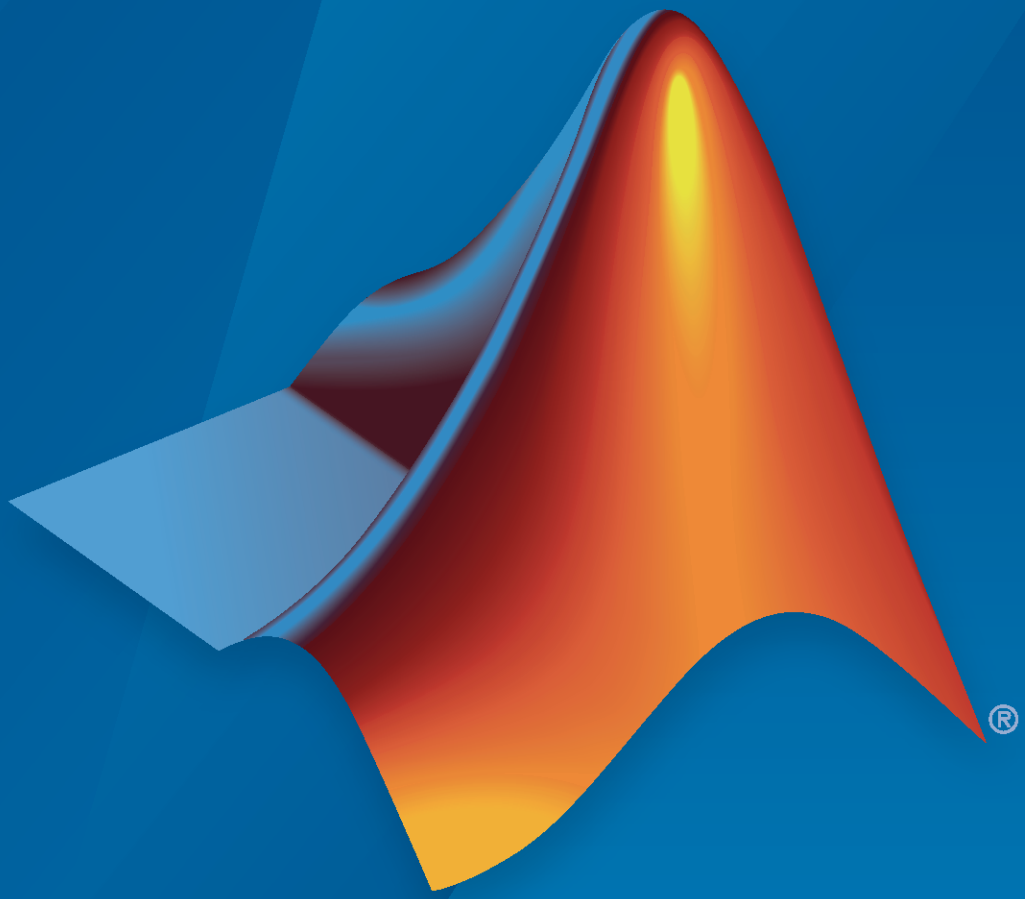
MATLAB® Compiler SDK™

Python® User's Guide



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R2021b

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Revision History

September 2015	Online only	New for Version 6.1 (Release 2015b)
March 2016	Online only	Revised for Version 6.2 (Release 2016a)
September 2016	Online only	Revised for Version 6.3 (Release R2016b)
March 2017	Online only	Revised for Version 6.3.1 (Release R2017a)
September 2017	Online only	Revised for Version 6.4 (Release R2017b)
March 2018	Online only	Revised for Version 6.5 (Release R2018a)
September 2018	Online only	Revised for Version 6.6 (Release R2018b)
March 2019	Online only	Revised for Version 6.6.1 (Release R2019a)
September 2019	Online only	Revised for Version 6.7 (Release R2019b)
March 2020	Online only	Revised for Version 6.8 (Release R2020a)
September 2020	Online only	Revised for Version 6.9 (Release R2020b)
March 2021	Online only	Revised for Version 6.10 (Release R2021a)
September 2021	Online only	Revised for Version 6.11 (Release R2021b)

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Python Package Installation

Install a MATLAB Compiler SDK Python Package

In this section...

With the Generated Installer

The Library Compiler app generates an installer that installs the MATLAB Runtime and the files required to install the generated Python package. The app places the installer in the `for_redistribution` folder.

1. Copy the installer from the `for_redistribution` folder to the desired location.
2. Run the installer.
3. Note where the installer writes the Python package files.
4. When the installer finishes, open a command terminal in the folder containing the Python package files.
5. Run the Python setup script. To install to a location other than the default, consult "Installing Python Modules" in the official Python documentation.

   ```
   python setup.py install
   ```
6. Set the required environment variables.

   On Linux®:

   ```
   setenv LD_LIBRARY_PATH ${LD_LIBRARY_PATH}:mcrroot/runtime/glnxa64:
          mcrroot/bin/glnxa64:mcrroot/sys/os/glnxa64:
          mcrroot/sys/opengl/lib/glnxa64
   ```

   On OS X:

   ```
   setenv DYLD_LIBRARY_PATH ${DYLD_LIBRARY_PATH}:mcrroot/runtime/maci64:
          mcrroot/sys/os/maci64:mcrroot/bin/maci64
   ```

   Note If `LD_LIBRARY_PATH` is not defined on Linux, remove `${LD_LIBRARY_PATH}:` from the code to set the environment variables. Similarly, on OS X, remove `${DYLD_LIBRARY_PATH}:` if `DYLD_LIBRARY_PATH` is not defined.

   Note *`mcrroot`* is the full path to the MATLAB Runtime installation.

   Note A command must be entered as a single line without white space between path components. Commands are wrapped here for readability.

Without the Generated Installer

If you already have the MATLAB Runtime installed, you can install the Python package.

1. Copy the contents of the `for_redistribution_files_only` folder to the desired location.
2. Open a command terminal in the folder containing the Python package files.

3. Run the Python setup script. To install to a location other than the default, consult "Installing Python Modules" in the official Python documentation.

```
python setup.py install
```

4. Set the required environment variables.

On Linux:

```
setenv LD_LIBRARY_PATH $LD_LIBRARY_PATH:mcrroot/runtime/glnxa64:
       mcrroot/bin/glnxa64:mcrroot/sys/os/glnxa64:
       mcrroot/sys/opengl/lib/glnxa64
```

On OS X:

```
setenv DYLD_LIBRARY_PATH $DYLD_LIBRARY_PATH:mcrroot/runtime/maci64:
       mcrroot/sys/os/maci64:mcrroot/bin/maci64
```

Note *mcrroot* is the full path to the MATLAB Runtime installation.

Note A command must be entered as a single line without white space between path components. Commands are wrapped here for readability.

See Also

Related Examples

- “Import Compiled Python Packages” on page 2-3
- “Initialize MATLAB Runtime” on page 2-4

Python Integration

Integrate a Python Package

To integrate a MATLAB Compiler SDK Python Package:

1. Install the compiled Python Package.

   See “Install a MATLAB Compiler SDK Python Package” on page 1-2.
2. In consultation with the MATLAB programmer, collect the MATLAB function signatures that comprise the services in the application.
3. Import the compiled Python package.

   See “Import Compiled Python Packages” on page 2-3.
4. Write the Python code to initialize the MATLAB Runtime, and load the MATLAB code.

   See “Initialize MATLAB Runtime” on page 2-4.
5. Create the required MATLAB data for function inputs and outputs.

   See “Create MATLAB Arrays in Python” on page 3-4.
6. Invoke the MATLAB functions.

   See “Invoke a Packaged MATLAB Function” on page 2-6 or “Invoke a Compiled MATLAB Function Asynchronously” on page 2-8.
7. Terminate each package using its `terminate()` function. If you do not call this function explicitly, it is called automatically when the program exits.

Import Compiled Python Packages

The MATLAB Compiler SDK Python target generates the Python code into a package that must be imported into Python before you can use the compiled MATLAB functions. You specify the package name and the namespace when compiling the MATLAB functions.

- If you use the Library Compiler app, you specify the package name with the **Library Name** field and the namespace with the **Namespace** field.

  The **Library Name** field defaults to the name of the first MATLAB file listed in the app. You can leave the **Namespace** field empty.
- If you use the `mcc` function, you specify the package name and namespace as part of the `-W python:`*`namespace.packageName`* flag.

  Specifying the namespace is optional.

For example, if you compile your MATLAB functions and specify the package name as`addmatrix` with no namespace, you import it as follows:

```
import addmatrix
```

If you compile your MATLAB functions using the `mcc` command with the option `-W python:com.mathworks.addmatrix`, you import it as follows:

```
import com.mathworks.addmatrix
```

See Also

Related Examples

- “Generate a Python Package and Build a Python Application”
- “Package Python Applications from Command Line”

Initialize MATLAB Runtime

When integrating compiled MATLAB functions into a Python application, your code must initialize MATLAB Runtime and any compiled packages in the application.

1. Call the `initialize_runtime()` function, which allows you to provide a list of startup options to MATLAB Runtime. This loads and starts MATLAB Runtime.
2. Use the `initialize()` function of each compiled package in the application to retrieve a handle that can be used to call the MATLAB functions within the package.

Provide MATLAB Runtime Startup Options

Note On macOS, you must pass the MATLAB Runtime options to the `mwpython` command when starting Python. Use `-mlstartup` followed by a comma-separated list of MATLAB Runtime options. MATLAB Runtime options passed to `initialize_runtime()` are ignored.

The MATLAB Runtime has two startup options that you can specify:

- `-nojvm` — disable the Java® Virtual Machine, which is enabled by default. This can help improve MATLAB Runtime's performance.
- `-nodisplay` — on Linux, run MATLAB Runtime without display functionality.

You specify these options before you initialize the compiled MATLAB functions. You do so by calling the `initialize_runtime()` method of a generated Python package with the MATLAB Runtime options. The list of MATLAB Runtime options is passed as a list of strings. For example, to start MATLAB Runtime for the package `addmatrix` with no display and no Java Virtual Machine:

```
import addmatrix

addmatrix.initialize_runtime(['-nojvm', '-nodisplay'])
```

If your application uses multiple Python packages, you call `initialize_runtime()` from only one package. The first call sets the run-time options for MATLAB Runtime session. Any subsequent calls are ignored.

Start MATLAB Runtime with Compiled MATLAB Functions

To invoke a compiled MATLAB function, load it into MATLAB Runtime. Do this by calling the `initialize()` method of the generated Python package. The `initialize()` method returns an object that can be used to invoke the compiled MATLAB functions in the package. For example, to start MATLAB Runtime and load the MATLAB functions in the `addmatrix` package, use:

```
import addmatrix

myAdder = addmatrix.initialize()
```

Note If the `initialize_runtime()` function is not called before a call to `initialize()` function, MATLAB Runtime is started with no startup options.

Note You cannot import `matlab.engine` after importing your component. For more information on `matlab.engine`, see “Start and Stop MATLAB Engine for Python”.

See Also

More About

- “Install and Configure MATLAB Runtime”

Invoke a Packaged MATLAB Function

In this section...

Invoke a compiled MATLAB function using the Python object returned from the `initialize()` function.

```
result1,...resultN = my_client.function_name(in_args, nargout=nargs,
                                             stdout=out_stream,
                                             stderr=err_stream)
```

- *`my_client`* — Name of object returned from `initialize()`
- *`function_name`* — Name of the function to invoke
- *`in_args`* — Comma-separated list of input arguments
- *`nargs`* — Number of expected results. The default value is `1`.
- *`out_stream`* — Python `StringIO` object receiving the console output. The default is to direct output to the console.
- *`err_stream`* — Python `StringIO` object receiving the error output. The default is to direct output to the console.

Each variable on the left side of the function call is populated with a single return value.

Note If you provide less than *`nargs`* variables on the left side of the function call, the last listed variable contains a list of the remaining results. For example

```
result1, result2 = myMagic.triple(5,nargout=3)
```

leaves `result1` containing a single value and `result2` containing a list with two values.

Invoke MATLAB Function with Single Output

To invoke the MATLAB function `result = mutate(m1, m2, m3)` from the package `mutations`, you use this code:

```
import mutations
import matlab

myMutator = mutations.initialize()

m1 = matlab.double([1,2,3])
m2 = matlab.double([10,20,30])
m3 = matlab.double([100,200,300])

result = myMutator.mutate(m1,m2,m3)
```

Invoke MATLAB Function with Zero Outputs

To invoke the MATLAB function `mutate(m1,m2,m3)` from the package `mutations`, you use this code:

```
import mutations
import matlab

myMutator = mutations.initialize()

m1 = matlab.double([1,2,3])
m2 = matlab.double([10,20,30])
m3 = matlab.double([100,200,300])

myMutator.mutate(m1,m2,m3,nargout=0)
```

Receive Multiple Results as Individual Variables

To invoke the MATLAB function `c1,c2 = copy(o1,o2)` from the package `copier`, use this code:

```
>>> import copier
>>> import matlab
>>> myCopier = copier.initialize()
>>> c1,c2 = myCopier.copy("blue",10,nargout=2)
>>> print(c1)
"blue"
>>> print(c2)
10
```

Receive Multiple Results as Single Object

To invoke the MATLAB function `copies = copy(o1,o2)` from the package `copier`, use this code:

```
>>> import copier
>>> import matlab
>>> myCopier = copier.initialize()
>>> copies = myCopier.copy("blue",10,nargout=2)
>>> print(copies)
["blue",10]
```

See Also

Related Examples

- “Initialize MATLAB Runtime” on page 2-4
- “Generate a Python Package and Build a Python Application”

Invoke a Compiled MATLAB Function Asynchronously

Asynchronously invoke a compiled MATLAB function that uses the Python object returned from the `initialize()` function by passing `async = True`.

```
future = my_client.function_name(in_args, nargout=nargs,
                                 stdout=out_stream,
                                 stderr=err_stream,
                                 async=True)
```

- *`my_client`* — Name of object returned from `initialize()`
- *`function_name`* — Name of the function to invoke
- *`in_args`* — Comma-separated list of input arguments
- *`nargs`* — Number of results expected from the server
- *`out_stream`* — Python `StringIO` object receiving the console output
- *`err_stream`* — Python `StringIO` object receiving the error output

When the `async` keyword is set to `True`, the MATLAB function is placed into a processing queue and a Python `Future` object is returned. You use the `Future` object to retrieve the results when the MATLAB function is finished processing.

To invoke the MATLAB function `c1,c2= copy(o1,o2)` from the package `copier` asynchronously, use the following code:

```
>>> import mutations
>>> import matlab
>>> myMutator = mutations.initialize()
>>> m1 = matlab.double([1,2,3])
>>> m2 = matlab.double([10,20,30])
>>> m3 = matlab.double([100,200,300])
>>> resultFuture = myMutator.mutate(m1,m2,m3, async=True)
>>> while !resultFuture.done():
...    time.sleep(1)
...
>>> result = resultFuture.result()
```

Tip You can cancel asynchronous requests using the `cancel()` method of the `Future` object.

See Also

Related Examples

- “Initialize MATLAB Runtime” on page 2-4
- “Generate a Python Package and Build a Python Application”

Differences Between MATLAB Engine API for Python and MATLAB Compiler SDK

MATLAB Engine API for Python enables you to call MATLAB as a computational engine. The main differences between MATLAB Engine API for Python and MATLAB Compiler SDK for Python are as follows:

- MATLAB Engine API for Python starts a MATLAB session out-of-process, which executes MATLAB as a separate process. MATLAB Compiler SDK for Python starts MATLAB Runtime in-process.
- You can use MATLAB Engine API for Python to call built-in or user-written MATLAB functions. MATLAB Compiler SDK for Python can only call user-written MATLAB functions.

  For an example of calling user-written MATLAB code with MATLAB Engine API for Python, see “Call User Scripts and Functions from Python”.
- MATLAB Engine API for Python allows you to work with a workspace, while MATLAB Compiler SDK for Python does not. Therefore you cannot call MATLAB classes (handles) with MATLAB Compiler SDK for Python.

  For more information on MATLAB Engine workspace, see “Use MATLAB Engine Workspace in Python”.

See Also

Related Examples

- “Generate a Python Package and Build a Python Application”
- “Initialize MATLAB Runtime” on page 2-4
- “Get Started with MATLAB Engine API for Python”
- “Start and Stop MATLAB Engine for Python”
- “Call MATLAB Functions from Python”

Data Handling

Pass Data Between MATLAB and Python

Pass Data from MATLAB to Python

When MATLAB functions return output arguments, MATLAB converts the data into equivalent Python data types.

MATLAB Output Argument Type (scalar unless otherwise noted)	Resulting Python Data Type
Numeric array	`matlab` numeric array object (see “Create MATLAB Arrays in Python” on page 3-4)
`double` `single`	`float`
Complex (any numeric type)	`complex`

`int8`
`uint8`
`int16`
`uint16`
`int32`
	`int`

`uint32`
`int64`
`uint64`
	`int`
	`long`

`NaN`	`float('nan')`
`Inf`	`float('inf')`
`logical`	`bool`
`char` array (1-by-`N`, `N`-by-1) `char` array (`M`-by-`N`)	`str` Not supported
structure	`dict`
Row or column cell array	`list`
`M`-by-`N` cell array	Not supported
MATLAB handle object (`table`, `containers.Map`, categorical array)	Not supported
Other object (e.g., Java)	Not supported
Function handle	Not supported
Sparse array	Not supported
String array	Not supported
Structure array	Not supported

Pass Data from Python to MATLAB

When you pass data as input arguments to MATLAB functions from Python, MATLAB converts the data into equivalent MATLAB data types.

Python Input Argument Type	Resulting MATLAB Data Type (scalar unless otherwise noted)
`matlab` numeric array object (see “Create MATLAB Arrays in Python” on page 3-4)	Numeric array
`float`	`double`
`complex`	Complex `double`
`int`	`int32`(Windows®) `int64`(Linux and Mac)
`long` [a]	`int64`
`float('nan')`	`NaN`
`float('inf')`	`Inf`
`bool`	`logical`
`str`	`char`
`bytearray`	`uint8` array
`bytes`	`uint8` array
`dict`	Structure if all keys are strings Not supported otherwise
`list`	Cell array
`set`	Cell array
`tuple`	Cell array
`memoryview`	Not supported
`range`	Cell array
`None`	Not supported
`module.type`	Not supported

a. `long` is a data type of Python 2.7 only

See Also

Related Examples

- “Create MATLAB Arrays in Python” on page 3-4
- “Use MATLAB Arrays in Python” on page 3-9

Create MATLAB Arrays in Python

In this section...

The `matlab` Python package provides array classes to represent arrays of MATLAB numeric types as Python variables. Other MATLAB types are also supported, as listed in “Pass Data to MATLAB from Python”.

MATLAB Arrays as Python Variables

You can create MATLAB numeric arrays in a Python session by calling constructors from the `matlab` Python package (for example, `matlab.double`, `matlab.int32`). The name of the constructor indicates the MATLAB numeric type. You can pass MATLAB arrays as input arguments to MATLAB functions called from Python. When a MATLAB function returns a numeric array as an output argument, the array is returned to Python.

You can initialize the array with an optional `initializer` input argument that contains numbers. The `initializer` argument must be a Python sequence type such as a list or a tuple. The optional `size` input argument sets the size of the initialized array. To create multidimensional arrays, specify `initializer` to contain multiple sequences of numbers, or specify `size` to be multidimensional. You can create a MATLAB array of complex numbers by setting the optional `is_complex` keyword argument to `True`. The `mlarray` module provides the MATLAB array constructors listed in the table.

Class from `matlab` Package	Constructor Call in Python	MATLAB Numeric Type
`matlab.double`	`matlab.double( initializer=None, size=None, is_complex=False)`	Double precision
`matlab.single`	`matlab.single( initializer=None, size=None, is_complex=False)`	Single precision
`matlab.int8`	`matlab.int8( initializer=None, size=None, is_complex=False)`	8-bit signed integer
`matlab.int16`	`matlab.int16( initializer=None, size=None, is_complex=False)`	16-bit signed integer

Class from `matlab` Package	Constructor Call in Python	MATLAB Numeric Type
`matlab.int32`	`matlab.int32( initializer=None, size=None, is_complex=False)`	32-bit signed integer
`matlab.int64`[a]	`matlab.int64( initializer=None, size=None, is_complex=False)`	64-bit signed integer
`matlab.uint8`	`matlab.uint8( initializer=None, size=None, is_complex=False)`	8-bit unsigned integer
`matlab.uint16`	`matlab.uint16( initializer=None, size=None, is_complex=False)`	16-bit unsigned integer
`matlab.uint32`	`matlab.uint32( initializer=None, size=None, is_complex=False)`	32-bit unsigned integer
`matlab.uint64`[b]	`matlab.uint64( initializer=None, size=None, is_complex=False)`	64-bit unsigned integer
`matlab.logical`	`matlab.logical( initializer=None, size=None)`[c]	Logical

a. In Python on Windows, `matlab.int64` is converted to `int32` in MATLAB. Also, MATLAB cannot return an `int64` array to Python.
b. In Python on Windows, `matlab.uint64` is converted to `uint32` in MATLAB. Also, MATLAB cannot return a `uint64` array to Python.
c. Logicals cannot be made into an array of complex numbers.

When you create an array with `N` elements, the size is 1-by-`N` because it is a MATLAB array.

```
import matlab
A = matlab.int8([1,2,3,4,5])
print(A.size)

(1, 5)
```

The initializer is a Python list containing five numbers. The MATLAB array size is 1-by-5, indicated by the tuple `(1,5)`.

MATLAB Array Attributes and Methods in Python

All MATLAB arrays created with `matlab` package constructors have the attributes and methods listed in the following table:

Attribute or Method	Purpose
`size`	Size of array returned as a tuple

Attribute or Method	Purpose
`reshape(size)`	Reshape the array as specified by the sequence `size`

Multidimensional MATLAB Arrays in Python

In Python, you can create multidimensional MATLAB arrays of any numeric type. Use two Python lists of floats to create a 2-by-5 MATLAB array of doubles.

```
import matlab
A = matlab.double([[1,2,3,4,5], [6,7,8,9,10]])
print(A)

[[1.0,2.0,3.0,4.0,5.0],[6.0,7.0,8.0,9.0,10.0]]
```

The `size` attribute of `A` shows it is a 2-by-5 array.

```
print(A.size)

(2, 5)
```

Index Into MATLAB Arrays in Python

You can index into MATLAB arrays just as you can index into Python lists and tuples.

```
import matlab
A = matlab.int8([1,2,3,4,5])
print(A[0])

[1,2,3,4,5]
```

The size of the MATLAB array is `(1,5)`; therefore, `A[0]` is `[1,2,3,4,5]`. Index into the array to get 3.

```
print(A[0][2])

3
```

Python indexing is zero-based. When you access elements of MATLAB arrays in a Python session, use zero-based indexing.

This example shows how to index into a multidimensional MATLAB array.

```
A = matlab.double([[1,2,3,4,5], [6,7,8,9,10]])
print(A[1][2])

8.0
```

Slice MATLAB Arrays in Python

You can slice MATLAB arrays just as you can slice Python lists and tuples.

```
import matlab
A = matlab.int8([1,2,3,4,5])
print(A[0][1:4])
```

```
[2,3,4]
```

You can assign data to a slice. This example shows an assignment from a Python list to the array.

```
A = matlab.double([[1,2,3,4],[5,6,7,8]])
A[0] = [10,20,30,40]
print(A)

[[10.0,20.0,30.0,40.0],[5.0,6.0,7.0,8.0]]
```

You can assign data from another MATLAB array, or from any Python iterable that contains numbers.

You can specify slices for assignment, as shown in this example.

```
A = matlab.int8([1,2,3,4,5,6,7,8])
A[0][2:4] = [30,40]
A[0][6:8] = [70,80]
print(A)

[[1,2,30,40,5,6,70,80]]
```

Note Slicing MATLAB arrays behaves differently from slicing a Python list. Slicing a MATLAB array returns a view instead of a shallow copy.

Given a MATLAB array and a Python list with the same values, assigning a slice results in different results.

```
>>>mlarray = matlab.int32([[1,2],[3,4],[5,6]])
>>>py_list = [[1,2],[3,4],[5,6]]
>>>mlarray[0] = mlarray[0][::-1]
>>>py_list[0] = py_list[0][::-1]
>>>mlarray[0]
matlab.int32([[2,2],[3,4],[5,6]])
>>>py_list
[[2,1],[3,4],[5,6]]
```

Reshaping MATLAB Arrays in Python

You can reshape a MATLAB array in Python with the `reshape` method. The input argument, `size`, must be a sequence that does not change the number of elements in the array. Use `reshape` to change a 1-by-9 MATLAB array to 3-by-3.

```
import matlab
A = matlab.int8([1,2,3,4,5,6,7,8,9])
A.reshape((3,3))
print(A)

[[1,4,7],[2,5,8],[3,6,9]]
```

See Also

Related Examples

- “Use MATLAB Arrays in Python” on page 3-9
- “Pass Data to MATLAB from Python”

Use MATLAB Arrays in Python

To use MATLAB arrays in Python, you can either install the Python engine before running your packaged application, as described in “Install MATLAB Engine API for Python”, or use `import mypackage` before `import matlab` in the following programs.

The MATLAB Engine API for Python provides a Python package named `matlab` that enables you to call MATLAB functions from Python. The `matlab` package provides constructors to create MATLAB arrays in Python. It can create arrays of any MATLAB numeric or logical type from Python sequence types. Multidimensional MATLAB arrays are supported. For a list of other supported array types, see “Pass Data to MATLAB from Python”.

Examples

1. Create a MATLAB array in Python, and call a MATLAB function on it. Assuming that you have a package named `mypackage` and a method called `mysqrt` inside the package, you can use `matlab.double` to create an array of doubles given a Python list that contains numbers. You can call the MATLAB function `mysqrt` on `x`, and the return value is another `matlab.double` array as shown in the following program:

   ```
   import matlab
   import mypackage
   pkg = mypackage.initialize()
   x = matlab.double([1,4,9,16,25])
   print(pkg.mysqrt(x))
   ```

   The output is:

   ```
   [[1.0,2.0,3.0,4.0,5.0]]
   ```

2. Create a multidimensional array. The `magic` function returns a 2-D array to Python scope. Assuming you have method called `mysqrt` inside `mypackage`, you can use the following code to call that method:

   ```
   import matlab
   import mypackage
   pkg = mypackage.initialize()
   x = matlab.double([1,4,9,16,25])
   print(pkg.mymagic(6))
   ```

   The output is:

   ```
   [[35.0,1.0,6.0,26.0,19.0,24.0],[3.0,32.0,7.0,21.0,23.0,25.0],
    [31.0,9.0,2.0,22.0,27.0,20.0],[8.0,28.0,33.0,17.0,10.0,15.0],
    [30.0,5.0,34.0,12.0,14.0,16.0],[4.0,36.0,29.0,13.0,18.0,11.0]]
   ```

See Also

More About

- “Create MATLAB Arrays in Python” on page 3-4
- “Pass Data to MATLAB from Python”

Functions

compiler.build.pythonPackage

Create Python package for deployment outside MATLAB

Syntax

```
compiler.build.pythonPackage(FunctionFiles)
compiler.build.pythonPackage(FunctionFiles,Name,Value)
compiler.build.pythonPackage(opts)
results = compiler.build.pythonPackage( ___ )
```

Description

`compiler.build.pythonPackage(FunctionFiles)` creates a Python package using the MATLAB functions specified by `FunctionFiles`.

`compiler.build.pythonPackage(FunctionFiles,Name,Value)` creates a Python package with additional options specified using one or more name-value arguments. Options include the package name, output directory, and additional files to include.

`compiler.build.pythonPackage(opts)` creates a Python package with options specified using a `compiler.build.PythonPackageOptions` object `opts`. You cannot specify any other options using name-value arguments.

`results = compiler.build.pythonPackage( ___ )` returns build information as a `compiler.build.Results` object using any of the input argument combinations in previous syntaxes. The build information consists of the build type, paths to the compiled files, and build options.

Examples

Create Python Package Using File

Create a Python package using a function file that generates a magic square.

In MATLAB, locate the MATLAB function that you want to deploy as a Python package. For this example, use the file `magicsquare.m` located in *`matlabroot`*`\extern\examples\compiler`.

```
appFile = fullfile(matlabroot,'extern','examples','compiler','magicsquare.m');
```

Build a Python package using the `compiler.build.pythonPackage` command.

```
compiler.build.pythonPackage(appFile);
```

The build function creates the following files within a folder named `magicsquarepythonPackage` in your current working directory:

- `GettingStarted.html`
- `includedSupportPackages.txt`
- `example`

- `mccExcludedFiles.log`
- `readme.txt`
- `requiredMCRProducts.txt`
- `setup.py`
- `unresolvedSymbols.txt`

Customize Python Package

Create a Python package and customize it using name-value arguments.

For this example, use the files `flames.m` and `flames.mat` located in *`matlabroot`*`\extern\examples\compiler`.

```
appFile = fullfile(matlabroot,'extern','examples','compiler','flames.m');
MATFile = fullfile(matlabroot,'extern','examples','compiler','flames.mat');
```

Build a Python package using the `compiler.build.pythonPackage` command. Use name-value arguments to specify the package name, add a MAT-file, and enable verbose output.

```
compiler.build.pythonPackage(appFile,'PackageName','FlamesApp',...
    'AdditionalFiles',MATFile,...
    'Verbose','on');
```

Create Multiple Python Packages Using Options Object

Create multiple Python packages using a `compiler.build.PythonPackageOptions` object.

For this example, use the file `magicsquare.m` located in *`matlabroot`*`\extern\examples\compiler`.

```
appFile = fullfile(matlabroot,'extern','examples','compiler','magicsquare.m');
```

Create a `PythonPackageOptions` object using `appFile`. Use name-value arguments to specify a common output directory, disable automatic detection of data files, and enable verbose output.

```
opts = compiler.build.PythonPackageOptions(appFile,...
    'OutputDir','D:\Documents\MATLAB\work\PythonPackageBatch',...
    'AutoDetectDataFiles','off',...
    'Verbose','on')
```

```
opts =

  PythonPackageOptions with properties:

           FunctionFiles: {'C:\Program Files\MATLAB\R2021b\extern\examples\compiler\magicsquare
    SampleGenerationFiles: {}
          AdditionalFiles: {}
      AutoDetectDataFiles: off
          SupportPackages: {'autodetect'}
                  Verbose: on
                OutputDir: 'D:\Documents\MATLAB\work\PythonPackageBatch'
```

Build the Python package using the `PythonPackageOptions` object.

```
compiler.build.pythonPackage(opts);
```

To compile using the function file `hello.m` with the same options, use dot notation to modify the `FunctionFiles` argument of the existing `PythonPackageOptions` object before running the build function again.

```
opts.FunctionFiles = fullfile(matlabroot,'extern','examples','compiler','hello.m');
compiler.build.pythonPackage(opts);
```

By modifying the `FunctionFiles` argument and recompiling, you can compile multiple components using the same options object.

Get Build Information from Python Package

Create a Python package and save information about the build type, generated files, included support packages, and build options to a `compiler.build.Results` object.

Compile using the file `magicsquare.m` located in *`matlabroot`*`\extern\examples\compiler`.

```
results = compiler.build.pythonPackage('magicsquare.m');
```

```
results =

  Results with properties:

            BuildType: 'pythonPackage'
                Files: {3×1 cell}
IncludedSupportPackages: {}
              Options: [1×1 compiler.build.PythonPackageOptions]
```

The `Files` property contains the paths to the following:

- `example` folder
- `setup.py`
- `GettingStarted.html`

Input Arguments

`FunctionFiles` — Files implementing MATLAB functions

character vector | string scalar | cell array of character vectors | string array

Files implementing MATLAB functions, specified as a character vector, a string scalar, a string array, or a cell array of character vectors. File paths can be relative to the current working directory or absolute. Files must have a `.m` extension.

Example: `["myfunc1.m","myfunc2.m"]`

Data Types: `char` | `string` | `cell`

`opts` — Python package build options

`compiler.build.PythonPackageOptions` object

Python package build options, specified as a `compiler.build.PythonPackageOptions` object.

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'Verbose','on'`

`AdditionalFiles` — Additional files

character vector | string scalar | cell array of character vectors | string array

Additional files to include in the Python package, specified as a character vector, a string scalar, a string array, or a cell array of character vectors. File paths can be relative to the current working directory or absolute.

Example: `'AdditionalFiles',["myvars.mat","data.txt"]`

Data Types: `char` | `string` | `cell`

`AutoDetectDataFiles` — Flag to automatically include data files

`'on'` (default) | on/off logical value

Flag to automatically include data files, specified as `'on'` or `'off'`, or as numeric or logical `1` (`true`) or `0` (`false`). A value of `'on'` is equivalent to `true`, and `'off'` is equivalent to `false`. Thus, you can use the value of this property as a logical value. The value is stored as an on/off logical value of type `matlab.lang.OnOffSwitchState`.

- If you set this property to `'on'`, then data files that you provide as inputs to certain functions (such as `load` and `fopen`) are automatically included in the package.
- If you set this property to `'off'`, then you must add data files to the package using the `AdditionalFiles` option.

Example: `'AutoDetectDataFiles','off'`

Data Types: `logical`

`PackageName` — Name of Python package

character vector | string scalar

Name of the Python package, specified as a character vector or a string scalar. Specify `'PackageName'` as a namespace, which is a period-separated list, such as `companyname.groupname.component`. The name of the generated package is set to the last entry of the period-separated list. The name must begin with a letter and contain only alphabetic characters and periods.

Example: `'PackageName','mathworks.pythonpackage.mymagic'`

Data Types: `char` | `string`

`SampleGenerationFiles` — MATLAB sample files

character vector | string scalar | cell array of character vectors | string array

MATLAB sample files used to generate sample Python files for functions included with the package, specified as a character vector, a string scalar, a string array, or a cell array of character vectors. File paths can be relative to the current working directory or absolute. Files must have a `.m` extension.

Example: `'SampleGenerationFiles',["sample1.m","sample2.m"]`

Data Types: `char` | `string` | `cell`

`OutputDir` — Path to output directory
character vector | string scalar

Path to the output directory where the build files are saved, specified as a character vector or a string scalar. The path can be relative to the current working directory or absolute.

The default name of the build folder is the package name appended with `pythonPackage`.

Example: `'OutputDir','D:\Documents\MATLAB\work\mymagicpythonPackage'`

Data Types: `char` | `string`

`SupportPackages` — Support packages
`'autodetect'` (default) | `'none'` | string scalar | cell array of character vectors | string array

Support packages to include, specified as one of the following options:

- `'autodetect'` (default) — The dependency analysis process detects and includes the required support packages automatically.
- `'none'` — No support packages are included. Using this option can cause runtime errors.
- A string scalar, character vector, or cell array of character vectors — Only the specified support packages are included. To list installed support packages or those used by a specific file, see `compiler.codetools.deployableSupportPackages`.

.

Example: `'SupportPackages',{'Deep Learning Toolbox Converter for TensorFlow Models','Deep Learning Toolbox Model for Places365-GoogLeNet Network'}`

Data Types: `char` | `string` | `cell`

`Verbose` — Flag to control build verbosity
`'off'` (default) | on/off logical value

Flag to control build verbosity, specified as `'on'` or `'off'`, or as numeric or logical `1` (`true`) or `0` (`false`). A value of `'on'` is equivalent to `true`, and `'off'` is equivalent to `false`. Thus, you can use the value of this property as a logical value. The value is stored as an on/off logical value of type `matlab.lang.OnOffSwitchState`.

- If you set this property to `'on'`, then the MATLAB command window displays progress information indicating compiler output during the build process.
- If you set this property to `'off'`, then the command window does not display progress information.

Example: `'Verbose','on'`

Data Types: `logical`

Output Arguments

`results` — Build results
`compiler.build.Results` object

Build results, returned as a `compiler.build.Results` object. The `Results` object contains:

- Build type, which is `'pythonPackage'`
- Paths to the following items:
  - `example` folder
  - `setup.py`
  - `GettingStarted.html`
- A list of included support packages
- Build options, specified as a `PythonPackageOptions` object

See Also

`compiler.build.PythonPackageOptions`

Introduced in R2021a

compiler.build.PythonPackageOptions

Options for building Python packages

Syntax

```
opts = compiler.build.PythonPackageOptions(FunctionFiles)
opts = compiler.build.PythonPackageOptions(FunctionFiles,Name,Value)
```

Description

`opts = compiler.build.PythonPackageOptions(FunctionFiles)` creates a `PythonPackageOptions` object using MATLAB functions specified by `FunctionFiles`. Use the `PythonPackageOptions` object as an input to the `compiler.build.pythonPackage` function.

`opts = compiler.build.PythonPackageOptions(FunctionFiles,Name,Value)` creates a `PythonPackageOptions` object with options specified using one or more name-value arguments. Options include the package name, output directory, and additional files to include.

Examples

Create Python Package Options Object Using File

Create a `PythonPackageOptions` object using file input.

For this example, use the file `magicsquare.m` located in *`matlabroot`*`\extern\examples\compiler`.

```
appFile = fullfile(matlabroot,'extern','examples','compiler','magicsquare.m');
opts = compiler.build.PythonPackageOptions(appFile)
```

```
opts =

  PythonPackageOptions with properties:

           FunctionFiles: {'C:\Program Files\MATLAB\R2021b\extern\examples\compiler'}
             PackageName: 'example.magicsquare'
    SampleGenerationFiles: {}
          AdditionalFiles: {}
      AutoDetectDataFiles: on
          SupportPackages: {'autodetect'}
                  Verbose: off
                OutputDir: '.\magicsquarepythonPackage'
```

You can modify the property values of an existing `PythonPackageOptions` object using dot notation. For example, enable verbose output.

```
opts.Verbose = 'on'
```

```
opts =

  PythonPackageOptions with properties:
```

```
            FunctionFiles: {'C:\Program Files\MATLAB\R2021b\extern\examples\compiler'}
              PackageName: 'example.magicsquare'
    SampleGenerationFiles: {}
          AdditionalFiles: {}
      AutoDetectDataFiles: on
          SupportPackages: {'autodetect'}
                  Verbose: on
                OutputDir: '.\magicsquarepythonPackage'
```

Use the `PythonPackageOptions` object as an input to the `compiler.build.pythonPackage` function to build a Python package.

```
buildResults = compiler.build.pythonPackage(opts);
```

Customize Python Package Options Object

Create a `PythonPackageOptions` object and customize it using name-value arguments.

For this example, use the file `magicsquare.m` located in *`matlabroot`*`\extern\examples\compiler`. Use name-value arguments to specify the output directory and disable automatic detection of data files.

```
opts = compiler.build.PythonPackageOptions('magicsquare.m',...
    'OutputDir','D:\Documents\MATLAB\work\MagicPythonPackage',...
    'AutoDetectDataFiles','off')
```

```
opts =

  PythonPackageOptions with properties:

            FunctionFiles: {'C:\Program Files\MATLAB\R2021b\extern\examples\compiler'}
              PackageName: 'example.magicsquare'
    SampleGenerationFiles: {}
          AdditionalFiles: {}
      AutoDetectDataFiles: off
          SupportPackages: {'autodetect'}
                  Verbose: off
                OutputDir: 'D:\Documents\MATLAB\work\MagicPythonPackage'
```

You can modify the property values of an existing `PythonPackageOptions` object using dot notation. For example, enable verbose output.

```
opts.Verbose = 'on'
```

```
opts =

  PythonPackageOptions with properties:

            FunctionFiles: {'C:\Program Files\MATLAB\R2021b\extern\examples\compiler'}
              PackageName: 'example.magicsquare'
    SampleGenerationFiles: {}
          AdditionalFiles: {}
      AutoDetectDataFiles: off
          SupportPackages: {'autodetect'}
                  Verbose: on
                OutputDir: 'D:\Documents\MATLAB\work\MagicPythonPackage'
```

Use the `PythonPackageOptions` object as an input to the `compiler.build.pythonPackage` function to build a Python package.

```
buildResults = compiler.build.pythonPackage(opts);
```

Input Arguments

`FunctionFiles` — Files implementing MATLAB functions

character vector | string scalar | cell array of character vectors | string array

Files implementing MATLAB functions, specified as a character vector, a string scalar, a string array, or a cell array of character vectors. File paths can be relative to the current working directory or absolute. Files must have a `.m` extension.

Example: `["myfunc1.m","myfunc2.m"]`

Data Types: `char` | `string` | `cell`

Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside quotes. You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'Verbose','on'`

`AdditionalFiles` — Additional files

character vector | string scalar | cell array of character vectors | string array

Additional files to include in the Python package, specified as a character vector, a string scalar, a string array, or a cell array of character vectors. File paths can be relative to the current working directory or absolute.

Example: `'AdditionalFiles',["myvars.mat","data.txt"]`

Data Types: `char` | `string` | `cell`

`AutoDetectDataFiles` — Flag to automatically include data files

`'on'` (default) | on/off logical value

Flag to automatically include data files, specified as `'on'` or `'off'`, or as numeric or logical `1` (`true`) or `0` (`false`). A value of `'on'` is equivalent to `true`, and `'off'` is equivalent to `false`. Thus, you can use the value of this property as a logical value. The value is stored as an on/off logical value of type `matlab.lang.OnOffSwitchState`.

- If you set this property to `'on'`, then data files that you provide as inputs to certain functions (such as `load` and `fopen`) are automatically included in the package.
- If you set this property to `'off'`, then you must add data files to the package using the `AdditionalFiles` option.

Example: `'AutoDetectDataFiles','off'`

Data Types: `logical`

`PackageName` — Name of Python package

character vector | string scalar

Name of the Python package, specified as a character vector or a string scalar. Specify `'PackageName'` as a namespace, which is a period-separated list, such as `companyname.groupname.component`. The name of the generated package is set to the last entry of the period-separated list. The name must begin with a letter and contain only alphabetic characters and periods.

Example: `'PackageName','mathworks.pythonpackage.mymagic'`

Data Types: `char` | `string`

`SampleGenerationFiles` — MATLAB sample files
character vector | string scalar | cell array of character vectors | string array

MATLAB sample files used to generate sample Python files for functions included with the package, specified as a character vector, a string scalar, a string array, or a cell array of character vectors. File paths can be relative to the current working directory or absolute. Files must have a `.m` extension.

Example: `'SampleGenerationFiles',["sample1.m","sample2.m"]`

Data Types: `char` | `string` | `cell`

`OutputDir` — Path to output directory
character vector | string scalar

Path to the output directory where the build files are saved, specified as a character vector or a string scalar. The path can be relative to the current working directory or absolute.

The default name of the build folder is the package name appended with `pythonPackage`.

Example: `'OutputDir','D:\Documents\MATLAB\work\mymagicpythonPackage'`

Data Types: `char` | `string`

`SupportPackages` — Support packages
`'autodetect'` (default) | `'none'` | string scalar | cell array of character vectors | string array

Support packages to include, specified as one of the following options:

- `'autodetect'` (default) — The dependency analysis process detects and includes the required support packages automatically.
- `'none'` — No support packages are included. Using this option can cause runtime errors.
- A string scalar, character vector, or cell array of character vectors — Only the specified support packages are included. To list installed support packages or those used by a specific file, see `compiler.codetools.deployableSupportPackages`.

.

Example: `'SupportPackages',{'Deep Learning Toolbox Converter for TensorFlow Models','Deep Learning Toolbox Model for Places365-GoogLeNet Network'}`

Data Types: `char` | `string` | `cell`

`Verbose` — Flag to control build verbosity
`'off'` (default) | on/off logical value

Flag to control build verbosity, specified as `'on'` or `'off'`, or as numeric or logical `1` (`true`) or `0` (`false`). A value of `'on'` is equivalent to `true`, and `'off'` is equivalent to `false`. Thus, you can use

the value of this property as a logical value. The value is stored as an on/off logical value of type `matlab.lang.OnOffSwitchState`.

- If you set this property to `'on'`, then the MATLAB command window displays progress information indicating compiler output during the build process.
- If you set this property to `'off'`, then the command window does not display progress information.

Example: `'Verbose','on'`

Data Types: `logical`

Output Arguments

`opts` — Python package build options

`PythonPackageOptions` object

Python package build options, returned as a `PythonPackageOptions` object.

See Also

`compiler.build.pythonPackage`

Introduced in R2021a

myDeployedModule.initialize

Python module to initialize package and return a handle

Syntax

```
myobj = myDeployedModule.initialize()
```

Description

`myobj = myDeployedModule.initialize()` initializes a package consisting of one or more deployed MATLAB functions. The return value is used as a handle on which any of the functions can be executed.

Examples

Create a Handle to a Deployed MATLAB Function

This example shows how to create a handle to a package named `myDeployedModule`. This handle is then used for calling a deployed MATLAB function called `makesqr`.

```
import myDeployedModule

myobj = myDeployedModule.initialize()

print(myobj.makesqr(3))

myobj.terminate()
```

Output Arguments

`myobj` — Output a handle to deployed MATLAB functions

Python object

Output a handle to deployed MATLAB functions, returned as a Python object used to execute deployed MATLAB functions.

See Also

`myDeployedModule.terminate`

Topics

“Invoke a Packaged MATLAB Function” on page 2-6

myDeployedModule.initialize_runtime

Python module to initialize MATLAB Runtime with a list of startup options

Syntax

```
myobj = myDeployedModule.initialize_runtime()
```

Description

`myobj = myDeployedModule.initialize_runtime()` initializes the MATLAB Runtime with a list of startup options that affects all packages opened within the script.

If it is not called explicitly, it is executed automatically, with an empty list of options, by the first call to `initialize()`. Do not call `initialize_runtime()` after calling `initialize()`. There is no corresponding `terminate_runtime()` call. The MATLAB Runtime terminates automatically when the script or session ends.

Input Arguments

`in_args` — Startup options to MATLAB Runtime

comma separated list of options

The MATLAB Runtime has two startup options that you can specify:

- -nojvm — Disable the Java Virtual Machine, which is enabled by default. This option can help improve the MATLAB Runtime performance.
- -nodisplay — On Linux, run the MATLAB Runtime without display functionality.

Output Arguments

`myobj` — Output a handle to deployed MATLAB functions

Python object

Output a handle to deployed MATLAB functions, returned as a Python object used to execute deployed MATLAB functions.

Examples

Specify MATLAB Runtime Options

This example shows how to specify MATLAB Runtime options when creating a handle to a package named `myDeployedModule`.

```
import myDeployedModule
myobj = myDeployedModule.initialize_runtime(['-nojvm', '-nodisplay'])
myobj = myDeployedModule.initialize()
```

```
print(myobj.makesqr(3))
myobj.terminate()
```

See Also

`myDeployedModule.terminate`

Topics

“Initialize MATLAB Runtime” on page 2-4

myDeployedModule.terminate

Python module to close a package

Syntax

```
myDeployedModule.terminate()
```

Description

`myDeployedModule.terminate()` closes a package consisting of one or more deployed MATLAB functions. `myDeployedModule.terminate()` can be called on a package handle, after which no functions can be called on the handle.

If you exit from a script or session, `myDeployedModule.terminate()` is called automatically. Hence, calling it explicitly is optional, but a good idea because it frees resources at that point. Alternatively, you can use `quit()` or `exit()`.

Examples

Close a Handle to a Deployed MATLAB Function

This example shows how to create a handle to a package named `myDeployedModule`, and close the handle after calling a deployed MATLAB function.

```
import myDeployedModule

myobj = myDeployedModule.initialize()

print(myobj.makesqr(3))

myobj.terminate()
```

See Also

`myDeployedModule.initialize` | `myDeployedModule.initialize_runtime`

Topics

“Invoke a Packaged MATLAB Function” on page 2-6

myDeployedModule.wait_for_figures_to_close

Python module to wait for all graphical figures to close before continuing

Syntax

```
myDeployedModule.wait_for_figures_to_close()
```

Description

`myDeployedModule.wait_for_figures_to_close()` enables the deployed application to process graphics events. The purpose of `myDeployedModule.wait_for_figures_to_close()` is to block execution of a calling program as long as figures created in deployed MATLAB code are displayed.

This function can only be called after `initialize()` has been called and before `terminate()` has been called. If this function is not called, any figure windows initially displayed by the application briefly appear, and then the application exits.

Examples

Keep a Figure in MATLAB Function Open

This example shows how to keep a MATLAB plot open after it is invoked using the `showplot` function in a package named `myDeployedModule`.

```
import myDeployedModule

myobj = myDeployedModule.initialize()

myobj.showplot()

myobj.wait_for_figures_to_close()

myobj.terminate()
```

See Also

`myDeployedModule.terminate`

mwpython

Start a Python session using a MATLAB Compiler SDK Python package on Mac OS X

Syntax

```
mwpython [-verbose] [py_args] [-mlstartup opt[,opt]] python_scriptname
mwpython [-verbose] [py_args] [-mlstartup opt[,opt]] -c cmd
mwpython [-verbose] [py_args] [-mlstartup opt[,opt]] -m mod
```

Description

`mwpython [-verbose] [py_args] [-mlstartup opt[,opt]] python_scriptname` Starts a Python session that executes a Python script.

`mwpython [-verbose] [py_args] [-mlstartup opt[,opt]] -c cmd` Starts Python session that executes a Python command.

`mwpython [-verbose] [py_args] [-mlstartup opt[,opt]] -m mod` Starts a Python session that executes a Python module.

Input Arguments

`py_args` — Python arguments

Python arguments, specified as a comma-separated list.

`opt[,opt]` — MATLAB Runtime startup options

-nojvm | -nodisplay | -logfile

MATLAB Runtime startup options, specified as a comma-separated list.

- `-nojvm` — disable the Java Virtual Machine, which is enabled by default. This can help improve the MATLAB Runtime performance.
- `-nodisplay` — on Linux, run the MATLAB Runtime without display functionality.

`python_scriptname` — Python script to execute

Python script to execute, specified as a character array with a `.py` extension.

`cmd` — Python command to execute

Python command to execute, specified as a character array.

`mod` — Python module to execute

Python module to execute, specified as a character array.

Note If you want to use a specific version of Python, set the `PYTHONHOME` environment variable on your machine to point to the location of your desired Python installation prior to invoking `mwpython`.

Examples

Execute a Python Script in Verbose Mode

```
mwpython -verbose myfile.py
```

Execute a Python Module with Arguments

```
mwpython -m mymod arg1 arg2
```

Introduced in R2015b