        |                     |
|------------------------|---------------------|
| <code>GetAccess</code> | <code>public</code> |
| <code>SetAccess</code> | <code>public</code> |

### Manufacturer — Processor manufacturer

character vector | string

Optional description of the target processor manufacturer.

Example: 'ARM Compatible'

**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

**Timers – Timers**

target.Counter object array

Provide timer information.

**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

**Overheads – Profiling instrumentation overheads**

vector

Specify instrumentation overhead values for removal from execution-time measurements.

**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

**NumberOfCores – Processor cores**

1 (default) | scalar

Number of physical cores in processor.

**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

Data Types: uint

**NumberOfThreadsPerCore – Threads per processor core**

1 (default) | scalar

Number of threads per processor core.

**Attributes:**

|           |        |
|-----------|--------|
| GetAccess | public |
| SetAccess | public |

Data Types: uint

**NumberOfLogicalCores – Logical cores**

scalar

Number of logical cores that processor provides, which is equal to NumberOfCores x NumberOfThreadsPerCore.

**Attributes:**

|           |         |
|-----------|---------|
| GetAccess | public  |
| SetAccess | private |

Data Types: uint

**Examples****Create New Hardware Implementation**

For examples that use this class, see:

- “Specify Hardware Implementation for New Device”
- “Create Hardware Implementation by Modifying Existing Implementation”
- “Create Hardware Implementation by Reusing Existing Implementation”

**Create Timer Object**

This example shows how you can create a timer object for your development computer.

Create the function signature for a timer. In this example, the function returns a uint64 data type and the function name `timestamp_x86`.

```
timerSignature = target.create('Function');
timerSignature.Name = 'timestamp_x86';
timerSignature.ReturnType = 'uint64';
```

Capture the function in an API object.

```
timerApi = target.create('API');
timerApi.Functions = timerSignature;
timerApi.Language = target.Language.C;
timerApi.Name = 'Linux Timer API';
```

Capture the dependencies of the function, that is, the source and header files that are required to run the function.

```
timerDependencies = target.create('BuildDependencies');
timerDependencies.IncludeFiles = {'host_timer_x86.h'};
timerDependencies.IncludePaths = ...
 {'$(MATLAB_ROOT)/toolbox/coder/profile/src'};
timerDependencies.SourceFiles = {'host_timer_x86.c'};
```

Create an object that combines the API and dependencies.

```
timerImplementation = target.create('APIImplementation');
timerImplementation.API = timerApi;
timerImplementation.BuildDependencies = timerDependencies;
timerImplementation.Name = 'Linux Timer Implementation';
```

Create the timer object and associate it with the timer information.

```
timer = target.create('Timer');
timer.APIImplementation = timerImplementation;
timer.Name = 'Linux Timer';
```

**Note** Using name-value arguments, you can create the timer object with this command.

```
timer = target.create('Timer', 'Name', 'Linux Timer', ...
 'FunctionName', 'timestamp_x86', ...
 'FunctionReturnType', 'uint64', ...
 'FunctionLanguage', target.Language.C, ...
 'SourceFiles', {'host_timer_x86.c'}, ...
 'IncludeFiles', {'host_timer_x86.h'}, ...
 'IncludePaths', {'$(MATLAB_ROOT)/toolbox/coder/profile/src'})
```

---

Assign the timer and add-ons to the processor object.

```
processor = target.get('Processor', 'Intel-x86-64 (Linux 64)');
processor.Timers = timer;
```

### Create Description for Intel Core Processor

Create a description for the Intel Core™ i7-8550U processor, which is a processor that supports hyperthreading.

```
i7 = target.create('Processor', ...
 'Name', 'i7-8550U', ...
 'Manufacturer', 'Intel', ...
 'NumberOfCores', 4, ...
 'NumberOfThreadsPerCore', 2);
target.add(i7);
```

### See Also

[target.LanguageImplementation](#) | [target.create](#)

### Topics

“Register New Hardware Devices”

### Introduced in R2019a

# target.remove

**Package:** target

Remove target object from internal database

## Syntax

```
target.remove(targetObject)
target.remove(targetType, targetObjectId)
target.remove(targetObject, Name, Value)
```

## Description

`target.remove(targetObject)` removes the target object from an internal database.

`target.remove(targetType, targetObjectId)` removes the target object specified by class and identifier.

`target.remove(targetObject, Name, Value)` uses name-value arguments to remove associated objects and suppress command-line output.

## Examples

### Remove Target Object From Internal Database

You can specify and add a hardware device implementation to an internal database.

```
armv8 = target.create('LanguageImplementation', ...
 'Name', 'Armv8-A LP64', ...
 'Copy', 'ARM Compatible-ARM Cortex');

a53 = target.create('Processor', ...
 'Name', 'Cortex-A53', ...
 'Manufacturer', 'ARM Compatible');

a53.LanguageImplementations = armv8;

target.add(a53)
```

When a target object is no longer required, you can use the function to remove the object from the internal database.

To remove only the `target.Processor` object, run:

```
target.remove(a53)
```

Or:

```
target.remove('Processor', 'ARM Compatible-Cortex-A53');
```

To remove the `target.Processor` object and its associated `target.LanguageImplementation` object and suppress the command-line output, run:

```
target.remove(a53, ...
 'IncludeAssociations', true, ...
 'SuppressOutput', true);
```

## Input Arguments

### **targetObject** — Target object

object

Specify the target object that you want to remove.

### **targetType** — Target type

character vector | string

Specify the class of the target object that you want to remove. For example:

- If the class is `target.Processor`, specify `'Processor'`.
- If the class is `target.LanguageImplementation`, specify `'LanguageImplementation'`.

Example: `'Processor'`

### **targetObjectId** — Target object identifier

character vector | string

Specify the unique identifier of the object that you want to remove, that is, the `Id` property value of the object.

### **Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*

Example: `target.remove(myTargetObject, 'IncludeAssociations', true);`

### **IncludeAssociations** — Remove associated objects

false (default) | true

Remove associated objects from internal database:

- `true` -- Function removes `targetObject` and associated target objects from the internal database. If an associated object is referenced by another target object, the function does not remove the associated object.
- `false` -- Function removes only `targetObject` from the internal database.

Example: `target.remove(myTargetObject, 'IncludeAssociations', true);`

Data Types: logical

### **SuppressOutput** — Control command-line output

false (default) | true

Control command-line output of function:

- `true` -- Suppress command-line output from the function.
- `false` -- Provide information about the objects that the function removes from the internal database.

Example: `target.remove(myTargetObject, 'SuppressOutput', true);`

Data Types: `logical`

## See Also

`target.add` | `target.create` | `target.get`

## Topics

“Register New Hardware Devices”

**Introduced in R2019a**

## target.upgrade

**Package:** target

Upgrade existing definitions of hardware devices

### Syntax

```
target.upgrade(upgraderForRegistrationMechanism, pathToRegistrationFile)
target.upgrade(___, Name, Value)
```

### Description

`target.upgrade(upgraderForRegistrationMechanism, pathToRegistrationFile)` uses an upgrade procedure to create objects from data definitions in current artifacts. The function creates `registerUpgradedTargets.m` in the current working folder.

To register the upgraded data definitions with MATLAB, run `registerUpgradedTargets()`.

For persistence across MATLAB sessions, run `registerUpgradedTargets('UserInstall', true)`.

`target.upgrade(___, Name, Value)` specifies additional options using one or more name-value pair arguments.

### Examples

#### Upgrade Hardware Device Data Definitions

For a workflow example that uses the function, see “Upgrade Data Definitions for Hardware Devices”.

### Input Arguments

#### **upgraderForRegistrationMechanism** — Upgrade procedure

'rtwTargetInfo'

Select upgrade procedure for current registration mechanism.

#### **pathToRegistrationFile** — Full file name

character vector | string

Specify file that contains current registration mechanism.

Example: `target.upgrade('rtwTargetInfo', 'myPath/mySubfolder/rtwTargetInfo.m')`

#### **Name-Value Pair Arguments**

Specify optional pairs of arguments as `Name1=Value1, ..., NameN=ValueN`, where `Name` is the argument name and `Value` is the corresponding value. Name-value arguments must appear after other arguments, but the order of the pairs does not matter.

*Before R2021a, use commas to separate each name and value, and enclose Name in quotes.*



Example: `target.upgrade('rtwTargetInfo', 'myPath/mySubfolder/  
rtwTargetInfo.m', 'ExportFileName', 'myNewFile')`

### **ExportToMATLABFunction — Export to MATLAB**

true (default) | false

- true -- Generate a MATLAB function that registers the upgraded definitions using `target.add`.
- false -- Do not generate a function.

### **ExportFileName — Generated function file name**

'registerUpgradedTargets.m' (default) | string

If `ExportToMATLABFunction` is true, the argument specifies the file name of the generated MATLAB function. Otherwise, the argument is ignored.

### **Overwrite — Overwrite existing file**

false (default) | true

- true -- If the file specified by `ExportFileName` exists, overwrite the file.
- false -- If the file specified by `ExportFileName` exists, the function produces an error.

If `ExportToMATLABFunction` is false, the argument is ignored.

## **See Also**

`target.add` | `target.create`

## **Topics**

“Register New Hardware Devices”

## **Introduced in R2019b**



# Objects

---

## **coder.CMSISNNConfig**

Parameters to configure deep learning code generation with the CMSIS-NN library for Cortex-M targets

### **Description**

The `coder.CMSISNNConfig` object contains CMSIS-NN library and associated ARM Cortex-M target specific parameters that `codegen` uses for generating C code for deep neural networks.

To use a `coder.CMSISNNConfig` object for code generation, assign it to the `DeepLearningConfig` property of a code generation configuration object that you pass to `codegen`.

### **Creation**

Create a CMSIS-NN configuration object by using the `coder.DeepLearningConfig` function with target library set as `'cmsis-nn'`.

### **Properties**

#### **CalibrationResultFile — Location of calibration MAT-file**

`''` (default) | character vector | string scalar

Location of the MAT-file containing the calibration data.

When performing quantization of a deep convolutional neural network, the `calibrate` function exercises the network and collects the dynamic ranges of the weights and biases in the convolution and fully connected layers of the network and the dynamic ranges of the activations in all layers of the network. To generate code for the quantized network, save the results from the `calibrate` function to a MAT-file and specify the location of this MAT-file to the code generator using this property. For more information, see “Code Generation for Quantized Deep Learning Networks”.

#### **DataType — Inference computation precision**

`'int8'` (default)

Precision of inference computations in supported layers.

#### **TargetLibrary — Target library name**

`'cmsis-nn'` (default)

Name of target library, specified as a character vector.

### **Examples**

## Specify Configuration Parameters for C Code Generation for a Deep Neural Network

Create an entry-point function `net_predict` that uses the `coder.loadDeepLearningNetwork` function to load the network object `net` from the MAT-file `netFile`. The function then performs prediction using this model object.

```
function out = net_predict(netFile, in)
net = coder.loadDeepLearningNetwork(netFile);
out = predict(net,in);
end
```

Create a `coder.config` configuration object for generation of a C static library.

```
cfg = coder.config('lib');
```

Create a `coder.CMSISNNConfig` deep learning configuration object and specify the location of the calibration MAT-file. Assign it to the `DeepLearningConfig` property of the `cfg` configuration object.

```
dlcfg = coder.DeepLearningConfig('cmsis-nn');
dlcfg.CalibrationResultFile = 'calibration.mat';
cfg.DeepLearningConfig = dlcfg;
```

Use the `-config` option of the `codegen` function to specify the `cfg` configuration object. The `codegen` function must determine the size, class, and complexity of MATLAB function inputs. Use the `-args` option to specify the size of the input to the entry-point function.

```
codegen -config cfg net_predict -args {coder.Constant('calibration.mat'), exampleinput}
```

The `codegen` command places all the generated files in the `codegen` folder.

## See Also

`codegen` | `coder.DeepLearningConfig` | `coder.ARMNEONConfig` | `coder.MkLDNNConfig`

## Topics

“Code Generation for Quantized Deep Learning Networks”

## Introduced in R2022a

## coder.CodeConfig

Configuration parameters for C/C++ code generation from MATLAB code

### Description

A `coder.CodeConfig` object contains the configuration parameters that `codegen` uses for generating a static library, a dynamically linked library, or an executable program. Pass the object to the `codegen` function by using the `-config` option.

### Creation

Create a `coder.CodeConfig` object by using the `coder.config` function.

Once you create a `coder.CodeConfig` object, you can modify its properties programmatically at the command line or interactively by using the Configuration Parameter Dialog Box. See “Specify Configuration Parameters in Command-Line Workflow Interactively”.

### Properties

#### BuildConfiguration — Compiler optimization or debug settings for toolchain

'Faster Runs' (default) | 'Faster Builds' | 'Debug' | 'Specify'

Compiler optimization or debug settings for toolchain, specified as one of the values in this table.

| Value           | Description                                                                                                                                                                                                                                                                                                                                    |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Faster Builds' | Optimizes the build for shorter build times.                                                                                                                                                                                                                                                                                                   |
| 'Faster Runs'   | Optimizes the build for faster running executables.                                                                                                                                                                                                                                                                                            |
| 'Debug'         | Optimizes the build for debugging.                                                                                                                                                                                                                                                                                                             |
| 'Specify'       | Enables the <code>CustomToolchainOptions</code> property for customization of settings for tools in the selected toolchain. If the <code>Toolchain</code> property is set to 'Automatically locate an installed toolchain', then setting <code>BuildConfiguration</code> to 'Specify' changes <code>Toolchain</code> to the located toolchain. |

#### CacheDynamicArrayDataPointer — Dynamic array optimization

true (default) | false

Dynamic array optimization, specified as one of the values in this table.

| Value | Description                                                                                                                                    |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator improves the execution time of generated C code by optimizing dynamic array access. |
| false | The code generator does not optimize dynamic array access.                                                                                     |

See “Optimize Dynamic Array Access”.

### CodeFormattingTool — Formatting tool for the generated code

'Auto' (default) | 'Clang-format' | 'MathWorks'

Code formatting options for generated code, specified as one of the values in the table.

| Value          | Description                                                                                                                                                                                                                                                              |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Clang-format' | The code generator formats the generated code according to a clang-format file.                                                                                                                                                                                          |
| 'Auto'         | Uses an internal heuristic to determine if the generated code is formatted by clang-format or a MathWorks formatting tool.<br><br>To determine whether the generated code is formatted by clang-format, in a coder.config object, set the Verbosity option to 'Verbose'. |
| 'MathWorks'    | Causes the code generator to revert to the MathWorks formatting tool.                                                                                                                                                                                                    |

### CodeReplacementLibrary — Code replacement library for generated code

character vector

Code replacement library for generated code, specified as one of the values in this table:

| Value                          | Description                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'None'                         | This value is the default value.<br><br>Does not use a code replacement library.                                                                                                                                                                                                                                                                                                                                          |
| Named code replacement library | Generates calls to a specific platform, compiler, or standards code replacement library. The list of named libraries depends on: <ul style="list-style-type: none"> <li>• Installed support packages.</li> <li>• System target file, language, language standard, and device vendor configuration.</li> <li>• Whether you created and registered code replacement libraries, using the Embedded Coder product.</li> </ul> |

Compatible libraries depend on these parameters:

- `TargetLang`
- `TargetLangStandard`
- `ProdHWDeviceType` in the hardware implementation configuration object.

Embedded Coder offers more libraries and the ability to create and use custom code replacement libraries.

MATLAB Coder generates the minimal set of `#include` statements for header files required by the selected code replacement library.

Before setting this parameter, verify that your compiler supports the library that you want to use. If you select a parameter value that your compiler does not support, compiler errors can occur.

---

**Note** MATLAB Coder software does not support TLC callbacks.

---

### **CompileTimeRecursionLimit — Maximum number of function specializations for compile-time recursion**

50 (default) | positive integer

Maximum number of function specializations for compile-time recursion, specified as a positive integer. To disallow recursion in the MATLAB code, set `CompileTimeRecursionLimit` to 0. The default compile-time recursion limit is large enough for most recursive functions that require this type of recursion. If code generation fails because of the compile-time recursion limit, and you want compile-time recursion, try to increase the limit. Alternatively, change your MATLAB code so that the code generator uses run-time recursion. See “Compile-Time Recursion Limit Reached”.

### **ConstantFoldingTimeout — Maximum number of instructions to be executed by the constant folder**

40000 (default) | positive integer

Maximum number of instructions that the constant folder executes. In some situations, code generation requires specific instructions to be constant. If constant folding stops before these instructions are constant-folded, code generation fails. In this case, increase the value of `ConstantFoldingTimeout`.

See “MATLAB Coder Optimizations in Generated Code”.

### **CppGenerateEnumClass — Generate C++11 enumeration class for MATLAB enumeration**

true (default) | false

Whether to generate C++11 code that contains enumeration classes or ordinary C enumerations, specified as one of the values in this table.



| Value | Description                                                                                                                                                                          |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces enumeration classes for MATLAB enumerations in the generated C++11 code. See “Code Generation for Enumerations”. |
| false | The code generator produces ordinary C enumerations for MATLAB enumerations in the generated C++11 code.                                                                             |

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

### **CppInterfaceClassName** — Interface class name for generated C++ code

' ' (default) | character vector

Name of interface class when you generate C++ code with `CppInterfaceStyle` set to 'Methods'. In this case, the generated code for MATLAB entry-point functions consists of methods contained in a C++ class with name specified by `CppInterfaceClassName`. This property has no effect when you set `CppInterfaceStyle` to 'Functions'.

See “Generate C++ Code with Class Interface”.

### **CppInterfaceStyle** — Interface style for generated C++ code

'Functions' (default) | 'Methods'

Style of interface to the generated C++ code for the MATLAB entry-point functions that you generate code from. By default, entry-point functions become C++ functions. If you choose 'Methods', then entry-point functions become methods in a C++ class. Specify the name of the class by using the property `CppInterfaceClassName`.

See “Generate C++ Code with Class Interface”.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

### **CppPackagesToNamespaces** — Generate C++ namespaces for MATLAB packages

true (default) | false

Whether to generate C++ namespaces for the packages in your MATLAB code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                 |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces C++ namespaces for the packages in your MATLAB code. See “Organize Generated C++ Code into Namespaces”. |

| Value | Description                                                                              |
|-------|------------------------------------------------------------------------------------------|
| false | The code generator does not produce C++ namespaces for the packages in your MATLAB code. |

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

Data Types: `logical`

### **CppNamespace — Namespace name for generated C++ code**

' ' (default) | character vector

Namespace for the generated C++ code. The code generator does not produce code in a namespace unless you specify a nonempty character vector.

See “Organize Generated C++ Code into Namespaces”.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

### **CppNamespaceForMathworksCode — Place C++ code generated for MathWorks code in a separate namespace**

' coder ' (default) | character vector

Namespace for the C++ code generated for MathWorks code. The code generator does not produce such a namespace if you specify this property as an empty character vector.

See “Organize Generated C++ Code into Namespaces”.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

Data Types: `char`

### **CppPreserveClasses — Generate C++ classes for MATLAB classes**

true (default) | false

Whether to generate C++ classes or C style structures for MATLAB classes, specified as one of the values in this table.

| Value | Description                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces C++ classes for MATLAB classes. See “Generate C++ Classes for MATLAB Classes”. |
| false | The code generator produces C style structures for MATLAB classes.                                                                                 |

When using GPU Coder, the code generator always disables this parameter.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

Data Types: `logical`

**CustomBLASCallback — BLAS callback class**

' ' (default) | character vector

Callback class for BLAS library calls in code generated for certain low-level vector and matrix operations in MATLAB code, specified as a character vector.

If you specify a BLAS callback class, for certain low-level vector and matrix functions, the code generator produces BLAS calls by using the CBLAS C interface to your BLAS library. The callback class provides the name of your CBLAS header file, the names of CBLAS data types, and the information required to link to your BLAS library. If this parameter is empty, the code generator produces code for matrix functions instead of a BLAS call.

See “Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”.

**CustomFFTCallback — Callback class for FFTW library calls**

' ' (default) | character vector

Callback class for FFTW library calls in code generated for FFT functions in MATLAB code, specified as a character vector.

To improve the execution speed of FFT functions, the code generator produces calls to the FFTW library that you specify in the callback class. If this parameter is empty, the code generator uses its own algorithms for FFT functions instead of calling the FFTW library.

See “Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”.

**CustomHeaderCode — Custom code that appears at top of generated C/C++ header files**

' ' (default) | character vector

Custom code that appears near the top of each C/C++ header file generated from your MATLAB code, except `rtwtypes.h` and `rtwhalf.h`, specified as a character vector.

**CustomInclude — Include folders to add to include path for compiling generated code**

' ' (default) | string array | cell array of character vectors | character vector

Include folders to add to the include path when compiling the generated code. Specify the list of include folders as a string array, cell array of character vector, or character vector.

Multiple folder names, specified as one of the values in this table.

| Value        | Description                                                                                                                     |
|--------------|---------------------------------------------------------------------------------------------------------------------------------|
| String array | A string array in <code>CustomInclude</code> . For example, <code>cfg.CustomInclude = ["C:\Project", "C:\Custom Files"];</code> |

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cell array of character vectors | A cell array of character vectors in CustomInclude. For example, <code>cfg.CustomInclude = {'C:\Project', 'C:\Custom Files'};</code>                                                                                                                                                                                                                                                                                                         |
| Character vector                | Separate include folders by a pathsep character in CustomInclude. For example, <code>cfg.CustomInclude = ['C:\Project' pathsep 'C:\Custom Files'];</code><br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

### CustomInitializer — Custom code to include in the generated initialize function

' ' (default) | character vector

Custom code to include in the generated initialize function, specified as a character vector.

### CustomLAPACKCallback — LAPACK callback class

' ' (default) | character vector

Callback class for LAPACK library calls in code generated for certain linear algebra functions in MATLAB code, specified as a character vector.

If you specify a LAPACK callback class, for certain linear algebra functions, the code generator produces LAPACK calls by using the LAPACKE C interface to your LAPACK library. The callback class provides the name of your LAPACKE header file and the information required to link to your LAPACK library. If this parameter is empty, the code generator produces code for linear algebra functions instead of a LAPACK call.

See “Speed Up Linear Algebra in Generated Standalone Code by Using LAPACK Calls”.

### CustomLibrary — Static library files to link with the generated code

' ' (default) | string array | cell array of character vectors | character vector

Static library files to link with the generated code, specified as a string array, cell array of character vector, or character vector.

Multiple static library file names, specified as one of the values in this table.

| Value                           | Description                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in CustomLibrary. For example, <code>cfg.CustomLibrary = ["myLib1.lib", "myLib2.lib"];</code>                    |
| Cell array of character vectors | A cell array of character vectors in CustomLibrary. For example, <code>cfg.CustomLibrary = {'myLib1.lib', 'myLib2.lib'};</code> |

| Value            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Character vector | <p>Separate static library file names by a <code>pathsep</code> character in <code>CustomLibrary</code>. For example, <code>cfg.CustomLibrary = ['myLib1.lib' pathsep 'myLib2.lib'];</code></p> <hr/> <p><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a>.</p> |

### CustomSource — Source files to compile and link with the generated code

' ' (default) | string array | cell array of character vectors | character vector

Source files to compile and link with the generated code, specified as a string array, cell array of character vector, or character vector.

The build process searches for the source files first in the current folder, and then in the include folders that you specify in `CustomInclude`. If source files with the same name occur in multiple folders on the search path, the build process might use a different file than the file that you specified.

Suppose that you specify `foo.cpp` as a source file. If `foo.c` and `foo.cpp` are both on the search path, you cannot be sure whether the build process uses `foo.c` or `foo.cpp`.

Multiple source file names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in <code>CustomSource</code> . For example, <code>cfg.CustomSource = ["mySrc1.c", "mySrc2.c"];</code>                                                                                                                                                                                                                                                                                                                                                      |
| Cell array of character vectors | A cell array of character vectors in <code>CustomSource</code> . For example, <code>cfg.CustomSource = {'mySrc1.c', 'mySrc2.c'};</code>                                                                                                                                                                                                                                                                                                                                   |
| Character vector                | <p>Separate source file names by a <code>pathsep</code> character in <code>CustomSource</code>. For example, <code>cfg.CustomSource = ['mySrc1.c' pathsep 'mySrc2.c'];</code></p> <hr/> <p><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a>.</p> |

### CustomSourceCode — Code to appear near the top of generated .c or .cpp files

' ' (default) | character vector

Specify code to appear near the top of each generated `.c` or `.cpp` file (except `rtwhalf.c` or `rtwhalf.cpp`), outside of any function. Specify code as a character vector.

Do not specify a C static function definition.

**CustomTerminator — Code that appears in the generated terminate function**`' ' (default) | character vector`

Code that appears in the generated terminate function, specified as a character vector.

**CustomToolchainOptions — Custom settings for tools in selected toolchain**`cell array`

Custom settings for tools in selected toolchain, specified as a cell array.

Dependencies:

- The `Toolchain` property determines which tools and options appear in the cell array.
- Setting the `BuildConfiguration` property to `Specify` enables `CustomToolchainOptions`.

First, get the current settings. For example:

```
cfg = coder.config('lib');
cfg.BuildConfiguration='Specify';
opt = cfg.CustomToolchainOptions
```

Then, edit the values in `opt`.

These values derive from the toolchain definition file and the third-party compiler options. See “Custom Toolchain Registration”.

**DataTypeReplacement — Data type replacement in generated code**`'CBuiltIn' | 'CoderTypeDefs'`

Data type replacement in generated code, specified as one of the values in this table.

| Value           | Description                                                                        |
|-----------------|------------------------------------------------------------------------------------|
| 'CBuiltIn'      | This value is the default value.<br>The code generator uses built-in C data types. |
| 'CoderTypeDefs' | The code generator uses predefined data types from <code>rtwtypes.h</code>         |

**DeepLearningConfig — Configuration object for deep learning code generation**

`coder.MkLDNNConfig` object | `coder.ARMNEONConfig` object | `coder.CuDNNConfig` object | `coder.TensorRTConfig` object

Configuration object for code generation for deep learning networks, specified as specified as one of the objects in this table.

| Object                                  | Requires                                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><code>coder.MkLDNNConfig</code></p>  | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• MATLAB Coder Interface for Deep Learning Libraries support package</li> </ul>                   | <p>A <code>coder.MkLDNNConfig</code> object contains parameters specific to C++ code generation for deep learning using Intel MKL-DNN. To create a <code>coder.MkLDNNConfig</code> object, use <code>coder.DeepLearningConfig</code>. For example:</p> <pre>cfg = coder.config('mex'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks with MKL-DNN”.</p>                         |
| <p><code>coder.ARMNEONConfig</code></p> | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• MATLAB Coder Interface for Deep Learning Libraries support package</li> </ul>                   | <p>A <code>coder.ARMNEONConfig</code> object contains parameters specific to C++ code generation for deep learning using the ARM Compute Library. To create a <code>coder.ARMNEONConfig</code> object, use <code>coder.DeepLearningConfig</code>. For example:</p> <pre>cfg = coder.config('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks with ARM Compute Library”.</p> |
| <p><code>coder.CuDNNConfig</code></p>   | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• GPU Coder</li> <li>• GPU Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A <code>coder.CuDNNConfig</code> object contains parameters specific to CUDA code generation for deep learning using the cuDNN library. To create a <code>coder.CuDNNConfig</code> object, use <code>coder.DeepLearningConfig</code>. For example:</p> <pre>cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks by Using cuDNN” (GPU Coder).</p>     |

| Object                            | Requires                                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>coder.TensorRTConfig</code> | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• GPU Coder</li> <li>• GPU Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A <code>coder.TensorRTConfig</code> object contains parameters specific to CUDA code generation for deep learning using the TensorRT library. To create a <code>coder.TensorRTConfig</code> object, use <code>coder.DeepLearningConfig</code>. For example:</p> <pre>cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks by Using TensorRT” (GPU Coder).</p> |

Dependency: If `DeepLearningConfig` is set, `codegen` sets `TargetLang` to `C++`.

#### Description – Object description

`'class CodeConfig: C code generation configuration.'` (default) | character vector

Object description, specified as a character vector.

#### DynamicMemoryAllocation – Dynamic memory allocation mode

`'Threshold'` (default) | `'AllVariableSizeArrays'` | `'Off'`

Dynamic memory allocation mode, specified as one of the values in this table.

| Value                                | Description                                                                                                                                                                                                                          |
|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>'Threshold'</code>             | <p>This value is the default value.</p> <p>The code generator allocates memory dynamically on the heap for variable-size arrays whose size (in bytes) is greater than or equal to <code>DynamicMemoryAllocationThreshold</code>.</p> |
| <code>'AllVariableSizeArrays'</code> | The code generator dynamically allocates memory for all variable-size arrays on the heap.                                                                                                                                            |
| <code>'Off'</code>                   | The code generator statically allocates memory for variable-size arrays on the stack.                                                                                                                                                |

Unbounded variable-size arrays require dynamic memory allocation.

Dependencies:

- `EnableVariableSizing` enables this parameter.
- Setting this `DynamicMemoryAllocation` to `'Threshold'` enables the `DynamicMemoryAllocationThreshold` parameter.

See “Generate Code for Variable-Size Data”.



### DynamicMemoryAllocationInterface – Dynamically allocated array at generated function interface

'Auto' (default) | 'C' | 'C++'

Implementation of dynamically allocated array at the interface of the generated C/C++ function, specified as one of the values in this table.

| Value  | Description                                                                                                                                                                                                                                                                        |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Auto' | This is the default value. If you set the TargetLang parameter to 'C++' or 'C', this value correspondingly behaves as the same option.                                                                                                                                             |
| 'C'    | The generated code uses the C style emxArray data structure to implement dynamically allocated arrays. See “Use C Arrays in the Generated Function Interfaces”.                                                                                                                    |
| 'C++'  | If you set the TargetLang parameter to 'C', this value is disabled.<br><br>Otherwise, the generated code uses the <code>coder::array</code> class template to implement dynamically allocated arrays. See “Use Dynamically Allocated C++ Arrays in Generated Function Interfaces”. |

When using GPU Coder, the code generator always uses the C style emxArray data structure.

Dependency:

- `EnableVariableSizing` enables this parameter.

### DynamicMemoryAllocationForFixedSizeArrays – Dynamic memory allocation mode for fixed-size arrays

'Never' (default) | 'Always' | 'Threshold'

Dynamic memory allocation mode for fixed-size arrays, specified as one of the values in this table.

| Value       | Description                                                                                                                                                                         |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Never'     | This value is the default value.<br><br>The code generator statically allocates memory for fixed-size arrays on the stack.                                                          |
| 'Always'    | The code generator dynamically allocates memory on the heap for all fixed-size arrays whose size is greater than 64 bytes.                                                          |
| 'Threshold' | The code generator allocates memory dynamically on the heap for fixed-size arrays whose size (in bytes) is greater than or equal to <code>DynamicMemoryAllocationThreshold</code> . |

Dependencies:

- Setting `DynamicMemoryAllocationForFixedSizeArrays` to `'Threshold'` enables the `DynamicMemoryAllocationThreshold` parameter.

### **DynamicMemoryAllocationForVariableSizeArrays – Dynamic memory allocation mode for variable-size arrays**

`'Threshold'` (default) | `'Always'` | `'Never'`

Dynamic memory allocation mode for variable-size arrays, specified as one of the values in this table.

| Value                    | Description                                                                                                                                                                                                                    |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>'Threshold'</code> | This value is the default value.<br><br>The code generator allocates memory dynamically on the heap for variable-size arrays whose size (in bytes) is greater than or equal to <code>DynamicMemoryAllocationThreshold</code> . |
| <code>'Always'</code>    | The code generator dynamically allocates memory for all variable-size arrays on the heap.                                                                                                                                      |
| <code>'Never'</code>     | The code generator statically allocates memory for variable-size arrays on the stack.                                                                                                                                          |

Unbounded variable-size arrays require dynamic memory allocation.

Dependencies:

- Setting `DynamicMemoryAllocationForVariableSizeArrays` to `'Threshold'` enables the `DynamicMemoryAllocationThreshold` parameter.

See “Generate Code for Variable-Size Data”.

### **DynamicMemoryAllocationThreshold – Size threshold for dynamic memory allocation of variable-size arrays**

65536 (default) | positive integer

Size threshold for dynamic memory allocation of variable-size arrays, specified as a positive integer. The code generator uses dynamic memory allocation for variable-size arrays whose size (in bytes) is greater than or equal to the threshold.

Dependency:

- Setting `DynamicMemoryAllocation`, `DynamicMemoryAllocationForFixedSizeArrays`, or `DynamicMemoryAllocationForVariableSizeArrays` to `'Threshold'` enables this parameter.

See “Generate Code for Variable-Size Data”.

### **EnableAutoExtrinsicCalls – Automatic extrinsic function calls**

`true` (default) | `false`

Automatic extrinsic function calls, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator treats some common visualization functions as extrinsic functions. You do not have to declare these functions as extrinsic by using <code>coder.extrinsic</code> . This capability reduces the amount of time that you spend making your code suitable for code generation. |
| false | The code generator does not treat common visualization functions as extrinsic functions unless you declare them as extrinsic by using <code>coder.extrinsic</code> .                                                                                                                                                                   |

Some common visualization functions are `plot`, `disp`, and `figure`. See “Use MATLAB Engine to Execute a Function Call in Generated Code”.

#### **EnableAutoParallelization — Automatic parallelization of for loops**

false (default) | true

Automatic parallelization of `for` loops, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                             |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Code generator does not automatically parallelize <code>for</code> loops.                                                                                                                                       |
| true  | The code generator automatically parallelizes <code>for</code> loops in the generated code. Automatic parallelization can significantly improve the execution speed of the generated code. See “Automatically Parallelize for Loops in Generated Code”. |

When using GPU Coder, the code generator always enables automatic parallelization of `for` loops.

Data Types: `logical`

#### **EnableAutoParallelizationReporting — Reporting for automatic parallelization of for loops**

true (default) | false

Reporting for automatic parallelization of `for` loops, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If you set <code>EnableAutoParallelization</code> to <code>true</code> , the code generator produces a code generation report for automatic parallelization of for loops. |
| false | The code generator does not produce a code generation report for automatic parallelization of for loops.                                                                                                          |

### **EnableImplicitExpansion** – Implicit expansion capabilities in generated code

true (default) | false

Implicit expansion capabilities in the generated code, specified as one of the values listed in this table.

| Value | Description                                                                                                                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator enables implicit expansion in the generated code. The code generator includes modifications in the generated code to apply implicit expansion. See “Compatible Array Sizes for Basic Operations”. |
| false | The generated code does not follow the rules of implicit expansion.                                                                                                                                                                                          |

Data Types: logical

### **EnableMemcpy** – memcpy optimization

true (default) | false

memcpy optimization, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the <code>memcpy</code> optimization. To optimize code that copies consecutive array elements, the <code>memcpy</code> optimization replaces the code with a <code>memcpy</code> call. When the number of elements to copy is known at compile time, the code generator uses the <code>MemcpyThreshold</code> property to determine whether to use the optimization. See “memcpy Optimization”. |
| false | The code generator does not use the <code>memcpy</code> optimization.                                                                                                                                                                                                                                                                                                                                                                                                        |

When using GPU Coder, the code generator always disables `Memcpy` optimization.

**EnableOpenMP — Parallelization of parfor-loops**

true (default) | false

Parallelization of parfor-loops, specified as one of the values in this table.

| Value | Description                                                                                                                                      |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the OpenMP library to produce loop iterations that run in parallel. |
| false | The code generator treats parfor-loops as for-loops.                                                                                             |

See parfor.

Use of the OpenMP library is not compatible with just-in-time (JIT) compilation. If EnableJIT and EnableOpenMP are true, the code generator uses JIT compilation and treats parfor-loops as for-loops.

When using GPU Coder, the code generator always treats parfor-loops as for-loops.

**EnableRuntimeRecursion — Run-time recursion support**

true (default) | false

Run-time recursion support, specified as one of the values in this table.

| Value | Description                                                                                    |
|-------|------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Recursive functions are allowed in the generated code. |
| false | Recursive functions are not allowed in the generated code.                                     |

Some coding standards, such as MISRA<sup>®</sup>, do not allow recursion. To increase the likelihood of generating code that is compliant with MISRA C<sup>®</sup>, set EnableRuntimeRecursion to false.

If your MATLAB code requires run-time recursion and EnableRuntimeRecursion is false, code generation fails.

See “Code Generation for Recursive Functions”.

**EnableVariableSizing — Variable-size array support**

true (default) | false

Variable-size array support, specified as one of the values in this table.

| Value | Description                                                                                   |
|-------|-----------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Variable-size arrays are allowed for code generation. |
| false | Variable-size arrays are not allowed for code generation.                                     |

Dependency:

- Enables Dynamic memory allocation.

See “Code Generation for Variable-Size Arrays”.

#### FilePartitionMethod – File partitioning mode

'MapMFileToCFile' (default) | 'SingleFile'

File partitioning mode specified as one of the values in this table.

| Value             | Description                                                                                                                                                                          |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'MapMFileToCFile' | This value is the default value.<br><br>The code generator produces separate C/C++ files for each MATLAB language file.                                                              |
| 'SingleFile'      | The code generator produces a single file for C/C++ functions that map to your MATLAB entry-point functions. The code generator produces separate C/C++ files for utility functions. |

See “How MATLAB Coder Partitions Generated Code”.

#### GenCodeOnly – Generation of only source code

false (default) | true

Generation of only source code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                             |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator produces C/C++ source code and builds object code.                                                                                                           |
| true  | The code generator produces C/C++ source code, but does not invoke the make command or build object code. When you iterate between modifying MATLAB code and generating C/C++ code, generating only code can save time. |

#### GenerateComments – Comments in generated code

true (default) | false

Comments in generated code, specified as one of the values in this table.

| Value | Description                                                                                       |
|-------|---------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator places comments in the generated code. |
| false | The code generator does not place comments in the generated code.                                 |

### GenerateExampleMain – Example C/C++ main file generation

'GenerateCodeOnly' (default) | 'DoNotGenerate' | 'GenerateCodeAndCompile'

Example C/C++ main file generation, specified as one of the values in this table.

| Value                    | Description                                                                                                                                                                                                                                                                           |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'GenerateCodeOnly'       | This value is the default value.<br><br>The code generator generates an example C/C++ main function but does not compile it.                                                                                                                                                          |
| 'DoNotGenerate'          | The code generator does not generate an example C/C++ main function.                                                                                                                                                                                                                  |
| 'GenerateCodeAndCompile' | The code generator generates an example C/C++ main function and compiles it to create a test executable. This executable does not return output.<br><br>If the <code>GenCodeOnly</code> parameter is <code>true</code> , the code generator does not compile the C/C++ main function. |

An example main function is a template to help you to write a C/C++ main function that calls generated C/C++ code. See “Incorporate Generated Code Using an Example Main Function”.

### GenerateMakefile – Makefile generation

true (default) | false

Makefile generation during the build process, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                  |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator generates a makefile during the build process.                                                                                                                                    |
| false | The code generator does not generate a makefile during the build process. Specify instructions for post-code-generation processing, including compilation and linking, in a post-code-generation command. See “Build Process Customization”. |

**GenerateNonFiniteFilesIfUsed – Generate support files for nonfinite data only if nonfinite data is used**`true (default) | false`

Generation of support files for nonfinite data, specified as one of the values in this table.

| Value              | Description                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | This value is the default value.<br><br>The code generator produces the support files for nonfinite data ( <code>Inf</code> and <code>NaN</code> ) only if the generated code uses nonfinite data. |
| <code>false</code> | The code generator always produces the support files for nonfinite data ( <code>Inf</code> and <code>NaN</code> ).                                                                                 |

Dependency:

- Setting `SupportNonFinite` to `true` enables this parameter.

**GenerateReport – Code generation report**`false (default) | true`

Code generation report, specified as one of the values in this table.

| Value              | Description                                                                                                                                                                          |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>false</code> | This value is the default value.<br><br>The code generator produces a report only if error or warning messages occur, or if you set <code>LaunchReport</code> to <code>true</code> . |
| <code>true</code>  | The code generator produces a code generation report.                                                                                                                                |

**Hardware – Object that specifies a hardware board**`coder.Hardware` object

Object that specifies a hardware board. To create the `coder.Hardware` object, use `coder.hardware`. For example:

```
cfg = coder.config('lib');
hw = coder.hardware('Raspberry Pi');
cfg.Hardware = hw;
```

Before you use `coder.hardware`, you must install the support package for the hardware.

Dependencies:

- Setting `Hardware` customizes the hardware implementation object and other configuration parameters for a particular hardware board.
- If `DeepLearningConfig` is set to a `coder.ARMNEONConfig` object and `Hardware` is empty, then `codegen` sets the `GenCodeOnly` property to `true`.

Note:



- Suppose that you create a `coder.CodeConfig` object `cfg` in a MATLAB session and use it in another MATLAB session. If the MATLAB host computer for the second session does not have the hardware board specified in the `cfg.Hardware` property installed on it, this parameter reverts to its default value. The default value is `[]`. Setting the **Hardware Board** option to `MATLAB Host Computer` in the app is equivalent to using `cfg.Hardware` and `cfg.HardwareImplementation.ProdHWDeviceType` with their default value.

### HardwareImplementation — Hardware implementation object

`coder.HardwareImplementation` object.

Hardware implementation object that specifies hardware-specific configuration parameters for C/C++ code generation. `coder.config` creates a `coder.CodeConfig` object with the `HardwareImplementation` property set to a `coder.HardwareImplementation` object with default parameter values for the MATLAB host computer.

### HeaderGuardStyle — Style of preprocessor directive in generated code

'UseIncludeGuard' (default) | 'UsePragmaOnce'

To prevent compilation errors due to multiple inclusion of header files, the code generator produces either `#ifndef` or `#pragma once` constructs in generated header files. If your project uses distinct files that use the same preprocessor macros, then generate code with the `#pragma once` construct. The compilation behavior of `#pragma once` is not standardized.

Specify `HeaderGuardStyle` as one of the values in this table.

| Value           | Description                                                                               |
|-----------------|-------------------------------------------------------------------------------------------|
| UseIncludeGuard | The code generator produces <code>#ifndef</code> style <code>#include</code> guards.      |
| UsePragmaOnce   | The code generator produces <code>#pragma once</code> style <code>#include</code> guards. |

### HighlightPotentialRowMajorIssues — Potential row-major layout issues

true (default) | false

Display of potential row-major layout efficiency issues, specified as one of the values in this table.

| Value | Description                                                                                                                 |
|-------|-----------------------------------------------------------------------------------------------------------------------------|
| true  | The code generation report displays potential efficiency issues due to row-major layout. (This value is the default value.) |
| false | The code generation report does not display issues related to array layout.                                                 |

See “Code Design for Row-Major Array Layout”.

### InitFltsAndDblsToZero — Assignment of float and double zero with memset

true (default) | false

Assignment of float and double zero with `memset`, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the <code>memset</code> optimization for assignment of floating-point zero to consecutive array elements. To assign consecutive array elements, the <code>memset</code> optimization uses a <code>memset</code> call. When the number of elements to assign is known at compile time, the code generator uses the <code>MemcpyThreshold</code> property to determine whether to use the optimization. See “memset Optimization”. |
| false | The code generator does not use the <code>memset</code> optimization for assignment of float and double zero to consecutive array elements.                                                                                                                                                                                                                                                                                                                                                                   |

#### **InlineBetweenMathWorksFunctions – Control inlining between MathWorks functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a MathWorks calls another MathWorks function, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the `coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

#### **InlineBetweenUserAndMathWorksFunctions – Control inlining between user-written functions and MathWorks functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a function that you wrote calls a MathWorks function, or a MathWorks function calls a function that you wrote. Specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the `coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

### **InLineBetweenUserFunctions – Control inlining between user-written functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a function that you wrote calls another function that you wrote, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the

`coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

### **InstructionSetExtensions — SIMD instruction set for target hardware**

'None' (default) | 'SSE' | 'SSE2' | 'SSE4.1' | 'AVX' | 'AVX2' | 'FMA' | 'AVX512F'

Instruction sets to generate single instruction, multiple data (SIMD) code for target hardware. This list shows the dependency of the instruction sets, where each instruction set depends on the instruction sets that precede it. The code generator loads the selected instruction set and the instruction sets that it depends on. For example, if you select AVX, the code generator loads AVX, SSE4.1, SSE2, and SSE.

See “Generate SIMD Code for MATLAB Functions”.

When using GPU Coder, the code generator always disables `InstructionSetExtensions`.

### **LaunchReport — Automatic open of code generation report**

false (default) | true

Automatic open of code generation report, specified as one of the values in this table.

| Value | Description                                                                                                                                                                         |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>If errors or warnings occur, or if <code>GenerateReport</code> is true, the code generator produces a report, but does not open the report. |
| true  | The code generator produces and opens a code generation report.                                                                                                                     |

### **LoopUnrollThreshold — Threshold on the number of iterations that determines whether to automatically unroll a for-loop or parfor-loop**

5 (default) | positive integer

Loops with fewer iterations than this threshold are candidates for automatic unrolling by the code generator. This threshold applies to all `for`-loops and `parfor`-loops in your MATLAB code. For an individual `for`-loop, a `coder.unroll` directive placed immediately before the loop takes precedence over the loop unrolling optimization. The threshold can also apply to some `for`-loops produced during code generation.

See “Unroll for-Loops and parfor-Loops”.

### **MATLABSourceComments — Inclusion of MATLAB source code as comments in generated code**

false (default) | true

Inclusion of MATLAB source code as comments in generated code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | <p>This value is the default value.</p> <p>The code generator does not insert MATLAB source code as comments in the generated code. The code generator does not include the MATLAB function signature in the function banner.</p>                                                                                                                                                                                                                                                                                 |
| true  | <p>The code generator inserts MATLAB source code as comments in the generated code. A traceability tag immediately precedes each line of source code. The traceability tag helps you to locate the corresponding MATLAB source code. See “Tracing Generated C/C++ Code to MATLAB Source Code”.</p> <p>If you have Embedded Coder, in the code generation report, the traceability tag links to the source code.</p> <p>The code generator also includes the MATLAB function signature in the function banner.</p> |

Dependency:

- GenerateComments enables this parameter.

See “Tracing Generated C/C++ Code to MATLAB Source Code”.

### MaxIdLength — Maximum number of characters in generated identifiers

31 | 1024 | positive integer

Maximum number of characters in generated identifiers, specified as a positive integer in the range [31, 2048]. This property applies to generated function, type definition, and variable names. To avoid truncation of identifiers by the target C/C++ compiler, specify a value that matches the maximum identifier length of the target C/C++ compiler.

This property does not apply to exported identifiers, such as the generated names for entry-point functions or mxArray API functions. If the length of an exported identifier exceeds the maximum identifier length of the target C compiler, the target C/C++ compiler truncates the exported identifier.

Default values:

- If TargetLang is set to 'C', the default value of MaxIdLength is 31.
- If TargetLang is set to 'C++', the default value of MaxIdLength is 1024.

### MemcpyThreshold — Minimum size for memcpy or memset optimization

64 (default) | positive integer

Minimum size, in bytes, for memcpy or memset optimization, specified as a positive integer.

To optimize generated code that copies consecutive array elements, the code generator tries to replace the code with a memcpy call. To optimize generated code that assigns a literal constant to consecutive array elements, the code generator tries to replace the code with a memset call.

The number of bytes is the number of array elements to copy or assign multiplied by the number of bytes required for the C/C++ data type.

If the number of elements to copy or assign is variable (not known at compile time), the code generator ignores the `MemcpyThreshold` property.

See “memcpy Optimization” and “memset Optimization”.

#### **MultiInstanceCode – Multi-instance, reentrant code**

`false` (default) | `true`

Multi-instance, reentrant code, specified as one of the values in this table.

| Value              | Description                                                                                                 |
|--------------------|-------------------------------------------------------------------------------------------------------------|
| <code>false</code> | This value is the default value.<br><br>The code generator does not produce multi-instance, reentrant code. |
| <code>true</code>  | The code generator produces reusable, multi-instance code that is reentrant.                                |

See “Reentrant Code”.

This option is not supported by the GPU Coder product.

#### **Name – Object name**

`'CodeConfig'` (default) | character vector

Object name, specified as a character vector.

#### **NumberOfCpuThreads – Maximum number of CPU threads to run parallel for-loops**

0 (default) | positive integer

Maximum number of CPU threads to run parallel for-loops in the generated C/C++ code, specified as a positive integer.

See “Specify Maximum Number of Threads to Run Parallel for-Loops in the Generated Code”.

#### **OptimizeReductions – Generate SIMD code for reduction operations | Parallelize for-loops performing reduction operations**

`'false'` (default) | `'true'`

Whether to generate SIMD code for reduction operations such as product and sum functions. To use this parameter, you must select an instruction set for the `InstructionSetExtensions` parameter. The code generator uses the specified instruction set to generate SIMD code for reduction operations.

See “Generate SIMD Code for MATLAB Functions”.

Parallelize for-loops performing reduction operations, specified as one of the values in this table.

| Value | Description                                                                                                                                                                    |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Code generator does not automatically parallelize for-loops performing reduction operations.                                           |
| true  | The code generator automatically parallelizes for-loops performing reduction operations in the generated code, only if you set <code>EnableAutoParallelization</code> to true. |

See “Parallelize for Loops Performing Reduction Operations”.

### OutputType — Output to build from generated C/C++ code

'LIB' | 'DLL' | 'EXE'

Output to build from generated C/C++ code, specified as one of the values in this table.

| Value | Description                |
|-------|----------------------------|
| 'LIB' | Static library             |
| 'DLL' | Dynamically linked library |
| 'EXE' | Executable program         |

### PassStructByReference — Pass structures by reference

true (default) | false

Pass structures by reference to entry-point functions, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                          |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The generated code passes structures by reference, which reduces memory usage and execution time by minimizing the number of copies of parameters at entry-point function boundaries.<br><br><b>Note</b> An entry-point function that writes to a field of a structure parameter overwrites the input value. |
| false | The generated code passes structures by value.                                                                                                                                                                                                                                                                                                       |

This parameter applies only to entry-point functions.

See “Pass Structure Arguments by Reference or by Value in Generated Code”.

### PostCodeGenCommand — Command to customize build processing

' ' (default) | character vector

Command to customize build processing after MEX function generation with `codegen`, specified as a character vector.

See “Build Process Customization”.

### **PreserveArrayDimensions – N-dimensional indexing**

false (default) | true

Generation of code that uses N-dimensional indexing, specified as one of the values in this table.

| <b>Value</b> | <b>Description</b>                                                                   |
|--------------|--------------------------------------------------------------------------------------|
| false        | Generate code that uses one-dimensional indexing. (This value is the default value.) |
| true         | Generate code that uses N-dimensional indexing.                                      |

See “Generate Code That Uses N-Dimensional Indexing”.

### **PreserveVariableNames – Variable names to preserve in the generated code**

'None' (default) | 'UserNames' | 'All'

Variable names to preserve in the generated code, specified as one of the values in this table.

| <b>Value</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'None'       | <p>This value is the default value.</p> <p>The code generator does not have to preserve any variable names. It can reuse any variables that meet the requirements for variable reuse.</p> <p>If your code uses large structures or arrays, setting <code>PreserveVariableNames</code> to 'None' can reduce memory usage or improve execution speed.</p>                                                                                                                                                                                                                                                                                                          |
| 'UserNames'  | <p>The code generator preserves names that correspond to variables that you define in the MATLAB code. It does not replace your variable name with another name and does not use your name for another variable. To improve readability, set <code>PreserveVariableNames</code> to 'UserNames'. Then, you can more easily trace the variables in the generated code back to the variables in your MATLAB code.</p> <p>Setting <code>PreserveVariableNames</code> to 'UserNames' does not prevent an optimization from removing your variables from the generated code or prevent the C/C++ compiler from reusing the variables in the generated binary code.</p> |
| 'All'        | <p>Preserve all variable names. This parameter value disables variable reuse. Use it only for testing or debugging, not for production code.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

See “Preserve Variable Names in Generated Code”.



**ReportInfoVarName — Name of variable containing code generation report information**

'' (default) | character vector

Name of variable to which you export information about code generation, specified as a character vector. The code generator creates this variable in the base MATLAB workspace. This variable contains information about code generation settings, input files, generated files, and code generation messages.

See “Access Code Generation Report Information Programmatically” and `coder.ReportInfo` Properties.

**ReportPotentialDifferences — Potential differences reporting**

true (default) | false

Potential difference reporting, specified as one of the values in this table:

| Value | Description                                                                                                                                                                                                                                                                  |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | The code generator reports potential behavior differences between generated code and MATLAB code. The potential differences are listed on a tab of the code generation report. A potential difference is a difference that occurs at run time only under certain conditions. |
| false | The code generator does not report potential differences.                                                                                                                                                                                                                    |

See “Potential Differences Reporting”.

**ReservedNameArray — Names that code generator must not use for functions or variables**

'' (default) | string array | cell array of character vectors | character vector

List of names that the code generator must not use for functions or variables, specified as a string arrays, cell array of character vectors, or character vector.

Multiple reserved names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String arrays                   | A string array in <code>ReservedNameArray</code> . For example, <code>cfg.ReservedNameArray = ["reserve1", "reserve2", "reserve3"]</code> .                    |
| Cell array of character vectors | A cell array of character vectors in <code>ReservedNameArray</code> . For example, <code>cfg.ReservedNameArray = {'reserve1', 'reserve2', 'reserve3'}</code> . |

| Value             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Character vectors | <p>A semicolon-separated list of reserved names in <code>ReservedNameArray</code>. For example, <code>cfg.ReservedNameArray = 'reserve1; reserve2; reserve3'</code>.</p> <p><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a>.</p> |

**RowMajor – Row-major array layout**

false (default) | true

Generation of code that uses row-major array layout, specified as one of the values in this table.

| Value | Description                                                                           |
|-------|---------------------------------------------------------------------------------------|
| false | Generate code that uses column-major array layout. (This value is the default value.) |
| true  | Generate code that uses row-major array layout.                                       |

See “Generate Code That Uses Row-Major Array Layout”.

**RunInitializeFcn – Automatically run the initialize function**

true (default) | false

Generation of a call to the initialize function at the beginning of the generated entry-point functions, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                               |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>A call to the initialize function is included at the beginning of the generated entry-point functions. The generated code includes checks to make sure that the initialize function is called only once, even if there are multiple entry-point functions.</p> |
| false | The generated entry-point functions do not include calls to the initialize function.                                                                                                                                                                                                                      |

See “Use Generated Initialize and Terminate Functions”.

Dependency:

- Setting `MultiInstanceCode` to true disables this parameter.

**RuntimeChecks – Run-time error detection and reporting in generated code**

false (default) | true

Run-time error detection and reporting in generated code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The generated code does not check for errors such as out-of-bounds array indexing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| true  | The generated code checks for errors such as out-of-bounds array indexing.<br><br>The error-reporting software uses <code>fprintf</code> to write error messages to <code>stderr</code> . It uses <code>abort</code> to terminate the application. If <code>fprintf</code> and <code>abort</code> are not available, you must provide them. The <code>abort</code> function abruptly terminates the program. If your system supports signals, you can catch the <code>abort</code> signal (SIGABRT) so that you can control the program termination.<br><br>Error messages are in English. |

See “Generate Standalone C/C++ Code That Detects and Reports Run-Time Errors”.

#### SaturateOnIntegerOverflow — Integer overflow support

true (default) | false

Integer overflow support, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces code to handle integer overflow. Overflows saturate to either the minimum or maximum value that the data type can represent.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| false | The code generator does not produce code to handle integer overflow. Do not set <code>SaturateOnIntegerOverflow</code> to <code>false</code> unless you are sure that your code does not depend on integer overflow support. If you disable integer overflow support and run-time error checking is enabled, the generated code produces an error for overflows. If you disable integer overflow support and you disable run-time error checking, the overflow behavior depends on your target C compiler. In the C standard, the behavior for integer overflow is undefined. However, most C compilers wrap on overflow. |

This parameter applies only to MATLAB built-in integer types. It does not apply to doubles, singles, or fixed-point data types.

See “Disable Support for Integer Overflow or Nonfinites”.

**StackUsageMax — Maximum stack usage per application**

200000 (default) | positive integer

Maximum stack usage per application, in bytes, specified as a positive integer. Set a limit that is lower than the available stack size. Otherwise, a run-time stack overflow might occur. The C compiler detects and reports stack overflows.

See “Disable Support for Integer Overflow or Nonfinites”.

**SupportNonFinite — Support for nonfinite values**

true (default) | false

Support for nonfinite values, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If <code>GenerateNonFiniteFilesIfUsed</code> is set to <code>true</code> , the code generator produces code to support nonfinite values ( <code>Inf</code> and <code>NaN</code> ) only if they are used.<br><br>If <code>GenerateNonFiniteFilesIfUsed</code> is set to <code>false</code> , the code generator always produces code to support nonfinite values ( <code>Inf</code> and <code>NaN</code> ). |
| false | The code generator does not produce code to support nonfinite values.                                                                                                                                                                                                                                                                                                                                                                              |

See “Disable Support for Integer Overflow or Nonfinites”.

**TargetLang — Language to use in generated code**

'C' (default) | 'C++'

Language to use in generated code, specified as 'C' or 'C++'. If you specify C++, the code generator wraps the C code into .cpp files so that you can use a C++ compiler and interface with external C++ applications. It does not generate C++ classes.

When using GPU Coder, the code generator sets `TargetLang` to C++.

Dependency: If `DeepLearningConfig` is set, `codegen` sets `TargetLang` to C++.

**TargetLangStandard — Language standard to use for the generated code**

'Auto' (default) | 'C89/C90 (ANSI)' | 'C99 (ISO)' | 'C++03 (ISO)' | 'C++11 (ISO)'

The 'Auto' option uses the `TargetLang` setting to choose which language standard to use for the generated code. The default language standard depends on the language that you select. For C, the default library is 'C99 (ISO)'. For C++, the default library is 'C++11 (ISO)'.

Language standards to use for the generated code, specified as one of these character vectors:

- 'C89/C90 (ANSI)'
- 'C99 (ISO)'
- 'C++03 (ISO)'

- 'C++11 (ISO)'

The code generator uses the standard library for calls to math and other operations.

See “Change the Language Standard”.

### **Toolchain — Toolchain to use for building a C/C++ library or executable program**

'Automatically locate an installed toolchain' (default) | character vector

Toolchain to use for building a C/C++ library or executable program, specified as a character vector. The list of available toolchains depends on the host computer platform, and can include custom toolchains that you added. If you do not specify a toolchain, the code generator locates an installed toolchain.

Note:

- Suppose that you create a `coder.CodeConfig` object `cfg` in a MATLAB session and use it in another MATLAB session. If the MATLAB host computer for the second session does not have the toolchain specified in the `cfg.Toolchain` property installed on it, this parameter reverts to its default value. The default value is 'Automatically locate an installed toolchain'.

### **Verbose — Code generation progress display (to be removed)**

false (default) | true

Code generation progress display, specified as one of the values in this table.

| Value | Description                                                                                                 |
|-------|-------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not display code generation progress.       |
| true  | The code generator displays code generation progress, including code generation stages and compiler output. |

### **Verbosity — Code generation progress display**

'Info' (default) | 'Silent' | 'Verbose'

Whether to display the status of the code generation progress at the MATLAB command line, specified as one of the values in this table.

| Value    | Description                                                                                                                                                      |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Silent' | If code generation succeeds without warning, all messages are suppressed, including when you generate a report.<br><br>Warning and error messages are displayed. |

| Value     | Description                                                                                                                                                                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Info'    | This value is the default value.<br><br>Compared to the 'Silent' mode, if code generation succeeds, these additional messages are displayed: <ul style="list-style-type: none"> <li>• Code generation successful</li> <li>• Link to the generated report, if any</li> </ul> |
| 'Verbose' | In addition to the messages shown in the 'Info' mode, code generation status and target build log messages are displayed.                                                                                                                                                   |

## Examples

### Specify Configuration Parameters for Generation of Standalone Code

Write a MATLAB function from which you can generate code. This example uses the function `myadd` that returns the sum of its inputs.

```
function c = myadd(a,b)
c = a + b;
end
```

Create a configuration object for generation of standalone C/C++ code (a static library, a dynamically linked library, or an executable program). For example, create a configuration object for generation of a static library.

```
cfg = coder.config('lib');
```

Change the values of the properties for which you do not want to use the default values. For example, enable run-time error detection and reporting in the generated C/C++ code.

```
cfg.RuntimeChecks = true;
```

Generate code by using `codegen`. Pass the configuration object to `codegen` by using the `-config` option. Specify that the input arguments are scalar double.

```
codegen myadd -config cfg -args {1 1} -report
```

### Alternative Functionality

To use default configuration parameters for build types 'LIB', 'DLL', or 'EXE', use the `codegen` option `-config:lib`, `-config:dll`, or `-config:exe`, respectively. Then, you do not have to create and pass a configuration object to `codegen`.

### Compatibility Considerations

#### Capability to Specify Multiple Entries in Code Configuration Objects by Using Character Vector Will Be Removed

*Behavior change in future release*

In a future release, specifying multiple file names, paths, or reserved names in code configuration objects by using character vectors or string scalars that have delimiters will be removed. Use string arrays and a cell array of character vector instead. For example, to include multiple folder names, you can use either a string array in `CustomInclude` as `cfg.CustomInclude = ["C:\Project", "C:\Custom Files"]`; or a cell array of character vectors as `cfg.CustomInclude = {'C:\Project', 'C:\Custom Files'}`; to include the path for compiling the generated code.

### **Verbose Property To Be Removed**

*Behavior change in future release*

In a future release, the `Verbose` property will be removed.

To configure the code generation progress display, use the `Verbosity` property.

### **DynamicMemoryAllocation Property To Be Removed**

*Not recommended starting in R2022a*

In a future release, the `DynamicMemoryAllocation` property will be removed.

To dynamically allocate memory for variable-size arrays, use the configuration parameter `DynamicMemoryAllocationForVariableSizeArrays`.

Do not use `DynamicMemoryAllocation` and `DynamicMemoryAllocationForVariableSizeArrays` together during code generation.

## **See Also**

### **Functions**

`codegen` | `coder.config` | `pathsep`

### **Objects**

`coder.MexCodeConfig` | `coder.EmbeddedCodeConfig` | `coder.HardwareImplementation`

### **Topics**

“Generating Standalone C/C++ Executables from MATLAB Code”

“Specify Configuration Parameters in Command-Line Workflow Interactively”

### **Introduced in R2011a**

## coder.EmbeddedCodeConfig

Configuration parameters for C/C++ code generation from MATLAB code with Embedded Coder

### Description

A `coder.EmbeddedCodeConfig` object contains the configuration parameters that `codegen` uses for generating a static library, a dynamically linked library, or an executable program with Embedded Coder. Pass the object to the `codegen` function by using the `-config` option.

### Creation

Create a `coder.EmbeddedCodeConfig` object by using the `coder.config` function.

Once you create a `coder.EmbeddedCodeConfig` object, you can modify its properties programmatically at the command line or interactively by using the Configuration Parameter Dialog Box. See “Specify Configuration Parameters in Command-Line Workflow Interactively”.

### Properties

#### BuildConfiguration — Compiler optimization or debug settings for toolchain

'Faster Runs' (default) | 'Faster Builds' | 'Debug' | 'Specify'

Compiler optimization or debug settings for toolchain, specified as one of the values in this table.

| Value           | Description                                                                                                                                                                                                                                                                                                                                    |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Faster Builds' | Optimizes the build for shorter build times.                                                                                                                                                                                                                                                                                                   |
| 'Faster Runs'   | Optimizes the build for faster running executables.                                                                                                                                                                                                                                                                                            |
| 'Debug'         | Optimizes the build for debugging.                                                                                                                                                                                                                                                                                                             |
| 'Specify'       | Enables the <code>CustomToolchainOptions</code> property for customization of settings for tools in the selected toolchain. If the <code>Toolchain</code> property is set to 'Automatically locate an installed toolchain', then setting <code>BuildConfiguration</code> to 'Specify' changes <code>Toolchain</code> to the located toolchain. |

#### CacheDynamicArrayDataPointer — Dynamic array optimization

true (default) | false

Dynamic array optimization, specified as one of the values in this table.



| Value | Description                                                                                                                                    |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator improves the execution time of generated C code by optimizing dynamic array access. |
| false | The code generator does not optimize dynamic array access.                                                                                     |

See “Optimize Dynamic Array Access”.

### CastingMode – Data type casting level

'Nominal' (default) | 'Standards' | 'Explicit'

Data type casting level for variables in the generated C/C++ code, specified as one of the values in this table.

| Value       | Description                                                                                                                                                                                                                                                            |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Nominal'   | This value is the default value.<br><br>Generates C/C++ code that uses default C compiler data type casting. For example:<br><br><pre>short addone(short x) {     int i;     i = x + 1;     if (i &gt; 32767) {         i = 32767;     }      return (short)i; }</pre> |
| 'Standards' | Generates C/C++ code that casts data types to conform to MISRA standards. For example:<br><br><pre>short addone(short x) {     int i;     i = (int)x + (int)1;     if (i &gt; (int)32767) {         i = (int)32767;     }      return (short)i; }</pre>                |

| Value      | Description                                                                                                                                                                                                                 |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Explicit' | Generates C/C++ code that casts data type values explicitly. For example:<br><br><pre>short addone(short x) {     int i;     i = (int)x + 1;     if (i &gt; 32767) {         i = 32767;     }      return (short)i; }</pre> |

See “Control Data Type Casts in Generated Code” (Embedded Coder).

#### **ClangFormatFile — Control generation of clang-format file**

'Generate' (default) | 'Existing'

Set this option to specify if you want to generate or use an existing clang-format file to format the generated code. Choose the formatting file selection method, specified as one of the values in the table.

| Value      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Generate' | This value is the default value.<br><br>Creates a clang-format file for your build based on your configuration settings. The clang-format file is generated in the codegen folder.                                                                                                                                                                                                                                                                                                                                                                 |
| 'Existing' | Formats the generated code by using a clang-format file of your choice. Using clang-format enables detailed control over the formatting of your generated code.<br><br>The code generator searches for an existing clang-format file in the code generation folder and then the folder tree above the code generation folder. The code generator looks for files whose name includes _clang-format or is a .clang-format file that it finds. If it is unable to find the required file, the code generator uses the built-in format specification. |

For more information, see <https://clang.llvm.org/docs/ClangFormatStyleOptions.html>.

#### **CodeExecutionProfiling — Execution time profiling during a SIL or PIL execution**

false (default) | true

Execution-time profiling during a software-in-the-loop (SIL) or processor-in-the-loop (PIL) execution, specified as one of the values in this table.

| Value | Description                                                                                              |
|-------|----------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Disables execution-time profiling during a SIL or PIL execution. |
| true  | Enables execution-time profiling during a SIL or PIL execution.                                          |

See “Execution Time Profiling for SIL and PIL” (Embedded Coder).

### **CodeFormattingTool — Formatting tool for generated code**

'Auto' (default) | 'Clang-format' | 'MathWorks'

Code formatting options for generated code, specified as one of the values in the table.

| Value          | Description                                                                                                                                                                                                                                                              |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Clang-format' | The code generator formats the generated code according to a clang-format file.                                                                                                                                                                                          |
| 'Auto'         | Uses an internal heuristic to determine if the generated code is formatted by clang-format or a MathWorks formatting tool.<br><br>To determine whether the generated code is formatted by clang-format, in a coder.config object, set the Verbosity option to 'Verbose'. |
| 'MathWorks'    | Causes the code generator to revert to the MathWorks formatting tool.                                                                                                                                                                                                    |

### **CodeTemplate — Code generation template for file and function banners**

[] (default) | coder.MATLABCodeTemplate object

Code generation template for file and function banners in the generated code. By default, CodeTemplate is empty and the code generator produces default banners. To produce custom banners, set CodeTemplate to a coder.MATLABCodeTemplate object created from a code generation template (CGT) file. See “Generate Custom File and Function Banners for C/C++ Code” (Embedded Coder).

### **CodeReplacementLibrary — Code replacement library for generated code**

character vector

Code replacement library for generated code, specified as one of the values in this table:

| Value  | Description                                                                      |
|--------|----------------------------------------------------------------------------------|
| 'None' | This value is the default value.<br><br>Does not use a code replacement library. |

| Value                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Named code replacement library | <p>Generates calls to a specific platform, compiler, or standards code replacement library. The list of named libraries depends on:</p> <ul style="list-style-type: none"> <li>• Installed support packages.</li> <li>• System target file, language, language standard, and device vendor configuration.</li> <li>• Whether you created and registered code replacement libraries, using the Embedded Coder product.</li> </ul> |

Compatible libraries depend on these parameters:

- TargetLang
- TargetLangStandard
- ProdHWDeviceType in the hardware implementation configuration object.

Embedded Coder offers more libraries and the ability to create and use custom code replacement libraries.

MATLAB Coder generates the minimal set of `#include` statements for header files required by the selected code replacement library.

Before setting this parameter, verify that your compiler supports the library that you want to use. If you select a parameter value that your compiler does not support, compiler errors can occur.

---

**Note** MATLAB Coder software does not support TLC callbacks.

---

**ColumnLimit** — Maximum number of columns before a line break in the generated code  
80 (default) | positive integer

Maximum number of columns before a line break in the generated code, specified as a positive integer in the range [45, 65536].

Other rules for placement of the line break can take precedence over the column limit that you specify.

**CommentStyle** — Comment style in the generated code  
'Auto' (default) | 'Single-line' | 'Multi-line'

Comment style in the generated code, specified as one of the values in this table.

| Value         | Description                                                                              |
|---------------|------------------------------------------------------------------------------------------|
| 'Auto'        | For C, generate multiline comments. For C++, generate single-line comments.              |
| 'Single-line' | Generate single-line comments preceded by <code>//</code> .                              |
| 'Multi-line'  | Generate single or multiline comments delimited by <code>/*</code> and <code>*/</code> . |

For C code generation, specify the single-line comment style only if your compiler supports it.

Dependency: `GenerateComments` enables this parameter.

See “Specify Comment Style for C/C++ Code” (Embedded Coder).

### **CompileTimeRecursionLimit** — Maximum number of function specializations for compile-time recursion

50 (default) | positive integer

Maximum number of function specializations for compile-time recursion, specified as a positive integer. To disallow recursion in the MATLAB code, set `CompileTimeRecursionLimit` to 0. The default compile-time recursion limit is large enough for most recursive functions that require this type of recursion. If code generation fails because of the compile-time recursion limit, and you want compile-time recursion, try to increase the limit. Alternatively, change your MATLAB code so that the code generator uses run-time recursion. See “Compile-Time Recursion Limit Reached”.

### **ConstantFoldingTimeout** — Maximum number of instructions to be executed by the constant folder

40000 (default) | positive integer

Maximum number of instructions that the constant folder executes. In some situations, code generation requires specific instructions to be constant. If constant folding stops before these instructions are constant-folded, code generation fails. In this case, increase the value of `ConstantFoldingTimeout`.

See “MATLAB Coder Optimizations in Generated Code”.

### **ConvertIfToSwitch** — Conversion of if-elseif-else patterns to switch-case statements

false (default) | true

Conversion of if-elseif-else patterns to switch-case statements in the generated code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not convert if-elseif-else patterns to switch-case statements.                                                                               |
| true  | The code generator tries to convert if-elseif-else patterns to switch-case statements. The code generator produces a switch-case statement only if all potential case expressions are scalar integer values. |

See “Controlling C Code Style” (Embedded Coder).

### **CppGenerateEnumClass** — Generate C++11 enumeration class for MATLAB enumeration

true (default) | false

Whether to generate C++11 code that contains enumeration classes or ordinary C enumerations, specified as one of the values in this table.

| Value | Description                                                                                                                                                                          |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces enumeration classes for MATLAB enumerations in the generated C++11 code. See “Code Generation for Enumerations”. |
| false | The code generator produces ordinary C enumerations for MATLAB enumerations in the generated C++11 code.                                                                             |

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

#### **CppInterfaceClassName — Interface class name for generated C++ code**

' ' (default) | character vector

Name of interface class when you generate C++ code with `CppInterfaceStyle` set to 'Methods'. In this case, the generated code for MATLAB entry-point functions consists of methods contained in a C++ class with name specified by `CppInterfaceClassName`. This property has no effect when you set `CppInterfaceStyle` to 'Functions'.

See “Generate C++ Code with Class Interface”.

#### **CppInterfaceStyle — Interface style for generated C++ code**

'Functions' (default) | 'Methods'

Style of interface to the generated C++ code for the MATLAB entry-point functions that you generate code from. By default, entry-point functions become C++ functions. If you choose 'Methods', then entry-point functions become methods in a C++ class. Specify the name of the class by using the property `CppInterfaceClassName`.

See “Generate C++ Code with Class Interface”.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

#### **CppPackagesToNamespaces — Generate C++ namespaces for MATLAB packages**

true (default) | false

Whether to generate C++ namespaces for the packages in your MATLAB code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                 |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces C++ namespaces for the packages in your MATLAB code. See “Organize Generated C++ Code into Namespaces”. |

| Value | Description                                                                              |
|-------|------------------------------------------------------------------------------------------|
| false | The code generator does not produce C++ namespaces for the packages in your MATLAB code. |

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

Data Types: logical

### CppNamespace — Namespace name for generated C++ code

' ' (default) | character vector

Namespace for the generated C++ code. The code generator does not produce code in a namespace unless you specify a nonempty character vector.

See “Organize Generated C++ Code into Namespaces”.

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

### CppNamespaceForMathworksCode — Place C++ code generated for MathWorks code in a separate namespace

' coder ' (default) | character vector

Namespace for the C++ code generated for MathWorks code. The code generator does not produce such a namespace if you specify this property as an empty character vector.

See “Organize Generated C++ Code into Namespaces”.

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

Data Types: char

### CppPreserveClasses — Generate C++ classes for MATLAB classes

true (default) | false

Whether to generate C++ classes or C style structures for MATLAB classes, specified as one of the values in this table.

| Value | Description                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces C++ classes for MATLAB classes. See “Generate C++ Classes for MATLAB Classes”. |
| false | The code generator produces C style structures for MATLAB classes.                                                                                 |

When using GPU Coder, the code generator always disables this parameter.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

Data Types: `logical`

#### **CustomBLASCallback — BLAS callback class**

' ' (default) | character vector

Callback class for BLAS library calls in code generated for certain low-level vector and matrix operations in MATLAB code, specified as a character vector.

If you specify a BLAS callback class, for certain low-level vector and matrix functions, the code generator produces BLAS calls by using the CBLAS C interface to your BLAS library. The callback class provides the name of your CBLAS header file, the names of CBLAS data types, and the information required to link to your BLAS library. If this parameter is empty, the code generator produces code for matrix functions instead of a BLAS call.

See “Speed Up Matrix Operations in Generated Standalone Code by Using BLAS Calls”.

#### **CustomFileNameStr — File name customization macro**

'\$N\$M' (default) | character vector

Macro that specifies the customization of generated file names with additional characters and tokens. For more information, see “Customize C/C++ File Names Generated from MATLAB Code” (Embedded Coder).

#### **CustomFFTCallback — Callback class for FFTW library calls**

' ' (default) | character vector

Callback class for FFTW library calls in code generated for FFT functions in MATLAB code, specified as a character vector.

To improve the execution speed of FFT functions, the code generator produces calls to the FFTW library that you specify in the callback class. If this parameter is empty, the code generator uses its own algorithms for FFT functions instead of calling the FFTW library.

See “Speed Up Fast Fourier Transforms in Generated Standalone Code by Using FFTW Library Calls”.

#### **CustomHeaderCode — Custom code that appears at top of generated C/C++ header files**

' ' (default) | character vector

Custom code that appears near the top of each C/C++ header file generated from your MATLAB code, except `rtwtypes.h` and `rtwhalf.h`, specified as a character vector.

#### **CustomInclude — Include folders to add to include path for compiling generated code**

' ' (default) | string array | cell array of character vectors | character vector

Include folders to add to the include path when compiling the generated code. Specify the list of include folders as a string array, cell array of character vector, or character vector.

Multiple folder names, specified as one of the values in this table.



| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in CustomInclude. For example, <code>cfg.CustomInclude = ["C:\Project", "C:\Custom Files"];</code>                                                                                                                                                                                                                                                                                                                            |
| Cell array of character vectors | A cell array of character vectors in CustomInclude. For example, <code>cfg.CustomInclude = {'C:\Project', 'C:\Custom Files'};</code>                                                                                                                                                                                                                                                                                                         |
| Character vector                | Separate include folders by a pathsep character in CustomInclude. For example, <code>cfg.CustomInclude = ['C:\Project' pathsep 'C:\Custom Files'];</code><br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

#### CustomInitializer – Custom code to include in the generated initialize function

'' (default) | character vector

Custom code to include in the generated initialize function, specified as a character vector.

#### CustomLAPACKCallback – LAPACK callback class

'' (default) | character vector

Callback class for LAPACK library calls in code generated for certain linear algebra functions in MATLAB code, specified as a character vector.

If you specify a LAPACK callback class, for certain linear algebra functions, the code generator produces LAPACK calls by using the LAPACKE C interface to your LAPACK library. The callback class provides the name of your LAPACKE header file and the information required to link to your LAPACK library. If this parameter is empty, the code generator produces code for linear algebra functions instead of a LAPACK call.

See “Speed Up Linear Algebra in Generated Standalone Code by Using LAPACK Calls”.

#### CustomLibrary – Static library files to link with the generated code

'' (default) | string array | cell array of character vectors | character vector

Static library files to link with the generated code, specified as a string array, cell array of character vector, or character vector.

Multiple static library file names, specified as one of the values in this table.

| Value        | Description                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------|
| String array | A string array in CustomLibrary. For example, <code>cfg.CustomLibrary = ["myLib1.lib", "myLib2.lib"];</code> |

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cell array of character vectors | A cell array of character vectors in <code>CustomLibrary</code> . For example, <code>cfg.CustomLibrary = {'myLib1.lib', 'myLib2.lib'};</code>                                                                                                                                                                                                                                                                                                                                |
| Character vector                | Separate static library file names by a <code>pathsep</code> character in <code>CustomLibrary</code> . For example, <code>cfg.CustomLibrary = ['myLib1.lib' pathsep 'myLib2.lib'];</code><br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

#### CustomSource — Source files to compile and link with the generated code

' ' (default) | string array | cell array of character vectors | character vector

Source files to compile and link with the generated code, specified as a string array, cell array of character vector, or character vector.

The build process searches for the source files first in the current folder, and then in the include folders that you specify in `CustomInclude`. If source files with the same name occur in multiple folders on the search path, the build process might use a different file than the file that you specified.

Suppose that you specify `foo.cpp` as a source file. If `foo.c` and `foo.cpp` are both on the search path, you cannot be sure whether the build process uses `foo.c` or `foo.cpp`.

Multiple source file names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in <code>CustomSource</code> . For example, <code>cfg.CustomSource = ["mySrc1.c", "mySrc2.c"];</code>                                                                                                                                                                                                                                                                                                                                           |
| Cell array of character vectors | A cell array of character vectors in <code>CustomSource</code> . For example, <code>cfg.CustomSource = {'mySrc1.c', 'mySrc2.c'};</code>                                                                                                                                                                                                                                                                                                                        |
| Character vector                | Separate source file names by a <code>pathsep</code> character in <code>CustomSource</code> . For example, <code>cfg.CustomSource = ['mySrc1.c' pathsep 'mySrc2.c'];</code><br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

#### CustomSourceCode — Code to appear near the top of generated .c or .cpp files

' ' (default) | character vector

Specify code to appear near the top of each generated `.c` or `.cpp` file (except `rtwhalf.c` or `rtwhalf.cpp`), outside of any function. Specify code as a character vector.

Do not specify a C static function definition.

#### **CustomSymbolStrEMXArray — Custom identifier format for EMX array types**

'emxArray\_\$\$N' (default) | character vector

Custom identifier format for generated EMX Array types (Embeddable mxArray types), specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrEMXArrayFcn — Custom identifier format for EMX array utility functions**

'emx\$\$N' (default) | character vector

Custom identifier format for generated EMX Array (Embeddable mxArrays) utility functions, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrFcn — Custom identifier format for local function identifiers**

'm\_\$\$N' (default) | character vector

Custom identifier format for generated local function identifiers, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrField — Custom identifier format for field names in global type identifiers**

'\$\$N' (default) | character vector

Custom identifier format for generated field names in global type identifiers, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrGlobalVar — Custom identifier format for global variable identifiers**

'\$\$N' (default) | character vector

Custom identifier format for generated global variable identifiers, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrMacro — Custom identifier format for constant macro identifiers**

'\$\$N' (default) | character vector

Custom identifier format for generated constant macro identifiers, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrTmpVar — Custom identifier format for local temporary variable identifiers**

'\$\$N' (default) | character vector

Custom identifier format for generated local temporary variable identifiers, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomSymbolStrType — Custom identifier format for global type identifiers**

'\$\$N' (default) | character vector

Custom identifier format for generated global type identifiers, specified as a character vector. To specify the format, see “Customize Generated Identifiers” (Embedded Coder).

#### **CustomTerminator — Code that appears in the generated terminate function**

' ' (default) | character vector

Code that appears in the generated terminate function, specified as a character vector.

**CustomToolchainOptions — Custom settings for tools in selected toolchain**

cell array

Custom settings for tools in selected toolchain, specified as a cell array.

Dependencies:

- The `Toolchain` property determines which tools and options appear in the cell array.
- Setting the `BuildConfiguration` property to `Specify` enables `CustomToolchainOptions`.

First, get the current settings. For example:

```
cfg = coder.config('lib');
cfg.BuildConfiguration='Specify';
opt = cfg.CustomToolchainOptions
```

Then, edit the values in `opt`.

These values derive from the toolchain definition file and the third-party compiler options. See “Custom Toolchain Registration”.

**DataTypeReplacement — Data type replacement in generated code**

'CBuiltIn' | 'CoderTypeDefs'

Data type replacement in generated code, specified as one of the values in this table.

| Value           | Description                                                                        |
|-----------------|------------------------------------------------------------------------------------|
| 'CBuiltIn'      | This value is the default value.<br>The code generator uses built-in C data types. |
| 'CoderTypeDefs' | The code generator uses predefined data types from <code>rtwtypes.h</code>         |

**DeepLearningConfig — Configuration object for deep learning code generation**

`coder.MkLDNNConfig` object | `coder.ARMNEONConfig` object | `coder.CuDNNConfig` object | `coder.TensorRTConfig` object

Configuration object for code generation for deep learning networks, specified as specified as one of the objects in this table.

| Object              | Requires                                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| coder.MkLDNNConfig  | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• MATLAB Coder Interface for Deep Learning Libraries support package</li> </ul>                   | <p>A coder.MkLDNNConfig object contains parameters specific to C++ code generation for deep learning using Intel MKL-DNN. To create a coder.MkLDNNConfig object, use coder.DeepLearningConfig. For example:</p> <pre>cfg = coder.config('mex'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks with MKL-DNN”.</p>                         |
| coder.ARMNEONConfig | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• MATLAB Coder Interface for Deep Learning Libraries support package</li> </ul>                   | <p>A coder.ARMNEONConfig object contains parameters specific to C++ code generation for deep learning using the ARM Compute Library. To create a coder.ARMNEONConfig object, use coder.DeepLearningConfig. For example:</p> <pre>cfg = coder.config('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks with ARM Compute Library”.</p> |
| coder.CuDNNConfig   | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• GPU Coder</li> <li>• GPU Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A coder.CuDNNConfig object contains parameters specific to CUDA code generation for deep learning using the cuDNN library. To create a coder.CuDNNConfig object, use coder.DeepLearningConfig. For example:</p> <pre>cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks by Using cuDNN” (GPU Coder).</p>     |

| Object                            | Requires                                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>coder.TensorRTConfig</code> | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• GPU Coder</li> <li>• GPU Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A <code>coder.TensorRTConfig</code> object contains parameters specific to CUDA code generation for deep learning using the TensorRT library. To create a <code>coder.TensorRTConfig</code> object, use <code>coder.DeepLearningConfig</code>. For example:</p> <pre>cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks by Using TensorRT” (GPU Coder).</p> |

Dependency: If `DeepLearningConfig` is set, `codegen` sets `TargetLang` to `C++`.

#### Description — Object description

'class CodeConfig: C code generation configuration.' (default) | character vector

Object description, specified as a character vector.

#### DynamicMemoryAllocation — Dynamic memory allocation mode

'Threshold' (default) | 'AllVariableSizeArrays' | 'Off'

Dynamic memory allocation mode, specified as one of the values in this table.

| Value                   | Description                                                                                                                                                                                                                          |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Threshold'             | <p>This value is the default value.</p> <p>The code generator allocates memory dynamically on the heap for variable-size arrays whose size (in bytes) is greater than or equal to <code>DynamicMemoryAllocationThreshold</code>.</p> |
| 'AllVariableSizeArrays' | The code generator dynamically allocates memory for all variable-size arrays on the heap.                                                                                                                                            |
| 'Off'                   | The code generator statically allocates memory for variable-size arrays on the stack.                                                                                                                                                |

Unbounded variable-size arrays require dynamic memory allocation.

Dependencies:

- `EnableVariableSizing` enables this parameter.
- Setting this `DynamicMemoryAllocation` to 'Threshold' enables the `DynamicMemoryAllocationThreshold` parameter.

See “Generate Code for Variable-Size Data”.

### DynamicMemoryAllocationInterface – Dynamically allocated array at generated function interface

'Auto' (default) | 'C' | 'C++'

Implementation of dynamically allocated array at the interface of the generated C/C++ function, specified as one of the values in this table.

| Value  | Description                                                                                                                                                                                                                                                |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Auto' | This is the default value. If you set the TargetLang parameter to 'C++' or 'C', this value correspondingly behaves as the same flag.                                                                                                                       |
| 'C'    | The generated code uses the C style emxArray data structure to implement dynamically allocated arrays. See “Use C Arrays in the Generated Function Interfaces”.                                                                                            |
| 'C++'  | If you set the TargetLang parameter to 'C', this value is disabled.<br><br>The generated code uses the coder::array class template to implement dynamically allocated arrays. See “Use Dynamically Allocated C++ Arrays in Generated Function Interfaces”. |

When using GPU Coder, the code generator always uses the C style emxArray data structure.

Dependency:

- EnableVariableSizing enables this parameter.

### DynamicMemoryAllocationForFixedSizeArrays – Dynamic memory allocation mode for fixed-size arrays

'Never' (default) | 'Always' | 'Threshold'

Dynamic memory allocation mode for fixed-size arrays, specified as one of the values in this table.

| Value       | Description                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Never'     | This value is the default value.<br><br>The code generator statically allocates memory for fixed-size arrays on the stack.                                            |
| 'Always'    | The code generator dynamically allocates memory on the heap for all fixed-size arrays whose size is greater than 64 bytes.                                            |
| 'Threshold' | The code generator allocates memory dynamically on the heap for fixed-size arrays whose size (in bytes) is greater than or equal to DynamicMemoryAllocationThreshold. |

Dependencies:

- Setting DynamicMemoryAllocationForFixedSizeArrays to 'Threshold' enables the DynamicMemoryAllocationThreshold parameter.

**DynamicMemoryAllocationForVariableSizeArrays — Dynamic memory allocation mode for variable-size arrays**

'Threshold' (default) | 'Always' | 'Never'

Dynamic memory allocation mode for variable-size arrays, specified as one of the values in this table.

| Value       | Description                                                                                                                                                                                                                    |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Threshold' | This value is the default value.<br><br>The code generator allocates memory dynamically on the heap for variable-size arrays whose size (in bytes) is greater than or equal to <code>DynamicMemoryAllocationThreshold</code> . |
| 'Always'    | The code generator dynamically allocates memory for all variable-size arrays on the heap.                                                                                                                                      |
| 'Never'     | The code generator statically allocates memory for variable-size arrays on the stack.                                                                                                                                          |

Unbounded variable-size arrays require dynamic memory allocation.

Dependencies:

- Setting `DynamicMemoryAllocationForVariableSizeArrays` to 'Threshold' enables this parameter.

See “Generate Code for Variable-Size Data”.

**DynamicMemoryAllocationThreshold — Size threshold for dynamic memory allocation of variable-size arrays**

65536 (default) | positive integer

Size threshold for dynamic memory allocation of fixed-size and variable-size arrays, specified as a positive integer. The code generator uses dynamic memory allocation for fixed-size and variable-size arrays whose size (in bytes) is greater than or equal to the threshold.

Dependency:

- Setting `DynamicMemoryAllocation`, `DynamicMemoryAllocationForFixedSizeArrays`, or `DynamicMemoryAllocationForVariableSizeArrays` to 'Threshold' enables this parameter.

See “Generate Code for Variable-Size Data”.

**EnableAutoExtrinsicCalls — Automatic extrinsic function calls**

true (default) | false

Automatic extrinsic function calls, specified as one of the values in this table.



| Value | Description                                                                                                                                                                                                                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator treats some common visualization functions as extrinsic functions. You do not have to declare these functions as extrinsic by using <code>coder.extrinsic</code> . This capability reduces the amount of time that you spend making your code suitable for code generation. |
| false | The code generator does not treat common visualization functions as extrinsic functions unless you declare them as extrinsic by using <code>coder.extrinsic</code>                                                                                                                                                                     |

Some common visualization functions are `plot`, `disp`, and `figure`. See “Use MATLAB Engine to Execute a Function Call in Generated Code”.

#### **EnableAutoParallelization — Automatic parallelization of for loops**

false (default) | true

Automatic parallelization of `for` loops, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                             |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Code generator does not automatically parallelize <code>for</code> loops.                                                                                                                                       |
| true  | The code generator automatically parallelizes <code>for</code> loops in the generated code. Automatic parallelization can significantly improve the execution speed of the generated code. See “Automatically Parallelize for Loops in Generated Code”. |

When using GPU Coder, the code generator always enables automatic parallelization of `for` loops.

Data Types: `logical`

#### **EnableAutoParallelizationReporting — Reporting for automatic parallelization of for loops**

true (default) | false

Reporting for automatic parallelization of `for` loops, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                         |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If you set <code>EnableAutoParallelization</code> to true, the code generator produces a code generation report for automatic parallelization of for loops. |
| false | The code generator does not produce a code generation report for automatic parallelization of for loops.                                                                                            |

#### **EnableCustomReplacementTypes — Custom names for data types in generated code**

false (default) | true

Custom names for MATLAB data types in generated C/C++ code, specified as one of the values in the table.

| Value | Description                                                                                                                                                                                                                      |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Custom names for the MATLAB data types are not allowed.                                                                                                                                  |
| true  | Custom names for the MATLAB data types are allowed. Specify custom names by using <code>ReplacementTypes</code> . Setting <code>EnableCustomReplacementTypes</code> to true enables the <code>ReplacementTypes</code> parameter. |

#### **EnableImplicitExpansion — Implicit expansion capabilities in generated code**

true (default) | false

Implicit expansion capabilities in the generated code, specified as one of the values listed in this table.

| Value | Description                                                                                                                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator enables implicit expansion in the generated code. The code generator includes modifications in the generated code to apply implicit expansion. See “Compatible Array Sizes for Basic Operations”. |
| false | The generated code does not follow the rules of implicit expansion.                                                                                                                                                                                          |

Data Types: logical

#### **EnableMemcpy — memcpy optimization**

true (default) | false

memcpy optimization, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the memcpy optimization. To optimize code that copies consecutive array elements, the memcpy optimization replaces the code with a memcpy call. When the number of elements to copy is known at compile time, the code generator uses the MemcpyThreshold property to determine whether to use the optimization. See “memcpy Optimization”. |
| false | The code generator does not use the memcpy optimization.                                                                                                                                                                                                                                                                                                                                                                 |

When using GPU Coder, the code generator always disables Memcpy optimization.

#### **EnableOpenMP — Parallelization of parfor-loops**

true (default) | false

Parallelization of parfor-loops, specified as one of the values in this table.

| Value | Description                                                                                                                                      |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the OpenMP library to produce loop iterations that run in parallel. |
| false | The code generator treats parfor-loops as for-loops.                                                                                             |

See parfor.

Use of the OpenMP library is not compatible with just-in-time (JIT) compilation. If EnableJIT and EnableOpenMP are true, the code generator uses JIT compilation and treats parfor-loops as for-loops.

When using GPU Coder, the code generator always treats parfor-loops as for-loops.

#### **EnableRuntimeRecursion — Run-time recursion support**

true (default) | false

Run-time recursion support, specified as one of the values in this table.

| Value | Description                                                                                    |
|-------|------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Recursive functions are allowed in the generated code. |
| false | Recursive functions are not allowed in the generated code.                                     |

Some coding standards, such as MISRA, do not allow recursion. To increase the likelihood of generating code that is compliant with MISRA C, set `EnableRuntimeRecursion` to `false`.

If your MATLAB code requires run-time recursion and `EnableRuntimeRecursion` is `false`, code generation fails.

See “Code Generation for Recursive Functions”.

### **EnableSignedLeftShifts — Replacement of multiplications by powers of two with signed left bitwise shifts**

`true` (default) | `false`

Replacement of multiplications by powers of two with signed left bitwise shifts in the generated C/C++ code, specified as one of the values in this table.

| Value              | Description                                                                                                                                                                                                                                           |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | This value is the default value.<br><br>The code generator uses signed left shifts for multiplication by powers of two. An example of generated C code that uses signed left shift for multiplication by eight is:<br><br><code>i &lt;&lt;= 3;</code> |
| <code>false</code> | The code generator does not use signed left shifts for multiplication by powers of two. An example of generated C code that does not use signed left shift for multiplication by eight is:<br><br><code>i = i * 8;</code>                             |

GPU Coder always sets the `EnableSignedLeftShifts` property to `true`.

Some coding standards, such as MISRA, do not allow bitwise operations on signed integers. To increase the likelihood of generating MISRA C compliant code, set `EnableSignedLeftShifts` to `false`.

See “Control Signed Left Shifts in Generated Code” (Embedded Coder).

### **EnableSignedRightShifts — Signed right bitwise shifts in generated code**

`true` (default) | `false`

Signed right bitwise shifts in generated code, specified as one of the values in this table.

| Value             | Description                                                                                                                                                                              |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code> | This value is the default value.<br><br>The code generator uses signed right shifts. An example of generated C code that uses a signed right shift is:<br><br><code>i &gt;&gt;= 3</code> |

| Value | Description                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | The code generator replaces right shifts on signed integers with a function call in the generated code. For example:<br><br><code>i = asr_s32(i, 3U);</code> |

GPU Coder always sets the `EnableSignedRightShifts` property to true.

Some coding standards, such as MISRA, do not allow bitwise operations on signed integers. To increase the likelihood of generating MISRA-C:2004 compliant code, set `EnableSignedRightShifts` to false.

### EnableStrengthReduction – Strength reduction optimization

false (default) | true

Strength reduction optimization, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not use the strength reduction optimization.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| true  | The code generator tries to use the strength reduction optimization to simplify array indexing in loops in the generated code. When possible, for array indices in loops, the code generator replaces multiply operations with add operations. Multiply operations can be expensive. When the C/C++ compiler on the target platform does not optimize the array indexing, the strength reduction optimization is useful. Even when the optimization replaces the multiply operations in the generated code, it is possible that the C/C++ compiler can generate multiply instructions. |

### EnableTraceability – Traceability in code generation report

true (default) | false

Traceability in code generation report, specified as one of the values in this table.

| Value | Description                                                                                                                                                                             |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generation report includes code traceability. See “Interactively Trace Between MATLAB Code and Generated C/C++ Code” (Embedded Coder). |
| false | The code generation report does not include code traceability.                                                                                                                          |

**EnableVariableSizing – Variable-size array support**

true (default) | false

Variable-size array support, specified as one of the values in this table.

| Value | Description                                                                               |
|-------|-------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br>Variable-size arrays are allowed for code generation. |
| false | Variable-size arrays are not allowed for code generation.                                 |

Dependency:

- Enables Dynamic memory allocation.

See “Code Generation for Variable-Size Arrays”.

**FilePartitionMethod – File partitioning mode**

'MapMFileToCFile' (default) | 'SingleFile'

File partitioning mode specified as one of the values in this table.

| Value             | Description                                                                                                                                                                          |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'MapMFileToCFile' | This value is the default value.<br>The code generator produces separate C/C++ files for each MATLAB language file.                                                                  |
| 'SingleFile'      | The code generator produces a single file for C/C++ functions that map to your MATLAB entry-point functions. The code generator produces separate C/C++ files for utility functions. |

See “How MATLAB Coder Partitions Generated Code”.

**GenerateCodeMetricsReport – Static code metrics report**

false (default) | true

Static code metrics report, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                              |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br>The code generator does not run static code metrics analysis at code generation time. You can run the analysis and produce the report later by clicking <b>Code Metrics</b> on the <b>Summary</b> tab of the code generation report. |

| Value | Description                                                                                           |
|-------|-------------------------------------------------------------------------------------------------------|
| true  | The code generator runs static code metrics analysis and produces the report at code generation time. |

To open a code metrics report, click the **Code Metrics** link on the **Summary** tab of the code generation report.

Dependency:

- The code generator produces a static code metrics report only if **GenerateReport** is true or if you specify the `-report` option of the `codegen` report.

See “Generating a Static Code Metrics Report for Code Generated from MATLAB Code” (Embedded Coder).

### GenCodeOnly – Generation of only source code

false (default) | true

Generation of only source code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                          |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator produces C/C++ source code and builds object code.                                                                                                                        |
| true  | The code generator produces C/C++ source code, but does not invoke the <code>make</code> command or build object code. When you iterate between modifying MATLAB code and generating C/C++ code, generating only code can save time. |

### GenerateCodeReplacementReport – Code replacement report

false (default) | true

Code replacement report, specified as on of the values in this table.

| Value | Description                                                                                                                                                                                                                                                          |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not produce a code replacements report.                                                                                                                                                              |
| true  | The code generator produces a code replacements report that summarizes the replacements from the selected code replacement library. The report provides a mapping between each code replacement instance and the line of MATLAB code that triggered the replacement. |

### GenerateComments – Comments in generated code

true (default) | false

Comments in generated code, specified as one of the values in this table.

| Value | Description                                                                                       |
|-------|---------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator places comments in the generated code. |
| false | The code generator does not place comments in the generated code.                                 |

#### **GenerateDefaultInSwitch – Default case for all switch statements**

false (default) | true

Default case for all switch statements, specified as one of the values in this table.

| Value | Description                                                                                                              |
|-------|--------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator might not generate a default case for some switch statements. |
| true  | The code generator produces a default case for all switch statements in the generated code.                              |

Some coding standards, such as MISRA, require the default case for switch statements.

#### **GenerateExampleMain – Example C/C++ main file generation**

'GenerateCodeOnly' (default) | 'DoNotGenerate' | 'GenerateCodeAndCompile'

Example C/C++ main file generation, specified as one of the values in this table.

| Value                    | Description                                                                                                                                                                                                                                                                           |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'GenerateCodeOnly'       | This value is the default value.<br><br>The code generator generates an example C/C++ main function but does not compile it.                                                                                                                                                          |
| 'DoNotGenerate'          | The code generator does not generate an example C/C++ main function.                                                                                                                                                                                                                  |
| 'GenerateCodeAndCompile' | The code generator generates an example C/C++ main function and compiles it to create a test executable. This executable does not return output.<br><br>If the <code>GenCodeOnly</code> parameter is <code>true</code> , the code generator does not compile the C/C++ main function. |

An example main function is a template to help you to write a C/C++ main function that calls generated C/C++ code. See “Incorporate Generated Code Using an Example Main Function”.

#### **GenerateMakefile – Makefile generation**

true (default) | false



Makefile generation during the build process, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                  |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator generates a makefile during the build process.                                                                                                                                    |
| false | The code generator does not generate a makefile during the build process. Specify instructions for post-code-generation processing, including compilation and linking, in a post-code-generation command. See "Build Process Customization". |

**GenerateNonFiniteFilesIfUsed – Generate support files for nonfinite data only if nonfinite data is used**

true (default) | false

Generation of support files for nonfinite data, specified as one of the values in this table.

| Value | Description                                                                                                                                                            |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces the support files for nonfinite data (Inf and NaN) only if the generated code uses nonfinite data. |
| false | The code generator always produces the support files for nonfinite data (Inf and NaN).                                                                                 |

Dependency:

- Setting SupportNonFinite to true enables this parameter.

**GenerateReport – Code generation report**

false (default) | true

Code generation report, specified as one of the values in this table.

| Value | Description                                                                                                                                               |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator produces a report only if error or warning messages occur, or if you set LaunchReport to true. |
| true  | The code generator produces a code generation report.                                                                                                     |

**Hardware – Object that specifies a hardware board**

coder.Hardware object

Object that specifies a hardware board. To create the coder.Hardware object, use coder.hardware. For example:

```
cfg = coder.config('lib');
hw = coder.hardware('Raspberry Pi');
cfg.Hardware = hw;
```

Before you use `coder.hardware`, you must install the support package for the hardware board.

Dependencies:

- Setting `Hardware` customizes the hardware implementation object and other configuration parameters for a particular hardware board.
- If `DeepLearningConfig` is set to a `coder.ARMNEONConfig` object and `Hardware` is empty, then `codegen` sets the `GenCodeOnly` property to `true`.

Note:

- Suppose that you create a `coder.CodeConfig` object `cfg` in a MATLAB session and use it in another MATLAB session. If the MATLAB host computer for the second session does not have the hardware board specified in the `cfg.Hardware` property installed on it, this parameter reverts to its default value. The default value is `[]`. Setting the **Hardware Board** option to **MATLAB Host Computer** in the app is equivalent to using `cfg.Hardware` and `cfg.HardwareImplementation.ProdHWDeviceType` with their default value.

To specify a hardware board for PIL execution, see “PIL Execution with ARM Cortex-A at the Command Line” (Embedded Coder).

### HardwareImplementation — Hardware implementation object

`coder.HardwareImplementation` object

Hardware implementation object that specifies hardware-specific configuration parameters for C/C++ code generation. `coder.config` creates a `coder.EmbeddedCodeConfig` object with the `HardwareImplementation` property set to a `coder.HardwareImplementation` object with default parameter values for the MATLAB host computer.

### HeaderGuardStyle — Style of preprocessor directive in generated code

`UseIncludeGuard` (default) | `UsePragmaOnce`

To prevent compilation errors due to multiple inclusion of header files, the code generator produces either `#ifndef` or `#pragma once` constructs in generated header files. If your project uses distinct files that use the same preprocessor macros, then generate code with the `#pragma once` construct. The compilation behavior of `#pragma once` is not standardized.

Specify `HeaderGuardStyle` as one of the values in this table.

| Value                        | Description                                                                               |
|------------------------------|-------------------------------------------------------------------------------------------|
| <code>UseIncludeGuard</code> | The code generator produces <code>#ifndef</code> style <code>#include</code> guards.      |
| <code>UsePragmaOnce</code>   | The code generator produces <code>#pragma once</code> style <code>#include</code> guards. |

### HighlightPotentialDataTypeIssues — Highlighting of potential data type issues in the code generation report

`false` (default) | `true`

Highlighting of potential data type issues in the code generation report, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>This code generation report does not highlight potential data type issues.                                                                                                                                                                                                |
| true  | The code generation report highlights MATLAB code that results in single-precision or double-precision operations in the generated C/C++ code. If you have Fixed-Point Designer, the report also highlights expressions in the MATLAB code that result in expensive fixed-point operations in the generated code. |

### HighlightPotentialRowMajorIssues — Potential row-major layout issues

true (default) | false

Display of potential row-major layout efficiency issues, specified as one of the values in this table.

| Value | Description                                                                                                                 |
|-------|-----------------------------------------------------------------------------------------------------------------------------|
| true  | The code generation report displays potential efficiency issues due to row-major layout. (This value is the default value.) |
| false | The code generation report does not display issues related to array layout.                                                 |

See “Code Design for Row-Major Array Layout”.

### IncludeInitializeFcn — Initialize function generation

true (default) | false

Initialize function generation, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces an initialize function.                                                                                                                                                                                                                                                                                                                                              |
| false | The code generator does not produce an initialize function. If you set <code>IncludeInitializeFcn</code> to <code>false</code> and an initialize function is required, for example, to call supporting code for nonfinite data ( <code>Inf</code> or <code>NaN</code> ), the code generator produces an error message.<br><br>See “MATLAB Code Patterns That Require a Nonempty Initialize Function in Generated Code” (Embedded Coder). |

When using GPU Coder, the code generator always produces an initialize function.

#### **IncludeTerminateFcn — Terminate function generation**

true (default) | false

Terminate function generation, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                            |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces a terminate function.                                                                                                                              |
| false | The code generator does not produce a terminate function. If you set <code>IncludeTerminateFcn</code> to false and a terminate function is required, for example, to free memory, the code generator issues a warning. |

When using GPU Coder, the code generator always produces an terminate function.

#### **IndentSize — Number of characters per indentation level**

2 (default) | positive integer

Number of characters per indentation level, specified as a positive integer in the range [2,8].

#### **IndentStyle — Style for placement of braces in the generated code**

'K&R' (default) | 'Allman'

Style for placement of braces in the generated code, specified as one of the values in this table.

| Value    | Description                                                                                                                                                                                                                                                                                            |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'K&R'    | This value is the default value.<br><br>For blocks within a function, an opening brace is on the same line as its control statement. For example:<br><br><pre>void addone(const double x[6], double z[6]) {     int i0;     for (i0 = 0; i0 &lt; 6; i0++) {         z[i0] = x[i0] + 1.0;     } }</pre> |
| 'Allman' | For blocks within a function, an opening brace is on its own line at the same indentation level as its control statement. For example:<br><br><pre>void addone(const double x[6], double z[6]) {     int i0;     for (i0 = 0; i0 &lt; 6; i0++)     {         z[i0] = x[i0] + 1.0;     } }</pre>        |

#### **InitFltsAndDblsToZero — Assignment of float and double zero with memset**

true (default) | false

Assignment of float and double zero with memset, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the memset optimization for assignment of floating-point zero to consecutive array elements. To assign consecutive array elements, the memset optimization uses a memset call. When the number of elements to assign is known at compile time, the code generator uses the MemcpyThreshold property to determine whether to use the optimization. See “memset Optimization”. |
| false | The code generator does not use the memset optimization for assignment of float and double zero to consecutive array elements.                                                                                                                                                                                                                                                                                                                            |

**InLineBetweenMathWorksFunctions – Control inlining between MathWorks functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a MathWorks calls another MathWorks function, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the coder.inline('always') or coder.inline('never') directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

**InLineBetweenUserAndMathWorksFunctions – Control inlining between user-written functions and MathWorks functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a function that you wrote calls a MathWorks function, or a MathWorks function calls a function that you wrote. Specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the `coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

#### **InLineBetweenUserFunctions – Control inlining between user-written functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a function that you wrote calls another function that you wrote, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the

`coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

### LaunchReport — Automatic open of code generation report

false (default) | true

Automatic open of code generation report, specified as one of the values in this table.

| Value | Description                                                                                                                                                                         |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>If errors or warnings occur, or if <code>GenerateReport</code> is true, the code generator produces a report, but does not open the report. |
| true  | The code generator produces and opens a code generation report.                                                                                                                     |

### LoopUnrollThreshold — Threshold on the number of iterations that determines whether to automatically unroll a for-loop and a parfor-loop

5 (default) | positive integer

Loops with fewer iterations than this threshold are candidates for automatic unrolling by the code generator. This threshold applies to all `for`-loops and `parfor`-loops in your MATLAB code. For an individual `for`-loop, a `coder.unroll` directive placed immediately before the loop takes precedence over the loop unrolling optimization. The threshold can also apply to some `for`-loops produced during code generation.

See “Unroll for-Loops and parfor-Loops”.

### MATLABFcnDesc — MATLAB function help text in function banner

true (default) | false

MATLAB function help text in function banner in generated code specified as one of the values in this table.

| Value | Description                                                                                                                                 |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator includes MATLAB function help text in the function banner in the generated code. |
| false | The code generator treats the help text as a user comment.                                                                                  |

If not selected, MATLAB Coder treats the help text as a user comment.

Dependencies:

- `GenerateComments` enables this parameter.

**MATLABSourceComments — Inclusion of MATLAB source code as comments in generated code**

false (default) | true

Inclusion of MATLAB source code as comments in generated code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | <p>This value is the default value.</p> <p>The code generator does not insert MATLAB source code as comments in the generated code. The code generator does not include the MATLAB function signature in the function banner.</p>                                                                                                                                                                                                                                                                                 |
| true  | <p>The code generator inserts MATLAB source code as comments in the generated code. A traceability tag immediately precedes each line of source code. The traceability tag helps you to locate the corresponding MATLAB source code. See “Tracing Generated C/C++ Code to MATLAB Source Code”.</p> <p>If you have Embedded Coder, in the code generation report, the traceability tag links to the source code.</p> <p>The code generator also includes the MATLAB function signature in the function banner.</p> |

Dependency:

- GenerateComments enables this parameter.

See “Tracing Generated C/C++ Code to MATLAB Source Code”.

**MaxIdLength — Maximum number of characters in generated identifiers**

31 | 1024 | positive integer

Maximum number of characters in generated identifiers, specified as a positive integer in the range [31, 2048]. This property applies to generated function, type definition, and variable names. To avoid truncation of identifiers by the target C/C++ compiler, specify a value that matches the maximum identifier length of the target C/C++ compiler.

This property does not apply to exported identifiers, such as the generated names for entry-point functions or mxArray API functions. If the length of an exported identifier exceeds the maximum identifier length of the target C/C++ compiler, the target C/C++ compiler truncates the exported identifier.

Default values:

- If TargetLang is set to 'C', the default value of MaxIdLength is 31.
- If TargetLang is set to 'C++', the default value of MaxIdLength is 1024.



**MemcpyThreshold — Minimum size for memcpy or memset optimization**

64 (default) | positive integer

Minimum size, in bytes, for memcpy or memset optimization, specified as a positive integer.

To optimize generated code that copies consecutive array elements, the code generator tries to replace the code with a memcpy call. To optimize generated code that assigns a literal constant to consecutive array elements, the code generator tries to replace the code with a memset call.

The number of bytes is the number of array elements to copy or assign multiplied by the number of bytes required for the C/C++ data type.

If the number of elements to copy or assign is variable (not known at compile time), the code generator ignores the MemcpyThreshold property.

See “memcpy Optimization” and “memset Optimization”.

**MultiInstanceCode — Multi-instance, reentrant code**

false (default) | true

Multi-instance, reentrant code, specified as one of the values in this table.

| Value | Description                                                                                                 |
|-------|-------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not produce multi-instance, reentrant code. |
| true  | The code generator produces reusable, multi-instance code that is reentrant.                                |

See “Reentrant Code”.

This option is not supported by the GPU Coder product.

**Name — Object name**

'EmbeddedCodeConfig' (default) | character vector

Object name, specified as a character vector.

**NumberOfCpuThreads — Maximum number of CPU threads to run parallel for-loops**

0 (default) | positive integer

Maximum number of CPU threads to run parallel for-loops in the generated C/C++ code, specified as a positive integer.

See “Specify Maximum Number of Threads to Run Parallel for-Loops in the Generated Code”.

**OutputType — Output to build from generated C/C++ code**

'LIB' | 'DLL' | 'EXE'

Output to build from generated C/C++ code, specified as one of the values in this table.

| Value | Description                |
|-------|----------------------------|
| 'LIB' | Static library             |
| 'DLL' | Dynamically linked library |
| 'EXE' | Executable program         |

### ParenthesesLevel – Parenthesization level in the generated code

'Nominal' (default) | 'Minimum' | 'Maximum'

Parenthesization level in the generated code, specified as one of the values in this table.

| Value     | Description                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Nominal' | <p>This value is the default value.</p> <p>The code generator inserts parentheses to balance readability and visual complexity. For example:</p> <pre>Out = ((In2 - In1 &gt; 1.0) &amp;&amp; (In2 &gt; 2.0));</pre>                                                                                                                                                                                   |
| 'Maximum' | <p>The code generator includes parentheses to specify meaning without relying on operator precedence. Code generated with this setting conforms to MISRA requirements. For example:</p> <pre>Out = (((In2 - In1) &gt; 1.0) &amp;&amp; (In2 &gt; 2.0));</pre>                                                                                                                                          |
| 'Minimum' | <p>The code generator inserts parentheses where required by ANSI<sup>®</sup> C or C++, or to override default precedence. For example:</p> <pre>Out = In2 - In1 &gt; 1.0 &amp;&amp; In2 &gt; 2.0;</pre> <p>If you generate C/C++ code that uses the minimum level, for certain settings in some compilers, you can receive compiler warnings. To eliminate these warnings, try the nominal level.</p> |

### PassStructByReference – Pass structures by reference

true (default) | false

Pass structures by reference to entry-point functions, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                 |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>The generated code passes structures by reference, which reduces memory usage and execution time by minimizing the number of copies of parameters at entry-point function boundaries.</p> <p><b>Note</b> An entry-point function that writes to a field of a structure parameter overwrites the input value.</p> |
| false | The generated code passes structures by value.                                                                                                                                                                                                                                                                                                              |

This parameter applies only to entry-point functions.

See “Pass Structure Arguments by Reference or by Value in Generated Code”.

#### **PostCodeGenCommand — Command to customize build processing**

' ' (default) | character vector

Command to customize build processing after MEX function generation with `codegen`, specified as a character vector.

See “Build Process Customization”.

#### **PreserveExternInFcnDecls — Preservation of the extern keyword in function declarations**

true (default) | false

Preservation of the `extern` keyword in function declarations in the generated code, specified as one of the values in this table.

| Value | Description                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>The code generator includes the <code>extern</code> keyword in declarations for external functions.</p> |
| false | The code generator removes the <code>extern</code> keyword from function declarations.                                                             |

#### **PreserveArrayDimensions — N-dimensional indexing**

false (default) | true

Generation of code that uses N-dimensional indexing, specified as one of the values in this table.

| Value | Description                                                                          |
|-------|--------------------------------------------------------------------------------------|
| false | Generate code that uses one-dimensional indexing. (This value is the default value.) |
| true  | Generate code that uses N-dimensional indexing.                                      |

See “Generate Code That Uses N-Dimensional Indexing”.

**PreserveUnusedStructFields — Preserve unused class properties or structure fields in the generated C/C++ code**`false` (default) | `true`

Preserve unused class properties or structure fields in the generated C/C++ code, specified as one of the values in this table.

| Value              | Description                                                                                                                                            |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>false</code> | This value is the default value.<br><br>The code generator produces the C/C++ code by removing the unused properties and fields in the generated code. |
| <code>true</code>  | The code generator produces the C/C++ code by preserving the unused properties and fields in the generated code.                                       |

See “Removal of Unused Class Properties in the Generated C/C++ Code” (Embedded Coder).

**PreserveVariableNames — Variable names to preserve in the generated code**`'None'` (default) | `'UserNames'` | `'All'`

Variable names to preserve in the generated code, specified as one of the values in this table.

| Value                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>'None'</code>      | This value is the default value.<br><br>The code generator does not have to preserve any variable names. It can reuse any variables that meet the requirements for variable reuse.<br><br>If your code uses large structures or arrays, setting <code>PreserveVariableNames</code> to <code>'None'</code> can reduce memory usage or improve execution speed.                                                                                                                                                                                                                                                                                                                        |
| <code>'UserNames'</code> | The code generator preserves names that correspond to variables that you define in the MATLAB code. It does not replace your variable name with another name and does not use your name for another variable. To improve readability, set <code>PreserveVariableNames</code> to <code>'UserNames'</code> . Then, you can more easily trace the variables in the generated code back to the variables in your MATLAB code.<br><br>Setting <code>PreserveVariableNames</code> to <code>'UserNames'</code> does not prevent an optimization from removing your variables from the generated code or prevent the C/C++ compiler from reusing the variables in the generated binary code. |

| Value | Description                                                                                                                               |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 'All' | Preserve all variable names. This parameter value disables variable reuse. Use it only for testing or debugging, not for production code. |

See “Preserve Variable Names in Generated Code”.

### PurelyIntegerCode – Detection of floating-point code

false (default) | true

Detection of floating-point code, specified as one of the values in this table.

| Value | Description                                                                                                                                                               |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator allows floating-point data and operations.                                                                     |
| true  | The code generator does not allow floating-point data or operations. If the code generator detects floating-point data or operations, code generation ends with an error. |

Dependency:

- Setting PurelyIntegerCode to true disables the SupportNonFinite parameter. Setting PurelyIntegerCode to false enables the SupportNonFinite parameter.

### ReplacementTypes – Specify custom names for MATLAB data types

coder.ReplacementTypes object

Specify custom names for these MATLAB built-in data types: double, single, uint8, uint16, uint32, uint64, int8, int16, int32, int64, char, and logical that are in the generated C/C++ code.

Dependency:

- Setting EnableCustomReplacementTypes to true enables the ReplacementTypes parameter. See “Customize Data Type Replacement” (Embedded Coder).

### ReportInfoVarName – Name of variable containing code generation report information

'' (default) | character vector

Name of variable to which you export information about code generation, specified as a character vector. The code generator creates this variable in the base MATLAB workspace. This variable contains information about code generation settings, input files, generated files, and code generation messages.

See “Access Code Generation Report Information Programmatically” and coder.ReportInfo Properties.

### ReportPotentialDifferences – Potential differences reporting

true (default) | false

Potential difference reporting, specified as one of the values in this table:

| Value | Description                                                                                                                                                                                                                                                                  |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | The code generator reports potential behavior differences between generated code and MATLAB code. The potential differences are listed on a tab of the code generation report. A potential difference is a difference that occurs at run time only under certain conditions. |
| false | The code generator does not report potential differences.                                                                                                                                                                                                                    |

See “Potential Differences Reporting”.

### ReservedNameArray — Names that code generator must not use for functions or variables

' ' (default) | string array | cell array of character vectors | character vector

List of names that the code generator must not use for functions or variables, specified as a string arrays, cell array of character vectors, or character vector.

Multiple reserved names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String arrays                   | A string array in ReservedNameArray. For example, <code>cfg.ReservedNameArray = ["reserve1", "reserve2", "reserve3"]</code> .                                                                                                                                                                                                                                                                                                            |
| Cell array of character vectors | A cell array of character vectors in ReservedNameArray. For example, <code>cfg.ReservedNameArray = {'reserve1', 'reserve2', 'reserve3'}</code> .                                                                                                                                                                                                                                                                                         |
| Character vectors               | A semicolon-separated list of reserved names in ReservedNameArray. For example, <code>cfg.ReservedNameArray = 'reserve1; reserve2; reserve3'</code> .<br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

### RowMajor — Row-major array layout

false (default) | true

Generation of code that uses row-major array layout, specified as one of the values in this table.

| Value | Description                                                                           |
|-------|---------------------------------------------------------------------------------------|
| false | Generate code that uses column-major array layout. (This value is the default value.) |
| true  | Generate code that uses row-major array layout.                                       |

See “Generate Code That Uses Row-Major Array Layout”.

**RunInitializeFcn – Automatically run the initialize function**

true (default) | false

Generation of a call to the initialize function at the beginning of the generated entry-point functions, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>A call to the initialize function is included at the beginning of the generated entry-point functions. The generated code includes checks to make sure that the initialize function is called only once, even if there are multiple entry-point functions. |
| false | The generated entry-point functions do not include calls to the initialize function.                                                                                                                                                                                                               |

Dependency:

- Setting `IncludeInitializeFcn` and `IncludeTerminateFcn` to `true` enables this parameter.
- Setting `MultiInstanceCode` to `true` disables this parameter.

See “Use Generated Initialize and Terminate Functions”.

**RuntimeChecks – Run-time error detection and reporting in generated code**

false (default) | true

Run-time error detection and reporting in generated code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The generated code does not check for errors such as out-of-bounds array indexing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| true  | The generated code checks for errors such as out-of-bounds array indexing.<br><br>The error-reporting software uses <code>fprintf</code> to write error messages to <code>stderr</code> . It uses <code>abort</code> to terminate the application. If <code>fprintf</code> and <code>abort</code> are not available, you must provide them. The <code>abort</code> function abruptly terminates the program. If your system supports signals, you can catch the abort signal ( <code>SIGABRT</code> ) so that you can control the program termination.<br><br>Error messages are in English. |

See “Generate Standalone C/C++ Code That Detects and Reports Run-Time Errors”.

**SaturateOnIntegerOverflow – Integer overflow support**

true (default) | false

Integer overflow support, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces code to handle integer overflow. Overflows saturate to either the minimum or maximum value that the data type can represent.                                                                                                                                                                                                                                                                                                                                                                                                             |
| false | The code generator does not produce code to handle integer overflow. Do not set <code>SaturateOnIntegerOverflow</code> to false unless you are sure that your code does not depend on integer overflow support. If you disable integer overflow support and run-time error checking is enabled, the generated code produces an error for overflows. If you disable integer overflow support and you disable run-time error checking, the overflow behavior depends on your target C compiler. In the C standard, the behavior for integer overflow is undefined. However, most C compilers wrap on overflow. |

This parameter applies only to MATLAB built-in integer types. It does not apply to doubles, singles, or fixed-point data types.

See “Disable Support for Integer Overflow or Nonfinites”.

#### **SILDebugging — Debugging of generated code during a SIL execution**

false (default) | true

Source-level debugging of generated code during a software-in-the-loop (SIL) execution, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                    |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Disables debugging of generated code during a SIL execution.                                                                                                                                                                           |
| true  | Enables the debugger to observe code behavior during a software-in-the-loop (SIL) execution.<br><br>Supported debuggers: <ul style="list-style-type: none"> <li>• On Windows, Microsoft Visual C++® debugger.</li> <li>• On Linux, GNU Data Display Debugger (DDD).</li> </ul> |

See “Debug Generated Code During SIL Execution” (Embedded Coder).

#### **SILPILCheckConstantInputs — Constant input checking mode for a SIL or PIL execution**

true (default) | false



Constant input checking mode for a SIL or PIL execution, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>The SIL or PIL execution compares the value that a test file provides for a constant input argument with the value specified at code generation time. If the values do not match, an error occurs.</p>                                                                                                                                                                                                                                                                |
| false | <p>The SIL or PIL execution does not compare the value that a test file provides for a constant input argument with the value specified at code generation time. The SIL or PIL execution uses the value specified at code generation time. If the test file uses a different value, then the results in MATLAB might differ from the results in the SIL or PIL execution.</p> <p>It is possible to speed up a SIL or PIL execution by setting <code>SILPILCheckConstantInputs</code> to <code>false</code>.</p> |

See “Speed Up SIL/PIL Execution by Disabling Constant Input Checking and Global Data Synchronization” (Embedded Coder)

**SILPILSyncGlobalData – Global data synchronization mode for a SIL or PIL execution**

true (default) | false

Global data synchronization mode for a SIL or PIL execution, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>A SIL or PIL execution synchronizes the values of global variables in the SIL or PIL execution environment with the values in the MATLAB workspace. If a global variable is constant and its value in the SIL or PIL execution environment differs from its value in the MATLAB workspace, an error occurs.</p>                                                             |
| false | <p>The SIL or PIL execution does not synchronize the values of global variables in the SIL or PIL execution environment with the values in the MATLAB workspace. If the values are not synchronized, the results in MATLAB might differ from the results in the SIL or PIL execution.</p> <p>It is possible to speed up a SIL or PIL execution by setting <code>SILPILSyncGlobalData</code> to <code>false</code>.</p> |

See “Speed Up SIL/PIL Execution by Disabling Constant Input Checking and Global Data Synchronization” (Embedded Coder)

### **SILPILVerbosity – Display communication I/O information during SIL or PIL execution**

'off' (default) | 'on'

Display of communication I/O information during software-in-the-loop (SIL) or processor-in-the-loop (PIL) execution, specified as one of the values in this table.

| Value | Description                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------|
| 'off' | This value is the default value.<br><br>The code generator does not display communication I/O information during SIL or PIL execution. |
| 'on'  | The code generator displays communication I/O information during SIL or PIL execution.                                                 |

See “Troubleshooting Host-Target Communication” (Embedded Coder).

### **StackUsageMax – Maximum stack usage per application**

200000 (default) | positive integer

Maximum stack usage per application, in bytes, specified as a positive integer. Set a limit that is lower than the available stack size. Otherwise, a run-time stack overflow might occur. The C compiler detects and reports stack overflows.

See “Disable Support for Integer Overflow or Nonfinites”.

### **SupportNonFinite – Support for nonfinite values**

true (default) | false

Support for nonfinite values, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If <code>GenerateNonFiniteFilesIfUsed</code> is set to <code>true</code> , the code generator produces code to support nonfinite values ( <code>Inf</code> and <code>NaN</code> ) only if they are used.<br><br>If <code>GenerateNonFiniteFilesIfUsed</code> is set to <code>false</code> , the code generator always produces code to support nonfinite values ( <code>Inf</code> and <code>NaN</code> ). |
| false | The code generator does not produce code to support nonfinite values.                                                                                                                                                                                                                                                                                                                                                                              |

See “Disable Support for Integer Overflow or Nonfinites”.

### **TargetLang – Language to use in generated code**

'C' (default) | 'C++'

Language to use in generated code, specified as 'C' or 'C++'. If you specify C++, the code generator wraps the C code into .cpp files so that you can use a C++ compiler and interface with external C++ applications. It does not generate C++ classes.

When using GPU Coder, the code generator sets TargetLang to C++.

Dependency: If DeepLearningConfig is set, codegen sets TargetLang to C++.

### TargetLangStandard — Language standard to use for the generated code

'Auto' (default) | 'C89/C90 (ANSI)' | 'C99 (ISO)' | 'C++03 (ISO)' | 'C++11 (ISO)'

The 'Auto' option uses the TargetLang setting to choose which language standard to use for the generated code. The default language standard depends on the language that you select. For C, the default library is 'C99 (ISO)'. For C++, the default library is 'C++11 (ISO)'.

Language standards to use for the generated code, specified as one of these character vectors:

- 'C89/C90 (ANSI)'
- 'C99 (ISO)'
- 'C++03 (ISO)'
- 'C++11 (ISO)'

The code generator uses the standard library for calls to math and other operations.

See “Change the Language Standard”.

### Toolchain — Toolchain to use for building a C/C++ library or executable program

'Automatically locate an installed toolchain' (default) | character vector

Toolchain to use for building a C/C++ library or executable program, specified as a character vector. The list of available toolchains depends on the host computer platform, and can include custom toolchains that you added. If you do not specify a toolchain, the code generator locates an installed toolchain.

Note:

- Suppose that you create a coder.CodeConfig object `cfg` in a MATLAB session and use it in another MATLAB session. If the MATLAB host computer for the second session does not have the toolchain specified in the `cfg.Toolchain` property installed on it, this parameter reverts to its default value. The default value is 'Automatically locate an installed toolchain'.

### Verbose — Code generation progress display (to be removed)

false (default) | true

Code generation progress display, specified as one of the values in this table.

| Value | Description                                                                                           |
|-------|-------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not display code generation progress. |

| Value | Description                                                                                                 |
|-------|-------------------------------------------------------------------------------------------------------------|
| true  | The code generator displays code generation progress, including code generation stages and compiler output. |

### Verbosity – Code generation progress display

'Info' (default) | 'Silent' | 'Verbose'

Whether to display the status of the code generation progress at the MATLAB command line, specified as one of the values in this table.

| Value     | Description                                                                                                                                                                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Silent'  | If code generation succeeds without warning, all messages are suppressed, including when you generate a report.<br><br>Warning and error messages are displayed.                                                                                                            |
| 'Info'    | This value is the default value.<br><br>Compared to the 'Silent' mode, if code generation succeeds, these additional messages are displayed: <ul style="list-style-type: none"> <li>• Code generation successful</li> <li>• Link to the generated report, if any</li> </ul> |
| 'Verbose' | In addition to the messages shown in the 'Info' mode, code generation status and target build log messages are displayed.                                                                                                                                                   |

### VerificationMode – Code verification mode

'None' (default) | 'SIL' | 'PIL'

Code verification mode, specified as one of the values in this table.

| Value  | Description                           |
|--------|---------------------------------------|
| 'None' | Normal execution                      |
| 'SIL'  | Software-in-the-loop (SIL) execution  |
| 'PIL'  | Processor-in-the-loop (PIL) execution |

See “Code Verification Through Software-in-the-Loop and Processor-in-the-Loop Execution” (Embedded Coder).

## Examples

### Specify Configuration Parameters for Generation of Standalone Code with Embedded Coder

Write a MATLAB function from which you can generate code. This example uses the function `myadd` that returns the sum of its inputs.

```
function c = myadd(a,b)
c = a + b;
end
```

Create a configuration object for generation of standalone C/C++ code (a static library, a dynamically linked library, or an executable program). For example, create a configuration object for generation of a static library.

```
cfg = coder.config('lib');
```

If Embedded Coder is installed, `coder.config` creates a `coder.EmbeddedCodeConfig` object.

Change the values of the properties for which you do not want to use the default values. For example, change the comment style in the generated code to single-line comments preceded by `//`.

```
cfg.CommentStyle = 'Single-line';
```

The `CommentStyle` property is available only in an Embedded Coder configuration object.

Generate code by using `codegen`. Pass the configuration object to `codegen` by using the `-config` option. Specify that the input arguments are scalar double.

```
codegen myadd -config cfg -args {1 1} -report
```

## Alternative Functionality

To use default configuration parameters for build types 'LIB', 'DLL', or 'EXE', use the `codegen` option `-config:lib`, `-config:dll`, or `-config:exe`, respectively. Then, you do not have to create and pass a configuration object to `codegen`.

## Compatibility Considerations

### Capability to Specify Multiple Entries in Code Configuration Objects by Using Character Vector Will Be Removed

*Behavior change in future release*

In a future release, specifying multiple file names, paths, or reserved names in code configuration objects by using character vectors or string scalars that have delimiters will be removed. Use string arrays and a cell array of character vector instead. For example, to include multiple folder names, you can use either a string array in `CustomInclude` as `cfg.CustomInclude = ["C:\Project", "C:\Custom Files"]`; or a cell array of character vectors as `cfg.CustomInclude = {'C:\Project', 'C:\Custom Files'}`; to include the path for compiling the generated code.

### Verbose Property To Be Removed

*Behavior change in future release*

In a future release, the `Verbose` property will be removed.

To configure the code generation progress display, use the `Verbosity` property.

### DynamicMemoryAllocation Property To Be Removed

*Not recommended starting in R2022a*

In a future release, the `DynamicMemoryAllocation` property will be removed.

To dynamically allocate memory for variable-size arrays, use the configuration parameter `DynamicMemoryAllocationForVariableSizeArrays`.

Do not use `DynamicMemoryAllocation` and `DynamicMemoryAllocationForVariableSizeArrays` together during code generation.

## **See Also**

### **Functions**

`codegen` | `coder.config` | `pathsep`

### **Objects**

`coder.MexCodeConfig` | `coder.CodeConfig` | `coder.HardwareImplementation` | `coder.ReplacementTypes`

### **Topics**

“Generating Standalone C/C++ Executables from MATLAB Code”

“Specify Configuration Parameters in Command-Line Workflow Interactively”

### **Introduced in R2011a**

# coder.hardware

Create hardware board configuration object for C/C++ code generation from MATLAB code

## Description

The `coder.hardware` function creates a `coder.Hardware` object that contains hardware board parameters for C/C++ code generation from MATLAB code.

To use a `coder.Hardware` object for code generation, assign it to the `Hardware` property of a `coder.CodeConfig` or `coder.EmbeddedCodeConfig` object that you pass to `codegen`. Assigning a `coder.Hardware` object to the `Hardware` property customizes the associated `coder.HardwareImplementation` object and other configuration parameters for the particular hardware board.

---

**Note** The code generator enables you to extend the range of supported hardware by using the `target.create` and `target.add` functions to register new devices. After you register a new device, you can create a `coder.Hardware` object for this new device as well.

---

## Creation

### Syntax

```
coder.hardware(boardname)
coder.hardware()
```

### Description

`coder.hardware(boardname)` creates a `coder.Hardware` object for the specified hardware board. The board must be supported by an installed support package. To see a list of available boards, call `coder.hardware` without input parameters.

`coder.hardware()` returns a cell array of names of boards supported by installed support packages.

### Input Arguments

#### **boardname** — hardware board name

character vector | string scalar

Hardware board name, specified as a character vector or a string scalar.

Example: 'Raspberry Pi'

Example: "Raspberry Pi"

## Properties

### Name — Name of hardware board

character vector | string scalar

Name of hardware board, specified as a character vector or a string scalar. The `coder.hardware` function sets this property using the `boardname` argument.

### CPULockRate — Clock rate of hardware board

100 (default) | double scalar

Clock rate of hardware board, specified as a double scalar.

## Examples

### Generate Code for a Supported Hardware Board

Configure code generation for a Raspberry Pi board and generate code for a function `foo`.

```
hwlist = coder.hardware();
if ismember('Raspberry Pi',hwlist)
 hw = coder.hardware('Raspberry Pi');
 cfg = coder.config('lib');
 cfg.Hardware = hw;
 codegen foo -config cfg -report
end
```

### Check Supported Hardware Boards

Before creating a `coder.Hardware` object for a hardware board, check that the board is supported by an installed support package.

List all boards for which a support package is installed.

```
hwlist = coder.hardware()
```

Test for an installed support package for a particular board.

```
hwlist = coder.hardware();
if ismember('Raspberry Pi',hwlist)
 hw = coder.hardware('Raspberry Pi');
end
```

## Tips

- In addition to the `Name` and `CPULockRate` properties, a `coder.Hardware` object has dynamic properties specific to the hardware board.
- To configure code generation parameters for processor-in-the-loop (PIL) execution on a supported hardware board, use `coder.hardware`. See “PIL Execution with ARM Cortex-A at the Command Line” (Embedded Coder) and “PIL Execution with ARM Cortex-A by Using the MATLAB Coder App” (Embedded Coder). PIL execution requires Embedded Coder.



## **See Also**

`coder.CodeConfig` | `coder.EmbeddedCodeConfig` | `coder.HardwareImplementation` | `codegen`

**Introduced in R2015b**

## coder.HardwareImplementation

Hardware-specific configuration parameters for C/C++ code generation from MATLAB code

### Description

A `coder.HardwareImplementation` object contains hardware-specific configuration parameters that `codegen` uses for generating a static library, a dynamically linked library, or an executable program.

To use a `coder.HardwareImplementation` object, you must associate it with a configuration object (a `coder.CodeConfig` object or a `coder.EmbeddedCodeConfig` object) that you pass to `codegen`. To create a `coder.HardwareImplementation` object and associate it with a configuration object, create the configuration object by using `coder.config`.

Access `coder.HardwareImplementation` properties in one of these ways:

- The `HardwareImplementation` property of the associated configuration object. For example:

```
cfg = coder.config('lib');
cfg.HardwareImplementation.ProdHWDeviceType
```

- A dialog box for the associated configuration object. See “Access Hardware Implementation Properties with a Dialog Box” on page 4-96.

By default, the `coder.HardwareImplementation` properties specify characteristics of the MATLAB host computer. To specify a different device, modify the `ProdHWDeviceType` property. The hardware device determines the values of the other device-specific properties and the properties that you can change.

### Creation

To create a `coder.HardwareImplementation` object, use `coder.config` to create a configuration object (a `coder.CodeConfig` object or a `coder.EmbeddedCodeConfig` object) for generation of standalone code. When `coder.config` creates the configuration object, it also creates a `coder.HardwareImplementation` object. `coder.config` sets the `HardwareImplementation` property of the configuration object to the `coder.HardwareImplementation` object.

### Properties

#### Description — Object description

```
'class HardwareImplementation: Hardware implementation specifications.'
(default) | character vector
```

Description of `coder.HardwareImplementation` object, specified as a character vector.

#### Name — Object name

```
'HardwareImplementation' (default) | character vector
```

Object name, specified as a character vector.

**ProdEqTarget — Equivalence of production and target hardware characteristics**`true (default) | false`

Equivalence of production and target (test) hardware characteristics, specified as `true` or `false`.

A `coder.HardwareImplementation` object has two sets of hardware properties—one for the characteristics of the production hardware and one for the characteristics of the target (test) hardware. By default, `codegen` uses the properties of the production hardware. Typically, you leave `ProdEqTarget` set to `true` and work only with the production properties.

Setting `ProdEqTarget` to `false` is an advanced feature that enables the target hardware properties. If you change `ProdEqTarget` to `false`, `codegen` uses the properties for the target hardware and generates code to emulate the behavior of the production hardware on the target hardware. If you set `ProdEqTarget` to `false` for testing, before you deploy the generated code to the production hardware, set `ProdEqTarget` to `true` and regenerate the code.

At the beginning of an Embedded Coder processor-in-the-loop (PIL) execution, the software checks the hardware implementation properties with reference to the target hardware on which the PIL execution runs. If `ProdEqTarget` is `true`, the software checks the production properties (properties that start with `Prod`). If `ProdEqTarget` is `false`, the software checks the target properties (properties that start with `Target`). See “Code Verification Through Software-in-the-Loop and Processor-in-the-Loop Execution” (Embedded Coder).

**Production Hardware Properties****ProdBitPerChar — Length in bits of the C char data type**`8 (default) | multiple of 8, from 8 through 32`

Length in bits of the C `char` data type that the production hardware supports, specified as an integer value from 8 through 32. The value must be a multiple of 8.

**ProdBitPerDouble — Length in bits of the C double data type**`64`

This property is read-only.

Length in bits of the C `double` data type that the production hardware supports.

**ProdBitPerFloat — Length in bits of the C floating-point data type**`32`

This property is read-only.

Length in bits of the C floating-point data type that the production hardware supports.

**ProdBitPerInt — Length in bits of the C int data type**`32 (default) | multiple of 8, from 8 through 32`

Length in bits of the C `int` data type that the production hardware supports, specified as an integer value from 8 through 32. The value must be a multiple of 8.

**ProdBitPerLong — Length in bits of the C long data type**`32 (default) | multiple of 8, from 32 through 128`

Length in bits of the C `long` data type that the production hardware supports, specified as an integer value from 32 through 128. The value must be a multiple of 8.

**ProdBitPerLongLong — Length in bits of the C long long data type**

64 (default) | multiple of 8, from 64 through 128

Length in bits of the C long long data type that the production hardware supports, specified as an integer value from 64 through 128. The value must be a multiple of 8.

Use the C long long data type only if your C compiler supports long long.

Dependency:

- ProdLongLongMode enables use of the ProdBitPerLongLong property.

**ProdBitPerPointer — Length in bits of pointer data**

64 (default) | multiple of 8, from 8 through 64

Length in bits of pointer data that the production hardware supports, specified as an integer value from 8 through 64. The value must be a multiple of 8.

**ProdBitPerPtrDiffT — Length in bits of ptrdiff\_t data**

64 (default) | 8 | 16 | 24 | 32 | 40 | 64 | 128

Length in bits of ptrdiff\_t data that the production hardware supports, specified as 8, 16, 24, 32, 40, 64, or 128. The value must be greater than or equal to the value of ProdBitPerInt.

**ProdBitPerShort — Length in bits of the C short data type**

16 (default) | multiple of 8, from 8 through 32

Length in bits of the C short data type that the production hardware supports, specified as a multiple of 8, from 8 through 32.

**ProdBitPerSizeT — Length in bits of size\_t data**

64 (default) | 8 | 16 | 24 | 32 | 40 | 64 | 128

Length in bits of size\_t data that the production hardware supports, specified as 8, 16, 24, 32, 40, 64, or 128. The value must be greater than or equal to the value of ProdBitPerInt.

**ProdEndianness — Significance of the first byte of a data word**

'LittleEndian' (default) | 'BigEndian' | 'Unspecified'

Significance of the first byte of a data word for the production hardware, specified as one of the values in this table.

| Value          | Description                                                                                            |
|----------------|--------------------------------------------------------------------------------------------------------|
| 'LittleEndian' | This value is the default value.<br><br>The least significant byte appears first in the byte ordering. |
| 'BigEndian'    | The most significant byte appears first in the byte ordering.                                          |
| 'Unspecified'  | The code determines the endianness of the hardware. This value produces less efficient code.           |

**ProdHWDeviceType — Manufacturer and type of the production hardware board**

'Generic-&gt;MATLAB Host Computer' (default) | character vector

Manufacturer and type of the production hardware board, specified as a character vector.

Specifying the `ProdHWDeviceType` property sets device-specific properties for the production hardware. You can modify a device-specific property only if it is enabled for the specified hardware.

codegen cannot generate code for ASICs or FPGAs. If you set `ProdHWDeviceType` to `'ASIC/FPGA->ASIC/FPGA'`, `ProdEqTarget` becomes `false` so that the code generator uses the properties for the `target(test)` device. `'ASIC/FPGA->ASIC/FPGA'` is not a valid value for `TargetHWDeviceType`.

### **ProdIntDivRoundTo — Rounding for division of two signed integers**

`'Zero'` (default) | `'Undefined'` | `'Floor'`

Rounding by the compiler for the production hardware of the result of division of two signed integers, specified as one of the values in this table.

| <b>Value</b>             | <b>Description</b>                                                                                                                          |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <code>'Zero'</code>      | This value is the default value.<br><br>If the quotient is between two integers, the compiler rounds to the integer that is closer to zero. |
| <code>'Floor'</code>     | If the quotient is between two integers, the compiler rounds to the integer that is closer to negative infinity.                            |
| <code>'Undefined'</code> | The compiler does not round toward zero or negative infinity, or the compiler rounding behavior is undefined.                               |

### **ProdLongLongMode — Long long data type support**

`true` (default) | `false`

C compiler support for the long long data type, specified as one of the values in this table.

| <b>Value</b>       | <b>Description</b>                                                                                                            |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | This value is the default value.<br><br>The code generator uses the C <code>long long</code> data type in the generated code. |
| <code>false</code> | The code generator does not use the C <code>long long</code> data type in the generated code.                                 |

Most C99 compilers support `long long`.

Tips:

- `ProdLongLongMode` is enabled only if the specified production hardware supports the C `long long` data type.
- If your compiler does not support C `long long`, do not select this parameter.

Dependency:

- `ProdLongLongMode` enables use of the `ProdBitPerLongLong` property.

**ProdShiftRightIntArith — Implementation of signed integer right shift as arithmetic right shift**

true (default) | false

Implementation by the C compiler for the production hardware of a signed integer right shift as an arithmetic right shift, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Indicates that the C compiler implements a right shift of a signed integer as an arithmetic right shift. An arithmetic right shift fills the bit vacated by the right shift with the value of the most significant bit. The most significant bit indicates the sign of the number. |
| false | Indicates that the C compiler does not implement a right shift of a signed integer as an arithmetic right shift.                                                                                                                                                                                                           |

**ProdWordSize — Microprocessor native word size**

64 (default) | multiple of 8, from 8 through 64

Microprocessor native word size for the production hardware, specified as an integer value from 8 through 64. The value must be a multiple of 8.

**Target Hardware Properties****TargetBitPerChar — Length in bits of the C char data type**

8 (default) | multiple of 8, from 8 through 32

Length in bits of the C char data type that the target hardware supports, specified as an integer value from 8 through 32. The value must be a multiple of 8.

**TargetBitPerDouble — Length in bits of the C double data type**

64

This property is read-only.

Length in bits of the C double data type that the target hardware supports.

**TargetBitPerFloat — Length in bits of the C floating-point data type**

32

This property is read-only.

Length in bits of the C floating-point data type that the target hardware supports.

**TargetBitPerInt — Length in bits of the C int data type**

32 (default) | multiple of 8, from 8 through 32

Length in bits of the C int data type that the target hardware supports, specified as an integer value from 8 through 32. The value must be a multiple of 8.

**TargetBitPerLong — Length in bits of the C long data type**

32 (default) | multiple of 8, from 32 through 128

Length in bits of the C long data type that the target hardware supports, specified as an integer value from 32 through 128. The value must be a multiple of 8.

**TargetBitPerLongLong — Length in bits of the C long long data type**

64 (default) | multiple of 8, from 64 through 128

Length in bits of the C long long data type that the target hardware supports, specified as an integer value from 64 through 128. The value must be a multiple of 8.

Use the C long long data type only if your C compiler supports long long.

Dependency:

- TargetLongLongMode enables use of the TargetBitPerLongLong property.

**TargetBitPerPointer — Length in bits of pointer data**

64 (default) | multiple of 8, from 8 through 64

Length in bits of pointer data that the target hardware supports, specified as an integer value from 8 through 64. The value must be a multiple of 8.

**TargetBitPerPtrDiffT — Length in bits of ptrdiff\_t data**

64 (default) | 8 | 16 | 24 | 32 | 40 | 64 | 128

Length in bits of ptrdiff\_t data, specified as 8, 16, 24, 32, 40, 64, or 128. The value must be greater than or equal to the value of ProdBitPerInt.

**TargetBitPerShort — Length in bits of the C short data type**

16 (default) | multiple of 8, from 8 through 32

Length in bits of the C short data type that the target hardware supports, specified as a multiple of 8, from 8 through 32.

**TargetBitPerSizeT — Length in bits of size\_t data**

64 (default) | 8 | 16 | 24 | 32 | 40 | 64 | 128

Length in bits of size\_t data that the target hardware supports, specified as 8, 16, 24, 32, 40, 64, or 128. The value must be greater than or equal to the value of ProdBitPerInt.

**TargetEndianness — Significance of the first byte of a data word**

'LittleEndian' (default) | 'BigEndian' | 'Unspecified'

Significance of the first byte of a data word for the target hardware, specified as one of the values in this table.

| Value          | Description                                                                                            |
|----------------|--------------------------------------------------------------------------------------------------------|
| 'LittleEndian' | This value is the default value.<br><br>The least significant byte appears first in the byte ordering. |

| Value         | Description                                                                                  |
|---------------|----------------------------------------------------------------------------------------------|
| 'BigEndian'   | The most significant byte appears first in the byte ordering.                                |
| 'Unspecified' | The code determines the endianness of the hardware. This value produces less efficient code. |

#### TargetHWDeviceType: — Manufacturer and type of the target (test) hardware board

'Generic->MATLAB Host Computer' (default) | character vector

Manufacturer and type of the target (test) hardware board, specified as a character vector.

Specifying the `TargetHWDeviceType` property sets values for the device-specific properties for the target hardware. You can modify a device-specific property only if it is enabled for the specified hardware.

codegen cannot generate code for ASICs or FPGAs. If you set `ProdHWDeviceType` to 'ASIC/FPGA->ASIC/FPGA', `ProdEqTarget` becomes `false` so that the code generator uses the properties for the target(test) device. 'ASIC/FPGA->ASIC/FPGA' is not a valid value for `TargetHWDeviceType`

#### TargetIntDivRoundTo — Rounding for division of two signed integers

'Zero' (default) | 'Undefined' | 'Floor'

Rounding by the compiler for the test hardware of the result of division of two signed integers, specified as one of the values in this table.

| Value       | Description                                                                                                                                 |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| 'Zero'      | This value is the default value.<br><br>If the quotient is between two integers, the compiler rounds to the integer that is closer to zero. |
| 'Floor'     | If the quotient is between two integers, the compiler rounds to the integer that is closer to negative infinity.                            |
| 'Undefined' | The compiler does not round toward zero or negative infinity, or the compiler rounding behavior is undefined.                               |

#### TargetLongLongMode — Long long data type support

true (default) | false

C compiler support for the long long data type, specified as one of the values in this table.

| Value | Description                                                                                                      |
|-------|------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator uses the C long long data type in the generated code. |
| false | The code generator does not use the C long long data type in the generated code.                                 |



When using GPU Coder, the code generator always uses the C long long data type in the generated code.

Most C99 compilers support long long.

Tips:

- TargetLongLongMode is enabled only if the specified production hardware supports the C long long data type.
- If your compiler does not support C long long, do not select this parameter.

Dependency:

- TargetLongLongMode enables use of the TargetBitPerLongLong property.

**TargetShiftRightIntArith — Implementation of signed integer right shift as arithmetic right shift**

true (default) | false

Implementation by the C compiler for the production hardware of a signed integer right shift as an arithmetic right shift, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Indicates that the C compiler implements a right shift of a signed integer as an arithmetic right shift. An arithmetic right shift fills the bit vacated by the right shift with the value of the most significant bit. The most significant bit indicates the sign of the number. |
| false | Indicates that the C compiler does not implement a right shift of a signed integer as an arithmetic right shift.                                                                                                                                                                                                           |

**TargetWordSize — Microprocessor native word size**

64 (default) | multiple of 8, from 8 through 64

Microprocessor native word size for the production hardware, specified as an integer value from 8 through 64. The value must be a multiple of 8.

**Examples**

**Specify Hardware-Specific Parameters for C Code Generation**

Create a configuration object for generation of standalone code. For example, create a configuration object for generation of a static library.

```
cfg = coder.config('lib');
```

coder.config sets the HardwareImplementation property of the configuration object to a coder.HardwareImplementation object with default parameter values for the MATLAB host computer.

To specify a different hardware device and customize the device-specific properties, set the `ProdHWDeviceType` property of the `coder.HardwareImplementation` object to one of the available devices. For example:

```
cfg.HardwareImplementation.ProdHWDeviceType = 'AMD->Athlon 64'
```

To use the `coder.HardwareImplementation` object for code generation, use the `-config` option to specify the code generation configuration object associated with the `coder.HardwareImplementation` object.

```
codegen -config cfg myFunction
```

### Access Hardware Implementation Properties with a Dialog Box

Open the dialog box for the configuration object that refers to the `coder.HardwareImplementation` object. For example:

```
cfg = coder.config('lib');
open('cfg');
```

In the dialog box, click the **Hardware** tab.

If you installed a support package for your hardware board (requires Embedded Coder), select the board from the options in **Hardware Board**. Otherwise, set **Hardware Board** to **None** - select device below. Then, set the **Device vendor** and **Device type**.

The hardware implementation settings have values for the specified device. To see or modify these settings, click the **Customize hardware implementation** link. You can modify a setting only if it is enabled for the specified device.

See “Specify Configuration Parameters in Command-Line Workflow Interactively”.

### Tips

To set the `ProdHWDeviceType` property, select the device from the available options by opening a dialog box for the configuration object that refers to the `coder.HardwareImplementation` object. See “Access Hardware Implementation Properties with a Dialog Box” on page 4-96.

### Alternative Functionality

- You can directly create a `coder.HardwareImplementation` object and assign it to a `coder.CodeConfig` object or a `coder.EmbeddedCodeConfig` object.

```
hw_cfg = coder.HardwareImplementation;
hw_cfg.ProdHWDeviceType = 'AMD->Athlon 64';
cfg = coder.config('lib');
cfg.HardwareImplementation = hw_cfg;
```

- If you install a support package for your hardware, you can customize hardware-specific code generation parameters by setting the `Hardware` property of a `coder.EmbeddedCodeConfig` object to a `coder.Hardware` object. To create a `coder.Hardware` object, use `coder.hardware`. For example:

```
cfg = coder.config('lib');
hw = coder.hardware('Raspberry Pi');
cfg.Hardware = hw;
```

## See Also

### Functions

codegen | coder.config

### Objects

coder.CodeConfig | coder.EmbeddedCodeConfig

### Topics

“Configure Build Settings”

“Specify Configuration Parameters in Command-Line Workflow Interactively”

### Introduced in R2011a

## coder.MexCodeConfig

Configuration parameters for MEX function generation from MATLAB code

### Description

A `coder.MexCodeConfig` object contains the configuration parameters that `codegen` uses when generating a MEX function. Pass the object to the `codegen` function by using the `-config` option.

### Creation

Create a `coder.MexCodeConfig` object by using the `coder.config` function.

Once you create a `coder.MexCodeConfig` object, you can modify its properties programmatically at the command line or interactively by using the Configuration Parameter Dialog Box. See “Specify Configuration Parameters in Command-Line Workflow Interactively”.

### Properties

#### CacheDynamicArrayDataPointer — Dynamic array optimization

`true` (default) | `false`

Dynamic array optimization, specified as one of the values in this table.

| Value              | Description                                                                                                                                    |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | This value is the default value.<br><br>The code generator improves the execution time of generated C code by optimizing dynamic array access. |
| <code>false</code> | The code generator does not optimize dynamic array access.                                                                                     |

See “Optimize Dynamic Array Access”.

#### CodeFormattingTool — Formatting tool for the generated code

`'Auto'` (default) | `'Clang-format'` | `'MathWorks'`

Code formatting options for generated code, specified as one of the values in the table.

| Value                       | Description                                                                                  |
|-----------------------------|----------------------------------------------------------------------------------------------|
| <code>'Clang-format'</code> | The code generator formats the generated code according to a <code>clang-format</code> file. |

| Value       | Description                                                                                                                                                                                                                                                                                                                                      |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Auto'      | <p>Uses an internal heuristic to determine if the generated code is formatted by <code>clang-format</code> or a MathWorks formatting tool.</p> <p>To determine whether the generated code is formatted by <code>clang-format</code>, in a <code>coder.config</code> object, set the <code>Verbosity</code> option to <code>'Verbose'</code>.</p> |
| 'MathWorks' | Causes the code generator to revert to the MathWorks formatting tool.                                                                                                                                                                                                                                                                            |

### **CompileTimeRecursionLimit** – Maximum number of function specializations for compile-time recursion

50 (default) | positive integer

Maximum number of function specializations for compile-time recursion, specified as a positive integer. To disallow recursion in the MATLAB code, set `CompileTimeRecursionLimit` to 0. The default compile-time recursion limit is large enough for most recursive functions that require this type of recursion. If code generation fails because of the compile-time recursion limit, and you want compile-time recursion, try to increase the limit. Alternatively, change your MATLAB code so that the code generator uses run-time recursion. See “Compile-Time Recursion Limit Reached”.

### **ConstantFoldingTimeout** – Maximum number of instructions to be executed by the constant folder

40000 (default) | positive integer

Maximum number of instructions that the constant folder executes. In some situations, code generation requires specific instructions to be constant. If constant folding stops before these instructions are constant-folded, code generation fails. In this case, increase the value of `ConstantFoldingTimeout`.

See “MATLAB Coder Optimizations in Generated Code”.

### **ConstantInputs** – Constant input checking mode

'CheckValues' (default) | 'IgnoreValues' | 'Remove'

Constant input checking mode, specified as one of the values in this table.

| Value          | Description                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'CheckValues'  | <p>This value is the default value.</p> <p>When you call the MEX function, it checks that the value you provide for a constant input argument is the value specified at code generation time.</p> <p>You can call the MEX function and the original MATLAB function with the same arguments. Therefore, you can use the same test file for both functions.</p> <p>Checking the values can slow down execution of the MEX function.</p> |
| 'IgnoreValues' | <p>When you call the MEX function, it ignores the value that you provide for a constant input argument. It uses the value specified at code generation time.</p> <p>You can use the same test file without the overhead of checking the constant argument values.</p>                                                                                                                                                                  |
| 'Remove'       | <p>The code generator removes constant input arguments from the MEX function signature. When you call the MEX function, you do not provide a value for a constant input argument.</p> <p>This option provides backward compatibility.</p>                                                                                                                                                                                              |

See “Constant Input Checking in MEX Functions”.

**CppGenerateEnumClass — Generate C++11 enumeration class for MATLAB enumeration**  
 true (default) | false

Whether to generate C++11 code that contains enumeration classes or ordinary C enumerations, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                 |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>The code generator produces enumeration classes for MATLAB enumerations in the generated C++11 code. See “Code Generation for Enumerations”.</p> |
| false | <p>The code generator produces ordinary C enumerations for MATLAB enumerations in the generated C++11 code.</p>                                                                             |

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

### CppPackagesToNamespaces — Generate C++ namespaces for MATLAB packages

true (default) | false

Whether to generate C++ namespaces for the packages in your MATLAB code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                 |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces C++ namespaces for the packages in your MATLAB code. See “Organize Generated C++ Code into Namespaces”. |
| false | The code generator does not produce C++ namespaces for the packages in your MATLAB code.                                                                                    |

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

Data Types: logical

### CppNamespace — Namespace name for generated C++ code

' ' (default) | character vector

Namespace for the generated C++ code. The code generator does not produce code in a namespace unless you specify a nonempty character vector.

See “Organize Generated C++ Code into Namespaces”.

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

### CppNamespaceForMathworksCode — Place C++ code generated for MathWorks code in a separate namespace

'coder' (default) | character vector

Namespace for the C++ code generated for MathWorks code. The code generator does not produce such a namespace if you specify this property as an empty character vector.

See “Organize Generated C++ Code into Namespaces”.

Dependency:

- Setting TargetLang to 'C++' enables this parameter.

Data Types: char

### CppPreserveClasses — Generate C++ classes for MATLAB classes

true (default) | false

Whether to generate C++ classes or C style structures for MATLAB classes, specified as one of the values in this table.

| Value | Description                                                                                                                                        |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces C++ classes for MATLAB classes. See “Generate C++ Classes for MATLAB Classes”. |
| false | The code generator produces C style structures for MATLAB classes.                                                                                 |

When using GPU Coder, the code generator always disables this parameter.

Dependency:

- Setting `TargetLang` to 'C++' enables this parameter.

Data Types: `logical`

#### **CustomHeaderCode** — Custom code that appears at top of generated C/C++ header files

' ' (default) | character vector

Custom code that appears near the top of each C/C++ header file generated from your MATLAB code, except `rtwtypes.h` and `rtwhalf.h`, specified as a character vector.

#### **CustomInclude** — Include folders to add to include path for compiling generated code

' ' (default) | string array | cell array of character vectors | character vector

Include folders to add to the include path when compiling the generated code. Specify the list of include folders as a string array, cell array of character vector, or character vector.

Multiple folder names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in <code>CustomInclude</code> . For example, <code>cfg.CustomInclude = ["C:\Project", "C:\Custom Files"];</code>                                                                                                                                                                                                                                                                                                                                         |
| Cell array of character vectors | A cell array of character vectors in <code>CustomInclude</code> . For example, <code>cfg.CustomInclude = {'C:\Project', 'C:\Custom Files'};</code>                                                                                                                                                                                                                                                                                                                      |
| Character vector                | Separate include folders by a <code>pathsep</code> character in <code>CustomInclude</code> . For example, <code>cfg.CustomInclude = ['C:\Project' pathsep 'C:\Custom Files'];</code><br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |



**CustomInitializer – Custom code to include in the generated initialize function**

'' (default) | character vector

Custom code to include in the generated initialize function, specified as a character vector.

**CustomLibrary – Static library files to link with the generated code**

'' (default) | string array | cell array of character vectors | character vector

Static library files to link with the generated code, specified as a string array, cell array of character vector, or character vector.

Multiple static library file names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                                                                                                                                 |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in CustomLibrary. For example, <code>cfg.CustomLibrary = ["myLib1.lib", "myLib2.lib"];</code>                                                                                                                                                                |
| Cell array of character vectors | A cell array of character vectors in CustomLibrary. For example, <code>cfg.CustomLibrary = {'myLib1.lib', 'myLib2.lib'};</code>                                                                                                                                             |
| Character vector                | Separate static library file names by a pathsep character in CustomLibrary. For example, <code>cfg.CustomLibrary = ['myLib1.lib' pathsep 'myLib2.lib'];</code>                                                                                                              |
|                                 | <b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

**CustomSource – Source files to compile and link with the generated code**

'' (default) | string array | cell array of character vectors | character vector

Source files to compile and link with the generated code, specified as a string array, cell array of character vector, or character vector.

The build process searches for the source files first in the current folder, and then in the include folders that you specify in CustomInclude. If source files with the same name occur in multiple folders on the search path, the build process might use a different file than the file that you specified.

Suppose that you specify `foo.cpp` as a source file. If `foo.c` and `foo.cpp` are both on the search path, you cannot be sure whether the build process uses `foo.c` or `foo.cpp`.

Multiple source file names, specified as one of the values in this table.

| Value        | Description                                                                                            |
|--------------|--------------------------------------------------------------------------------------------------------|
| String array | A string array in CustomSource. For example, <code>cfg.CustomSource = ["mySrc1.c", "mySrc2.c"];</code> |

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cell array of character vectors | A cell array of character vectors in CustomSource. For example, <code>cfg.CustomSource = {'mySrc1.c', 'mySrc2.c'};</code>                                                                                                                                                                                                                                                                                                 |
| Character vector                | <p>Separate source file names by a pathsep character in CustomSource. For example, <code>cfg.CustomSource = ['mySrc1.c' pathsep 'mySrc2.c'];</code></p> <p><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see Compatibility Considerations.</p> |

#### CustomSourceCode — Code to appear near the top of the generated .c or .cpp files

' ' (default) | character vector

Specify code to appear near the top of each generated .c or .cpp file (except `rtwhalf.c` or `rtwhalf.cpp`), outside of any function. Specify code as a character vector.

Do not specify a C static function definition.

#### CustomTerminator — Code that appears in the generated terminate function

' ' (default) | character vector

Code that appears in the generated terminate function, specified as a character vector.

#### DeepLearningConfig — Configuration object for deep learning code generation

`coder.MkLDNNConfig` object | `coder.CuDNNConfig` object | `coder.TensorRTConfig` object

Configuration object for code generation for deep learning networks, specified as specified as one of the objects in this table.

| Object                          | Requires                                                                                                                                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>coder.MkLDNNConfig</code> | <ul style="list-style-type: none"> <li>Deep Learning Toolbox</li> <li>MATLAB Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A <code>coder.MkLDNNConfig</code> object contains parameters specific to C++ code generation for deep learning using Intel MKL-DNN. To create a <code>coder.MkLDNNConfig</code> object, use <code>coder.DeepLearningConfig</code>. For example:</p> <pre>cfg = coder.config('mex'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks with MKL-DNN”.</p> |

| Object               | Requires                                                                                                                                                                  | Description                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| coder.CuDNNConfig    | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• GPU Coder</li> <li>• GPU Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A coder.CuDNNConfig object contains parameters specific to CUDA code generation for deep learning using the cuDNN library. To create a coder.CuDNNConfig object, use coder.DeepLearningConfig. For example:</p> <pre>cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks by Using cuDNN” (GPU Coder).</p>             |
| coder.TensorRTConfig | <ul style="list-style-type: none"> <li>• Deep Learning Toolbox</li> <li>• GPU Coder</li> <li>• GPU Coder Interface for Deep Learning Libraries support package</li> </ul> | <p>A coder.TensorRTConfig object contains parameters specific to CUDA code generation for deep learning using the TensorRT library. To create a coder.TensorRTConfig object, use coder.DeepLearningConfig. For example:</p> <pre>cfg = coder.gpuConfig('lib'); cfg.TargetLang = 'C++'; cfg.DeepLearningConfig = coder.DeepLearningConfig;</pre> <p>See “Code Generation for Deep Learning Networks by Using TensorRT” (GPU Coder).</p> |

**Note** MEX code generation is not supported for deep learning using the ARM Compute Library.

Dependency: If DeepLearningConfig is set, codegen sets TargetLang to C++.

#### DynamicMemoryAllocation – Dynamic memory allocation mode

'Threshold' (default) | 'AllVariableSizeArrays' | 'Off'

Dynamic memory allocation mode, specified as one of the values in this table.

| Value                   | Description                                                                                                                                                                                                                    |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Threshold'             | This value is the default value.<br><br>The code generator allocates memory dynamically on the heap for variable-size arrays whose size (in bytes) is greater than or equal to <code>DynamicMemoryAllocationThreshold</code> . |
| 'AllVariableSizeArrays' | The code generator dynamically allocates memory for all variable-size arrays on the heap.                                                                                                                                      |
| 'Off'                   | The code generator statically allocates memory for variable-size arrays on the stack.                                                                                                                                          |

Unbounded variable-size arrays require dynamic memory allocation.

Dependencies:

- `EnableVariableSizing` enables this parameter.
- Setting this `DynamicMemoryAllocation` to 'Threshold' enables the `DynamicMemoryAllocationThreshold` parameter.

See “Generate Code for Variable-Size Data”.

#### **DynamicMemoryAllocationInterface — Dynamically allocated array at generated function interface**

'Auto' (default) | 'C' | 'C++'

Implementation of dynamically allocated array at the interface of the generated C/C++ function, specified as one of the values in this table.

| Value  | Description                                                                                                                                                                                                                                                                          |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Auto' | This is the default value. If you set the <code>TargetLang</code> parameter to 'C++' or 'C', this value correspondingly behaves as the same flag.                                                                                                                                    |
| 'C'    | The generated code uses the C style <code>emxArray</code> data structure to implement dynamically allocated arrays. See “Use C Arrays in the Generated Function Interfaces”.                                                                                                         |
| 'C++'  | If you set the <code>TargetLang</code> parameter to 'C', this value is disabled.<br><br>The generated code uses the <code>coder::array</code> class template to implement dynamically allocated arrays. See “Use Dynamically Allocated C++ Arrays in Generated Function Interfaces”. |

When using GPU Coder, the code generator always uses the C style `emxArray` data structure.

Dependency:

- `EnableVariableSizing` enables this parameter.

### DynamicMemoryAllocationForFixedSizeArrays – Dynamic memory allocation mode for fixed-size arrays

'Never' (default) | 'Always' | 'Threshold'

Dynamic memory allocation mode for fixed-size arrays, specified as one of the values in this table.

| Value       | Description                                                                                                                                                           |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Never'     | This value is the default value.<br><br>The code generator statically allocates memory for fixed-size arrays on the stack.                                            |
| 'Always'    | The code generator dynamically allocates memory on the heap for all fixed-size arrays whose size is greater than 64 bytes.                                            |
| 'Threshold' | The code generator allocates memory dynamically on the heap for fixed-size arrays whose size (in bytes) is greater than or equal to DynamicMemoryAllocationThreshold. |

Dependencies:

- Setting DynamicMemoryAllocationForFixedSizeArrays to 'Threshold' enables the DynamicMemoryAllocationThreshold parameter.

### DynamicMemoryAllocationForVariableSizeArrays – Dynamic memory allocation mode for variable-size arrays

'Threshold' (default) | 'Always' | 'Never'

Dynamic memory allocation mode for variable-size arrays, specified as one of the values in this table.

| Value       | Description                                                                                                                                                                                                      |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Threshold' | This value is the default value.<br><br>The code generator allocates memory dynamically on the heap for variable-size arrays whose size (in bytes) is greater than or equal to DynamicMemoryAllocationThreshold. |
| 'Always'    | The code generator dynamically allocates memory for all variable-size arrays on the heap.                                                                                                                        |
| 'Never'     | The code generator statically allocates memory for variable-size arrays on the stack.                                                                                                                            |

Unbounded variable-size arrays require dynamic memory allocation.

Dependencies:

- Setting DynamicMemoryAllocationForVariableSizeArrays to 'Threshold' enables the DynamicMemoryAllocationThreshold parameter.

See “Generate Code for Variable-Size Data”.

**DynamicMemoryAllocationThreshold — Size threshold for dynamic memory allocation of variable-size arrays**

65536 (default) | positive integer

Size threshold for dynamic memory allocation of fixed-size and variable-size arrays, specified as a positive integer. The code generator uses dynamic memory allocation for fixed-size and variable-size arrays whose size (in bytes) is greater than or equal to the threshold.

Dependency:

- Setting `DynamicMemoryAllocation`, `DynamicMemoryAllocationForFixedSizeArrays`, or `DynamicMemoryAllocationForVariableSizeArrays` to 'Threshold' enables this parameter.

See “Generate Code for Variable-Size Data”.

**EnableAutoParallelization — Automatic parallelization of for loops**

false (default) | true

Automatic parallelization of `for` loops, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Code generator does not automatically parallelize for loops.                                                                                                                                       |
| true  | The code generator automatically parallelizes for loops in the generated code. Automatic parallelization can significantly improve the execution speed of the generated code. See “Automatically Parallelize for Loops in Generated Code”. |

When using GPU Coder, the code generator always enables automatic parallelization of `for` loops.

Data Types: `logical`

**EnableAutoParallelizationReporting — Reporting for automatic parallelization of for loops**

true (default) | false

Reporting for automatic parallelization of `for` loops, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                      |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If you set <code>EnableAutoParallelization</code> to <code>true</code> , the code generator produces a code generation report for automatic parallelization of for loops |

| Value | Description                                                                                              |
|-------|----------------------------------------------------------------------------------------------------------|
| false | The code generator does not produce a code generation report for automatic parallelization of for loops. |

### EchoExpressions – Expression echoing

true (default) | false

Expression echoing, specified as one of the values in this table.

| Value | Description                                                                                                              |
|-------|--------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br>The MEX function displays the output of statements that do not end with a semicolon. |
| false | The MEX function does not display the output of statements that do not end with a semicolon.                             |

This property does not apply to common visualization functions, such as `disp`, `plot`, or `figure` when they are called as an extrinsic function. MEX functions display the output of those functions regardless of the presence of a semicolon or the value of `EchoExpressions`.

### EnableAutoExtrinsicCalls – Automatic extrinsic function calls

true (default) | false

Automatic extrinsic function calls, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                        |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br>The code generator treats some common visualization functions as extrinsic functions. You do not have to declare these functions as extrinsic by using <code>coder.extrinsic</code> . This capability reduces the amount of time that you spend making your code suitable for code generation. |
| false | The code generator does not treat common visualization functions as extrinsic functions unless you declare them as extrinsic by using <code>coder.extrinsic</code> .                                                                                                                                                               |

Some common visualization functions are `plot`, `disp`, and `figure`. See “Use MATLAB Engine to Execute a Function Call in Generated Code”.

### EnableDebugging – C compiler debugging mode

false (default) | true

C compiler debugging mode, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                  |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not enable the C compiler debugging mode.                                                                                    |
| true  | The code generator enables the C compiler debugging mode. When debugging mode is enabled, the C compiler does not optimize the code. The compilation is faster, but the execution is slower. |

#### **EnableImplicitExpansion – Implicit expansion capabilities in generated code**

true (default) | false

Implicit expansion capabilities in the generated code, specified as one of the values listed in this table.

| Value | Description                                                                                                                                                                                                                                                  |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator enables implicit expansion in the generated code. The code generator includes modifications in the generated code to apply implicit expansion. See “Compatible Array Sizes for Basic Operations”. |
| false | The generated code does not follow the rules of implicit expansion.                                                                                                                                                                                          |

Data Types: logical

#### **EnableJIT – Just-in-time (JIT) compilation mode**

false (default) | true

Just-in-time (JIT) compilation mode, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                  |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator creates a C/C++ MEX function by generating and compiling C/C++ code.                                                                                                                                                              |
| true  | The code generator uses just-in-time (JIT) compilation technology for MEX function generation. The code generator creates a JIT MEX function that contains an abstract representation of the MATLAB code. When you run the JIT MEX function, MATLAB generates the executable code in memory. |

To speed up generation of MEX functions, set `EnableJIT` to `true`.



JIT compilation is incompatible with certain code generation features and options, such as custom code or use of the OpenMP library. If you specify JIT compilation and the code generator is unable to use it, it generates a C/C++ MEX function with a warning. If `EnableJIT` and `EnableOpenMP` are `true`, and your code uses `parfor`, the code generator uses JIT compilation and treats the `parfor`-loops as `for`-loops.

See “Speed Up MEX Generation by Using JIT Compilation”.

### **EnableMemcpy — memcpy optimization**

`true` (default) | `false`

memcpy optimization, specified as one of the values in this table.

| <b>Value</b>       | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | This value is the default value.<br><br>If possible, the code generator uses the <code>memcpy</code> optimization. To optimize code that copies consecutive array elements, the <code>memcpy</code> optimization replaces the code with a <code>memcpy</code> call. When the number of elements to copy is known at compile time, the code generator uses the <code>MemcpyThreshold</code> property to determine whether to use the optimization. See “memcpy Optimization”. |
| <code>false</code> | The code generator does not use the <code>memcpy</code> optimization.                                                                                                                                                                                                                                                                                                                                                                                                        |

When using GPU Coder, the code generator always disables `Memcpy` optimization.

### **EnableMexProfiling — Instrumentation for profiling**

`false` (default) | `true`

Enabling profiling of generated MEX function, specified as one of the values in this table.

| <b>Value</b>       | <b>Description</b>                                                                                                                                                                                          |
|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>false</code> | This value is the default value.<br><br>The code generator does not include the instrumentation for profiling in the generated MEX function.                                                                |
| <code>true</code>  | The code generator includes the instrumentation for profiling in the generated MEX function. You can then use the MATLAB Profiler to profile the MEX. See “Profile MEX Functions by Using MATLAB Profiler”. |

### **EnableOpenMP — Parallelization of parfor-loops**

`true` (default) | `false`

Parallelization of `parfor`-loops, specified as one of the values in this table.

| Value | Description                                                                                                                                      |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the OpenMP library to produce loop iterations that run in parallel. |
| false | The code generator treats parfor-loops as for-loops.                                                                                             |

See parfor.

Use of the OpenMP library is not compatible with just-in-time (JIT) compilation. If `EnableJIT` and `EnableOpenMP` are `true`, the code generator uses JIT compilation and treats parfor-loops as for-loops.

When using GPU Coder, the code generator always treats parfor-loops as for-loops.

#### **EnableRuntimeRecursion — Run-time recursion support**

true (default) | false

Run-time recursion support, specified as one of the values in this table.

| Value | Description                                                                                    |
|-------|------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Recursive functions are allowed in the generated code. |
| false | Recursive functions are not allowed in the generated code.                                     |

Some coding standards, such as MISRA, do not allow recursion. To increase the likelihood of generating code that is compliant with MISRA C, set `EnableRuntimeRecursion` to `false`.

If your MATLAB code requires run-time recursion and `EnableRuntimeRecursion` is `false`, code generation fails.

See “Code Generation for Recursive Functions”.

#### **EnableVariableSizing — Variable-size array support**

true (default) | false

Variable-size array support, specified as one of the values in this table.

| Value | Description                                                                                   |
|-------|-----------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>Variable-size arrays are allowed for code generation. |
| false | Variable-size arrays are not allowed for code generation.                                     |

Dependency:

- Enables Dynamic memory allocation.

See “Code Generation for Variable-Size Arrays”.

### ExtrinsicCalls – Extrinsic function call support

true (default) | false

Extrinsic function call support, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>For an extrinsic function, the code generator produces a call to a MATLAB function. The code generator does not generate the internal code for the function.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| false | The code generator ignores an extrinsic function. It does not generate code for the call to the MATLAB function. If the extrinsic function affects the output of the MATLAB function, the code generator issues a compilation error.<br><br>If you set <code>ExtrinsicCalls</code> to <code>false</code> , the generated MEX function cannot display run-time messages from <code>error</code> or <code>assert</code> statements in your MATLAB code. The MEX function reports that it cannot display the error message. To see the error message, set <code>ExtrinsicCalls</code> to <code>true</code> and generate the MEX function again. |

The value of `ExtrinsicCalls` affects how a MEX function generates random numbers for `rand`, `randi`, and `randn`. If `ExtrinsicCalls` is `true`, the MEX function uses the MATLAB global random number stream to generate random numbers. Otherwise, the MEX function uses a self-contained random number generator.

See “Use MATLAB Engine to Execute a Function Call in Generated Code”.

### FilePartitionMethod – File partitioning mode

'MapMFileToCFile' (default) | 'SingleFile'

File partitioning mode specified as one of the values in this table.

| Value             | Description                                                                                                                                                                          |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'MapMFileToCFile' | This value is the default value.<br><br>The code generator produces separate C/C++ files for each MATLAB language file.                                                              |
| 'SingleFile'      | The code generator produces a single file for C/C++ functions that map to your MATLAB entry-point functions. The code generator produces separate C/C++ files for utility functions. |

See “How MATLAB Coder Partitions Generated Code”.

**GenCodeOnly — Generation of only source code**

false (default) | true

Generation of only source code, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                             |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator produces C/C++ source code and builds object code.                                                                                                           |
| true  | The code generator produces C/C++ source code, but does not invoke the make command or build object code. When you iterate between modifying MATLAB code and generating C/C++ code, generating only code can save time. |

**GenerateComments — Comments in generated code**

true (default) | false

Comments in generated code, specified as one of the values in this table.

| Value | Description                                                                                       |
|-------|---------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator places comments in the generated code. |
| false | The code generator does not place comments in the generated code.                                 |

**GenerateReport — Code generation report**

false (default) | true

Code generation report, specified as one of the values in this table.

| Value | Description                                                                                                                                               |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator produces a report only if error or warning messages occur, or if you set LaunchReport to true. |
| true  | The code generator produces a code generation report.                                                                                                     |

**GlobalDataSyncMethod — Global data synchronization mode**

'SyncAlways' (default) | 'SyncAtEntryAndExits' | 'NoSync'

Global data synchronization mode, specified as one of the values in this table.

| Value                  | Description for Global Data                                                                                                                                                                                                                                                                                                                                                                   | Description for Constant Global Data                                                                                                                                                                                                                                                                                                                                                                |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'SyncAlways' (default) | This value is the default value.<br><br>Synchronizes global data at MEX function entry and exit and for extrinsic calls for maximum consistency between MATLAB and the generated MEX function. To maximize performance, if the extrinsic calls do not change global data, use this option with the <code>coder.extrinsic -sync:off</code> option to turn off synchronization for these calls. | Verifies consistency of constant global data at MEX function entry and after extrinsic calls. If the global data values in the MATLAB global workspace are inconsistent with the compile-time constant global values in the MEX function, the MEX function ends with an error. Use the <code>coder.extrinsic -sync:off</code> option to turn off consistency checks after specific extrinsic calls. |
| 'SyncAtEntryAndExits'  | Synchronizes global data at MEX function entry and exit only. To maximize performance, if only a few extrinsic calls change global data, use this option with the <code>coder.extrinsic -sync:on</code> option to turn on synchronization for these calls.                                                                                                                                    | Verifies constant global data at MEX function entry only. If the global data values in the MATLAB global workspace are inconsistent with the compile-time constant global values in the MEX function, the MEX function ends with an error. Use the <code>coder.extrinsic -sync:on</code> option to turn on consistency checks after specific extrinsic calls.                                       |
| 'NoSync'               | Disables synchronization. Before disabling synchronization, verify that your MEX function does not interact with MATLAB global data. Otherwise, inconsistencies between MATLAB and the MEX function can occur.                                                                                                                                                                                | Disables consistency checks.                                                                                                                                                                                                                                                                                                                                                                        |

See “Generate Code for Global Data”.

### HighlightPotentialRowMajorIssues — Potential row-major layout issues

`true` (default) | `false`

Display of potential row-major layout efficiency issues, specified as one of the values in this table.

| Value              | Description                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | The code generation report displays potential efficiency issues due to row-major layout. (This value is the default value.) |
| <code>false</code> | The code generation report does not display issues related to array layout.                                                 |

See “Code Design for Row-Major Array Layout”.

### InitFltsAndDblsToZero — Assignment of float and double zero with memset

`true` (default) | `false`

Assignment of float and double zero with `memset`, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>If possible, the code generator uses the <code>memset</code> optimization for assignment of floating-point zero to consecutive array elements. To assign consecutive array elements, the <code>memset</code> optimization uses a <code>memset</code> call. When the number of elements to assign is known at compile time, the code generator uses the <code>MemcpyThreshold</code> property to determine whether to use the optimization. See “memset Optimization”. |
| false | The code generator does not use the <code>memset</code> optimization for assignment of float and double zero to consecutive array elements.                                                                                                                                                                                                                                                                                                                                                                   |

#### **InlineBetweenMathWorksFunctions – Control inlining between MathWorks functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a MathWorks calls another MathWorks function, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the `coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

#### **InlineBetweenUserAndMathWorksFunctions – Control inlining between user-written functions and MathWorks functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a function that you wrote calls a MathWorks function, or a MathWorks function calls a function that you wrote. Specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the `coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

### **InLineBetweenUserFunctions – Control inlining between user-written functions**

'Speed' (default) | 'Always' | 'Readability' | 'Never'

Inlining behavior at all call sites where a function that you wrote calls another function that you wrote, specified as one of the values in this table.

| Value         | Description                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Speed'       | This value is the default value.<br><br>Uses internal heuristics to determine whether to perform inlining at a call site. This setting usually leads to highly optimized code.                      |
| 'Always'      | Always performs inlining at a call site.                                                                                                                                                            |
| 'Readability' | Almost never inlines function calls, except for calls to very small functions. Preserves modularity of code without sacrificing too much speed, whenever possible. Results in highly readable code. |
| 'Never'       | Never inlines function calls. Results in maximum readability. This setting might significantly reduce the performance of the generated code.                                                        |

Even if you select the 'Always' or the 'Never' option for a setting, in certain cases, the code generator might not strictly follow that instruction. For example, if there is a conflict, the

`coder.inline('always')` or `coder.inline('never')` directive placed inside a function body overrides this option. For more information, see “Interaction Between Different Inlining Controls”.

See “Control Inlining to Fine-Tune Performance and Readability of Generated Code”.

### **IntegrityChecks — Memory integrity checking**

`true` (default) | `false`

Memory integrity checking, specified as one of the values in this table.

| <b>Value</b>       | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>true</code>  | This value is the default value.<br><br>The generated code detects memory integrity violations and stops execution with a diagnostic message.                                                                                                                                                                                                                                                                                                                                                      |
| <code>false</code> | The generated code does not detect memory integrity violations.<br><br>Setting <code>IntegrityChecks</code> to <code>false</code> can improve performance. However, without memory integrity checks, violations result in unpredictable behavior. Set <code>IntegrityChecks</code> to <code>false</code> only if you have verified that array bounds checking and dimension checking are unnecessary. Setting <code>IntegrityChecks</code> to <code>false</code> also disables the run-time stack. |

See “Control Run-Time Checks”.

### **LaunchReport — Automatic open of code generation report**

`false` (default) | `true`

Automatic open of code generation report, specified as one of the values in this table.

| <b>Value</b>       | <b>Description</b>                                                                                                                                                                                |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>false</code> | This value is the default value.<br><br>If errors or warnings occur, or if <code>GenerateReport</code> is <code>true</code> , the code generator produces a report, but does not open the report. |
| <code>true</code>  | The code generator produces and opens a code generation report.                                                                                                                                   |

### **MATLABSourceComments — Inclusion of MATLAB source code as comments in generated code**

`false` (default) | `true`

Inclusion of MATLAB source code as comments in generated code, specified as one of the values in this table.



| Value | Description                                                                                                                                                                                                                                                                                                                                                                               |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>The code generator does not insert MATLAB source code as comments in the generated code. The code generator does not include the MATLAB function signature in the function banner.                                                                                                                                                                |
| true  | The code generator inserts MATLAB source code as comments in the generated code. A traceability tag immediately precedes each line of source code. The traceability tag helps you to locate the corresponding MATLAB source code. See “Tracing Generated C/C++ Code to MATLAB Source Code”.<br><br>The code generator also includes the MATLAB function signature in the function banner. |

Dependency:

- `GenerateComments` enables this parameter.

See “Tracing Generated C/C++ Code to MATLAB Source Code”.

### **MemcpyThreshold — Minimum size for memcpy or memset optimization**

64 (default) | positive integer

Minimum size, in bytes, for memcpy or memset optimization, specified as a positive integer.

To optimize generated code that copies consecutive array elements, the code generator tries to replace the code with a `memcpy` call. To optimize generated code that assigns a literal constant to consecutive array elements, the code generator tries to replace the code with a `memset` call.

The number of bytes is the number of array elements to copy or assign multiplied by the number of bytes required for the C/C++ data type.

If the number of elements to copy or assign is variable (not known at compile time), the code generator ignores the `MemcpyThreshold` property.

See “memcpy Optimization” and “memset Optimization”.

### **Name — Object name**

'MexCodeConfig' (default) | character vector

Object name, specified as a character vector.

### **NumberOfCpuThreads — Maximum number of CPU threads to run parallel for-loops**

0 (default) | positive integer

Maximum number of CPU threads to run parallel for-loops in the generated C/C++ code, specified as a positive integer.

See “Specify Maximum Number of Threads to Run Parallel for-Loops in the Generated Code”.

**PostCodeGenCommand — Command to customize build processing**

'' (default) | character vector

Command to customize build processing after MEX function generation with codegen, specified as a character vector.

See “Build Process Customization”.

**PreserveArrayDimensions — N-dimensional indexing**

false (default) | true

Generation of code that uses N-dimensional indexing, specified as one of the values in this table.

| Value | Description                                                                          |
|-------|--------------------------------------------------------------------------------------|
| false | Generate code that uses one-dimensional indexing. (This value is the default value.) |
| true  | Generate code that uses N-dimensional indexing.                                      |

See “Generate Code That Uses N-Dimensional Indexing”.

**PreserveVariableNames — Variable names to preserve in the generated code**

'None' (default) | 'UserNames' | 'All'

Variable names to preserve in the generated code, specified as one of the values in this table.

| Value       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'None'      | <p>This value is the default value.</p> <p>The code generator does not have to preserve any variable names. It can reuse any variables that meet the requirements for variable reuse.</p> <p>If your code uses large structures or arrays, setting <code>PreserveVariableNames</code> to 'None' can reduce memory usage or improve execution speed.</p>                                                                                                                                                                                                                                                                                                                 |
| 'UserNames' | <p>The code generator preserves names that correspond to variables that you define in the MATLAB code. It does not replace your variable name with another name and does not use your name for another variable. To improve readability, set <code>PreserveVariableNames</code> to 'UserNames'.</p> <p>Then, you can more easily trace the variables in the generated code back to the variables in your MATLAB code.</p> <p>Setting <code>PreserveVariableNames</code> to 'UserNames' does not prevent an optimization from removing your variables from the generated code or prevent the C/C++ compiler from reusing the variables in the generated binary code.</p> |

| Value | Description                                                                                                                               |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 'All' | Preserve all variable names. This parameter value disables variable reuse. Use it only for testing or debugging, not for production code. |

See “Preserve Variable Names in Generated Code”.

### ReportInfoVarName — Name of variable containing code generation report information

' ' (default) | character vector

Name of variable to which you export information about code generation, specified as a character vector. The code generator creates this variable in the base MATLAB workspace. This variable contains information about code generation settings, input files, generated files, and code generation messages.

See “Access Code Generation Report Information Programmatically” and `coder.ReportInfo` Properties.

### ReportPotentialDifferences — Potential differences reporting

true (default) | false

Potential difference reporting, specified as one of the values in this table:

| Value | Description                                                                                                                                                                                                                                                                  |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | The code generator reports potential behavior differences between generated code and MATLAB code. The potential differences are listed on a tab of the code generation report. A potential difference is a difference that occurs at run time only under certain conditions. |
| false | The code generator does not report potential differences.                                                                                                                                                                                                                    |

See “Potential Differences Reporting”.

### ReservedNameArray — Names that the code generator cannot use for functions or variables

' ' (default) | string array | cell array of character vectors | character vector

List of names that the code generator must not use for functions or variables, specified as a string arrays, cell array of character vectors, or character vector.

Multiple reserved names, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String arrays                   | A string array in <code>ReservedNameArray</code> . For example, <code>cfg.ReservedNameArray = ["reserve1", "reserve2", "reserve3"]</code> .                    |
| Cell array of character vectors | A cell array of character vectors in <code>ReservedNameArray</code> . For example, <code>cfg.ReservedNameArray = {'reserve1', 'reserve2', 'reserve3'}</code> . |

| Value             | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Character vectors | <p>A semicolon-separated list of reserved names in <code>ReservedNameArray</code>. For example, <code>cfg.ReservedNameArray = 'reserve1; reserve2; reserve3'</code>.</p> <p><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a>.</p> |

### ResponsivenessChecks — Responsiveness checks

true (default) | false

Responsiveness checks, specified as one of the values in this table.

| Value | Description                                                                                                             |
|-------|-------------------------------------------------------------------------------------------------------------------------|
| true  | <p>This value is the default value.</p> <p>You can use <b>Ctrl+C</b> to stop execution of a generated MEX function.</p> |
| false | <p>To end a long-running MEX function, you might have to terminate MATLAB.</p>                                          |

When using GPU Coder, the code generator always disables this parameter.

See “Control Run-Time Checks”.

### RowMajor — Row-major array layout

false (default) | true

Generation of code that uses row-major array layout, specified as one of the values in this table.

| Value | Description                                                                                  |
|-------|----------------------------------------------------------------------------------------------|
| false | <p>Generate code that uses column-major array layout. (This value is the default value.)</p> |
| true  | <p>Generate code that uses row-major array layout.</p>                                       |

See “Generate Code That Uses Row-Major Array Layout”.

### SaturateOnIntegerOverflow — Integer overflow support

true (default) | false

Integer overflow support, specified as one of the values in this table.

| Value | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| true  | This value is the default value.<br><br>The code generator produces code to handle integer overflow. Overflows saturate to either the minimum or maximum value that the data type can represent.                                                                                                                                                                                                                                                                                                                                                                                                |
| false | The code generator does not produce code to handle integer overflow. Do not set <code>SaturateOnIntegerOverflow</code> to false unless you are sure that your code does not depend on integer overflow support. If you disable integer overflow support and integrity checks are enabled, the generated code produces an error for overflows. If you disable integer overflow support and you disable integrity checks, the overflow behavior depends on your target C compiler. In the C standard, the behavior for integer overflow is undefined. However, most C compilers wrap on overflow. |

This parameter applies only to MATLAB built-in integer types. It does not apply to doubles, singles, or fixed-point data types.

See “Disable Support for Integer Overflow or Nonfinites”.

### **StackUsageMax — Maximum stack usage per application**

200000 (default) | positive integer

Maximum stack usage per application, in bytes, specified as a positive integer. Set a limit that is lower than the available stack size. Otherwise, a run-time stack overflow might occur. The C compiler detects and reports stack overflows.

See “Control Stack Space Usage”.

### **TargetLang — Language to use in generated code**

'C' (default) | 'C++'

Language to use in generated code, specified as 'C' or 'C++'. If you specify C++, the code generator wraps the C code into .cpp files so that you can use a C++ compiler and interface with external C++ applications. It does not generate C++ classes.

When using GPU Coder, the code generator sets TargetLang to C++.

Dependency: If DeepLearningConfig is set, codegen sets TargetLang to C++.

### **Verbosity — Code generation progress display**

'Info' (default) | 'Silent' | 'Verbose'

Whether to display the status of the code generation progress at the MATLAB command line, specified as one of the values in this table.

| Value     | Description                                                                                                                                                                                                                                                                 |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 'Silent'  | If code generation succeeds without warning, all messages are suppressed, including when you generate a report.<br><br>Warning and error messages are displayed.                                                                                                            |
| 'Info'    | This value is the default value.<br><br>Compared to the 'Silent' mode, if code generation succeeds, these additional messages are displayed: <ul style="list-style-type: none"> <li>• Code generation successful</li> <li>• Link to the generated report, if any</li> </ul> |
| 'Verbose' | In addition to the messages shown in the 'Info' mode, code generation status and target build log messages are displayed.                                                                                                                                                   |

## Examples

### Specify Configuration Parameters for MEX Function Generation

Write a MATLAB function from which you can generate code. This example uses the function `myadd` that returns the sum of its inputs.

```
function c = myadd(a,b)
c = a + b;
end
```

Create a configuration object for MEX function generation.

```
cfg = coder.config('mex');
```

Change the values of the properties for which you do not want to use the default values. For example, enable just-in-time (JIT) compilation.

```
cfg.EnableJIT = true;
```

Generate code by using `codegen`. Pass the configuration object to `codegen` by using the `-config` option. Specify that the input arguments are scalar double.

```
codegen myadd -config cfg -args {1 1} -report
```

### Alternative Functionality

To use default configuration parameter values for MEX function generation, instead of creating a configuration object, you can call `codegen` without specifying a configuration object or with the `-config:mex` option.

## Compatibility Considerations

### Capability to Specify Multiple Entries in Code Configuration Objects by Using Character Vector Will Be Removed

*Behavior change in future release*

In a future release, specifying multiple file names, paths, or reserved names in code configuration objects by using character vectors or string scalars that have delimiters will be removed. Use string arrays and a cell array of character vector instead. For example, to include multiple folder names, you can use either a string array in `CustomInclude` as `cfg.CustomInclude = ["C:\Project", "C:\Custom Files"]`; or a cell array of character vectors as `cfg.CustomInclude = {'C:\Project', 'C:\Custom Files'}`; to include the path for compiling the generated code.

### DynamicMemoryAllocation Property To Be Removed

*Not recommended starting in R2022a*

In a future release, the `DynamicMemoryAllocation` property will be removed.

To dynamically allocate memory for variable-size arrays, use the configuration parameter `DynamicMemoryAllocationForVariableSizeArrays`.

Do not use `DynamicMemoryAllocation` and `DynamicMemoryAllocationForVariableSizeArrays` together during code generation.

## See Also

### Functions

`codegen` | `coder.config` | `pathsep`

### Objects

`coder.CodeConfig` | `coder.EmbeddedCodeConfig`

### Topics

“Accelerate MATLAB Algorithm by Generating MEX Function”

“Specify Configuration Parameters in Command-Line Workflow Interactively”

### Introduced in R2011a

## coder.ReplacementTypes

Configuration parameter to specify custom names for MATLAB built-in data types in C/C++ code generation

### Description

A `coder.ReplacementTypes` object contains the configuration parameters that the code generator uses for creating custom data type names for MATLAB built-in data types in C/C++ code generation.

You must associate `coder.ReplacementTypes` object with an Embedded Coder configuration object (a `coder.EmbeddedCodeConfig` object) that you pass to the `codegen` function.

You can access `coder.ReplacementTypes` properties from either the command-line interface (see “Specify Custom Names for MATLAB Built-in Data Types” on page 4-128) or a dialog box for the associated configuration object (see “Access Replacement Types Properties Through a Dialog Box” on page 4-130).

### Creation

Use the `coder.config` function to create a `coder.EmbeddedCodeConfig` object for generation of standalone code. When the `coder.config` function creates a `coder.EmbeddedCodeConfig` object, it sets the `ReplacementTypes` property to `coder.ReplacementTypes` object.

### Properties

#### **double** — Custom name for double data type

' ' (default) | character vector | string scalar

Custom name for a `double` data type in the generated C/C++ code, specified as a character vector or string scalar.

#### **single** — Custom name for single data type

' ' (default) | character vector | string scalar

Custom name for a `single` data type in the generated C/C++ code, specified as a character vector or string scalar.

#### **uint8** — Custom name for uint8 data type

' ' (default) | character vector | string scalar

Custom name for a `uint8` data type in the generated C/C++ code, specified as a character vector or string scalar.

#### **uint16** — Custom name for uint16 data type

' ' (default) | character vector | string scalar

Custom name for a `uint16` data type in the generated C/C++ code, specified as a character vector or string scalar.



**uint32 – Custom name for uint32 data type**`'' (default) | character vector | string scalar`

Custom name for a `uint32` data type in the generated C/C++ code, specified as a character vector or string scalar.

**uint64 – Custom name for uint64 data type**`'' (default) | character vector | string scalar`

Custom name for a `uint64` data type in the generated C/C++ code, specified as a character vector or string scalar.

**int8 – Custom name for int8 data type**`'' (default) | character vector | string scalar`

Custom name for a `int8` data type in the generated C/C++ code, specified as a character vector or string scalar.

**int16 – Custom name for int16 data type**`'' (default) | character vector | string scalar`

Custom name for a `int16` data type in the generated C/C++ code, specified as a character vector or string scalar.

**int32 – Custom name for int32 data type**`'' (default) | character vector | string scalar`

Custom name for a `int32` data type in the generated C/C++ code, specified as a character vector or string scalar.

**int64 – Custom name for int64 data type**`'' (default) | character vector | string scalar`

Custom name for a `int64` data type in the generated C/C++ code, specified as a character vector or string scalar.

**char – Custom name for char data type**`'' (default) | character vector | string scalar`

Custom name for a `char` data type in the generated C/C++ code, specified as a character vector or string scalar.

**logical – Custom name for logical data type**`'' (default) | character vector | string scalar`

Custom name for a `logical` data type in the generated C/C++ code, specified as a character vector or string scalar.

**IsExtern – Import type definition from external header files**`false (default) | true | logical`

Enable or disable importing type definitions from external header files for use in the generated C/C++ code.

| Value | Description                                                                                                                                                                                                                                                                                                                       |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| false | This value is the default value.<br><br>Custom type definitions are generated in the file <code>rtwtypes.h</code> . Importing type definitions from external header files is not allowed for code generation.                                                                                                                     |
| true  | Importing type definitions from external header files is allowed for code generation. The specified header files are included in <code>&lt;function&gt;_types.h</code> . For example, if the function name is <code>myFunc</code> , the external header file is included in a generated header file <code>myFunc_types.h</code> . |

### HeaderFiles — Name of external header file for import

' ' (default) | string array | cell array of character vectors | character vector

External header file names that contain custom type definitions.

Multiple header files, specified as one of the values in this table.

| Value                           | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| String array                    | A string array in <code>ReplacementTypes.HeaderFiles</code> . For example, <code>cfg.ReplacementTypes.HeaderFiles = ["myHeader1.h", "myHeader2.h", "myHeader3.h"]</code> .                                                                                                                                                                                                                                                                                                             |
| Cell array of character vectors | A cell array of character vectors in <code>ReplacementTypes.HeaderFiles</code> . For example, <code>cfg.ReplacementTypes.HeaderFiles = {'myHeader1.h', 'myHeader2.h', 'myHeader3.h'}</code> .                                                                                                                                                                                                                                                                                          |
| Character vector                | A semicolon-separated list of header file names in <code>ReplacementTypes.HeaderFiles</code> . For example, <code>cfg.ReplacementTypes.HeaderFiles = 'myHeader1.h;myHeader2.h;myHeader3.h'</code> .<br><br><b>Note</b> Specifying multiple entries in code configuration objects by using character vectors will be removed in a future release. Use string array and cell array of character vector instead. For more information, see <a href="#">Compatibility Considerations</a> . |

## Examples

### Specify Custom Names for MATLAB Built-in Data Types

Write a MATLAB function from which you can generate code. This example uses the function `myAdd.m`, which returns the sum of its inputs.

```
function c = myAdd(a,b)
c = a + b;
end
```

Create a `coder.EmbeddedCodeConfig` object for generation of a static library.

```
cfg = coder.config('lib','ecoder',true);
```

Set the `EnableCustomReplacementTypes` to `true`.

```
cfg.EnableCustomReplacementTypes = true;
```

Specify custom names for MATLAB built-in data types. For example, in the code, `double` is named as `Custom_Double` and `int8` is named as `Custom_Int8`.

```
cfg.ReplacementTypes.double = "Custom_Double";
cfg.ReplacementTypes.int8 = "Custom_Int8";
```

Generate code by using the `codegen` function and the `-config` option.

```
codegen myAdd.m -args {1,int8(1)} -config cfg -report
```

The generated code contains custom data type names.

### Import Custom Type Definitions from External Header Files

Create a writable folder `myFiles`.

Write a MATLAB function from which you can generate code. Save the function in `myFiles`. This example uses the function `myAdd.m`, which returns the sum of its inputs.

```
function c = myAdd(a,b)
c = a + b;
end
```

Write your header file `myHeader.h` that contains type definitions for the two inputs of the function `myAdd.m`. Save it in `myFiles`.

```
#if !defined(MYHEADER)
#define MYHEADER
typedef double Custom_Double;
typedef char Custom_Int8;
#endif
```

Create a `coder.EmbeddedCodeConfig` object for generation of a static library.

```
cfg = coder.config('lib','ecoder',true);
```

Specify custom names for MATLAB built-in data types. For example, in the code, `double` is named as `Custom_Double` and `int8` is named as `Custom_Int8`.

```
cfg.EnableCustomReplacementTypes = true;
cfg.ReplacementTypes.double = "Custom_Double";
cfg.ReplacementTypes.int8 = "Custom_Int8";
```

Specify configuration properties for importing external header files.

```
% Include single header file

cfg.ReplacementTypes.IsExtern = true;
cfg.ReplacementTypes.HeaderFiles = "myHeader.h";
cfg.CustomInclude = 'C:\myFiles'; % Include path of the header file

% Include multiple header files

cfg.ReplacementTypes.IsExtern = true;
cfg.ReplacementTypes.HeaderFiles = "myHeader1.h;myHeader2.h;myHeader3.h";
cfg.CustomInclude = 'C:\Program Files\MATLAB\myFiles'; % Include path of the header files
```

Generate code by using the `codegen` function and the `-config` option.

```
codegen myAdd.m -args {1,int8(1)} -config cfg -report
```

In the generated code, `myAdd_types.h` includes the external header file `myHeader.h`.

To read more about importing custom data type definitions from external header files, see “Import Custom Data Type Definitions from External Header Files” (Embedded Coder).

### Access Replacement Types Properties Through a Dialog Box

Open the dialog box for the configuration object that refers to the `coder.ReplacementTypes` object. For example:

```
cfg = coder.config('lib');
open('cfg');
```

In the dialog box, click the **Code Appearance** tab.

Select **Enable custom data type replacement**. The **Custom Data Type Replacement** table lists the name of the supported data types. Specify your custom names for these data types and press **Enter**.

You can import your own custom type definitions from external header files. Select the **Import custom types from external header files** check box. In the **Header files** text field, enter a semicolon-separated list of external header file names. For more information, see “Import Custom Data Type Definitions from External Header Files” (Embedded Coder).

See “Specify Configuration Parameters in Command-Line Workflow Interactively”.

## Compatibility Considerations

### Capability to Specify Multiple Entries in Code Configuration Objects by Using Character Vector Will Be Removed

*Behavior change in future release*

In a future release, specifying multiple file names, paths, or reserved names in code configuration objects by using character vectors or string scalars that have delimiters will be removed. Use string arrays and a cell array of character vector instead. For example, to include multiple header file names, you can use either a string array in `ReplacementTypes.HeaderFiles` as

```
cfg.ReplacementTypes.HeaderFiles =
["myHeader1.h", "myHeader2.h", "myHeader3.h"] or a cell array of character vectors as
cfg.ReplacementTypes.HeaderFiles =
{'myHeader1.h', 'myHeader2.h', 'myHeader3.h'}.
```

## See Also

### Functions

`codegen` | `coder.config` | `coder.cinclude`

### Objects

`coder.CodeConfig` | `coder.EmbeddedCodeConfig`

### Topics

“Customize Data Type Replacement” (Embedded Coder)

“Import Custom Data Type Definitions from External Header Files” (Embedded Coder)

“Specify Configuration Parameters in Command-Line Workflow Interactively”

### Introduced in R2019b

## RTW.BuildInfo

Provide information for compiling and linking generated code

### Description

An `RTW.BuildInfo` object contains information for compiling and linking generated code.

### Creation

#### Syntax

```
buildInformation = RTW.BuildInfo
```

#### Description

`buildInformation = RTW.BuildInfo` returns a build information object. You can use the object to specify information for compiling and linking generated code. For example:

- Compiler options
- Preprocessor identifier definitions
- Linker options
- Source files and paths
- Include files and paths
- Precompiled external libraries

### Properties

#### **ComponentName** — Component name

character vector | string

Name of generated code component.

### Object Functions

|                               |                                                         |
|-------------------------------|---------------------------------------------------------|
| <code>addCompileFlags</code>  | Add compiler options to build information               |
| <code>addDefines</code>       | Add preprocessor macro definitions to build information |
| <code>addIncludeFiles</code>  | Add include files to build information                  |
| <code>addIncludePaths</code>  | Add include paths to build information                  |
| <code>addLinkFlags</code>     | Add link options to build information                   |
| <code>addLinkObjects</code>   | Add link objects to build information                   |
| <code>addNonBuildFiles</code> | Add nonbuild-related files to build information         |
| <code>addSourceFiles</code>   | Add source files to build information                   |
| <code>addSourcePaths</code>   | Add source paths to build information                   |
| <code>addTMFTokens</code>     | Add template makefile (TMF) tokens to build information |
| <code>findBuildArg</code>     | Find a specific build argument in build information     |

|                                           |                                                                                                    |
|-------------------------------------------|----------------------------------------------------------------------------------------------------|
| <code>findIncludeFiles</code>             | Find and add include (header) files to build information                                           |
| <code>getBuildArgs</code>                 | Get build arguments from build information                                                         |
| <code>getCompileFlags</code>              | Get compiler options from build information                                                        |
| <code>getDefines</code>                   | Get preprocessor macro definitions from build information                                          |
| <code>getFullFileList</code>              | Get list of files from build information                                                           |
| <code>getIncludeFiles</code>              | Get include files from build information                                                           |
| <code>getIncludePaths</code>              | Get include paths from build information                                                           |
| <code>getLinkFlags</code>                 | Get link options from build information                                                            |
| <code>getNonBuildFiles</code>             | Get nonbuild-related files from build information                                                  |
| <code>getSourceFiles</code>               | Get source files from build information                                                            |
| <code>getSourcePaths</code>               | Get source paths from build information                                                            |
| <code>removeSourceFiles</code>            | Remove source files from build information object                                                  |
| <code>setTargetProvidesMain</code>        | Disable inclusion of code generator provided (generated or static) main.c source file during build |
| <code>updateFilePathsAndExtensions</code> | Update files in build information with missing paths and file extensions                           |
| <code>updateFileSeparator</code>          | Update file separator character for file lists in build information                                |

## Examples

### Retrieve Build Information Object

When you build generated code, the build process stores an `RTW.BuildInfo` object in the `buildInfo.mat` file. To retrieve the object, from the code generation folder that contains the `buildInfo.mat` file, run:

```
bi=load('buildInfo.mat');
bi.buildInfo
```

ans =

BuildInfo with properties:

```

 ComponentName: 'slexAircraftExample'
 Viewer: []
 Tokens: [27x1 RTW.BuildInfoKeyValuePair]
 BuildArgs: [13x1 RTW.BuildInfoKeyValuePair]
 MakeVars: []
 MakeArgs: ''
TargetPreCompLibLoc: ''
 TargetLibSuffix: ''
 ModelRefs: []
 SysLib: [1x1 RTW.BuildInfoModules]
 Maps: [1x1 struct]
 LinkObj: []
 Options: [1x1 RTW.BuildInfoOptions]
 Inc: [1x1 RTW.BuildInfoModules]
 Src: [1x1 RTW.BuildInfoModules]
 Other: [1x1 RTW.BuildInfoModules]
 Path: []
 Settings: [1x1 RTW.BuildInfoSettings]
 DisplayLabel: 'Build Info'
 Group: ''
```

The object contains build information.

### **Configure RTW.BuildInfo to Specify Code for Compilation**

This example shows how to create an RTW.BuildInfo object and register source files.

Create an RTW.BuildInfo object.

```
buildInfo = RTW.BuildInfo;
```

Register source files.

```
buildInfo.ComponentName = 'foo1';
addSourceFiles(buildInfo, 'foo1.c');
```

Specify the build method and create a static library.

```
tmf = fullfile(tmffolder, 'ert_vcx64.tmf');
buildResult1 = codebuild(pwd, buildInfo, tmf)
```

### **See Also**

**Introduced in R2006a**



# coder.ARMNEONConfig

Parameters to configure deep learning code generation with the ARM Compute Library

## Description

The `coder.ARMNEONConfig` object contains ARM Compute Library and target specific parameters that `codegen` uses for generating C++ code for deep neural networks.

To use a `coder.ARMNEONConfig` object for code generation, assign it to the `DeepLearningConfig` property of a code generation configuration object that you pass to `codegen`.

## Creation

Create an ARM NEON configuration object by using the `coder.DeepLearningConfig` function with target library set as `'arm-compute'`.

## Properties

### ArmComputeVersion — Version of ARM Compute Library

'20.02.1' (default) | '19.05'

Version of ARM Compute Library used on the target hardware, specified as a character vector or string scalar. If you set `ArmComputeVersion` to a version later than `'20.02.1'`, `ArmComputeVersion` is set to `'20.02.1'`.

### ArmArchitecture — ARM architecture supported in the target hardware

'armv8' | 'armv7'

ARM architecture supported in the target hardware, specified as a character vector or string scalar. The specified architecture must be the same as the architecture for the ARM Compute Library on the target hardware.

`ARMArchitecture` must be specified for these cases:

- You do not use a hardware support package (the `Hardware` property of the code generation configuration object is empty).
- You use a hardware support package, but generate code only.

### DataType — Inference computation precision

'fp32' (default) | 'int8'

Specify the precision of the inference computations in supported layers. When performing inference in 32-bit floats, use `'fp32'`. For 8-bit integer, use `'int8'`. Default value is `'fp32'`.

### CalibrationResultFile — Location of calibration MAT-file

'' (default) | character vector | string scalar

Location of the MAT-file containing the calibration data. Default value is ''. This option is applicable only when `DataType` is set to `'int8'`.

When performing quantization of a deep convolutional neural network, the `calibrate` function exercises the network and collects the dynamic ranges of the weights and biases in the convolution and fully connected layers of the network and the dynamic ranges of the activations in all layers of the network. To generate code for the quantized network, save the results from the `calibrate` function to a MAT-file and specify the location of this MAT-file to the code generator using this property. For more information, see “Code Generation for Quantized Deep Learning Networks”.

### TargetLibrary — Target library name

`'arm-compute'`

Name of target library, specified as a character vector.

## Examples

### Specify Configuration Parameters for C++ Code Generation for the SqueezeNet Network

Create an entry-point function `squeezenet` that uses the `coder.loadDeepLearningNetwork` function to load the `squeezenet` object.

```
function out = squeezenet_predict(in)

persistent mynet;
if isempty(mynet)
 mynet = coder.loadDeepLearningNetwork('squeezenet', 'squeezenet');
end

out = predict(mynet,in);
```

Create a `coder.config` configuration object for generation of a static library.

```
cfg = coder.config('lib');
```

Set the target language to C++. Specify that you want to generate only source code.

```
cfg.TargetLang = 'C++';
cfg.GenCodeOnly=true;
```

Create a `coder.ARMNEONConfig` deep learning configuration object. Assign it to the `DeepLearningConfig` property of the `cfg` configuration object.

```
dlcfg = coder.DeepLearningConfig('arm-compute');
dlcfg.ArmArchitecture = 'armv8';
dlcfg.ArmComputeVersion = '20.02.1';
cfg.DeepLearningConfig = dlcfg;
```

Use the `-config` option of the `codegen` function to specify the `cfg` configuration object. The `codegen` function must determine the size, class, and complexity of MATLAB function inputs. Use the `-args` option to specify the size of the input to the entry-point function.

```
codegen -args {ones(227,227,3,'single')} -config cfg squeezenet_predict
```

The `codegen` command places all the generated files in the `codegen` folder. The folder contains the C++ code for the entry-point function `squeezenet_predict.cpp`, header, and source files

containing the C++ class definitions for the convolutional neural network (CNN), weight, and bias files.

**See Also**

`coder.DeepLearningConfig` | `coder.MkLDNNConfig` | `codegen` | `coder.CodeConfig`

**Topics**

“Code Generation for Deep Learning Networks with ARM Compute Library”

**Introduced in R2019a**

## coder.MkLDNNConfig

Parameters to configure deep learning code generation with the Intel Math Kernel Library for Deep Neural Networks

### Description

The `coder.MkLDNNConfig` object contains the Intel MKL-DNN specific parameters that `codegen` uses for generating C++ code for deep neural networks.

To use a `coder.MkLDNNConfig` object for code generation, assign it to the `DeepLearningConfig` property of a code generation configuration object that you pass to `codegen`.

### Creation

Create an MKL-DNN configuration object by using the `coder.DeepLearningConfig` function with target library set as `'mkl_dnn'`.

### Properties

#### TargetLib — Target library name

`'mkl_dnn'`

Name of target library, specified as a character vector.

### Examples

#### Specify Configuration Parameters for MEX Function Generation for the ResNet-50 Network

Create an entry-point function `resnet_predict` that uses the `coder.loadDeepLearningNetwork` function to load the `resnet50` `SeriesNetwork` object.

```
function out = resnet_predict(in)

persistent mynet;
if isempty(mynet)
 mynet = coder.loadDeepLearningNetwork('resnet50', 'myresnet');
end
```

```
out = predict(mynet,in);
```

Create a `coder.config` configuration object for MEX code generation.

```
cfg = coder.config('mex');
```

Set the target language to C++.

```
cfg.TargetLang = 'C++';
```

Create a `coder.MkLDNNConfig` deep learning configuration object. Assign it to the `DeepLearningConfig` property of the `cfg` configuration object.

```
cfg.DeepLearningConfig = coder.DeepLearningConfig('mklDnn');
```

Use the `-config` option of the `codegen` function to pass the `cfg` configuration object. The `codegen` function must determine the size, class, and complexity of MATLAB function inputs. Use the `-args` option to specify the size of the input to the entry-point function.

```
codegen -args {ones(224,224,3,'single')} -config cfg resnet_predict
```

The `codegen` command places all the generated files in the `codegen` folder. The folder contains the C++ code for the entry-point function `resnet_predict.cpp`, header, and source files containing the C++ class definitions for the convolutional neural network (CNN), weight, and bias files.

## See Also

`codegen` | `coder.CodeConfig` | `coder.DeepLearningConfig` | `coder.ARMNEONConfig`

### Topics

“Code Generation for Deep Learning Networks with MKL-DNN”

“Code Generation for Deep Learning Networks with ARM Compute Library”

“Code Generation for Deep Learning Networks by Using cuDNN” (GPU Coder)

“Code Generation for Deep Learning Networks by Using TensorRT” (GPU Coder)

### Introduced in R2018b

## coder.OutputType

Output type from an entry-point function to specify as an input type

### Description

A `coder.OutputType` object represents the type of an entry-point function output variable. Use `coder.OutputType` to specify an input for another entry-point function. Pass the input by using the `codegen -args` option. Do not pass a `coder.OutputType` object as an input to a generated MEX function.

### Creation

#### Syntax

```
t = coder.OutputType(func)
t = coder.OutputType(func,n)
```

#### Description

---

**Note** You can also create a `coder.OutputType` object interactively by using the Coder Type Editor. See “Create and Edit Input Types by Using the Coder Type Editor”.

---

`t = coder.OutputType(func)` creates an object that is derived from the `coder.OutputType` class to represent the first output of the entry-point function `func`.

`t = coder.OutputType(func,n)` creates an object that is derived from the `coder.OutputType` class to represent the `n`-th output of the entry-point function `func`.

#### Input Arguments

##### **func** — Entry-point function name

character vector | string scalar

Name of entry-point function from which to define the output type.

Example: `coder.OutputType('myConstructor')`

##### **n** — Entry-point function output index

integer value

Index that indicates the `n`-th output variable of the corresponding entry-point function.

Example: `coder.OutputType('myFnWithTwoOutputs',1)`

Example: `coder.OutputType('myFnWithTwoOutputs',2)`

## Properties

### FunctionName — Entry-point function name

character vector | string scalar

Name of entry-point function from which the output type is derived.

### OutputIndex — Entry-point function output index

integer value

Index of entry-point function output from which the output type is derived.

## Examples

### Use `coder.OutputType` to Represent a Variable-Size String Input

Suppose that you have a function `useString` that is intended to operate on a variable-size string input. Write a constructor function for a variable-size string. Pass the output as an input to `useString` by using `coder.OutputType`.

Write a MATLAB function `useString` that performs operations on an input string.

```
function y = useString(x)
 %#codegen
 y = replace(x,"be","not be");
end
```

To construct a variable-size input, write a constructor function.

```
function str = myConstructor(charArr)
 %#codegen
 str = string(charArr);
```

To generate code, specify an input type to the construction function. Declare a variable-size character vector input by using `coder.typeof`. Use `coder.OutputType` to represent the output type of the constructor function as the input type to the string operation function.

```
% get type of var-size char array bounded as 1-by-100
t = coder.typeof('a', [1 100], [0 1]);
% get output type
v = coder.OutputType('myConstructor');
% generate MEX function
codegen myConstructor -args {t} useString -args {v} -report -config:mex
```

Test the generated code by calling the MEX function in MATLAB:

```
a = myConstructor_mex('myConstructor','To be, or not to be.')
b = myConstructor_mex('useString',a)
```

```
a =
 "To be, or not to be."
```

```
b =
 "To not be, or not to not be."
```

### Limitations

- You cannot use `coder.OutputType` in the field of a structure, cell, or in an array.

### See Also

`coder.ArrayType` | `coder.Constant` | `coder.EnumType` | `coder.PrimitiveType` |  
`coder.StructType` | `coder.ClassType` | `coder.Type` | `coder.newtype` | `coder.typeof` |  
`codegen`

### Topics

"Pass an Entry-Point Function Output as an Input"

"Generate Code for Multiple Entry-Point Functions"

"Create and Edit Input Types by Using the Coder Type Editor"

### Introduced in R2018b



# coder.BuildLog Properties

Build logs produced during code generation

## Description

`coder.BuildLog` properties contain the description of a build log that is produced during code generation from MATLAB code. Build logs contain compilation and linking errors and warnings. All `coder.BuildLog` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.BuildLog` object. A `coder.ReportInfo` object contains one `coder.BuildLog` object for every build log produced during code generation. These `coder.BuildLog` objects are automatically created when you export code generation report information to a `coder.ReportInfo` object. For more information, see [coder.ReportInfo Properties](#) and “Access Code Generation Report Information Programmatically”.

## Properties

### Type — Type of build log

'Target' | 'Example'

This property is read-only.

Type of the build log produced during code generation from MATLAB code, specified as one of the values in this table.

| Value     | Description                                                          |
|-----------|----------------------------------------------------------------------|
| 'Target'  | The example main is not compiled.                                    |
| 'Example' | The example main is compiled and linked to create a test executable. |

Data Types: char

### Text — Contents of build log

character vector

This property is read-only.

Contents of the build log produced during code generation from MATLAB code, specified as a character vector.

Data Types: char

## See Also

[coder.ReportInfo Properties](#)

## Topics

“Access Code Generation Report Information Programmatically”

**Introduced in R2019b**

# coder.CallSite Properties

Information about a function call site in your MATLAB code

## Description

The `coder.CallSite` properties contain information about a function call site in your MATLAB code, including the name of the callee, the name of the source file that contains the call, and the start and end index of the call in the source file string. All `coder.CallSite` properties are read-only. You can use the dot notation to query these properties.

You do not directly create a `coder.CallSite` object. A `coder.ScreenerInfo` object (that you create by using the `coder.screener` function) contains a `coder.CallSite` object for each call to a function that is not supported for code generation.

## Properties

### **CalleeName — Name of the callee**

character vector

This property is read-only.

Name of the function your MATLAB code calls, specified as a character vector.

### **File — File containing the function call**

`coder.CodeFile` object

This property is read-only.

Description of the `.m` or `.mlx` file containing the function call, specified as a `coder.CodeFile` object. See `coder.CodeFile` Properties.

### **StartIndex — Start index of the function call**

double

This property is read-only.

1-based index of the first character of the function call in the file string.

To manually inspect the code, the line and column numbers corresponding to `StartIndex` are useful. Use the `getLineColumn` function to obtain that information.

### **EndIndex — End index of the function call**

double

This property is read-only.

1-based index of the last character of the function call in the file string.

To manually inspect the code, the line and column numbers corresponding to `EndIndex` are useful. Use the `getLineColumn` function to obtain that information.

**See Also**

`coder.screener` | `getLineColumn` | `coder.ScreenerInfo` Properties | `coder.CodeFile` Properties

**Introduced in R2022a**

# coder.ReportInfo Properties

Code generation report information

## Description

The `coder.ReportInfo` properties contain information about code generation settings, input files, generated files, code generation messages, code insights, and build logs. All `coder.ReportInfo` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.ReportInfo` object. When you export code generation report information to a variable in your base MATLAB workspace, a `coder.ReportInfo` object is automatically created that contains this information. See “Access Code Generation Report Information Programmatically”.

---

**Note** Your MATLAB source code is included in the properties of the `coder.ReportInfo` object.

---

## Properties

### Summary — Summary of code generation

`coder.Summary` object

This property is read-only.

A summary of code generation including information about code generation success, path to the code generation output, toolbox licenses checked out during code generation, toolchain, and build configuration, specified as a `coder.Summary` object. See `coder.Summary` Properties.

### Config — Code generation configuration settings

`coder.MexCodeConfig` object | `coder.CodeConfig` object | `coder.EmbeddedCodeConfig` object

This property is read-only.

Code generation configuration settings, specified as a `coder.MexCodeConfig`, `coder.CodeConfig`, or `coder.EmbeddedCodeConfig` object.

### InputFiles — Input files for code generation

array of `coder.CodeFile` objects | array of `coder.File` objects

This property is read-only.

Heterogeneous array containing descriptions of input files for code generation. Each element of the array contains a description of one input file.

- If an input file contains text, the corresponding array element is a `coder.CodeFile` object. See `coder.CodeFile` Properties.
- If an input file does not contain text (for example, a P-coded file), the corresponding array element is a `coder.File` object. See `coder.File` Properties.

**GeneratedFiles — Generated files**array of `coder.CodeFile` objects | array of `coder.File` objects

This property is read-only.

Heterogeneous array containing descriptions of generated files. Each element of the array contains a description of one generated file.

- If the generated file contains text, the corresponding array element is a `coder.CodeFile` object. See `coder.CodeFile` Properties.
- If the generated file does not contain text (for example, a P-coded file), the corresponding array element is a `coder.File` object. See `coder.File` Properties.

**Functions — MATLAB functions and methods used in code generation**array of `coder.Function` objects | array of `coder.Method` objects

This property is read-only.

Heterogeneous array containing descriptions of MATLAB functions and methods that are used in code generation. Each element of the array contains a description of one function or method.

- Array elements containing descriptions of functions are `coder.Function` objects. See `coder.Function` Properties.
- Array elements containing descriptions of methods are `coder.Method` objects. See `coder.Method` Properties.

**Messages — Code generation error, warning, and informational messages**array of `coder.Message` objects

This property is read-only.

Array containing descriptions of error, warning, and informational messages produced during code generation. Each element of the array is a `coder.Message` object that contains a description of one message. See `coder.Message` Properties.

**CodeInsights — Messages about potential issues with the generated code**array of `coder.Message` objects

This property is read-only.

Array containing descriptions of messages about potential issues with the generated code. Each element of the array is a `coder.Message` object that contains a description of one message. These messages also appear in the code generation report **Code Insights** tab. See `coder.Message` Properties.

**BuildLogs — Build logs produced during code generation**array of `coder.BuildLog` objects

Array containing build logs produced during code generation. The build logs contain compilation and linking errors and warnings. Each element of the array is a `coder.BuildLog` object that contains the type and text of one build log. These messages also appear in the code generation report **Build Logs** tab. See `coder.BuildLog` Properties.

## **See Also**

[coder.Summary Properties](#) | [coder.File Properties](#) | [coder.CodeFile Properties](#) | [coder.Function Properties](#) | [coder.Method Properties](#) | [coder.Message Properties](#) | [coder.BuildLog Properties](#)

## **Topics**

[“Access Code Generation Report Information Programmatically”](#)

**Introduced in R2019a**

## coder.Summary Properties

Summary of code generation from MATLAB code

### Description

`coder.Summary` properties contain a summary of code generation from MATLAB code. The summary includes information about code generation success, path to the code generation output, toolbox licenses checked out during code generation, toolchain, and build configuration. All `coder.Summary` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.Summary` object. When you generate a `coder.ReportInfo` object that contains code generation report information, a `coder.Summary` object is automatically created as one of its properties. For more information, see `coder.ReportInfo` Properties and “Access Code Generation Report Information Programmatically”.

### Properties

#### Success — Status of code generation

true | false

This property is read-only.

Status of code generation from MATLAB code, specified as one of the values in this table.

| Value | Description                |
|-------|----------------------------|
| true  | Code generation succeeded. |
| false | Code generation failed.    |

Data Types: logical

#### Date — Date and time of code generation

character vector

This property is read-only.

Date and time of code generation from MATLAB code, specified as a character vector.

Example: '28-Nov-2018 09:59:54'

Data Types: char

#### OutputFile — Path to output of code generation

character vector

This property is read-only.

Path to the generated files, specified as a character vector.

Example: 'C:\coder\R2019a\Report Info Object\codegen\lib\foo\foo.lib'

Data Types: char



**Processor — Information about processor used for code generation**

character vector

This property is read-only.

Information about processor used for code generation from MATLAB code, specified as a character vector.

Example: 'Generic->MATLAB Host Computer'

Data Types: char

**Version — Version of MATLAB Coder used for code generation**

character vector

This property is read-only.

Version of MATLAB Coder used for code generation from MATLAB code, specified as a character vector.

Example: 'MATLAB Coder 4.2 (R2019a)'

Data Types: char

**ToolboxLicenses — Toolbox licenses checked out during code generation**

string vector

This property is read-only.

Toolbox licenses that the code generator checks out during code generation from MATLAB code, specified as a string vector.

Example: ["statistics\_toolbox" "wavelet\_toolbox"]

---

**Note** If you generate MEX code, these licenses are checked out again when you load the MEX function.

If you generate static library or dynamically linked library, the toolbox licenses are checked out only during code generation. The code generator does not write license checkouts into generated standalone code.

---

Data Types: string

**Toolchain — Toolchain used for code generation**

character vector

This property is read-only.

Toolchain used for code generation from MATLAB code, specified as a character vector. This property is present only if you generate standalone code.

Data Types: char

**BuildConfiguration — Build configuration selected for code generation**

character vector

This property is read-only.

Build configuration selected for code generation from MATLAB code, specified as a character vector. This property is present only if you generate standalone code.

Example: 'Faster Builds'

Data Types: char

### **See Also**

`coder.ReportInfo` Properties

### **Topics**

"Access Code Generation Report Information Programmatically"

**Introduced in R2019a**

# coder.File Properties

Description of file without text that is involved in code generation

## Description

`coder.File` properties contain the path and extension of a file that is involved in code generation from MATLAB code and does not have text (for example, a P-coded file). All `coder.File` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.File` object. A `coder.ReportInfo` object contains one `coder.File` object for every file involved in code generation that does not have text. These `coder.File` objects are automatically created when you export code generation report information to a `coder.ReportInfo` object. For more information, see `coder.ReportInfo` Properties and “Access Code Generation Report Information Programmatically”.

Descriptions of files that have text are stored in `coder.CodeFile` objects. See `coder.CodeFile` Properties.

## Properties

### Path — Path to the file

character vector

This property is read-only.

Path to a file that does not have text (for example, a P-coded file) and is involved in code generation from MATLAB code, specified as a character vector.

Example: 'C:\coder\R2019a\Report Info Object\foo.p'

Data Types: char

### Extension — Extension of the file

' .p' | ...

This property is read-only.

Extension of a file that does not have text (for example, a P-coded file) and is involved in code generation from MATLAB code, specified as a character vector.

Data Types: char

## See Also

`coder.ReportInfo` Properties | `coder.CodeFile` Properties

## Topics

“Access Code Generation Report Information Programmatically”

## Introduced in R2019a

## coder.CodeFile Properties

Description of file containing text that is involved in code generation

### Description

`coder.CodeFile` properties contain the text, path, and extension of a file that is involved in code generation from MATLAB code. All `coder.CodeFile` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.CodeFile` object. A `coder.ReportInfo` object contains one `coder.CodeFile` object for every file involved in code generation that has text. These `coder.CodeFile` objects are automatically created when you export code generation report information to a `coder.ReportInfo` object. For more information, see `coder.ReportInfo` Properties and “Access Code Generation Report Information Programmatically”.

Descriptions of files that do not have text are stored in `coder.File` objects. See `coder.File` Properties.

### Properties

#### **Text — Text of the file**

character vector

This property is read-only.

Text of a file that is involved in code generation from MATLAB code, specified as a character vector.

Data Types: `char`

#### **Path — Path to the file**

character vector

This property is read-only.

Path to a file with text that is involved in code generation from MATLAB code, specified as a character vector.

Example: `'C:\coder\R2019a\Report Info Object\foo.m'`

Data Types: `char`

#### **Extension — Extension of the file**

`'.m' | '.mlx' | '.c' | '.cpp' | '.cu' | '.h' | '.hpp' | '.cuh'`

This property is read-only.

Extension of a file with text that is involved in code generation from MATLAB code, specified as a character vector.

Data Types: `char`

## **See Also**

coder.ReportInfo Properties | coder.File Properties

## **Topics**

“Access Code Generation Report Information Programmatically”

**Introduced in R2019a**

## coder.Function Properties

Description of MATLAB function used in code generation

### Description

`coder.Function` properties contain the description of a MATLAB function that is used in code generation. All `coder.Function` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.Function` object. A `coder.ReportInfo` object contains one `coder.Function` object for every MATLAB function that is used in code generation. These `coder.Function` objects are automatically created when you export code generation report information to a `coder.ReportInfo` object. For more information, see `coder.ReportInfo` Properties and “Access Code Generation Report Information Programmatically”.

### Properties

#### **Name — Name of function**

character vector

This property is read-only.

Name of a MATLAB function used in code generation, specified as a character vector.

Example: 'foo'

Data Types: char

#### **Specialization — Specialization identifier of a function**

double

This property is read-only.

The specialization identifier of a MATLAB function used in code generation. A value of zero indicates that the function is not specialized. A positive value indicates that the function is specialized.

Data Types: double

#### **File — MATLAB file containing the function**

`coder.CodeFile` object | `coder.File` object

This property is read-only.

A description of the MATLAB file that contains the function used in code generation.

- If the file contains text, this property is a `coder.CodeFile` object. See `coder.CodeFile` Properties.
- If the file does not contain text (for example, a P-coded file), this property is a `coder.File` object. See `coder.File` Properties.

#### **StartIndex — Index of the first character of the function in the text of the file**

double

This property is read-only.

1-based index of the first character of the function in the text of the file. If the file does not contain text (for example, a P-coded file), this property is equal to 0.

To manually inspect the code, the line and column numbers corresponding to `StartIndex` are useful. Use the `getLineColumn` function to obtain that information.

Data Types: `double`

### **EndIndex — Index of the last character of the function in the text of the file**

`double`

This property is read-only.

1-based index of the last character of the function in the text of the file. If the file does not contain text (for example, a P-coded file), this property is equal to 0.

To manually inspect the code, the line and column numbers corresponding to `EndIndex` are useful. Use the `getLineColumn` function to obtain that information.

Data Types: `double`

### **Variables — Variables that the function uses**

Array of `coder.Variable` objects

This property is read-only.

The array consists of one `coder.Variable` object for each variable the function uses, including input, output, and local variables.

Each `coder.Variable` object has these properties:

- **Name:** Name of the variable, specified as a character vector.
- **Scope:** Scope of the variable, specified as a character vector. Possible scope values are: 'Input', 'Output', 'Local', 'Global', 'Persistent', and 'InputOutput'.
- **Type:** Data type of the variable specified as a `coder.Type` object.

This property is applicable only in the context of the MATLAB function report of a MATLAB Function block. See “Programmatically Access MATLAB Function Reports” (Simulink).

### **Calleees — MATLAB functions and methods that are called by this function**

array of `coder.Function` objects | array of `coder.Method` objects

This property is read-only.

Heterogeneous array containing descriptions of MATLAB functions and methods that are called by this function. Each element of the array contains a description of one function or method.

- Array elements containing descriptions of functions are `coder.Function` objects.
- Array elements containing descriptions of methods are `coder.Method` objects. See `coder.Method Properties`.

### **See Also**

`coder.ReportInfo Properties` | `coder.File Properties` | `coder.CodeFile Properties` | `getLineColumn`

**Topics**

“Access Code Generation Report Information Programmatically”

**Introduced in R2019a**



# coder.Method Properties

Description of method in a MATLAB class used in code generation

## Description

`coder.Method` properties contain the description of a method in a MATLAB class that is used in code generation. All `coder.Method` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.Method` object. A `coder.ReportInfo` object contains one `coder.Method` object for every method in the MATLAB classes that are used in code generation. These `coder.Method` objects are automatically created when you export code generation report information to a `coder.ReportInfo` object. For more information, see `coder.ReportInfo` Properties and “Access Code Generation Report Information Programmatically”.

## Properties

### **Name — Name of method**

character vector

This property is read-only.

Name of a method in a MATLAB class used in code generation, specified as a character vector.

Example: 'foo'

Data Types: char

### **ClassName — Name of class containing the method**

character vector

This property is read-only.

Name of the class containing the method, specified as a character vector.

Example: 'MyClass'

Data Types: char

### **Specialization — Specialization identifier of the method**

double

This property is read-only.

The specialization identifier of the method. A value of zero indicates that the method is not specialized. A positive value indicates that the method is specialized.

Data Types: double

### **ClassSpecialization — Specialization identifier of the class containing the method**

double

This property is read-only.

The specialization identifier of the class containing the method. A value of zero indicates that the class is not specialized. A positive value indicates that the class is specialized.

Data Types: `double`

### **File — MATLAB file containing the method**

`coder.CodeFile` object | `coder.File` object

This property is read-only.

A description of the MATLAB file that contains the method used in code generation.

- If the file contains text, this property is a `coder.CodeFile` object. See `coder.CodeFile` Properties.
- If the file does not contain text (for example, a P-coded file), this property is a `coder.File` object. See `coder.File` Properties.

### **StartIndex — Index of the first character of the method in the text of the file**

`double`

This property is read-only.

1-based index of the first character of the method in the text of the file. If the file does not contain text (for example, a P-coded file), this property is equal to 0.

To manually inspect the code, the line and column numbers corresponding to `StartIndex` are useful. Use the `getLineColumn` function to obtain that information.

Data Types: `double`

### **EndIndex — Index of the last character of the method in the text of the file**

`double`

This property is read-only.

1-based index of the last character of the method in the text of the file. If the file does not contain text, this property is equal to 0.

To manually inspect the code, the line and column numbers corresponding to `EndIndex` are useful. Use the `getLineColumn` function to obtain that information.

Data Types: `double`

### **Variables — Variables that the method uses**

Array of `coder.Variable` objects

This property is read-only.

The array consists of one `coder.Variable` object for each variable the method uses, including input, output, and local variables.

Each `coder.Variable` object has these properties:

- **Name:** Name of the variable, specified as a character vector.
- **Scope:** Scope of the variable, specified as a character vector. Possible scope values are: 'Input', 'Output', 'Local', 'Global', 'Persistent', and 'InputOutput'.

- **Type:** Data type of the variable specified as a `coder.Type` object.

This property is applicable only in the context of the MATLAB function report of a MATLAB Function block. See “Programmatically Access MATLAB Function Reports” (Simulink).

### **Calles — MATLAB functions and methods that are called by this method**

array of `coder.Function` objects | array of `coder.Method` objects

This property is read-only.

Heterogeneous array containing descriptions of MATLAB functions and methods that are called by the this method. Each element of the array contains a description of one function or method.

- Array elements containing descriptions of functions are `coder.Function` objects. See `coder.Function` Properties.
- Array elements containing descriptions of methods are `coder.Method` objects.

### **See Also**

`coder.ReportInfo` Properties | `coder.File` Properties | `coder.CodeFile` Properties | `getLineColumn`

### **Topics**

“Access Code Generation Report Information Programmatically”

### **Introduced in R2019a**

## coder.Message Properties

Description of message produced during code generation readiness analysis or during code generation

### Description

The `coder.Message` properties contain the description of an error, warning, or informational message that is produced during code generation readiness analysis of your MATLAB code or during code generation. All `coder.Message` properties are read-only. You can use dot notation to query these properties.

You do not directly create a `coder.Message` object. These objects are created as parts of other objects:

- A `coder.ScreenerInfo` object contains one `coder.Message` object for every message produced during code generation readiness analysis
- A `coder.ReportInfo` object contains one `coder.Message` object for every message produced during code generation

These `coder.Message` objects are automatically created when you export a code generation readiness report or a code generation report to an associated object. For more information, see:

- `coder.ScreenerInfo` Properties
- `coder.ReportInfo` Properties and “Access Code Generation Report Information Programmatically”

### Properties

#### Identifier — Message identifier

character vector

This property is read-only.

The identifier associated with a message, specified as a character vector.

Example: `'Coder:toolbox:unsupportedClass'`

Data Types: `char`

#### Type — Type of message

`'Error' | 'Warn' | 'Info'`

This property is read-only.

The type of a message, specified as one of the values in this table.

| Value                | Description     |
|----------------------|-----------------|
| <code>'Error'</code> | Error message   |
| <code>'Warn'</code>  | Warning message |

| Value  | Description           |
|--------|-----------------------|
| 'Info' | Informational message |

Data Types: char

### Text — Text of message

character vector

This property is read-only.

The text of a message, specified as a character vector.

Example: 'Function 'svd' is not defined for values of class 'string'.'

Data Types: char

### Category — Category of a code insight

'PotentialDifferencesFromMATLAB' | 'DataTypeIssues' | 'RowMajorIssues' | 'GpuDiagnostics'

This property is read-only.

Category of a message about potential issues with the generated code, specified as one of the values in this table. These messages also appear in the code generation report **Code Insights** tab.

| Value                            | Description                                                                                           |
|----------------------------------|-------------------------------------------------------------------------------------------------------|
| 'PotentialDifferencesFromMATLAB' | Potential difference in behavior of the generated code from MATLAB code                               |
| 'DataTypeIssues'                 | Potential data type issues                                                                            |
| 'RowMajorIssues'                 | Potential inefficiencies caused by array layout                                                       |
| 'GpuDiagnostics'                 | Potential graphics processing unit (GPU) issues. This value is applicable only if you have GPU Coder. |

Data Types: char

### SubCategory — Subcategory of a code insight in the 'GpuDiagnostics' category

'kernelCreation' | 'memory' | 'pragma' | 'designPattern' | 'other'

This property is read-only.

The 'GpuDiagnostics' category provides information that you can use to troubleshoot code generation issues, improve code execution time, and reduce memory usage of generated code. This property is applicable only if you have GPU Coder.

Data Types: char

### File — MATLAB file containing code that caused the message

coder.CodeFile object | coder.File object

This property is read-only.

A description of the MATLAB file that contains code that caused the message.

- If the file contains text, this property is a `coder.CodeFile` object. See `coder.CodeFile` Properties.
- If the file does not contain text (for example, a P-coded file), this property is a `coder.File` object. See `coder.File` Properties.

### **StartIndex — Start index of code that caused the message**

double

This property is read-only.

1-based index of the first character of the part of the file text that caused the message. If the file does not contain text (for example, a P-coded file), this property is equal to 0.

To manually inspect the code, the line and column numbers corresponding to `StartIndex` are useful. Use the `getLineColumn` function to obtain that information.

Data Types: double

### **EndIndex — End index of code that caused the message**

double

This property is read-only.

1-based index of the last character of the part of the file text that caused the message. If the file does not contain text (for example, a P-coded file), this property is equal to 0.

To manually inspect the code, the line and column numbers corresponding to `EndIndex` are useful. Use the `getLineColumn` function to obtain that information.

Data Types: double

## **See Also**

`coder.ReportInfo` Properties | `coder.File` Properties | `coder.CodeFile` Properties | `getLineColumn`

## **Topics**

“Access Code Generation Report Information Programmatically”

## **Introduced in R2019a**

# coder.ScreenerInfo Properties

Code generation readiness information

## Description

The `coder.ScreenerInfo` properties contain information about code generation readiness of your MATLAB code. The `coder.screener` function returns this object as an optional output argument. All `coder.ScreenerInfo` properties are read-only. You can use the dot notation to query these properties.

The `coder.ScreenerInfo` object contains information about:

- MATLAB files analyzed by the Code Generation Readiness Tool
- Code generation readiness messages
- Calls to functions not supported for code generation

You can export the entire code generation readiness report to a MATLAB string by passing the `coder.ScreenerInfo` object to the object function `textReport`. See “Access Code Generation Readiness Results Programmatically” on page 2-206.

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**Note** Your MATLAB source code is included in the properties of the `coder.ScreenerInfo` object.

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## Properties

### Files — MATLAB files analyzed for code generation readiness

array of `coder.CodeFile` objects | array of `coder.File` objects

This property is read-only.

Heterogeneous array containing descriptions of files that were analyzed for code generation readiness. Each element of the array contains a description of one file.

- If an file contains text, the corresponding array element is a `coder.CodeFile` object. See `coder.CodeFile` Properties.
- If an file does not contain text (for example, a P-coded file), the corresponding array element is a `coder.File` object. See `coder.File` Properties.

### Messages — Code generation readiness error or warning messages

array of `coder.Message` objects

This property is read-only.

Array containing descriptions of error and warning messages produced by the code generation readiness tool. Each element of the array is a `coder.Message` object that contains the description of one message. See `coder.Message` Properties.

### UnsupportedCalls — Calls to functions not supported for code generation

array of `coder.CallSite` objects

This property is read-only.

Array containing descriptions of calls to functions not supported for code generation in your MATLAB code. Each element of the array is a `coder.CallSite` object that contains the description of one such function call. See `coder.CallSite` Properties.

### **See Also**

`coder.screener` | `getLineColumn` | `coder.CallSite` Properties | `coder.CodeFile` Properties | `coder.File` Properties | `coder.Message` Properties

**Introduced in R2022a**



# Tools

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## Code Replacement Viewer

Explore content of code replacement libraries

### Description

The Code Replacement Viewer displays the content of code replacement libraries and tables. You can use this tool to explore and choose a code replacement library or to view a predefined code replacement table. If you develop a custom code replacement library, you can use this viewer to verify table entries for the following properties:

- Argument order is correct.
- Conceptual argument names match code generator naming conventions.
- Implementation argument names are correct.
- Header or source file specification is not missing.
- I/O types are correct.
- Relative priority of entries is correct (highest priority is 0, and lowest priority is 100).
- Saturation or rounding mode specifications are not missing.

If you specify a library name when you open the viewer, the viewer displays the code replacement tables for that library. If you specify a table name when you open the viewer, the viewer displays the function and operator code replacement entries for that table. The viewer can only display code replacement tables that are defined. For more information on creating code replacement tables, see “Define Code Replacement Library Optimizations” (Embedded Coder).

### Abbreviated Entry Information

In the middle pane, the viewer displays entries that are in the selected code replacement table, along with abbreviated information for each entry.

| Field                 | Description                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Name</b>           | Name or identifier of the function or operator being replaced (for example, <code>cos</code> or <code>RTW_OP_ADD</code> ).                                                                                                                                                                                                                                                                                         |
| <b>Implementation</b> | Name of the implementation function, which can match or differ from <b>Name</b> .                                                                                                                                                                                                                                                                                                                                  |
| <b>NumIn</b>          | Number of input arguments.                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>In1Type</b>        | Data type of the first conceptual input argument.                                                                                                                                                                                                                                                                                                                                                                  |
| <b>In2Type</b>        | Data type of the second conceptual input argument.                                                                                                                                                                                                                                                                                                                                                                 |
| <b>OutType</b>        | Data type of the conceptual output argument.                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Priority</b>       | The entry's match priority, relative to other entries of the same name and to the conceptual argument list within the selected code replacement library. The priority can range from 0 to 100, with 0 being the highest priority. The default is 100. If the library provides two implementations for a function or operator, the implementation with the higher priority shadows the one with the lower priority. |

| Field      | Description |
|------------|-------------|
| UsageCount | Not used.   |

### Detailed Entry Information

In the middle pane, when you select an entry, the viewer displays entry details.

| Field                        | Description                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Description</b>           | Text description of the table entry (can be empty).                                                                                                                                                                                                                                                                                                                                                                |
| <b>Key</b>                   | Name or identifier of the function or operator being replaced (for example, <code>cos</code> or <code>RTW_OP_ADD</code> ), and the number of conceptual input arguments.                                                                                                                                                                                                                                           |
| <b>Implementation</b>        | Name of the implementation function, and the number of implementation input arguments.                                                                                                                                                                                                                                                                                                                             |
| <b>Implementation type</b>   | Type of implementation: <code>FCN_IMPL_FUNCT</code> for function or <code>FCN_IMPL_MACRO</code> for macro.                                                                                                                                                                                                                                                                                                         |
| <b>Saturation mode</b>       | Saturation mode that the implementation function supports. One of:<br><code>RTW_SATURATE_ON_OVERFLOW</code><br><code>RTW_WRAP_ON_OVERFLOW</code><br><code>RTW_SATURATE_UNSPECIFIED</code>                                                                                                                                                                                                                          |
| <b>Rounding modes</b>        | Rounding modes that the implementation function supports. One or more of:<br><code>RTW_ROUND_FLOOR</code><br><code>RTW_ROUND_CEILING</code><br><code>RTW_ROUND_ZERO</code><br><code>RTW_ROUND_NEAREST</code><br><code>RTW_ROUND_NEAREST_ML</code><br><code>RTW_ROUND_SIMPLEST</code><br><code>RTW_ROUND_CONV</code><br><code>RTW_ROUND_UNSPECIFIED</code>                                                          |
| <b>GenCallback file</b>      | Not used.                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Implementation header</b> | Name of the header file that declares the implementation function.                                                                                                                                                                                                                                                                                                                                                 |
| <b>Implementation source</b> | Name of the implementation source file.                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Priority</b>              | The entry's match priority, relative to other entries of the same name and to the conceptual argument list within the selected code replacement library. The priority can range from 0 to 100, with 0 being the highest priority. The default is 100. If the library provides two implementations for a function or operator, the implementation with the higher priority shadows the one with the lower priority. |
| <b>Total Usage Count</b>     | Not used.                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>Entry class</b>           | Class from which the current table entry is instantiated.                                                                                                                                                                                                                                                                                                                                                          |
| <b>Conceptual arguments</b>  | Name, I/O type ( <code>RTW_IO_OUTPUT</code> or <code>RTW_IO_INPUT</code> ), and data type for each conceptual argument.                                                                                                                                                                                                                                                                                            |
| <b>Implementation</b>        | Name, I/O type ( <code>RTW_IO_OUTPUT</code> or <code>RTW_IO_INPUT</code> ), data type, and alignment requirement for each implementation argument.                                                                                                                                                                                                                                                                 |

### Fixed-Point Entry Information

When you select an operator entry that specifies net slope fixed-point parameters, the viewer displays fixed-point information.

| Field                                | Description                                                                                                                                                                                                                                                                                                               |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Net slope adjustment factor F</b> | Slope adjustment factor (F) part of the net slope factor, $F2^E$ , for net slope table entries. You use this factor with fixed-point multiplication and division replacement to map a range of slope and bias values to a replacement function.                                                                           |
| <b>Net fixed exponent E</b>          | Fixed exponent (E) part of the net slope factor, $F2^E$ , for net slope table entries. You use this fixed exponent with fixed-point multiplication and division replacement to map a range of slope and bias values to a replacement function.                                                                            |
| <b>Slopes must be the same</b>       | Indicates whether code replacement request processing must check that the slopes on arguments (input and output) are equal. You use this information with fixed-point addition and subtraction replacement to disregard specific slope and bias values, and map relative slope and bias values to a replacement function. |
| <b>Must have zero net bias</b>       | Indicates whether code replacement request processing must check that the net bias on arguments is zero. You use this information with fixed-point addition and subtraction replacement to disregard specific slope and bias values, and map relative slope and bias values to a replacement function.                    |

## Open the Code Replacement Viewer

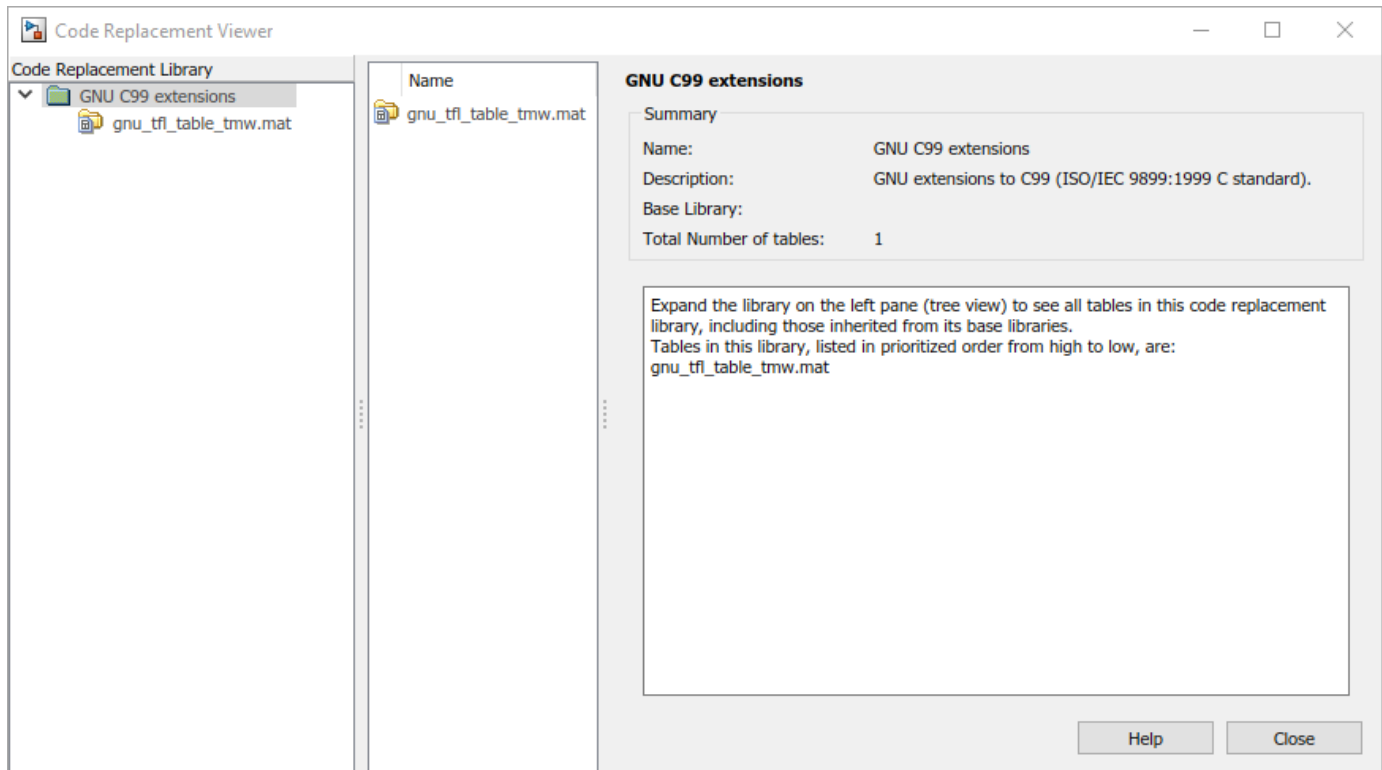
Open from the MATLAB command prompt using `crviewer`.

### Examples

#### Display Contents of Code Replacement Library

This example opens the registered code replacement library GNU C99 extensions.

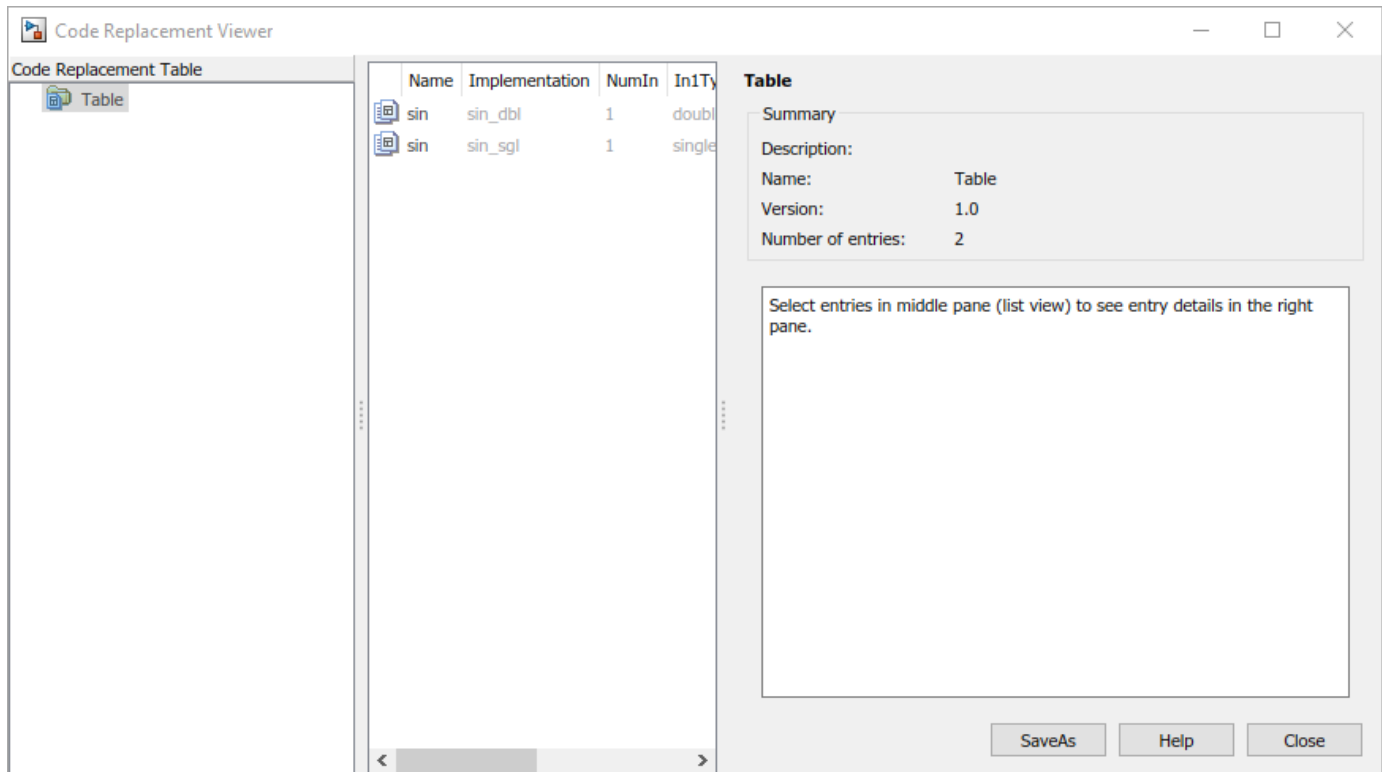
```
crviewer('GNU C99 extensions')
```



### Display Contents of Code Replacement Table

This example opens a predefined code replacement table `crl_table_sinfcn`. To learn how to create this example table, see "Define Code Replacement Library Optimizations" (Embedded Coder).

```
crviewer(crl_table_sinfcn)
```



- “Choose a Code Replacement Library”

## Programmatic Use

`crviewer('library')` opens the Code Replacement Viewer and displays the contents of `library`, where `library` is a character vector that names a registered code replacement library.

`crviewer(table)` opens the Code Replacement Viewer and displays the contents of a predefined `table`, where `table` is a MATLAB file that defines code replacement tables. The table must be user predefined and the file must be in the current folder or on the MATLAB path.

## See Also

### Topics

- “Choose a Code Replacement Library”
- “What Is Code Replacement?”
- “Code Replacement Libraries”
- “Code Replacement Terminology”

### Introduced in R2014b