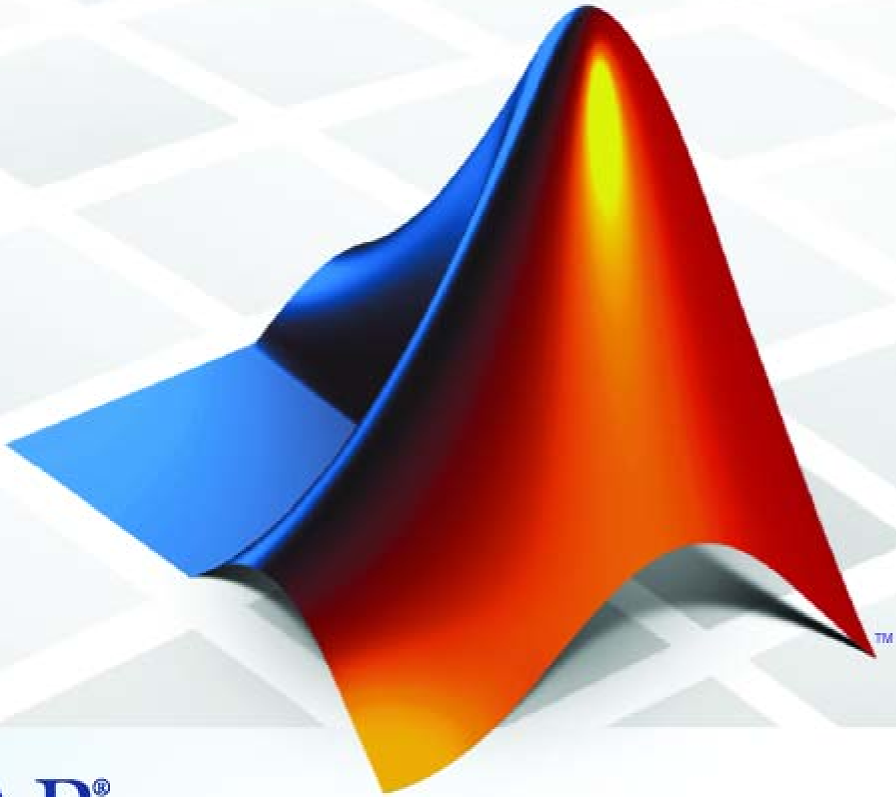
MATLAB® Compiler™ 4
User's Guide



MATLAB®

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Getting Started

Product Overview

The MATLAB® Compiler™ product can compile M-files, MEX-files, MATLAB® objects, or other MATLAB code. Using the MATLAB Compiler product, you can generate the following:

- Standalone applications on UNIX®, Windows®, and Macintosh® platforms
- C and C++ shared libraries (dynamically linked libraries, or DLLs, on Microsoft® Windows)

How Does the MATLAB Compiler Product Work?

In this section...

MATLAB Compiler Generated Application or Library

When you package and distribute applications and libraries that the MATLAB Compiler product generates, you include the MATLAB Compiler Runtime (MCR) as well as a set of supporting files generated by the MATLAB Compiler product. You also set the system paths on the target machine so that the MCR and supporting files can be found.

An application or library generated by the MATLAB Compiler product has two parts: a platform-specific binary file and an archive file containing MATLAB functions and data. An application's binary file consists of a main function. By contrast, a library's binary file consists of multiple functions for exporting.

Wrapper Files

To create the platform-specific binaries that you specify, the MATLAB Compiler product generates one or more *wrapper* files. A wrapper file provides an interface to the compiled M-code. Wrapper files differ depending on the execution environment.

The wrapper file does the following:

- Performs initialization and termination as needed by a particular interface.
- Defines data arrays containing path information, encryption keys, and other information needed by the MCR.
- Provides the necessary code to forward calls from the interface functions to the MATLAB functions in the MCR.
- For an application, contains the `main` function

- For a library, contains the entry points for each public M-file function. When using libraries generated by the MATLAB Compiler product, call the library initialization and termination routines in their client code.

Component Technology File (CTF)

The MATLAB Compiler product also generates a Component Technology File (CTF). This file is independent of the final target type (standalone application or library) and specific to each operating system platform. This file, which is named with a `.ctf` suffix, contains the MATLAB functions and data that define the application or library and is embedded in the binaries of shared C/C++ libraries and standalones by default. To override this default embedding behavior, see "Overriding Default CTF Archive Embedding Using the MCR Component Cache" on page 5-21.

Caution Do not extract the files within the`.ctf` file and place them individually under version control. Since the `.ctf` file contains interdependent MATLAB functions and data, the files within it must be accessed only by accessing the `.ctf` file. For best results, place the entire `.ctf` file under version control.

Before You Begin

Before you can use the MATLAB Compiler product, you must have it installed and configured properly on your system. Refer to Chapter 2, "Installation and Configuration" for more information. At a minimum, run the following command once after installing a new version of the MATLAB Compiler product:

```
mbuild -setup
```

If you need information about writing the M-files that you plan to compile, see MATLAB Programming, which is part of the MATLAB product documentation.

Magic Square Example

This example shows you how to:

- Access the examples provided with the MATLAB Compiler product.
- Use the MATLAB Compiler product to create and package a simple standalone application.

About the Examples The examples for the MATLAB Compiler product are in `*matlabroot*\extern\examples\compiler`. For *`matlabroot`*, substitute the MATLAB root directory on your system. Type `matlabroot` to see this directory name.

The Magic Square example shows you how to create and package a simple application that compiles an M-file, `magicsquare.m`.

magicsquare.m

```
function m = magicsquare(n)
%MAGICSQUARE generates a magic square matrix of the size specified
%    by the input parameter n.

% Copyright 2003-2007 The MathWorks, Inc.

if ischar(n)
    n=str2num(n);
end
m = magic(n)
```

1. Create a subdirectory in your work directory and name it `MagicExample`. This procedure assumes that your work directory is `D:\Work`.
2. Copy the following file to `MagicExample`:

   ```
   matlabroot\extern\examples\compiler\magicsquare.m
   ```

3. At the MATLAB command prompt, change directory to `D:\Work\MagicExample`.

4 While in MATLAB, type `deploytool` to open the Deployment Tool window.

The Deployment Tool opens as a dockable window in the MATLAB desktop, and a menu labeled **Project** is added to the MATLAB menu bar.

5 Create a new project:

a In the Deployment Tool toolbar, click the New Project icon.

As an alternative, you can select **File > New Deployment Project** in the MATLAB menu bar.

b In the New Deployment Project dialog box, select **Standalone Applications**, and enter the following settings:

- In the **Name** field, enter `MagicExample.prj` as the project name.
- In the **Location** field, enter the name of your work directory followed by the project name.

  In this example, that is `D:\Work\MagicExample`.

c Click **OK**.

The MATLAB Compiler product displays the project folder (`MagicExample.prj`) in the Deployment Tool window. The folder contains three folders, which are empty.

d Drag the `magicsquare.m` file from the Current Directory browser in MATLAB to the project folder in the Deployment Tool window.

The MATLAB Compiler product adds the M-file to the **Main function** folder.

6 Build the application as follows:

- In the Deployment Tool toolbar, click the Build Project icon.
- As an alternative, you can select **Tools > Build** in the MATLAB menu bar.

The build process begins, and a log of the build appears in the **Deployment Tool Output** pane. The status of the process is displayed in the status bar at the bottom of the output pane. The **Deployment Tool Output** pane is dockable; by default it appears across the bottom of the MATLAB desktop.

The MATLAB Compiler product puts the files that are needed for the application in two newly created subdirectories, `src` and `distrib`, in the `MagicExample` directory. A copy of the build log is placed in the `src` directory.

Tip When your source code has been compiled successfully, a file named `readme.txt` is written to the `src` directory. Use this file as a guide to the system requirements and other prerequisites you must satisfy to deploy your first component on a target computer.

---

7. Package the application so it can run on machines that do not have MATLAB installed. Note that the **Include MATLAB® Compiler™ Runtime (MCR)** option is selected (in the Packaging pane of Project Settings) by default. Deselect the option if you do not want to include the MCR in your package.

   - In the Deployment Tool toolbar, click the Package Project icon.
   - As an alternative, you can select **Tools > Package** in the MATLAB menu bar.

   The MATLAB Compiler product creates a package in the `distrib` subdirectory. On Windows, the package is a self-extracting executable, and on platforms other than Windows, it is a `.zip` file.

8. Deploy the application to end users as described in "Deploying to End Users" on page 4-8.

Using the mcc Command

Instead of the GUI, you can use the mcc command to run the MATLAB Compiler product. The following table shows sample commands to create a standalone application or a shared library using mcc at the operating system prompt.

Desired Result	Command
Standalone application from the M-file mymfunction	`mcc -m mymfunction.m` Creates a standalone application named mymfunction.exe on Windows platforms and mymfunction on platforms that are not Windows.
Shared library from the M-file mymfunction	`mcc -l mymfunction.m` Creates a shared library named mymfunction.dll on Windows, mymfunction.so on Linux® and Solaris™, and mymfunction.dylib on Mac OS® X.
C shared library from the M-files file1.m, file2.m, and file3.m	`mcc -l file1.m file2.m file3.m` Creates a shared library named file1.dll on Windows, file1.so on Linux and Solaris, and file1.dylib on Mac OS X.
C++ shared library from the M-files file1.m, file2.m, and file3.m	`mcc -l file1.m file2.m file3.m -W cpplib -T link:lib` Creates a shared library named file1.dll on Windows, file1.so on Linux and Solaris, and file1.dylib on Mac OS X.

Note The `-l` option is a bundle option that expands into the following:

```
-W lib -T link:lib
```

A bundle is a collection of `mcc` input options. See *`matlabroot`*`/toolbox/compiler/bundles` for the available bundles.

The `-W lib` option tells the MATLAB Compiler product to generate a function wrapper for a shared library. The `-T link:lib` option specifies the target output as a shared library.

See Chapter 5, “Compiler Commands” for more information about using the `mcc` command and its options.

Developing and Testing Components on a Development Machine

In this section...

Packaging Your Software

To deploy your software to another development machine that does not have the MATLAB software installed or has a different version of MATLAB installed, use the GUI to package your software automatically. To do this, open the project and click the Package icon (in the Deployment Tool toolbar).

When you develop and test software created by the MATLAB Compiler product, set your path so that the system can support the compiled code at run time. To run the application on your development machine, make sure that you have your path set properly. See "Directories Required for Development and Testing" on page 10-2.

You cannot use the GUI to configure the development machine.

Replacement of MCRInstaller.zip and BUILDMCR Functionality

In past releases, you included `MCRInstaller.zip` in your packaged application (created by running the `buildmcr` command). Now, you run the following files, which trigger self-extracting archives, that replace the functionality previously provided by `MCRInstaller.zip`. These files ship with the MATLAB Compiler product:

Platform	File Replacing MCRInstaller.zip	File Location
Windows 32-bit	`MCRInstaller.exe`	*`matlabroot`*`\toolbox\compiler\deploy\win32`
Windows 64-bit	`MCRInstaller.exe`	*`matlabroot`*`\toolbox\compiler\deploy\win64`
Linux (glnx86)	`MCRInstaller.bin`	*`matlabroot`*`/toolbox/compiler/deploy/glnx86`
Linux (glnxa64)	`MCRInstaller.bin`	*`matlabroot`*`/toolbox/compiler/deploy/glnxa64`
Mac®	`MCRInstaller.dmg`	*`matlabroot`*`/toolbox/compiler/deploy/mac`
Maci	`MCRInstaller.dmg`	*`matlabroot`*`/toolbox/compiler/deploy/maci`
Solaris (sol64)	`MCRInstaller.bin`	*`matlabroot`*`/toolbox/compiler/deploy/sol64`

Note Since you no longer create `MCRInstaller.zip`, `buildmcr` is no longer supported.

Creating a Package

The package must include the following:

- Your software (the standalone or shared library) and the embedded CTF archive that the MATLAB Compiler product created (*`component_name`*`.ctf`). See “Overriding Default CTF Archive Embedding Using the MCR Component Cache” on page 5-21 for more information.
- `MCRInstaller` See “Replacement of MCRInstaller.zip and BUILDMCR Functionality” on page 1-11 for the location of `MCRInstaller` on various platforms.

Configuring the Development Environment by Installing the MCR

To accurately produce the results of software compiled with the MATLAB Compiler product on a computer that doesn’t have MATLAB installed, you must:

- Install the MCR, if it is not already installed on the development machine.
- Set path environment variables properly.

1. Open the package created by you or the Deployment Tool.
2. Run `MCRInstaller` *once* on the machine where you want to develop the application or library. `MCRInstaller` opens a command window and begins preparation for the installation.
3. Add the required platform-specific directories to your dynamic library path. See “Directories Required for Run-Time Deployment” on page 10-5.

For More Information

About This	Look Here
Detailed information on standalone applications	Chapter 6, “Standalone Applications”
Creating libraries	Chapter 7, “Libraries”
Using the `mcc` command	Chapter 5, “Compiler Commands”
Troubleshooting	Chapter 9, “Troubleshooting”

Installation and Configuration

This chapter describes the system requirements for MATLAB Compiler. It also contains installation and configuration information for all supported platforms.

When you install your ANSI® C or C++ compiler, you may be required to provide specific configuration details regarding your system. This chapter contains information for each platform that can help you during this phase of the installation process.

Requirements

In this section...

System Requirements

To install MATLAB Compiler, you must have the proper version of MATLAB installed on your system. The MATLAB Compiler Platform & Requirements page, which is accessible from our Web site, provides this information. MATLAB Compiler imposes no operating system or memory requirements beyond those that are necessary to run MATLAB. MATLAB Compiler consumes a small amount of disk space.

MATLAB Compiler requires that a supported ANSI C or C++ compiler be installed on your system. Certain output targets require particular compilers.

Note Before you use MATLAB Compiler for the first time, you must run `mbuild -setup` to configure your C/C++ compiler to work with MATLAB Compiler.

In general, MATLAB Compiler supports the current release of a third-party compiler and its previous release. Since new versions of compilers are released on a regular basis, it is important to check our Web site for the latest supported compilers.

Supported Third-Party Compilers

For an up-to-date list of all the compilers supported by MATLAB and MATLAB Compiler, see the MathWorks™ Technical Support Department's Technical Notes at

```
http://www.mathworks.com/support/compilers/current_release/
```

Supported ANSI C and C++ Windows Compilers

Use one of the following 32-bit C/C++ compilers that create 32-bit Windows dynamically linked libraries (DLLs) or Windows applications:

- Lcc C version 2.4.1 (included with MATLAB). This is a C-only compiler; it does *not* work with C++.
- Microsoft® Visual C++® (MSVC) Versions 6.0, 7.1, 8.0, and 9.0.

Note The only compiler that supports the building of COM objects and Excel® plug-ins is Microsoft Visual C++ (Versions 6.0, 7.1, 8.0, and 9.0). The only compiler that supports the building of .NET objects is Microsoft Visual C# Compiler for the .NET Framework (Version 2.0 and higher).

Supported ANSI C and C++ UNIX Compilers

MATLAB Compiler supports the native system compilers on Solaris. On Linux, Linux x86-64, and Mac OS X, MATLAB Compiler supports `gcc` and `g++`.

Installation

In this section...
"Installing MATLAB® Compiler " on page 2-4
"Installing an ANSI C or C++ Compiler" on page 2-5

Installing MATLAB Compiler

MATLAB Compiler requires a supported ANSI C or C++ compiler installed on your system as well. Refer to the "Installing an ANSI C or C++ Compiler" on page 2-5 for more information.

Windows Operating System

To install MATLAB Compiler on Windows, follow the instructions in the Installation Guide for Windows documentation. If you have a license to install MATLAB Compiler, it will appear as one of the installation choices that you can select as you proceed through the installation process.

If MATLAB Compiler does not appear in your list of choices, contact The MathWorks to obtain an updated License File (`license.dat`) for multiuser network installations, or an updated Personal License Password (PLP) for single-user, standard installations.

You can contact The MathWorks:

- Via the Web at `www.mathworks.com`. On the MathWorks home page, click **My Account** to access your MathWorks Account, and follow the instructions.
- Via e-mail at `service@mathworks.com`.

UNIX Operating System

To install MATLAB Compiler on UNIX workstations, follow the instructions in the Installation Guide for UNIX documentation. If you have a license to install MATLAB Compiler, it appears as one of the installation choices that you can select as you proceed through the installation process. If MATLAB

Compiler does not appear as one of the installation choices, contact The MathWorks to get an updated license file (`license.dat`).

Note In order to run compiled applications from the DOS command prompt, you must reboot (or log out and log in) after installing MATLAB Compiler.

Installing an ANSI C or C++ Compiler

To install your ANSI C or C++ compiler, follow the vendor's instructions that accompany your C or C++ compiler. Be sure to test the C or C++ compiler to make sure it is installed and configured properly. Typically, the compiler vendor provides some test procedures.

Note If you encounter problems relating to the installation or use of your ANSI C or C++ compiler, consult the documentation or customer support organization of your C or C++ compiler vendor.

When you install your C or C++ compiler, you might encounter configuration questions that require you to provide particular details. These tables provide information on some of the more common issues.

Windows Operating System

Issue	Comment
Installation options	We recommend that you do a full installation of your compiler. If you do a partial installation, you may omit a component that MATLAB Compiler relies on.
Installing debugger files	For the purposes of MATLAB Compiler, it is not necessary to install debugger (DBG) files. However, you may need them for other purposes.
Microsoft Foundation Classes (MFC)	This is not required.

Windows Operating System (Continued)

Issue	Comment
16-bit DLLs	This is not required.
ActiveX®	This is not required.
Running from the command line	Make sure you select all relevant options for running your compiler from the command line.
Updating the registry	If your installer gives you the option of updating the registry, you should do it.
Installing Microsoft Visual C++ Version 6.0	If you need to change the location where this compiler is installed, you must change the location of the `Common` directory. Do not change the location of the `VC98` directory from its default setting.

UNIX Operating System

Issue	Comment
Determine which C or C++ compiler is installed on your system.	See your system administrator.
Determine the path to your C or C++ compiler.	See your system administrator.

Configuration

About the mbuild Utility

The `mbuild` script provides an easy way for you to specify an options file that lets you:

- Set the default compiler and linker settings for each supported compiler.
- Change compilers or compiler settings.
- Build your application.

`mbuild` simplifies the process of setting up a C or C++ compiler. Typically, you only need to use the `mbuild` utility's `setup` option once to specify which third-party compiler you want to use. For more information on the `mbuild` utility, see the `mbuild` reference page.

MATLAB Compiler (`mcc`) automatically invokes `mbuild` under certain conditions. In particular, `mcc -m` or `mcc -l` invokes `mbuild` to perform compilation and linking.

See the reference page for more information about `mbuild`. For examples of `mbuild` usage, see "Compiling the Driver Application" on page 7-6.

Configuring an ANSI C or C++ Compiler

Compiler Options Files

Options files contain flags and settings that control the operation of your installed C and C++ compiler. Options files are compiler-specific, i.e., there is a unique options file for each supported C/C++ compiler, which The MathWorks provides.

When you select a compiler to use with MATLAB Compiler , the corresponding options file is activated on your system. To select a default compiler, use

```
mbuild -setup
```

Additional information on the options files is provided in this chapter for those users who may need to modify them to suit their own needs. Many users never have to be concerned with the inner workings of the options files and only need the `setup` option to initially designate a C or C++ compiler. If you need more information on options files, see "Options Files" on page 2-12.

Note The following examples apply only to the 32-bit version of MATLAB.

Windows. Executing the command on Windows gives

```
Please choose your compiler for building standalone MATLAB applications:

Would you like mbuild to locate installed compilers [y]/n? n

Select a compiler:
[1] Lcc-win32 C 2.4.1
[2] Microsoft Visual C++ 6.0
[3] Microsoft Visual C++ .NET 2003
[4] Microsoft Visual C++ 2005 SP1
[5] Microsoft Visual C++ 2008
[6] Microsoft Visual C++ 2008 Express

[0] None
```

The preconfigured options files that are included with MATLAB for Windows are shown below.

Note These options apply only to the 32-bit version of MATLAB.

Options File	Compiler
`lcccompp.bat`	Lcc C, Version 2.4.1 (included with MATLAB)

`msvc60compp.bat`
`msvc71compp.bat`
`msvc80compp.bat`
 	
`msvc90compp.bat`
	Microsoft Visual C/C++, Version 6.0
	Microsoft Visual C/C++, Version 7.1
	Microsoft Visual C/C++, Version 8.0
	Microsoft Visual C/C++, Version 8.0 Express Edition
	Microsoft Visual C/C++, Version 9.0
	Microsoft Visual C/C++, Version 9.0 Express Edition

UNIX. Executing the command on UNIX gives

```
mbuild -setup

Using the 'mbuild -setup' command selects an options file that
is placed in ~/.matlab/current_release and
 used by default for 'mbuild'. An options file in the current
working directory or specified on
the command line overrides the default options file
in ~/.matlab/current_release.

Options files control which compiler to use, the compiler
and link command options, and the run time libraries to link
against.

To override the default options file, use the 'mbuild -f'
command (see 'mbuild -help' for more information).

The options files available for mbuild are:

1: matlabroot/bin/mbuildopts.sh :
Build and link with MATLAB C-API or MATLAB Compiler-generated
library via the system ANSI C/C++ compiler

matlabroot/bin/mbuildopts.sh is being copied to
/home/user/.matlab/current_release/mbuildopts.sh
```

The preconfigured options file that is included with MATLAB for UNIX is `mbuildopts.sh`, which uses the system native ANSI compiler for Solaris and `gcc` for Linux and Macintosh.

Supported Compiler Restrictions

The known restrictions regarding the use of supported compilers on the Windows operating system are:

- The LCC C compiler does not support C++ or versions of Windows other than 32–bit.
- The only compiler that supports the building of COM objects and Excel plug-ins is Microsoft Visual C/C++ (Versions 6.0, 7.1, 8.0, and 9.0).
- The only compiler that supports the building of .NET objects is the Microsoft Visual C# Compiler for the .NET Framework (Version 2.0 and higher).

Options Files

In this section...
"Locating the Options File" on page 2-12
"Changing the Options File" on page 2-13

Locating the Options File

Windows Operating System

To locate your options file on Windows, the `mbuild` script searches the following locations:

- Current directory
- The `user profile` directory (see "User Profile Directory Under Windows" on page 2-12 for more information about this directory)

`mbuild` uses the first occurrence of the options file it finds. If no options file is found, `mbuild` searches your machine for a supported C compiler and uses the factory default options file for that compiler. If multiple compilers are found, you are prompted to select one.

User Profile Directory Under Windows. The Windows `user profile` directory is a directory that contains user-specific information such as desktop appearance, recently used files, and **Start** menu items. The `mbuild` utility stores its options files, `compopts.bat`, which is created during the `-setup` process, in a subdirectory of your `user profile` directory, named `Application Data\MathWorks\MATLAB\`*`current_release`*. Under Windows with user profiles enabled, your `user profile` directory is `%windir%\Profiles\username`. Under Windows with user profiles disabled, your `user profile` directory is `%windir%`. You can determine whether or not user profiles are enabled by using the **Passwords** control panel.

UNIX Operating System

To locate your options file on UNIX, the `mbuild` script searches the following locations:

- Current directory
- `$HOME/.matlab/`*`current_release`*
- *`matlabroot`*`/bin`

`mbuild` uses the first occurrence of the options file it finds. If no options file is found, `mbuild` displays an error message.

Changing the Options File

Although it is common to use one options file for all of your MATLAB Compiler related work, you can change your options file at anytime. The `setup` option resets your default compiler so that the new compiler is used every time. To reset your C or C++ compiler for future sessions, use

```
mbuild -setup
```

Windows Operating System

Modifying the Options File. You can use of the `setup` option to change your options file settings on Windows. The `setup` option copies the appropriate options file to your `user profile` directory.

To modify your options file on Windows:

1. Use `mbuild -setup` to make a copy of the appropriate options file in your local area.
2. Edit your copy of the options file in your `user profile` directory to correspond to your specific needs and save the modified file.

After completing this process, the `mbuild` script will use the new options file every time with your modified settings.

UNIX Operating System

The `setup` option creates a user-specific, `matlab` directory in your individual home directory and copies the appropriate options file to the directory. (If the directory already exists, a new one is not created.) This `matlab` directory is used for your individual options files only; each user can have his or her own default options files (other MATLAB products may place options files in this directory). Do not confuse these user-specific `matlab` directories with the system `matlab` directory, where MATLAB is installed.

Modifying the Options File. You can use the `setup` option to change your options file settings on UNIX. For example, if you want to make a change to the current linker settings, or you want to disable a particular set of warnings, you should use the `setup` option.

To modify your options file on the Linux operating system:

1. Use `mbuild -setup` to make a copy of the appropriate options file in your local area.
2. Edit your copy of the options file to correspond to your specific needs and save the modified file.

This sets your default compiler's options file to your specific version.

Compilation Process

This chapter provides an overview of how MATLAB Compiler works. In addition, it lists the various sets of input and output files used by this product.

Overview of MATLAB Compiler Technology

In this section...

MATLAB Compiler Runtime

MATLAB Compiler 4 uses the MATLAB Compiler Runtime (MCR), which is a standalone set of shared libraries that enable the execution of M-files. The MCR provides complete support for all features of the MATLAB language.

Note Since the MCR technology provides full support for the MATLAB language, including the Java™ programming language, starting a compiled application takes approximately the same amount of time as starting MATLAB. The amount of resources consumed by the MCR is necessary in order to retain the power and functionality of a full version of MATLAB.

The MCR makes use of thread locking so that only one thread is allowed to access the MCR at a time. As a result, calls into the MCR are threadsafe for MATLAB Compiler generated libraries, COM objects, and .NET objects.

Component Technology File

MATLAB Compiler also embeds a Component Technology File (CTF) archive in each generated binary to house the deployable package. All M-files are encrypted in the CTF archive using the Advanced Encryption Standard (AES) cryptosystem where symmetric keys are protected by 1024-bit RSA keys.

Each application or shared library produced by MATLAB Compiler has an associated CTF archive. The archive contains all the MATLAB based content (M-files, MEX-files, etc.) associated with the component. If you choose the extract the CTF archive as a separate file (see "Overriding Default CTF Archive Embedding Using the MCR Component Cache" on page 5-21), the files remain encrypted.

Additional Details

Multiple CTF archives, such as COM, .NET, or Excel components, can coexist in the same user application, but you cannot mix and match the M-files they contain. You cannot combine encrypted and compressed M-files from multiple CTF archives into another CTF archive and distribute them.

All the M-files from a given CTF archive are locked together with a unique cryptographic key. M-files with different keys will not execute if placed in the same CTF archive. If you want to generate another application with a different mix of M-files, you must recompile these M-files into a new CTF archive.

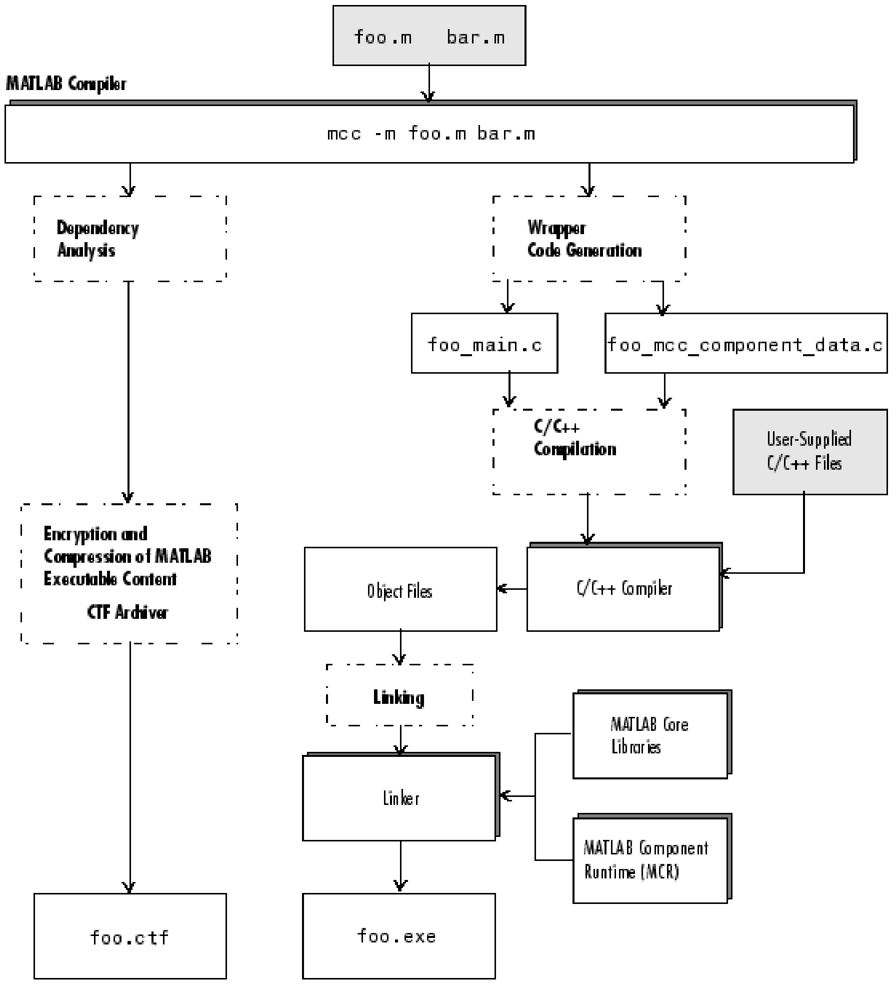
The CTF archive and generated binary will be cleaned up following a failed compilation, but only if these files did not exist before compilation was initiated.

Build Process

The process of creating software components with MATLAB Compiler is completely automatic. For example, to create a standalone MATLAB application, you supply the list of M-files that make up the application. MATLAB Compiler then performs the following operations:

- Dependency analysis
- Code generation
- Archive creation
- Compilation
- Linking

This figure illustrates how MATLAB Compiler takes user code and generates a standalone executable.



Creating a Standalone Executable

Dependency Analysis

The first step determines all the functions on which the supplied M-files, MEX-files, and P-files depend. This list includes all the M-files called by the given files as well as files that they call, and so on. Also included are all built-in functions and MATLAB objects.

Wrapper Code Generation

This step generates all the source code needed to create the target component, including

- The C/C++ interface code to those M-functions supplied on the command line (`foo_main.c`). For libraries and components, this file includes all of the generated interface functions.
- A component data file that contains information needed to execute the M-code at run-time. This data includes path information and encryption keys needed to load the M-code stored in the component's CTF archive.

Archive Creation

The list of MATLAB files (M-files and MEX-files) created during dependency analysis is used to create a CTF archive that contains the files needed by the component to properly execute at run-time. The files are encrypted and compressed into a single file for deployment. Directory information is also included so that the content is properly installed on the target machine.

C/C++ Compilation

This step compiles the generated C/C++ files from wrapper code generation into object code. For targets that support the inclusion of user-supplied C/C++ code on the `mcc` command line, this code is also compiled at this stage.

Linking

The final step links the generated object files with the necessary MATLAB libraries to create the finished component.

The C/C++ compilation and linking steps use the `mbuild` utility that is included with MATLAB Compiler.

Input and Output Files

In this section...

Standalone Executable

In this example, MATLAB Compiler takes the M-files `foo.m` and `bar.m` as input and generates a standalone called `foo`.

```
mcc -m foo.m bar.m
```

File	Description
`foo_main.c`	The main-wrapper C source file containing the program's `main` function. The `main` function takes the input arguments that are passed on the command line and passes them as strings to the `foo` function.
`foo_mcc_component_data.c`	C source file containing data needed by the MCR to run the application. This data includes path information, encryption keys, and other initialization information for the MCR.
`foo`	The main file of the application. This file reads and executes the content stored in the embedded CTF archive. On Windows, this file is `foo.exe`.
`run_`*`component`*`.sh`	`mcc` generates `run_<component>.sh` file on UNIX (including Mac) systems for standalone applications. It temporarily sets up the environment variables needed at runtime and executes the application. On Windows, `mcc` doesn't generate this run script file, because the environment variables have already been set up by the installer. In this case, you just run your standalone `.exe` file.

C Shared Library

In this example, MATLAB Compiler takes the M-files `foo.m` and `bar.m` as input and generates a C shared library called `libfoo`.

```
mcc -W lib:libfoo -T link:lib foo.m bar.m
```

File	Description
`libfoo.c`	The library wrapper C source file containing the exported functions of the library representing the C interface to the two M-functions (`foo.m` and `bar.m`) as well as library initialization code.
`libfoo.h`	The library wrapper header file. This file is included by applications that call the exported functions of `libfoo`.
`libfoo_mcc_component_data.c`	C source file containing data needed by the MCR to initialize and use the library. This data includes path information, encryption keys, and other initialization for the MCR.
`libfoo.exports`	The exports file used by `mbuild` to link the library.
`libfoo`	The shared library binary file. On Windows, this file is `libfoo.dll`. On Solaris, this file is `libfoo.so`. **Note** UNIX extensions vary depending on the platform. See the External Interfaces documentation for additional information.

File	Description
`libname.exp`	Exports file used by the linker. The linker uses the export file to build a program that contains exports, usually a dynamic-link library (`.dll`). The import library is used to resolve references to those exports in other programs.
`libname.lib`	Import library. An import library is used to validate that a certain identifier is legal, and will be present in the program when the `.dll` is loaded. The linker uses the information from the import library to build the lookup table for using identifiers that are not included in the `.dll`. When an application or `.dll` is linked, an import library may be generated, which will be used for all future `.dll`s that depend on the symbols in the application or `.dll`.

C++ Shared Library

In this example, MATLAB Compiler takes the M-files `foo.m` and `bar.m` as input and generates a C++ shared library called `libfoo`.

```
mcc -W cpplib:libfoo -T link:lib foo.m bar.m
```

File	Description
`libfoo.cpp`	The library wrapper C++ source file containing the exported functions of the library representing the C++ interface to the two M-functions (`foo.m` and `bar.m`) as well as library initialization code.
`libfoo.h`	The library wrapper header file. This file is included by applications that call the exported functions of `libfoo`.
`libfoo_mcc_component_data.c`	C++ source file containing data needed by the MCR to initialize and use the library. This data includes path information, encryption keys, and other initialization for the MCR.
`libfoo.exports`	The exports file used by `mbuild` to link the library.
`libfoo`	The shared library binary file. On Windows, this file is `libfoo.dll`. On Solaris, this file is `libfoo.so`. **Note** UNIX extensions vary depending on the platform. See the External Interfaces documentation for additional information.

File	Description
`libname.exp`	Exports file used by the linker. The linker uses the export file to build a program that contains exports (usually a dynamic-link library (`.dll`). The import library is used to resolve references to those exports in other programs.
`libname.lib`	Import library. An import library is used to validate that a certain identifier is legal, and will be present in the program when the `.dll` is loaded. The linker uses the information from the import library to build the lookup table for using identifiers that are not included in the `.dll`. When an application or `.dll` is linked, an import library may be generated, which will need to be used for all future `.dll`s that depend on the symbols in the application or `.dll`.

Deployment Process

This chapter tells you how to deploy compiled M-code to programmers and to end users.

Overview

After you create a library, a component, or an application, the next step is typically to deploy it to others to use on their machines, independent of the MATLAB environment. These users could be programmers who want to use the library or component to develop an application, or end users who want to run a standalone application.

- "Deploying to Programmers" on page 4-3
- "Deploying to End Users" on page 4-8

Note When you deploy, you provide the wrappers for the compiled M-code and the software needed to support the wrappers, including the MCR. The MCR is version specific, so you must ensure that programmers as well as users have the proper version of the MCR installed on their machines.

Deploying to Programmers

In this section...

Steps by the Programmer to Deploy to Programmers

Note If you are programming on the same machine where you created the component, you can skip the steps described here.

1 Create a package that contains the software necessary to support the compiled M-code. It is frequently helpful to install the MCR on development machines, for testing purposes. See "What Software Does a Programmer Need?" on page 4-4

   Note You can use the Deployment Tool to create a package for programmers. For Windows platforms, the package created by the Deployment Tool is a self-extracting executable. For UNIX platforms, the package created by the Deployment Tool is a zip file that must be decompressed and installed manually. SeeChapter 1, "Getting Started" to get started using the Deployment Tool.

2 Write instructions for how to use the package.

   a If your package was created with the Deployment Tool, Windows programmers can just run the self-extracting executable created by the Deployment Tool. UNIX programmers must unzip and install manually.

   b All programmers must set path environment variables properly. See "Directories Required for Development and Testing" on page 10-2.

3 Distribute the package and instructions.

What Software Does a Programmer Need?

The software that you provide to a programmer who wants to use compiled M-code depends on which of the following kinds of software the programmer will be using:

- "Standalone Application" on page 4-4
- "C or C++ Shared Library" on page 4-5
- ".NET Component" on page 4-6
- "COM Component" on page 4-6
- "Java Component" on page 4-6
- "COM Component to Use with Microsoft® Excel" on page 4-7

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11 for more details including complete file paths to all install programs.

Standalone Application

To distribute a standalone application created with MATLAB Compiler to a development machine, create a package that includes the following files.

Software Module	Description
`MCRInstaller.exe` (Windows)	`MCRInstaller` is a self-extracting executable that installs the necessary components to develop your application. This file is included with MATLAB Compiler.
`MCRInstaller.bin` (UNIX)	`MCRInstaller` is a self-extracting executable that installs the necessary components to develop your application on UNIX machines (other than Mac). This file is included with MATLAB Compiler.

Software Module	Description
`MCRInstaller.dmg` (Mac)	`MCRInstaller.dmg` is a self-extracting executable that installs the necessary components to develop your application on Mac machines. This file is included with MATLAB Compiler.
`application_name``.exe` (Windows)	Application created by MATLAB Compiler.
`application_name` (UNIX)	

C or C++ Shared Library

To distribute a shared library created with MATLAB Compiler to a development machine, create a package that includes the following files.

Software Module	Description
`MCRInstaller.bin` (UNIX)	MATLAB Compiler Runtime library archive; platform-dependent file that must correspond to the end user's platform
`MCRInstaller.dmg` (Mac)	`MCRInstaller.dmg` is a self-extracting executable that installs the necessary components to develop your application on Mac machines. This file is included with MATLAB Compiler.
`MCRInstaller.exe` (Windows)	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform
`libmatrix`	Shared library; extension varies by platform, for example, `DLL` on Windows
`libmatrix.h`	Library header file
`libmatrix.lib`	Application library file; file is needed to create the driver application for the shared library.

.NET Component

To distribute a .NET component to a development machine, create a package that includes the following files.

Software Module	Description
`componentName.xml`	Documentation files
`componentName.pdb` (if **Debug** option is selected)	Program Database File, which contains debugging information
`componentName.dll`	Component assembly file
`MCRInstaller.exe`	MCR Installer (if not already installed on the target machine)

COM Component

To distribute a COM component to a development machine, create a package that includes the following files.

Software Module	Description
`mwcomutil.dll`	Utilities required for array processing. Provides type definitions used in data conversion.
`componentname_version.dll`	Component that contains compiled M-code.
`MCRInstaller.exe`	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform. `MCRInstaller.exe` installs MATLAB Compiler Runtime (MCR), which users of your component need to install on the target machine once per release.

Java Component

To distribute a Java component to a development machine, create a package that includes the `componentname.jar` file, a Java package containing the Java interface to M-code.

Note For more information, see the `MWArray` Javadoc, which is searchable from the Help or from the MathWorks Web site.

COM Component to Use with Microsoft Excel

To distribute a COM component for Excel to a development machine, create a package that includes the following files.

Software Module	Description
`componentname_projectversion``.dll`	Compiled component.
`MCRInstaller.exe`	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform. `MCRInstaller.exe` installs the MATLAB Compiler Runtime (MCR), which users of your component need to install on the target machine once per release.
`*.xla`	Any user-created Excel add-in files found in the `<projectdir>\distrib` directory

Deploying to End Users

In this section...

Steps by the Programmer to Deploy to End Users

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11 for more details including complete file paths to all install programs.

For an end user to run an application or use a library that contains compiled M-code, there are two sets of tasks. Some tasks are for the programmer who developed the application or library, and some tasks are for the end user.

1 Create a package that contains the software needed at run time. See "What Software Does a Programmer Need?" on page 4-4 for more details.

Note The package needed for end users must include the `.ctf` file, which includes all the files in your preferences directory. Thus, you should make sure that you do not have files in your preferences directory that you do not want to expose to end users. MATLAB preferences set at compile time are inherited by a compiled application. Preferences set by a compiled application do not affect the MATLAB preferences, and preferences set in MATLAB do not affect a compiled application until that application is recompiled.

The preferences directory is as follows:

- `$HOME/.matlab/`*`current_release`* on UNIX
- *`system root`*`\profiles\`*`user`*`\application data\mathworks\matlab\`*`current_release`* on Windows

The directory will be stored in the CTF archive in a directory with a generated name, such as:

`mwapplication``_mcr/`*`myapplication`*`_7CBEDC3E1DB3D462C18914C13CBFA649`.

Caution MATLAB does not save your preferences directory until you exit MATLAB. Therefore, if you change your MATLAB preferences, stop and restart MATLAB before attempting to recompile using your new preferences.

2. Write instructions for the end user. See "Steps by the End User" on page 4-9.
3. Distribute the package to your end user, along with the instructions.

Steps by the End User

1. Open the package containing the software needed at run time.
2. Run `MCRInstaller` *once* on the target machine, that is, the machine where you want to run the application or library. The `MCRInstaller` opens a

command window and begins preparation for the installation. See "Using the MCR Installer GUI" on page 4-10.

3 If you are deploying a Java application to end users, they must set the class path on the target machine.

Note for Windows® Applications You must have administrative privileges to install the MCR on a target machine since it modifies both the system registry and the system path.

Running the `MCRInstaller` after the MCR has been set up on the target machine requires only user-level privileges.

Using the MCR Installer GUI

1 When the MCR Installer wizard appears, click **Next** to begin the installation. Click **Next** to continue.

2 In the Select Installation Folder dialog box, specify where you want to install the MCR and whether you want to install the MCR for just yourself or others. Click **Next** to continue.

Note The **Install MATLAB Compiler Runtime for yourself, or for anyone who uses this computer** option is not implemented for this release. The current default is **Everyone**.

---

3 Confirm your selections by clicking **Next**.

The installation begins. The process takes some time due to the quantity of files that are installed.

The MCRInstaller automatically:

- Copies the necessary files to the target directory you specified.
- Registers the components as needed.

- Updates the system path to point to the MCR binary directory, which is `<target_directory>/<version>/runtime/bin/win32`.

4 When the installation completes, click **Close** on the Installation Completed dialog box to exit.

What Software Does the End User Need?

The software required by end users depends on which of the following kinds of software is to be run by the user:

- "Standalone Compiled Application That Accesses Shared Library" on page 4-11
- ".NET Application" on page 4-12
- "COM Application" on page 4-12
- "Java Application" on page 4-13
- "Microsoft® Excel Add-In" on page 4-13

Standalone Compiled Application That Accesses Shared Library

To distribute a shared library created with MATLAB Compiler to end users, create a package that includes the following files.

Component	Description
`MCRInstaller.exe` (Windows)	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform.

Component	Description
`matrixdriver.exe` (Windows) `matrixdriver` (UNIX)	Application
`libmatrix`	Shared library; extension varies by platform. Extensions are: • Windows — `.dll` • Solaris, Linux, Linux x86-64 — `.so` • Mac OS X — `.dylib`

.NET Application

To distribute a .NET application that uses components created with MATLAB® Builder™ NE, create a package that includes the following files.

Software Module	Description
`componentName``.xml`	Documentation files
`componentName``.pdb` (if **Debug** option is selected)	Program Database File, which contains debugging information
`componentName``.dll`	Component assembly file
`MCRInstaller.exe`	MCR Installer (if not already installed on the target machine)
`application``.exe`	Application

COM Application

To distribute a COM application that uses components created with MATLAB Builder NE or MATLAB Builder EX, create a package that includes the following files.

Software Module	Description
componentname.ctf	Component Technology File (ctf) archive. This is a platform-dependent file that must correspond to the end user's platform.
componentname _*version*.dll	Component that contains compiled M-code
_install.bat	Script run by the self-extracting executable
MCRInstaller.exe	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform. MCRInstaller.exe installs MATLAB Compiler Runtime (MCR), which users of your component need to install on the target machine once per release.
application.exe	Application

Java Application

To distribute a Java application created with MATLAB Builder JA, create a *componentname*.jar file. To deploy the application on computers without MATLAB, you must include the MCR when creating your Java component.

Microsoft Excel Add-In

To distribute an Excel add-in created with MATLAB Builder EX, create a package that includes the following files.

Software Module	Description
componentname _*version*.dll	Component that contains compiled M-code
_install.bat	Script run by the self-extracting executable

Software Module	Description
`MCRInstaller.exe`	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform
`*.xla`	Any Excel add-in files found in *`projectdirectory`*`\distrib`

Using Relative Paths with Project Files

Project files now support the use of relative paths as of R2007b of MATLAB Compiler, enabling you to share a single project file for convenient deployment over the network. Simply share your project directory and use relative paths to define your project location to your distributed computers.

Porting Generated Code to a Different Platform

You can distribute an application generated by MATLAB Compiler to any target machine that has the same operating system as the machine on which the application was compiled. For example, if you want to deploy an application to a Windows machine, you must use the Windows version of MATLAB Compiler to build the application on a Windows machine.

Note Since binary formats are different on each platform, the components generated by MATLAB Compiler cannot be moved from platform to platform as is.

To deploy an application to a machine with an operating system different from the machine used to develop the application, you must rebuild the application on the desired targeted platform. For example, if you want to deploy a previous application developed on a Windows machine to a Linux machine, you must use MATLAB Compiler on a Linux machine and completely rebuild the application. You must have a valid MATLAB Compiler license on both platforms to do this.

Extracting a CTF Archive Without Executing the Component

CTF archives contain content (M-files and MEX-files) that need to be extracted from the archive before they can be executed. In order to extract the archive you must override the default CTF embedding option (see "Overriding Default CTF Archive Embedding Using the MCR Component Cache" on page 5-21). To do this, ensure that you compile your component with the "-C Do Not Embed CTF Archive by Default" on page 12-29 option.

The CTF archive automatically expands the first time you run a MATLAB Compiler-based component (a MATLAB Compiler based standalone application or an application that calls a MATLAB Compiler-based shared library, COM, or .NET component).

To expand an archive without running the application, you can use the `extractCTF` (`.exe` on Windows) standalone utility provided in the *`matlabroot`*`/toolbox/compiler/deploy/`*`arch`* directory, where *`arch`* is your system architecture, Windows = `win32`, Linux = `glnx86`, Solaris = `sol64`, x86-64 = `glnxa64`, and Mac OS X = `mac`. This utility takes the CTF archive as input and expands it into the directory in which it resides. For example, this command expands `hello.ctf` into the directory where it resides:

```
extractCTF hello.ctf
```

The archive expands into a directory called `hello_mcr`. In general, the name of the directory containing the expanded archive is `<componentname>_mcr`, where `componentname` is the name of the CTF archive without the extension.

Note To run `extractCTF` from any directory, you must add *`matlabroot`*`/toolbox/compiler/deploy/`*`arch`* to your `PATH` environment variable. Run `extractCTF.exe` from a system prompt. If you run it from MATLAB, be sure to use the bang (`!`) operator.

Dependency Analysis Function (depfun) and User Interaction with the Compilation Path

MATLAB Compiler uses a dependency analysis function (`depfun`) to determine the list of necessary files to include in the CTF package. In some cases, this process includes an excessive number of files, for example, when MATLAB object classes are included in the compilation and it cannot resolve overloaded methods at compile time. The dependency analysis is an iterative process that also processes `include/exclude` information on each pass. Consequently, this process can lead to very large CTF archives resulting in long compilation times for relatively small applications.

`depfun` searches for "executable" content such as:

- M-files
- P-files
- Java classes and `.jar` files
- `.fig` files
- MEX-files and dependent binaries

`depfun` does not search for data files of any kind. You must manually `include` data files.

M-files are encrypted by `depfun`, and `depfun` creates authorization files for each MEX-file. This file guards against MEX-files of the same name (but of different functionality) being placed into exploded CTF directories.

The most effective way to reduce the number of files is to constrain the MATLAB path that `depfun` uses at compile time. MATLAB Compiler includes features that enable you to manipulate the path. Currently, there are three ways to interact with the compilation path:

- `addpath` and `rmpath` in MATLAB
- Passing `-I <directory>` on the `mcc` command line
- Passing `-N` and `-p` directories on the `mcc` command line

addpath and rmpath in MATLAB

If you run MATLAB Compiler from the MATLAB prompt, you can use the `addpath` and `rmpath` commands to modify the MATLAB path before doing a compilation. There are two disadvantages:

- The path is modified for the current MATLAB session only.
- If MATLAB Compiler is run outside of MATLAB, this doesn't work unless a `savepath` is done in MATLAB.

Note The path is also modified for any interactive work you are doing in the MATLAB environment as well.

Passing -I <directory> on the Command Line

You can use the `-I` option to add a directory to the beginning of the list of paths to use for the current compilation. This feature is useful when you are compiling files that are in directories currently not on the MATLAB path.

Passing -N and -p <directory> on the Command Line

There are two MATLAB Compiler options that provide more detailed manipulation of the path. This feature acts like a "filter" applied to the MATLAB path for a given compilation. The first option is `-N`. Passing `-N` on the `mcc` command line effectively clears the path of all directories except the following core directories (this list is subject to change over time):

- *`matlabroot`*`/toolbox/matlab`
- *`matlabroot`*`/toolbox/local`
- *`matlabroot`*`/toolbox/compiler/deploy`
- *`matlabroot`*`/toolbox/compiler`

It also retains all subdirectories of the above list that appear on the MATLAB path at compile time. Including `-N` on the command line allows you to replace directories from the original path, while retaining the relative ordering of the included directories. All subdirectories of the included directories that appear on the original path are also included. In addition, the `-N` option retains all directories that the user has included on the path that are not under *`matlabroot`*`/toolbox`.

Use the `-p` option to add a directory to the compilation path in an order-sensitive context, i.e., the same order in which they are found on your MATLAB path. The syntax is

```
p <directory>
```

where `<directory>` is the directory to be included. If `<directory>` is not an absolute path, it is assumed to be under the current working directory. The rules for how these directories are included are

- If a directory is included with `-p` that is on the original MATLAB path, the directory and all its subdirectories that appear on the original path are added to the compilation path in an order-sensitive context.
- If a directory is included with `-p` that is not on the original MATLAB path, that directory is not included in the compilation. (You can use `-I` to add it.)
- If a path is added with the `-I` option while this feature is active (`-N` has been passed) and it is already on the MATLAB path, it is added in the order-sensitive context as if it were included with `-p`. Otherwise, the directory is added to the head of the path, as it normally would be with `-I`.

Note The `-p` option requires the `-N` option on the `mcc` command line.

Working with the MCR

In this section...

Understanding the MCR

MATLAB Compiler was designed to work with a large range of applications that use the MATLAB programming language. Because of this, run-time libraries are large.

If you do not have MATLAB installed on the target machine and you want to run components created by MATLAB Compiler , you still need to install the MCR on the target machine, whether you are a developer or end user. You have to install the MCR only once. There is no way to distribute your application with any subset of the files that are installed by the MCRInstaller.

You can install the MCR by running `MCRInstaller.exe.`

On platforms other than Windows, you must also set paths and environment variables. See "Directories Required for Run-Time Deployment" on page 10-5 for more information about these settings.

Note The MCR is version-specific.

You must run your applications with the version of the MCR associated with the version of MATLAB Compiler with which it was created. For example, if you compiled an application using version 4.10 (R2009a) of MATLAB Compiler, users who do not have MATLAB installed must have version 7.10 of the MCR installed. Use `mcrversion` to return the version number of the MCR.

Note If you are deploying .NET component applications to programmers or end users, make sure to tell them to install .NET Framework before installing the MCR. The `MCRinstaller.exe` must detect the presence of .NET Framework on a system for it to install MCR .NET support. Alternatively, you can package .NET Framework with the component installer that you provide to them as part of your deployment package.

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See “Replacement of MCRInstaller.zip and BUILDMCR Functionality” on page 1-11 for more details including complete file paths to all install programs.

See “Deploying to End Users” on page 4-8 for more information about the general steps for installing the MCR as part of the deployment process.

See also “Using MCR Installer Command Line Options” on page 10-9 for more information.

Installing the MCR and MATLAB on the Same Machine

You do not need to install the MCR on your machine if your machine has both MATLAB and MATLAB Compiler installed. The version of MATLAB should be the same as the version of MATLAB that was used to create the deployed component.

Modifying the Path

If you install the MCR on a machine that already has MATLAB on it, you must adjust the library path according to your needs.

Note To run the deployed component using MCR libraries, the MCR run-time directory must appear before the MATLAB run-time directory on the library path.

To ensure that the deployed component is always run using MCR, MCR needs to be set before MATLAB in the path variable.

Windows. To run deployed components, `<mcr_root>\<ver>\runtime\win32` must appear on your system path before *`matlabroot`*`\bin\win32`. To run MATLAB, *`matlabroot`*`\bin\win32` must appear on your system path before `<mcr_root>\<ver>\runtime\win32`.

UNIX. To run deployed components on Linux, Linux x86-64, or Solaris, the `<mcr_root>/runtime/<arch>` directory must appear on your `LD_LIBRARY_PATH` before *`matlabroot`*`/bin/<arch>`, and `XAPPLRESDIR` should point to `<mcr_root>/X11/app-defaults`. See "Directories Required for Run-Time Deployment" on page 10-5 for the platform-specific commands.

To run MATLAB on Linux, Linux x86-64, or Solaris, *`matlabroot`*`/bin/<arch>` must appear on your `LD_LIBRARY_PATH` before the `<mcr_root>/runtime/<arch>` directory, and `XAPPLRESDIR` should point to *`matlabroot`*`/X11/app-defaults`..

To run deployed components on Mac OS X, the `<mcr_root>/runtime/mac` directory must appear on your `DYLD_LIBRARY_PATH` before *`matlabroot`*`/bin/mac`, and `XAPPLRESDIR` should point to `<mcr_root>/X11/app-defaults`.

To run MATLAB on Mac OS X or Intel® Mac, *`matlabroot`*`/bin/mac` must appear on your `DYLD_LIBRARY_PATH` before the `<mcr_root>/bin/mac` directory, and `XAPPLRESDIR` should point to *`matlabroot`*`/X11/app-defaults`.

Note For Intel Mac, substitute `mac` in path names for `maci`.

Installing Multiple MCRs on One Machine

`MCRInstaller` supports the installation of multiple versions of the MCR on a target machine. This allows applications compiled with different versions of the MCR to execute side by side on the same machine.

If you do not want multiple MCR versions on the target machine, you can remove the unwanted ones. On Windows, run **Add or Remove Programs** from the Control Panel to remove any of the previous versions. On UNIX, you manually delete the unwanted MCR. You can remove unwanted versions before or after installation of a more recent version of the MCR, as versions can be installed or removed in any order.

Note for Mac OS® X Users Installing multiple versions of the MCR on the same machine is not supported on Mac OS X. When you receive a new version of MATLAB, you must recompile and redeploy all of your applications and components. Also, when you install a new MCR onto a target machine, you must delete the old version of the MCR and install the new one. You can only have one version of the MCR on the target machine.

Deploying a Recompiled Application

Always run your compiled applications with the version of the MCR that corresponds to the MATLAB version with which your application was built. If you upgrade your MATLAB Compiler software on your development machine and distribute the recompiled application to your users, you should also distribute the corresponding version of the MCR. Users should upgrade their MCR to the new version. If users need to maintain multiple versions of the MCR on their systems, refer to "Installing Multiple MCRs on One Machine" on page 4-22 for more information.

Retrieving JVM Status, Log File Name, and Display Mode from MCR State for Shared Libraries

Use these new functions to return data about MCR state when working with shared libraries (this does not apply to standalone applications).

Function and Signature	When to Use	Return Value
`bool mclIsMCRInitialized()`	Use `mclIsMCRInitialized()` to determine whether or not the MCR has been properly initialized.	Boolean (`true` or `false`). Returns `true` if MCR is already initialized, else returns `false`.
`bool mclIsJVMEnabled()`	Use `mclIsJVMEnabled()` to determine if the MCR was launched with an instance of a Java Virtual Machine (JVM).	Boolean (`true` or `false`). Returns `true` if MCR is launched with a JVM instance, else returns `false`.
`const char* mclGetLogFileName()`	Use `mclGetLogFileName()` to retrieve the name of the log file used by the MCR	Character string representing log file name used by MCR
`bool mclIsNoDisplaySet()`	Use `mclIsNoDisplaySet()` to determine if `-nodisplay` option is enabled.	Boolean (`true` or `false`). Returns `true` if `-nodisplay` is enabled, else returns `false`. **Note** `false` is always returned on Windows systems since the `-nodisplay` option is not supported on Windows systems.

Note All of these attributes have properties of write-once, read-only.

Example: Retrieving Information from MCR State

```
const char* options[4];
   options[0] = "-logfile";
   options[1] = "logfile.txt";
   options[2] = "-nojvm";
   options[3] = "-nodisplay";
   if( !mclInitializeApplication(options,4) )
   {
       fprintf(stderr, "Could not initialize the application.\n");
       return -1;
   }
   printf("MCR initialized : %d\n", mclIsMCRInitialized());
   printf("JVM initialized : %d\n", mclIsJVMEnabled());
   printf("Logfile name : %s\n", mclGetLogFileName());
   printf("nodisplay set : %d\n", mclIsNoDisplaySet());
   fflush(stdout);
```

Improving Data Access Using the MCR User Data Interface

The MCR User Data Interface lets you easily access MCR data. It allows keys and values to be passed between an MCR instance, the M-code running on the MCR, and the wrapper code that created the MCR. Through calls to the MCR User Data Interface API, you access MCR data by creating a per-MCR-instance associative array of `mxArrays`, consisting of a mapping from string keys to `mxArray` values. Reasons for doing this include, but are not limited to the following:

- You need to supply run-time configuration information to a client running an application created with the Parallel Computing Toolbox. You supply and change configuration information on a per-execution basis. For example, two instances of the same application may run simultaneously with different configuration files. See "Deploying Applications Created Using the Parallel Computing Toolbox" on page 4-30for more information.

- You want to set up a global workspace, a global variable or variables that MATLAB and your client can access.
- You want to store the state of any variable or group of variables.

The API consists of:

- Two MATLAB M-functions callable from within deployed application M-code
- Four external C functions callable from within deployed application wrapper code

---

Note The M-functions are available to other modules since they are native to MATLAB. These built-in functions are implemented in the MCLMCR module, which lives in the standalone directory.

For implementations using .NET components, Java components, or COM components with Excel, see the *MATLAB Builder NE User's Guide*, *MATLAB Builder JA User's Guide*, and *MATLAB Builder EX User's Guide*, respectively.

MATLAB Functions

Use the M-language functions `getmcruserdata` and `setmcruserdata` from deployed M applications. They are loaded by default only in applications created with the MATLAB Compiler or builder products. See Chapter 12, "Functions — Alphabetical List", for more information.

Caution These functions will produce an `Unknown function` error when called in MATLAB if the MCLMCR module cannot be located. This can be avoided by calling `isdeployed` before calling `getmcruserdata` and `setmcruserdata`. For more information about the`isdeployed` function, see the `isdeployed` reference page.

External C Functions

Use the following C functions in deployed C/C++ applications. See Chapter 12, "Functions — Alphabetical List" for more information.

- `*libname*GetMcrID`
- `mclSetMCRUserData`
- `mclGetMCRUserData`
- `mclSetCmdLineMCRUserData`

Setting MCR Data for Standalone Executables

MCR data can be set for a standalone executable with the `-mcruserdata` command line argument.

The following example demonstrates how to set MCR user data for use with a Parallel Computing Toolbox configuration `.mat` file:

```
parallelapp.exe -mcruserdata
                 ParallelConfigurationFile:config.mat
```

The argument following `-mcruserdata` is interpreted as a key/value MCR user data pair, where the colon separates the key from the value. The standalone executable accesses this data by using `getmcruserdata`.

Setting and Retrieving MCR Data for Shared Libraries

As mentioned in "Improving Data Access Using the MCR User Data Interface" on page 4-24, there are many possible scenarios for working with MCR Data. The most general scenario involves setting the MCR with specific data for later retrieval, as follows:

1. Outside the scope of your main code, use *libname*`GetMcrID` to retrieve the key value of the MCR data you want to update.

2. In your code, Include the MCR header file and the library header generated by MATLAB Compiler.

3. Properly initialize your application using `mclInitializeApplication`.

4 After creating your input data, write or "set" it to the MCR with `setmcruserdata` or `mclSetMCRUserData`, as appropriate. Use `mclSetCmdLineMCRUserData` to set data from the command line.

5 After calling functions or performing other processing, retrieve the new MCR data with `getmcruserdata` or `mclGetMCRUserData`, as appropriate.

6 Free up storage memory in work areas by disposing of unneeded arrays with `mxDestroyArray`.

7 Shut down your application properly with `mclTerminateApplication`.

Example: MagicMatrix. This following is an end-to-end example showing how to set and retrieve MCR data with the `magicmatrix` application and the MCR User Data interface API:

Building on UNIX

```
mbuild -gv -output magicmatrix magicmatrix.c libmagicmatrix.so
```

Building on Windows

```
mbuild -gv -output magicmatrix magicmatrix.c libmagicmatrix.lib
```

Running on UNIX

```
% ./magicmatrix
```

Running on Windows

```
C:\> magicmatrix.exe
```

magicmatrix.c

```
#include <stdio.h>

/* Include the MCR header file and the library specific header
 * file as generated by MATLAB Compiler */
#include "libmagicmatrix.h"

/* This function is used to display a double matrix stored in
```

```
 * an mxArray */
void display(const mxArray* in);

int run_main(int argc, char **argv)
{
    /* Input and output parameters. For testing, keep inputValue
     *   and outputValue in separate arrays, so a dangling
     *   pointer can't
     * cause a false positive.
     */
    mxArray *key, *inputValue;
    mxArray *outputValue = NULL;

    /* Column-major 3x3 magic square. */
    double data[] = {8, 3, 4, 1, 5, 9, 6, 7, 2};

    /* Initialize the application */
    if( !mclInitializeApplication(NULL,0) )
    {
        fprintf(stderr,
         "Could not initialize the application.\n");
     return -1;
    }

    /* Call the library intialization routine and make sure
     * that the
     * library was initialized properly. */
    if (!libmagicmatrixInitialize()){
        fprintf(stderr,"Could not initialize the library.\n");
        return -2;
    }
    else
    {
        /* Declare an array to hold the inputs */
        mxArray *key = 0, *inputValue = 0;

        /* Create the input data */
        inputValue = mxCreateDoubleMatrix(3,3,mxREAL); /* key */
        key = mxCreateString("MagicMatrix");       /* value */
        memcpy(mxGetPr(inputValue), data, 9*sizeof(double));
        /* Set the user data: 2 inputs, no outputs */
        mlfSetmcruserdata(key, inputValue);

        /* Call the library function */
        mlfMagicmatrix(0, NULL, NULL);

        /* Get the MCR user data - it should be different now */
        mlfGetmcruserdata(1, &outputValue, key);

        display(outputValue);

        /* Clean up */
        mxDestroyArray(outputValue); outputValue=0;

        /* Call the library termination routine */
        libmagicmatrixTerminate();

        /* Free the memory created for the inputs */
        mxDestroyArray(key); key = 0;
        mxDestroyArray(inputValue); inputValue = 0;
    }

    /* Shut everything down */
    mclTerminateApplication();
    return 0;
}


/*DISPLAY This function will display the double matrix stored
 * in an mxArray.
 * This function assumes that the mxArray passed as
 * input contains double array.
 */
void display(const mxArray* in)
{
    int i=0, j=0; /* loop index variables */
    int r=0, c=0; /* variables to store the row and column
    * length of the matrix */
    double *data; /* variable to point to the double data
```

```
        * stored within the mxArray */

        /* Get the size of the matrix */
        r = mxGetM(in);
        c = mxGetN(in);
        /* Get a pointer to the double data in mxArray */
        data = mxGetPr(in);

        /* Loop through the data and display the same in
        * matrix format */
        for( i = 0; i < c; i++ ){
            for( j = 0; j < r; j++){
                printf("%4.2f\t",data[j*c+i]);
            }
            printf("\n");
        }
        printf("\n");
    }

    int main()
    {
        mclmcrInitialize();
        return mclRunMain((mclMainFcnType)run_main,0,NULL);
    }
```

Deploying Applications Created Using the Parallel Computing Toolbox

For information about creating and exporting configurations from Parallel Computing Toolbox applications, see “Programming with User Configurations”.

For information on using the MCR User Data Interface with MATLAB Builder JA, MATLAB Builder NE, and MATLAB Builder EX, see “Improving Data Access Using the MCR User Data Interface” in the appropriate user’s guide.

For a working example of how to use Parallel Computing Toolbox with the MCR User Data Interface, see “Example: Supplying Run-Time Configuration Information For Parallel Computing Toolbox Applications.”

Deploying a Standalone Application on a Network Drive

You can deploy a compiled standalone application to a network drive so that it can be accessed by all network users without having them install the MCR on their individual machines.

1. On any Windows machine, execute `MCRInstaller.exe` to install the MATLAB Compiler Runtime (MCR).

2. Copy the entire MCR directory (the directory where MCR is installed) onto a network drive.

3. Copy the compiled application into a separate directory in the network drive and add the path `<mcr_root>\<ver>\runtime\<arch>` to all client machines. All network users can then execute the application.

4. Run `vcredist_x86.exe` on the client machines.

5. If you are using MATLAB Builder EX, register `mwcomutil.dll` and `mwcommgr.dll` on every client machine.

   If you are using MATLAB Builder NE (to create COM objects), register `mwcomutil.dll` on every client machine.

   To register the DLLs, at the DOS prompt enter

   ```
   regsvr32 <fully_qualified_pathname\dllname.dll>
   ```

   These DLLs are located in `<mcr_root>\<ver>\runtime\<arch>`.

   Note These libraries are automatically registered on the machine on which the installer was run.

MATLAB Compiler Deployment Messages

To enable display of MATLAB Compiler deployment messages, see “Enabling MATLAB Compiler Deployment Messages” in *MATLAB Desktop Tools and Development Environment*.

Using MATLAB Compiler Generated DLLs in Windows Services

If you have a Windows service that is built using DLL files generated by MATLAB Compiler, do the following to ensure stable performance:

1. Create a file named `java.opts`.
2. Add the following line to the file:

   ```
   -Xrs
   ```

3. Save the file to: *`MCRROOT`*`/`*`version`*`/bin/win32`, where *`MCRROOT`* is the installation directory of the MATLAB Compiler Runtime and *`version`* is the MCR version (for example, `v74` for MATLAB Compiler 4.4 (R2006a)).

Caution Failure to create the `java.opts` file using these steps may result in unpredictable results such as premature termination of Windows services.

Compiler Commands

This chapter describes `mcc`, which is the command that invokes MATLAB Compiler.

Command Overview

In this section...

Compiler Options

`mcc` is the MATLAB command that invokes MATLAB Compiler. You can issue the `mcc` command either from the MATLAB command prompt (MATLAB mode) or the DOS or UNIX command line (standalone mode).

You may specify one or more MATLAB Compiler option flags to `mcc`. Most option flags have a one-letter name. You can list options separately on the command line, for example,

```
mcc -m -g myfun
```

Macros are MathWorks supplied MATLAB Compiler options that simplify the more common compilation tasks. Instead of manually grouping several options together to perform a particular type of compilation, you can use a simple macro option. You can always use individual options to customize the compilation process to satisfy your particular needs. For more information on macros, see "Using Macros to Simplify Compilation" on page 5-5.

Combining Options

You can group options that do not take arguments by preceding the list of option flags with a single dash (-), for example:

```
mcc -mg myfun
```

Options that take arguments cannot be combined unless you place the option with its arguments last in the list. For example, these formats are valid:

```
mcc -v -W main -T link:exe myfun   % Options listed separately
mcc -vW main -T link:exe myfun     % Options combined
```

This format is *not* valid:

```
mcc -Wv main -T link:exe myfun
```

In cases where you have more than one option that takes arguments, you can only include one of those options in a combined list and that option must be last. You can place multiple combined lists on the `mcc` command line.

If you include any C or C++ file names on the `mcc` command line, the files are passed directly to `mbuild`, along with any MATLAB Compiler generated C or C++ files.

Conflicting Options on the Command Line

If you use conflicting options, MATLAB Compiler resolves them from left to right, with the rightmost option taking precedence. For example, using the equivalencies in "Macro Options" on page 5-5,

```
mcc -m -W none test.m
```

is equivalent to:

```
mcc -W main -T link:exe -W none test.m
```

In this example, there are two conflicting `-W` options. After working from left to right, MATLAB Compiler determines that the rightmost option takes precedence, namely, `-W none`, and the product does not generate a wrapper.

Caution Macros and regular options may both affect the same settings and may therefore override each other depending on their order in the command line.

Using File Extensions

The valid, recommended file extension for a file submitted to MATLAB Compiler is `.m`. Always specify the complete file name, including the `.m` extension, when compiling with mcc or you may encounter unpredictable results.

Note P-files (.p) have precedence over M-files, therefore if both P-files and M-files reside in a directory, and a file name is specified without an extension, the P-file will be selected.

Using Macros to Simplify Compilation

In this section...
"Macro Options" on page 5-5
"Working With Macro Options" on page 5-5

Macro Options

MATLAB Compiler, through its exhaustive set of options, gives you access to the tools you need to do your job. If you want a simplified approach to compilation, you can use one simple option, i.e., *macro*, that allows you to quickly accomplish basic compilation tasks. Macros let you group several options together to perform a particular type of compilation.

This table shows the relationship between the macro approach to accomplish a standard compilation and the multioption alternative.

Macro Option	Bundle File	Creates	Option Equivalence
			`Function Wrapper`
			`|`
				
				`Output Stage`
				`|`

`-l`	`macro_option_l`	Library	`-W lib`	`-T link:lib`
`-m`	`macro_option_m`	Standalone C application	`-W main`	`-T link:exe`

Working With Macro Options

The `-m` option tells MATLAB Compiler to produce a standalone C application. The `-m` macro is equivalent to the series of options

```
-W main -T link:exe
```

This table shows the options that compose the `-m` macro and the information that they provide to MATLAB Compiler.

-m Macro

Option	Function
`-W main`	Produce a wrapper file suitable for a standalone application.
`-T link:exe`	Create an executable link as the output.

Changing Macro Options

You can change the meaning of a macro option by editing the corresponding `macro_option` bundle file in *`matlabroot`*`/toolbox/compiler/bundles`. For example, to change the `-m` macro, edit the file `macro_option_m` in the `bundles` directory.

Note This changes the meaning of `-m` for all users of this MATLAB installation.

Specifying Default Macro Options

As the `MCCSTARTUP` functionality has been replaced by bundle file technology, the `macro_default` file that resides in `toolbox\compiler\bundles` can be used to specify default options to the compiler.

For example, adding `-mv` to the `macro_default` file causes the command:

```
mcc foo.m
```

to execute as though it were:

```
mcc -mv foo.m
```

Similarly, adding `-v` to the `macro_default` file causes the command:

```
mcc -W 'lib:libfoo' -T link:lib foo.m
```

to behave as though the command were:

```
mcc -v -W 'lib:libfoo' -T link:lib foo.m
```

Using Path Names

If you specify a full path name to an M-file on the `mcc` command line, MATLAB Compiler

1 Breaks the full name into the corresponding path name and file names (`<path>` and `<file>`).

2 Replaces the full path name in the argument list with "`-I <path> <file>`". For example,

   ```
   mcc -m /home/user/myfile.m
   ```

   would be treated as

   ```
   mcc -m -I /home/user myfile.m
   ```

In rare situations, this behavior can lead to a potential source of confusion. For example, suppose you have two different M-files that are both named `myfile.m` and they reside in `/home/user/dir1` and `/home/user/dir2`. The command

```
mcc -m -I /home/user/dir1 /home/user/dir2/myfile.m
```

would be equivalent to

```
mcc -m -I /home/user/dir1 -I /home/user/dir2 myfile.m
```

MATLAB Compiler finds the `myfile.m` in `dir1` and compiles it instead of the one in `dir2` because of the behavior of the `-I` option. If you are concerned that this might be happening, you can specify the `-v` option and then see which M-file MATLAB Compiler parses. The `-v` option prints the full path name to the M-file during the dependency analysis phase.

Note MATLAB Compiler produces a warning (`specified_file_mismatch`) if a file with a full path name is included on the command line and MATLAB Compiler finds it somewhere else.

Using Bundle Files

Bundle files provide a convenient way to group sets of MATLAB Compiler options and recall them as needed. The syntax of the bundle file option is:

```
-B <filename>[:<a1>,<a2>,...,<an>]
```

When used on the `mcc` command line, the bundle option `-B` replaces the entire string with the contents of the specified file. The file should contain only `mcc` command-line options and corresponding arguments and/or other file names. The file may contain other `-B` options.

A bundle file can include replacement parameters for MATLAB Compiler options that accept names and version numbers. For example, there is a bundle file for C shared libraries, `csharedlib`, that consists of:

```
-W lib:%1% -T link:lib
```

To invoke MATLAB Compiler to produce a C shared library using this bundle, you could use:

```
mcc -B csharedlib:mysharedlib myfile.m myfile2.m
```

In general, each `%n%` in the bundle file will be replaced with the corresponding option specified to the bundle file. Use `%%` to include a `%` character. It is an error to pass too many or too few options to the bundle file.

Note You can use the `-B` option with a replacement expression as is at the DOS or UNIX prompt. To use `-B` with a replacement expression at the MATLAB prompt, you must enclose the expression that follows the `-B` in single quotes when there is more than one parameter passed. For example,

```
>>mcc -B csharedlib:libtimefun weekday data tic calendar toc
```

can be used as is at the MATLAB prompt because `libtimefun` is the only parameter being passed. If the example had two or more parameters, then the quotes would be necessary as in

```
>>mcc -B 'cexcel:component,class,1.0' ...
weekday data tic calendar toc
```

See the following table for a list of bundle files available with MATLAB Compiler.

Bundle File	Creates	Contents
`cpplib`	C++ Library	`-W cpplib:<shared_library_name> -T link:lib`
`csharedlib`	C Shared Library	`-W lib:<shared_library_name> -T link:lib`

Note Additional bundle files are available when you have a license for products layered on MATLAB Compiler. For example, if you have a license for MATLAB Builder NE , you can use the `mcc` command with bundle files that create COM objects and .NET objects.

Using Wrapper Files

In this section...

What Are Wrapper Files?

Wrapper files encapsulate, or wrap, the M-files in your application with an interface that enables the M-files to operate in a given target environment.

To provide the required interface, the wrapper does the following:

- Performs wrapper-specific initialization and termination
- Provides the dispatching of function calls to the MCR

To specify the type of wrapper to generate, use the following syntax:

```
-W <type>
```

The following sections detail the available wrapper types.

Main File Wrapper

The `-W main` option generates wrappers that are suitable for building standalone applications. These POSIX-compliant main wrappers accept strings from the POSIX shell and return a status code. They pass these command-line strings to the M-file function(s) as MATLAB strings. They are meant to translate "command-like" M-files into POSIX main applications.

POSIX Main Wrapper

Consider this M-file, `sample.m`.

```
function y = sample(varargin)
varargin{:}
```

```
y = 0;
```

You can compile `sample.m` into a POSIX main application. If you call `sample` from MATLAB, you get

```
sample hello world
ans =
hello

ans =
world

ans =
     0
```

If you compile `sample.m` and call it from the DOS shell, you get

```
C:\> sample hello world

ans =
hello

ans =
world

C:\>
```

The difference between the MATLAB and DOS/UNIX environments is the handling of the return value. In MATLAB, the return value is handled by printing its value; in the DOS/UNIX shell, the return value is handled as the return status code. When you compile a function into a POSIX main application, the return status is set to 0 if the compiled M-file is executed without errors and is nonzero if there are errors.

C Library Wrapper

The `-l` option, or its equivalent `-W lib:libname`, produces a C library wrapper file. This option produces a shared library from an arbitrary set of M-files. The generated header file contains a C function declaration for each of the compiled M-functions. The export list contains the set of symbols that are exported from a C shared library.

Note You must generate a library wrapper file when calling any MATLAB Compiler generated code from a larger application.

C++ Library Wrapper

The `-W cpplib:libname` option produces the C++ library wrapper file. This option allows the inclusion of an arbitrary set of M-files into a library. The generated header file contains all of the entry points for all of the compiled M-functions.

Note You must generate a library wrapper file when calling any MATLAB Compiler generated code from a larger application.

Interfacing M-Code to C/C++ Code

In this section...

Overview

MATLAB Compiler supports calling arbitrary C/C++ functions from your M-code. To use this feature, provide an M-function stub that determines how the code will behave in M, and then provide an implementation of the body of the function in C or C++.

Code Proper Return Types From C and C++ Methods

When coding, keep in mind that LCC compilers can be more strict in enforcing `bool` return types from C and `void` returns from C++ than Microsoft compilers. To avoid potential problems, ensure all C methods you write (and reference from within M) return a `bool` return type indicating the status, and any C++ methods return `void`.

C Example

Suppose you have a C function that reads data from a measurement device. In M-code, you want to simulate the device by providing a sine wave output, so you provide a function that returns the measurement obtained from the device. For example, this C function, `measure_from_device()`, returns a `double`, which is the current measurement.

`collect.m` contains the M-code for the simulation of your application.

```
function collect

    y = zeros(1,100); % pre-allocate the matrix
    for i = 1:100
        y(i) = collect_one;
    end


function y = collect_one
    %#EXTERNAL
    persistent t;

    if (isempty(t))
        t = 0;
    else
        t = t+0.05;
    end
    y = sin(t);
```

To replace the implementation of the `collect_one` function with a C implementation, use the `%#external` pragma.

This pragma informs MATLAB Compiler that the function will be hand written and will not be generated from the M-code. This pragma affects only the single function in which it appears. Any M-function may contain this pragma (local, global, private, or method).

Compile the MATLAB code with the `%#external` pragma once to generate the header file *`function_name`*`_external.h`, where *`function_name`* is the name of the initial M-function containing the `%#external` pragma. This header file will contain the `extern` declaration of the function that you must provide. This function must conform to the same interface as code generated by MATLAB Compiler.

Note If you compile a program that contains the `%#external` pragma, you must explicitly pass each file that contains this pragma on the `mcc` command line.

MATLAB Compiler will generate the interface for any functions that contain the `%#external` pragma into a separate file called *`function_name`*`_external.h`. The C or C++ file generated by MATLAB

Compiler will include this header file to get the declaration of the function being provided.

In this example, place the pragma in the `collect_one` local function.

```
function collect

y = zeros(1, 100); % preallocate the matrix
for i = 1:100
   y(i) = collect_one;
end
disp (y)

function y = collect_one

%#external
persistent t;
if (isempty(t))
   t = 0;
end
t = t + 0.05;
y = sin(t);
```

When this file is compiled, MATLAB Compiler creates the additional header file `collect_one_external.h`, which contains the interface between MATLAB Compiler generated code and your code. In this example, it would contain:

```
extern bool mlxCollect_one(int nlhs, mxArray *plhs[],
                            int nrhs, mxArray *prhs[]);
```

Note The return type has changed from `void` to `bool` in MATLAB Compiler post-R13.

It is recommended that you include this header file when defining the function. This function could be implemented in this C file, `measure.c`, using the `measure_from_device()` function.

```
#include "collect_one_external.h"
#include <math.h>
```

```
extern double measure_from_device(void);

bool mlxCollect_one(int nlhs, mxArray *plhs[],
                    int nrhs, mxArray *prhs[])

{
   plhs[0] = mxCreateDoubleMatrix(1,1,mxREAL);
   *(mxGetPr(plhs[0])) = measure_from_device();
}

double measure_from_device(void)
{
   static double t = 0.0;
   t = t + 0.05;
   return sin(t);
  }
```

To generate the application, use

```
mcc -m collect.m measure.c
```

Note For information on the `mxArray`, see the External Interfaces documentation.

C++ Example

Suppose you have a C function that reads data from a measurement device. In M-code, you want to simulate the device by providing a sine wave output, so you provide a function that returns the measurement obtained from the device. For example, this C function, `measure_from_device()`, returns a `double`, which is the current measurement.

`collect.m` contains the M-code for the simulation of your application.

```
function collect

    y = zeros(1,100); % pre-allocate the matrix
    for i = 1:100
```

```
            y(i) = collect_one;
        end



    function y = collect_one
        %#EXTERNAL
        persistent t;

        if (isempty(t))
            t = 0;
        else
            t = t+0.05;
        end
        y = sin(t);
```

To replace the implementation of the `collect_one` function with a C implementation, use the `%#external` pragma.

This pragma informs MATLAB Compiler that the function will be hand written and will not be generated from the M-code. This pragma affects only the single function in which it appears. Any M-function may contain this pragma (local, global, private, or method).

Compile the MATLAB code with the `%#external` pragma once to generate the header file *`function_name`*`_external.h`, where *`function_name`* is the name of the initial M-function containing the `%#external` pragma. This header file will contain the `extern` declaration of the function that you must provide. This function must conform to the same interface as code generated by MATLAB Compiler.

Note If you compile a program that contains the `%#external` pragma, you must explicitly pass each file that contains this pragma on the `mcc` command line.

MATLAB Compiler will generate the interface for any functions that contain the `%#external` pragma into a separate file called *`function_name`*`_external.h`. The C or C++ file generated by MATLAB

Compiler will include this header file to get the declaration of the function being provided.

In this example, place the pragma in the `collect_one` local function.

```
function collect

y = zeros(1, 100); % preallocate the matrix
for i = 1:100
   y(i) = collect_one;
end
disp (y)

function y = collect_one

%#external
persistent t;
if (isempty(t))
   t = 0;
end
t = t + 0.05;
y = sin(t);
```

When this file is compiled, MATLAB Compiler creates the additional header file `collect_one_external.h`, which contains the interface between MATLAB Compiler generated code and your code. In this example, it would contain:

```
extern bool mlxCollect_one(int nlhs, mxArray *plhs[],
                           int nrhs, mxArray *prhs[]);
```

Note The return type has changed from `void` to `bool` in MATLAB Compiler post-R13.

It is recommended that you include this header file when defining the function. This function could be implemented in this C file, `measure.cpp`, using the `measure_from_device()` function.

```
#include "collect_one_external.h"
#include <math.h>
```

```
extern double measure_from_device(void);

bool mlxCollect_one(int nlhs, mxArray *plhs[],
                    int nrhs, mxArray *prhs[])

{
   plhs[0] = mxCreateDoubleMatrix(1,1,mxREAL);
   *(mxGetPr(plhs[0])) = measure_from_device();
}

double measure_from_device(void)
{
   static double t = 0.0;
   t = t + 0.05;
   return sin(t);
  }
```

To generate the application, use

```
mcc -m collect.m measure.cpp
```

Note For information on the `mxArray`, see the External Interfaces documentation.

Overriding Default CTF Archive Embedding Using the MCR Component Cache

As of R2008a, CTF data is automatically embedded directly in the C/C++, main and Winmain, shared libraries and standalones by default. In order to override this default functionality, you must compile using the option "-C Do Not Embed CTF Archive by Default" on page 12-29.

If you do not use the `mcc -C` option to specify that a separate CTF file be generated, you can add environment variables to specify various options, such as:

- Defining the location where you want the CTF archive to be extracted
- Adding diagnostic error printing options that can be used when extracting the CTF, for troubleshooting purposes
- Tuning the MCR component cache size for performance reasons.

Use the following environment variables to change these settings.

Environment Variable	Purpose	Notes
MCR_CACHE_ROOT	When set to the location of where you want the CTF archive to be extracted, this variable overrides the default per-user component cache location.	N/A

Environment Variable	Purpose	Notes
MCR_CACHE_VERBOSE	When set, this variable prints details about the component cache for diagnostic reasons. This can be very helpful if problems are encountered during CTF archive extraction.	N/A
MCR_CACHE_SIZE	When set, this variable overrides the default component cache size.	The initial limit for this variable is 32M (megabytes). This may, however, be changed after you have set the variable the first time. Edit the file `.max_size`, which resides in the file designated by running the `mcrcachedir` command, with the desired cache size limit.

Note If you run `mcc` specifying conflicting wrapper and target types, the CTF will not be embedded into the generated component. For example, if you run:

```
mcc -W lib:myLib -T link:exe test.m test.c
```

the generated `test.exe` will not have the CTF embedded in it, as if you had specified a `-C` option to the command line.

Using Pragmas

In this section...

Using feval

In standalone C and C++ modes, the pragma

```
%#function <function_name-list>
```

informs MATLAB Compiler that the specified function(s) should be included in the compilation, whether or not the MATLAB Compiler dependency analysis detects it. Without this pragma, the MATLAB Compiler dependency analysis will not be able to locate and compile all M-files used in your application. This pragma adds the top-level function as well as all the subfunctions in the file to the compilation.

You cannot use the `%#function` pragma to refer to functions that are not available in M-code.

Example: Using %#function

A good coding technique involves using `%#function` in your code wherever you use `feval` statements. This example shows how to use this technique to help MATLAB Compiler find the appropriate files during compile time, eliminating the need to include all the files on the command line.

```
function ret = mywindow(data,filterName)
%MYWINDOW Applies the window specified on the data.
%

% Get the length of the data.
N= length(data);

% List all the possible windows.
% Note the list of functions in the following function pragma is
% on a single line of code.
```

```
%#function bartlett, barthannwin, blackman, blackmanharris,
bohmanwin, chebwin, flattopwin, gausswin, hamming, hann, kaiser,
nuttallwin, parzenwin, rectwin, tukeywin, triang

window = feval(filterName,N);
% Apply the window to the data.
ret = data.*window;
```

Using mxArray

For full documentation on the mxArray API, see “MX Array Manipulation” in *MATLAB C and Fortran API Reference*.

For a complete description of data types used with mxArray, see “MATLAB Data” in *MATLAB External Interfaces*.

For general information on data handling, see *MATLAB External Interfaces*.

Script Files

Converting Script M-Files to Function M-Files

MATLAB provides two ways to package sequences of MATLAB commands:

- Function M-files
- Script M-files

Some things to remember about script and function M-files:

- Variables used inside function M-files are local to that function; you cannot access these variables from the MATLAB interpreter's workspace unless they are passed back by the function. By contrast, variables used inside script M-files are shared with the caller's workspace; you can access these variables from the MATLAB interpreter command line.
- Variables that are declared as persistent in a MEX-file may not retain their values through multiple calls from MATLAB.

MATLAB Compiler can compile script M-files or can compile function M-files that call scripts. You can either specify an script M-file explicitly on the `mcc` command line, or you can specify function M-files that include scripts.

Converting a script into a function is usually fairly simple. To convert a script to a function, simply add a `function` line at the top of the M-file.

Running this script M-file from a MATLAB session creates variables `m` and `t` in your MATLAB workspace browser.

If desired, convert this script M-file into a function M-file by simply adding a `function` header line.

```
function houdini(sz)
```

```
m = magic(sz); % Assign magic square to m.
t = m .^ 3;    % Cube each element of m.
disp(t)        % Display the value of t.
```

MATLAB Compiler can now compile `houdini.m`. However, because this makes `houdini` a function, running the function no longer creates variables `m` and `t` in the MATLAB workspace browser. If it is important to have `m` and `t` accessible from the MATLAB workspace browser, you can change the beginning of the function to

```
function [m,t] = houdini(sz)
```

The function now returns the values of `m` and `t` to its caller.

Including Script Files in Deployed Applications

Compiled applications consist of two layers of M-files. The top layer is the interface layer and consists of those functions that are directly accessible from C or C++.

In standalone applications, the interface layer consists of only the main M-file. In libraries, the interface layer consists of the M-files specified on the `mcc` command line.

The second layer of M-files in compiled applications includes those M-files that are called by the functions in the top layer. You can include scripts in the second layer, but not in the top layer.

For example, you could produce an application from the `houdini.m` script M-file by writing a new M-function that calls the script, rather than converting the script into a function.

```
function houdini_fcn
 houdini;
```

To produce the `houdini_fcn` , which will call the `houdini.m` script M-file, use

```
mcc -m houdini_fcn
```

Compiler Tips

In this section...

Calling Built-In Functions from C or C++

To enable a C or C++ program to call a built-in function directly, you must write an M-file wrapper around each built-in function you want to access outside of MATLAB. This is necessary because there are no C callable interfaces to built-in functions. For example, to use the `magic` function in a deployed application, you can use this M-file:

```
function m = magicsquare(n)
%MAGICSQUARE generates a magic square matrix of size specified
%    by the input parameter n.

% Copyright 2003 The MathWorks, Inc.

if (ischar(n))
    n=str2num(n);
end
m = magic(n);
```

Calling a Function from the Command Line

You can make a MATLAB function into a standalone that is directly callable from the system command line. All the arguments passed to the MATLAB function from the system command line are strings. Two techniques to work with these functions are:

- Modify the original MATLAB function to test each argument and convert the strings to numbers.
- Write a wrapper MATLAB function that does this test and then calls the original MATLAB function.

  For example:

  ```
  function x=foo(a, b)
   if (isstr(a)), a = str2num(a), end;
   if (isstr(b)), b = str2num(b), end;

  % The rest of your M-code here...
  ```

  You only do this if your function expects numeric input. If your function expects strings, there is nothing to do because that's the default from the command line.

Using MAT-Files in Deployed Applications

To use a MAT-file in a deployed application, use the MATLAB Compiler `-a` option to include the file in the CTF archive. For more information on the `-a` option, see "-a Add to Archive" on page 12-26.

Compiling a GUI That Contains an ActiveX Control

When you save a GUI that contains ActiveX components, GUIDE creates a file in the current directory for each such component. The file name consists of the name of the GUI followed by an underscore (_) and `activex`*n*, where *n* is a sequence number. For example, if the GUI is named `ActiveXcontrol` then the file name would be `ActiveXcontrol_activex1`. The file name does not have an extension.

If you use MATLAB Compiler `mcc` command to compile a GUIDE-created GUI that contains an ActiveX component, you must use the `-a` option to add the ActiveX control files that GUIDE saved in the current directory to the CTF archive. Your command should be similar to

```
mcc -m mygui -a mygui_activex1
```

where `mygui_activex1` is the name of the file. If you have more than one such file, use a separate `-a` option for each file.

Debugging MATLAB Compiler Generated Executables

As of MATLAB Compiler 4, it is no longer possible to debug your entire program using a C/C++ debugger; most of the application is M-code, which can only be debugged in MATLAB. Instead, run your code in MATLAB and verify that it produces the desired results. Then you can compile it. The compiled code will produce the same results.

Deploying Applications That Call the Java Native Libraries

If your application interacts with Java, you need to specify the search path for native method libraries by editing `librarypath.txt` and deploying it.

1. Copy `librarypath.txt` from *`matlabroot`*`/toolbox/local/librarypath.txt`.

2. Place `librarypath.txt` in `<mcr_root>/<ver>/toolbox/local`.

   `<mcr_root>` refers to the complete path where the MCR library archive files are installed on your machine.

3. Edit `librarypath.txt` by adding the directory that contains the native library that your application's Java code needs to load.

Locating .fig Files in Deployed Applications

MATLAB Compiler locates `.fig` files automatically when there is an M-file with the same name as the `.fig` file in the same directory. If the `.fig` file does not follow this rule, it must be added with the `-a` option.

Blocking Execution of a Console Application That Creates Figures and Terminating Figures by Force

- "Blocking Execution of a Console Application with the mclWaitForFiguresToDie Method" on page 5-31
- "Terminating Figures by Force with the mclKillAllFigures Method" on page 5-32

Blocking Execution of a Console Application with the mclWaitForFiguresToDie Method

The purpose of `mclWaitForFiguresToDie` is to block execution of a calling program as long as figures created in encapsulated M-code are displayed. `mclWaitForFiguresToDie` takes no arguments. Your application can call `mclWaitForFiguresToDie` any time during execution. Typically you use `mclWaitForFiguresToDie` when:

- There are one or more figures you want to remain open.
- The function that displays the graphics requires user input before continuing.
- The function that calls the figures was called from `main()` in a console program.

When `mclWaitForFiguresToDie` is called, execution of the calling program is blocked if any figures created by the calling object remain open.

Both MATLAB Builder NE and MATLAB Builder JA use `mclWaitForFiguresToDie` through the use of wrapper methods. See "Blocking Execution of a Console Application that Creates Figures" in the MATLAB Builder NE User's Guide and "Blocking Execution of a Console Application that Creates Figures" in the MATLAB Builder JA User's Guide for more details and code fragment examples.

Caution Use caution when calling the `mclWaitForFiguresToDie` function. Calling this function from an interactive program like Excel can hang the application. This function should be called *only* from console-based programs.

Terminating Figures by Force with the mclKillAllFigures Method

`mclKillAllFigures` finds all open figures and deletes them. This function uses the same internal algorithm to locate open figures as `mclWaitForFiguresToDie`. The published signature is:

```
void mclKillAllFigures(HMCRINSTANCE inst)
```

Typically you use `mclKillAllFigures` when:

- You need to kill figures that are being displayed as the result of a programming problem, such as an endless loop.
- You want to ensure all figures are closed before the execution of another application.

Example: Terminating and Deleting Open Figures Using mclKillAllFigures. In this example, `mclKillAllFigures` is used to terminate and delete three figures displayed by the shared library calls `showknot()`, `showpeak()`, and `showbottle()` using three methods, all of which have the same result of terminating all figures (knot, peak, and bottle).

```
showknot();
showpeak();
showbottle();
mclKillAllFigures((HMCRINSTANCE)0);

showknot();
showpeak();
showbottle();
mclKillAllFigures(0);

showknot();
showpeak();
showbottle();
mclKillAllFigures(NULL);
```

Passing Arguments to and from a Standalone Application

To pass input arguments to a MATLAB Compiler generated standalone application, you pass them just as you would to any console-based application.

For example, to pass a file called `helpfile` to the compiled function called `filename`, use

```
filename helpfile
```

To pass numbers or letters (e.g., 1, 2, and 3), use

```
filename 1 2 3
```

Do not separate the arguments with commas.

To pass matrices as input, use

```
filename "[1 2 3]" "[4 5 6]"
```

You have to use the double quotes around the input arguments if there is a space in it. The calling syntax is similar to the `dos` command. For more information, see the MATLAB `dos` command.

The things you should keep in mind for your M-file before you compile are:

- The input arguments you pass to your application from a system prompt are considered as string input. If, in your M-code before compilation, you are expecting the data in different format, say double, you will need to convert the string input to the required format. For example, you can use `str2num` to convert the string input to numerical data. You can determine at run time whether or not to do this by using the `isdeployed` function. If your M-file expects numeric inputs in MATLAB, the code can check whether it is being run as a standalone application. For example:

  ```
  function myfun (n1, n2)
  if (isdeployed)
   n1 = str2num(n1);
   n2 = str2num(n2);
  end
  ```

- You cannot return back values from your standalone application to the user. The only way to return values from compiled code is to either display it on the screen or store it in a file. To display your data on the screen, you either need to unsuppress (do not use semicolons) the commands whose results yield data you want to return to the screen or, use the `disp` command to display the value. You can then redirect these outputs to other applications using output redirection (> operator) or pipes (only on UNIX systems).

Passing Arguments to a Double-Clickable Application

On Windows, if you want to run the standalone application by double-clicking it, you can create a batch file that calls this standalone application with the specified input arguments. Here is an example of the batch file:

```
rem main.bat file that calls sub.exe with input parameters
sub "[1 2 3]" "[4 5 6]"
@echo off
pause
```

The last two lines of code keep your output on the screen until you press a key. If you save this file as `main.bat`, you can run your code with the specified arguments by double-clicking the `main.bat` icon.

Using Graphical Applications in Shared Library Targets

When deploying a GUI as a shared library to a C/C++ application, use `mclWaitForFiguresToDie` to display the GUI until it is explicitly terminated.

Using the VER Function in a Compiled MATLAB Application

When you use the `VER` function in a compiled MATLAB application, it will perform with the same functionality as if you had called it from MATLAB. However, be aware that when using `VER` in a compiled MATLAB application, only version information for toolboxes which the compiled application uses will be displayed.

Standalone Applications

This chapter describes how to use MATLAB Compiler to code and build standalone applications. You can distribute standalone applications to users who do not have MATLAB software on their systems.

Introduction

Suppose you want to create an application that calculates the rank of a large magic square. One way to create this application is to code the whole application in C or C++; however, this would require writing your own magic square, rank, and singular value routines. An easier way to create this application is to write it as one or more M-files, taking advantage of the power of MATLAB and its tools.

You can create MATLAB applications that take advantage of the mathematical functions of MATLAB, yet do not require that end users own MATLAB. Standalone applications are a convenient way to package the power of MATLAB and to distribute a customized application to your users.

The source code for standalone C applications consists either entirely of M-files or some combination of M-files, MEX-files, and C or C++ source code files.

MATLAB Compiler takes your M-files and generates C source code functions that allow your M-files to be invoked from outside of interactive MATLAB. After compiling this C source code, the resulting object file is linked with the run-time libraries. A similar process is used to create C++ standalone applications.

You can call MEX-files from MATLAB Compiler generated standalone applications. The MEX-files will then be loaded and called by the standalone code.

C Standalone Application Target

In this section...

Compiling the Application

This example takes an M-file, `magicsquare.m`, and creates a standalone C application, `magicsquare`.

1 Copy the file `magicsquare.m` from

```
matlabroot/extern/examples/compiler
```

to your work directory.

2 To compile the M-code, use

```
mcc -mv magicsquare.m
```

The `-m` option tells MATLAB Compiler (`mcc`) to generate a C standalone application. The `-v` option (verbose) displays the compilation steps throughout the process and helps identify other useful information such as which third-party compiler is used and what environment variables are referenced.

This command creates the standalone application called `magicsquare` and additional files. The Windows platform appends the `.exe` extension to the name. See the table in "Standalone Executable" on page 3-6 for the complete list of files created.

Testing the Application

These steps test your standalone application on your development machine.

Note Testing your application on your development machine is an important step to help ensure that your application is compilable. To verify that your application compiled properly, you must test all functionality that is available with the application. If you receive an error message similar to `Undefined function` or `Attempt to execute script` *`script_name`* `as a function`, it is likely that the application will not run properly on deployment machines. Most likely, your CTF archive is missing some necessary functions. Use `-a` to add the missing functions to the archive and recompile your code.

---

1 Update your path as follows:

Windows. Add the following directory to your path.

```
matlabroot\bin\win32
```

UNIX. Add the following platform-specific directories to your dynamic library path.

Note For readability, the following commands appear on separate lines, but you must enter each `setenv` command on one line.

Linux

```
setenv LD_LIBRARY_PATH
 matlabroot/sys/os/glnx86:
 matlabroot/bin/glnx86:
 matlabroot/sys/java/jre/glnx86/jre/lib/i386/native_threads:
 matlabroot/sys/java/jre/glnx86/jre/lib/i386/server:
 matlabroot/sys/java/jre/glnx86/jre/lib/i386:
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Solaris 64

```
setenv LD_LIBRARY_PATH
/usr/lib/lwp:
matlabroot/sys/os/sol64:
matlabroot/bin/sol64:
```

```
matlabroot/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/native_threads:
matlabroot/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/server:
matlabroot/sys/java/jre/sol64/jre1.5.0/lib/sparcv9:
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Linux x86-64

```
setenv LD_LIBRARY_PATH
 matlabroot/sys/os/glnxa64:
 matlabroot/bin/glnxa64:
 matlabroot/extern/lib/glnxa64:
 matlabroot/sys/java/jre/glnxa64/jre/lib/amd64/native_threads:
 matlabroot/sys/java/jre/glnxa64/jre/lib/amd64/server:
 matlabroot/sys/java/jre/glnxa64/jre/lib/amd64:
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Mac OS X

```
setenv DYLD_LIBRARY_PATH
 matlabroot/bin/mac:
 matlabroot/sys/os/mac:
 /System/Library/Frameworks/JavaVM.framework/JavaVM:
 /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Intel Mac (Maci)

```
setenv DYLD_LIBRARY_PATH
  matlabroot/bin/maci:
  matlabroot/sys/os/maci:
  /System/Library/Frameworks/JavaVM.framework/JavaVM:
  /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Note If you are running a version of Intel Mac later than 10.3, use the `bsh`, rather than the `csh`, shell.

---

2 Run the standalone application from the system prompt (shell prompt on UNIX or DOS prompt on Windows) by typing the application name.

```
magicsquare.exe 4              (On Windows)
magicsquare 4                  (On UNIX)
```

The results are:

```
ans =
    16     2     3    13
     5    11    10     8
     9     7     6    12
     4    14    15     1
```

Deploying the Application

You can distribute a MATLAB Compiler generated standalone application to any target machine that has the same operating system as the machine on which the application was compiled.

For example, if you want to deploy an application to a Windows machine, you must use MATLAB Compiler to build the application on a Windows machine. If you want to deploy the same application to a UNIX machine, you must use MATLAB Compiler on the same UNIX platform and completely rebuild the application. To deploy an application to multiple platforms requires MATLAB and MATLAB Compiler licenses on all the desired platforms.

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11 for more details including complete file paths to all install programs.

Windows

Gather and package the following files and distribute them to the deployment machine.

Component	Description
`MCRInstaller.exe`	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform.
`magicsquare`	Application; `magicsquare.exe` for Windows

UNIX

Distribute and package your standalone application on UNIX by packaging the following files and distributing them to the deployment machine.

Component	Description
`MCRInstaller.bin`	MATLAB Compiler Runtime library archive; platform-dependent file that must correspond to the end user's platform
`magicsquare`	Application

Running the Application

These steps describe the process that end users must follow to install and run the application on their machines.

Preparing Your Machines

1. Install the MCR by running the `MCRInstaller` in a directory. For example, run `MCRInstaller.exe` in `C:\MCR`. For more information on running the MCR Installer utility, see"Working with the MCR" on page 4-19 and "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11.

2. Add the following directory to your system path:

Note For readability, the following commands appear on separate lines, but you must enter each `setenv` command on one line.

On Windows XP, this directory is automatically added to your path.

Windows

```
<mcr_root>\<ver>\runtime\win32
```

Linux

```
setenv LD_LIBRARY_PATH
 <mcr_root>/<ver>/runtime/glnx86:
 <mcr_root>/<ver>/sys/os/glnx86:
 <mcr_root>/<ver>/sys/java/jre/glnx86/jre/lib/i386/native_threads:
 <mcr_root>/<ver>/sys/java/jre/glnx86/jre/lib/i386/server:
 <mcr_root>/<ver>/sys/java/jre/glnx86/jre/lib/i386:
setenv XAPPLRESDIR <mcr_root>/<ver>/X11/app-defaults
```

Solaris 64

```
setenv LD_LIBRARY_PATH
/usr/lib/lwp:
<mcr_root>/<ver>/runtime/sol64:
<mcr_root>/<ver>/sys/os/sol64:
<mcr_root>/<ver>/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/native_threads:
<mcr_root>/<ver>/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/server:
<mcr_root>/<ver>/sys/java/jre/sol64/jre1.5.0/lib/sparcv9:
setenv XAPPLRESDIR <mcr_root>/<ver>/X11/app-defaults
```

Linux x86-64

```
setenv LD_LIBRARY_PATH
 <mcr_root>/<ver>/runtime/glnxa64:
 <mcr_root>/<ver>/sys/os/glnxa64:
 <mcr_root>/<ver>/sys/java/jre/glnxa64/jre/lib/amd64/native_threads:
 <mcr_root>/<ver>/sys/java/jre/glnxa64/jre/lib/amd64/server:
 <mcr_root>/<ver>/sys/java/jre/glnxa64/jre/lib/amd64:
setenv XAPPLRESDIR <mcr_root>/<ver>/X11/app-defaults
```

Mac OS X

```
setenv DYLD_LIBRARY_PATH
 <mcr_root>/<ver>/runtime/mac:
 <mcr_root>/<ver>/sys/os/mac:
 <mcr_root>/<ver>/bin/mac:
 /System/Library/Frameworks/JavaVM.framework/JavaVM:
 /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR <mcr_root>/<ver>/X11/app-defaults
```

Intel Mac (Maci)

```
setenv DYLD_LIBRARY_PATH
   <mcr_root>/version/runtime/maci:
   <mcr_root>/version/sys/os/maci:
   <mcr_root>/version/bin/maci:
   /System/Library/Frameworks/JavaVM.framework/JavaVM:
   /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR <mcr_root>/version/X11/app-defaults
```

Note If you are running a version of Intel Mac later than 10.3, use the `bsh`, rather than the `csh`, shell.

Caution There is a limitation regarding directories on your path. If the target machine has a MATLAB installation, the `<mcr_root>` directories must be first on the path to run the deployed application. To run MATLAB, the *`matlabroot`* directories must be first on the path. This restriction only applies to configurations involving an installed MCR and an installed MATLAB on the same machine.

Executing the Application

Run the `magicsquare` standalone application from the system prompt and provide a number representing the size of the desired magic square, for example, 4.

```
magicsquare 4
```

The results are displayed as:

```
ans =
    16     2     3    13
     5    11    10     8
     9     7     6    12
     4    14    15     1
```

Note Input arguments you pass to and from a system prompt are treated as string input and you need to consider that in your application. For more information, see "Passing Arguments to and from a Standalone Application" on page 5-32.

Note Before executing your MATLAB Compiler generated executable, set the `LD_PRELOAD` environment variable to `/lib/libgcc_s.so.1`.

Coding with M-Files Only

In this section...

M-File Advantages

One way to create a standalone application is to write all the source code in one or more M-files or MEX-files as in the previous magic square example. Coding an application with M allows you to take advantage of the MATLAB interactive development environment. Once the M-file version of your program works properly, compile the code and build it into a standalone application.

Example

Consider a simple application whose source code consists of two M-files, `mrank.m` and `main.m`. This example generates C code from your M-files.

mrank.m

`mrank.m` returns a vector of integers, `r`. Each element of `r` represents the rank of a magic square. For example, after the function completes, `r(3)` contains the rank of a 3-by-3 magic square.

```
function r = mrank(n)
r = zeros(n,1);
for k = 1:n
   r(k) = rank(magic(k));
end
```

In this example, the line `r = zeros(n,1)` preallocates memory to help the performance of MATLAB Compiler.

main.m

`main.m` contains a "main routine" that calls `mrank` and then prints the results.

```
function main
r = mrank(5)
```

Compiling the Example

To compile these functions into code that can be built into a standalone application, invoke MATLAB Compiler.

```
mcc -m main mrank
```

The `-m` option causes MATLAB Compiler to generate C source code suitable for standalone applications. For example, MATLAB Compiler generates C source code files `main_main.c` and `main_mcc_component_data.c`. `main_main.c` contains a C function named `main`; `main_mcc_component_data.c` contains data needed by the MCR to run the application.

To build an application, you can use `mbuild` to compile and link these files. Or, you can automate the entire build process (invoke MATLAB Compiler on both M-files, use `mbuild` to compile the files with your ANSI C compiler, and link the code) by using the command

```
mcc -m main mrank
```

If you need to combine other code with your application (Fortran, for example, a language not supported byMATLAB Compiler), or if you want to build a makefile that compiles your application, you can use the command

```
mcc -mc main mrank
```

The `-c` option inhibits invocation of `mbuild`. You will probably need to examine the verbose output of `mbuild` to determine how to set the compiler options in your makefile. Run

```
mcc -mv main mrank
```

to see the switches and options that `mbuild` uses on your platform.

Mixing M-Files and C or C++

In this section...

Examples Overview

The examples in this section illustrate how to mix M-files and C or C++ source code files:

- The first example is a simple application that mixes M-files and C code.
- The second example illustrates how to write C code that calls a compiled M-file.

One way to create a standalone application is to code some of it as one or more function M-files and to code other parts directly in C or C++. To write a standalone application this way, you must know how to do the following:

- Call the external C or C++ functions generated by MATLAB Compiler.
- Handle the results these C or C++ functions return.

Note If you include compiled M-code into a larger application, you must produce a library wrapper file even if you do not actually create a separate library. For more information on creating libraries, see Chapter 7, "Libraries".

For more information on mxArray, see "Using mxArray" on page 5-25.

Simple Example

This example involves mixing M-files and C code. Consider a simple application whose source code consists of `mrank.m`, `mrankp.c`, `main_for_lib.c`, and `main_for_lib.h`.

mrank.m

`mrank.m` contains a function that returns a vector of the ranks of the magic squares from 1 to n.

```
function r = mrank(n)
r = zeros(n,1);
for k = 1:n
   r(k) = rank(magic(k));
end
```

Copy `mrank.m`, `printmatrix.m`, `mrankp.c`, `main_for_lib.c`, and `main_for_lib.h` into your current directory.

Build Process

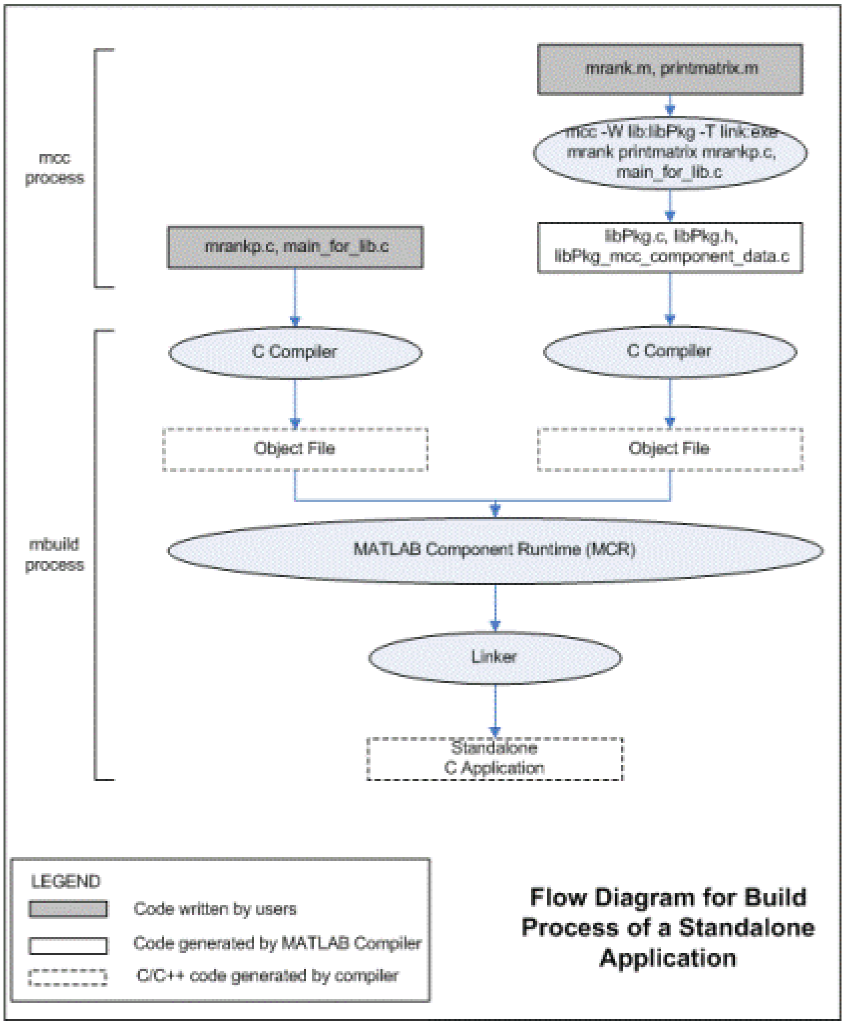
The steps needed to build this standalone application are:

1. Compile the M-code.
2. Generate the library wrapper file.
3. Create the binary.

To perform these steps, enter the following on a single line:

```
mcc -W lib:libPkg -T link:exe mrank printmatrix mrankp.c
main_for_lib.c
```

The following flow diagram shows the mixing of M-files and C-files that forms this sample standalone application. The top part of the diagram shows the `mcc` process and the lower part shows the `mbuild` process.


mcc process
mbuild process
mrank.m, printmatrix.m
mcc -W lib:libPkg -T link:exe mrank printmatrix mrankp.c, main_for_lib.c
mrankp.c, main_for_lib.c
libPkg.c, libPkg.h, libPkg_mcc_component_data.c
C Compiler
C Compiler
Object File
Object File
MATLAB Component Runtime (MCR)
Linker
Standalone C Application
LEGEND
Code written by users
Code generated by MATLAB Compiler
C/C++ code generated by compiler
Flow Diagram for Build Process of a Standalone Application

MATLAB Compiler generates the following C source code files:

- `libPkg.c`
- `libPkg.h`
- `libPkg_mcc_component_data.c`

This command invokes `mbuild` to compile the resulting MATLAB Compiler generated source files with the existing C source files (`mrankp.c` and `main_for_lib.c`) and link against the required libraries.

MATLAB Compiler provides two different versions of `mrankp.c` in the *`matlabroot`*`/extern/examples/compiler` directory:

- `mrankp.c` contains a POSIX-compliant `main` function. `mrankp.c` sends its output to the standard output stream and gathers its input from the standard input stream.
- `mrankwin.c` contains a Windows version of `mrankp.c`.

mrankp.c

The code in `mrankp.c` calls `mrank` and outputs the values that `mrank` returns.

```
/*
 * MRANKP.C
 * "Posix" C main program
 * Calls mlfMrank, obtained by using MCC to compile mrank.m.
 *
 * $Revision: 1.1.4.48 $
 *
 */

#include <stdio.h>
#include <math.h>
#include "libPkg.h"

main( int argc, char **argv )
{
    mxArray *N;        /* Matrix containing n. */
    mxArray *R = NULL; /* Result matrix. */
    int      n;        /* Integer parameter from command line.*/

    /* Get any command line parameter. */
    if (argc >= 2) {
        n = atoi(argv[1]);
    } else {
        n = 12;
    }
    mclInitializeApplication(NULL,0);
    libPkgInitialize();/* Initialize library of M-Functions */

    /* Create a 1-by-1 matrix containing n. */
    N = mxCreateDoubleScalar(n);

    /* Call mlfMrank, the compiled version of mrank.m. */
    mlfMrank(1, &R, N);

    /* Print the results. */
    mlfPrintmatrix(R);

    /* Free the matrices allocated during this computation. */
    mxDestroyArray(N);
    mxDestroyArray(R);

    libPkgTerminate(); /* Terminate library of M-functions */
    mclTerminateApplication();
}
```

Explanation of mrankp.c

The heart of `mrankp.c` is a call to the `mlfMrank` function. Most of what comes before this call is code that creates an input argument to `mlfMrank`. Most of what comes after this call is code that displays the vector that `mlfMrank` returns. First, the code must initialize the MCR and the generated `libPkg` library.

```
mclInitializeApplication(NULL,0);
libPkgInitialize(); /* Initialize the library of M-Functions */
```

To understand how to call `mlfMrank`, examine its C function header, which is

```
void mlfMrank(int nargout, mxArray** r, mxArray* n);
```

According to the function header, `mlfMrank` expects one input parameter and returns one value. All input and output parameters are pointers to the `mxArray` data type. (See the External Interfaces documentation for details on the `mxArray` data type.)

To create and manipulate `mxArray *` variables in your C code, you can call the `mx` routines described in the External Interfaces documentation. For example, to create a 1-by-1 `mxArray *` variable named `N` with real data, `mrankp` calls `mxCreateDoubleScalar`.

```
N = mxCreateDoubleScalar(n);
```

`mrankp` can now call `mlfMrank`, passing the initialized `N` as the sole input argument.

```
R = mlfMrank(1,&R,N);
```

`mlfMrank` returns its output in a newly allocated `mxArray *` variable named `R`. The variable `R` is initialized to `NULL`. Output variables that have not been assigned to a valid `mxArray` should be set to `NULL`. The easiest way to display the contents of `R` is to call the `mlfPrintmatrix` function.

```
mlfPrintmatrix(R);
```

This function is defined in `Printmatrix.m`.

Finally, `mrankp` must free the heap memory allocated to hold matrices and call the termination functions.

```
mxDestroyArray(N);
mxDestroyArray(R);
libPkgTerminate();  /* Terminate the library of M-functions */
mclTerminateApplication();  /* Terminate the MCR */
```

Advanced C Example

This section provides an advanced example that illustrates how to write C code that calls a compiled M-file. Consider a standalone application whose source code consists of the files:

- `multarg.m`, which contains a function named `multarg`
- `multargp.c`, which contains C wrapper code that calls the C interface function for the M-code
- `printmatrix.m`, which contains the helper function to print a matrix to the screen

- `main_for_lib.c`, which contains one `main` function
- `main_for_lib.h`, which is the header for structures used in `main_for_lib.c` and `multargp.c`

`multarg.m` specifies two input parameters and returns two output parameters.

```
function [a,b] = multarg(x,y)
a = (x + y) * pi;
b = svd(svd(a));
```

The code in `multargp.c` calls `mlfMultarg` and then displays the two values that `mlfMultarg` returns.

```
#include <stdio.h>
#include <string.h>
#include <math.h>
#include "libMultpkg.h"

/*
 * Function prototype; MATLAB Compiler creates mlfMultarg
 * from multarg.m
 */

void PrintHandler( const char *text )
{
    printf(text);
}

int main( )   /* Programmer-written coded to call mlfMultarg */
{
#define ROWS  3
#define COLS  3
    mclOutputHandlerFcn PrintHandler;
    mxArray *a = NULL, *b = NULL, *x, *y;
    double  x_pr[ROWS * COLS] = {1, 2, 3, 4, 5, 6, 7, 8, 9};
    double  x_pi[ROWS * COLS] = {9, 2, 3, 4, 5, 6, 7, 8, 1};
    double  y_pr[ROWS * COLS] = {1, 2, 3, 4, 5, 6, 7, 8, 9};
    double  y_pi[ROWS * COLS] = {2, 9, 3, 4, 5, 6, 7, 1, 8};
    double *a_pr, *a_pi, value_of_scalar_b;
    /* Initialize with a print handler to tell mlfPrintMatrix
     * how to display its output.
     */
    mclInitializeApplication(NULL,0);
    libMultpkgInitializeWithHandlers(PrintHandler,PrintHandler);


    /* Create input matrix "x" */
    x = mxCreateDoubleMatrix(ROWS, COLS, mxCOMPLEX);
    memcpy(mxGetPr(x), x_pr, ROWS * COLS * sizeof(double));
    memcpy(mxGetPi(x), x_pi, ROWS * COLS * sizeof(double));

    /* Create input matrix "y" */
    y = mxCreateDoubleMatrix(ROWS, COLS, mxCOMPLEX);
    memcpy(mxGetPr(y), y_pr, ROWS * COLS * sizeof(double));
    memcpy(mxGetPi(y), y_pi, ROWS * COLS * sizeof(double));

    /* Call the mlfMultarg function. */
    mlfMultarg(2, &a, &b, x, y);

    /* Display the entire contents of output matrix "a". */
    mlfPrintmatrix(a);

    /* Display the entire contents of output scalar "b" */
    mlfPrintmatrix(b);

    /* Deallocate temporary matrices. */
    mxDestroyArray(a);
    mxDestroyArray(b);
    libMultpkgTerminate();
    mclTerminateApplication();
    return(0);
}
```

You can build this program into a standalone application by entering this command on a single line:

```
mcc -W lib:libMultpkg -T link:exe multarg printmatrix
multargp.c main_for_lib.c
```

The program first displays the contents of a 3-by-3 matrix a, and then displays the contents of scalar b.

```
     6.2832 +34.5575i  25.1327 +25.1327i  43.9823 +43.9823i
    12.5664 +34.5575i  31.4159 +31.4159i  50.2655 +28.2743i
    18.8496 +18.8496i  37.6991 +37.6991i  56.5487 +28.2743i

    143.4164
```

Explanation of This C Code

Invoking MATLAB Compiler on multarg.m generates the C function prototype.

```
  extern void mlfMultarg(int nargout, mxArray** a, mxArray** b,
  mxArray* x, mxArray* y);
```

This C function header shows two input arguments (mxArray* x and mxArray* y) and two output arguments (the return value and mxArray** b).

Use mxCreateDoubleMatrix to create the two input matrices (x and y). Both x and y contain real and imaginary components. The memcpy function initializes the components, for example:

```
  x = mxCreateDoubleMatrix(,ROWS, COLS, mxCOMPLEX);
  memcpy(mxGetPr(x), x_pr, ROWS * COLS * sizeof(double));
  memcpy(mxGetPi(y), x_pi ROWS * COLS * sizeof(double));
```

The code in this example initializes variable x from two arrays (x_pr and x_pi) of predefined constants. A more realistic example would read the array values from a data file or a database.

After creating the input matrices, main calls mlfMultarg.

```
  mlfMultarg(2, &a, &b, x, y);
```

The mlfMultarg function returns matrices a and b. a has both real and imaginary components; b is a scalar having only a real component. The program uses mlfPrintmatrix to output the matrices, for example:

```
  mlfPrintmatrix(a);
```

Libraries

This chapter describes how to use MATLAB Compiler to create libraries.

Introduction

You can use MATLAB Compiler to create C or C++ shared libraries (DLLs on Microsoft Windows) from your MATLAB algorithms. You can then write C or C++ programs that can call the MATLAB functions in the shared library, much like calling the functions from the MATLAB command line.

Addressing mwArrays Above the 2 GB Limit

In R2007b, you had to define `MX_COMPAT_32_OFF` in the `mbuild` step to address `MWArrays` above the 2 GB limit on 64-bit architectures. If you did not define `MX_COMPAT_32_OFF`, the compile time variable `MX_COMPAT_32` was defined for you, limiting you to using smaller arrays on all architectures.

In R2008a, the default definition of `MX_COMPAT_32` was removed, and large array support is now the default for both C and C++ code. This default may, in some cases, cause compiler warnings and errors. You can define `MX_COMPAT_32` in your `mbuild` step to return to the previously default behavior.

Code compiled with `MX_COMPAT_32` is *not* 64-bit aware. In addition, `MX_COMPAT_32` controls the behavior of some type definitions. For instance, when `MX_COMPAT_32` is defined, `mwSize` and `mwIndex` are defined to `int`s. When `MX_COMPAT_32` is not defined, `mwSize` and `mwIndex` are defined to `size_t`. This can lead to compiler warnings and errors with respect to signed and unsigned mismatches.

In R2008b, all support for MX_COMPAT_32 will be removed.

See Appendix C, "C++ Utility Library Reference", for detailed changes to `mwArray` classes and method signatures.

C Shared Library Target

In this section...

C Shared Library Wrapper

The C library wrapper option allows you to create a shared library from an arbitrary set of M-files on both Microsoft Windows and UNIX operating systems. MATLAB Compiler generates a wrapper file, a header file, and an export list. The header file contains all of the entry points for all of the compiled M-functions. The export list contains the set of symbols that are exported from a C shared library.

Note Even if you are not producing a shared library, you must use `-W lib` or `-W cpplib` when including any MATLAB Compiler generated code into a larger application.

Note `mclmcrrt.lib` is required for successful linking. For more information, see the MathWorks Support database and search for information on the MSVC shared library.

C Shared Library Example

This example takes several M-files and creates a C shared library. It also includes a standalone driver application to call the shared library.

Building the Shared Library

1 Copy the following files from *`matlabroot`*`/extern/examples/compiler` to your work directory:

```
matlabroot/extern/examples/compiler/addmatrix.m
matlabroot/extern/examples/compiler/multiplymatrix.m
matlabroot/extern/examples/compiler/eigmatrix.m
matlabroot/extern/examples/compiler/matrixdriver.c
```

Note `matrixdriver.c` contains the standalone application's `main` function.

2 To create the shared library, enter the following command on a single line:

```
mcc -B csharedlib:libmatrix addmatrix.m multiplymatrix.m
eigmatrix.m -v
```

The `-B csharedlib` option is a bundle option that expands into

```
-W lib:<libname> -T link:lib
```

The `-W lib:<libname>` option tells MATLAB Compiler to generate a function wrapper for a shared library and call it `libname`. The `-T link:lib` option specifies the target output as a shared library. Note the directory where the product puts the shared library because you will need it later on.

Writing the Driver Application

All programs that call MATLAB Compiler generated shared libraries have roughly the same structure:

1 Declare variables and process/validate input arguments.

2 Call `mclInitializeApplication`, and test for success. This function sets up the global MCR state and enables the construction of MCR instances.

3 Call, once for each library, `<libraryname>Initialize`, to create the MCR instance required by the library.

4 Invoke functions in the library, and process the results. (This is the main body of the program.)

Note If your driver application displays MATLAB figure windows, you should include a call to `mclWaitForFiguresToDie(NULL)` before calling the `Terminate` functions and `mclTerminateApplication` in the following two steps.

5. Call, once for each library, `<libraryname>Terminate`, to destroy the associated MCR.
6. Call `mclTerminateApplication` to free resources associated with the global MCR state.
7. Clean up variables, close files, etc., and exit.

This example uses `matrixdriver.c` as the driver application.

Note You must call `mclInitializeApplication` once at the beginning of your driver application. You must make this call before calling any other MathWorks functions or when linking to a MATLAB library such as `mclmcrrt.lib` (for example, before accessing an `MWArray`). See “Calling a Shared Library” on page 7-10 for complete details on using a MATLAB Compiler generated library in your application.

Compiling the Driver Application

To compile the driver code, `matrixdriver.c`, you use your C/C++ compiler. Execute the following `mbuild` command that corresponds to your development platform. This command uses your C/C++ compiler to compile the code.

```
mbuild matrixdriver.c libmatrix.lib    (Windows)
mbuild matrixdriver.c -L. -lmatrix -I. (UNIX)
```

Note This command assumes that the shared library and the corresponding header file created from step 2 are in the current working directory.

On UNIX, if this is not the case, replace the "`.`" (dot) following the `-L` and `-I` options with the name of the directory that contains these files, respectively.

On Windows, if this is not the case, specify the full path to `libmatrix.lib`, and use a `-I` option to specify the directory containing the header file.

This generates a standalone application, `matrixdriver.exe`, on Windows, and `matrixdriver`, on UNIX.

Difference in the Exported Function Signature. The interface to the `mlf` functions generated by MATLAB Compiler from your M-file routines has changed from earlier versions of the product. The generic signature of the exported `mlf` functions is

- M-functions with no return values

```
bool MW_CALL_CONV mlf<function-name>(<list_of_input_variables>);
```

- M-functions with at least one return value

```
bool MW_CALL_CONV mlf<function-name>(int number_of_return_values,
<list_of_pointers_to_return_variables>,
<list_of_input_variables>);
```

Refer to the header file generated for your library for the exact signature of the exported function. For example, in the library created in the previous section, the signature of the exported addmatrix function is

```
void mlfAddmatrix(int nlhs,mxArray **a,mxArray *a1,mxArray *a2);
```

Testing the Driver Application

These steps test your standalone driver application and shared library on your development machine.

Note Testing your application on your development machine is an important step to help ensure that your application is compilable. To verify that your application compiled properly, you must test all functionality that is available with the application. If you receive an error message similar to `Undefined function` or `Attempt to execute script` *`script_name`* `as a function`, it is likely that the application will not run properly on deployment machines. Most likely, your CTF archive is missing some necessary functions. Use `-a` to add the missing functions to the archive and recompile your code.

---

1 To run the standalone application, add the directory containing the shared library that was created in step 2 in "Building the Shared Library" on page 7-4to your dynamic library path.

2 Update the path for your platform by following the instructions in "Developing and Testing Components on a Development Machine" on page 1-11.

3 Run the driver application from the prompt (DOS prompt on Windows, shell prompt on UNIX) by typing the application name.

```
matrixdriver.exe            (On Windows)
matrixdriver                (On UNIX)
```

The results are displayed as

```
The value of added matrix is:
2.00  8.00  14.00
4.00  10.00  16.00
6.00  12.00  18.00

The value of the multiplied matrix is:
30.00  66.00  102.00
36.00  81.00  126.00
42.00  96.00  150.00

The eigenvalues of the first matrix are:
16.12  -1.12  -0.00
```

Creating Shared Libraries from C with mbuild

`mbuild` can also create shared libraries from C source code. If a file with the extension `.exports` is passed to `mbuild`, a shared library is built. The `.exports` file must be a text file, with each line containing either an exported symbol name, or starting with a `#` or `*` in the first column (in which case it is treated as a comment line). If multiple `.exports` files are specified, all symbol names in all specified `.exports` files are exported.

Deploying Standalone Applications That Call MATLAB Compiler Based Shared Libraries

Gather and package the following files and distribute them to the deployment machine.

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11 for more details including complete file paths to all install programs.

Component	Description
`MCRInstaller.exe` (Windows)	Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform.
`matrixdriver`	Application; `matrixdriver.exe` for Windows.
`libmatrix`	Shared library; extension varies by platform. Extensions are: • Windows — `.dll` • Solaris, Linux, Linux x86-64 — `.so` • Mac OS X — `.dylib`

Note You can distribute a MATLAB Compiler generated standalone application to any target machine that has the same operating system as the machine on which the application was compiled. If you want to deploy the same application to a different platform, you must use MATLAB Compiler on the different platform and completely rebuild the application.

Deploying Shared Libraries to Be Used with Other Projects

To distribute the shared library for use with an external application, you need to distribute the following.

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11 for more details including complete file paths to all install programs.

Component	Description
`MCRInstaller.exe`	(Windows) Self-extracting MATLAB Compiler Runtime library utility; platform-dependent file that must correspond to the end user's platform
`libmatrix`	Shared library; extension varies by platform, for example, `DLL` on Windows
`libmatrix.h`	Library header file

Calling a Shared Library

At run-time, there is an MCR instance associated with each individual shared library. Consequently, if an application links against two MATLAB Compiler generated shared libraries, there will be two MCR instances created at run-time.

You can control the behavior of each MCR instance by using MCR options. The two classes of MCR options are global and local. Global MCR options are identical for each MCR instance in an application. Local MCR options may differ for MCR instances.

To use a shared library, you must use these functions:

- `mclInitializeApplication`
- `mclTerminateApplication`

You may also have a need to use `mclInhibitShutdown` when initializing and terminating an application repeatedly.

Initializing and Terminating Your Application with mclInitializeApplication and mclTerminateApplication

`mclInitializeApplication` allows you to set the global MCR options. They apply equally to all MCR instances. You must set these options before creating your first MCR instance.

These functions are necessary because some MCR options such as whether or not to start Java, whether or not to use the MATLAB JIT feature, and so on, are set when the first MCR instance starts and cannot be changed by subsequent instances of the MCR.

Caution You must call `mclInitializeApplication` once at the beginning of your driver application. You must make this call before calling any other MathWorks functions. This also applies to shared libraries. Avoid calling `mclInitializeApplication` multiple times in an application as it will cause the application to hang.

After you call `mclTerminateApplication`, you may not call `mclInitializeApplication` again. No MathWorks functions may be called after `mclTerminateApplication`.

The function signatures are

```
bool mclInitializeApplication(const char **options, int count);
bool mclTerminateApplication(void);
```

mclInitializeApplication. Takes an array of strings of user-settable options (these are the very same options that can be provided to `mcc` via the `-R` option) and a count of the number of options (the length of the option array). Returns `true` for success and `false` for failure.

mclTerminateApplication. Takes no arguments and can *only* be called after all MCR instances have been destroyed. Returns `true` for success and `false` for failure.

This C example shows typical usage of the functions:

```
int main(){

    mxArray *in1, *in2; /* Define input parameters */
    mxArray *out = NULL;/* and output parameters to pass to
                           the library functions */

    double data[] = {1,2,3,4,5,6,7,8,9};

    /* Call library initialization routine and make sure that
       the library was initialized properly */
    mclInitializeApplication(NULL,0);
    if (!libmatrixInitialize()){
        fprintf(stderr,"could not initialize the library
                        properly\n");
        return -1;
    }

    /* Create the input data */
    in1 = mxCreateDoubleMatrix(3,3,mxREAL);
    in2 = mxCreateDoubleMatrix(3,3,mxREAL);
    memcpy(mxGetPr(in1), data, 9*sizeof(double));
    memcpy(mxGetPr(in2), data, 9*sizeof(double));

    /* Call the library function */
    mlfAddmatrix(1, &out, in1, in2);
    /* Display the return value of the library function */
    printf("The value of added matrix is:\n");
    display(out);
    /* Destroy return value since this variable will be reused
```

```
           in next function call. Since we are going to reuse the
           variable, we have to set it to NULL. Refer to MATLAB
           Compiler documentation for more information on this. */
        mxDestroyArray(out); out=0;
        mlfMultiplymatrix(1, &out, in1, in2);
        printf("The value of the multiplied matrix is:\n");
        display(out);
        mxDestroyArray(out); out=0;
        mlfEigmatrix(1, &out, in1);
        printf("The Eigen value of the first matrix is:\n");
        display(out);
        mxDestroyArray(out); out=0;

        /* Call the library termination routine */
        libmatrixTerminate();

        /* Free the memory created */
        mxDestroyArray(in1); in1=0;
        mxDestroyArray(in2); in2 = 0;
        mclTerminateApplication();
        return 0;
    }
```

Caution `mclInitializeApplication` can only be called *once* per application. Calling it a second time generates an error, and will cause the function to return `false`. This function must be called before calling any C MEX function or MAT-file API function.

Initializing and Terminating Your Application Multiple Times With mclInhibitShutdown

Sometimes, repeated initialization and termination of an application may cause the application to hang. To avoid this, call `mclInhibitShutdown()` immediately after calling `mclInitializeApplication()`. For example:

```
if( !mclInitializeApplication(NULL,0) )
{
    fprintf(stderr,
              "Could not initialize the application.\n");
*err = -1;
        return(x);
    }
    mclInhibitShutdown();
```

Using a Shared Library

To use a MATLAB Compiler generated shared library in your application, you must perform the following steps:

1 Include the generated header file for each library in your application. Each MATLAB Compiler generated shared library has an associated header file named *`libname`*`.h`, where *`libname`* is the library's name that was passed in on the command line when the library was compiled.

2 Initialize the MATLAB libraries by calling the `mclInitializeApplication` API function. You must call this function once per application, and it must be called before calling any other MATLAB API functions, such as C-Mex functions or C MAT-file functions. `mclInitializeApplication` must be called before calling any functions in a MATLAB Compiler generated shared library. You may optionally pass in application-level options to this function. `mclInitializeApplication` returns a Boolean status code. A return value of `true` indicates successful initialization, and `false` indicates failure.

3 For each MATLAB Compiler generated shared library that you include in your application, call the library's initialization function. This function performs several library-local initializations, such as unpacking the CTF archive, and starting an MCR instance with the necessary information to execute the code in that archive. The library initialization function will be named *`libname`*`Initialize()`, where *`libname`* is the library's name that was passed in on the command line when the library was compiled. This function returns a Boolean status code. A return value of `true` indicates successful initialization, and `false` indicates failure.

Note On Windows, if you want to have your shared library call a MATLAB shared library (as generated by MATLAB Compiler), the MATLAB library initialization function (e.g., `<libname>Initialize`, `<libname>Terminate`, `mclInitialize`, `mclTerminate`) cannot be called from your shared library during the `DllMain(DLL_ATTACH_PROCESS)` call. This applies whether the intermediate shared library is implicitly or explicitly loaded. You must place the call somewhere after `DllMain()`.

---

4. Call the exported functions of each library as needed. Use the C MEX API to process input and output arguments for these functions.

5. When your application no longer needs a given library, call the library's termination function. This function frees the resources associated with its MCR instance. The library termination function will be named `<libname>Terminate()`, where `<libname>` is the library's name that was passed in on the command line when the library was compiled. Once a library has been terminated, that library's exported functions should not be called again in the application.

6. When your application no longer needs to call any MATLAB Compiler generated libraries, call the `mclTerminateApplication` API function. This function frees application-level resources used by the MCR. Once you call this function, no further calls can be made to MATLAB Compiler generated libraries in the application.

Loading Libraries in a Compiled Function

With MATLAB Compiler version 4.0 (R14) and later, you can use M-file prototypes as described below to load your library in a compiled application. Loading libraries using H-file headers is not supported in compiled applications. This behavior occurs when `loadlibrary` is compiled with the header argument as in the statement:

```
loadlibrary(library, header)
```

In order to work around this issue, execute the following command at the MATLAB command prompt:

```
loadlibrary(library, header, 'mfilename', 'mylibrarymfile');
```

where *mylibrarymfile* is the name of an M-file you would like to use when loading this library. This step only needs to be performed once to generate an M-file for the library.

In the code that is be compiled, you can now call `loadlibrary` with the following syntax:

```
loadlibrary(library, @mylibrarymfile, 'alias', alias)
```

With MATLAB Compiler versions 4.0.1 (R14+) and later, generated M-files will automatically be included in the CTF file as part of the compilation process. For MATLAB Compiler versions 4.0 (R14) and later, include your library M-file in the compilation with the `-a` option with `mcc`.

Caution With MATLAB Compiler Version 3.0 (R13SP1) and earlier, you cannot compile calls to `loadlibrary` because of general restrictions and limitations of the product.

Note You can use your operating system's `loadlibrary` function to call a MATLAB Compiler shared library function as long as you first call the initialization and termination functions `mclInitializeApplication()` and `mclTerminateApplication()`.

C++ Shared Library Target

In this section...

C++ Shared Library Wrapper

The C++ library wrapper option allows you to create a shared library from an arbitrary set of M-files. MATLAB Compiler generates a wrapper file and a header file. The header file contains all of the entry points for all of the compiled M-functions.

Note Even if you are not producing a shared library, you must use `-W lib` or `-W cpplib` when including any MATLAB Compiler generated code into a larger application. For more information, refer to "Mixing M-Files and C or C++" on page 6-13.

C++ Shared Library Example

This example rewrites the previous C shared library example using C++. The procedure for creating a C++ shared library from M-files is identical to the procedure for creating a C shared library, except you use the `cpplib` wrapper. Enter the following command on a single line:

```
mcc -W cpplib:libmatrixp -T link:lib addmatrix.m
multiplymatrix.m eigmatrix.m -v
```

The `-W cpplib:<libname>` option tells MATLAB Compiler to generate a function wrapper for a shared library and call it `<libname>`. The `-T link:lib` option specifies the target output as a shared library. Note the directory where the product puts the shared library because you will need it later.

Writing the Driver Application

Note Due to name mangling in C++, you must compile your driver application with the same version of your third-party compiler that you use to compile your C++ shared library.

This example uses a C++ version of the `matrixdriver` application, `matrixdriver.cpp`. In the C++ version, arrays are represented by objects of the class `mwArray`. Every `mwArray` class object contains a pointer to a MATLAB array structure. For this reason, the attributes of an `mwArray` object are a superset of the attributes of a MATLAB array. Every MATLAB array contains information about the size and shape of the array (i.e., the number of rows, columns, and pages) and either one or two arrays of data. The first array stores the real part of the array data and the second array stores the imaginary part. For arrays with no imaginary part, the second array is not present. The data in the array is arranged in column-major, rather than row-major, order.

```
/*==============================================================
 *
 * MATRIXDRIVER.CPP
 * Sample driver code that calls a C++ shared library created
 * using MATLAB Compiler. Refer to MATLAB Compiler documentation
 * for more information on this
 *
 * This is the wrapper CPP code to call a shared library
 *  created using the MATLAB Compiler.
 *
 * Copyright 1984-2005 The MathWorks, Inc.
 *
 *============================================================*/

// Include the library specific header file as generated by the
// MATLAB Compiler
#include "libmatrixp.h"

int run_main(int argc, char **argv)
{
    // Call application and library initialization.
    // Perform init before calling any API functions or
    // Compiler-generated libraries.
    if (!mclInitializeApplication(NULL,0))
    {
        std::cerr << "could not initialize the application
                                 properly"
                  << std::endl;
     return -1;
    }
    if( !libmatrixpInitialize() )
    {
        std::cerr << "could not initialize the library properly"
                  << std::endl;
return -1;
    }
    else
    {
        try
        {
            // Create input data
            double data[] = {1,2,3,4,5,6,7,8,9};
            mwArray in1(3, 3, mxDOUBLE_CLASS, mxREAL);
            mwArray in2(3, 3, mxDOUBLE_CLASS, mxREAL);
            in1.SetData(data, 9);
            in2.SetData(data, 9);

            // Create output array
            mwArray out;

            // Call the library function
            addmatrix(1, out, in1, in2);

            // Display the return value of the library function
            std::cout << "Value of added matrix is:"
                      << std::endl;
            std::cout << out << std::endl;

            multiplymatrix(1, out, in1, in2);
            std::cout << "Value of the multiplied matrix is:"
                      << std::endl;
```

```
                std::cout << out << std::endl;

                eigmatrix(1, out, in1);
                std::cout << "Eigenvalues of the first matrix are:"
                          << std::endl;
                std::cout << out << std::endl;
            }
            catch (const mwException& e)
            {
              std::cerr << e.what() << std::endl;
              return -2;
            }
            catch (...)
            {
              std::cerr << "Unexpected error thrown" << std::endl;
              return -3;
            }
            // Call the application and library termination routine
            libmatrixpTerminate();
        }
    /* You should call mclTerminate application at the end of
     * your application.
     */
        mclTerminateApplication();
        return 0;
    }

    int main()
    {
        mclmcrInitialize();
        return mclRunMain((mclMainFcnType)run_main,0,NULL);
    }
```

Compiling the Driver Application

To compile the `matrixdriver.cpp` driver code, you use your C++ compiler. By executing the following `mbuild` command that corresponds to your development platform, you will use your C++ compiler to compile the code.

```
mbuild matrixdriver.cpp libmatrixp.lib          (Windows)
mbuild matrixdriver.cpp -L. -lmatrixp -I.       (UNIX)
```

Note This command assumes that the shared library and the corresponding header file are in the current working directory.

On Windows, if this is not the case, specify the full path to `libmatrixp.lib`, and use a `-I` option to specify the directory containing the header file.

On UNIX, if this is not the case, replace the "`.`" (dot) following the `-L` and `-I` options with the name of the directory that contains these files, respectively.

Incorporating a C++ Shared Library into an Application

There are two important points to note when incorporating a C++ shared library into an application:

- Interface functions use the `mwArray` type to pass arguments, rather than the `mxArray` type used with C shared libraries.
- C++ exceptions are used to report errors to the caller. Therefore, all calls must be wrapped in a `try-catch` block.

Exported Function Signature

The C++ shared library target generates two sets of interfaces for each M-function. The first set of exported interfaces is identical to the `mlx` signatures that are generated in C shared libraries. The second set of interfaces is the C++ function interfaces. The generic signature of the exported C++ functions is as follows:

M-Functions with No Return Values.

```
bool MW_CALL_CONV mlx<function-name>(<list_of_input_variables>);
```

M-Functions with at Least One Return Value.

```
bool MW_CALL_CONV mlx<function-name>(int number_of_return_values),
     <list_of_return_variables>, <list_of_input_variables>);
```

In this case, `<list_of_input_variables>` represents a comma-separated list of type `const mwArray&` and `<list_of_return_variables>` represents a comma-separated list of type `mwArray&`. For example, in the `libmatrix` library, the C++ interfaces to the `addmatrix` M-function is generated as:

```
void addmatrix(int nargout, mwArray& a , const mwArray& a1,
               const mwArray& a2);
```

Error Handling

C++ interface functions handle errors during execution by throwing a C++ exception. Use the `mwException` class for this purpose. Your application can catch `mwExceptions` and query the `what()` method to get the error message. To correctly handle errors when calling the C++ interface functions, wrap each call inside a `try-catch` block.

```
 try
{
  ...
  (call function)
  ...
}
catch (const mwException& e)
{
  ...
  (handle error)
  ...
}
```

The `matrixdriver.cpp` application illustrates the typical way to handle errors when calling the C++ interface functions.

MATLAB Compiler Generated Interface Functions

In this section...

Functions in the Shared Library

A shared library generated by MATLAB Compiler contains at least seven functions. There are three generated functions to manage library initialization and termination, one each for printed output and error messages, and two generated functions for each M-file compiled into the library.

To generate the functions described in this section, first copy `sierpinski.m`, `main_for_lib.c`, `main_for_lib.h`, and `triangle.c` from *`matlabroot`*`/extern/examples/compiler` into your directory, and then execute the appropriate MATLAB Compiler command.

Type of Application

For a C Application on Windows

```
mcc -W lib:libtriangle -T link:lib sierpinski.m
mbuild triangle.c main_for_lib.c libtriangle.lib
```

For a C Application on UNIX

```
mcc -W lib:libtriangle -T link:lib sierpinski.m
```

```
mbuild triangle.c main_for_lib.c -L. -ltriangle -I.
```

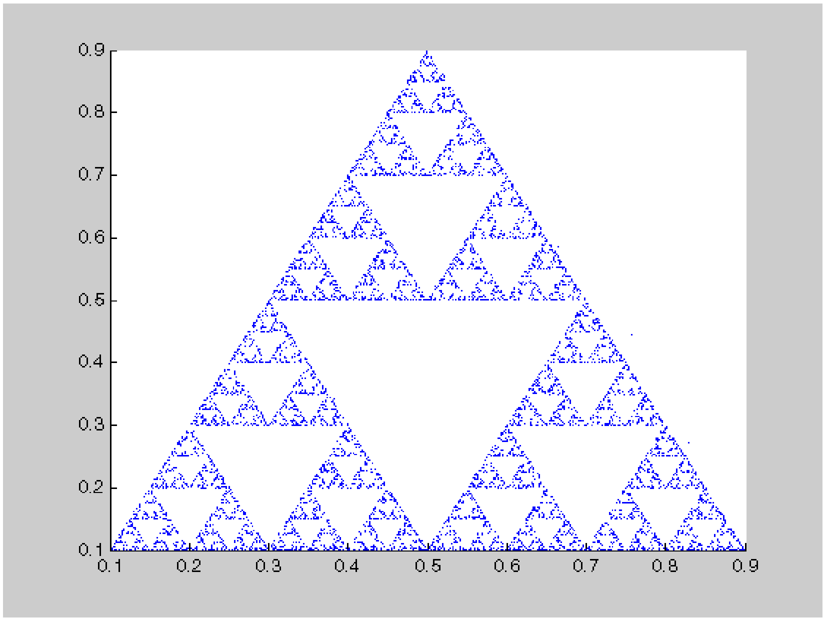
For a C++ Application on Windows

```
mcc -W cpplib:libtrianglep -T link:lib sierpinski.m
mbuild triangle.cpp main_for_lib.c libtrianglep.lib
```

For a C++ Application on UNIX

```
mcc -W cpplib:libtriangle -T link:lib sierpinski.m
mbuild triangle.cpp main_for_lib.c -L. -ltriangle -I.
```

These commands create a main program named `triangle`, and a shared library named `libtriangle`. The library exports a single function that uses a simple iterative algorithm (contained in `sierpinski.m`) to generate the fractal known as Sierpinski's Triangle. The main program in `triangle.c` or `triangle.cpp` can optionally take a single numeric argument, which, if present, specifies the number of points used to generate the fractal. For example, `triangle 8000` generates a diagram with 8,000 points.



In this example, MATLAB Compiler places all of the generated functions into the generated file `libtriangle.c` or `libtriangle.cpp`.

Structure of Programs That Call Shared Libraries

All programs that call MATLAB Compiler generated shared libraries have roughly the same structure:

1. Declare variables and process/validate input arguments.
2. Call `mclInitializeApplication`, and test for success. This function sets up the global MCR state and enables the construction of MCR instances.
3. Call, once for each library, `<libraryname>Initialize`, to create the MCR instance required by the library.
4. Invoke functions in the library, and process the results. (This is the main body of the program.)

5. Call, once for each library, `<libraryname>Terminate`, to destroy the associated MCR.

6. Call `mclTerminateApplication` to free resources associated with the global MCR state.

7. Clean up variables, close files, etc., and exit.

To see these steps in an actual example, review the main program in this example, `triangle.c`.

Library Initialization and Termination Functions

The library initialization and termination functions create and destroy, respectively, the MCR instance required by the shared library. You must call the initialization function before you invoke any of the other functions in the shared library, and you should call the termination function after you are finished making calls into the shared library (or you risk leaking memory).

There are two forms of the initialization function and one type of termination function. The simpler of the two initialization functions takes no arguments; most likely this is the version your application will call. In this example, this form of the initialization function is called `libtriangleInitialize`.

```
bool libtriangleInitialize(void)
```

This function creates an MCR instance using the default print and error handlers, and other information generated during the compilation process.

However, if you want more control over how printed output and error messages are handled, you may call the second form of the function, which takes two arguments.

```
bool libtriangleInitializeWithHandlers(
    mclOutputHandlerFcn error_handler,
    mclOutputHandlerFcn print_handler
)
```

By calling this function, you can provide your own versions of the print and error handling routines called by the MCR. Each of these routines has the same signature (for complete details, see “Print and Error Handling

Functions" on page 7-27). By overriding the defaults, you can control how output is displayed and, for example, whether or not it goes into a log file.

Note Before calling either form of the library initialization routine, you must first call `mclInitializeApplication` to set up the global MCR state. See "Calling a Shared Library" on page 7-10 for more information.

On Microsoft Windows platforms, MATLAB Compiler generates an additional initialization function, the standard Microsoft DLL initialization function `DllMain`.

```
BOOL WINAPI DllMain(HINSTANCE hInstance, DWORD dwReason,
                    void *pv)
```

The generated `DllMain` performs a very important service; it locates the directory in which the shared library is stored on disk. This information is used to find the CTF archive, without which the application will not run. If you modify the generated `DllMain` (not recommended), make sure you preserve this part of its functionality.

Library termination is simple.

```
void libtriangleTerminate(void)
```

Call this function (once for each library) before calling `mclTerminateApplication`.

Print and Error Handling Functions

By default, MATLAB Compiler generated applications and shared libraries send printed output to standard output and error messages to standard error. MATLAB Compiler generates a default print handler and a default error handler that implement this policy. If you'd like to change this behavior, you must write your own error and print handlers and pass them in to the appropriate generated initialization function.

You may replace either, both, or neither of these two functions. The MCR sends all regular output through the print handler and all error output through the error handler. Therefore, if you redefine either of these functions, the MCR will use your version of the function for all the output that falls into class for which it invokes that handler.

The default print handler takes the following form.

```
static int mclDefaultPrintHandler(const char *s)
```

The implementation is straightforward; it takes a string, prints it on standard output, and returns the number of characters printed. If you override or replace this function, your version must also take a string and return the number of characters “handled.” The MCR calls the print handler when an executing M-file makes a request for printed output, e.g., via the MATLAB function `disp`. The print handler does not terminate the output with a carriage return or line feed.

The default error handler has the same form as the print handler.

```
static int mclDefaultErrorHandler(const char *s)
```

However, the default implementation of the print handler is slightly different. It sends the output to the standard error output stream, but if the string does not end with carriage return, the error handler adds one. If you replace the default error handler with one of your own, you should perform this check as well, or some of the error messages printed by the MCR will not be properly formatted.

Caution The error handler, despite its name, does not handle the actual errors, but rather the message produced after the errors have been caught and handled inside the MCR. You cannot use this function to modify the error handling behavior of the MCR – use the `try` and `catch` statements in your M-files if you want to control how a MATLAB Compiler generated application responds to an error condition.

Note If you provide alternate C++ implementations of either `mclDefaultPrintHandler` or `mclDefaultErrorHandler`, then functions must be declared `extern "C"`. For example:

```
extern "C" int myPrintHandler(const char *s);
```

Omitting `extern "C"` will generate warnings on the Solaris platform.

Functions Generated from M-Files

For each M-file specified on the MATLAB Compiler command line, the product generates two functions, the `mlx` function and the `mlf` function. Each of these generated functions performs the same action (calls your M-file function). The two functions have different names and present different interfaces. The name of each function is based on the name of the first function in the M-file (`sierpinski`, in this example); each function begins with a different three-letter prefix.

Note For C shared libraries, MATLAB Compiler generates the `mlx` and `mlf` functions as described in this section. For C++ shared libraries, the product generates the `mlx` function the same way it does for the C shared library. However, the product generates a modified `mlf` function with these differences:

- The `mlf` before the function name is dropped to keep compatibility with R13.
- The arguments to the function are `mwArray` instead of `mxArray`.

mlx Interface Function

The function that begins with the prefix `mlx` takes the same type and number of arguments as a MATLAB MEX-function. (See the External Interfaces documentation for more details on MEX-functions.) The first argument, `nlhs`, is the number of output arguments, and the second argument, `plhs`, is a pointer to an array that the function will fill with the requested number of return values. (The “`lhs`” in these argument names is short for “left-hand side" – the output variables in a MATLAB expression are those on the left-hand side of the assignment operator.) The third and fourth parameters are the number of inputs and an array containing the input variables.

```
void mlxSierpinski(int nlhs, mxArray *plhs[], int nrhs,
                   mxArray *prhs[])
```

mlf Interface Function

The second of the generated functions begins with the prefix `mlf`. This function expects its input and output arguments to be passed in as individual variables rather than packed into arrays. If the function is capable of producing one or more outputs, the first argument is the number of outputs requested by the caller.

```
void mlfSierpinski(int nargout, mxArray** x, mxArray** y,
                   mxArray* iterations, mxArray* draw)
```

In both cases, the generated functions allocate memory for their return values. If you do not delete this memory (via `mxDestroyArray`) when you are done with the output variables, your program will leak memory.

Your program may call whichever of these functions is more convenient, as they both invoke your M-file function in an identical fashion. Most programs will likely call the `mlf` form of the function to avoid managing the extra arrays required by the `mlx` form. The example program in `triangle.c` calls `mlfSierpinski`.

```
mlfSierpinski(2, &x, &y, iterations, draw);
```

In this call, the caller requests two output arguments, `x` and `y`, and provides two inputs, `iterations` and `draw`.

If the output variables you pass in to an `mlf` function are not NULL, the `mlf` function will attempt to free them using `mxDestroyArray`. This means that you can reuse output variables in consecutive calls to `mlf` functions without worrying about memory leaks. It also implies that you must pass either `NULL` or a valid MATLAB array for all output variables or your program will fail because the memory manager cannot distinguish between a noninitialized (invalid) array pointer and a valid array. It will try to free a pointer that is not NULL – freeing an invalid pointer usually causes a segmentation fault or similar fatal error.

Using varargin and varargout in an M-Function Interface

If your M-function interface uses `varargin` or `varargout`, you must pass them as cell arrays. For example, if you have `N` `varargins`, you need to create one cell array of size `1-by-N`. Similarly, `varargouts` are returned back as one cell array. The length of the `varargout` is equal to the number of return values specified in the function call minus the number of actual variables passed. As in the MATLAB software, the cell array representing `varagout` has to be the last return variable (the variable preceding the first input variable) and the cell array representing `varargins` has to be the last formal parameter to the function call.

For information on creating cell arrays, refer to the C MEX function interface in the External Interfaces documentation.

For example, consider this M-file interface:

```
[a,b,varargout] = myfun(x,y,z,varargin)
```

The corresponding C interface for this is

```
void mlfMyfun(int numOfRetVars, mxArray **a, mxArray **b,
              mxArray **varargout, mxArray *x, mxArray *y,
              mxArray *z, mxArray *varargin)
```

In this example, the number of elements in `varargout` is `(numOfRetVars - 2)`, where `2` represents the two variables, `a` and `b`, being returned. Both `varargin` and `varargout` are single row, multiple column cell arrays.

Retrieving MCR State Information While Using Shared Libraries

When using shared libraries (note this does not apply to standalone applications), you may call functions to retrieve specific information from MCR state. For details, see “Retrieving JVM Status, Log File Name, and Display Mode from MCR State for Shared Libraries” on page 4-22.

Using C/C++ Shared Libraries on a Mac OS X System

To use a MATLAB Compiler generated library on a Mac OS X system, you must create a separate thread that initializes the shared library and call that library's functions. The main thread of the application is the thread that calls your driver program's `main()` function. The body of your `main()` function must create a new thread, passing to it the address of a thread-function containing the library initialization and necessary calls to the shared library generated by MATLAB Compiler. The new thread does the main work of the application, including calling MATLAB Compiler generated libraries.

In past releases, it was necessary to create and execute a `CFRunLoop` in the main thread, as well as to call `mclSetExitCode`. Now, however, the same functionality can be accomplished with a single call to `mclRunMain`.

The following example illustrates this procedure. This example rewrites the C shared library example from this chapter for use on Mac OS X. Follow the same procedure as in the earlier example to build and run this application.

```
/*==============================================================
 *
 * MATRIXDRIVER.C Sample driver code that calls the shared
 *         library created using MATLAB Compiler. Refer to the
 *          documentation of MATLAB Compiler for more info
 *          on this
 *
 * This is the wrapper C code to call a shared library created
 * using MATLAB Compiler.
 *
 * Copyright 1984-2005 The MathWorks, Inc.
 *
 *==============================================================*/

#include <stdio.h>

#ifdef __APPLE_CC__
#include <CoreFoundation/CoreFoundation.h>
#endif

/* Include the MCR header file and the library specific header
```

```
 * file as generated by MATLAB Compiler */
#include "libmatrix.h"

/* This function displays double matrix stored in mxArray */
void display(const mxArray* in);

void *run_main(void *x)
{
  int *err = x;
    mxArray *in1, *in2; /* Define input parameters */
    mxArray *out = NULL;/* and output parameters to be
                         * passed to lib functions */

    double data[] = {1,2,3,4,5,6,7,8,9};

    /* Call the mclInitializeApplication routine. Make sure that
     * the application was initialized properly by checking the
     * return status. This initialization has to be done before
     * calling any MATLAB API's or MATLAB Compiler generated
     * shared library functions.  */
    if( !mclInitializeApplication(NULL,0) )
    {
        fprintf(stderr, "Could not initialize application.\n");
 *err = -1;
        return(x);
    }

    /* Create the input data */
    in1 = mxCreateDoubleMatrix(3,3,mxREAL);
    in2 = mxCreateDoubleMatrix(3,3,mxREAL);
    memcpy(mxGetPr(in1), data, 9*sizeof(double));
    memcpy(mxGetPr(in2), data, 9*sizeof(double));

    /* Call the library intialization routine and make sure that
     * the library was initialized properly. */
    if (!libmatrixInitialize()){
        fprintf(stderr,"Could not initialize the library.\n");
        *err = -2;
    }
    else
    {
        /* Call the library function */
        mlfAddmatrix(1, &out, in1, in2);
 /* Display the return value of the library function */
 printf("The value of added matrix is:\n");
 display(out);
 /* Destroy the return value since this variable will be reused
  * in the next function call. Since we are going to reuse the
  * variable, we have to set it to NULL. Refer to
  * documentation for more information on this. */
 mxDestroyArray(out); out=0;
 mlfMultiplymatrix(1, &out, in1, in2);
 printf("The value of the multiplied matrix is:\n");
 display(out);
 mxDestroyArray(out); out=0;
 mlfEigmatrix(1, &out, in1);
 printf("The eigenvalues of the first matrix are:\n");
 display(out);
 mxDestroyArray(out); out=0;

 /* Call the library termination routine */
 libmatrixTerminate();

 /* Free the memory created */
 mxDestroyArray(in1); in1=0;
 mxDestroyArray(in2); in2 = 0;
    }
/* On MAC, you need to call mclRunMain with the appropriate
* exit status. Also, you should call mclmcrInitialize
* application before you call mclRunMain.
* mclTerminateApplication terminates the entire application. */
mclTerminateApplication();
return 0
}
int main()
{
mclmcrInitialize();
return mclRunMain((mclmainFcn)run_main,0,NULL);}
```

```
/*DISPLAY This function will display the double matrix
 * stored in an mxArray. This function assumes that
 * the mxArray passed as input contains double array.
 */
void display(const mxArray* in)
{
    int i=0, j=0; /* loop index variables */
    int r=0, c=0; /* variables to store the row
                   * and column length of the matrix */
    double *data; /* variable to point to the double data stored
                   * within the mxArray */

    /* Get the size of the matrix */
    r = mxGetM(in);
    c = mxGetN(in);
    /* Get a pointer to the double data in mxArray */
    data = mxGetPr(in);

    /* Loop through data and display in matrix format */
        for( i = 0; i < c; i++ ){
        for( j = 0; j < r; j++){
            printf("%4.2f\t",data[j*c+i]);
        }
        printf("\n");
    }
    printf("\n");
}
```

The Mac version of the `matrixdriver` application differs from the version on other platforms in these significant ways:

- The `run_main()` function performs the basic tasks of initialization, calling the library's functions, and termination. Compare this function with the `matrixdriver` `main()` function on other platforms, listed in the earlier example.
- In this example, the `main()` function creates a new thread using `pthread_create`, and passes the address of the `run_main()` function to it.

About Memory Management and Cleanup

In this section...

Overview

Generated C++ code provides consistent garbage collection via the object destructors and the MCR's internal memory manager optimizes to avoid heap fragmentation.

If memory constraints are still present on your system, try preallocating arrays in M. This will reduce the number of calls to the memory manager, and the degree to which the heap fragments.

Passing mxArrays to Shared Libraries

When an `mxArray` is created in an application which uses the MCR, it is created in the managed memory space of the MCR.

Therefore, it is very important that you never create `mxArrays` (or call any other MathWorks function) before calling `mclInitializeApplication`.

It is safe to call `mxDestroyArray` when you no longer need a particular `mxArray` in your code, even when the input has been assigned to a persistent or global variable in MATLAB. MATLAB uses reference counting to ensure that when `mxDestroyArray` is called, if another reference to the underlying data still exists, the memory will not be freed. Even if the underlying memory is not freed, the `mxArray` passed to `mxDestroyArray` will no longer be valid.

For more information about `mclInitializeApplication` and `mclTerminateApplication`, see "Calling a Shared Library" on page 7-10.

For more information about `mxArray`, see "Using mxArray" on page 5-25.

Limitations and Restrictions

Limitations About What May Be Compiled

In this section...

Compiling MATLAB and Toolboxes

MATLAB Compiler supports the full MATLAB language and almost all toolboxes based on MATLAB. However, some limited MATLAB and toolbox functionality is not licensed for compilation.

- Most of the prebuilt graphical user interfaces included in MATLAB and its companion toolboxes will not compile.
- Functionality that cannot be called directly from the command line will not compile.
- Some toolboxes, such as Symbolic Math Toolbox™, will not compile.

Compiled applications can only run on operating systems that run MATLAB. Also, since the MCR is approximately the same size as MATLAB, applications built with MATLAB Compiler need specific storage memory and RAM to operate. For the most up-to-date information about system requirements, go to the MathWorks Web site.

To see a full list of MATLAB Compiler limitations, visit `http://www.mathworks.com/products/compiler/compiler_support.html`.

Note See "Unsupported Functions" on page 8-9 for a list of functions that cannot be compiled.

Fixing Callback Problems: Missing Functions

When MATLAB Compiler creates a standalone application, it compiles the M-file(s) you specify on the command line and, in addition, it compiles any other M-files that your M-file(s) calls. MATLAB Compiler uses a dependency analysis, which determines all the functions on which the supplied M-files, MEX-files, and P-files depend. The dependency analysis may not locate a function if the only place the function is called in your M-file is a call to the function either

- In a callback string
- In a string passed as an argument to the `feval` function or an ODE solver

---

Tip Dependent functions can also be hidden from `depfun` in `.mat` files that get loaded by compiled applications. Use the `mcc -a` argument or the `%#function` pragma to identify `.mat` file classes or functions that should be supported by the `load` command.

MATLAB Compiler does not look in these text strings for the names of functions to compile.

Symptom

Your application runs, but an interactive user interface element, such as a push button, does not work. The compiled application issues this error message:

```
An error occurred in the callback: change_colormap
The error message caught was    : Reference to unknown function
                change_colormap from FEVAL in stand-alone mode.
```

Workaround

There are several ways to eliminate this error:

- Using the `%#function pragma` and specifying callbacks as strings
- Specifying callbacks with function handles
- Using the `-a` option

Specifying Callbacks as Strings. Create a list of all the functions that are specified only in callback strings and pass these functions using separate `%#function` pragma statements. This overrides the product's dependency analysis and instructs it to explicitly include the functions listed in the `%#function` pragmas.

For example, the call to the `change_colormap` function in the sample application, `my_test`, illustrates this problem. To make sure MATLAB Compiler processes the `change_colormap` M-file, list the function name in the `%#function` pragma.

```
function my_test()
% Graphics library callback test application

%#function change_colormap

peaks;

p_btn = uicontrol(gcf,...
                 'Style', 'pushbutton',...
                 'Position',[10 10 133 25 ],...
                 'String', 'Make Black & White',...
                 'CallBack','change_colormap');
```

Specifying Callbacks with Function Handles. To specify the callbacks with function handles, use the same code as in the example above and replace the last line with

```
    'CallBack',@change_colormap);
```

For more information on specifying the value of a callback, see “Specifying the Value of Callback Function Properties” in the MATLAB Programming Fundamentals documentation.

Using the -a Option. Instead of using the `%#function` pragma, you can specify the name of the missing M-file on the MATLAB Compiler command line using the `-a` option.

Finding Missing Functions in an M-File

To find functions in your application that may need to be listed in a `%#function` pragma, search your M-file source code for text strings specified as callback strings or as arguments to the `feval`, `fminbnd`, `fminsearch`, `funm`, and `fzero` functions or any ODE solvers.

To find text strings used as callback strings, search for the characters “Callback” or “fcn” in your M-file. This will find all the `Callback` properties defined by Handle Graphics® objects, such as `uicontrol` and `uimenu`. In addition, this will find the properties of figures and axes that end in `Fcn`, such as `CloseRequestFcn`, that also support callbacks.

Suppressing Warnings on the UNIX System

Several warnings may appear when you run a standalone application on the UNIX system. This section describes how to suppress these warnings.

- To suppress the `app-defaults` warnings, set `XAPPLRESDIR` to point to `<mcr_root>/<ver>/X11/app-defaults`.
- To suppress the `libjvm.so` warning, make sure you set the dynamic library path properly for your platform. See “Directories Required for Run-Time Deployment” on page 10-5.

  You can also use the MATLAB Compiler option `-R -nojvm` to set your application’s `nojvm` run-time option, if the application is capable of running without Java.

Cannot Use Graphics with the -nojvm Option

If your program uses graphics and you compile with the `-nojvm` option, you will get a run-time error.

Cannot Create the Output File

If you receive the error

```
Can't create the output file filename
```

there are several possible causes to consider:

- Lack of write permission for the directory where MATLAB Compiler is attempting to write the file (most likely the current working directory).
- Lack of free disk space in the directory where MATLAB Compiler is attempting to write the file (most likely the current working directory).
- If you are creating a standalone application and have been testing it, it is possible that a process is running and is blocking MATLAB Compiler from overwriting it with a new version.

No M-File Help for Compiled Functions

If you create an M-file with self-documenting online help by entering text on one or more contiguous comment lines beginning with the second line of the file and then compile it, the results of the command

```
help filename
```

will be unintelligible.

Note Due to performance reasons, M-file comments are stripped out before MCR encryption.

No MCR Versioning on Mac OS X

The feature that allows you to install multiple versions of the MCR on the same machine is currently not supported on Mac OS X. When you receive a new version of MATLAB , you must recompile and redeploy all of your applications and components. Also, when you install a new MCR onto a target machine, you must delete the old version of the MCR and install the new one. You can only have one version of the MCR on the target machine.

Older Neural Networks Not Deployable with MATLAB Compiler

Loading networks saved from older Neural Network Toolbox™ versions requires some initialization routines that are not deployable. Therefore, these networks cannot be deployed without first being updated.

For example, deploying with Neural Network Toolbox Version 5.0.1 (2006b) and MATLAB Compiler Version 4.5 (R2006b) yields the following errors at run time:

```
??? Error using ==> network.subsasgn
"layers{1}.initFcn" cannot be set to non-existing
 function "initwb".
Error in ==> updatenet at 40
Error in ==> network.loadobj at 10

??? Undefined function or method 'sim' for input
arguments of type 'struct'.
Error in ==> mynetworkapp at 30
```

Restrictions on Calling PRINTDLG with Multiple Arguments in Compiled Mode

In compiled mode, only one argument can be present in a call to the MATLAB `printdlg` function (for example, `printdlg(gcf)`).

You will not receive an error when making at call to `printdlg` with multiple arguments. However, when an application containing the multiple-argument call is compiled, the compile will fail with the following error message:

```
Error using = => printdlg at 11
PRINTDLG requires exactly one argument
```

Compiling a Function with WHICH Does Not Search Current Working Directory

Using `which`, as in this example:

```
function pathtest
which myFile.mat
open('myFile.mat')
```

does not cause the current working directory to be searched in deployed applications. In addition, it may cause unpredictable behavior of the `open` function.

Use one of the following solutions as alternatives to using `which`:

1. Use the `pwd` function to explicitly point to the file in the current directory, as follows:

   ```
   open([pwd 'myFile.mat'])
   ```

2. Rather than using the general `open` function, use `load` or other specialized functions for your particular file type, as `load` explicitly checks for the file in the current directory. For example:

   ```
   load myFile.mat
   ```

3. Use `addpath(pwd)` to add the current directory to the deployed application's file search path. This directory should not include any unencrypted M-files, as these cannot be executed by the compiled application.

4. Include your file using the **Other Files** area of your project using `deploytool` (and the `-a` flag using `mcc`).

Unsupported Functions

Note The sheer number of MathWorks products makes keeping an up-to-date list of unsupported functions difficult if not impossible. If you have a question as to whether a specific MathWorks product's function is able to be compiled or not, refer to that product's documentation.

Some functions are not supported in standalone mode; that is, you cannot compile them with MATLAB Compiler. These functions are in the following categories:

- Functions that print or report MATLAB code from a function, for example, the MATLAB `help` function or debug functions, will not work.
- Simulink® functions, in general, will not work.
- Functions that require a command line, for example, the MATLAB `lookfor` function, will not work.
- `clc`, `home`, and `savepath` will not do anything in deployed mode.
- Tools that allow run-time manipulation of figures

Returned values from standalone applications will be 0 for successful completion or a nonzero value otherwise.

In addition, there are functions that have been identified as nondeployable due to licensing restrictions.

`mccExcludedFiles.log` lists all the functions and files excluded by `mcc` if they can not be compiled. It is created after each attempted build if there are functions or files that cannot be compiled.

List of Unsupported Functions

```
add_block
add_line
```

List of Unsupported Functions (Continued)

`applescript`

`close_system`

`colormapeditor`

`createClassFromWsdl`

`dbclear`

`dbcont`

`dbdown`

`dbquit`

`dbstack`

`dbstatus`

`dbstep`

`dbstop`

`dbtype`

`dbup`

`delete_block`

`delete_line`

`depfun`

`doc`

`echo`

`edit`

`fields`

`figure_palette`

`get_param`

`help`

`home`

`inmem`

`keyboard`

List of Unsupported Functions (Continued)

`linmod`

`mislocked`

`mlock`

`more`

`munlock`

`new_system`

`open_system`

`pack`

`plotbrowser`

`plotedit`

`plottools`

`propedit`

`propertyeditor`

`publish`

`rehash`

`run`

`set_param`

`sim`

`simget`

`simset`

`sldebug`

`type`

Troubleshooting

Introduction

MATLAB Compiler software converts your MATLAB programs into self-contained applications and software components and enables you to share them with end users who do not have MATLAB installed. MATLAB Compiler takes MATLAB applications (M-files, MEX-files, and other MATLAB executable code) as input and generates redistributable standalone applications or shared libraries. The resulting applications and components are platform specific.

Another use of MATLAB Compiler is to build C or C++ shared libraries (DLLs on Windows) from a set of M-files. You can then write C or C++ programs that can call the functions in these libraries. The typical workflow for building a shared library is to compile your M-code on a development machine, write a C/C++ driver application, build an executable from the driver code, test the resulting executable on that machine, and deploy the executable and MCR to a test or customer machine without MATLAB.

Compiling a shared library is very similar to compiling an executable. The command line differs as shown:

```
mcc -B csharedlib:hellolib hello.m
```

or

```
mcc -B cpplib:hellolib hello.m
```

Once you have compiled a shared library, the next step is to create a driver application that initializes and terminates the shared library as well as invokes method calls. This driver application can be compiled and linked with your shared library with the `mbuild` command. For example:

```
mbuild helloapp.c hellolib.lib
```

or

```
mbuild helloapp.cpp hellolib.lib
```

The only header file that needs to be included in your driver application is the one generated by your `mcc` command (`hellolib.h` in the above example). See Chapter 7, “Libraries” for examples of how to correctly access a shared library.

Common Issues

Some of the most common issues encountered when using MATLAB Compiler generated standalone executables or shared libraries are:

- **Compilation fails with an error message.** This could indicate a failure during any one of the internal steps involved in producing the final output.
- **Compilation succeeds but the application does not execute because required DLLs are not found.** All shared libraries required for your standalone executable or shared library are contained in the MATLAB Compiler Runtime (MCR). Installing the MCR is required for any of the deployment targets.
- **Compilation succeeds, and the resultant file starts to execute but then produces errors and/or generates a crash dump.**
- **The compiled program executes on the machine where it was compiled but not on other machines.**
- **The compiled program executes on some machines and not others.**

If any of these issues apply to you, search “Failure Points and Possible Solutions” on page 9-4 for common solutions.

Failure Points and Possible Solutions

In this section...

How to Use this Section

Use the following list of questions to diagnose some of the more common issues associated with using MATLAB Compiler software.

Does the Failure Occur During Compilation?

You typically compile your M-code on a development machine, test the resulting executable on that machine, and deploy the executable and MATLAB Compiler Runtime (MCR) to a test or customer machine without MATLAB. The compilation process performs dependency analysis on your M-code, creates an encrypted archive of your code and required toolbox code, generates wrapper code, and compiles the wrapper code into an executable. If your application fails to build an executable, the following questions may help you isolate the problem.

Is your selected compiler supported by MATLAB Compiler?

See the current list of supported compilers at `http://www.mathworks.com/support/compilers/current_release/`.

Are error messages produced at compile time?

See error messages in "MATLAB® Compiler" on page 9-15.

Did you compile with the verbose flag?

Compilation can fail in MATLAB because of errors encountered by the system compiler when the generated wrapper code is compiled into an executable. Additional errors and warnings are printed when you use the verbose flag as such:

```
mcc -mv myApplication.m
```

In this example, `-m` tells MATLAB Compiler to create a standalone application and `-v` tells MATLAB Compiler and other processors to display messages about the process.

Are you compiling within or outside of MATLAB?

`mcc` can be invoked from the operating system command line or from the MATLAB prompt. When you run `mcc` inside the MATLAB environment, MATLAB will modify environment variables in its environment as necessary so `mcc` will run. Issues with `PATH`, `LD_LIBRARY_PATH`, or other environment variables seen at the operating system command line are often not seen at the MATLAB prompt. The environment that MATLAB uses for `mcc` can be listed at the MATLAB prompt. For example:

```
>>!set
```

lists the environment on Windows platforms.

```
>>!printenv
```

lists the environment on UNIX platforms. Using this path allows you to use `mcc` from the operating system command line.

Does a simple read/write application such as “Hello World” compile successfully?

Sometimes applications won’t compile because of MEX-file issues, other toolboxes, or other dependencies. Compiling a `helloworld` application can determine if MATLAB Compiler is correctly set up to produce any executable. For example, try compiling:

```
function helloworld
```

```
    disp('hello world')
```

with:

```
  >>mcc -mv helloworld.m
```

Have you tried to compile any of the examples in MATLAB Compiler help?

The source code for all examples is provided with MATLAB Compiler and is located in `*matlabroot*\extern\examples\compiler`, where *`matlabroot`* is the root directory of your MATLAB installation.

Does your code compile with the LCC compiler?

The LCC compiler is a free compiler provided with MATLAB on Windows. If there are installation or path problems with other system compilers, you may be able to compile your application with LCC.

Did the M-code compile successfully before this failure?

The three most common reasons for M-code to stop compiling are:

- Upgrading to MATLAB without running `mbuild -setup` — Running `mbuild -setup` is required after any upgrade to MATLAB Compiler.
- A change in the selection of the system compiler — It is possible to inadvertently change the system compiler for versions of MATLAB that store preferences in a common directory. For example, MATLAB 7.0.1 (R14SP1) and MATLAB 7.0.4 (R14SP2) store their preferences in the same directory. Changing the system compiler in R14SP1 will also change the system compiler in R14SP2.
- An upgrade to MATLAB that didn't include an upgrade to MATLAB Compiler — The versions of MATLAB Compiler and MATLAB must be the same in order to work together. It is possible to see conflicts in installations where the MATLAB installation is local and the MATLAB Compiler installation is on a network or vice versa.

Are you receiving errors when trying to compile a shared library?

Errors at compile time can indicate issues with either `mcc` or `mbuild`. For troubleshooting `mcc` issues, see the previous section on compile time issues. It is recommended that your driver application be compiled and linked using `mbuild`. `mbuild` can be executed with the `-v` switch to provide additional information on the compilation process. If you receive errors at this stage, ensure that you are using the correct header files and/or libraries produced by `mcc`, in your C or C++ driver. For example:

```
mcc -B csharedlib:hellolib hello.m
```

produces `hellolib.h`, which is required to be included in your C/C++ driver, and `hellolib.lib` or `hellolib.so`, which is required on the `mbuild` command line.

If you are compiling a driver application, are you using mbuild?

The MathWorks recommends and supports using `mbuild` to compile your driver application. `mbuild` is designed and tested to correctly build driver applications. It will ensure that all MATLAB header files are found by the C/C++ compiler, and that all necessary libraries are specified and found by the linker.

Are you trying to compile your driver application using Microsoft Visual Studio or another IDE?

If using an IDE, in addition to linking to the generated export library, you need to include an additional dependency to `mclmcrrt.lib`. This library is provided for all supported third-party compilers in *`matlabroot`*`\extern\lib\`*`vendor-name`*.

Are you importing the correct versions of import libraries?

If you have multiple versions of MATLAB installed on your machine, it is possible that an older or incompatible version of the library is referenced. Ensure that the only MATLAB library that you are linking to is `mclmcrrt.lib` and that it is referenced from the appropriate vendor directory. Do not reference libraries as `libmx` or `libut`. In addition, verify that your library path references the version of MATLAB that your shared library was built with.

Are you able to compile the matrixdriver example?

Typically, if you cannot compile the examples in the documentation, it indicates an issue with the installation of MATLAB or your system compiler. See Chapter 7, "Libraries", for these examples.

Does the Failure Occur When Testing Your Application?

After you have successfully compiled your application, the next step is to test it on a development machine and deploy it on a target machine. Typically the target machine does not have a MATLAB installation and requires that the MATLAB Compiler Runtime (MCR) be installed. A distribution includes all of the files that are required by your application to run, which include the executable, CTF archive and the MCR.

See Chapter 4, "Deployment Process", for information on distribution contents for specific application types and platforms.

Test the application on the development machine by running the application against the MCR shipped with MATLAB Compiler. This will verify that library dependencies are correct, that the CTF archive can be extracted and that all M-code, MEX—files and support files required by the application have been included in the archive. If you encounter errors testing your application, the questions in the column to the right may help you isolate the problem.

Are you able to execute the application from MATLAB?

On the development machine, you can test your application's execution by issuing `!`*`application-name`* at the MATLAB prompt. If your application executes within MATLAB but not from outside, this could indicate an issue with the system `PATH` variable. For more information, see "Directories Required for Development and Testing" on page 10-2.

Does the application begin execution and result in MATLAB or other errors?

Ensure that you included all necessary files when compiling your application (see the `readme.txt` file generated with your compilation for more details).

Functions that are called from your main M-file are automatically included by MATLAB Compiler; however, functions that are not explicitly called, for example through EVAL, need to be included at compilation using the `-a` switch of the `mcc` command. Also, any support files like `.mat`, `.txt`, or `.html` files need to be added to the archive with the `-a` switch. There is a limitation on the functionality of MATLAB and associated toolboxes that can be compiled. Check the documentation to see that the functions used in your application's M-files are valid. Check the file `mccExcludedFiles.log` on the development machine. This file lists all functions called from your application that cannot be compiled.

Does the application emit a warning like "MATLAB file may be corrupt"?

See the listing for this error message in "MATLAB® Compiler" on page 9-15 for possible solutions.

Do you have multiple MATLAB versions installed?

Executables generated by MATLAB Compiler are designed to run in an environment where multiple versions of MATLAB are installed. Some older versions of MATLAB may not be fully compatible with this architecture. Ensure that the *`matlabroot`*`/bin/win32` of the version of MATLAB in which you are compiling appears ahead of *`matlabroot`*`/bin/win32` of other versions of MATLAB installed on the `PATH` environment variable on your machine. On UNIX, you can compare the outputs of `!printenv` at the MATLAB prompt and `printenv` at the shell prompt. Using this path should allow you to use `mcc` from the operating system command line.

If you are testing a standalone executable or shared library and driver application, did you install the MCR?

All shared libraries required for your standalone executable or shared library are contained in the MATLAB Compiler Runtime (MCR). Installing the MCR is required for any of the deployment targets.

Do you receive an error message about a missing DLL?

Error messages indicating missing DLLs such as `mclmcrrt7x.dll` or `mclmcrrt7x.so` are generally caused by incorrect installation of the MCR.

It is also possible that the MCR is installed correctly, but that the `PATH`, `LD_LIBRARY_PATH`, or `DYLD_LIBRARY_PATH` variables are set incorrectly. For information on installing the MCR on a deployment machine, refer to "Working with the MCR" on page 4-19.

Caution Do not solve these problems by moving libraries or other files within the MCR directory structure. The runtime system is designed to accommodate different MCR versions operating on the same machine. The directory structure is an important part of this feature.

Are you receiving errors when trying to run the shared library application?

Calling MATLAB Compiler generated shared libraries requires correct initialization and termination in addition to library calls themselves. For information on calling shared libraries, see "MATLAB® Compiler Generated Interface Functions" on page 7-23.

Some key points to consider to avoid errors at run time:

- Ensure that the calls to `mclinitializeApplication` and `*libname*Initialize` are successful. The first function enables construction of MCR instances. The second creates the MCR instance required by the library named `*libname*`. If these calls are not successful, your application will not execute.
- Do not use any `mw-` or `mx`-functions before calling `mclinitializeApplication`. This includes static and global variables that are initialized at program start. Referencing `mw-` or `mx`-functions before initialization results in undefined behavior.
- Do not reinitialize (call `mclinitializeApplication`) after terminating it with `mclTerminateApplication`. The `mclinitializeApplication` and`*libname*Initialize` functions should be called only once.
- Ensure that you do not have any library calls after `mclTerminateApplication`.
- Ensure that you are using the correct syntax to call the library and its functions.

Does the Failure Occur When Deploying the Application to End Users?

After the application is working on the test machine, failures can be isolated in end-user deployment. The end users of your application need to execute `MCRInstaller` in order to install the MATLAB Compiler Runtime (MCR) on their machines. The MCR includes a set of shared libraries that provides support for all features of MATLAB. If your application fails during end-user deployment, the following questions in the column to the right may help you isolate the problem.

Is the MCR installed?

All shared libraries required for your standalone executable or shared library are contained in the MCR. Installing the MCR is required for any of the deployment targets. See "Working with the MCR" on page 4-19 for complete information.

If running on UNIX or Mac, did you update the dynamic library path after installing the MCR?

For information on installing the MCR on a deployment machine, refer to "Working with the MCR" on page 4-19.

Do you receive an error message about a missing DLL?

Error messages indicating missing DLLs such as `mclmcrrt7x.dll` or `mclmcrrt7x.so` are generally caused by incorrect installation of the MCR. It is also possible that the MCR is installed correctly, but that the `PATH`, `LD_LIBRARY_PATH`, or `DYLD_LIBRARY_PATH` variables are set incorrectly. For information on installing the MCR on a deployment machine, refer to "Working with the MCR" on page 4-19.

Caution Do not solve these problems by moving libraries or other files within the MCR directory structure. The runtime system is designed to accommodate different MCR versions operating on the same machine. The directory structure is an important part of this feature.

Do you have write access to the directory the application is installed in?

The first operation attempted by a compiled application is extraction of the CTF archive. If the archive is not extracted, the application cannot access the compiled M-code and the application fails. If the application has write access to the installation directory, a subdirectory named `application-name_mcr` is created the first time the application is run. After this subdirectory is created, the application no longer needs write access for subsequent executions.

Are you executing a newer version of your application?

When deploying a newer version of an executable, both the executable needs to be redeployed, since it also contains the embedded CTF file. The CTF file is keyed to a specific compilation session. Every time an application is recompiled, a new, matched CTF file is created. As above, write access is required to expand the new CTF file. Deleting the existing `application-name_mcr` directory and running the new executable will verify that the application can expand the new CTF file.

mbuild

This section identifies some of the more common problems that might occur when configuring `mbuild` to create standalone applications.

Options File Not Writeable. When you run `mbuild -setup`, `mbuild` makes a copy of the appropriate options file and writes some information to it. If the options file is not writeable, you are asked if you want to overwrite the existing options file. If you choose to do so, the existing options file is copied to a new location and a new options file is created.

Directory or File Not Writeable. If a destination directory or file is not writeable, ensure that the permissions are properly set. In certain cases, make sure that the file is not in use.

mbuild Generates Errors. If you run `mbuild filename` and get errors, it may be because you are not using the proper options file. Run `mbuild -setup` to ensure proper compiler and linker settings.

Compiler and/or Linker Not Found. On Windows, if you get errors such as `unrecognized command` or `file not found`, make sure the command-line tools are installed and the path and other environment variables are set correctly in the options file. For Microsoft® Visual Studio®, for example, make sure to run `vcvars32.bat` (MSVC 6.x and earlier) or `vsvars32.bat` (MSVC 7.x).

mbuild Not a Recognized Command. If `mbuild` is not recognized, verify that *`matlabroot`*`\bin` is in your path. On UNIX, it may be necessary to rehash.

mbuild Works from the Shell But Not from MATLAB (UNIX). If the command

```
mcc -m hello
```

works from the UNIX command prompt but not from the MATLAB prompt, you may have a problem with your `.cshrc` file. When MATLAB launches a new C shell to perform compilations, it executes the `.cshrc` script. If this script causes unexpected changes to the `PATH` environment variable, an error may occur. You can test this before starting MATLAB by performing the following:

```
setenv SHELL /bin/sh
```

If this works correctly, then you should check your `.cshrc` file for problems setting the `PATH` environment variable.

Cannot Locate Your Compiler (Windows). If `mbuild` has difficulty locating your installed compilers, it is useful to know how it finds compilers. `mbuild` automatically detects your installed compilers by first searching for locations specified in the following environment variables:

- `MSVCDIR` for Microsoft Visual C++, Version 6.0, 7.1, or 8.0

Next, `mbuild` searches the Windows registry for compiler entries.

Internal Error when Using mbuild -setup (Windows). Some antivirus software packages may conflict with the `mbuild -setup` process. If you get an error message during `mbuild -setup` of the following form

```
mex.bat: internal error in sub get_compiler_info(): don't
recognize <string>
```

then you need to disable your antivirus software temporarily and rerun `mbuild -setup`. After you have successfully run the `setup` option, you can reenable your antivirus software.

Verification of mbuild Fails. If none of the previous solutions addresses your difficulty with `mbuild`, contact Technical Support at The MathWorks at `http://www.mathworks.com/contact_TS.html`.

MATLAB Compiler

Typically, problems that occur when building standalone C and C++ applications involve `mbuild`. However, it is possible that you may run into some difficulty with MATLAB Compiler. A good source for additional troubleshooting information for the product is the MATLAB Compiler Product Support page at the MathWorks Web site.

libmwlapack: load error: stgsy2_. This error occurs when a customer has both the R13 and the R14 version of MATLAB or MCR/MGL specified in the directory path and the R14 version fails to load because of a lapack incompatability.

Licensing Problem. If you do not have a valid license for MATLAB Compiler , you will get an error message similar to the following when you try to access MATLAB Compiler:

```
Error: Could not check out a Compiler License:
No such feature exists.
```

If you have a licensing problem, contact The MathWorks. A list of contacts at The MathWorks is provided at the beginning of this document.

MATLAB Compiler Does Not Generate the Application. If you experience other problems with MATLAB Compiler, contact Technical Support at The MathWorks at `http://www.mathworks.com/contact_TS.html`.

"MATLAB file may be corrupt" Message Appears. If you receive the message

```
This MATLAB file does not have proper version information and
may be corrupt. Please delete the extraction directory and
rerun the application.
```

when you run your standalone application that was generated by MATLAB Compiler, you should check the following:

- Do you have a `startup.m` file that calls `addpath`? If so, this will cause run-time errors. As a workaround, use `isdeployed` to have the `addpath` command execute only from MATLAB. For example, use a construct such as:

```
if ~isdeployed
 addpath(path);
end
```

- Verify that the `.ctf` archive file self extracted and that you have write permission to the directory.
- Verify that none of the files in the `<application name>_mcr` directory have been modified or removed. Modifying this directory is not supported, and if you have modified it, you should delete it and redeploy or restart the application.
- If none of the above possible causes apply, then the error is likely caused by a corruption. Delete the `<application name>_mcr` directory and run the application.

Missing Functions in Callbacks. If your application includes a call to a function in a callback string or in a string passed as an argument to the `feval` function or an ODE solver, and this is the only place in your M-file this function is called, MATLAB Compiler will not compile the function. MATLAB Compiler does not look in these text strings for the names of functions to compile. See "Fixing Callback Problems: Missing Functions" on page 8-3 for more information.

"MCRInstance not available" Message Appears. If you receive the message `MCRInstance not available` when you try to run a standalone application that was generated with MATLAB Compiler, it could be that the MCR is not located properly on your path or the CTF file is not in the proper directory (if you extracted it from your binary).
The UNIX verification process is the same, except you use the appropriate UNIX path information.

To verify that the MCR is properly located on your path, from a development Windows machine, confirm that *`matlabroot`*`\bin\win32`, where *`matlabroot`* is your root MATLAB directory, appears on your system path ahead of any other MATLAB installations.

From a Windows target machine, verify that `<mcr_root>\<ver>\runtime\win32`, where `<mcr_root>` is your root MCR directory, appears on your system path. To verify that the CTF file that MATLAB Compiler generated in the build process resides in the same directory as your program's file, look at the directory containing the program's file and make sure the corresponding `.ctf` file is also there.

Unable to Run MCRInstaller.exe on a Target Windows Machine. If you receive the message

```
This advertised application would not be installed because it
might be Unsafe. Contact your administrator to change the
installation user interface option of the package to basic.
```

when you try to install MATLAB Compiler Runtime (MCR) using `MCRInstaller.exe` on a Windows machine, you need to log in as an administrator. If this is not possible and you have no objection to installing the MCR in the default location, try the following command from a DOS window:

```
msiexec /qb /I MCRInstaller.msi
```

`MCRInstaller.msi` should have been placed in the installation directory after your first attempt to install the MCR. This command will start the installer using the basic UI configuration, which will execute at a lower security level.

Warning C:\WORK\R2008B~1\LCC\foo_delay_load.c: 21 static 'void function(void) FailedToLoadMCR' is not referenced. This warning message is produced as indirect output from of an internal delay load job that is only seen by Microsoft Visual C++ compiler users. The message is benign and should be ignored.

warning LNK4248: unresolved typeref token (01000028) for 'mxArray_tag'; image may not run test3.obj. If you receive this message while compiling an MSVC application that calls a MATLAB Compiler generated shared library, you can safely ignore it. The message is due to changes in the Visual C++® 2005 compiler and will not interfere with successful running of your application. If you desire, you can suppress the message by including an empty definition for `mxArray_tag` inside your `.cpp` file (`test3.cpp`, in this case). For example, if you add the line

```
struct mxArray_tag {};
```

at the beginning of your code and after the `include` statements, the warning will not recur.

Deployed Applications

Failed to decrypt file. The M-file "<ctf_root>\toolbox\compiler\deploy\matlabrc.m" cannot be executed. The application is trying to use a CTF archive that does not belong to it. Applications and CTF archives are tied together at compilation time by a unique cryptographic key, which is recorded in both the application and the CTF archive. The keys must match at run time. If they don't match, you will get this error.

To work around this, delete the `*_mcr` directory corresponding to the CTF archive and then rerun the application. If the same failure occurs, you will likely need to recompile the application using MATLAB Compiler and copy both the application binary and the CTF archive into the installation directory.

This application has requested the run time to terminate in an unusual way. This indicates a segmentation fault or other fatal error. There are too many possible causes for this message to list them all.

To try to resolve this problem, run the application in the debugger and try to get a stack trace or locate the line on which the error occurs. Fix the offending code, or, if the error occurs in a MathWorks library or generated code, contact MathWorks technical support.

Checking access to X display <IP-address>:0.0 . . .
If no response hit ^C and fix host or access control to host.
Otherwise, checkout any error messages that follow and fix . . .
Successful. . . . . This message can be ignored.

??? Error: File: /home/username/<M-file_name> Line: 1651 Column: 8 Arguments to IMPORT must either end with ".*" or else specify a fully qualified class name: "<class_name>" fails this test. The `import` statement is referencing a Java class (`<class_name>`) that MATLAB Compiler (if the error occurs at compile time) or the MCR (if the error occurs at run time) cannot find.

To work around this, ensure that the JAR file that contains the Java class is stored in a directory that is on the Java class path. (See `*matlabroot*/toolbox/local/classpath.txt` for the class path.) If the error occurs at run time, the classpath is stored in `*matlabroot*/toolbox/local/classpath.txt` when running on the development machine. It is stored in `<mcr_root>/toolbox/local/classpath.txt` when running on a target machine.

Warning: Unable to find Java library: matlabroot\sys\java\jre\win32\jre<version>\bin\client\jvm.dll Warning: Disabling Java support. This warning indicates that a compiled application could not find the Java virtual machine, and therefore, the compiled application cannot run any Java code. This will affect your ability to display graphics.

To resolve this, ensure that `jvm.dll` is in the `*matlabroot*\sys\java\jre\win32\jre<version>\bin\client` directory and that this directory is on your system path.

Warning: matlabroot\toolbox\local\pathdef.m not found. Toolbox Path Cache is not being used. Type 'help toolbox_path_cache' for more info. The `pathdef.m` file defines the MATLAB startup path. MATLAB Compiler does not include this file in the generated CTF archive because the MCR path is a subset of the full MATLAB path.
This message can be ignored.

Undefined function or variable 'matlabrc'. When MATLAB or the MCR starts, they attempt to execute the M-file `matlabrc.m`. This message means that this file cannot be found.

To work around this, try each of these suggestions in this order:

- Ensure that your application runs in MATLAB (uncompiled) without this error.
- Ensure that MATLAB starts up without this error.
- Verify that the generated CTF archive contains a file called `matlabrc.m`.
- Verify that the generated code (in the `*_mcc_component_data.c*` file) adds the CTF archive directory containing `matlabrc.m` to the MCR path.
- Delete the `*_mcr` directory and rerun the application.
- Recompile the application.

This MATLAB file does not have proper version information and may be corrupt. Please delete the extraction directory and rerun the application. The M-file <M-file> cannot be executed. MATLAB:err_parse_cannot_run_m_file. This message is an indication that the MCR has found nonencrypted M-files on its path and has attempted to execute them. This error is often caused by the use of `addpath`, either explicitly in your application, or implicitly in a `startup.m` file. If you use `addpath` in a compiled application, you must ensure that the added directories contain only data files. (They cannot contain M-files, or you'll get this error.)

To work around this, protect your calls to `addpath` with the `isdeployed` function.

This application has failed to start because mclmcrrt7x.dll was not found. Re-installing the application may fix this problem. `mclmcrrt7x.dll` contains the public interface to the MCR. This library must be present on all machines that run applications generated by MATLAB Compiler. Typically, this means that either the MCR is not installed on this machine, or that the PATH does not contain the directory where this DLL is located.

To work around this, install the MCR or modify the path appropriately. The path must contain `<mcr_root>/<version>/runtime/<arch>`, for example: `c:\mcr\v73\runtime\win32`.

Linker cannot find library and fails to create standalone application (win32 and win64). If you try building your standalone application without `mbuild`, you must link to the following dynamic library:

```
mclmcrrt.lib
```

This library is found in one of the following locations, depending on your architecture:

```
matlabroot\extern\lib\win32\arch
matlabroot\extern\lib\win64\arch
```

where *`arch`* is `microsoft`, `watcom`, or `lcc`.

Version 'GCC_4.2.0' not found. When running on Linux platforms, users may report that a run time error occurs that states that the GCC_4.2.0 library is not found by applications built with MATLAB Compiler.

To resolve this error, do the following:

1 Navigate to *`matlabroot`*`/sys/os/glnx86`.

2 Rename the following files with a prefix of `old_`:

   - `libgcc_s.so.1`
   - `libstdc++.so.6.0.8`
   - `libgfortran.so.1.0.0`

   For example, rename `libgcc_s.so.1` to `old_libgcc_s.so.1`. you must rename all three of the above files. Alternately, you can create a subdirectory named `old` and move the files there.

Error: library mclmcrrt76.dll not found. This error can occur for the following reasons:

- The machine on which you are trying to run the application an different, incompatible version of the MCR installed on it than the one the application was originally built with.
- You are not running a version of MATLAB Compiler compatible with the MCR version the application was built with.

To solve this problem, on the deployment machine, install the version of MATLAB you used to build the application.

Invalid .NET Framework.\*n* Either the specified framework was not found or is not currently supported. This error occurs when the .NET Framework version your application is specifying (represented by *n*) is not supported by the current version of MATLAB Compiler.

Reference Information

Directories Required for Development and Testing

In this section...

Overview

The following information is for programmers developing applications that use libraries or components that contain compiled M-code. These settings are required on the machine where you are developing your application. Other settings required by end users at run time are described in "Directories Required for Run-Time Deployment" on page 10-5.

Note For *`matlabroot`*, substitute the MATLAB root directory on your system. Type `matlabroot` to see this directory name.

Path for Java Development on All Platforms

There are additional requirements when programming in the Java programming language. See "Deploying Applications That Call the Java Native Libraries" on page 5-30.

Windows Settings for Development and Testing

When programming with components that are generated with MATLAB Compiler, add the following directory to your system `PATH` environment variable:

```
matlabroot\bin\win32
```

UNIX Settings for Development and Testing

When programming with components that are generated with MATLAB Compiler, use the following commands to add the required platform-specific directories to your dynamic library path.

Note For readability, the following commands appear on separate lines, but you must enter each `setenv` command on one line. The `setenv` command is specific to the C shell (csh). See "Compiling and Linking MAT-File Programs" for more information.

Linux

```
setenv LD_LIBRARY_PATH
 matlabroot/sys/os/glnx86:
 matlabroot/bin/glnx86:
 matlabroot/sys/java/jre/glnx86/jre/lib/i386/native_threads:
 matlabroot/sys/java/jre/glnx86/jre/lib/i386/server:
 matlabroot/sys/java/jre/glnx86/jre/lib/i386:
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Solaris 64

```
setenv LD_LIBRARY_PATH
/usr/lib/lwp:
matlabroot/sys/os/sol64:
matlabroot/bin/sol64:
matlabroot/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/native_threads:
matlabroot/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/server:
matlabroot/sys/java/jre/sol64/jre1.5.0/lib/sparcv9:
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Linux x86-64

```
setenv LD_LIBRARY_PATH
 matlabroot/sys/os/glnxa64:
 matlabroot/bin/glnxa64:
```

```
 matlabroot/sys/java/jre/glnxa64/jre/lib/amd64/native_threads:
 matlabroot/sys/java/jre/glnxa64/jre/lib/amd64/server:
 matlabroot/sys/java/jre/glnxa64/jre/lib/amd64:
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Mac OS X

```
setenv DYLD_LIBRARY_PATH
 matlabroot/bin/mac:
 matlabroot/sys/os/mac:
 /System/Library/Frameworks/JavaVM.framework/JavaVM:
 /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR matlabroot>/X11/app-defaults
```

You can then run the compiled applications on your development machine to test them.

Intel Mac (Maci)

```
setenv DYLD_LIBRARY_PATH
  matlabroot/bin/maci:
  matlabroot/sys/os/maci:
  /System/Library/Frameworks/JavaVM.framework/JavaVM:
  /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR matlabroot/X11/app-defaults
```

Note If you are running a version of Intel Mac later than 10.3, use the `bsh`, rather than the `csh`, shell.

Directories Required for Run-Time Deployment

In this section...

General Path Guidelines

Regardless of platform, be aware of the following guidelines with regards to placing specific directories on the path:

- Always avoid including `bin` or `arch` on the path. Failure to do so may inhibit ability to run multiple MCR instances.
- Ideally, set the environment in a separate shell script to avoid runtime errors caused by path-related issues.

Path for Java Applications on All Platforms

When your users run applications that contain compiled M-code, you must instruct them to set the path so that the system can find the MCR.

Note When you deploy a Java application to end users, they must set the class path on the target machine.

The system needs to find `.jar` files containing the MATLAB libraries. To tell the system how to locate the `.jar` files it needs, specify a `classpath` either in the `javac` command or in your system environment variables.

Windows Path for Run-Time Deployment

The following directory should be added to the system path:

```
mcr_root\version\runtime\win32
```

where *mcr_root* refers to the complete path where the MCR library archive files are installed on the machine where the application is to be run.

mcr_root is version specific; you must determine the path after you install the MCR.

UNIX Paths for Run-Time Deployment

Note For readability, the following commands appear on separate lines, but you must enter each setenv command on one line. The setenv command is specific to the C shell (csh). See "Compiling and Linking MAT-File Programs" for more information.

Linux

```
setenv LD_LIBRARY_PATH
 mcr_root/version/runtime/glnx86:
 mcr_root/version/sys/os/glnx86:
 mcr_root/version/sys/java/jre/glnx86/jre/lib/i386/native_threads:
 mcr_root/version/sys/java/jre/glnx86/jre/lib/i386/server:
 mcr_root/version/sys/java/jre/glnx86/jre/lib/i386:
setenv XAPPLRESDIR mcr_root/version/X11/app-defaults
```

Solaris 64

```
setenv LD_LIBRARY_PATH
 /usr/lib/lwp:
 mcr_root/version/runtime/sol64:
 mcr_root/version/sys/os/sol64:
 mcr_root/version/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/native_threads:
 mcr_root/version/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/server:
  mcr_root/version/sys/java/jre/sol64/jre1.5.0/lib/sparcv9/client:
  mcr_root/version/sys/java/jre/sol64/jre1.5.0/lib/sparcv9:
setenv XAPPLRESDIR mcr_root/version/X11/app-defaults
```

Linux x86-64

```
setenv LD_LIBRARY_PATH
 mcr_root/version/runtime/glnxa64:
 mcr_root/version/sys/os/glnxa64:
 mcr_root/version/sys/java/jre/glnxa64/jre/lib/amd64/native_threads:
 mcr_root/version/sys/java/jre/glnxa64/jre/lib/amd64/server:
 mcr_root/version/sys/java/jre/glnxa64/jre/lib/amd64:
setenv XAPPLRESDIR mcr_root/version/X11/app-defaults
```

Mac OS X

```
setenv DYLD_LIBRARY_PATH
 mcr_root/version/runtime/mac:
 mcr_root/version/sys/os/mac:
 mcr_root/version/bin/mac:
 /System/Library/Frameworks/JavaVM.framework/JavaVM:
 /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR mcr_root/version/X11/app-defaults
```

Intel Mac (Maci)

```
setenv DYLD_LIBRARY_PATH
   mcr_root/version/runtime/maci:
   mcr_root/version/sys/os/maci:
   mcr_root/version/bin/maci:
   /System/Library/Frameworks/JavaVM.framework/JavaVM:
   /System/Library/Frameworks/JavaVM.framework/Libraries
setenv XAPPLRESDIR mcr_root/version/X11/app-defaults
```

Note If you are running a version of Intel Mac later than 10.3, use the `bsh`, rather than the `csh`, shell.

MATLAB Compiler Licensing

Using MATLAB Compiler Licenses for Development

You can run MATLAB Compiler from the MATLAB command prompt (MATLAB mode) or the DOS/UNIX prompt (standalone mode).

Running MATLAB Compiler in MATLAB Mode

When you run MATLAB Compiler from “inside” of the MATLAB environment, that is, you run `mcc` from the MATLAB command prompt, you hold the MATLAB Compiler license as long as MATLAB remains open. To give up the MATLAB Compiler license, exit MATLAB.

Running MATLAB Compiler in Standalone Mode

If you run MATLAB Compiler from a DOS or UNIX prompt, you are running from “outside” of MATLAB. In this case, MATLAB Compiler

- Does not require MATLAB to be running on the system where MATLAB Compiler is running
- Gives the user a dedicated 30-minute time allotment during which the user has complete ownership over a license to MATLAB Compiler

Each time a user requests MATLAB Compiler , the user begins a 30-minute time period as the sole owner of the MATLAB Compiler license. Anytime during the 30-minute segment, if the same user requests MATLAB Compiler , the user gets a new 30-minute allotment. When the 30-minute interval has elapsed, if a different user requests MATLAB Compiler , the new user gets the next 30-minute interval.

When a user requests MATLAB Compiler and a license is not available, the user receives the message

```
Error: Could not check out a Compiler License.
```

This message is given when no licenses are available. As long as licenses are available, the user gets the license and no message is displayed. The best way to guarantee that all MATLAB Compiler users have constant access to MATLAB Compiler is to have an adequate supply of licenses for your users.

Using MCR Installer Command Line Options

In this section...

Overview

If you distribute your compiled components to users who do not have MATLAB installed on their systems, they must install the MATLAB Compiler Runtime (MCR). To install the MCR, users of your component must run the MCR Installer for their platform: `MCRInstaller.exe` for Windows systems and `MCRInstaller.bin` for UNIX and Linux systems. (The MathWorks uses a different MCR installation program on Macintosh systems.)

The MCR Installer supports command line options that can be helpful in certain instances. For example, if you want to automate installation of the MCR for users of your component, you might want to run the MCR Installer in silent mode, where no interaction with the user is required. To accomplish this, you must use MCR Installer command line options. The following sections describe some commonly used command line options for Windows, UNIX, and Linux systems.

Displaying MCR Installer Location and Related Information

Use the `mcrinstaller` command to display information about the location of available MCR installers on your system. See the Chapter 11, "Function Reference" for more information about using this command.

Accessing MCR Installer Command Line Options on Windows Systems

The following table lists some frequently used command line options for the MCR Installer on Windows systems (`MCRInstaller.exe`). The MCR installer is implemented using both an InstallShield wizard and the Windows Installer tool, `Msiexec.exe`. Both installers support command line options and you can specify these options on the MCR installer command line. To specify `Msiexec` command line arguments, you must use the InstallShield `/v` argument. For more information about these tools, see the appropriate documentation from their vendors: InstallShield (the Basic MSI project options only) and `Msiexec.exe`. Examples of using these command line options follow.

Frequently Used MCR Installation Options on Windows Systems

Option	Description
`/a`	Performs installation as an administrator. This option is useful if you want to uncompress the installation so you can extract the MSI install and repackage it with your options. The `/a` option requires Windows Administrator access.
`/L`*`decimal_language_ID`*	Specifies the language (*`decimal_language_ID`*) to be used by a multi-language installation program.
`/n`	Runs without a GUI. This is an `Msiexec.exe` option that must be passed using the `/v` option.
`/q`	Runs in quiet mode. This is an `Msiexec.exe` option that must be passed using the `/v` option.
`/s`	Runs the installation in silent mode. There must be a space after `/s`.
`/v`	Pass command-line options and values of public properties to `Msiexec.exe`. Make sure there is no space after `/v`. Also, you can use double quotation marks (`"  "`) to delimit the arguments to `/v`, but you still cannot have a space between `/v` and the enclosing quotation marks.

Frequently Used MCR Installation Options on Windows Systems (Continued)

Option	Description
`/x`	Uninstall the MCR.
`/w`	Wait until the installation is complete before exiting.

Example: Performing a Silent Installation

To perform a silent installation, you must use the `/s` option, to suppress the InstallShield wizard, and specify the `/q` and `/n` options to suppress the `Msiexec` GUI. In the following example, you must use the `/v` option to pass the `Msiexe` options, and there is no space between the `/v` and the quotation mark that encloses the `Msiexec` options. The example specifies the directory where you want to install the MCR. You only need to specify this if you don't want to use the default installation directory:*`matlabroot`*`\MATLAB Compiler Runtime\`*`mcrversion`*, where *`matlabroot`* is the root directory for the MATLAB installation and *`mcrversion`* is the version number of the MCR. The example also specifies the language, using the `/L` option

```
MCRInstaller.exe /L1033 /s /v"/qn INSTALLDIR=D:\MCR\release"
```

Example: Requesting a Verbose Log of the Install Process

The following command causes the installer to create a verbose log of the install process in `C:\log.txt`. For information about the `Msiexec` options passed with `/v`, see the `Msiexec` documentation.

```
MCRInstaller.exe /v"/L*v \"C:\log.txt\""
```

.

Accessing MCR Installer Command Line Options on UNIX and Linux Systems

The following table lists some frequently used command line options for the MCR Installer on UNIX and Linux systems (`MCRInstaller.bin`). The MCR Installer on UNIX and Linux systems is implemented using the InstallShield

Universal Java installer. The universal installer supports two types of command line options: installation launcher options and run-time options. You can specify any mix of these options on the MCR Installer command line. If you extract the Jar file from the installation launcher (using installation launcher options) and call it directly, you must use the run-time options. Examples of using these command line options follow.

Frequently Used MCR Installer Options on UNIX or Linux Systems

Option	Description
`-cp:a <classpath>`	Appends (add to the end) `<classpath>` to the launcher's classpath.
`-cp:p <classpath>`	Prepends (add to the beginning) `<classpath>` to the launcher's classpath
`-is:extract`	Extracts the contents of the archive.
`-is:help`	Displays command line option help text and exits.
`-is:log <filename>`	Specifies file in which to write debug messages.
`-log`	Specifies file in which to write debug messages (run-time version)
`-is:nospacecheck`	Turns off launcher disk space checking.
`-P`	Specifies properties of a product bean, such as the bean ID.
`-is:silent`	Prevents the display of the application launcher UI. To run in silent mode, use the `-silent` run-time option.
`-silent`	Specifies to install or uninstall the product in silent mode, where the installation/uninstallation is performed with no user interaction.
`-is:tempdir <dir>`	Specifies the temporary directory to be used by the launcher.

Uninstalling the MCR on UNIX Systems

To remove an MCR installation on UNIX systems, run the `uninstaller.bin` program.

It is important to run the uninstaller, rather than just removing the MCR installation directory using the `rm` command, because an MCR installation affects other aspects of your environment. For example, the MCR installer creates a directory named `InstallShield` in your UNIX home directory that stores information about your particular MCR installation. When you use the MCR uninstaller, it removes some of these additional directories.

To run the MCR uninstaller, follow this procedure:

1. Navigate to your MCR installation directory using the `cd` command.

2. `cd` into the `_uninst` directory

3. Run the `uninstaller.bin` program. If you want to run the uninstaller noninteractively, specify the `-silent` option on the command line.

Example: Extracting the Jar File from the MCR Installer

The MathWorks includes the JRE required by the MCR Installer. However, your Linux system might not support this version of the JRE. To work around this issue, you can extract the Jar file from the MCR installer (MCRInstaller.bin) and call the Jar file directly, using the JRE that works with your system. The following provides a step-by-step instructions.

1. Extract the Java Jar file from the application launcher, using the `is:extract` installation launcher option.

   ```
   MCRInstaller.bin -is:extract
   ```

   This option extracts the components, including the Jar file`setup.jar`.

2. Run the Jar file using the JRE that works with your system.

   ```
   java -jar setup.jar
   ```

   This starts the installer GUI.

Example: Performing a Noninteractive (Silent) Installation of the MCR

To perform a noninteractive (silent) installation, you must use the `-silent` run-time option. This example also uses the `-P` option to specify a particular Java bean.

```
MCRInstaller.bin -P bean421.installLocation="desiredInstallPath" -silent
```

Function Reference

Pragmas

`%#external`	Pragma to call arbitrary C/C++ functions from M-code
`%#function`	Pragma to help MATLAB Compiler locate functions called through `feval`, `eval`, or Handle Graphics® callback

Command-Line Tools

`builder2prj`	Convert project files with suffixes `.cbl`, `.nbl`, and `.mxl` to `.prj` (`deploytool`) format
`ctfroot`	Root directory of application in deployed mode
`deployprint`	Use to print (as substitute for MATLAB `print` function) when working with deployed Windows applications
`deploytool`	Open Deployment Tool, GUI for MATLAB Compiler
`hardcopy`	Saves figure window to file
`isdeployed`	Determine whether code is running in deployed or MATLAB mode
`ismcc`	Test if code is running during compilation process (using `mcc`)
`mbuild`	Compile and link source files into standalone application or shared library
`mcc`	Invoke MATLAB Compiler

`mcrinstaller`	Displays version and location information for MCR installer(s) corresponding to current platform.
`mcrversion`	Determine version of installed MATLAB Compiler Runtime (MCR)

API Functions

`<library>Initialize[WithHandlers]`	Initializes MCR instance associated with *`library`*
`<library>Terminate`	Frees all resources allocated by MCR instance associated with *`library`*
`GetMcrID`	Return identifier of MCR instance associated with software component `libname`
`getmcruserdata`	Retrieve MATLAB array value associated with given string key
`mclGetLogFileName`	Retrieves name of log file used by the MCR
`mclGetMCRUserData`	Retrieve MATLAB data associated with string key of MCR instance uniquely identified by `mcrID`
`mclInitializeApplication`	Sets up application state shared by all (future) MCR instances created in current process. Called only once per process.
`mclIsJVMEnabled`	Determines if MCR was launched with instance of a Java Virtual Machine (JVM)
`mclIsMCRInitialized`	Determines if MCR has been properly initialized

`mclIsNoDisplaySet`	Determines if `-nodisplay` mode is enabled.
`mclKillAllFigures`	Finds and deletes open figures
`mclSetCmdLineMCRUserData`	Associate MATLAB data value with string key of MCR instance uniquely identified by `mcrID`
`mclSetMCRUserData`	Associate MATLAB data value with string key of MCR instance uniquely identified by `mcrID`
`mclTerminateApplication`	Closes down all MCR-internal application state. Called only once per process.
`mclWaitForFiguresToDie`	Enables deployed applications to process Handle Graphics events, enabling figure windows to remain displayed.
`setmcruserdata`	Associate MATLAB data value with string key

Functions — Alphabetical List

Purpose

Pragma to call arbitrary C/C++ functions from M-code

Syntax

`%#external`

Description

The `%#external` pragma informs MATLAB Compiler that the implementation version of the function (`Mlx`*`f`*) will be hand written and not generated from the M-code. This pragma affects only the single function in which it appears, and any M-function may contain this pragma (local, global, private, or method).

Note If you compile a program that contains the `%#external` pragma, you must explicitly pass each file that contains this pragma on the `mcc` command line.

When using this pragma, MATLAB Compiler will generate an additional header file called *`function_name`*`_external.h`, where *`function_name`* is the name of the initial M-function containing the `%#external` pragma. This header file will contain the `extern` declaration of the function that the user must provide. This function must conform to the same interface as code generated by MATLAB Compiler. For more information on the `%#external` pragma, see “Interfacing M-Code to C/C++ Code” on page 5-14.

# %#function

Purpose

Pragma to help MATLAB Compiler locate functions called through `feval`, `eval`, or Handle Graphics® callback

Syntax

`%#function` *`function1`* `[`*`function2 ... functionN`*`]`

`%#function` *`object_constructor`*

Description

The `%#function` pragma informs MATLAB Compiler that the specified function(s) will be called through an `feval`, `eval`, or Handle Graphics callback.

Use the `%#function` pragma in standalone C and C++ applications to inform MATLAB Compiler that the specified function(s) should be included in the compilation, whether or not MATLAB Compiler's dependency analysis detects the function(s). It is also possible to include objects by specifying the object constructor.

Without this pragma, the product's dependency analysis will not be able to locate and compile all M-files used in your application. This pragma adds the top-level function as well as all the subfunctions in the file to the compilation.

Examples

Example 1

```
function foo
  %#function bar

     feval('bar');

  end %function foo
```

By implementing this example, MATLAB Compiler is notified that function `bar` will be included in the compilation and is called through `feval`.

Example 2

```
function foo
   %#function bar foobar
```

```
       feval('bar');
       feval('foobar');

   end %function foo
```

In this example, multiple functions (bar and foobar) are included in the compilation and are called through feval.

builder2prj

Purpose

Convert project files with suffixes `.cbl`, `.nbl`, and `.mxl` to `.prj` (`deploytool`) format

Syntax

```
builder2prj
builder2prj([project.cbl,project.nbl,project.mxl])
builder2prj([project.cbl,project.nbl,project.mxl],
            new_project.prj)
```

Description

This function converts project files in older formats such as`.cbl`, `.nbl`, and `.mxl`, to a format usable by `deploytool` (`.prj`).

Examples

Example 1

```
builder2prj;
```

Entering this command opens the Builder Project File dialog box, which enables you to browse for the project you wish to convert. Navigate to the `.cbl`, `.nbl`, or `.mxl` project file, select the file name, and click Open to start the conversion process.

Example 2

```
builder2prj(my_project.cbl);
```

In this example, `builder2prj` locates `my_project.cbl` in your present working directory and converts the file to `deploytool`-compatible format (`.prj` format). In this example, after `builder2prj` runs, only the file suffix (`.cbl`) has changed. The new project name is the same as the old project name, but with a new suffix (`my_project.prj`).

Example 3

```
builder2prj(my_project.mxl,renamed_project.prj);
```

By specifying a second file name argument, you can choose a specific name for your `deploytool`-compatible project. In this example, `my_project.mxl` is located in your present working directory and `builder2prj` is run, converting the `.mxl` project to a `.prj` project. The new project is named `renamed_project.prj`.

ctfroot

Purpose Root directory of application in deployed mode

Syntax `ctfroot`

Description `root = ctfroot` returns a string that is the name of the directory where the CTF file for the deployed application is expanded.

To determine the location of various toolbox directories in deployed mode, use the `toolboxdir` function.

Example `appRoot = ctfroot;` will return the root of your applications in this form: *`application_name`*`_mcr`.

Use this function to access any file that the user would have included in their project (excluding the ones in the packaging directory).

Purpose

Use to print (as substitute for MATLAB `print` function) when working with deployed Windows applications

Syntax

```
deployprint
```

Description

In cases where the `print` command would normally be issued when running MATLAB software, use `deployprint` when working with deployed applications.

`deployprint` is available on all platforms, however it is only required on Windows.

`deployprint` supports all of the input arguments supported by `print` except for the following.

Argument	Description
`-d`	Used to specify the type of the output (for example. .JPG, .BMP, etc.). `deployprint` only produces .BMP files. **Note** To print to a file, use the `print` function.
`-noui`	Used to suppress printing of user interface controls. Similar to use in MATLAB `print` function.
`-setup`	The `-setup` option is not supported.
`-s` *`windowtitle`*	MATLAB Compiler does not support Simulink®.

`deployprint` supports a subset of the figure properties supported by `print`. The following are supported:

- `PaperPosition`
- `PaperSize`

- `PaperUnits`
- `Orientation`
- `PrintHeader`

Note `deployprint` requires write access to the file system in order to write temporary files.

Examples

The following is a simple example of how to print a figure in your application, regardless of whether the application has been deployed or not:

```
figure;
plot(1:10);
if isdeployed
 deployprint;
else
 print(gcf);
end
```

See Also

`isdeployed`, `print`

Purpose Open Deployment Tool, GUI for MATLAB Compiler

Syntax

```
deploytool
```

Description The `deploytool` command opens the Deployment Tool window, which is the graphical user interface (GUI) for MATLAB Compiler.

See Chapter 1, “Getting Started”, to get started using the Deployment Tool to create standalone applications and libraries.

GetMcrID

Purpose

Return identifier of MCR instance associated with software component `libname`

Syntax

`extern "C" long` *`libname`*`GetMcrID`

Description

The `extern "C" long` *`libname`*`GetMcrID` returns the identifier of the MCR instance associated with the software component *`libname`*. It allows applications that use more than one MATLAB Compiler generated software component (and hence, have more than one MCR instance active in-process) to distinguish between MCR instances when setting or getting MCR instance specific data. This function is automatically generated into every component created by MATLAB Compiler. This command is part of the MCR User Data interface API. For information about this function, as well as complete examples of usage, see "Improving Data Access Using the MCR User Data Interface" on page 4-24.

Example

```
if( !mclInitializeApplication(NULL,0) )
{
    fprintf(stderr, "Could not initialize the application.
            \n");
    return -1;
}

if (!libmatrixInitialize())
{
    fprintf(stderr,"Could not initialize the library.\n");
    return -2;
}

long mcrID = libmatrixGetMcrID();
mxArray *value = mxCreateString("/home/user/config.xml");
if (!mclSetMCRUserData(mcrID, "DCTConfigFile", value) )
{
    fprintf(stderr, "Could not set DCTConfigFile
                    MCR user data. \n");
```

```
        return -3;
    }

    ...
```

See Also `mclGetMCRUserData`, `mclSetMCRUserData`

getmcruserdata

Purpose

Retrieve MATLAB array value associated with given string key

Syntax

```
function_value = getmcruserdata(key)
```

Description

The `function_value = getmcruserdata(key)` command is part of the MCR User Data interface API. It returns an empty matrix if no such key exists. For information about this function, as well as complete examples of usage, see "Improving Data Access Using the MCR User Data Interface" on page 4-24.

Example

```
function_value =
              getmcruserdata('ParallelConfigurationFile');
```

See Also

`setmcruserdata`

Purpose

Saves figure window to file

Syntax

`hardcopy(`*`handle`*`,'`*`filename`*`','`*`format`*`')`

Description

The `hardcopy(`*`handle`*`,'`*`filename`*`','`*`format`*`')` command saves the figure window with *`handle`* to the designated *`filename`* in the specified *`format`*. Legal formats are:

- `-dps`
- `-deps`
- `-dps2`
- `-deps2`
- `-dill`
- `-dhpgl`

Caution

Call this function when converting a figure to pixel data. This can be necessary in some Web deployments. Do *not* use this function merely as a substitute for the `print` function.

isdeployed

Purpose Determine whether code is running in deployed or MATLAB mode

Syntax

```
x = isdeployed
```

Description `x = isdeployed` returns true (1) when the function is running in deployed mode and false (0) if it is running in a MATLAB session.

If you include this function in an application and compile the application with MATLAB Compiler, the function will return true when the application is run in deployed mode. If you run the application containing this function in a MATLAB session, the function will return false.

Purpose

Test if code is running during compilation process (using `mcc`)

Syntax

```
x = ismcc
```

Description

`x = ismcc` returns true when the function is being executed by `mcc` dependency checker and false otherwise.

When this function is executed by the compilation process started by `mcc`, it will return true. This function will return false when executed within MATLAB as well as in deployed mode. To test for deployed mode execution, use `isdeployed`. This function should be used to guard code in `matlabrc`, or `hgrc` (or any function called within them, for example `startup.m` in the example on this page), from being executed by MATLAB Compiler (`mcc`) or any of the Builder products.

In a typical example, a user has `ADDPATH` calls in their M-code. These can be guarded from executing using `ismcc` during the compilation process and `isdeployed` for the deployed application or component as shown in the example on this page.

Example

```
`% startup.m
         if( ismcc || isdeployed)
           addpath(fullfile(matlabroot,'work'));
```

See Also

`isdeployed`, `mcc`, `matlabrc`

<library>Initialize[WithHandlers]

Purpose

Initializes MCR instance associated with *library*

Syntax

```
bool libraryInitialize(void)
bool libraryInitializeWithHandlers(
            mclOutputHandlerFcn error_handler,
            mclOutputHandlerFcn print_handler)
```

Description

Each generated library has its own MCR instance. These two functions, `*library*Initialize` and `*library*InitializeWithHandlers` initialize the MCR instance associated with *library*. Users must call one of these functions after calling `mclInitializeApplication` and before calling any of the compiled functions exported by the library. Each returns a boolean indicating whether or not initialization was successful. If they return `false`, calling any further compiled functions will result in unpredictable behavior. `*library*InitializeWithHandlers` allows users to specify how to handle error messages and printed text. The functions passed to `*library*InitializeWithHandlers` will be installed in the MCR instance and called whenever error text or regular text is to be output.

Example

```
bool libtriangleInitialize(void)

bool libtriangleInitializeWithHandlers(
mclOutputHandlerFcn error_handler,
mclOutputHandlerFcn print_handler
)
```

See Also

"Library Initialization and Termination Functions" on page 7-26

`<library>Terminate`

Purpose

Frees all resources allocated by MCR instance associated with *`library`*

Syntax

```
void libraryTerminate(void)
```

Description

This function should be called after you finish calling the functions in this MATLAB Compiler-generated library, but before `mclTerminateApplication` is called.

Example

Call `libmatrixInitialize` to initialize `libmatrix` library properly near the start of your program:

```
/* Call the library intialization routine and make sure that
* the library was initialized properly. */
if (!libmatrixInitialize()){
    fprintf(stderr,"Could not initialize the library.\n");
    *err = -2;
}
else
    ...
```

Near the end of your program (but before calling `mclTerminateApplication`) free resources allocated by the MCR instance associated with library `libmatrix`:

```
/* Call the library termination routine */
libmatrixTerminate();
/* Free the memory created */
mxDestroyArray(in1); in1=0;
mxDestroyArray(in2); in2 = 0;
}
```

See Also

"Library Initialization and Termination Functions" on page 7-26

`<library>Initialize[WithHandlers]`

Purpose

Compile and link source files into standalone application or shared library

Syntax

```
mbuild [option1 ... optionN] sourcefile1 [... sourcefileN]
   [objectfile1 ... objectfileN] [libraryfile1 ... libraryfileN]
   [exportfile1 ... exportfileN]
```

Note Supported types of source files are `.c`, `.cpp`, `.idl`, `.rc`. To specify IDL source files to be compiled with the Microsoft Interface Definition Language (MIDL) Compiler, add `<filename>.idl` to the `mbuild` command line. To specify a DEF file, add `<filename>.def` to the command line. To specify an RC file, add `<filename>.rc` to the command line. Source files that are not one of the supported types are passed to the linker.

Description

`mbuild` is a script that supports various options that allow you to customize the building and linking of your code. This table lists the set of `mbuild` options. If no platform is listed, the option is available on both UNIX and Windows.

Option	Description
`@<rspfile>`	(Windows only) Include the contents of the text file `<rspfile>` as command line arguments to `mbuild`.
`-<arch>`	Build an output file for architecture `-<arch>`. To determine the value for `-<arch>`, type `computer('arch')` at the MATLAB Command Prompt on the target machine. Note: Valid values for `-<arch>` depend on the architecture of the build platform.
`-c`	Compile only. Creates an object file only.

Option	Description
`-D<name>`	Define a symbol name to the C preprocessor. Equivalent to a `#define <name>` directive in the source.
`-D<name>=<value>`	Define a symbol name and value to the C preprocessor. Equivalent to a `#define <name> <value>` directive in the source.
`-f <optionsfile>`	Specify location and name of options file to use. Overrides the `mbuild` default options file search mechanism.
`-g`	Create an executable containing additional symbolic information for use in debugging. This option disables the `mbuild` default behavior of optimizing built object code (see the `-O` option).
`-h[elp]`	Print help for `mbuild`.
`-I<pathname>`	Add `<pathname>` to the list of directories to search for `#include` files.
`-inline`	Inline matrix accessor functions (`mx*`). The executable generated may not be compatible with future versions of MATLAB.
`-l<name>`	Link with object library. On Windows, `<name>` will be expanded to `<name>.lib` or `lib<name>.lib` and on UNIX to `lib<name>`. **Note** When linking with a library, it is essential that you first specify the path (with `-I<pathname>`, for example).

Option	Description
`-L<directory>`	Add `<directory>` to the list of directories to search for libraries specified with the `-l` option.
`-lang <language>`	Specify compiler language. `<language>` can be `c` or `cpp`. By default, `mbuild` determines which compiler (C or C++) to use by inspection of the source file's extension. This option overrides that default.
`-n`	No execute mode. Print out any commands that `mbuild` would otherwise have executed, but do not actually execute any of them.
`-O`	Optimize the object code. Optimization is enabled by default and by including this option on the command line. If the `-g` option appears without the `-O` option, optimization is disabled.
`-outdir <dirname>`	Place all output files in directory `<dirname>`.
`-output <resultname>`	Create an executable named `<resultname>`. An appropriate executable extension is automatically appended. Overrides the `mbuild` default executable naming mechanism.
`-regsvr`	(Windows only) Use the `regsvr32` program to register the resulting shared library at the end of compilation. MATLAB Compiler uses this option whenever it produces a COM or .NET wrapper file.
`-setup`	Interactively specify the compiler options file to use as the default for future invocations of `mbuild` by placing it in the user profile directory (returned by the `prefdir` command). When this option is specified, no other command line input is accepted.

Option	Description
`-U<name>`	Remove any initial definition of the C preprocessor symbol `<name>`. (Inverse of the `-D` option.)
`-v`	Verbose mode. Print the values for important internal variables after the options file is processed and all command line arguments are considered. Prints each compile step and final link step fully evaluated.
`<name>=<value>`	Supplement or override an options file variable for variable `<name>`. This option is processed after the options file is processed and all command line arguments are considered. You may need to use the shell's quoting syntax to protect characters such as spaces that have a meaning in the shell syntax. On Windows double quotes are used (e.g., `COMPFLAGS="opt1 opt2"`), and on UNIX single quotes are used (e.g., `CFLAGS='opt1 opt2'`). It is common to use this option to supplement a variable already defined. To do this, refer to the variable by prepending a `$` (e.g., `COMPFLAGS="$COMPFLAGS opt2"` on Windows or `CFLAGS='$CFLAGS opt2'` on UNIX).

Caution

On Windows platforms, at either the MATLAB prompt or the DOS prompt, use double quotes (") when specifying command-line overrides with `mbuild`. For example:

```
mbuild -v COMPFLAGS="$COMPFLAGS -Wall"
           LINKFLAGS="$LINKFLAGS /VERBOSE" yprime.c
```

At the MATLAB command line on UNIX platforms, (") when specifying command-line overrides with `mbuild`. Use the backslash (\) escape character before the dollar sign ($). For example:

```
mbuild -v CFLAGS="\$CFLAGS -Wall"
             LDFLAGS="\$LDFLAGS-w" yprime.c
```

At the shell command line on UNIX platforms, use single quotes ('). For example:

```
mbuild -v CFLAGS='$CFLAGS -Wall'
            LDFLAGS='$LDFLAGS -w' yprime.c
```

Note Some of these options (`-f`, `-g`, and `-v`) are available on the `mcc` command line and are passed along to `mbuild`. Others can be passed along using the `-M` option to `mcc`. For details on the `-M` option, see the `mcc` reference page.

Note MBUILD can also create shared libraries from C source code. If a file with the extension `.exports` is passed to MBUILD, a shared library is built. The `.exports` file must be a text file, with each line containing either an exported symbol name, or starting with a `#` or `*` in the first column (in which case it is treated as a comment line). If multiple `.exports` files are specified, all symbol names in all specified `.exports` files are exported.

Examples

To set up or change the default C/C++ compiler for use with MATLAB Compiler, use

```
mbuild -setup
```

To compile and link an external C program `foo.c` against `libfoo`, use

```
mbuild foo.c -L. -lfoo (on UNIX)
mbuild foo.c libfoo.lib (on Windows)
```

This assumes both `foo.c` and the library generated above are in the current working directory.

mcc

Purpose

Invoke MATLAB Compiler

Syntax

```
mcc [-options] mfile1  [mfile2 ... mfileN]
                                   [C/C++file1 ... C/C++fileN]
```

Description

`mcc` is the MATLAB command that invokes MATLAB Compiler. You can issue the `mcc` command either from the MATLAB command prompt (MATLAB mode) or the DOS or UNIX command line (standalone mode).

`mcc` prepares M-file(s) for deployment outside of the MATLAB environment, generates wrapper files in C or C++, optionally builds standalone binary files, and writes any resulting files into the current directory, by default.

If more than one M-file is specified on the command line, MATLAB Compiler generates a C or C++ function for each M-file. If C or object files are specified, they are passed to `mbuild` along with any generated C files.

Options

-a Add to Archive

Add a file to the CTF archive. Use

```
-a filename
```

to specify a file to be directly added to the CTF archive. Multiple `-a` options are permitted. MATLAB Compiler looks for these files on the MATLAB path, so specifying the full path name is optional. These files are not passed to `mbuild`, so you can include files such as data files.

If only a directory name is included with the `-a` option, the entire contents of that directory are added recursively to the CTF archive. For example:

```
mcc -m hello.m -a ./testdir
```

In this example, `testdir` is a directory in the current working directory. All files in `testdir`, as well as all files in subdirectories of `testdir`, are added to the CTF archive, and the directory subtree in `testdir` is preserved in the CTF archive.

If a wildcard pattern is included in the file name, only the files in the directory that match the pattern are added to the CTF archive and subdirectories of the given path are not processed recursively. For example:

```
mcc -m hello.m -a ./testdir/*
```

In this example, all files in `./testdir` are added to the CTF archive and subdirectories under `./testdir` are not processed recursively.

```
mcc -m hello.m -a ./testdir/*.m
```

In this example, all files with the extension `.m` under `./testdir` are added to the CTF archive and subdirectories of `./testdir` are not processed recursively.

Note Currently, `*` is the only supported wildcard.

All files added to the CTF archive using `-a` (including those that match a wildcard pattern or appear under a directory specified using `-a`) that do not appear on the MATLAB path at the time of compilation will cause a path entry to be added to the deployed application's run-time path so that they will appear on the path when the deployed application or component is executed.

When files are included, the absolute path for the DLL and header files is changed. The files are placed in the `.\exe_mcr\` folder when the CTF file is expanded. The file is not placed in the local directory. This folder gets created from the CTF file the first time the EXE file is executed. The `isdeployed` function is provided to help you accommodate this difference in deployed mode.

The `-a` switch also creates a `.auth` file for authorization purposes. It ensures that the executable looks for the DLL- and H-files in the *`exe`*`_mcr\`*`exe`* folder.

Note If the `-a` flag is used to include custom Java classes, standalone applications will work without any need to change the `classpath` as long as the Java class is not a member of a package. The same applies for JAR files. However, if the class being added is a member of a package, the M-code will need to make an appropriate call to `javaaddpath` that will update the `classpath` with the parent directory of the package.

-b Generate Excel Compatible Formula Function

Generate a Visual Basic file (`.bas`) containing the Microsoft Excel Formula Function interface to the COM object generated by MATLAB Compiler. When imported into the workbook Visual Basic code, this code allows the MATLAB function to be seen as a cell formula function. This option requires MATLAB Builder EX.

-B Specify Bundle File

Replace the file on the `mcc` command line with the contents of the specified file. Use

```
-B filename[:<a1>,<a2>,...,<an>]
```

The bundle file `filename` should contain only `mcc` command line options and corresponding arguments and/or other file names. The file may contain other `-B` options. A bundle file can include replacement parameters for Compiler options that accept names and version numbers. See "Using Bundle Files" on page 5-9 for a list of the bundle files included with MATLAB Compiler.

-c Generate C Code Only

When used with a macro option, generate C wrapper code but do not invoke `mbuild`, i.e., do not produce a standalone application. This option is equivalent to the defunct `-T codegen` placed at the end of the `mcc` command line.

-C Do Not Embed CTF Archive by Default

Overrides automatically embedding the CTF archive in C/C++ and main/Winmain shared libraries and standalone binaries by default. See "Overriding Default CTF Archive Embedding Using the MCR Component Cache" on page 5-21 for more information.

-d Specified Directory for Output

Place output in a specified directory. Use

```
-d directory
```

to direct the output files from the compilation to the directory specified by the `-d` option.

-e Suppress MS-DOS Command Window

Suppress appearance of the MS-DOS command window when generating a standalone application. Use *`-e`* in place of the *`-m`* option. This option is available for Windows only. Use with `-R` option to generate error logging as such:

```
mcc -e -R -logfile,filename -v function_name
```

This macro is equivalent to the defunct:

```
-W WinMain -T link:exe
```

Note This feature requires the application to successfully compile with a Microsoft Compiler (such as that offered with the free Microsoft Visual Studio Express).

-f Specified Options File

Override the default options file with the specified options file. Use

```
-f filename
```

to specify `filename` as the options file when calling `mbuild`. This option allows you to use different ANSI compilers for different invocations of MATLAB Compiler. This option is a direct pass-through to the `mbuild` script.

Note The MathWorks recommends that you use `mbuild -setup`.

-F Specified Project File

Specify that `mcc` use settings contained in the specified project file. Use

```
-F project_name.prj
```

to specify `project_name` as the project file name when calling `mcc`. This option enables the `.prj` file, along with all of its associated settings, to be fed back to `mcc`. Project files created using either `mcc` or `deploytool` are eligible to use this option. When using `-F`, no other arguments may be invoked against `mcc`.

-g Generate Debugging Information

Include debugging symbol information for the C/C++ code generated by MATLAB Compiler. It also causes `mbuild` to pass appropriate debugging flags to the system C/C++ compiler. The debug option enables you to backtrace up to the point where you can identify if the failure occurred in the initialization of MCR, the function call, or the termination routine. This option does not allow you to debug your M-files with a C/C++ debugger.

-G Debug Only

Same as `-g`.

-I Add Directory to Include Path

Add a new directory path to the list of included directories. Each `-I` option adds a directory to the beginning of the list of paths to search. For example,

```
-I <directory1> -I <directory2>
```

would set up the search path so that `directory1` is searched first for M-files, followed by `directory2`. This option is important for standalone compilation where the MATLAB path is not available.

-l Generate a Function Library

Macro to create a function library. This option generates a library wrapper function for each M-file on the command line and calls your C compiler to build a shared library, which exports these functions. The library name is the component name, which is derived from the name of the first M-file on the command line. This macro is equivalent to

```
-W lib:string link:lib
```

-m Generate a Standalone Application

Macro to produce a standalone application. This macro is equivalent to the defunct:

```
-W main -T link:exe
```

Use the `-e` option instead of the `-m` option to generate a standalone application while suppressing the appearance of the MS-DOS Command Window.

Note Using the `-e` option requires the application to successfully compile with a Microsoft Compiler (such as that offered with the free Microsoft Visual Studio Express).

-M Direct Pass Through

Define compile-time options. Use

```
-M string
```

to pass `string` directly to the `mbuild` script. This provides a useful mechanism for defining compile-time options, e.g., `-M "-Dmacro=value"`.

Note Multiple `-M` options do not accumulate; only the rightmost `-M` option is used.

-N Clear Path

Passing `-N` effectively clears the path of all directories except the following core directories (this list is subject to change over time):

- *`matlabroot`*`/toolbox/matlab`
- *`matlabroot`*`/toolbox/local`
- *`matlabroot`*`/toolbox/compiler/deploy`

It also retains all subdirectories of the above list that appear on the MATLAB path at compile time. Including `-N` on the command line allows you to replace directories from the original path, while retaining the relative ordering of the included directories. All subdirectories of the included directories that appear on the original path are also included. In addition, the `-N` option retains all directories that the user has included on the path that are not under *`matlabroot`*`/toolbox`.

-o Specify Output Name

Specify the name of the final executable (standalone applications only). Use

```
-o outputfile
```

to name the final executable output of MATLAB Compiler. A suitable, possibly platform-dependent, extension is added to the specified name (e.g., `.exe` for Windows standalone applications).

-p Add Directory to Path

Used in conjunction with required option `-N` to add specific directories (and subdirectories) under *`matlabroot`*/toolbox to the compilation MATLAB path in an order sensitive way. Use the syntax:

```
-N -p directory
```

where `directory` is the directory to be included. If `directory` is not an absolute path, it is assumed to be under the current working directory. The rules for how these directories are included are

- If a directory is included with `-p` that is on the original MATLAB path, the directory and all its subdirectories that appear on the original path are added to the compilation path in an order-sensitive context.
- If a directory is included with `-p` that is not on the original MATLAB path, that directory is not included in the compilation. (You can use `-I` to add it.)

If a path is added with the `-I` option while this feature is active (`-N` has been passed) and it is already on the MATLAB path, it is added in the order-sensitive context as if it were included with `-p`. Otherwise, the directory is added to the head of the path, as it normally would be with `-I`.

-R Run-Time

Provide MCR run-time options. Use the syntax

```
-R option
```

to provide one of these run-time options.

Option	Description
`-nojvm`	Do not use the Java Virtual Machine (JVM).
`-logfile` *`filename`*	Specify a log file name.
`-nodisplay`	Suppress the MATLAB `nodisplay` run-time warning.

Note The `-R` option is available only for standalone applications. To override MCR options in the other MATLAB Compiler targets, use the `mclInitializeApplication` and `mclTerminateApplication` functions. For more information on these functions, see "Calling a Shared Library" on page 7-10.

-S Create Singleton MCR

Create a singleton MCR when compiling a COM object. Each instance of the component uses the same MCR. Requires MATLAB Builder NE.

-v Verbose

Display the compilation steps, including:

- MATLAB Compiler version number
- The source file names as they are processed
- The names of the generated output files as they are created
- The invocation of `mbuild`

The `-v` option passes the `-v` option to `mbuild` and displays information about `mbuild`.

Note `MCRInstaller.exe` has obsoleted the need for the function `buildmcr` or the creation of `MCRInstaller.zip`. See "Replacement of MCRInstaller.zip and BUILDMCR Functionality" on page 1-11 for more details including complete file paths to all install programs.

-w Warning Messages

Displays warning messages. Use the syntax

```
-w option[:<msg>]
```

to control the display of warnings. This table lists the valid syntaxes.

Syntax	Description
`-w list`	Generates a table that maps `<string>` to warning message for use with `enable`, `disable`, and `error`. Appendix B, "Error and Warning Messages", lists the same information.
`-w enable`	Enables complete warnings.
`-w disable[:<`*`string`*`>]`	Disables specific warning associated with `<`*`string`*`>`. Appendix B, "Error and Warning Messages", lists the valid `<`*`string`*`>` values. Leave off the optional `<`*`string`*`>` to apply the `disable` action to all warnings.

Syntax	Description
`-w enable[:<string>]`	Enables specific warning associated with <*string*>. Appendix B, "Error and Warning Messages", lists the valid <*string*> values. Leave off the optional <*string*> to apply the `enable` action to all warnings.
`-w error[:<string>]`	Treats specific warning associated with <*string*> as error. Leave off the optional <*string*> to apply the `error` action to all warnings.

-W Wrapper Function

Controls the generation of function wrappers. Use the syntax

```
-W type
```

to control the generation of function wrappers for a collection of M-files generated by MATLAB Compiler. You provide a list of functions and MATLAB Compiler generates the wrapper functions and any appropriate global variable definitions. This table shows the valid options.

Type	Description
`main`	Produces a POSIX shell `main()` function.

Type	Description
`lib:<string>`	Creates a C interface and produces an initialization and termination function for use when compiling this compiler generated code into a larger application. This option also produces a header file containing prototypes for all public functions in all M-files specified. `<string>` becomes the base (file) name for the generated C/C++ and header file. Creates a `.exports` file that contains all nonstatic function names.
`cpplib:<string>`	Creates a C++ interface and produces an initialization and termination function for use when compiling this compiler generated code into a larger application. This option also produces a header file containing prototypes for all public functions in all M-files specified. `<string>` becomes the base (file) name for the generated C/C++ and header file. Creates a `.exports` file that contains all nonstatic function names.
`none`	Does not produce a wrapper file. The default is `none`.

-Y License File

Use

```
-Y license.dat_file
```

to override the default `license.dat` file with the specified argument.

-z Specify Path

Specify the path for library and include files. Use

```
-z path
```

to specify `path` to use for the compiler libraries and include files instead of the path returned by `matlabroot`.

-? Help Message

Display MATLAB Compiler help at the command prompt.

Linux mcc Cache Management Command Options

The Bourne shell front-end interface to MATLAB Compiler uses a cache file to speed execution. The cache file contains precomputed values of critical environment variables. The cache is automatically built whenever the back-end interface is called, providing that the cache file doesn't already exist and the `-nocache` option is not used. Later executions of `mcc` will use it unless overridden by `-nocache`. Special command-line options are available to manage this cache, but they can only be executed on Linux in standalone command-line mode (not through MATLAB). The table summarizes these options.

Linux Command Option	Description
`-cache`	Prints the cache if used as the only argument. Can be used to rebuild the cache when used with other arguments in this table.
`-rmcache`	Removes the cache.
`-nocache`	Ignores the cache.

Examples

Make a standalone executable for `myfun.m`.

```
mcc -m myfun
```

Make a standalone executable for `myfun.m`, but look for `myfun.m` in the `/files/source` directory and put the resulting C files and in the `/files/target` directory.

```
mcc -m -I /files/source -d /files/target myfun
```

Make the standalone `myfun1` from `myfun1.m` and `myfun2.m` (using one `mcc` call).

```
mcc -m myfun1 myfun2
```

See Also

`deploytool`

mclGetLogFileName

Purpose

Retrieves name of log file used by the MCR

Syntax

```
const char* mclGetLogFileName()
```

Description

Use `mclGetLogFileName()` to retrieve the name of the log file used by the MCR. Returns a character string representing log file name used by MCR. For more information, see "Retrieving JVM Status, Log File Name, and Display Mode from MCR State for Shared Libraries" on page 4-22 in the user guide.

Example

```
printf("Logfile name : %s\n",mclGetLogFileName());
```

Purpose

Retrieve MATLAB data associated with string key of MCR instance uniquely identified by `mcrID`

Syntax

```
extern "C"
mxArray *mclGetMCRUserData(
    long mcrID,
    const char *key
);
```

Description

This external C function retrieves the MATLAB data associated with the string key of an MCR instance uniquely identified by *`mcrID`*. `mclGetMCRUserData` returns an empty matrix if no data has been associated with the specified key. The returned `mxArray` is a shared copy of the `mxArray` stored in the user data table. Dispose of this shared copy properly by calling `mxDestroyArray`.

This command is part of the MCR User Data interface API. For information about this function, as well as complete examples of usage, see "Improving Data Access Using the MCR User Data Interface" on page 4-24.

Example

```
mxArray *value = mclGetMCRUserData(mcrID,
                     "ParallelConfigurationFile");
```

See Also

`mclSetCmdLineMCRUserData`, `mclSetMCRUserData`

mclInitializeApplication

Purpose Sets up application state shared by all (future) MCR instances created in current process. Called only once per process.

Syntax

```
bool mclInitializeApplication(const char **options, int count)
```

Description MATLAB Compiler-generated standalone executables contain auto-generated code to call this function; users of shared libraries must call this function manually. The function takes an array of strings (possibly of zero length) and a count containing the size of the string array. The string array may contain the following MATLAB command line switches, which have the same meaning as they do when used in MATLAB. :

- `-appendlogfile`
- `-Automation`
- `-beginfile`
- `-debug`
- `-defer`
- `-display`
- `-Embedding`
- `-endfile`
- `-fork`
- `-java`
- `-jdb`
- `-logfile`
- `-minimize`
- `-MLAutomation`
- `-noaccel`
- `-nodisplay`

- `-noFigureWindows`
- `-nojit`
- `-noshelldde`
- `-nosplash`
- `-r`
- `-Regserver`
- `-shelldde`
- `-student`
- `-Unregserver`
- `-useJavaFigures`
- `-mwvisual`
- `-xrm`

Caution

`mclInitializeApplication` must be called once only per process. Calling `mclInitializeApplication` more than once may cause your application to exhibit unpredictable or undesirable behavior.

Example

To start all MCRs in a given process with the `-nodisplay` option, for example, use the following code:

```
char *args[] = { "-nodisplay" };
   bool success = mclInitializeApplication(args, 1);
```

See Also

"Initializing and Terminating Your Application with mclInitializeApplication and mclTerminateApplication" on page 7-11

`mclTerminateApplication`

mclIsJVMEnabled

Purpose

Determines if MCR was launched with instance of a Java Virtual Machine (JVM)

Syntax

```
bool mclIsJVMEnabled()
```

Description

Use `mclIsJVMEnabled()` to determine if the MCR was launched with an instance of a Java Virtual Machine (JVM). Returns `true` if MCR is launched with a JVM instance, else returns `false`. For more information, see “Retrieving JVM Status, Log File Name, and Display Mode from MCR State for Shared Libraries” on page 4-22 in the user guide.

Example

```
printf("JVM initialized : %d\n", mclIsJVMEnabled());
```

Purpose

Determines if MCR has been properly initialized

Syntax

```
bool mclIsMCRInitialized()
```

Description

Use `mclIsMCRInitialized()` to determine whether or not the MCR has been properly initialized. Returns `true` if MCR is already initialized; else returns `false`. For more information, see "Retrieving JVM Status, Log File Name, and Display Mode from MCR State for Shared Libraries" on page 4-22 in the user guide.

Example

```
printf("MCR initialized : %d\n", mclIsMCRInitialized());
```

mclIsNoDisplaySet

Purpose Determines if -nodisplay mode is enabled.

Syntax

```
bool mclIsNoDisplaySet()
```

Description Use mclIsNoDisplaySet() to determine if -nodisplay mode is enabled. Returns true if -nodisplay is enabled, else returns false. For more information, see "Retrieving JVM Status, Log File Name, and Display Mode from MCR State for Shared Libraries" on page 4-22 in the user guide.

Note Always returns false on Windows systems since the -nodisplay option is not supported on Windows systems.

Example

```
printf("nodisplay set : %d\n",mclIsNoDisplaySet());
```

mclKillAllFigures

Purpose

Finds and deletes open figures

Syntax

Description

This function uses the same internal algorithm to locate open figures as `mclWaitForFiguresToDie`.

Typically you use `mclKillAllFigures` when you need to kill figures that are being displayed as the result of a programming problem, such as an endless loop. Alternately, you might use it to ensure all figures are closed before the execution of another application.

Examples

Following are three alternate ways of using `mclKillAllFigures` to terminate three figures displayed by shared library calls to `showknot()`,`showpeak()`, and `showbottle()`.

```
showknot();
showpeak();
showbottle();
mclKillAllFigures((HMCRINSTANCE)0);

showknot();
showpeak();
showbottle();
mclKillAllFigures(0);

showknot();
showpeak();
showbottle();
mclKillAllFigures(NULL);
```

See Also

`mclWaitForFiguresToDie`

"Terminating Figures by Force with the mclKillAllFigures Method" on page 5-32

Purpose

Associate MATLAB data value with string key of MCR instance uniquely identified by `mcrID`

Syntax

```
extern "C"
size_t mclSetCmdLineMCRUserData(
    long mcrID,
    int argc,
    const char **argv
);
```

Description

This external C function examines the arguments on the command line for the switch `-mcruserdata` and calls `mclSetMCRUserData` on the argument of any such switches that it finds. It then returns the new size of `argv` (the new value for `argc`). MCR user data is specified on the command line using the `-mcruserdata` switch, as in the following example:

```
% myapp -mcruserdata
        "ParallelConfigurationFile:/usr/userdir/config.mat"
```

Users may pass MCR user data to an application on the command line with the `-mcruserdata` switch. The switch argument syntax is `key:value`, where both `key` and `value` are strings. The key string may not contain any colons, but the value string may contain them. The string is split into `key` and `value` at the first colon. Multiple switches may appear on a command line.

Caution

Be aware that all standalone applications attempt to parse the command line. Use the `-mcruserdata` switch with great care.

Note The generated main function for a C/C++ application changes to call `mclSetCmdLineMCRUserData` after initializing the MCR. Generated code for a software component or shared library does not change. It is the user's responsibility to call `mclSetMCRUserData` after calling the library initialization function.

This command is part of the MCR User Data interface API. For information about this function, as well as complete examples of usage, see "Improving Data Access Using the MCR User Data Interface" on page 4-24.

Examples

Call using this basic structure:

```
int run_main(int argc, const char **argv)
{
    // Other run_main code here ...

    // Get -mcruserdata switches from the command line
    size_t dataCount =
           mclSetCmdLineMCRUserData(_mcr_inst, argc, argv);

    _retval = mclMain(_mcr_inst, argc, argv, "tctf", 0);

    // Other run_main code here ...
}
```

Use the following code sample as a reference:

```
int run_main(int argc, const char **argv)
{
  int _retval;
  /* Generate and populate the path_to_component. */
  char path_to_component[(PATH_MAX*2)+1];
  separatePathName(argv[0],
    path_to_component, (PATH_MAX*2)+1);
  __MCC_tctf_component_data.path_to_component =
                              path_to_component;
  if (!tctfInitialize()) {
    return -1;
  }

  size_t dataCount =
          mclSetCmdLineMCRUserData(_mcr_inst, argc, argv);

  _retval = mclMain(_mcr_inst, argc, argv, "tctf", 0);
  if (_retval == 0 /* no error */)
              mclWaitForFiguresToDie(NULL);
  tctfTerminate();
  mclTerminateApplication();
  return _retval;
}
```

Purpose

Associate MATLAB data value with string key of MCR instance uniquely identified by `mcrID`

Syntax

```
extern "C"
bool mclSetMCRUserData(
    long mcrID,          // Integer MCR instance identifier
    const char *key,     // Store user data under this key
    mxArray *value       // User data value
);
```

Description

This external C function associates a MATLAB data value with the string key of the MCR instance uniquely identified by *`mcrID`*. `mclSetMCRUserData` registers the `mxArray` value under the string key, which may later be used by `mclGetMCRInstanceData` to retrieve the data. `mclSetMCRUserData` is defined in the MCLMCR module and is only available to wrapper code in deployed applications. This function makes a shared copy of the input data and does not assume ownership of the `mxArray` value. You must call `mxDestroyArray` on *`value`* eventually in your application or memory leak problems may occur.

This command is part of the MCR User Data interface API. For information about this function, as well as complete examples of usage, see "Improving Data Access Using the MCR User Data Interface" on page 4-24.

Example

```
mxArray *value = mxCreateString("/usr/userdir/config.mat");
if (!mclSetMCRUserData(mcrID, "ParallelConfigurationFile",
      "/usr/userdir/config.mat") )
{
    fprintf(stderr, "Could not set PCTConfigFile MCR
                     user data. \n");
    return -3;
}
```

See Also

`mclSetCmdLineMCRUserData`, `mclGetMCRUserData`

mclTerminateApplication

Purpose

Closes down all MCR-internal application state. Called only once per process.

Syntax

```
bool mclTerminateApplication(void)
```

Description

Call this function once at the end of your program to close down all MCR-internal application state. After you have called this function, you cannot call any further MATLAB Compiler-generated functions or any functions in any MATLAB library.

Caution

`mclTerminateApplication` must be called once only per process. Calling `mclTerminateApplication` more than once may cause your application to exhibit unpredictable or undesirable behavior.

Example

At the start of your program, call `mclInitializeApplication` to ensure your library was properly initialized:

```
mclInitializeApplication(NULL,0);
if (!libmatrixInitialize()){
fprintf(stderr,"could not initialize the library
properly\n");
return -1;
}
```

At your program's exit point, call `mclTerminateApplication` to properly shut the application down:

```
mxDestroyArray(in1); in1=0;
mxDestroyArray(in2); in2 = 0;
mclTerminateApplication();
return 0;
```

See Also

"Initializing and Terminating Your Application with mclInitializeApplication and mclTerminateApplication" on page 7-11

`mclInitializeApplication`

Purpose

Enables deployed applications to process Handle Graphics events, enabling figure windows to remain displayed.

Syntax

```
void mclWaitForFiguresToDie(HMCRINSTANCE inst)
```

Description

Calling `void mclWaitForFiguresToDie(HMCRINSTANCE inst)` enables the deployed application to process Handle Graphics events. If this function is not called, any figure windows initially displayed by the application will briefly appear and then the application will exit.

This function returns only when the last figure window is manually closed — therefore, this function should be called after the library launches at least one figure window.

This function may be called multiple times. If the input argument, an MCR instance, is `null`, the function monitors the figures of the current MCR.

This function can only be called after `<library>Initialize` has been called and before `<library>Terminate` has been called.

Note `WaitForFiguresToDie` will block the calling program only for MATLAB figures. It will not block any Java GUIs, ActiveX controls, and other non-MATLAB GUIs unless they are embedded in a MATLAB figure window.

Example

```
int run_main(int argc, const char** argv)
{
    int some_variable = 0;

    if (argc > 1)
        test_to_run = atoi(argv[1]);
    /* Initialize application */
    if( !mclInitializeApplication(NULL,0) )
    {
        fprintf(stderr, "Could not initialize the application.\n");
```

```
            return(-1);
        }
        if (test_to_run == 1 || test_to_run == 0)
        {
            /* Initialize ax1ks library */
            if (!libax1ksInitialize())
            {
                fprintf(stderr,"Could not initialize the ax1ks library.
                return (-2);
            }
        }
        if (test_to_run == 2 || test_to_run == 0)
        {
            /* Initialize simple library */
            if (!libsimpleInitialize())
            {
                fprintf(stderr,"Could not initialize the simple library
                return (-3);
            }
        }
        /*           your code here
        /*           your code here
        /*           your code here
        /*           your code here
        /*
        /* Block on open figures */
        mclWaitForFiguresToDie(NULL);
        /* Terminate libraries */
        if (test_to_run == 1 || test_to_run == 0)
            libax1ksTerminate();
        if (test_to_run == 2 || test_to_run == 0)
            libsimpleTerminate();
        /* Terminate application */
        mclTerminateApplication();
        return(0);
    }
```

See Also

`mclKillAllFigures`

"Blocking Execution of a Console Application with the mclWaitForFiguresToDie Method" on page 5-31

Purpose

Displays version and location information for MCR installer(s) corresponding to current platform.

Syntax

```
[INSTALLER_PATH, MAJOR, MINOR, PLATFORM,
   LIST] = mcrinstaller;
```

Description

Displays information about available MCR installers using the format: `[INSTALLER_PATH, MAJOR, MINOR, PLATFORM, LIST] = mcrinstaller;` where:

- *`INSTALLER_PATH`* is the full path to the installer for the current platform.
- *`MAJOR`* is the major version number of the installer.
- *`MINOR`* is the minor version number of the installer.
- *`PLATFORM`* is the name of the current platform (returned by `COMPUTER(`*`arch`*`)`).
- *`LIST`* is a cell array of strings containing the full paths to MCR installers for other platforms. This list is non-empty only in a multi-platform MATLAB installation.

Note You must distribute the MATLAB Compiler Runtime library to your end users to enable them to run applications developed with MATLAB Compiler. Prebuilt MCR installers for all licensed platforms ship with MATLAB Compiler.

See the Chapter 10, “Reference Information” chapter for more information about the MCR installer.

Example

```
mcrinstaller


The WIN32 MCR Installer, version 7.8, is:
    X:\user\buildversion\matlab\toolbox\compiler\
                    deploy\win32\MCRInstaller.exe

MCR installers for other platforms are located in:
    X:\user\buildversion\matlab\toolbox\compiler\
                                      deploy\<ARCH>
  <ARCH> is the value of COMPUTER('arch') on the
                                    target machine.

For more information, read your local MCR Installer help.
Or see the online documentation at The MathWorks' web site.

ans =
  X:\user\buildversion\matlab\toolbox\compiler\
                    deploy\win32\MCRInstaller.exe
```

Purpose

Determine version of installed MATLAB Compiler Runtime (MCR)

Syntax

```
[major, minor] = mcrversion;
```

Description

The MCR version number consists of two digits, separated by a decimal point. This function returns each digit as a separate output variable: `[major, minor] = mcrversion;` Major and minor are returned as integers.

If the version number ever increases to three or more digits, call `mcrversion` with more outputs, as follows:

```
[major, minor, point] = mcrversion;
```

At this time, all outputs past “minor” are returned as zeros.

Typing only `mcrversion` will return the major version number only.

Example

```
mcrversion
ans =
     7
```

setmcruserdata

Purpose Associate MATLAB data value with string key

Syntax `function setmcruserdata(key, value)`

Description The *function* `setmcruserdata(`*key*`, `*value*`)` command is part of the MCR User Data interface API. For information about this function, as well as complete examples of usage, see "Improving Data Access Using the MCR User Data Interface" on page 4-24.

Examples

```
setmcruserdata(`ParallelConfigurationFile','config.mat')

mxArray *value = mxCreateString("/usr/userdir/config.mat");
if (!SetMCRUserData(mcrID, "ParallelConfigurationFile",
       "/usr/userdir/config.mat") )
{
    fprintf(stderr, "Could not set PCTConfigFile MCR user
       data.\n");
    return -3;
}
```

See Also `getmcruserdata`

MATLAB Compiler Quick Reference

Common Uses of MATLAB Compiler

In this section...

Create a Standalone Application

Example 1

To create a standalone application from `mymfile.m`, use

```
mcc -m mymfile
```

Example 2

To create a standalone application from `mymfile.m`, look for `mymfile.m` in the directory `/files/source`, and put the resulting C files and in `/files/target`, use

```
mcc -m -I /files/source -d /files/target mymfile
```

Example 3

To create a standalone application `mymfile1` from `mymfile1.m` and `mymfile2.m` using a single `mcc` call, use

```
mcc -m mymfile1 mymfile2
```

Create a Library

Example 1

To create a C shared library from `foo.m`, use

```
mcc -l foo.m
```

Example 2

To create a C shared library called `library_one` from `foo1.m` and `foo2.m`, use

```
mcc -W lib:library_one -T link:lib foo1 foo2
```

Note You can add the `-g` option to any of these for debugging purposes.

mcc

Bold entries in the Comment/Options column indicate default values.

Option	Description	Comment/Options
`-a` *`filename`*	Add `filename` to the CTF archive.	None
`-b`	Generate Excel compatible formula function.	Requires MATLAB Builder EX
`-B filename[:arg[,arg]]`	Replace `-B filename` on the `mcc` command line with the contents of `filename`.	The file should contain only `mcc` command-line options. These are MathWorks included options files: • `-B csharedlib:foo` — C shared library • `-B cpplib:foo` — C++ library
`-c`	Generate C wrapper code.	Equivalent to `-T codegen`
`-C`	Directs `mcc` to not embed the CTF archive in C/C++ and main/Winmain shared libraries and standalone binaries by default.	See “Overriding Default CTF Archive Embedding Using the MCR Component Cache” on page 5-21 for more information.
`-d directory`	Place output in specified directory.	None

Option	Description	Comment/Options
`-e`	Suppresses appearance of the MS-DOS Command Window when generating a standalone application.	Use `-e` in place of the *-m* option. Available for Windows only. Use with `-R` option to generate error logging. Equivalent to `-W WinMain -T link:exe` **Note** This feature requires the application to successfully compile with a Microsoft Compiler (such as that offered with the free Microsoft Visual Studio Express).
`-f filename`	Use the specified options file, `filename`, when calling `mbuild`.	`mbuild -setup` is recommended.
`-F project_name.prj`	Use the specified project file as input to `mcc`.	When using `-F`, no other arguments can be invoked against `mcc`.
`-g`	Generate debugging information.	None
`-G`	Same as `-g`	None
`-I directory`	Add directory to search path for M-files.	MATLAB path is automatically included when running from MATLAB, but not when running from a DOS/UNIX shell.
`-l`	Macro to create a function library.	Equivalent to `-W lib -T link:lib`
`-m`	Macro to generate a C standalone application.	Equivalent to `-W main -T link:exe`
`-M string`	Pass string to `mbuild`.	Use to define compile-time options.
`-N`	Clear the path of all but a minimal, required set of directories.	None

Option	Description	Comment/Options
`-o outputfile`	Specify name of final output file.	Adds appropriate extension
`-p directory`	Add `directory` to compilation path in an order-sensitive context.	Requires `-N` option
`-R` *`option`*	Specify run-time options for MCR.	*`option`* = `-nojvm` `-nodisplay` `-logfile` *`filename`*
`-S`	Create Singleton MCR.	Requires MATLAB Builder NE
`-v`	Verbose; display compilation steps.	None
`-w` *`option`*	Display warning messages.	*`option`* = `list` *`level`* *`level`*`:string` `where` *`level`* `= disable` `enable` `error`
`-W` *`type`*	Control the generation of function wrappers.	*`type`* = `main` `cpplib:<string>` `lib:<string>` **`none`** `com:compname,clname,version`
`-Y licensefile`	Use `licensefile` when checking out a MATLAB Compiler license.	None
`-z path`	Specify path for library and include files.	None
`-?`	Display help message.	None

Error and Warning Messages

About Error and Warning Messages

This appendix lists and describes error messages and warnings generated by MATLAB Compiler. Compile-time messages are generated during the compile or link phase. It is useful to note that most of these compile-time error messages should not occur if the MATLAB software can successfully execute the corresponding M-file.

Use this reference to:

- Confirm that an error has been reported
- Determine possible causes for an error
- Determine possible ways to correct an error

When using MATLAB Compiler, if you receive an internal error message, record the specific message and report it to Technical Support at `http://www.mathworks.com/contact_TS.html`.

Compile-Time Errors

Error: An error occurred while shelling out to mex/mbuild (error code = errorno). Unable to build (specify the -v option for more information). MATLAB Compiler reports this error if `mbuild` or `mex` generates an error.

Error: An error occurred writing to file "filename": reason. The file could not be written. The reason is provided by the operating system. For example, you may not have sufficient disk space available to write the file.

Error: Cannot write file "filename" because MCC has already created a file with that name, or a file with that name was specified as a command line argument. MATLAB Compiler has been instructed to generate two files with the same name. For example:

```
mcc -W lib:liba liba -t  % Incorrect
```

Error: Could not check out a Compiler license. No additional MATLAB Compiler licenses are available for your workgroup.

Error: Could not find license file "filename". (*Windows only*) The `license.dat` file could not be found in `*matlabroot*\bin`.

Error: Initializing preferences required to run the application. The `.ctf` file and the corresponding target (standalone application or shared library) created using MATLAB Compiler do not match. Ensure that the `.ctf` file and the target file are created as output from the same `mcc` command. Verify the time stamp of these files to ensure they were created at the same time. Never combine the `.ctf` file and the target application created during execution of different `mcc` commands.

Error: File: "filename" not found. A specified file could not be found on the path. Verify that the file exists and that the path includes the file's location. You can use the `-I` option to add a directory to the search path.

Error: File: "filename" is a script M-file and cannot be compiled with the current Compiler. MATLAB Compiler cannot compile script M-files. To learn how to convert script M-files to function M-files, see “Converting Script M-Files to Function M-Files” on page 5-26.

Error: File: filename Line: # Column: # A variable cannot be made storageclass1 after being used as a storageclass2. You cannot change a variable's storage class (global/local/persistent). Even though MATLAB allows this type of change in scope, MATLAB Compiler does not.

Error: Found illegal whitespace character in command line option: "string". The strings on the left and right side of the space should be separate arguments to MCC. For example:

```
mcc('-m', '-v', 'hello')% Correct
mcc('-m -v', 'hello')   % Incorrect
```

Error: Improper usage of option -optionname. Type "mcc -?" for usage information. You have incorrectly used a MATLAB Compiler option. For more information about MATLAB Compiler options, see Chapter 11, "Function Reference", or type `mcc -?` at the command prompt.

Error: libraryname library not found. MATLAB has been installed incorrectly.

Error: No source files were specified (-? for help). You must provide MATLAB Compiler with the name of the source file(s) to compile.

Error: "optionname" is not a valid -option option argument. You must use an argument that corresponds to the option. For example:

```
mcc -W main ... % Correct
mcc -W mex  ... % Incorrect
```

Error: Out of memory. Typically, this message occurs because MATLAB Compiler requests a larger segment of memory from the operating system than is currently available. Adding additional memory to your system could alleviate this problem.

Error: Previous warning treated as error. When you use the `-w error` option, this error appears immediately after a warning message.

Error: The argument after the -option option must contain a colon. The format for this argument requires a colon. For more information, see Chapter 11, "Function Reference", or type `mcc -?` at the command prompt.

Error: The environment variable MATLAB must be set to the MATLAB root directory. On UNIX, the `MATLAB` and `LM_LICENSE_FILE` variables must be set. The `mcc` shell script does this automatically when it is called the first time.

Error: The license manager failed to initialize (error code is errornumber). You do not have a valid MATLAB Compiler license or no additional MATLAB Compiler licenses are available.

Error: The option -option is invalid in modename mode (specify -? for help). The specified option is not available.

Error: The specified file "filename" cannot be read. There is a problem with your specified file. For example, the file is not readable because there is no read permission.

Error: The -optionname option requires an argument (e.g. "proper_example_usage"). You have incorrectly used a MATLAB Compiler option. For more information about MATLAB Compiler options, see Chapter 11, "Function Reference", or type `mcc -?` at the command prompt.

Error: -x is no longer supported. MATLAB Compiler no longer generates MEX-files because there is no longer any performance advantage to doing so. The MATLAB JIT Accelerator makes compilation for speed obsolete.

Error: Unable to open file "filename":<string>. There is a problem with your specified file. For example, there is no write permission to the output directory, or the disk is full.

Error: Unable to set license linger interval (error code is errornumber). A license manager failure has occurred. Contact Technical Support with the full text of the error message.

Error: Unknown warning enable/disable string: warningstring. `-w enable:`, `-w disable:`, and `-w error:` require you to use one of the warning string identifiers listed in "Warning Messages" on page B-6.

Error: Unrecognized option: -option. The option is not a valid option. See Chapter 11, "Function Reference", for a complete list of valid options for MATLAB Compiler, or type `mcc -?` at the command prompt.

Warning Messages

This section lists the warning messages that MATLAB Compiler can generate. Using the `-w` option for `mcc`, you can control which messages are displayed. Each warning message contains a description and the warning message identifier string (in parentheses) that you can enable or disable with the `-w` option. For example, to produce an error message if you are using a demo MATLAB Compiler license to create your standalone application, you can use:

```
mcc -w error:demo_license -mvg hello
```

To enable all warnings except those generated by the `save` command, use:

```
mcc -w enable -w disable:demo_license ...
```

To display a list of all the warning message identifier strings, use:

```
mcc -w list -m mfilename
```

For additional information about the `-w` option, see Chapter 11, "Function Reference".

Warning: File: filename Line: # Column: # The #function pragma expects a list of function names. *(pragma_function_missing_names)* This pragma informs MATLAB Compiler that the specified function(s) provided in the list of function names will be called through an `feval` call. This will automatically compile the selected functions.

Warning: M-file "filename" was specified on the command line with full path of "pathname", but was found on the search path in directory "directoryname" first. (*specified_file_mismatch*) MATLAB Compiler detected an inconsistency between the location of the M-file as given on the command line and in the search path. MATLAB Compiler uses the location in the search path. This warning occurs when you specify a full path name on the `mcc` command line and a file with the same base name (file name) is found earlier on the search path. This warning is issued in the following example if the file `afile.m` exists in both `dir1` and `dir2`:

```
mcc -m -I /dir1 /dir2/afile.m
```

Warning: The file filename was repeated on MATLAB Compiler command line. *(repeated_file)* This warning occurs when the same file name appears more than once on the compiler command line. For example:

```
mcc -m sample.m sample.m % Will generate the warning
```

Warning: The name of a shared library should begin with the letters "lib". "libraryname" doesn't. *(missing_lib_sentinel)* This warning is generated if the name of the specified library does not begin with the letters "lib". This warning is specific to UNIX and does not occur on the Windows operating system. For example:

```
mcc -t -W lib:liba -T link:lib a0 a1 % No warning
mcc -t -W lib:a -T link:lib a0 a1    % Will generate a warning
```

Warning: All warnings are disabled. *(all_warnings)* This warning displays all warnings generated by MATLAB Compiler. This warning is disabled.

Warning: A line has num1 characters, violating the maximum page width (num2). *(max_page_width_violation)* This warning is generated if there are lines that exceed the maximum page width, `num2`. This warning is disabled.

Warning: The option -optionname is ignored in modename mode (specify -? for help). *(switch_ignored)* This warning is generated if an option is specified on the `mcc` command line that is not meaningful in the specified mode. This warning is enabled.

Warning: Unrecognized Compiler pragma "pragmaname". *(unrecognized_pragma)* This warning is generated if you use an unrecognized pragma. This warning is enabled.

Warning: "functionname1" is a MEX- or P-file being referenced from "functionname2". *(mex_or_p_file)* This warning is generated if `functionname2` calls `functionname1`, which is a MEX- or P-file. This warning is enabled.

Note A link error is produced if a call to this function is made from standalone code.

DEMO Compiler license. The generated application will expire 30 days from today, on date. *(demo_license)* This warning displays the date that the deployed application will expire. This warning is enabled.

depfun Errors

In this section...

About depfun Errors

MATLAB Compiler uses a dependency analysis (`depfun`) to determine the list of necessary files to include in the CTF package. If this analysis encounters a problem, `depfun` displays an error.

These error messages take the form

```
depfun Error: <message>
```

There are three causes of these messages:

- MCR/Dispatcher errors
- XML parser errors
- `depfun`-produced errors

MCR/Dispatcher Errors

These errors originate directly from the MCR/Dispatcher. If one of these error occurs, report it to Technical Support at The MathWorks at `http://www.mathworks.com/contact_TS.html`.

XML Parser Errors

These errors appear as

```
depfun Error: XML error: <message>
```

Where `<message>` is a message returned by the XML parser. If this error occurs, report it to Technical Support at The MathWorks at `http://www.mathworks.com/contact_TS.html`.

depfun-Produced Errors

These errors originate directly from `depfun`.

depfun Error: Internal error. This error occurs if an internal error is encountered that is unexpected, for example, a memory allocation error or a system error of some kind. This error is never user generated. If this error occurs, report it to Technical Support at The MathWorks at `http://www.mathworks.com/contact_TS.html`.

depfun Error: Unexpected error thrown. This error is similar to the previous one. If this error occurs, report it to Technical Support at The MathWorks at `http://www.mathworks.com/contact_TS.html`.

depfun Error: Invalid file name: <filename>. An invalid file name was passed to `depfun`.

depfun Error: Invalid directory: <dirname>. An invalid directory was passed to `depfun`.

C++ Utility Library Reference

Primitive Types

The mwArray API supports all primitive types that can be stored in a MATLAB array. This table lists all the types.

Type	Description	mxClassID
mxChar	Character type	mxCHAR_CLASS
mxLogical	Logical or Boolean type	mxLOGICAL_CLASS
mxDouble	Double-precision floating-point type	mxDOUBLE_CLASS
mxSingle	Single-precision floating-point type	mxSINGLE_CLASS
mxInt8	1-byte signed integer	mxINT8_CLASS
mxUint8	1-byte unsigned integer	mxUINT8_CLASS
mxInt16	2-byte singed integer	mxINT16_CLASS
mxUint16	2-byte unsigned integer	mxUINT16_CLASS
mxInt32	4-byte signed integer	mxINT32_CLASS
mxUint32	4-byte unsigned integer	mxUINT32_CLASS
mxInt64	8-byte signed integer	mxINT64_CLASS
mxUint64	8-byte unsigned integer	mxUINT64_CLASS

Utility Classes

The following are C++ utility classes:

- “mwString Class” on page C-4
- “mwException Class” on page C-20
- “mwArray Class” on page C-29

mwString Class

In this section...

About mwString

The `mwString` class is a simple string class used by the `mwArray` API to pass string data as output from certain methods.

Constructors

- `mwString()`
- `mwString(const char* str)`
- `mwString(const mwString& str)`

Methods

- `int Length() const`

Operators

- `operator const char* () const`
- `mwString& operator=(const mwString& str)`
- `mwString& operator=(const char* str)`
- `bool operator==(const mwString& str) const`
- `bool operator!=(const mwString& str) const`
- `bool operator<(const mwString& str) const`
- `bool operator<=(const mwString& str) const`

- `bool operator>(const mwString& str) const`
- `bool operator>=(const mwString& str) const`
- `friend std::ostream& operator<<(std::ostream& os, const mwString& str)`

mwString()

Purpose Construct empty string

C++ Syntax

```
#include "mclcppclass.h"
mwString str;
```

Arguments None

Return Value None

Description Use this constructor to create an empty string.

Purpose

Construct new string and initialize strings data with supplied char buffer

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
```

Arguments

`str`
: NULL-terminated char buffer to initialize the string.

Return Value

None

Description

Use this constructor to create a string from a NULL-terminated char buffer.

mwString(const mwString& str)

Purpose

Copy constructor for `mwString`

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString new_str(str);    // new_str contains a copy of the
                          // characters in str.
```

Arguments

`str`

`mwString` to be copied.

Return Value

None

Description

Use this constructor to create an `mwString` that is a copy of an existing one. Constructs a new string and initializes its data with the supplied `mwString`.

Purpose Return number of characters in string

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
int len = str.Length();          // len should be 16.
```

Arguments None

Return Value The number of characters in the string.

Description Use this method to get the length of an `mwString`. The value returned does not include the terminating NULL character.

operator const char* () const

Purpose Return pointer to internal buffer of string

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
const char* pstr = (const char*)str;
```

Arguments None

Return Value A pointer to the internal buffer of the string.

Description Use this operator to get direct read-only access to the string's data buffer.

Purpose

mwString assignment operator

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString new_str = str;   // new_str contains a copy of
                          // the data in str.
```

Arguments

str
String to make a copy of.

Return Value

A reference to the invoking mwString object.

Description

Use this operator to copy the contents of one string into another.

mwString& operator=(const char* str)

Purpose

mwString assignment operator

C++ Syntax

```
#include "mclcppclass.h"
const char* pstr = "This is a string";
mwString str = pstr; // str contains copy of data in pstr.
```

Arguments

str

char buffer to make copy of.

Return Value

A reference to the invoking mwString object.

Description

Use this operator to copy the contents of a NULL-terminated buffer into an mwString.

Purpose

Test two `mwString`s for equality

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString str2("This is another string");
bool ret = (str == str2);// ret should have value of false.
```

Arguments

`str`
String to compare.

Return Value

The result of the comparison.

Description

Use this operator to test two strings for equality.

bool operator!=(const mwString& str) const

Purpose

Test two `mwStrings` for inequality

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString str2("This is another string");
bool ret = (str != str2);  // ret should have value of
                           // true.
```

Arguments

`str`

String to compare.

Return Value

The result of the comparison.

Description

Use this operator to test two strings for inequality.

Purpose

Compare input string with this string and return `true` if this string is lexicographically less than input string

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString str2("This is another string");
bool ret = (str < str2);         // ret should have a value
                                 //  of true.
```

Arguments

`str`

String to compare.

Return Value

The result of the comparison.

Description

Use this operator to test two strings for order.

bool operator<=(const mwString& str) const

Purpose Compare input string with this string and return `true` if this string is lexicographically less than or equal to input string

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString str2("This is another string");
bool ret = (str <= str2);        // ret should have value
                                 //  of true.
```

Arguments

`str`

String to compare.

Return Value The result of the comparison.

Description Use this operator to test two strings for order.

Purpose

Compare input string with this string and return `true` if this string is lexicographically greater than input string

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString str2("This is another string");
bool ret = (str > str2);         // ret should have value
                                 // of false.
```

Arguments

`str`

String to compare.

Return Value

The result of the comparison.

Description

Use this operator to test two strings for order.

bool operator>=(const mwString& str) const

Purpose

Compare input string with this string and return `true` if this string is lexicographically greater than or equal to input string

C++ Syntax

```
#include "mclcppclass.h"
mwString str("This is a string");
mwString str2("This is another string");
bool ret = (str >= str2);//ret should have value of false.
```

Arguments

`str`

String to compare.

Return Value

The result of the comparison.

Description

Use this operator to test two strings for order.

friend std::ostream& operator<<(std::ostream& os, const mwString& str)

Purpose

Copy contents of input string to specified `ostream`

C++ Syntax

```
#include "mclcppclass.h"
#include <ostream>
mwString str("This is a string");
std::cout << str << std::endl; //should print "This is a
                               //string" to standard out.
```

Arguments

`os`

`ostream` to copy string to.

`str`

String to copy.

Return Value

The input `ostream`.

Description

Use this operator to print the contents of an `mwString` to an `ostream`.

mwException Class

In this section...

About mwException

The `mwException` class is the basic exception type used by the `mwArray` API and the C++ interface functions. All errors created during calls to the `mwArray` API and to MATLAB Compiler generated C++ interface functions are thrown as `mwExceptions`.

Constructors

- `mwException()`
- `mwException(const char* msg)`
- `mwException(const mwException& e)`
- `mwException(const std::exception& e)`

Methods

- `const char *what() const throw()`

Operators

- `mwException& operator=(const mwException& e)`
- `mwException& operator=(const std::exception& e)`

mwException Class Functions

The functions on the following pages are in the `mwException` class.

Purpose

Construct new `mwException` with default error message

C++ Syntax

```
#include "mclcppclass.h"
throw mwException();
```

Arguments

None

Return Value

None

Description

Use this constructor to create an `mwException` without specifying an error message.

Purpose

Construct new `mwException` with specified error message

C++ Syntax

```
#include "mclcppclass.h"
try
{
    throw mwException("This is an error");
}
catch (const mwException& e)
{
      std::cout << e.what() << std::endl // Displays "This
                                         // is an error" to
                                         // standard out.
}
```

Arguments

`msg`
    Error message.

Return Value

None

Description

Use this constructor to create an `mwException` with a specified error message.

mwException(const mwException& e)

Purpose

Copy constructor for `mwException` class

C++ Syntax

```
#include "mclcppclass.h"
try
{
        throw mwException("This is an error");
}
catch (const mwException& e)
{
        throw mwException(e);     // Rethrows same error.
}
```

Arguments

`e`

`mwException` to create copy of.

Return Value

None

Description

Use this constructor to create a copy of an `mwException`. The copy will have the same error message as the original.

Purpose

Create new `mwException` from existing `std::exception`

C++ Syntax

```
#include "mclcppclass.h"
try
{
    ...
}
catch (const std::exception& e)
{
    throw mwException(e);         // Rethrows same error.
}
```

Arguments

`e`

  `std::exception` to create copy of.

Return Value

None

Description

Use this constructor to create a new `mwException` and initialize the error message with the error message from the given `std::exception`.

const char *what() const throw()

Purpose

Return error message contained in this exception

C++ Syntax

```
#include "mclcppclass.h"
try
{
    ...
}
catch (const std::exception& e)
{
    std::cout << e.what() << std::endl; // Displays error
                                        // message to
                                        // standard out.
}
```

Arguments

None

Return Value

A pointer to a NULL-terminated character buffer containing the error message.

Description

Use this method to retrieve the error message from an `mwException`.

Purpose

Assignment operator for `mwException` class

C++ Syntax

```
#include "mclcppclass.h"
try
{
    ...
}
catch (const mwException& e)
{
    mwException e2 = e;
    throw e2;
}
```

Arguments

`e`

`mwException` to create copy of.

Return Value

A reference to the invoking `mwException`.

Description

Use this operator to create a copy of an `mwException`. The copy will have the same error message as the original.

mwException& operator=(const std::exception& e)

Purpose Assignment operator for `mwException` class

C++ Syntax

```
#include "mclcppclass.h"
try
{
    ...
}
catch (const std::exception& e)
{
    mwException e2 = e;
    throw e2;
}
```

Arguments

`e`

  `std::exception` to initialize copy with.

Return Value A reference to the invoking `mwException`.

Description Use this operator to create a copy of an `std::exception`. The copy will have the same error message as the original.

mwArray Class

In this section...

About mwArray

Use the `mwArray` class to pass input/output arguments to MATLAB Compiler generated C++ interface functions. This class consists of a thin wrapper around a MATLAB array. As explained in further detail in the MATLAB documentation, all data in MATLAB is represented by matrices (in other words, even a simple data structure should be declared as a 1-by-1 matrix). The `mwArray` class provides the necessary constructors, methods, and operators for array creation and initialization, as well as simple indexing.

Note Arithmetic operators, such as addition and subtraction, are no longer supported as of Release 14.

Constructors

- `mwArray()`
- `mwArray(mxClassID mxID)`
- `mwArray(mwSize num_rows, mwSize num_cols, mxClassID mxID, mxComplexity cmplx = mxREAL)`
- `mwArray(mwSize num_dims, const mwSize* dims, mxClassID mxID, mxComplexity cmplx = mxREAL)`
- `mwArray(const char* str)`
- `mwArray(mwSize num_strings, const char** str)`

- `mwArray(mwSize num_rows, mwSize num_cols, int num_fields, const char** fieldnames)`
- `mwArray(mwSize num_dims, const mwSize* dims, int num_fields, const char** fieldnames)`
- `mwArray(const mwArray& arr)`
- `mwArray(<type> re)`
- `mwArray(<type> re, <type> im)`

Methods

- `mwArray Clone() const`
- `mwArray SharedCopy() const`
- `mwArray Serialize() const`
- `mxClassID ClassID() const`
- `int ElementSize() const`
- `size_t ElementSize() const`
- `mwSize NumberOfElements() const`
- `mwSize NumberOfNonZeros() const`
- `mwSize MaximumNonZeros() const`
- `mwSize NumberOfDimensions() const`
- `int NumberOfFields() const`
- `mwString GetFieldName(int index)`
- `mwArray GetDimensions() const`
- `bool IsEmpty() const`
- `bool IsSparse() const`
- `bool IsNumeric() const`
- `bool IsComplex() const`
- `bool Equals(const mwArray& arr) const`
- `int CompareTo(const mwArray& arr) const`

- `int HashCode() const`
- `mwString ToString() const`
- `mwArray RowIndex() const`
- `mwArray ColumnIndex() const`
- `void MakeComplex()`
- `mwArray Get(mwSize num_indices, ...)`
- `mwArray Get(const char* name, mwSize num_indices, ...)`
- `mwArray GetA(mwSize num_indices, const mwIndex* index)`
- `mwArray GetA(const char* name, mwSize num_indices, const mwIndex* index)`
- `mwArray Real()`
- `mwArray Imag()`
- `void Set(const mwArray& arr)`
- `void GetData(<numeric-type>* buffer, mwSize len) const`
- `void GetLogicalData(mxLogical* buffer, mwSize len) const`
- `void GetCharData(mxChar* buffer, mwSize len) const`
- `void SetData(<numeric-type>* buffer, mwSize len)`
- `void SetLogicalData(mxLogical* buffer, mwSize len)`
- `void SetCharData(mxChar* buffer, mwSize len)`

Operators

- `mwArray operator()(mwIndex i1, mwIndex i2, mwIndex i3, ..., )`
- `mwArray operator()(const char* name, mwIndex i1, mwIndex i2, mwIndex i3, ..., )`
- `mwArray& operator=(const <type>& x)`
- `operator <type>() const`

Static Methods

- `static mwArray Deserialize(const mwArray& arr)`
- `static double GetNaN()`
- `static double GetEps()`
- `static double GetInf()`
- `static bool IsFinite(double x)`
- `static bool IsInf(double x)`
- `static bool IsNaN(double x)`

mwArray Class Functions

The functions on the following pages are in the `mwArray` class:

mwArray()

Purpose Construct empty array of type mxDOUBLE_CLASS

C++ Syntax

```
#include "mclcppclass.h"
mwArray a;
```

Return Value None

Description Use this constructor to create an empty array of type mxDOUBLE_CLASS.

Purpose

Construct empty array of specified type

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(mxDOUBLE_CLASS);
```

Return Value

None

Description

Use this constructor to create an empty array of the specified type. You can use any valid `mxClassID`. See the External Interfaces documentation for more information on `mxClassID`.

mwArray(mwSize num_rows, mwSize num_cols, mxClassID mxID, mxComplexity cmplx = mxREAL)

Purpose

Construct 2-D matrix of specified type and dimensions

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray b(3, 3, mxSINGLE_CLASS, mxCOMPLEX);
mwArray c(2, 3, mxCELL_CLASS);
```

Arguments

`num_rows`
: The number of rows.

`num_cols`
: The number of columns.

`mxID`
: The data type `type` of the matrix.

`cmplx`
: The complexity of the matrix (numeric types only).

Return Value

None

Description

Use this constructor to create a matrix of the specified type and complexity. For numeric types, the matrix can be either real or complex. You can use any valid `mxClassID`. Consult the External Interfaces documentation for more information on `mxClassID`. For numeric types, pass `mxCOMPLEX` for the last argument to create a complex matrix. All elements are initialized to zero. For cell matrices, all elements are initialized to empty cells.

mwArray(mwSize num_dims, const mwSize* dims, mxClassID mxID, mxComplexity cmplx = mxREAL)

Purpose

Construct n-dimensional array of specified type and dimensions

C++ Syntax

```
#include "mclcppclass.h"
int dims[3] = {2,3,4};
mwArray a(3, dims, mxDOUBLE_CLASS);
mwArray b(3, dims, mxSINGLE_CLASS, mxCOMPLEX);
mwArray c(3, dims, mxCELL_CLASS);
```

Arguments

`num_dims`
: Size of the `dims` array.

`dims`
: Dimensions of the array.

`mxID`
: The data type `type` of the matrix.

`cmplx`
: The complexity of the matrix (numeric types only).

Return Value

None

Description

Use this constructor to create an `n`-dimensional array of the specified type and complexity. For numeric types, the array can be either real or complex. You can use any valid `mxClassID`. Consult the External Interfaces documentation for more information on `mxClassID`. For numeric types, pass `mxCOMPLEX` for the last argument to create a complex matrix. All elements are initialized to zero. For cell arrays, all elements are initialized to empty cells.

mwArray(const char* str)

Purpose

Construct character array from supplied string

C++ Syntax

```
#include "mclcppclass.h"
mwArray a("This is a string");
```

Arguments

`str`
NULL-terminated string

Return Value

None

Description

Use this constructor to create a 1-by-n array of type `mxCHAR_CLASS`, with `n = strlen(str)`, and initialize the array's data with the characters in the supplied string.

mwArray(mwSize num_strings, const char** str)

Purpose

Construct character matrix from list of strings

C++ Syntax

```
#include "mclcppclass.h"
const char* str[] = {"String1", "String2", "String3"};
mwArray a(3, str);
```

Arguments

`num_strings`
: Number of strings in the input array

str
: Array of NULL-terminated strings

Return Value

None

Description

Use this constructor to create a matrix of type `mxCHAR_CLASS`, and initialize the array's data with the characters in the supplied strings. The created array has dimensions `m`-by-`max`, where `max` is the length of the longest string in `str`.

mwArray(mwSize num_rows, mwSize num_cols, int num_fields, const char** fieldnames)

Purpose

Construct 2-D MATLAB structure matrix of specified dimensions and field names

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};
mwArray a(2, 2, 3, fields);
```

Arguments

`num_rows`
: Number of rows in the `struct` matrix.

`num_cols`
: Number of columns in the `struct` matrix.

`num_fields`
: Number of fields in the `struct` matrix.

`fieldnames`
: Array of NULL-terminated strings representing the field names.

Return Value

None

Description

Use this constructor to create a matrix of type `mxSTRUCT_CLASS`, with the specified field names. All elements are initialized with empty cells.

mwArray(mwSize num_dims, const mwSize* dims, int num_fields, const char** fieldnames)

Purpose

Construct n-dimensional MATLAB structure array of specified dimensions and field names

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};
int dims[3] = {2, 3, 4}
mwArray a(3, dims, 3, fields);
```

Arguments

`num_dims`
: Size of the `dims` array.

`dims`
: Dimensions of the `struct` array.

`num_fields`
: Number of fields in the `struct` array.

`fieldnames`
: Array of NULL-terminated strings representing the field names.

Return Value

None

Description

Use this constructor to create an `n`-dimensional array of type `mxSTRUCT_CLASS`, with the specified field names. All elements are initialized with empty cells.

mwArray(const mwArray& arr)

Purpose Constructs new `mwArray` from existing array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray b(a);
```

Arguments

`arr`
: `mwArray` to copy.

Return Value None

Description Use this constructor to create a copy of an existing array. The new array contains a deep copy of the input array.

Purpose

Construct real scalar array of type of the input argument and initialize data with input argument's value

C++ Syntax

```
#include "mclcppclass.h"
double x = 5.0;
mwArray a(x);   // Creates 1X1 double array with value 5.0
```

Arguments

`re`

Scalar value to initialize array with.

Return Value

None

Description

Use this constructor to create a real scalar array. `<type>` can be any of the following:

- `mxDouble`
- `mxSingle`
- `mxInt8`
- `mxUint8`
- `mxInt16`
- `mxUint16`
- `mxInt32`
- `mxUint32`
- `mxInt64`
- `mxUint64`
- `mxLogical`

The scalar array is created with the type of the input argument.

mwArray(<type> re, <type> im)

Purpose

Construct complex scalar array of type of input arguments and initialize real and imaginary parts of data with input argument's values

C++ Syntax

```
#include "mclcppclass.h"
double re = 5.0;
double im = 10.0;
mwArray a(re, im); // Creates 1X1 complex array with
                   // value 5+10i
```

Arguments

`re`

Scalar value to initialize real part with.

`im`

Scalar value to initialize imaginary part with.

Return Value

None

Description

Use this constructor to create a complex scalar array. The first input argument initializes the real part and the second argument initializes the imaginary part. `<type>` can be any of the following: `mxDouble`, `mxSingle`, `mxInt8`, `mxUint8`, `mxInt16`, `mxUint16`, `mxInt32`, `mxUint32`, `mxInt64`, or `mxUint64`.

- `mxDouble`
- `mxSingle`
- `mxInt8`
- `mxUint8`
- `mxInt16`
- `mxUint16`
- `mxInt32`
- `mxUint32`
- `mxInt64`

- `mxUint64`
- `mxLogical`

The scalar array is created with the type of the input arguments.

mwArray Clone() const

Purpose Return new array representing deep copy of array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray b = a.Clone();
```

Arguments None

Return Value New `mwArray` representing a deep copy of the original.

Description Use this method to create a copy of an existing array. The new array contains a deep copy of the input array.

Purpose Return new array representing shared copy of array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray b = a.SharedCopy();
```

Arguments None

Return Value New `mwArray` representing a reference counted version of the original.

Description Use this method to create a shared copy of an existing array. The new array and the original array both point to the same data.

Purpose

Serialize underlying array into byte array, and return data in new array of type `mxUINT8_CLASS`

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray s = a.Serialize();
```

Arguments

None

Return Value

New `mwArray` of type `mxUINT8_CLASS` containing the serialized data.

Description

Use this method to serialize an array into bytes. A 1-by-`n` numeric matrix of type `mxUINT8_CLASS` is returned containing the serialized data. The data can be deserialized back into the original representation by calling `mwArray::Deserialize()`.

Purpose Return type of array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mxClassID id = a.ClassID();// Should return mxDOUBLE_CLASS
```

Arguments None

Return Value The `mxClassID` of the array.

Description Use this method to determine the type of the array. Consult the External Interfaces documentation for more information on `mxClassID`.

int ElementSize() const

Purpose Return size in bytes of element of array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
int size = a.ElementSize();// Should return sizeof(double)
```

Arguments None

Return Value The size in bytes of an element of this type of array.

Description Use this method to determine the size in bytes of an element of array type.

Purpose

Return size in bytes of element in array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
int size = a.ElementSize();// Should return sizeof(double)
```

Arguments

None

Return Value

The size in bytes of an element of this type of array.

Description

Use this method to determine the size in bytes of an element of array type.

mwSize NumberOfElements() const

Purpose Return number of elements in array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
int n = a.NumberOfElements();// Should return 4
```

Arguments None

Return Value Number of elements in array.

Description Use this method to determine the total size of the array.

mwSize NumberOfNonZeros() const

Purpose

Return number of nonzero elements for sparse array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
int n = a.NumberOfNonZeros();// Should return 4
```

Arguments

None

Return Value

Actual number of nonzero elements in array.

Description

Use this method to determine the size of the of the array's data. If the underlying array is not sparse, this returns the same value as `NumberOfElements()`.

Note This method does not analyze the actual values of the array elements. Instead, it returns the number of elements that could potentially be nonzero. This is exactly the number of elements for which the sparse matrix has allocated storage.

---

mwSize MaximumNonZeros() const

Purpose

Return maximum number of nonzero elements for sparse array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
int n = a.MaximumNonZeros();// Should return 4
```

Arguments

None

Return Value

Number of allocated nonzero elements in array.

Description

Use this method to determine the allocated size of the of the array's data. If the underlying array is not sparse, this returns the same value as `NumberOfElements()`.

Note This method does not analyze the actual values of the array elements.

Purpose Return number of dimensions in array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
int n = a.NumberOfDimensions();// Should return 2
```

Arguments None

Return Value Number of dimensions in array.

Description Use this method to determine the dimensionality of the array.

int NumberOfFields() const

Purpose Return number of fields in `struct` array

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};
mwArray a(2, 2, 3, fields);
int n = a.NumberOfFields(); // Should return 3
```

Arguments None

Return Value Number of fields in the array.

Description Use this method to determine the number of fields in a `struct` array. If the underlying array is not of type `struct`, zero is returned.

Purpose

Return string representing name of (zero-based) field in `struct` array

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};
mwArray a(2, 2, 3, fields);
mwString tempname = a.GetFieldName(1);
const char* name = (const char*)tempname; // Should
                                          // return "b"
```

Arguments

`Index`
: Zero-based field number.

Return Value

`mwString` containing the field name.

Description

Use this method to determine the name of a given field in a `struct` array. If the underlying array is not of type `struct`, an exception is thrown.

mwArray GetDimensions() const

Purpose Return array of type mxINT32_CLASS representing dimensions of array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray dims = a.GetDimensions();
```

Arguments None

Return Value mwArray type mxINT32_CLASS containing the dimensions of the array.

Description Use this method to determine the size of each dimension in the array. The size of the returned array is 1-by-NumberOfDimensions().

Purpose Return `true` if underlying array is empty

C++ Syntax

```
#include "mclcppclass.h"
mwArray a;
bool b = a.IsEmpty(); // Should return true
```

Arguments None

Return Value Boolean indicating if the array is empty.

Description Use this method to determine if an array is empty.

bool IsSparse() const

Purpose

Return `true` if underlying array is sparse

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
bool b = a.IsSparse(); // Should return false
```

Arguments

None

Return Value

Boolean indicating if the array is sparse.

Description

Use this method to determine if an array is sparse.

Purpose Return `true` if underlying array is numeric

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
bool b = a.IsNumeric(); // Should return true.
```

Arguments None

Return Value Boolean indicating if the array is numeric.

Description Use this method to determine if an array is numeric.

bool IsComplex() const

Purpose

Return `true` if underlying array is complex

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS, mxCOMPLEX);
bool b = a.IsComplex(); // Should return true.
```

Arguments

None

Return Value

Boolean indicating if the array is complex.

Description

Use this method to determine if an array is complex.

Purpose

Test two arrays for equality

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(1, 1, mxDOUBLE_CLASS);
mwArray b(1, 1, mxDOUBLE_CLASS);
a = 1.0;
b = 1.0;
bool c = a.Equals(b); // Should return true.
```

Arguments

`arr`

Array to compare to array.

Return Value

Boolean value indicating the equality of the two arrays.

Description

Returns `true` if the input array is byte-wise equal to this array. This method makes a byte-wise comparison of the underlying arrays. Therefore, arrays of the same type should be compared. Arrays of different types will not in general be equal, even if they are initialized with the same data.

int CompareTo(const mwArray& arr) const

Purpose

Compare two arrays for order

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(1, 1, mxDOUBLE_CLASS);
mwArray b(1, 1, mxDOUBLE_CLASS);
a = 1.0;
b = 1.0;
int n = a.CompareTo(b); // Should return 0
```

Arguments

`arr`

Array to compare to this array.

Return Value

Returns a negative integer, zero, or a positive integer if this array is less than, equal to, or greater than the specified array.

Description

Compares this array with the specified array for order. This method makes a byte-wise comparison of the underlying arrays. Therefore, arrays of the same type should be compared. Arrays of different types will, in general, not be ordered equivalently, even if they are initialized with the same data.

Purpose

Return hash code for array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(1, 1, mxDOUBLE_CLASS);
int n = a.HashCode();
```

Arguments

None

Return Value

An integer value representing a unique hash code for the array.

Description

This method constructs a unique hash value form the underlying bytes in the array. Therefore, arrays of different types will have different hash codes, even if they are initialized with the same data.

Purpose

Return string representation of underlying array

C++ Syntax

```
#include <stdio.h>
#include "mclcppclass.h"
mwArray a(1, 1, mxDOUBLE_CLASS, mxCOMPLEX);
a.Real() = 1.0;
a.Imag() = 2.0;
printf("%s\n", (const char*)(a.ToString()));// Should print
                                            // "1 + 2i" on
                                            // screen.
```

Arguments

None

Return Value

An `mwString` containing the string representation of the array.

Description

This method returns a string representation of the underlying array. The string returned is the same string that is returned by typing a variable’s name at the MATLAB command prompt.

Purpose

Return array containing row indices of each element in array

C++ Syntax

```
#include <stdio.h>
#include "mclcppclass.h"
mwArray a(1, 1, mxDOUBLE_CLASS);
mwArray rows = a.RowIndex();
```

Arguments

None

Return Value

An `mwArray` containing the row indices.

Description

Returns an array of type `mxINT32_CLASS` representing the row indices (first dimension) of this array. For sparse arrays, the indices are returned for just the non-zero elements and the size of the array returned is 1-by-`NumberOfNonZeros()`. For nonsparse arrays, the size of the array returned is 1-by-`NumberOfElements()`, and the row indices of all of the elements are returned.

mwArray ColumnIndex() const

Purpose

Return array containing column indices of each element in array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(1, 1, mxDOUBLE_CLASS);
mwArray rows = a.ColumnIndex();
```

Arguments

None

Return Value

An `mwArray` containing the column indices.

Description

Returns an array of type `mxINT32_CLASS` representing the column indices (second dimension) of this array. For sparse arrays, the indices are returned for just the non-zero elements and the size of the array returned is 1-by-`NumberOfNonZeros()`. For nonsparse arrays, the size of the array returned is 1-by-`NumberOfElements()`, and the column indices of all of the elements are returned.

Purpose

Convert real numeric array to complex

C++ Syntax

```
#include "mclcppclass.h"
double rdata[4] = {1.0, 2.0, 3.0, 4.0};
double idata[4] = {10.0, 20.0, 30.0, 40.0};
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(rdata, 4);
a.MakeComplex();
a.Imag().SetData(idata, 4);
```

Arguments

None

Return Value

None

Description

Use this method to convert a numeric array that has been previously allocated as `real` to `complex`. If the underlying array is of a nonnumeric type, an `mwException` is thrown.

mwArray Get(mwSize num_indices, ...)

Purpose

Return single element at specified 1-based index

C++ Syntax

```
#include "mclcppclass.h"
double data[4] = {1.0, 2.0, 3.0, 4.0};
double x;
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(data, 4);
x = a.Get(1,1);          // x = 1.0
x = a.Get(2, 1, 2);      // x = 3.0
x = a.Get(2, 2, 2);      // x = 4.0
```

Arguments

`num_indices`
: Number of indices passed in.

`...`
: Comma-separated list of input indices. Number of items must equal `num_indices` but should not exceed 32.

Return Value

An `mwArray` containing the value at the specified index.

Description

Use this method to fetch a single element at a specified index. The index is passed by first passing the number of indices followed by a comma-separated list of 1-based indices. The valid number of indices that can be passed in is either 1 (single subscript indexing), in which case the element at the specified 1-based offset is returned, accessing data in column-wise order, or `NumberOfDimensions()` (multiple subscript indexing), in which case, the index list is used to access the specified element. The valid range for indices is `1 <= index <= NumberOfElements()`, for single subscript indexing. For multiple subscript indexing, the *`i`*th index has the valid range: `1 <= index[i] <= GetDimensions().Get(1, i)`. An `mwException` is thrown if an invalid number of indices is passed in or if any index is out of bounds.

mwArray Get(const char* name, mwSize num_indices, ...)

Purpose

Return single element at specified field name and 1-based index in struct array

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};

mwArray a(1, 1, 3, fields);
mwArray b = a.Get("a", 1, 1);           // b=a(1).a;
mwArray b = a.Get("b", 2, 1, 1);        // b=a(1,1).b;
```

Arguments

`name`
: NULL-terminated string containing the field name to get.

`num_indices`
: Number of indices passed in.

`...`
: Comma-separated list of input indices. Number of items must equal `num_indices`.

Return Value

An `mwArray` containing the value at the specified field name and index.

Description

Use this method to fetch a single element at a specified field name and index. This method may only be called on an array that is of type `mxSTRUCT_CLASS`. An `mwException` is thrown if the underlying array is not a `struct` array. The field name passed must be a valid field name in the `struct` array. The index is passed by first passing the number of indices followed by a comma-separated list of 1-based indices. The valid number of indices that can be passed in is either 1 (single subscript indexing), in which case the element at the specified 1-based offset is returned, accessing data in column-wise order, or `NumberOfDimensions()` (multiple subscript indexing), in which case, the index list is used to access the specified element. The valid range for indices is `1 <= index <= NumberOfElements()`, for single subscript indexing. For multiple subscript indexing, the ith index has the valid range: `1 <= index[i] <= GetDimensions().Get(1, i)`. An mwException is thrown if an invalid number of indices is passed in or if any index is out of bounds.

mwArray GetA(mwSize num_indices, const mwIndex* index)

Purpose

Return single element at specified 1-based index

C++ Syntax

```
#include "mclcppclass.h"
double data[4] = {1.0, 2.0, 3.0, 4.0};
int index[2] = {1, 1};
double x;
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(data, 4);
x = a.GetA(1, index);        // x = 1.0
x = a.GetA(2, index);        // x = 1.0
index[0] = 2;
index[1] = 2;
x = a.Get(2, index);         // x = 4.0
```

Arguments

`num_indices`
Size of index array.

`index`
Array of at least size `num_indices` containing the indices.

Return Value

An `mwArray` containing the value at the specified index.

Description

Use this method to fetch a single element at a specified index. The index is passed by first passing the number of indices, followed by an array of 1-based indices. The valid number of indices that can be passed in is either 1 (single subscript indexing), in which case the element at the specified 1-based offset is returned, accessing data in column-wise order, or `NumberOfDimensions()` (multiple sub-script indexing), in which case, the index list is used to access the specified element. The valid range for indices is `1 <= index <= NumberOfElements()`, for single subscript indexing. For multiple subscript indexing, the ith index has the valid range: `1 <= index[i] <= GetDimensions().Get(1, i)`. An `mwException` is thrown if an invalid number of indices is passed in or if any index is out of bounds.

mwArray GetA(const char* name, mwSize num_indices, const mwIndex* index)

Purpose

Return single element at specified field name and 1-based index in `struct` array

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};
int index[2] = {1, 1};
mwArray a(1, 1, 3, fields);
mwArray b = a.Get("a", 1, index);        // b=a(1).a;
mwArray b = a.Get("b", 2, index);        // b=a(1,1).b;
```

Arguments

`name`
: NULL-terminated string containing the field name to get.

`num_indices`
: Number of indices passed in.

`index`
: Array of at least size `num_indices` containing the indices.

Return Value

An `mwArray` containing the value at the specified field name and index.

Description

Use this method to fetch a single element at a specified field name and index. This method may only be called on an array that is of type `mxSTRUCT_CLASS`. An `mwException` is thrown if the underlying array is not a `struct` array. The field name passed must be a valid field name in the `struct` array. The index is passed by first passing the number of indices followed by an array of 1-based indices. The valid number of indices that can be passed in is either 1 (single subscript indexing), in which case the element at the specified 1-based offset is returned, accessing data in column-wise order, or `NumberOfDimensions()` (multiple subscript indexing), in which case, the index list is used to access the specified element. The valid range for indices is `1 <= index <= NumberOfElements()`, for single subscript indexing. For multiple subscript indexing, the ith index has the valid range: `1 <= index[i] <= GetDimensions().Get(1, i)`. An `mwException` is thrown if an invalid number of indices is passed in or if any index is out of bounds.

mwArray Real()

Purpose

Return mwArray that references real part of complex array

C++ Syntax

```
#include "mclcppclass.h"
double rdata[4] = {1.0, 2.0, 3.0, 4.0};
double idata[4] = {10.0, 20.0, 30.0, 40.0};
mwArray a(2, 2, mxDOUBLE_CLASS, mxCOMPLEX);
a.Real().SetData(rdata, 4);
a.Imag().SetData(idata, 4);
```

Arguments

None

Return Value

An mwArray referencing the real part of the array.

Description

Use this method to access the real part of a complex array. The returned mwArray is considered real and has the same dimensionality and type as the original.

Complex arrays consist of Complex numbers, which are 1 X 2 vectors (pairs). For example, if the number is 3+5i, then the pair is (3,5i). An array of Complex numbers is therefore two dimensional (N X 2), where *N* is the number of complex numbers in the array. 2+4i, 7-3i, 8+6i would be represented as (2,4i) (7,3i) (8,6i). Complex numbers have two components, real and imaginary.

The MATLAB functions Real and Imag can be applied to an array of Complex numbers. These functions extract the corresponding part of the Complex number. For example, REAL(3,5i) == 3 and IMAG(3+5i) == 5. Imag returns 5 in this case and not 5i. Imag returns the magnitude of the imaginary part of the number as a real number.

Purpose

Return `mwArray` that references imaginary part of complex array

C++ Syntax

```
#include "mclcppclass.h"
double rdata[4] = {1.0, 2.0, 3.0, 4.0};
double idata[4] = {10.0, 20.0, 30.0, 40.0};
mwArray a(2, 2, mxDOUBLE_CLASS, mxCOMPLEX);
a.Real().SetData(rdata, 4);
a.Imag().SetData(idata, 4);
```

Arguments

None

Return Value

An `mwArray` referencing the imaginary part of the array.

Description

Use this method to access the imaginary part of a complex array. The returned `mwArray` is considered real and has the same dimensionality and type as the original.

Complex arrays consist of Complex numbers, which are 1 X 2 vectors (pairs). For example, if the number is `3+5i`, then the pair is `(3,5i)`. An array of Complex numbers is therefore two dimensional `(N X 2)`, where *N* is the number of complex numbers in the array. `2+4i, 7-3i, 8+6i` would be represented as `(2,4i) (7,3i) (8,6i)`. Complex numbers have two components, real and imaginary.

The MATLAB functions `Real` and `Imag` can be applied to an array of Complex numbers. These functions extract the corresponding part of the Complex number. For example, `REAL(3,5i) == 3` and `IMAG(3+5i) == 5`. `Imag` returns `5` in this case and not `5i`. `Imag` returns the magnitude of the imaginary part of the number as a real number.

void Set(const mwArray& arr)

Purpose

Assign shared copy of input array to currently referenced cell for arrays of type mxCELL_CLASS and mxSTRUCT_CLASS

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
mwArray b(2, 2, mxINT16_CLASS);
mwArray c(1, 2, mxCELL_CLASS);
c.Get(1,1).Set(a);                        // Sets c(1) = a
c.Get(1,2).Set(b);                        // Sets c(2) = b
```

Arguments

arr
    mwArray to assign to currently referenced cell.

Return Value

None

Description

Use this method to construct cell and struct arrays.

void GetData(<numeric-type>* buffer, mwSize len) const

Purpose

Copy array's data into supplied numeric buffer

C++ Syntax

```
#include "mclcppclass.h"
double rdata[4] = {1.0, 2.0, 3.0, 4.0};
double data_copy[4] ;
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(rdata, 4);
a.GetData(data_copy, 4);
```

Arguments

`buffer`
Buffer to receive copy.

`len`
Maximum length of buffer. A maximum of `len` elements will be copied.

Return Value

None

Description

Valid types for `<numeric-type>` are:

- `mxDOUBLE_CLASS`
- `mxSINGLE_CLASS`
- `mxINT8_CLASS`
- `mxUINT8_CLASS`
- `mxINT16_CLASS`
- `mxUINT16_CLASS`
- `mxINT32_CLASS`
- `mxUINT32_CLASS`
- `mxINT64_CLASS`
- `mxUINT64_CLASS`

The data is copied in column-major order. If the underlying array is not of the same type as the input buffer, the data is converted to this type as it is copied. If a conversion cannot be made, an `mwException` is thrown.

void GetLogicalData(mxLogical* buffer, mwSize len) const

Purpose

Copy array’s data into supplied `mxLogical` buffer

C++ Syntax

```
#include "mclcppclass.h"
mxLogical data[4] = {true, false, true, false};
mxLogical data_copy[4] ;
mwArray a(2, 2, mxLOGICAL_CLASS);
a.SetData(data, 4);
a.GetData(data_copy, 4);
```

Arguments

`buffer`

Buffer to receive copy.

`len`

Maximum length of buffer. A maximum of `len` elements will be copied.

Return Value

None

Description

The data is copied in column-major order. If the underlying array is not of type `mxLOGICAL_CLASS`, the data is converted to this type as it is copied. If a conversion cannot be made, an `mwException` is thrown.

void GetCharData(mxChar* buffer, mwSize len) const

Purpose

Copy array's data into supplied `mxChar` buffer

C++ Syntax

```
#include "mclcppclass.h"
mxChar data[6] = {'H', 'e' , `l' , 'l' , 'o' , '\0'};
mxChar data_copy[6] ;
mwArray a(1, 6, mxCHAR_CLASS);
a.SetData(data, 6);
a.GetData(data_copy, 6);
```

Arguments

`buffer`

Buffer to receive copy.

`len`

Maximum length of buffer. A maximum of `len` elements will be copied.

Return Value

None

Description

The data is copied in column-major order. If the underlying array is not of type `mxCHAR_CLASS`, the data is converted to this type as it is copied. If a conversion cannot be made, an `mwException` is thrown.

void SetData(<numeric-type>* buffer, mwSize len)

Purpose

Copy data from supplied numeric buffer into array

C++ Syntax

```
#include "mclcppclass.h"
double rdata[4] = {1.0, 2.0, 3.0, 4.0};
double data_copy[4] ;
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(rdata, 4);
a.GetData(data_copy, 4);
```

Arguments

`buffer`
    Buffer containing data to copy.

`len`
    Maximum length of buffer. A maximum of `len` elements will be copied.

Return Value

None

Description

Valid types for `<numeric-type>` are `mxDOUBLE_CLASS`, `mxSINGLE_CLASS`, `mxINT8_CLASS`, `mxUINT8_CLASS`, `mxINT16_CLASS`, `mxUINT16_CLASS`, `mxINT32_CLASS`, `mxUINT32_CLASS`, `mxINT64_CLASS`, and `mxUINT64_CLASS`. The data is copied in column-major order. If the underlying array is not of the same type as the input buffer, the data is converted to this type as it is copied. If a conversion cannot be made, an `mwException` is thrown.

void SetLogicalData(mxLogical* buffer, mwSize len)

Purpose

Copy data from supplied `mxLogical` buffer into array

C++ Syntax

```
#include "mclcppclass.h"
mxLogical data[4] = {true, false, true, false};
mxLogical data_copy[4] ;
mwArray a(2, 2, mxLOGICAL_CLASS);
a.SetData(data, 4);
a.GetData(data_copy, 4);
```

Arguments

`buffer`
: Buffer containing data to copy.

`len`
: Maximum length of buffer. A maximum of `len` elements will be copied.

Return Value

None

Description

The data is copied in column-major order. If the underlying array is not of type `mxLOGICAL_CLASS`, the data is converted to this type as it is copied. If a conversion cannot be made, an `mwException` is thrown.

Purpose

Copy data from supplied mxChar buffer into array

C++ Syntax

```
#include "mclcppclass.h"
mxChar data[6] = {'H', 'e' , 'l' , 'l' , 'o' , '\0'};
mxChar data_copy[6] ;
mwArray a(1, 6, mxCHAR_CLASS);
a.SetData(data, 6);
a.GetData(data_copy, 6);
```

Arguments

`buffer`
: Buffer containing data to copy.

`len`
: Maximum length of buffer. A maximum of `len` elements will be copied.

Return Value

None

Description

The data is copied in column-major order. If the underlying array is not of type `mxCHAR_CLASS`, the data is converted to this type as it is copied. If a conversion cannot be made, an `mwException` is thrown.

mwArray operator()(mwIndex i1, mwIndex i2, mwIndex i3, ...,)

Purpose

Return single element at specified 1-based index

C++ Syntax

```
#include "mclcppclass.h"
double data[4] = {1.0, 2.0, 3.0, 4.0};
double x;
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(data, 4);
x = a(1,1);                    // x = 1.0
x = a(1,2);                    // x = 3.0
x = a(2,2);                    // x = 4.0
```

Arguments

`i1, i2, i3, ...,`
Comma-separated list of input indices.

Return Value

An `mwArray` containing the value at the specified index.

Description

Use this operator to fetch a single element at a specified index. The index is passed as a comma-separated list of 1-based indices. This operator is overloaded to support 1 through 32 indices. The valid number of indices that can be passed in is either 1 (single subscript indexing), in which case the element at the specified 1-based offset is returned, accessing data in column-wise order, or `NumberOfDimensions()` (multiple subscript indexing), in which case, the index list is used to access the specified element. The valid range for indices is `1 <= index <= NumberOfElements()`, for single subscript indexing. For multiple subscript indexing, the ith index has the valid range: `1 <= index[i] <= GetDimensions().Get(1, i)`. An `mwException` is thrown if an invalid number of indices is passed in or if any index is out of bounds.

mwArray operator()(const char* name, mwIndex i1, mwIndex i2, mwIndex i3, ...,)

Purpose

Return single element at specified field name and 1-based index in `struct` array

C++ Syntax

```
#include "mclcppclass.h"
const char* fields[] = {"a", "b", "c"};
int index[2] = {1, 1};
mwArray a(1, 1, 3, fields);
mwArray b = a("a", 1, 1);                  // b=a(1).a;
mwArray b = a("b", 1, 1);                  // b=a(1,1).b;
```

Arguments

`name`
: NULL-terminated string containing the field name to get.

`i1, i2, i3, ...,`
: Comma-separated list of input indices.

Return Value

An `mwArray` containing the value at the specified field name and index

Description

Use this method to fetch a single element at a specified field name and index. This method may only be called on an array that is of type `mxSTRUCT_CLASS`. An `mwException` is thrown if the underlying array is not a `struct` array. The field name passed must be a valid field name in the `struct` array. The index is passed by first passing the number of indices, followed by an array of 1-based indices. This operator is overloaded to support 1 through 32 indices. The valid number of indices that can be passed in is either 1 (single subscript indexing), in which case the element at the specified 1-based offset is returned, accessing data in column-wise order, or `NumberOfDimensions()` (multiple subscript indexing), in which case, the index list is used to access the specified element. The valid range for indices is `1 <= index <= NumberOfElements()`, for single subscript indexing. For multiple subscript indexing, the ith index has the valid range: `1 <= index[i] <= GetDimensions().Get(1, i)`. An `mwException` is thrown if an invalid number of indices is passed in or if any index is out of bounds.

mwArray& operator=(const <type>& x)

Purpose

Assign single scalar value to array

C++ Syntax

```
#include "mclcppclass.h"
mwArray a(2, 2, mxDOUBLE_CLASS);
a(1,1) = 1.0;               // assigns 1.0 to element (1,1)
a(1,2) = 2.0;               // assigns 2.0 to element (1,2)
a(2,1) = 3.0;               // assigns 3.0 to element (2,1)
a(2,2) = 4.0;               // assigns 4.0 to element (2,2)
```

Arguments

x

Value to assign.

Return Value

A reference to the invoking mwArray.

Description

Use this operator to set a single scalar value. This operator is overloaded for all numeric and logical types.

operator <type>() const

Purpose Fetch single scalar value from array

C++ Syntax

```
#include "mclcppclass.h"
double data[4] = {1.0, 2.0, 3.0, 4.0};
double x;
mwArray a(2, 2, mxDOUBLE_CLASS);
a.SetData(data, 4);
x = (double)a(1,1);                         // x = 1.0
x = (double)a(1,2);                         // x = 3.0
x = (double)a(2,1);                         // x = 2.0
x = (double)a(2,2);                         // x = 4.0
```

Arguments None

Return Value A single scalar value from the array.

Description Use this operator to fetch a single scalar value. This operator is overloaded for all numeric and logical types.

static mwArray Deserialize(const mwArray& arr)

Purpose

Deserialize array that was serialized with `mwArray::Serialize`

C++ Syntax

```
#include "mclcppclass.h"
double rdata[4] = {1.0, 2.0, 3.0, 4.0};
mwArray a(1,4,mxDOUBLE_CLASS);
a.SetData(rdata, 4);
mwArray b = a.Serialize();
a = mwArray::Deserialize(b);// a should contain same
                            // data as original
```

Arguments

`arr`

`mwArray` that has been obtained by calling `mwArray::Serialize`.

Return Value

A new `mwArray` containing the deserialized array.

Description

Use this method to deserialize an array that has been serialized with `mwArray::Serialize()`. The input array must be of type `mxUINT8_CLASS` and contain the data from a serialized array. If the input data does not represent a serialized `mwArray`, the behavior of this method is undefined.

Purpose

Get value of NaN (Not-a-Number)

C++ Syntax

```
#include "mclcppclass.h"
double x = mwArray::GetNaN();
```

Arguments

None

Return Value

The value of NaN (Not-a-Number) on your system.

Description

Call `mwArray::GetNaN` to return the value of `NaN` for your system. `NaN` is the IEEE arithmetic representation for Not-a-Number. Certain mathematical operations return `NaN` as a result, for example:

- 0.0/0.0
- `Inf-Inf`

The value of `NaN` is built in to the system; you cannot modify it.

static double GetEps()

Purpose Get value of eps

C++ Syntax

```
#include "mclcppclass.h"
double x = mwArray::GetEps();
```

Arguments None

Return Value The value of the MATLAB eps variable.

Description Call mwArray::GetEps to return the value of the MATLAB eps variable. This variable is the distance from 1.0 to the next largest floating-point number. Consequently, it is a measure of floating-point accuracy. The MATLAB pinv and rank functions use eps as a default tolerance.

Purpose

Get value of `Inf` (infinity)

C++ Syntax

```
#include "mclcppclass.h"
double x = mwArray::GetInf();
```

Arguments

None

Return Value

The value of `Inf` (infinity) on your system.

Description

Call `mwArray::GetInf` to return the value of the MATLAB internal `Inf` variable. `Inf` is a permanent variable representing IEEE arithmetic positive infinity. The value of `Inf` is built into the system; you cannot modify it.

Operations that return `Inf` include

- Division by 0. For example, 5/0 returns `Inf`.
- Operations resulting in overflow. For example, `exp(10000)` returns `Inf` because the result is too large to be represented on your machine.

static bool IsFinite(double x)

Purpose Test if value is finite and return `true` if value is finite

C++ Syntax

```
#include "mclcppclass.h"
bool x = mwArray::IsFinite(1.0);       // Returns true
```

Arguments Value to test for finiteness.

Return Value Result of test.

Description Call `mwArray::IsFinite` to determine whether or not a value is finite. A number is finite if it is greater than `-Inf` and less than `Inf`.

Purpose Test if value is infinite and return `true` if value is infinite

C++ Syntax

```
#include "mclcppclass.h"
bool x = mwArray::IsInf(1.0);          // Returns false
```

Arguments Value to test for infinity.

Return Value Result of test.

Description Call `mwArray::IsInf` to determine whether or not a value is equal to infinity or minus infinity. MATLAB stores the value of infinity in a permanent variable named `Inf`, which represents IEEE arithmetic positive infinity. The value of the variable, `Inf`, is built into the system; you cannot modify it.

Operations that return infinity include

- Division by 0. For example, 5/0 returns infinity.
- Operations resulting in overflow. For example, `exp(10000)` returns infinity because the result is too large to be represented on your machine. If the value equals `NaN` (Not-a-Number), then `mxIsInf` returns `false`. In other words, `NaN` is not equal to infinity.

static bool IsNaN(double x)

Purpose Test if value is `NaN` (Not-a-Number) and return `true` if value is `NaN`

C++ Syntax

```
#include "mclcppclass.h"
bool x = mwArray::IsNaN(1.0);           // Returns false
```

Arguments Value to test for `NaN`.

Return Value Result of test.

Description Call `mwArray::IsNaN` to determine whether or not the value is `NaN`. `NaN` is the IEEE arithmetic representation for Not-a-Number. `NaN` is obtained as a result of mathematically undefined operations such as

- `0.0/0.0`
- `Inf-Inf`

The system understands a family of bit patterns as representing `NaN`. In other words, `NaN` is not a single value, rather it is a family of numbers that the MATLAB software (and other IEEE-compliant applications) use to represent an error condition or missing data.

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