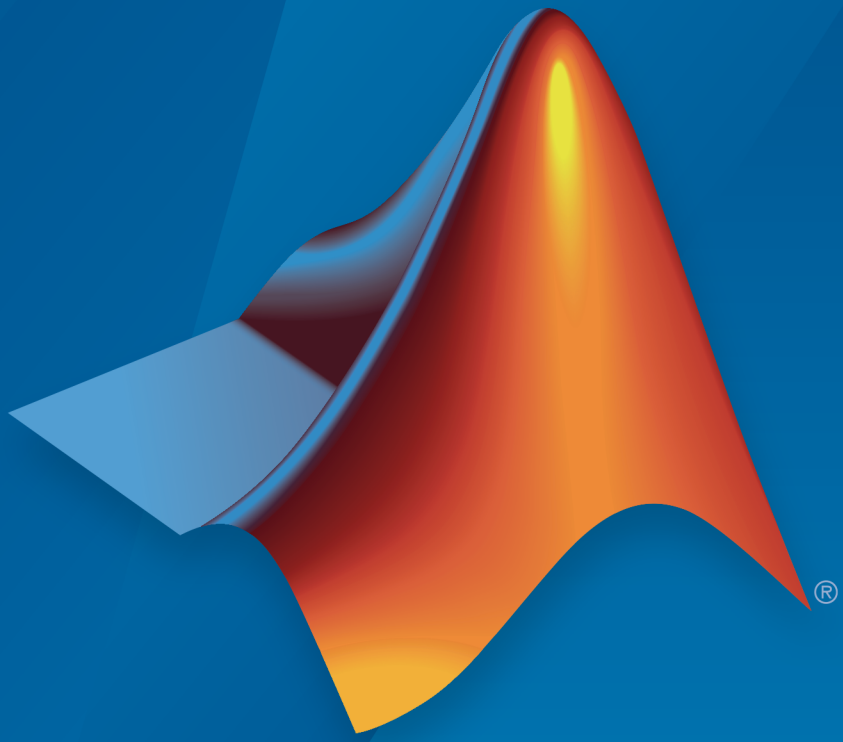
MATLAB® Compiler™

Excel® Add-In User's Guide



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Excel® Add-In User's Guide

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Getting Started

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- "MATLAB Compiler for Microsoft Excel Add-In Prerequisites" on page 1-3
- "Choosing Function Deployment Workflow" on page 1-7
- "Package Excel Add-In with Library Compiler App" on page 1-9
- "Integrate an Add-In and COM Component with Microsoft Excel" on page 1-13
- "Next Steps" on page 1-18

How Excel Add-In for MATLAB Compiler Works

The compiler converts MATLAB functions to methods of a class that you define. From this class, the compiler creates Excel add-in (an `.xla` file and a `.bas` file).

The MATLAB Compiler creates COM objects as Microsoft® Excel add-in that are accessible from Microsoft Excel through Visual Basic® for Applications (VBA). The MATLAB Compiler integrates the COM wrapper with the MATLAB Compiler-generated VBA code, saving you considerable development resources and time.

COM is an acronym for Component Object Model, which is a Microsoft binary standard for object interoperability. COM components use a common integration architecture that provides a consistent model across multiple applications. All Microsoft Office applications support COM add-in.

Each COM object exposes a *class* to the Visual Basic programming environment. The class contains a set of functions called *methods*. These methods correspond to the original MATLAB functions included in the project. MATLAB Compiler generated COM components contain a single class. This class provides the interface to the MATLAB functions that you add to the class at build time. The COM component provides a set of methods that wrap the MATLAB code and a DLL file.

The MATLAB Compiler generates supporting files. Include these supporting files when you package and distribute an application. Include the MATLAB Runtime, which gives you access to an entire library of MATLAB functions within one file.

For information about how MATLAB Compiler works, see “How Does MATLAB Deploy Functions?” on page 4-3.

MATLAB Compiler for Microsoft Excel Add-In Prerequisites

In this section...
“Your Role in the Deployment Process” on page 1-3
“Products, Compilers, and IDE Installation” on page 1-4
“Macro Execution Security Levels in Microsoft Excel” on page 1-4
“Deployment Target Architectures and Compatibility” on page 1-5
“Dependency and Non-Compilable Code Considerations” on page 1-5
“For More Information” on page 1-6

Your Role in the Deployment Process

The table Application Deployment Roles, Goals, and Tasks describes the different roles, or jobs, that MATLAB Compiler users typically perform. It also describes tasks they would most likely perform when running the examples in this documentation.

You may occupy one or more of the following roles.

Application Deployment Roles, Goals, and Tasks

Role	Knowledge Base	Responsibilities
MATLAB programmer	• Understand the end-user business requirements and the mathematical models that support them. • MATLAB expert • No IT experience	• Build a Microsoft Excel add-in with MATLAB tools. • Package the component for distribution to customers. • Pass the package to the Microsoft Excel developer for further integration into the end-user environment. .
Microsoft Excel developer	• Little or no MATLAB experience.	• Roll out the packaged component and integrate

Role	Knowledge Base	Responsibilities
	• Microsoft Excel expert. • Proficient writing VB/ VBA code.	it into the end-user environment. • Write VB/VBA code to complement or augment the Excel add-in built by the MATLAB programmer. Add and modify code as needed. • Uses Function Wizard to customize the add-in and create executable macros. • Verify that the final application executes reliably in the end-user environment.

Products, Compilers, and IDE Installation

Install the following products to run the example described in this chapter:

- MATLAB
- MATLAB Compiler
- A supported C or C++ compiler

Macro Execution Security Levels in Microsoft Excel

If you will be creating macros and generating add-ins with MATLAB Compiler, adjust the security settings accordingly in Microsoft Excel.

Failure to do so may result in add-ins not being generated or warning messages sent to MATLAB Compiler

Depending on what version of Microsoft Office you are using, do one of the following:

- For Microsoft Office 2003:

  1 Click

Tools > Macro > Security.

2. For **Security Level**, select **Medium**.

- For Microsoft Office 2007:

1. Click the 2007 Office ribbon button.
2. Click **Excel Options > Trust Center > Trust Center Settings > Macro Settings**.
3. In **Developer Macro Settings**, select **Trust access to the VBA project object model**.

- For Microsoft Office 2010:

1. Click **File > Options > Trust Center > Trust Center Settings > Macro Settings**.
2. In **Developer Macro Settings**, select **Trust access to the VBA project object model**.

Deployment Target Architectures and Compatibility

Before you deploy a component with MATLAB Compiler, consider if your target machines are 32-bit or 64-bit.

Applications developed on one architecture must be compatible with the architecture on the system where they are deployed.

For example, if you have a 64-bit system, you usually install a 64-bit version of MATLAB (and most other applications), by default. Running functions you have developed with a 64-bit version of MATLAB requires a Function Wizard installed with a 64-bit version of Microsoft Excel.

Migration Considerations for 32-bit and 64-bit Microsoft Excel

Add-ins created with MATLAB Compiler are compatible with both 32–bit and 64–bit versions of Microsoft Excel. MATLAB Compiler itself is in 64–bit only.

Dependency and Non-Compilable Code Considerations

Before you deploy your code, examine the code for dependencies on functions that may not be compatible with MATLAB Compiler.

For more detailed information about dependency analysis (`depfun`) and how MATLAB Compiler evaluates MATLAB code prior to compilation, see "Write Deployable MATLAB Code" in the MATLAB Compiler documentation.

For More Information

If you...	See...
Want to verify your MATLAB code or function can be deployed successfully	"Write Deployable MATLAB Code"
Know your function is deployable and want to select a Getting Started workflow	"Choosing Function Deployment Workflow" on page 1-7

Choosing Function Deployment Workflow

In this section...
"Is Your Function Ready for Deployment?" on page 1-7
"Other Examples" on page 1-7

Is Your Function Ready for Deployment?

If These Statements are True...	See...
• I have a MATLAB function that conforms to guidelines in "Write Deployable MATLAB Code". • I want to create a Microsoft Excel compatible add-in from my existing MATLAB function. • I have tested and debugged my MATLAB function with MATLAB.	"Package Excel Add-In with Library Compiler App" on page 1-9 to build your add-in and "Integrate an Add-In and COM Component with Microsoft Excel" on page 1-13 to execute the newly built add-in and create macros and associated GUIs with the Function Wizard and Microsoft Excel.
• I have not yet developed a MATLAB function for deployment as an add-in or I am in the process of developing it. • I have not tested my MATLAB function thoroughly with MATLAB.	"End-to-End Deployment of MATLAB Function" on page 3-22 for an end-to-end example of creating, debugging, building, and packaging MATLAB function from scratch using the Function Wizard.

Other Examples

For other types of examples, see the following:

- "Execute a Graphical Function" on page 5-11
- "Create Dialog Box and Error Message Macros" on page 5-14
- "Work with Variable-Length Inputs and Outputs" on page 5-5
- MATLAB Central. Set the Search field to `File Exchange` and search for one or more of the following:
  - `InterpExcelDemo`

- `MatrixMathExcelDemo`
- `ExcelCurveFit`

Package Excel Add-In with Library Compiler App

This example shows how to create a Microsoft Excel add-in that computes a magic square using the Library Compiler app. The example uses a MATLAB function, `mymagic`, which computes a magic square. You can use this example as a template for deploying functions with no output, scalar output, or multidimensional matrix output.

You can find the code for `mymagic.m` in the *`matlabroot`*`\toolbox\matlabxl\examples\xlmagic` folder. To deploy your code, move your example code to a new working folder.

Create Function in MATLAB

Examine the MATLAB code to deploy as an Excel add-in.

```
function y = mymagic(x)
% MYMAGIC Magic square of size x.
%   Y = MYMAGIC(X) returns a magic square of size x.
%   This file is used as an example for the MATLAB Compiler product.
%   Copyright 2001-2007 The MathWorks, Inc.
y = magic(x)
```

Verify that the example runs in MATLAB.

```
mymagic(5)
```

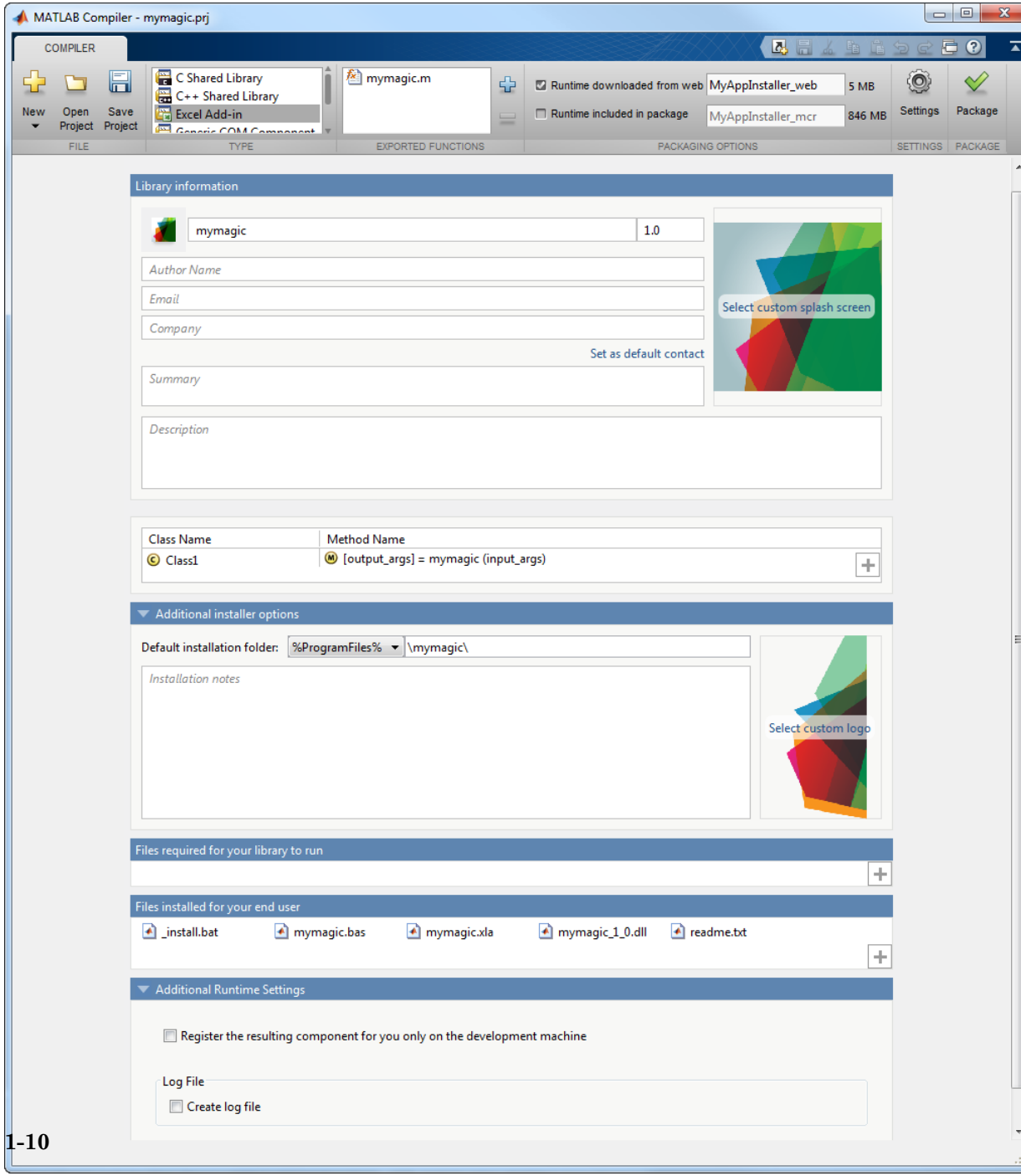
```
17 24  1  8 15
23  5  7 14 16
 4  6 13 20 22
10 12 19 21  3
11 18 25  2  9
```

Create Add-In Using Library Compiler App

Launch the Library Compiler app from the MATLAB command line.

```
libraryCompiler
```

You can also launch the Library Compiler app on the Apps tab in the Application Deployment section.


MATLAB Compiler - mymagic.prj
COMPILER
New
Open Project
Save Project
FILE
C Shared Library
C++ Shared Library
Excel Add-in
TYPE
mymagic.m
EXPORTED FUNCTIONS
Runtime downloaded from web
MyAppInstaller_web
5 MB
Runtime included in package
MyAppInstaller_mcr
846 MB
PACKAGING OPTIONS
Settings
SETTINGS
Package
PACKAGE
Library information
mymagic
1.0
Author Name
Email
Company
Set as default contact
Summary
Description
Select custom splash screen
Class Name
Method Name
Class1
[output_args] = mymagic (input_args)
Additional installer options
Default installation folder:
%ProgramFiles%
\mymagic\
Installation notes
Select custom logo
Files required for your library to run
Files installed for your end user
_install.bat
mymagic.bas
mymagic.xla
mymagic_1_0.dll
readme.txt
Additional Runtime Settings
Register the resulting component for you only on the development machine
Log File
Create log file

On the **Compiler** tab, in the **Type** section, select **Excel Add-in**.

To add the function, on the **Compiler** tab in the **Exported Functions** section, click plus to add the function. Browse and select function `mymagic.m`. The Library Compiler app uses the name of the file as the name of the deployment project file (`.prj`), shown in the title bar, and as the name of the add-in, shown in the first field of the Library information area. The project file stores the deployment settings so that you can reopen the project.

Modify the main body of the MATLAB Compiler project window as required.

- **Library Information** — Information that you can add and modify about the deployed application.
- **Additional Installer Options** — Default installation path for the generated installer.
- **Files required for your library to run** — Additional files for the generated application that are part of the generated application installer.
- **Files installed for your end user** — List of files installed with your application. These files include a Visual Basic file, a DLL, an Excel add-in file, and a read me text file.
- **Additional Runtime Settings** — Access to other compiler options.

To create an application installer, on the **Compiler** tab in the **Packaging Options**, select the **Runtime downloaded from web**. This option creates an application installer that automatically downloads the MATLAB Runtime and installs it along with the deployed add-in.

On the **Compiler** tab, click **Package** to build Excel add-in.

The Library Compiler app creates a log file PackagingLog.txt and three folders for redistribution and testing.

- `for_redistribution` folder consists of the install file of the application. The install file will install the MATLAB Runtime and the application.
- `for_testing` folder consists of all the artifacts created by `mcc` like binaries, jar files, header, and source files depending on the target. Use these files to test the installation.

- `for_redistribution_files_only` folder is a subset of the testing folder files. The folder consists of the files required to redistribute the application.

See Also

`libraryCompiler`

Integrate an Add-In and COM Component with Microsoft Excel

In this section...
“Files Necessary for Deployment” on page 1-13
“Add-In and COM Component Registration” on page 1-14
“COM Component Incorporation into Microsoft Excel using the Function Wizard” on page 1-15
“MATLAB Runtime” on page 1-15
“Add-In Installation and Distribution” on page 1-17

Key Tasks for the Microsoft Excel End User

Task	Reference
Verify that you have received all necessary files from the MATLAB programmer.	“Files Necessary for Deployment” on page 1-13
Verify registry permissions for the add-in file and associated component.	“Add-In and COM Component Registration” on page 1-14
Execute your generated functions and create macros.	“Execute Functions and Create Macros” on page 3-2
Install the MATLAB Runtime on target systems and update system paths.	“MATLAB Runtime” on page 1-15
Use the Excel add-in.	“Add-In Installation and Distribution” on page 1-17

Files Necessary for Deployment

Before beginning, verify that you have access to the following files:

- The MCR Installer. For locations of all the MATLAB Runtime installers, run the mcrinstaller command.
- `.xla` file (the add-in)
- `.bas` file (the generated VBA code)
- `.dll` file

- `readme.txt`

Add-In and COM Component Registration

When you create your COM component, it is registered in either `HKEY_LOCAL_MACHINE` or `HKEY_CURRENT_USER`, based on your log-in privileges.

If you find you need to change your run-time permissions due to security standards imposed by Microsoft or your installation, you can do one of the following before deploying your COM component or add-in:

- Log on as `administrator` before running your COM component or add-in
- Run the following `mwregsvr` command prior to running your COM component or add-in, as follows:

  `mwregsvr [/u] [/s] [/useronly]` *`project_name`*`.dll`
  where:

  - `/u` allows any user to unregister a COM component or add-in for this server
  - `/s` runs this command silently, generating no messages. This is helpful for use in silent installations.
  - `/useronly` allows only the currently logged-in user to run the COM component or add-in on this server

---

Caution: If your COM component is registered in the `USER` hive, it will not be visible to Windows Vista™ or Windows® 7 users running as `administrator` on systems with UAC (**User Access Control**) enabled.

If you register a component to the `USER` hive under Windows 7 or Windows Vista, your COM component may fail to load when running with elevated (`administrator`) privileges.

If this occurs, do the following to re-register the component to the `LOCAL MACHINE` hive:

1. Unregister the component with this command:

   `mwregsvr /u /useronly` *`my_dll`*`.dll`

2. Reregister the component to the `LOCAL MACHINE` hive with this command:

```
mwregsvr my_dll.dll
```

COM Component Incorporation into Microsoft Excel using the Function Wizard

Now that your add-in and COM component have been created, use the Function Wizard to integrate the COM component into Microsoft Excel.

See “Execute Functions and Create Macros” on page 3-2 for a complete example of how to execute functions and create macros using the Magic Square example in this chapter.

MATLAB Runtime

The *MATLAB Runtime* is an execution engine made up of the same shared libraries MATLAB uses to enable execution of MATLAB files on systems without an installed version of MATLAB.

The MATLAB Runtime is available for downloading from the web to simplify the distribution of your applications created using the MATLAB Compiler or the MATLAB Compiler SDK™. Download the MATLAB Runtime from the MATLAB Runtime product page.

The MATLAB Runtime installer does the following:

1. Install the MATLAB Runtime.
2. Install the component assembly in the folder from which the installer is run.
3. Copy the `MWArray` assembly to the Global Assembly Cache (GAC), as part of installing the MATLAB Runtime.

MATLAB Runtime Prerequisites

1. The MATLAB Runtime installer requires administrator privileges to run.
2. The version of the MATLAB Runtime that runs your application on the target computer must be compatible with the version of MATLAB Compiler or MATLAB Compiler SDK that built the deployed code.

3 Do not install the MATLAB Runtime in MATLAB installation directories.

4 The MATLAB Runtime installer requires approximately 2 GB of disk space.

Add the MATLAB Runtime Installer to the Installer

This example shows how to include the MATLAB Runtime in the generated installer, using one of the compiler apps. The generated installer contains all files needed to run the standalone application or shared library built with MATLAB Compiler or MATLAB Compiler SDK and properly lays them out on a target system.

1 On the **Packaging Options** section of the compiler interface, select one or both of the following options:

- **Runtime downloaded from web** — This option builds an installer that invokes the MATLAB Runtime installer from the MathWorks website.
- **Runtime included in package** — The option includes the MATLAB Runtime installer into the generated installer.

2 Click **Package**.

3 Distribute the installer as needed.

Install the MATLAB Runtime

This example shows how to install the MATLAB Runtime on a system.

If you are given an installer containing the compiled artifacts, then the MATLAB Runtime is installed along with the application or shared library. If you are given just the raw binary files, download the MATLAB Runtime installer from the web and run the installer.

Note: If you are running on a platform other than Windows, modify the path on the target machine. Setting the paths enables your application to find the MATLAB Runtime. For more information on setting the path, see "MATLAB Runtime Path Settings for Run-Time Deployment" (MATLAB Compiler SDK).

Windows paths are set automatically. On Linux® and Mac, you can use the run script to set paths. See "Using MATLAB Compiler on Mac or Linux" for detailed information on performing all deployment tasks specifically with UNIX® variants such as Linux and Mac.

Add-In Installation and Distribution

Since Microsoft Excel add-ins are written directly to the `distrib` folder by MATLAB Compiler, you and your end users install them exactly as you installed the Function Wizard in "Installation of the Function Wizard" on page 3-4.

Calling Add-In Code from the Excel Spreadsheet

To run the executable code from a cell in the Excel spreadsheet, invoke the add-in name with a method call. For example, if you deployed a piece of MATLAB code called `mymagic.m`, or a figure called `mymagic.fig`, you invoke that code by entering the following in a cell in the spreadsheet:

```
=mymagic()
```

Tip: If the method call does not evaluate immediately, press **Ctrl**, **Shift**, and **Enter** simultaneously.

Next Steps

MATLAB Compiler includes several examples, in addition to the magic square example. You can find these examples in folders in *`matlabroot`*`\toolbox\matlabxl\examples\`. The following table identifies examples by folder:

For Example Files Relating To...	Find Example Code in Folder...	For Example Documentation See...
Magic Square Example	`xlmagic`	"Package Excel Add-In with Library Compiler App" on page 1-9 "Integrate an Add-In and COM Component with Microsoft Excel" on page 1-13
Variable-Length Argument Example	`xlmulti`	"Work with Variable-Length Inputs and Outputs" on page 5-5
Calling Compiled MATLAB Functions from Microsoft Excel	`xlbasic`	"Calling Compiled MATLAB Functions from Microsoft Excel" on page 7-4
Spectral Analysis Example	`xlspectral`	"Build and Integrate Spectral Analysis Functions" on page 6-16

The following topics detail some of the more common tasks you perform as you continue to develop your applications.

To:	See:
Try more examples using the MATLAB Compiler	MATLAB Central. Set the Search field to `File Exchange` and search for one or more of the following: • `InterpExcelDemo` • `MatrixMathExcelDemo` • `ExcelCurveFit`
Learn how to write MATLAB code that is optimized for deployability	"Write Deployable MATLAB Code"

To:	See:
Work with functions having graphical output	“Execute a Graphical Function” on page 5-11
Work with functions having variable inputs and output	“Work with Variable-Length Inputs and Outputs” on page 5-5
Create displayable dialog boxes and error messages	“Create Dialog Box and Error Message Macros” on page 5-14
Troubleshoot common error messages	Appendix B
Integrate your application into your enterprise environment by enhancing your application's generated Visual Basic code	“Integrate Components using Visual Basic Application” on page 6-3

Customizing a Compiler Project

- "Customize the Installer" on page 2-2
- "Manage Required Files in Compiler Project" on page 2-6
- "Specify Files to Install with Application" on page 2-8
- "Manage Support Packages" on page 2-9

Customize the Installer

In this section...
“Change the Application Icon” on page 2-2
“Add Application Information” on page 2-3
“Change the Splash Screen” on page 2-3
“Change the Installation Path” on page 2-4
“Change the Logo” on page 2-4
“Edit the Installation Notes” on page 2-5

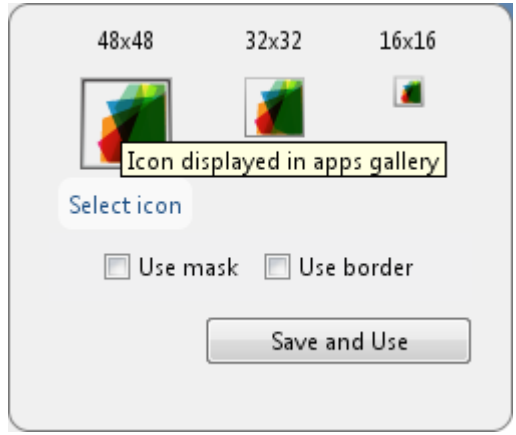
Change the Application Icon

The application icon is used for the generated installer. For standalone applications, it is also the application's icon.

You can change the default icon in **Application Information**. To set a custom icon:

1. Click the graphic to the left of the **Application name** field.

   A window previewing the icon opens.



2. Click **Select icon**.
3. Using the file explorer, locate the graphic file to use as the application icon.
4. Select the graphic file.

5 Click **OK** to return to the icon preview.
6 Select **Use mask** to fill any blank spaces around the icon with white.
7 Select **Use border** to add a border around the icon.
8 Click **Save and Use** to return to the main window.

Add Application Information

The **Application Information** section of the app allows you to provide these values:

- Name

  Determines the name of the installed MATLAB artifacts. For example, if the name is `foo`, the installed executable would be `foo.exe`, the Windows start menu entry would be **foo**. The folder created for the application would be *`InstallRoot`*`/foo`.

  The default value is the name of the first function listed in the **Main File(s)** field of the app.
- Version

  The default value is 1.0.
- Author name
- Support e-mail address
- Company name

  Determines the full installation path for the installed MATLAB artifacts. For example, if the company name is `bar`, the full installation path would be *`InstallRoot`*`/bar/`*`ApplicationName`*.
- Summary
- Description

This information is all optional and, unless otherwise stated, is only used for display purposes. It appears on the first page of the installer. On Windows systems, this information is also displayed in the Windows **Add/Remove Programs** control panel.

Change the Splash Screen

The installer's splash screen displays after the installer is started. It is displayed, along with a status bar, while the installer initializes.

You can change the default image by clicking the **Select custom splash screen** link in **Application Information**. When the file explorer opens, locate and select a new image.

Note: You can drag and drop a custom image onto the default splash screen.

Change the Installation Path

Default Installation Paths lists the default path the installer will use when installing the compiled binaries onto a target system.

Default Installation Paths

Windows	`C:\Program Files\`*`companyName`*`\`*`appName`*
Mac OS X	`/Applications/`*`companyName`*`/`*`appName`*
Linux	`/usr/`*`companyName`*`/`*`appName`*

You can change the default installation path by editing the **Default installation folder** field under **Additional Installer Options**.

The **Default installation folder** field has two parts:

- root folder — A drop down list that offers options for where the install folder is installed. Custom Installation Roots lists the optional root folders for each platform.

  Custom Installation Roots

Windows	`C:\Users\`*`userName`*`\AppData`
Linux	`/usr/local`

- install folder — A text field specifying the path appended to the root folder.

Change the Logo

The logo displays after the installer is started. It is displayed on the right side of the installer.

You change the default image by clicking the **Select custom logo** link in **Additional Installer Options**. When the file explorer opens, locate and select a new image.

Note: You can drag and drop a custom image onto the default logo.

Edit the Installation Notes

Installation notes are displayed once the installer has successfully installed the packaged files on the target system. They can provide useful information concerning any additional set up that is required to use the installed binaries or simply provide instructions for how to run the application.

The field for editing the installation notes is in **Additional Installer Options**.

Manage Required Files in Compiler Project

In this section...
"Dependency Analysis" on page 2-6
"Using the Compiler Apps" on page 2-6
"Using mcc" on page 2-6

Dependency Analysis

The compiler uses a dependency analysis function to automatically determine what additional MATLAB files are required for the application to compile and run. These files are automatically compiled into the generated binary. The compiler does not generate any wrapper code allowing direct access to the functions defined by the required files.

Using the Compiler Apps

If you are using one of the compiler apps, the required files discovered by the dependency analysis function are listed in the **Files required by your application to run** field.

To add files:

1. Click the plus button in the field.
2. Select the desired file from the file explorer.
3. Click **OK**.

To remove files:

1. Select the desired file.
2. Press the **Delete** key.

Caution: Removing files from the list of required files may cause your application to not compile or to not run properly when deployed.

Using mcc

If you are using `mcc` to compile your MATLAB code, the compiler does not display a list of required files before running. Instead, it compiles all of the required files that are

discovered by the dependency analysis function and adds them to the generated binary file.

You can add files to the list by passing one, or more, `-a` arguments to `mcc`. The `-a` arguments add the specified files to the list of files to be added into the generated binary. For example, `-a hello.m` adds the file `hello.m` to the list of required files and `-a ./foo` adds all of the files in `foo`, and its subfolders, to the list of required files.

Specify Files to Install with Application

The compiler apps package files to install along with the ones it generates. By default the installer includes a readme file with instructions on installing the MATLAB Runtine and configuring it.

These files are listed in the **Files installed for your end user** section of the app.

To add files to the list:

1. Click the plus button in the field.
2. Select the desired file from the file explorer.
3. Click **OK** to close the file explorer.

Jar files are added to the application classpath in the same ways as if the user called `javaaddpath`.

To remove files from the list:

1. Select the desired file.
2. Press the **Delete** key.

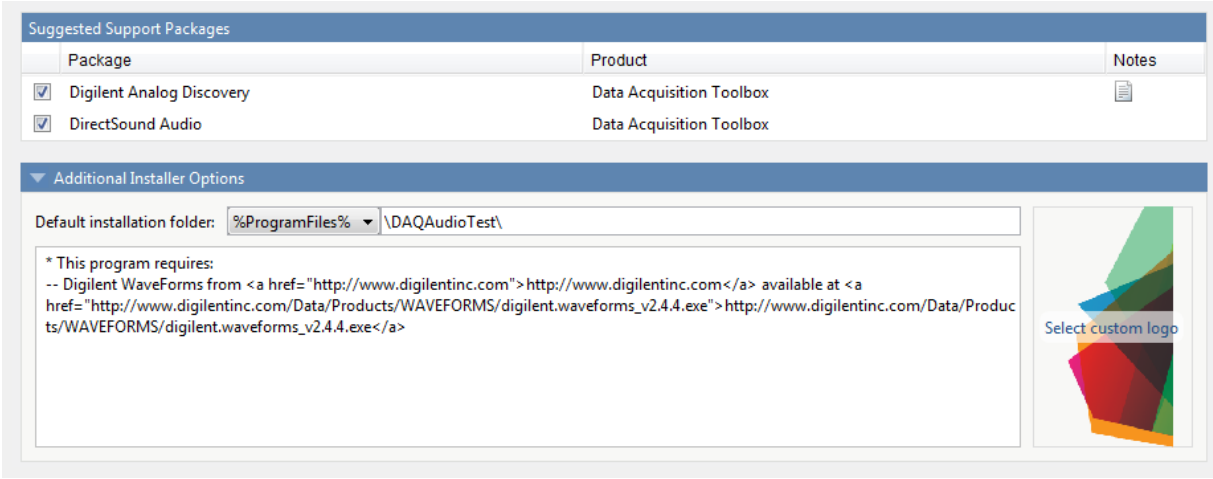
Caution: Removing the binary targets from the list results in an installer that does not install the intended functionality.

When installed on a target computer, the files listed in the **Files installed for your end user** are placed in the `application` folder.

Manage Support Packages

Using a Compiler App

Many MATLAB toolboxes use support packages to interact with hardware or to provide additional processing capabilities. If your MATLAB code uses a toolbox with an installed support package, the app displays a **Suggested Support Packages** section.



The list displays all installed support packages that your MATLAB code requires. The list is determined using these criteria:

- the support package is installed
- your code has a direct dependency on the support package
- your code is dependent on the base product of the support package
- your code is dependent on at least one of the files listed as a dependency in the `mcc.xml` file of the support package, and the base product of the support package is MATLAB

Deselect support packages that are not required by your application.

Some support packages require third-party drivers that the compiler cannot package. In this case, the compiler adds the information to the installation notes. You can edit

installation notes in the **Additional Installer Options** section of the app. To remove the installation note text, deselect the support package with the third-party dependency.

Caution: Any text you enter beneath the generated text will be lost if you deselect the support package.

Using the Command Line

Many MATLAB toolboxes use support packages to interact with hardware or to provide additional processing capabilities. If your MATLAB code uses a toolbox with an installed support package, use the `-a` flag with `mcc` command when packaging your MATLAB code to specify supporting files in the support package folder. For example, if your function uses the `OS Generic Video Interface` support package, run the following command:

```
mcc -m -v test.m -a C:\MATLAB\SupportPackages\R2016b\toolbox\daq\supportpackages\daqauc
```

Some support packages require third-party drivers that the compiler cannot package. In this case, you are responsible for downloading and installing the required drivers.

3

The Function Wizard

- "Execute Functions and Create Macros" on page 3-2
- "End-to-End Deployment of MATLAB Function" on page 3-22

Execute Functions and Create Macros

In this section...
"What Can the Function Wizard Do for Me?" on page 3-3
"Installation of the Function Wizard" on page 3-4
"Function Wizard Start-Up" on page 3-5
"Workflow Selection for MATLAB Functions Ready for Deployment" on page 3-6
"Defining Functions Ready to Execute" on page 3-7
"Function Execution" on page 3-17
"Macro Creation" on page 3-17
"Macro Execution" on page 3-18
"Microsoft Visual Basic Code Access (Optional Advanced Task)" on page 3-18
"For More Information" on page 3-20

If your MATLAB function is ready to be deployed and you have already built your add-in and COM component with the Deployment Tool, follow this workflow to incorporate your built COM component into Microsoft Excel using the Function Wizard. To follow the workflow in this section effectively, you must run "Package Excel Add-In with Library Compiler App" on page 1-9.

The Function Wizard also allows you to iteratively test, develop, and debug your MATLAB function. Using this end-to-end workflow assumes you are still in the process of developing your MATLAB function for deployment. See "End-to-End Deployment of MATLAB Function" on page 3-22 for complete instructions for this workflow.

See "Choosing Function Deployment Workflow" on page 1-7 for further details.

Key Tasks for the End User

Task	Reference
1. Install the Function Wizard.	"Installation of the Function Wizard" on page 3-4
2. Start the Function Wizard.	"Function Wizard Start-Up" on page 3-5

Task	Reference
3. Select the option to incorporate your built COM component into Microsoft Excel.	"Workflow Selection for MATLAB Functions Ready for Deployment" on page 3-6
4. Define the new MATLAB function you want to prototype by adding it to the Function Wizard and establishing input and output ranges.	"Defining Functions Ready to Execute" on page 3-7
5. Test your MATLAB function by executing it with the Function Wizard.	"Function Execution" on page 3-17
6. Create a macro.	"Macro Creation" on page 3-17
7. Execute the macro you created using the Function Wizard.	"Macro Execution" on page 3-18
8. Optionally inspect or modify the Microsoft Visual Basic code you generated with the COM component. Optionally, attach the macro you created to a GUI button.	"Microsoft Visual Basic Code Access (Optional Advanced Task)" on page 3-18

What Can the Function Wizard Do for Me?

The Function Wizard enables you to pass Microsoft Excel (Excel 2000 or later) worksheet values to a compiled MATLAB model and then return model output to a cell or range of cells in the worksheet.

The Function Wizard provides an intuitive interface to Excel worksheets. You do not need previous knowledge of Microsoft Visual Basic for Applications (VBA) programming.

The Function Wizard reflects any changes that you make in the worksheets, such as range selections. You also use the Function Wizard to control the placement and output of data from MATLAB functions to the worksheets.

Note: The Function Wizard does not currently support the MATLAB `sparse`, and `complex` data types.

Installation of the Function Wizard

Before you can use the Function Wizard, you must first install it as an add-in that is accessible from Microsoft Excel.

After you install the Function Wizard, the entry **MATLAB Functions** appears as an available Microsoft Excel add-in button.

Using Office 2010 or Office 2013

1. Click the **File** tab.
2. On the left navigation pane, select **Options**.
3. In the Excel Options dialog box, on the left navigation pane, select **Add-Ins**.
4. In the Manage drop-down, select **Excel Add-Ins**, and click **Go**.
5. In the Add-Ins dialog box, click **Browse**.
6. Browse to *`matlabroot`*`/toolbox/matlabxl/matlabxl/`*`arch`*, and select `FunctionWizard2007.xlam`. Click **OK**.
7. In the Excel Add-Ins dialog, verify that the entry **MATLAB Compiler Function Wizard** is selected. Click **OK**.

The Home tab of the Microsoft Office Ribbon should now contain the Function Wizard tile. See The Home Tab of the Microsoft Office Ribbon with Function Wizard Installed.

Using Office 2007

1. Start Microsoft Excel if it is not already running.
2. Click the Office Button ( ) and select **Excel Options**.
3. In the left pane of the Excel Options dialog box, click **Add-Ins**.
4. In the right pane of the Excel Options dialog box, select **Excel Add-ins** from the **Manage** drop-down box.
5. Click **Go**.
6. Click **Browse**. Navigate to *`matlabroot`*`\toolbox\matlabxl\matlabxl\`*`arch`* and select `FunctionWizard2007.xlam`. Click **OK**.
7. In the Excel Add-Ins dialog box, verify that the entry **MATLAB Compiler Function Wizard** is selected. Click **OK**.

Using Office 2003

1. Select **Tools** > **Add-Ins** from the Excel main menu.
2. If the Function Wizard was previously installed, **MATLAB Compiler Function Wizard** appears in the list. Select the item, and click **OK**.

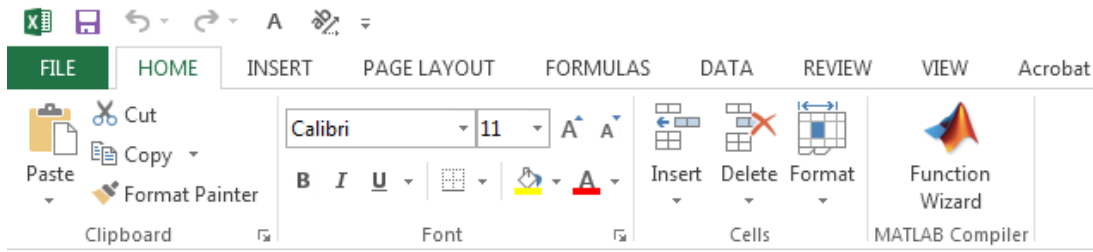
   If the Function Wizard was not previously installed, click **Browse** and navigate to *`matlabroot`*`\toolbox\matlabxl\matlabxl` folder. Select `FunctionWizard.xla`. Click **OK** to proceed.

Function Wizard Start-Up

Start the Function Wizard in one of the following ways. When the wizard has initialized, the Function Wizard Start Page dialog box displays.

Using Office 2007 or Office 2010 or 2013

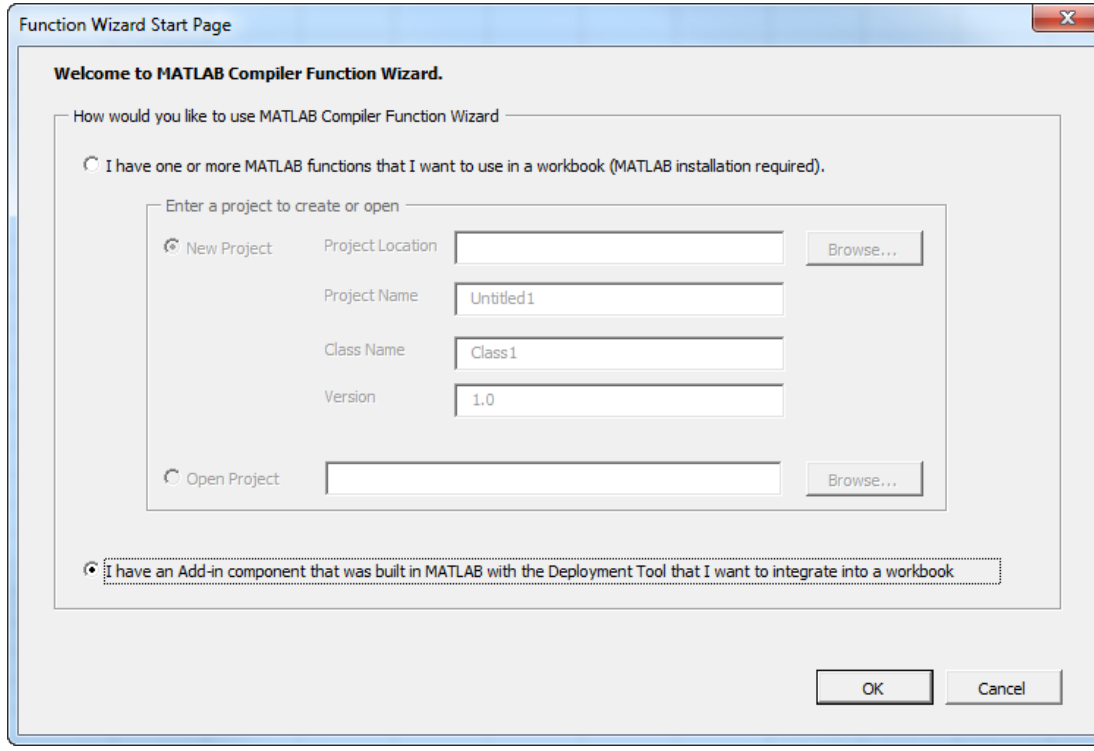
In Microsoft Excel, on the Microsoft Office ribbon, on the **Home** tab, select **Function Wizard**.



The Home Tab of the Microsoft Office Ribbon with Function Wizard Installed

You can also access Function Wizard from the File tab.

1. Select **File** > **Options** > **Add-Ins** from the Excel main menu.
2. Select **Function Wizard**.

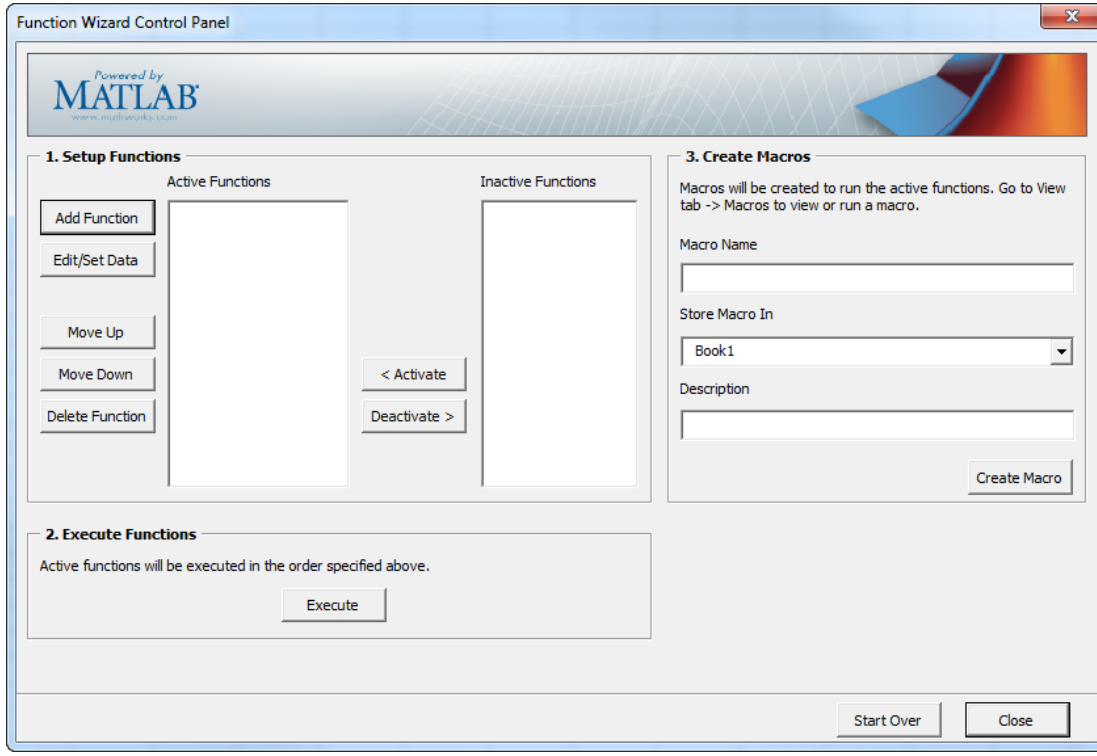


The Function Wizard Start Page Dialog Box

Workflow Selection for MATLAB Functions Ready for Deployment

After you have installed and started the Function Wizard, do the following:

1. From the Function Wizard Start Page, select the option **I have an Add-in component that was built in MATLAB with the Deployment Tool that I want to integrate into a workbook**.
2. Click **OK**. The Function Wizard Control Panel opens with the **Add Function** button enabled.



The Function Wizard Control Panel for Working with MATLAB Functions Ready for Deployment

Tip: To return to the Function Wizard Start Page, click **Start Over**.

Defining Functions Ready to Execute

1. Define the function you want to execute to the Function Wizard. Click **Add Function** in the Set Up Functions area of the Function Wizard Control Panel. The MATLAB Components dialog box opens.
2. In the Available Components area of the MATLAB Components dialog box, select the name of your component (`xlmagic`) from the drop-down box.

3 Select the function you want to execute (`mymagic`) from the box labeled **Functions for Class xlmagic**.

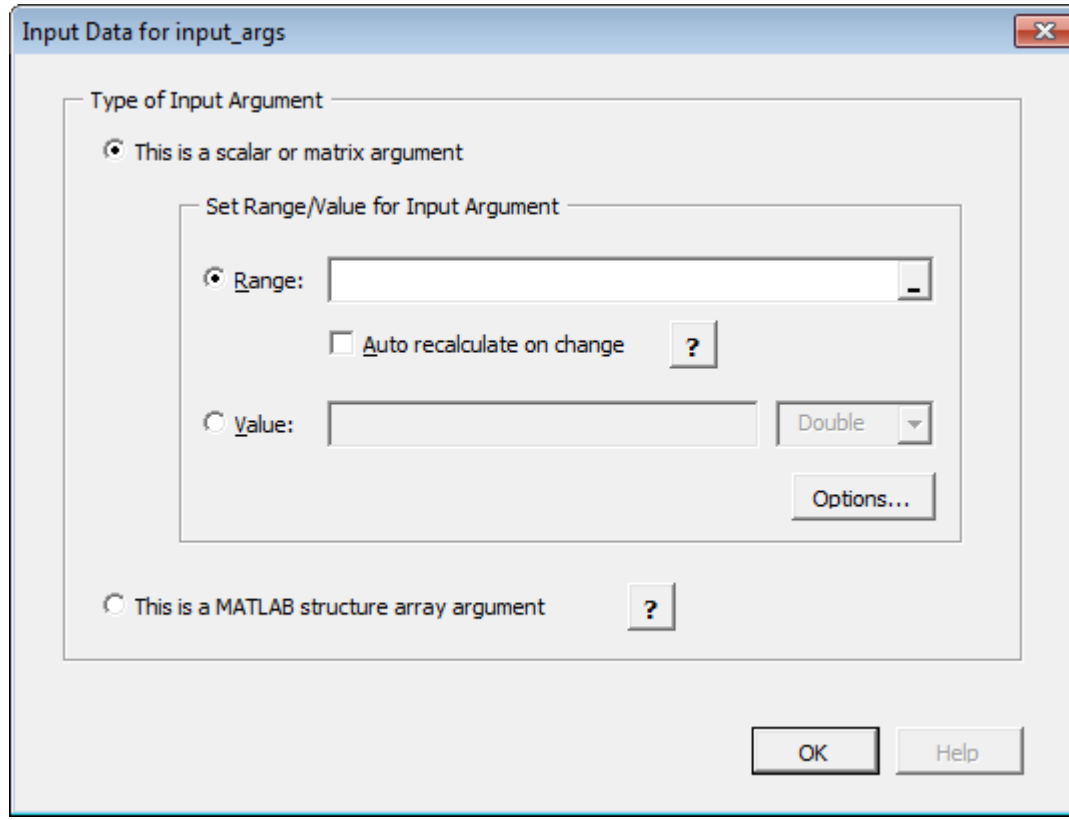
4 Click Add Function. The Function Properties dialog box opens.

Tip: The **Function Syntax and Help** area, in the Function Properties dialog box, displays the first help text line (sometimes called the *H1 line*) in a MATLAB function. Displaying these comments in the Function Properties dialog box can be helpful when deploying new or unfamiliar MATLAB functions to end-users.

---

5 Define input argument properties as follows.

a On the **Input** tab, click **Set Input Data**. The Input Data for *n* dialog box opens.



b Specify a **Range** or **Value** by selecting the appropriate option and entering the value. If the argument refers to a *structure array* (*struct*), select the option **This is a MATLAB structure array argument**. See "Working with Struct Arrays" on page 3-12 for information on assigning ranges and values to fields in a struct array.

Caution: Avoid selecting ranges using arrow keys. If you must use arrow keys to select ranges, apply the necessary fix from the Microsoft site: http://support.microsoft.com/kb/291110.

Note: Select the **Auto Recalculate on Change** option to force Microsoft Excel to automatically recalculate the spreadsheet data each time it changes.

---

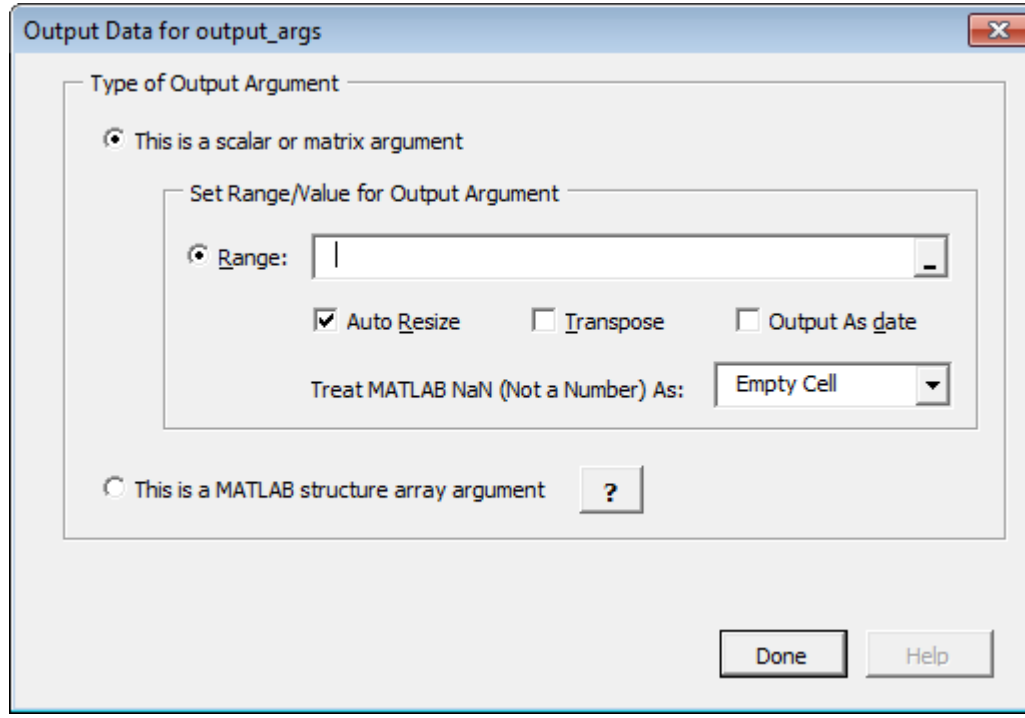
c Click **OK**.

Tip: To specify how MATLAB Compiler for Excel add-ins handles blank cells (or cells containing no data), see "Empty Cell Value Control" on page 3-11.

---

6 Define output argument properties as follows.

a On the **Output** tab, click **Set Output Data**. The Output Data for *y* dialog box appears, where *y* is the name of the output variable you are defining properties of.



Tip: You can also specify MATLAB Compiler to **Auto Resize**, **Transpose** or output your data in date format (**Output as date**). To do so, select the appropriate option in the Argument Properties for *y* dialog box.

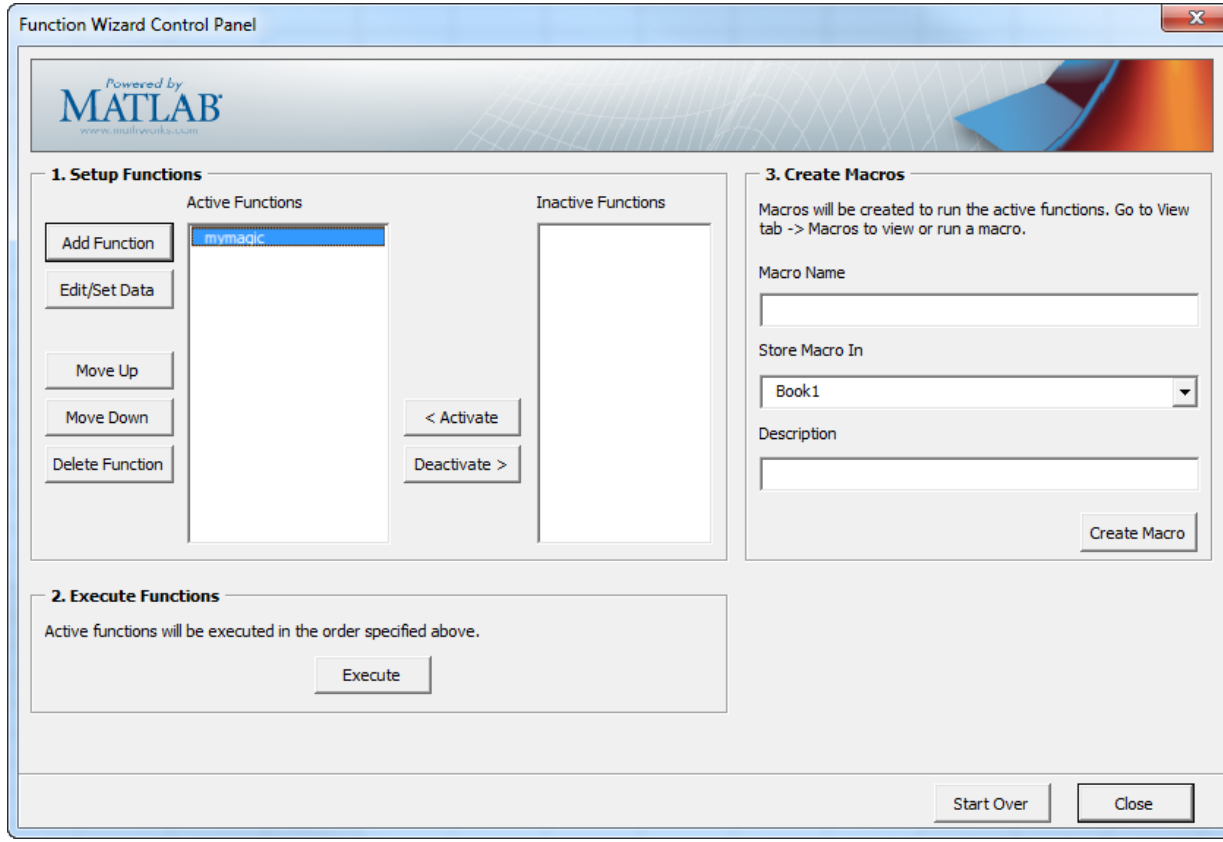
b Specify a **Range**. Alternately, select a range of cells on your Excel sheet; the range will be entered for you in the **Range** field.

Caution: Avoid selecting ranges using arrow keys. If you must use arrow keys to select ranges, apply the necessary fix from the Microsoft site: http://support.microsoft.com/kb/291110.

c Select **Auto Resize** if it is not already selected.

d Click **Done** in the Output Data for *y* dialog box.

e Click **Done** in the Function Properties dialog box.



`mymagic` now appears in the **Active Functions** list of the Function Wizard Control Panel.

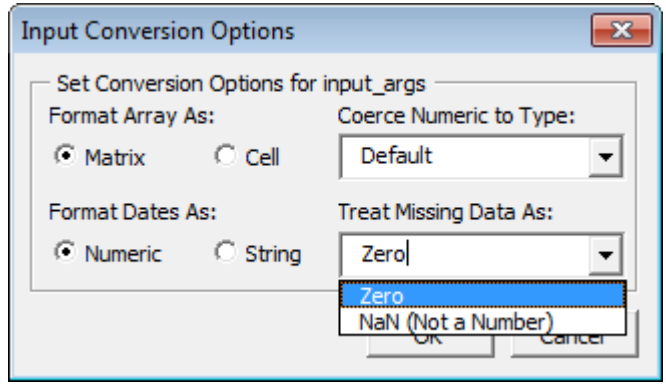
Empty Cell Value Control

You can specify how MATLAB Compiler processes empty cells, allowing you to assign undefined or unrepresented (`NaN`, for example) data values to them.

To specify how to handle empty cells, do the following.

1. Click **Options** in the Input Data for *N* dialog box.

   The Input Conversion Options dialog box opens.



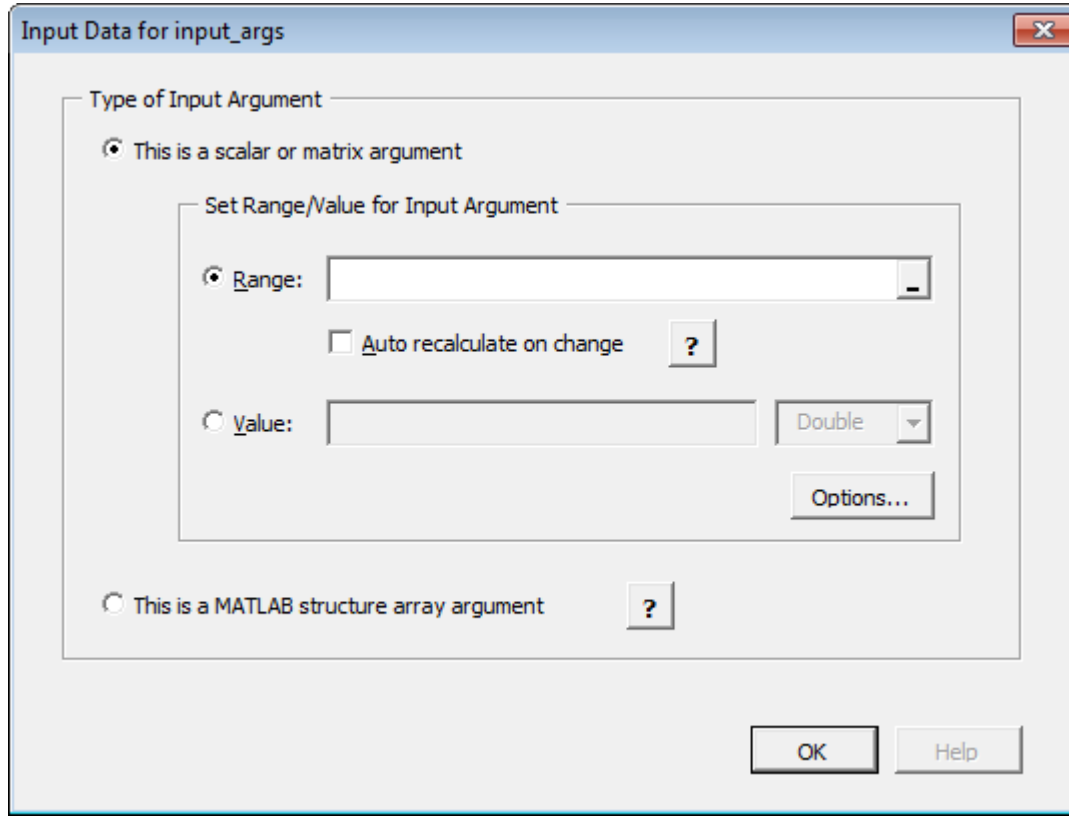
2 Click the **Treat Missing Data As** drop-down box.

3 Specify either **Zero** or **NaN (Not a Number)**, depending on how you want to handle empty cells.

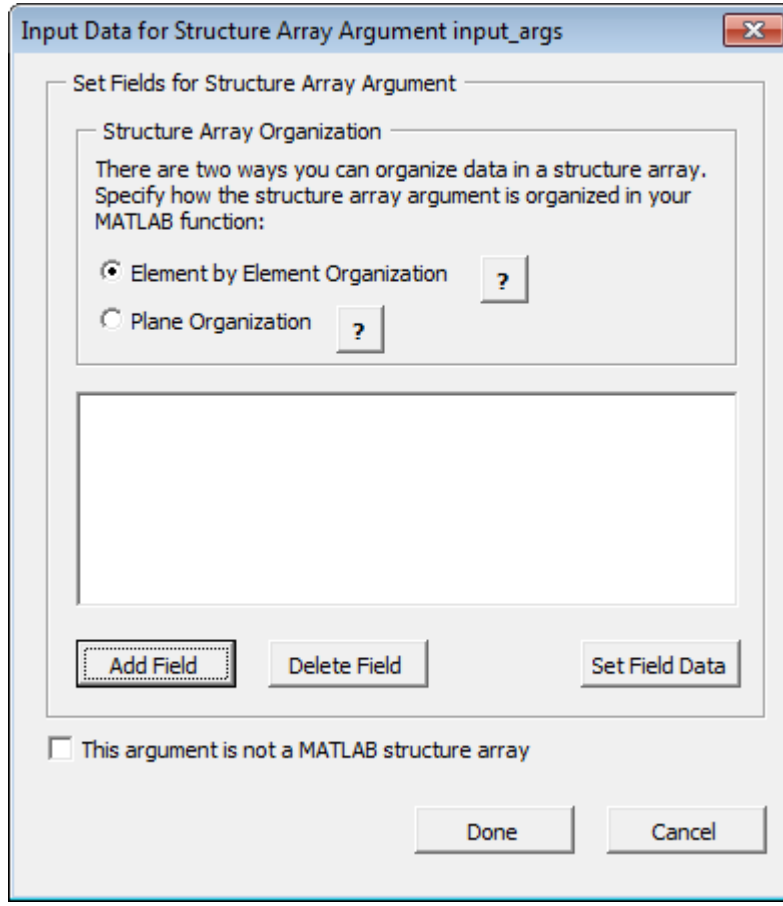
Working with Struct Arrays

To assign ranges to fields in a struct array, do the following:

1 If you have not already done so, select **This is a MATLAB structure array argument** in the Input Data for *n* dialog box and click **OK**.



The Input Data for Structure Array Argument *n* dialog box opens.

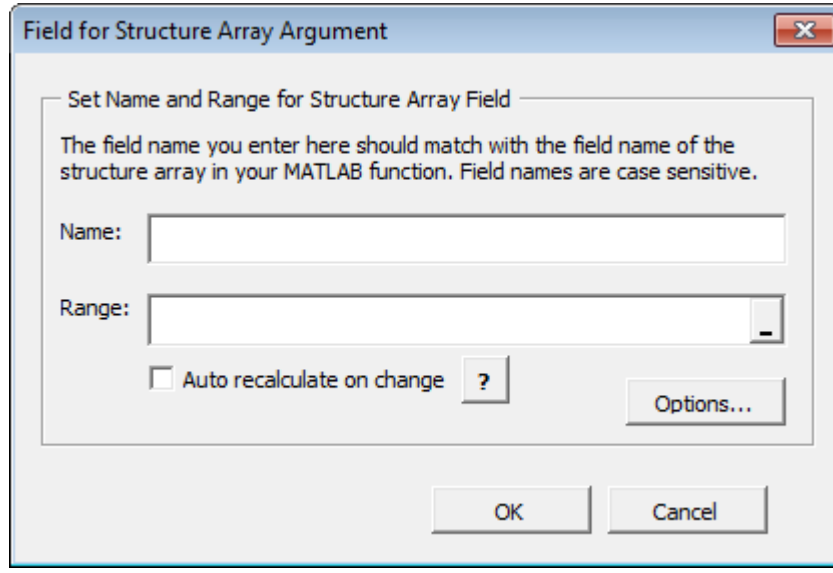


2 The Function Wizard supports Vector and Two-dimensional struct arrays organized in either Element by Element or Plane organization, for both input and output.

In the Input Data for Structure Array Argument *n* dialog box, do the following:

a In the Structure Array Organization area, select either **Element by Element Organization** or **Plane Organization**.

b Click **Add Field** to add fields for each of your struct array arguments. The Field for Structure Array Argument dialog box opens.

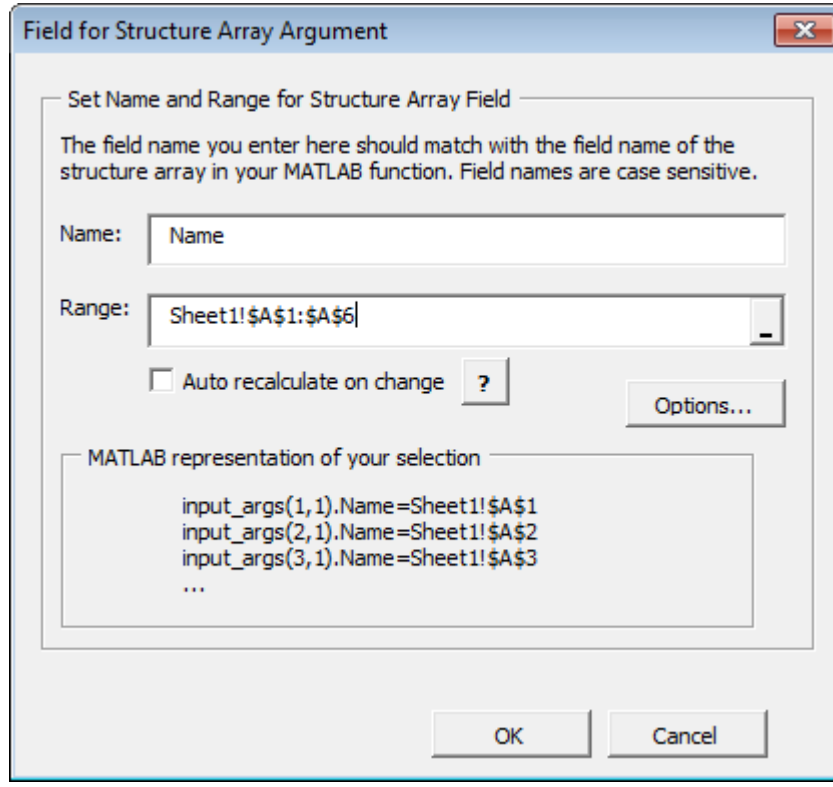


3 In the Field for Argument dialog box, do the following:

a In the **Name** field, define the field name. The **Name** you specify must match the field name of the structure array in your MATLAB function.

b Specify the **Range** for the field.

Caution: Avoid selecting ranges using arrow keys. If you must use arrow keys to select ranges, apply the necessary fix from the Microsoft site: http://support.microsoft.com/kb/291110.



c Click **Done**.

How Structure Arrays are Supported

MATLAB Compiler supports one and two-dimensional MATLAB structure arrays.

The product converts data passed into structure arrays in *element-by-element organization* or *plane organization*. See *MATLAB Programming Fundamentals* for more information about all MATLAB data types, including structures.

Deploying Structure Arrays as Inputs and Outputs

If you are a MATLAB programmer and want to deploy a MATLAB function with structure arrays as input or output arguments, build Microsoft Excel macros using the

Function Wizard and pass them (with the Excel add-in and COM component) to the end users. If you can't do this, let your end users know:

- Which arguments are structure arrays
- Field names of the structure arrays

Using Macros with Struct Arrays

The macro generation feature of MATLAB Compiler for Excel add-ins works with struct arrays as input or output arguments. See "Macro Creation" on page 3-17 if you have a MATLAB function you are ready to deploy. See "Microsoft Excel Add-In and Macro Creation Using the Function Wizard" on page 3-43 if you are using the Function Wizard to create your MATLAB function from scratch. See "Choosing Function Deployment Workflow" on page 1-7 for more information on both workflows.

Function Execution

In the Execute Functions area of the Function Wizard Control Panel, click **Execute** to run `mymagic`. Cells `A1:E5` on the Excel sheet are automatically populated with the output of `mymagic` (a magic square of dimension `5`).

A	B	C	D	E
17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Macro Creation

Continuing the example, create a Microsoft Excel macro using the Function Wizard Control Panel:

1. In the Create Macros area of the control panel, enter `mymagic` in the **Macro Name** field.
2. Select the location of where to store the macro in the **Store Macro** drop-down box.

3 Enter a brief description of the macro's functionality in the **Description** field.

4 Click **Create Macro**.

A macro is created in the current Excel workbook.

Macro Execution

Run the macro you created in "Macro Creation" on page 3-17 by doing one of the following, after first clearing cells `A1:E5` (which contain the output of the Magic Square function you ran in "Function Execution" on page 3-17).

Tip: You may need to enable the proper security settings before running macros in Microsoft Excel. For information about macro permissions and related error messages, see the Appendix B appendix.

Using Office 2007 or Office 2010 or 2013

1 In Microsoft Excel, click **View > Macros > View Macros**.

2 Select `mymagic` from the **Macro name** drop-down box.

3 Click **Run**. Cells `A1:E5` on the Excel sheet are automatically populated with the output of `mymagic`.

Using Office 2003

1 In Microsoft Excel, click **Tools > Macro > Macros**.

2 Select `mymagic` from the **Macro name** drop-down box.

3 Click **Run**. Cells `A1:E5` on the Excel sheet are automatically populated with the output of `mymagic`.

Microsoft Visual Basic Code Access (Optional Advanced Task)

Optionally, you may want to access the Visual Basic code or modify it, depending on your programming expertise or the availability of an Excel developer. If so, follow these steps.

From the Excel main window, open the Microsoft Visual Basic editor by doing one of the following. select **Tools > Macro > Visual Basic Editor**.

Using Office 2007 or Office 2010 or 2013

1. Click **Developer > Visual Basic**.
2. When the Visual Basic Editor opens, in the **Project - VBAProject** window, double-click to expand `VBAProject (mymagic.xls)`.
3. Expand the `Modules` folder and double-click the `Matlab Macros` module.

   This opens the Visual Basic Code window with the code for this project.

Using Office 2003

1. Click **Tools > Macro > Visual Basic Editor**.
2. When the Visual Basic Editor opens, in the **Project - VBAProject** window, double-click to expand `VBAProject (mymagic.xls)`.
3. Expand the `Modules` folder and double-click the `Matlab Macros` module.

   This opens the VB Code window with the code for this project.

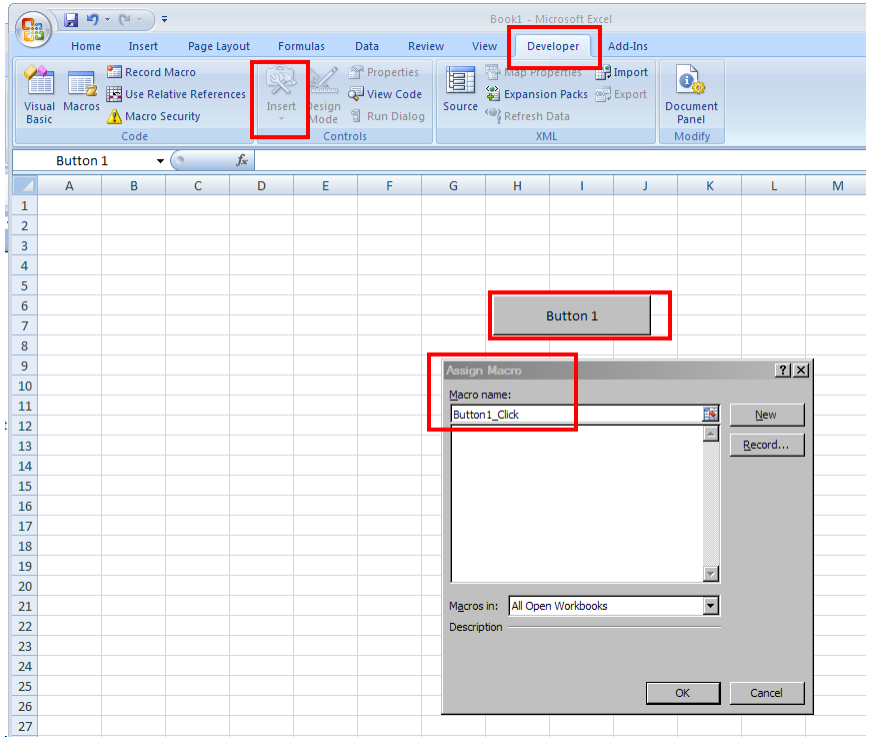
Mapping a Macro to a GUI Button or Control (Optional)

To attach the macro to a GUI button, do the following:

1. Click **Developer > Insert**.
2. From the **Form Controls** menu, select the **Button (Form Control)** icon.

   Tip: Hover your mouse over the Form Controls menu to see the various control labels.

3. In the Assign Macros dialog box, select the macro you want to assign the GUI button to, and click **OK**.



Attaching a Macro to a Button

For More Information

If you want to...	See...
• Perform basic MATLAB Programmer tasks • Understand how the deployment products process your MATLAB functions • Understand how the deployment products work together • Explore guidelines about writing deployable MATLAB code	"Write Deployable MATLAB Code" on page 4-10

If you want to...	See...
See more examples about building add-ins and COM components	"Create Macros from MATLAB Functions" on page 5-5
Learn how to customize and integrate the COM component you built by modifying the Microsoft Visual Basic code	"Integrate Components using Visual Basic Application" on page 6-3

End-to-End Deployment of MATLAB Function

In this section...
"What Can the Function Wizard Do for Me?" on page 3-3
"Example File Copying" on page 3-24
"mymagic Testing" on page 3-25
"Installation of the Function Wizard" on page 3-4
"Function Wizard Start-Up" on page 3-27
"Workflow Selection for Prototyping and Debugging MATLAB Functions" on page 3-28
"New MATLAB Function Definition" on page 3-30
"MATLAB Function Prototyping and Debugging" on page 3-41
"Function Execution from MATLAB" on page 3-42
"Microsoft Excel Add-In and Macro Creation Using the Function Wizard" on page 3-43
"Function Execution from the Deployed Component" on page 3-45
"Macro Execution" on page 3-18
"Microsoft Excel Add-In and Macro Packaging using the Function Wizard" on page 3-46
"Microsoft Visual Basic Code Access (Optional Advanced Task)" on page 3-18
"For More Information" on page 3-48

If you are still in the process of developing a MATLAB function that is not yet ready to be deployed, you may find this example to be an appropriate introduction to using MATLAB Compiler for Excel add-ins.

The Function Wizard allows you to iteratively test, develop, and debug your MATLAB function. It does this by invoking MATLAB from the Function Wizard Control Panel.

Developing your function in an interactive environment ensures that it works in an expected manner, prior to deployment to larger-scale applications. Usually, these applications are programmed by the Excel Developer using an enterprise language like Microsoft Visual Basic.

Similar to the Magic Square example, the Prototyping and Debugging example develops a function named `mymagic`, which wraps a MATLAB function, `magic`, which computes a magic square, a function with a single multidimensional matrix output.

If your MATLAB function is ready to be deployed and you have already built your add-in and COM component with the Deployment Tool, see “Execute Functions and Create Macros” on page 3-2.

Key Tasks for the MATLAB Programmer

Task	Reference
1. Review MATLAB Compiler for Excel add-ins prerequisites, if you have not already done so.	“MATLAB Compiler for Microsoft Excel Add-In Prerequisites” on page 1-3
2. Prepare to run the example by copying the example files.	“Example File Copying” on page 3-24
3. Test the MATLAB function you want to deploy as an add-in or COM component.	“mymagic Testing” on page 3-25
4. Install the Function Wizard.	“Installation of the Function Wizard” on page 3-4
5. Start the Function Wizard.	“Function Wizard Start-Up” on page 3-5
6. Select the prototyping and debugging workflow.	“Workflow Selection for Prototyping and Debugging MATLAB Functions” on page 3-28
7. Define the new MATLAB function you want to prototype by adding it to the Function Wizard and establishing input and output ranges.	“New MATLAB Function Definition” on page 3-30
8. Test your MATLAB function by executing it with the Function Wizard.	“Function Execution from MATLAB” on page 3-42
9. Prototype and Debug the MATLAB function if needed, using MATLAB and the Function Wizard.	“MATLAB Function Prototyping and Debugging” on page 3-41
10. Create the add-in and COM component, as well as the macro, using the Function Wizard to invoke MATLAB and the Deployment Tool.	“Microsoft Excel Add-In and Macro Creation Using the Function Wizard” on page 3-43

Task	Reference
11. Execute the your function from the newly created component, to ensure the function's behavior is identical to when it was tested.	"Function Execution from the Deployed Component" on page 3-45
12. Execute the macro you created using the Function Wizard.	"Macro Execution" on page 3-18
13. Package your deployable add-in and macro using the Function Wizard to invoke MATLAB and the Deployment Tool.	"Microsoft Excel Add-In and Macro Packaging using the Function Wizard" on page 3-46
14. Optionally inspect or modify the Microsoft Visual Basic code you generated with the COM component. Optionally, attach the macro you created to a GUI button.	"Microsoft Visual Basic Code Access (Optional Advanced Task)" on page 3-18

What Can the Function Wizard Do for Me?

The Function Wizard enables you to pass Microsoft Excel (Excel 2000 or later) worksheet values to a compiled MATLAB model and then return model output to a cell or range of cells in the worksheet.

The Function Wizard provides an intuitive interface to Excel worksheets. You do not need previous knowledge of Microsoft Visual Basic for Applications (VBA) programming.

The Function Wizard reflects any changes that you make in the worksheets, such as range selections. You also use the Function Wizard to control the placement and output of data from MATLAB functions to the worksheets.

Note: The Function Wizard does not currently support the MATLAB `sparse`, and `complex` data types.

Example File Copying

All MATLAB Compiler examples reside in *`matlabroot`*`\toolbox\matlabxl\examples\`. The following table identifies examples by folder:

For Example Files Relating To...	Find Example Code in Folder...	For Example Documentation See...
Magic Square Example	`xlmagic`	"Integrate an Add-In and COM Component with Microsoft Excel" on page 1-13
Variable-Length Argument Example	`xlmulti`	"Work with Variable-Length Inputs and Outputs" on page 5-5
Calling Compiled MATLAB Functions from Microsoft Excel	`xlbasic`	"Calling Compiled MATLAB Functions from Microsoft Excel" on page 7-4
Spectral Analysis Example	`xlspectral`	"Build and Integrate Spectral Analysis Functions" on page 6-16

mymagic Testing

In this example, you test a MATLAB file (`mymagic.m`) containing the predefined MATLAB function `magic`. You test to have a baseline to compare to the results of the function when it is ready to deploy.

1. In MATLAB, locate mymagic.m. See "Example File Copying" on page 3-24 for locations of examples. The contents of the file are as follows:

```
function y = mymagic(x)
%MYMAGIC Magic square of size x.
%   Y = MYMAGIC(X) returns a magic square of size x.
%   This file is used as an example for the MATLAB Compiler product.

%   Copyright 2001-2012 The MathWorks, Inc.

y = magic(x)
```

2. At the MATLAB command prompt, enter `mymagic(5)`. View the resulting output, which appears as follows:

```
17 24  1  8 15
23  5  7 14 16
 4  6 13 20 22
10 12 19 21  3
```

11 18 25 2 9

Installation of the Function Wizard

Before you can use the Function Wizard, you must first install it as an add-in that is accessible from Microsoft Excel.

After you install the Function Wizard, the entry **MATLAB Functions** appears as an available Microsoft Excel add-in button.

Using Office 2010 or Office 2013

1. Click the **File** tab.
2. On the left navigation pane, select **Options**.
3. In the Excel Options dialog box, on the left navigation pane, select **Add-Ins**.
4. In the Manage drop-down, select **Excel Add-Ins**, and click **Go**.
5. In the Add-Ins dialog box, click **Browse**.
6. Browse to *`matlabroot`*`/toolbox/matlabxl/matlabxl/`*`arch`*, and select `FunctionWizard2007.xlam`. Click **OK**.
7. In the Excel Add-Ins dialog, verify that the entry **MATLAB Compiler Function Wizard** is selected. Click **OK**.

The Home tab of the Microsoft Office Ribbon should now contain the Function Wizard tile. See The Home Tab of the Microsoft Office Ribbon with Function Wizard Installed.

Using Office 2007

1. Start Microsoft Excel if it is not already running.
2. Click the Office Button ( ) and select **Excel Options**.
3. In the left pane of the Excel Options dialog box, click **Add-Ins**.
4. In the right pane of the Excel Options dialog box, select **Excel Add-ins** from the **Manage** drop-down box.
5. Click **Go**.
6. Click **Browse**. Navigate to *`matlabroot`*`\toolbox\matlabxl\matlabxl\`*`arch`* and select `FunctionWizard2007.xlam`. Click **OK**.

7 In the Excel Add-Ins dialog box, verify that the entry **MATLAB Compiler Function Wizard** is selected. Click **OK**.

Using Office 2003

1 Select **Tools** > **Add-Ins** from the Excel main menu.

2 If the Function Wizard was previously installed, **MATLAB Compiler Function Wizard** appears in the list. Select the item, and click **OK**.

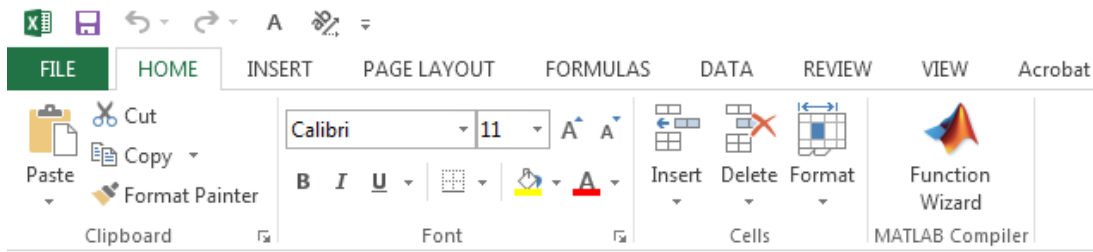
   If the Function Wizard was not previously installed, click **Browse** and navigate to *`matlabroot`*`\toolbox\matlabxl\matlabxl` folder. Select `FunctionWizard.xla`. Click **OK** to proceed.

Function Wizard Start-Up

Start the Function Wizard in one of the following ways. When the wizard has initialized, the Function Wizard Start Page dialog box displays.

Using Office 2007 or Office 2010 or 2013

In Microsoft Excel, on the Microsoft Office ribbon, on the **Home** tab, select **Function Wizard**.

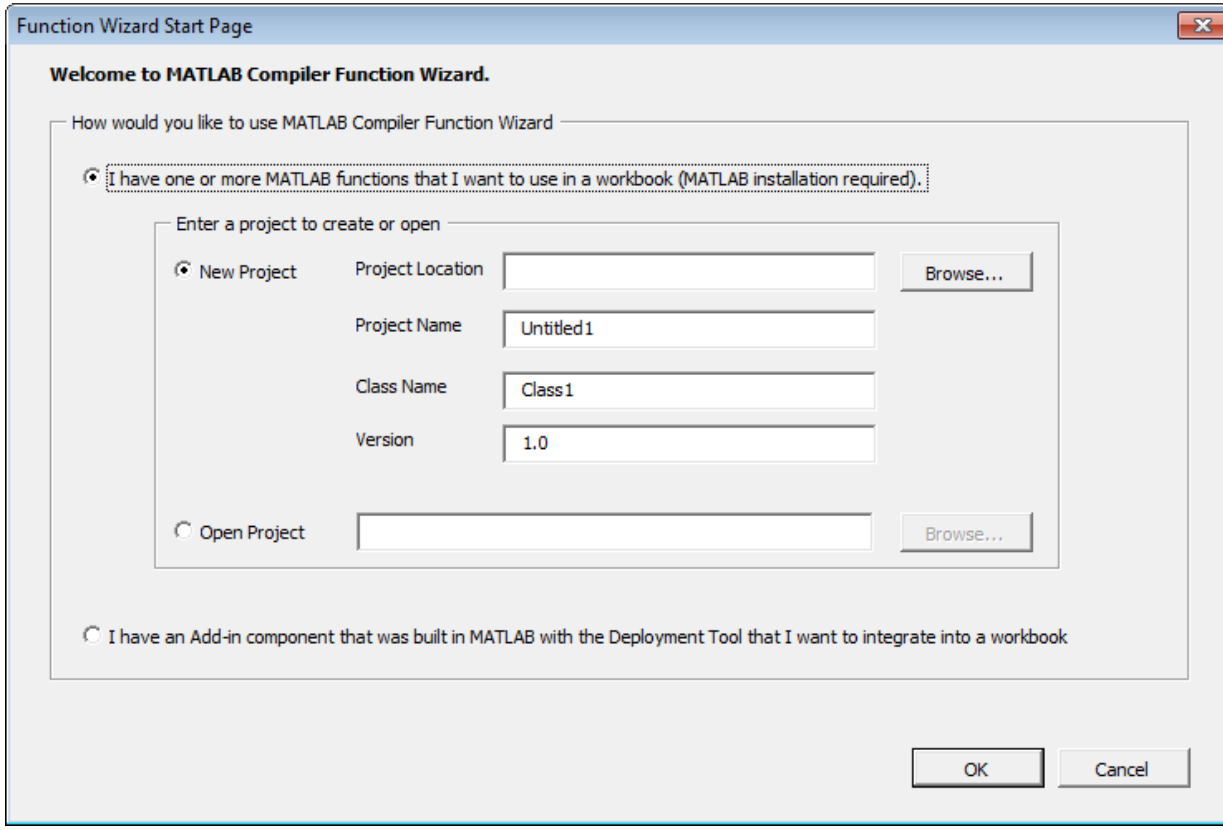


The Home Tab of the Microsoft Office Ribbon with Function Wizard Installed

You can also access Function Wizard from the File tab.

1 Select **File** > **Options** > **Add-Ins** from the Excel main menu.

2 Select **Function Wizard**.



The Function Wizard Start Page Dialog Box

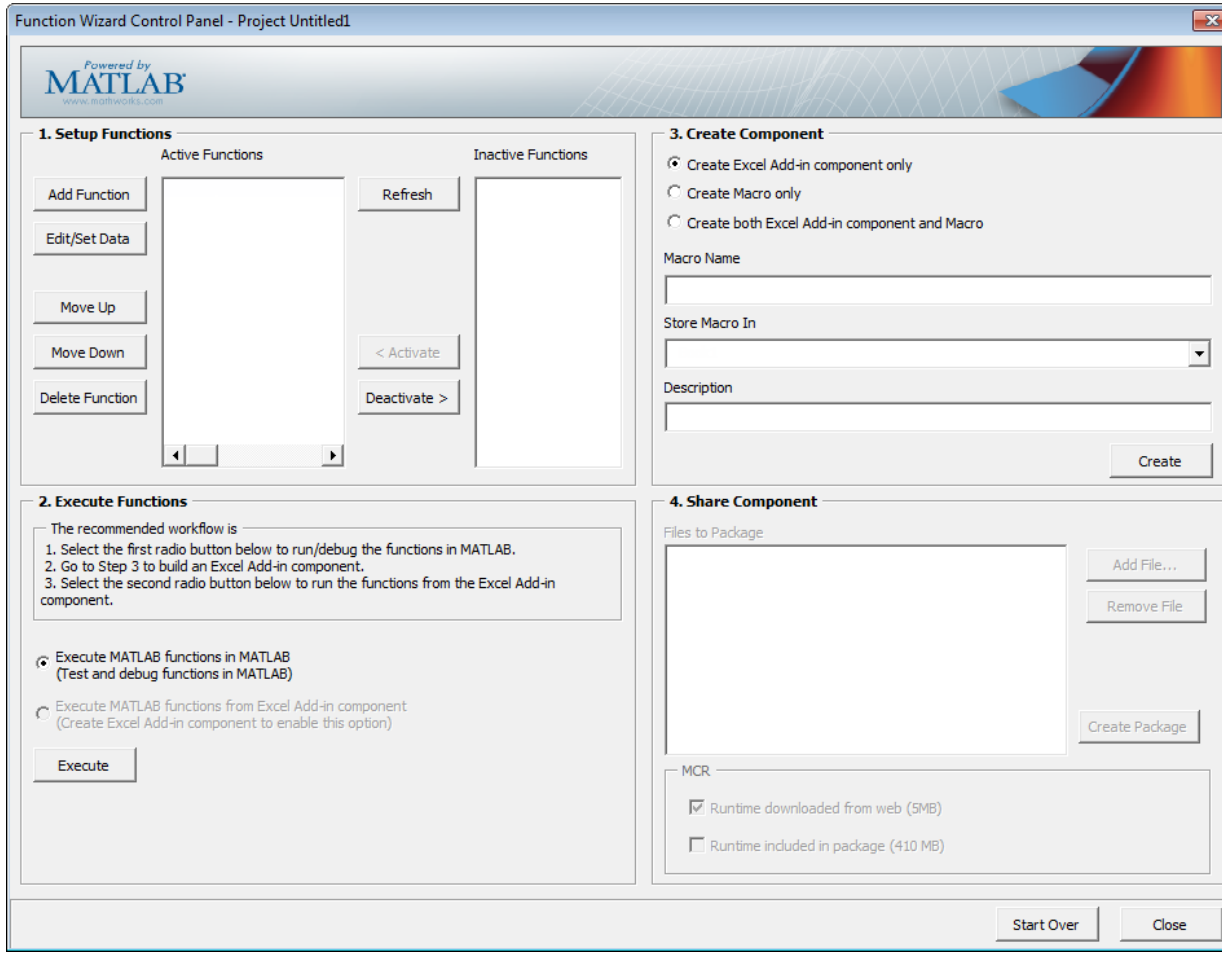
Workflow Selection for Prototyping and Debugging MATLAB Functions

After you have installed and started the Function Wizard, do the following.

1 From the Function Wizard Start Page dialog box, select **I have one or more MATLAB functions that I want to use in a workbook (MATLAB installation required)**. The **New Project** option is selected by default. Enter a meaningful project name in the **Project Name** field, like `testmymagic`, for example.

Tip: Some customers find it helpful to assign a unique name as the **Class Name** (default is `Class1`) and to assign a **Version** number for source control purposes.

2 Click **OK**. The Function Wizard Control Panel displays with the **Add Function** button enabled.



About Project Files

Keep in mind the following information about project files when working with the Function Wizard:

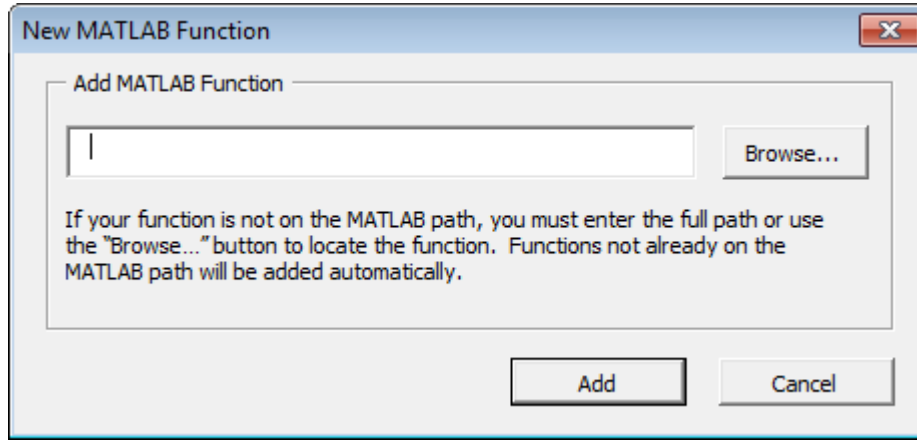
- The project files created by the Function Wizard are the same project files created and used by the Deployment Tool (`deploytool`).
- The Function Wizard prompts you to specify a location for your project files when you open your first new project. Project files are auto-saved to this location and may be opened in the future through either the Deployment Tool or the Function Wizard.
- If you previously built a component using the Function Wizard, the wizard will prompt you to load it.

Quitting the MATLAB Session Invoked by the Function Wizard

Avoid manually terminating the MATLAB session invoked by the Function Wizard. Doing so can prevent you from using the Wizard's MATLAB-related features from your Excel session. If you want to quit the remotely invoked MATLAB session, restart Excel.

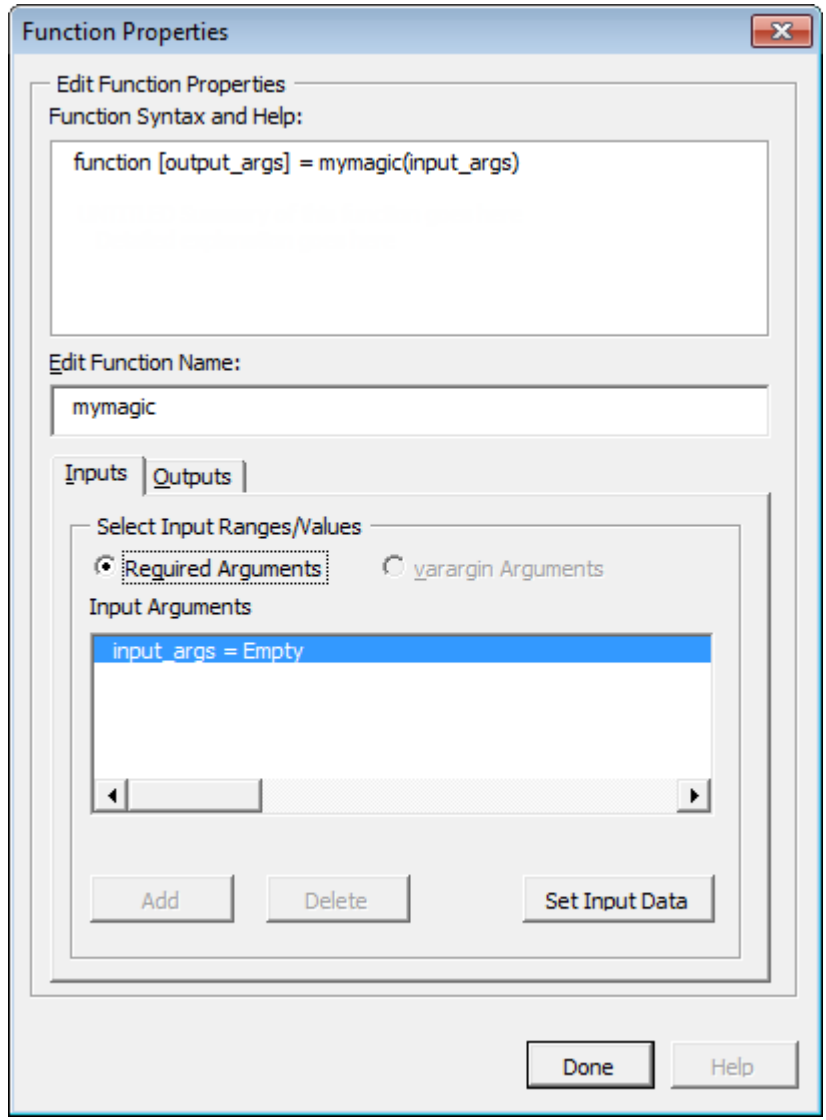
New MATLAB Function Definition

1. Add the function you want to deploy to the Function Wizard. Click **Add** in the Set Up Functions area of the Function Wizard Control Panel. The New MATLAB Function dialog box appears.



2. Browse to locate your MATLAB function. Select the function and click **Open**.

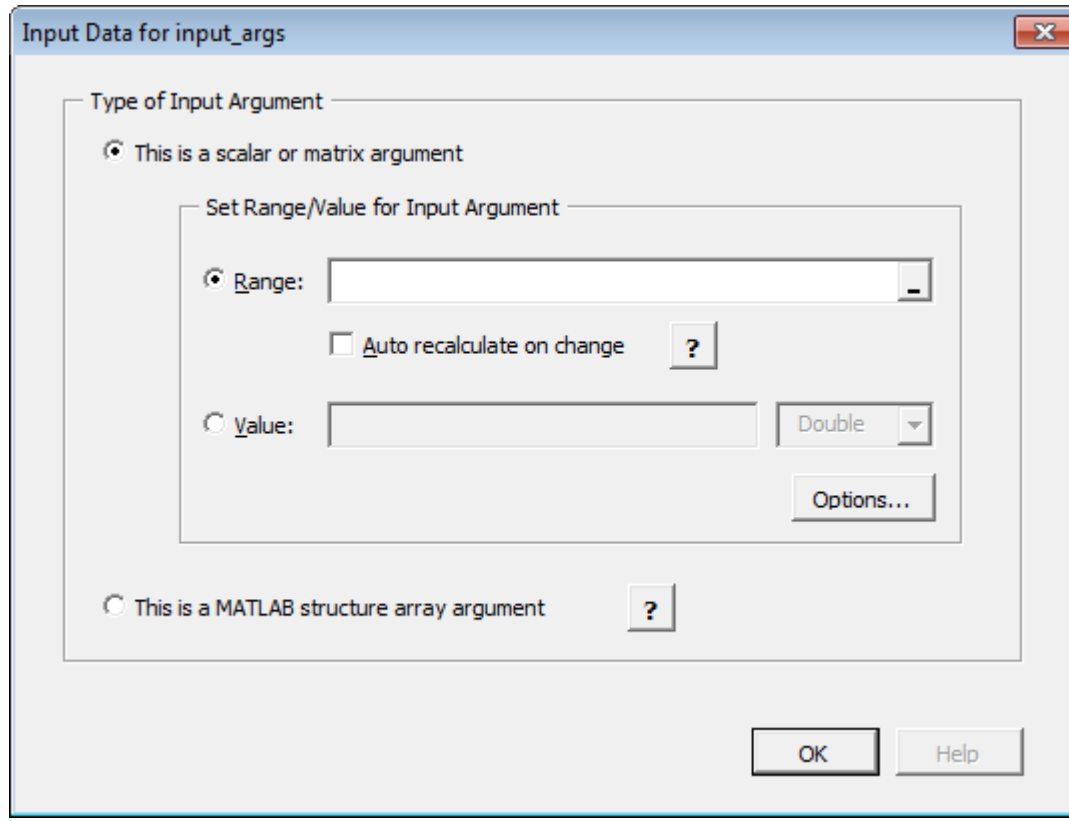
3 In the New MATLAB Function dialog box, click **Add**. The Function Properties dialog box appears.



Tip: The **Function Syntax and Help** area, in the Function Properties dialog box, displays the first help text line (sometimes called the *H1 line*) in a MATLAB function. Displaying these comments in the Function Properties dialog box can be helpful when deploying new or unfamiliar MATLAB functions to end-users.

4 Define input argument properties as follows.

a On the **Input** tab, click **Set Input Data**. The Input Data for *n* dialog box appears.



b Specify a **Range** or **Value** by selecting the appropriate option and entering the value.

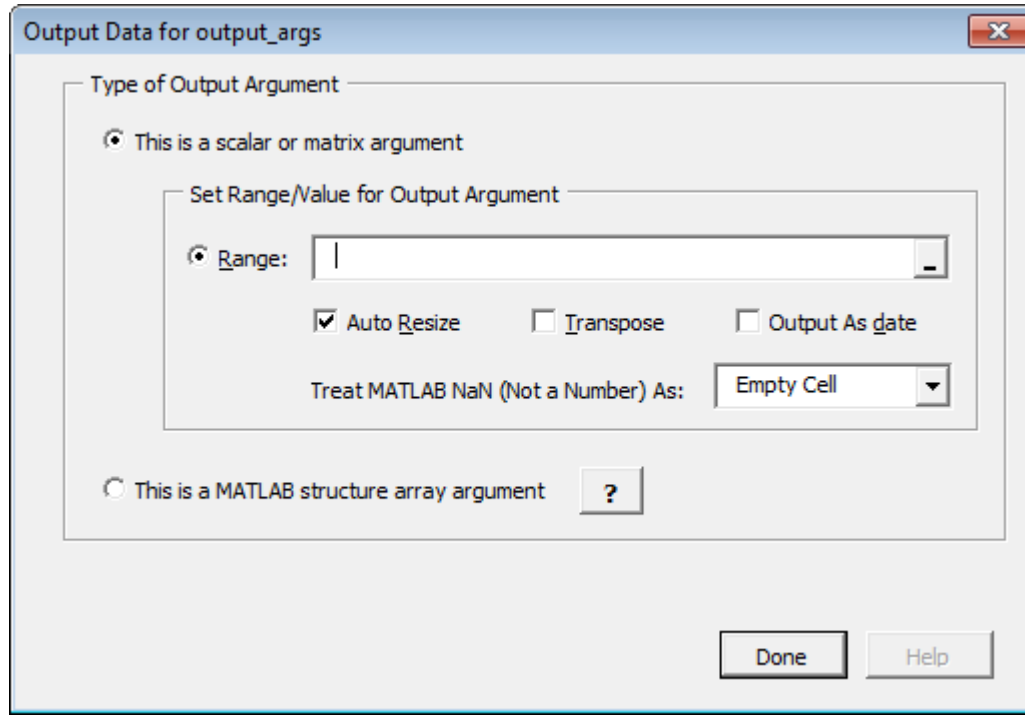
Caution: Avoid selecting ranges using arrow keys. If you must use arrow keys to select ranges, apply the necessary fix from the Microsoft site: http://support.microsoft.com/kb/291110.

c Click **Done**.

Tip: To specify how MATLAB Compiler for Excel add-ins handles blank cells (or cells containing no data), see "Empty Cell Value Control" on page 3-11.

5 Define output argument properties as follows.

a On the **Output** tab, click **Set Output Data**. The Output Data for *y* dialog box appears, where *x* is the name of the output variable you are defining properties of.



Tip: You can also specify MATLAB Compiler to **Auto Resize**, **Transpose** or output your data in date format (**Output as date**). To do so, select the appropriate option in the Argument Properties For *y* dialog box.

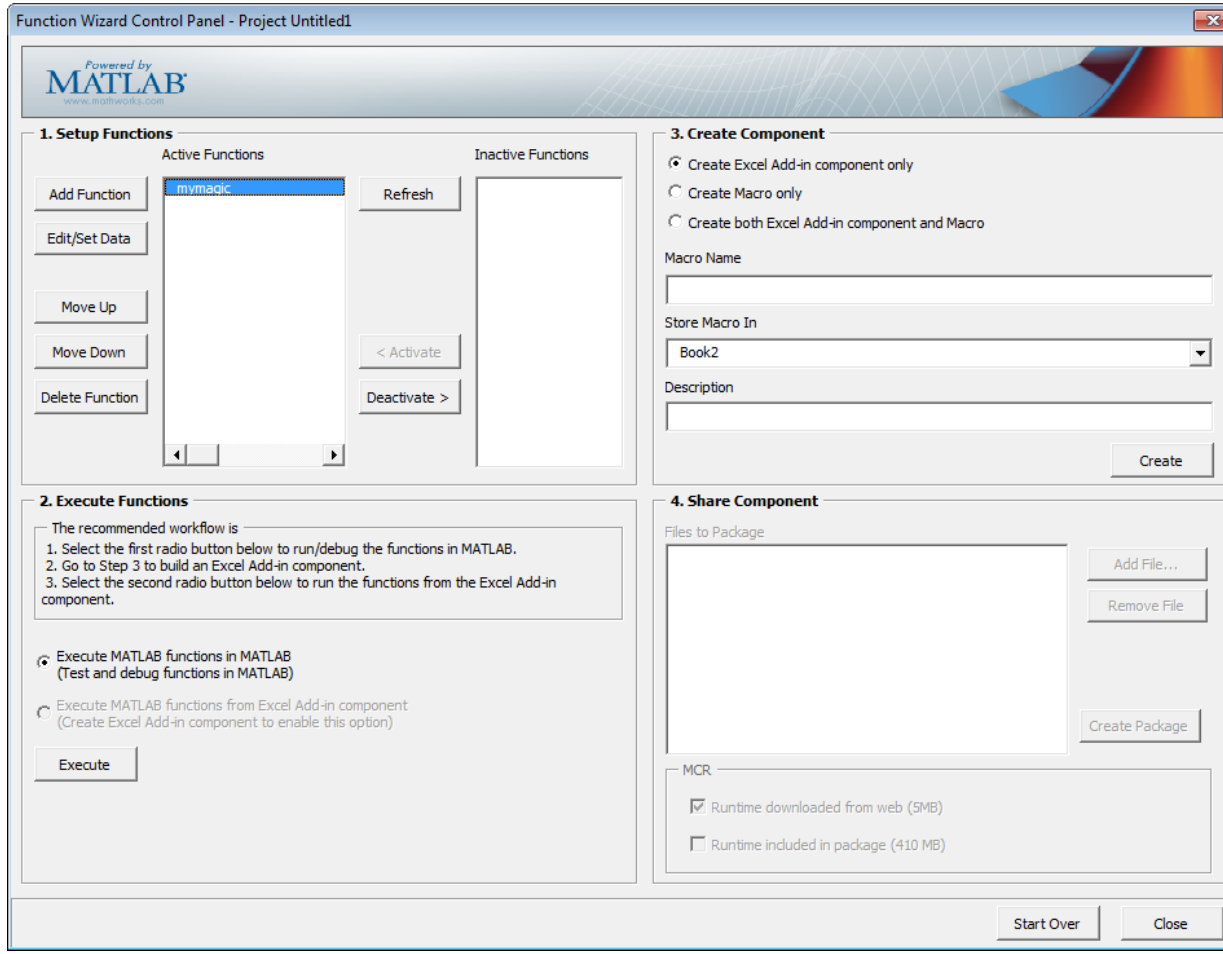
b Specify a **Range**. Alternately, select a range of cells on your Excel sheet; the range will be entered for you in the **Range** field.

Caution: Avoid selecting ranges using arrow keys. If you must use arrow keys to select ranges, apply the necessary fix from the Microsoft site: http://support.microsoft.com/kb/291110.

c Select **Auto Resize** if it is not already selected.

d Click **Done** in the Argument Properties For *y* dialog box.

e Click **Done** in the Function Properties dialog box. `mymagic` now appears in the **Active Functions** list of the Function Wizard Control Panel.



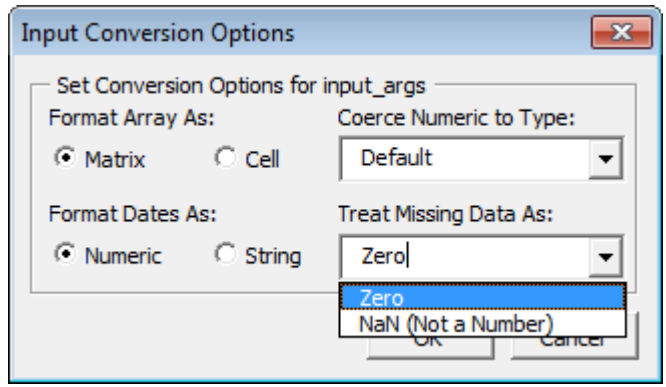
Empty Cell Value Control

You can specify how MATLAB Compiler processes empty cells, allowing you to assign undefined or unrepresented (`NaN`, for example) data values to them.

To specify how to handle empty cells, do the following.

1 Click **Options** in the Input Data for *N* dialog box.

The Input Conversion Options dialog box opens.



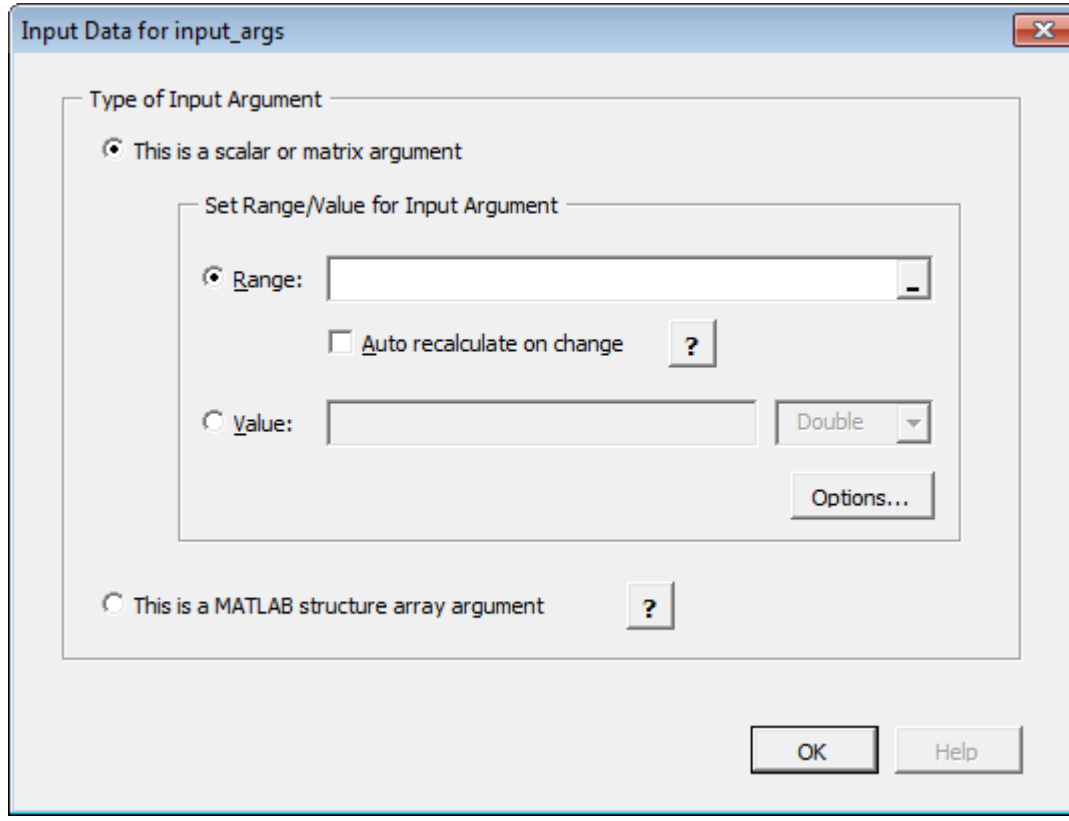
2 Click the **Treat Missing Data As** drop-down box.

3 Specify either **Zero** or **NaN (Not a Number)**, depending on how you want to handle empty cells.

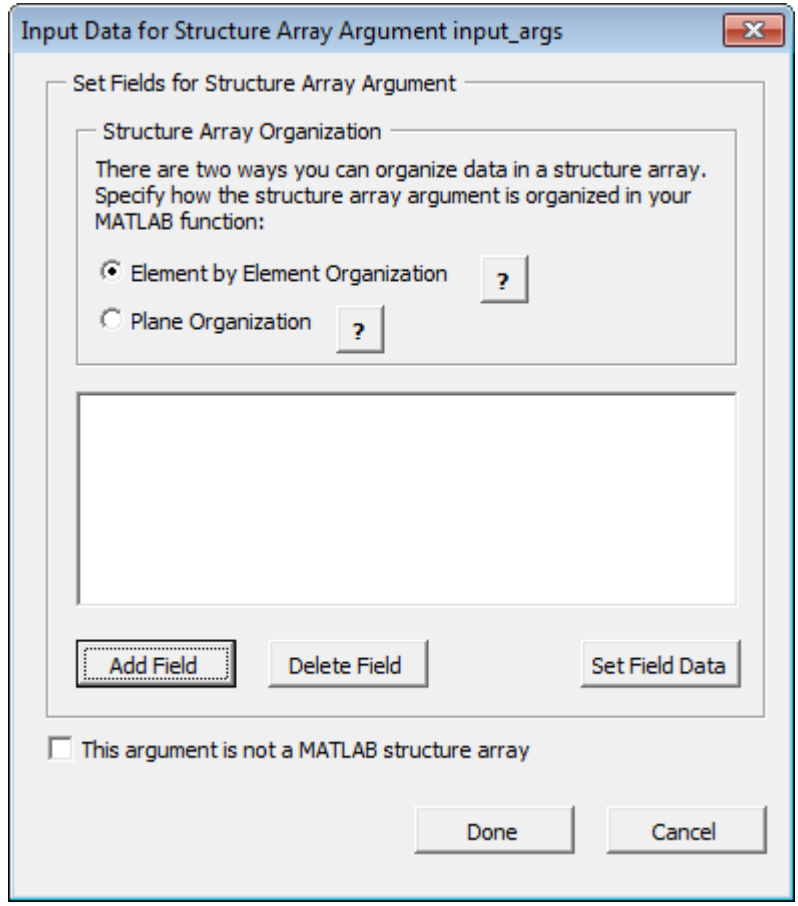
Working with Struct Arrays

To assign ranges to fields in a struct array, do the following:

1 If you have not already done so, select **This is a MATLAB structure array argument** in the Input Data for *n* dialog box and click **OK**.



The Input Data for Structure Array Argument *n* dialog box opens.

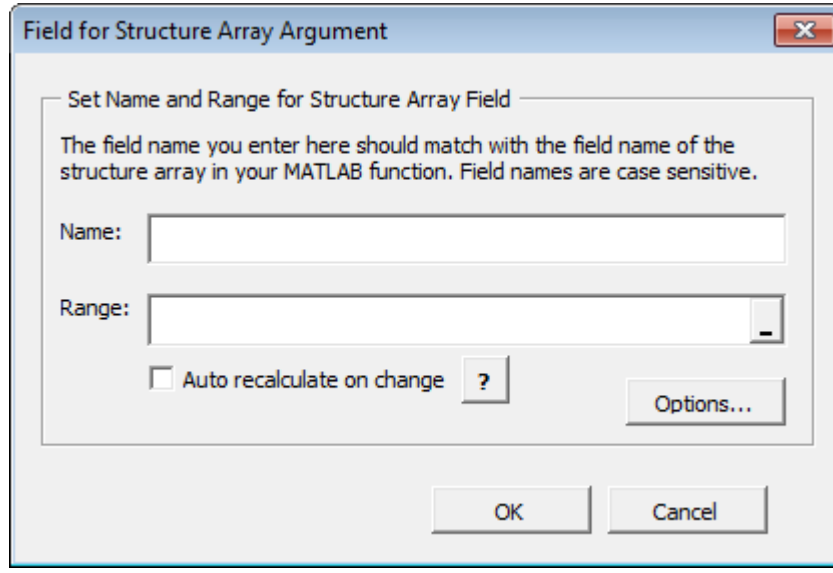


2 The Function Wizard supports Vector and Two-dimensional struct arrays organized in either Element by Element or Plane organization, for both input and output.

In the Input Data for Structure Array Argument *n* dialog box, do the following:

a In the Structure Array Organization area, select either **Element by Element Organization** or **Plane Organization**.

b Click **Add Field** to add fields for each of your struct array arguments. The Field for Structure Array Argument dialog box opens.

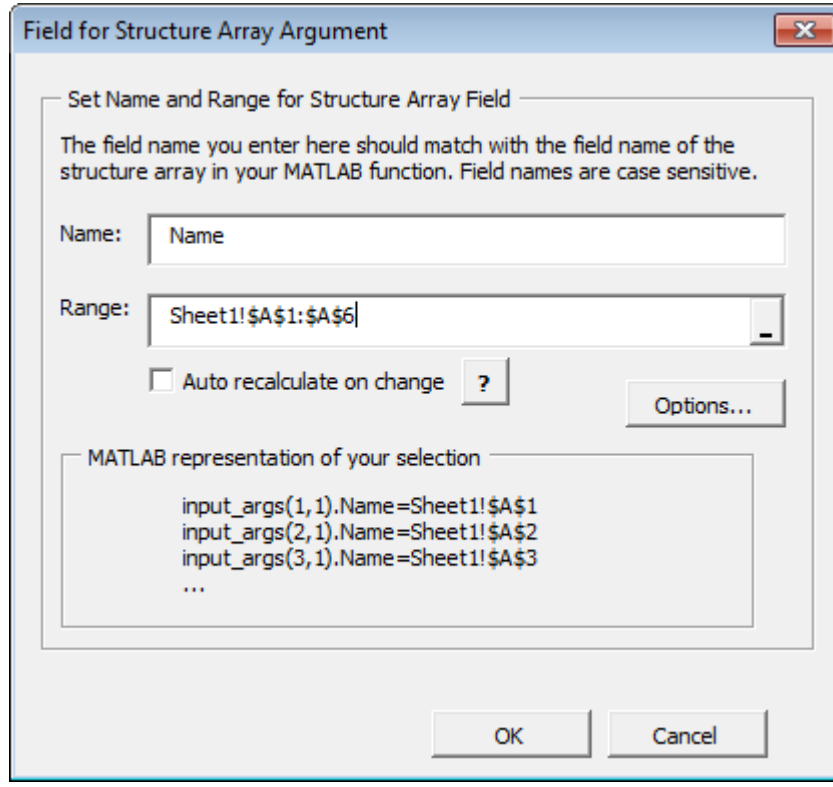


3 In the Field for Argument dialog box, do the following:

a In the **Name** field, define the field name. The **Name** you specify must match the field name of the structure array in your MATLAB function.

b Specify the **Range** for the field.

Caution: Avoid selecting ranges using arrow keys. If you must use arrow keys to select ranges, apply the necessary fix from the Microsoft site: http://support.microsoft.com/kb/291110.



c Click **Done**.

How Structure Arrays are Supported

MATLAB Compiler supports one and two-dimensional MATLAB structure arrays.

The product converts data passed into structure arrays in *element-by-element organization* or *plane organization*. See *MATLAB Programming Fundamentals* for more information about all MATLAB data types, including structures.

Deploying Structure Arrays as Inputs and Outputs

If you are a MATLAB programmer and want to deploy a MATLAB function with structure arrays as input or output arguments, build Microsoft Excel macros using the

Function Wizard and pass them (with the Excel add-in and COM component) to the end users. If you can't do this, let your end users know:

- Which arguments are structure arrays
- Field names of the structure arrays

Using Macros with Struct Arrays

The macro generation feature of MATLAB Compiler for Excel add-ins works with struct arrays as input or output arguments. See "Macro Creation" on page 3-17 if you have a MATLAB function you are ready to deploy. See "Microsoft Excel Add-In and Macro Creation Using the Function Wizard" on page 3-43 if you are using the Function Wizard to create your MATLAB function from scratch. See "Choosing Function Deployment Workflow" on page 1-7 for more information on both workflows.

MATLAB Function Prototyping and Debugging

Use the Function Wizard to interactively prototype and debug a MATLAB function.

Since `mymagic` calls the prewritten MATLAB `magic` function directly, it does not provide an illustrative example of how to use the prototyping and debugging feature of MATLAB Compiler.

Following is an example of how you might use this feature with `myprimes`, a function containing multiple lines of code.

Prototyping and Debugging with myprimes

For example, say you are in the process of prototyping code that uses the equation `P = myprimes(n)`. This equation returns a row vector of prime numbers less than or equal to `n` (a prime number has no factors other than 1 and the number itself).

Your code uses `P = myprimes(n)` as follows:

```
function [p] = myprimes(n)

if length(n)~=1, error('N must be a scalar'); end
if n < 2, p = zeros(1,0); return, end
p = 1:2:n;
q = length(p);
p(1) = 2;
for k = 3:2:sqrt(n)
```

```
  if p((k+1)/2)
     p(((k*k+1)/2):k:q) = 0;
  end

end

p = (p(p>0));
```

In designing your code, you want to handle various use cases. For example, you want to experiment with scenarios that may assign a column vector value to the output variable `p` ((`myprimes` only returns a row vector, as stated previously). You follow this general workflow:

1. Set a breakpoint in `myprimes` at the first `if` statement, using the GUI or `dbstop`, for instance.
2. On the Function Wizard Control Panel, in the Execute Functions area, click **Execute**. Execution will stop at the previously set breakpoint. Note the value of `p`. Step-through and debug your code as you normally would using the MATLAB Editor.

For more information about debugging MATLAB code, see "Debug a MATLAB Program" (MATLAB).

Function Execution from MATLAB

Test your deployable MATLAB function by executing it in MATLAB:

1. From the Function Wizard Control Panel, in the Execute Functions area, select **Execute MATLAB Functions in MATLAB**.
2. Click **Execute**. In Excel, the Magic Square function executes, producing results similar to the following.

A	B	C	D	E
17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

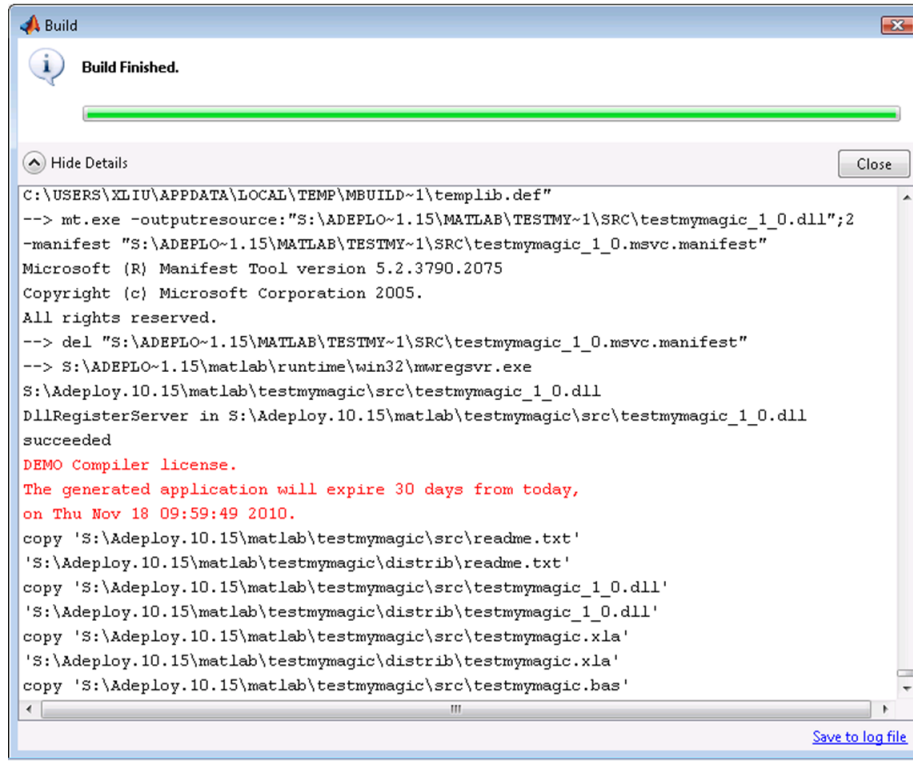
Microsoft Excel Add-In and Macro Creation Using the Function Wizard

The Function Wizard can automatically create a deployable Microsoft Excel add-in and macro. To create your add-in in this manner, use one of the following procedures.

Creating an Add-In and Associated Excel Macro

To create both a deployable add-in and an associated Excel macro:

1. In the Function Wizard Control Panel dialog box, in the Create Component area, select **Create Both Excel Add-in Component and Excel Macro**.
2. Enter `mymagic` in the **Macro Name** field.
3. Select the location of where to store the macro, using the **Store Macro In** drop-down box.
4. Enter a brief description of the macro's functionality in the **Description** field.
5. Click **Create** to build both the add-in (as well as the underlying COM component) and the associated macro. The Deployment Tool Build dialog box appears, indicating the status of the add-in and COM component compilation (build).



The Build Dialog

Creating a COM Component or a Macro Only Without Creating an Add-In

To create either a COM component or a macro without also creating the Excel add-in, do the following

1. In the Function Wizard Control Panel dialog box, in the Create Component area, select either **MATLAB Excel Add-in Component Only** or **Create Excel Macro Only**.
2. Enter `mymagic` in the **Macro Name** field.
3. Select the location of where to store the macro, using the **Store Macro In** drop-down box.
4. Enter a brief description of the macro's functionality in the **Description** field.

5 Click **Create**.

Function Execution from the Deployed Component

Execute your function as you did similarly in "Function Execution from MATLAB" on page 3-42, but this time execute it from the deployed component to ensure it matches your previous output.

1 From the Function Wizard Control Panel, in the Execute Functions area, select **Execute MATLAB Functions from Deployed Component**.

2 Click **Execute**. In Excel, the Magic Square function executes, producing results similar to the following.

A	B	C	D	E
17	24	1	8	15
23	5	7	14	16
4	6	13	20	22
10	12	19	21	3
11	18	25	2	9

Macro Execution

Run the macro you created in "Macro Creation" on page 3-17 by doing one of the following, after first clearing cells `A1:E5` (which contain the output of the Magic Square function you ran in "Function Execution" on page 3-17).

Tip: You may need to enable the proper security settings before running macros in Microsoft Excel. For information about macro permissions and related error messages, see the Appendix B appendix.

Using Office 2007 or Office 2010 or 2013

1 In Microsoft Excel, click **View > Macros > View Macros**.

2 Select `mymagic` from the **Macro name** drop-down box.

3 Click **Run**. Cells `A1:E5` on the Excel sheet are automatically populated with the output of `mymagic`.

Using Office 2003

1 In Microsoft Excel, click **Tools > Macro > Macros**.

2 Select `mymagic` from the **Macro name** drop-down box.

3 Click **Run**. Cells `A1:E5` on the Excel sheet are automatically populated with the output of `mymagic`.

Microsoft Excel Add-In and Macro Packaging using the Function Wizard

The Function Wizard can automatically package a deployable Microsoft Excel add-in and macro for sharing. To package your add-in in this manner, use one of the following procedures.

1 After successfully building your component and add-in, in the Share Component area of the Function Wizard Control Panel dialog box, review the files listed in the **Files to include in packaging** field. **Add File**s or **Remove File**s to and from the package by clicking the appropriate buttons.

2 To add access to the MATLAB Runtime installer to your package, select one of the options in the MATLAB Runtime area. For information about the MATLAB Runtime and the MATLAB Runtime installer, see "Install and Configure the MATLAB Runtime".

3 When you are ready to create your package, click **Create Package**.

Microsoft Visual Basic Code Access (Optional Advanced Task)

Optionally, you may want to access the Visual Basic code or modify it, depending on your programming expertise or the availability of an Excel developer. If so, follow these steps.

From the Excel main window, open the Microsoft Visual Basic editor by doing one of the following. select **Tools > Macro > Visual Basic Editor**.

Using Office 2007 or Office 2010 or 2013

1 Click **Developer > Visual Basic**.

2 When the Visual Basic Editor opens, in the **Project - VBAProject** window, double-click to expand `VBAProject (mymagic.xls)`.

3 Expand the `Modules` folder and double-click the `Matlab Macros` module.

This opens the Visual Basic Code window with the code for this project.

Using Office 2003

1 Click **Tools > Macro > Visual Basic Editor**.

2 When the Visual Basic Editor opens, in the **Project - VBAProject** window, double-click to expand `VBAProject (mymagic.xls)`.

3 Expand the `Modules` folder and double-click the `Matlab Macros` module.

This opens the VB Code window with the code for this project.

Mapping a Macro to a GUI Button or Control (Optional)

To attach the macro to a GUI button, do the following:

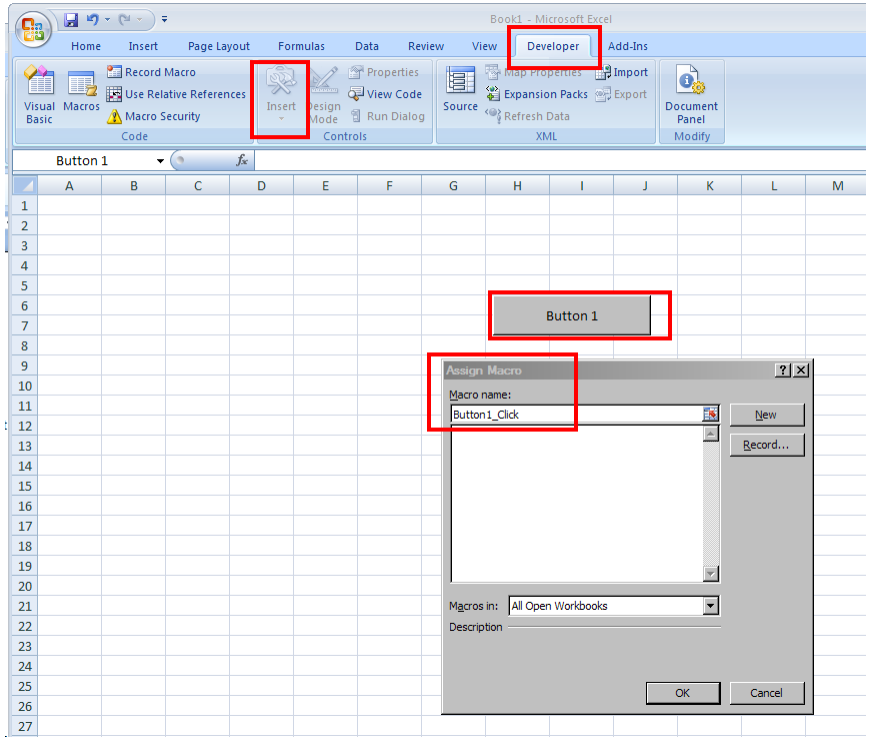
1 Click **Developer > Insert**.

2 From the **Form Controls** menu, select the **Button (Form Control)** icon.

Tip: Hover your mouse over the Form Controls menu to see the various control labels.

---

3 In the Assign Macros dialog box, select the macro you want to assign the GUI button to, and click **OK**.



Attaching a Macro to a Button

For More Information

If you want to...	See...
• Perform basic MATLAB Programmer tasks • Understand how the deployment products process your MATLAB functions • Understand how the deployment products work together • Explore guidelines about writing deployable MATLAB code	"Write Deployable MATLAB Code" on page 4-10

If you want to...	See...
See more examples about building add-ins and COM components	“Create Macros from MATLAB Functions” on page 5-5
Learn more about the MATLAB Runtime	“About the MATLAB Runtime”
Learn how to customize and integrate the COM component you built by modifying the Microsoft Visual Basic code	“Integrate Components using Visual Basic Application” on page 6-3“Build and Integrate Spectral Analysis Functions” on page 6-16

4

MATLAB Code Deployment

- "Differences Between Compiler Apps and Command Line" on page 4-2
- "How Does MATLAB Deploy Functions?" on page 4-3
- "Dependency Analysis" on page 4-4
- "MEX-Files, DLLs, or Shared Libraries" on page 4-6
- "Deployable Archive" on page 4-7
- "Write Deployable MATLAB Code" on page 4-10
- "Calling Shared Libraries in Deployed Applications" on page 4-14
- "MATLAB Data Files in Compiled Applications" on page 4-16

Differences Between Compiler Apps and Command Line

You perform the same functions using either the compiler apps or the `mcc` command-line interface. The interactive menus and dialogs used in the compiler apps build `mcc` commands that are customized to your specification. As such, your MATLAB code is processed the same way as if you were compiling it using `mcc`.

Compiler app advantages include:

- You perform related deployment tasks with a single intuitive interface.
- You maintain related information in a convenient project file.
- Your project state persists between sessions.
- You load previously stored compiler projects from a prepopulated menu.
- Package applications for distribution.

How Does MATLAB Deploy Functions?

To deploy MATLAB functions, the compiler performs these tasks:

1. Analyzes files for dependencies using a dependency analysis function. Dependencies affect deployability and originate from functions called by the file. Deployability is affected by:

   - File type — MATLAB, Java®, MEX, and so on.
   - File location — MATLAB, MATLAB toolbox, user code, and so on.

   For more information about how the compiler does dependency analysis, see "Dependency Analysis" on page 4-4.

2. Validates MEX-files. In particular, `mexFunction` entry points are verified.

   For more details about MEX-file processing, see "MEX-Files, DLLs, or Shared Libraries" on page 4-6.

3. Creates a deployable archive from the input files and their dependencies.

   For more details about deployable archives see "Deployable Archive" on page 4-7.

4. Generates target-specific wrapper code.

5. Generates target-specific binary package.

   For library targets such as C++ shared libraries, Java packages, or .NET assemblies, the compiler invokes the required third-party compiler.

Dependency Analysis

In this section...
"Function Dependency" on page 4-4
"Data File Dependency" on page 4-4

MATLAB Compiler uses a dependency analysis function to determine the list of necessary files to include in the generated package. Sometimes, this process generates a large list of files, particularly when MATLAB object classes exist in the compilation and the dependency analyzer cannot resolve overloaded methods at compile time. Dependency analysis also processes `include`/`exclude` files on each pass.

Tip: To improve compile time performance and lessen application size, prune the path with the `mcc` command's `-N` and `-p` flags. You can also specify **Files required for your application** in the compiler app.

Function Dependency

The dependency analyzer searches for executable content such as:

- MATLAB files
- P-files

  Note: If the MATLAB file corresponding to the p-file is not available, the dependency analysis will not be able to determine the p-file's dependencies.

- Java classes and `.jar` files
- `.fig` files
- MEX-files

Data File Dependency

In addition to executable content listed above, MATLAB Compiler can detect and automatically include files that your MATLAB functions access by calling any of these functions: `audioinfo`, `audioread`, `csvread`, `daqread`, `dlmread`, `fileread`, `fopen`,

`imfinfo`, `importdata`, `imread`, `load`, `matfile`, `mmfileinfo`, `open`, `readtable`, `type`, `VideoReader`, `xlsfinfo`, `xlsread`, `xmlread`, and `xslt`.

If you are using the compiler app, these data files are automatically added to the **Files required for your application to run** area of the app.

MEX-Files, DLLs, or Shared Libraries

When you compile MATLAB functions containing MEX-files, ensure that the dependency analyzer can find them. Doing so allows you to avoid many common compilation problems. In particular, note that:

- Since the dependency analyzer cannot examine MEX-files, DLLs, or shared libraries to determine their dependencies, explicitly include all executable files these files require. To do so, use either the `mcc -a` option or the **Files required for your application to run** field in the compiler app.
- If you have any doubts that the dependency analyzer can find a MATLAB function called by a MEX-file, DLL, or shared library, then manually include that function. To do so, use either the `mcc -a` option or the **Files required for your application to run** field in the compiler app.
- Not all functions are compatible with the compiler. Check the file `mccExcludedFiles.log` after your build completes. This file lists all functions called from your application that you cannot deploy.

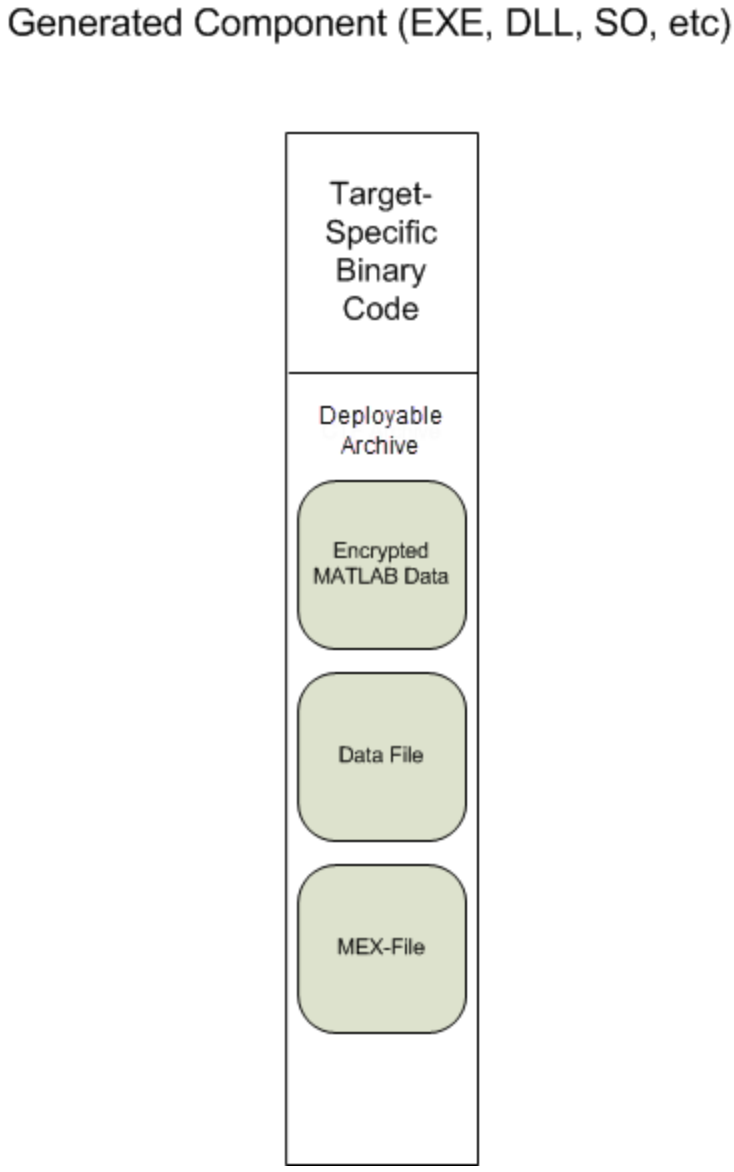
Deployable Archive

Each application or shared library you produce using the compiler has an embedded deployable archive. The archive contains all the MATLAB based content (MATLAB files, MEX-files, and so on). All MATLAB files in the deployable archive are encrypted using the Advanced Encryption Standard (AES) cryptosystem.

If you choose to extract the deployable archive as a separate file, the files remain encrypted. For more information on how to extract the deployable archive refer to the references in the following table.

Information on Deployable Archive Embedding/Extraction and Component Cache

Product	Refer to
MATLAB Compiler SDK C/C++ integration	"MATLAB Runtime Component Cache and Deployable Archive Embedding" (MATLAB Compiler SDK)
MATLAB Compiler SDK .NET integration	"MATLAB Runtime Component Cache and Deployable Archive Embedding" (MATLAB Compiler SDK)
MATLAB Compiler SDK Java integration	"Deployable Archive Embedding and Extraction" (MATLAB Compiler SDK)
MATLAB Compiler Excel integration	"MATLAB Runtime Component Cache and Deployable Archive Embedding" on page 7-11


Generated Component (EXE, DLL, SO, etc)
Target-Specific Binary Code
Deployable Archive
Encrypted MATLAB Data
Data File
MEX-File

Additional Details

Multiple deployable archives, such as those generated with COM components, .NET assemblies, or Excel add-ins, can coexist in the same user application. You cannot, however, mix and match the MATLAB files they contain. You cannot combine encrypted and compressed MATLAB files from multiple deployable archives into another deployable archive and distribute them.

All the MATLAB files from a given deployable archive associate with a unique cryptographic key. MATLAB files with different keys, placed in the same deployable archive, do not execute. If you want to generate another application with a different mix of MATLAB files, recompile these MATLAB files into a new deployable archive.

The compiler deletes the deployable archive and generated binary following a failed compilation, but only if these files did not exist before compilation initiates. Run `help mcc -K` for more information.

Caution: Release Engineers and Software Configuration Managers: Do not use build procedures or processes that strip shared libraries on deployable archives. If you do, you can possibly strip the deployable archive from the binary, resulting in run-time errors for the driver application.

Write Deployable MATLAB Code

In this section...

"Compiled Applications Do Not Process MATLAB Files at Run Time" on page 4-10
"Do Not Rely on Changing Directory or Path to Control the Execution of MATLAB Files" on page 4-11
"Use isdeployed Functions To Execute Deployment-Specific Code Paths" on page 4-11
"Gradually Refactor Applications That Depend on Noncompilable Functions" on page 4-11
"Do Not Create or Use Nonconstant Static State Variables" on page 4-12
"Get Proper Licenses for Toolbox Functionality You Want to Deploy" on page 4-13

Compiled Applications Do Not Process MATLAB Files at Run Time

The compiler secures your code against unauthorized changes. Deployable MATLAB files are suspended or frozen at the time. This does not mean that you cannot deploy a flexible application—it means that *you must design your application with flexibility in mind*. If you want the end user to be able to choose between two different methods, for example, both methods must be available in the deployable archive.

The MATLAB Runtime only works on MATLAB code that was encrypted when the deployable archive was built. Any function or process that dynamically generates new MATLAB code will not work against the MATLAB Runtime.

Some MATLAB toolboxes, such as the Neural Network Toolbox™ product, generate MATLAB code dynamically. Because the MATLAB Runtime only executes encrypted MATLAB files, and the Neural Network Toolbox generates unencrypted MATLAB files, some functions in the Neural Network Toolbox cannot be deployed.

Similarly, functions that need to examine the contents of a MATLAB function file cannot be deployed. `HELP`, for example, is dynamic and not available in deployed mode. You can use LOADLIBRARY in deployed mode if you provide it with a MATLAB function prototype.

Instead of compiling the function that generates the MATLAB code and attempting to deploy it, perform the following tasks:

1. Run the code once in MATLAB to obtain your generated function.
2. Compile the MATLAB code, including the generated function.

Tip: Another alternative to using EVAL or FEVAL is using anonymous function handles.

If you require the ability to create MATLAB code for dynamic run-time processing, your end users must have an installed copy of MATLAB.

Do Not Rely on Changing Directory or Path to Control the Execution of MATLAB Files

In general, good programming practices advise against redirecting a program search path dynamically within the code. Many developers are prone to this behavior since it mimics the actions they usually perform on the command line. However, this can lead to problems when deploying code.

For example, in a deployed application, the MATLAB and Java paths are fixed and cannot change. Therefore, any attempts to change these paths (using the `cd` command or the `addpath` command) fails

If you find you cannot avoid placing `addpath` calls in your MATLAB code, use `ismcc` and `isdeployed`. See "Use isdeployed Functions To Execute Deployment-Specific Code Paths" on page 4-11 for details.

Use isdeployed Functions To Execute Deployment-Specific Code Paths

The `isdeployed` function allows you to specify which portion of your MATLAB code is deployable, and which is not. Such specification minimizes your compilation errors and helps create more efficient, maintainable code.

For example, you find it unavoidable to use `addpath` when writing your `startup.m`. Using `ismcc` and `isdeployed`, you specify when and what is compiled and executed.

Gradually Refactor Applications That Depend on Noncompilable Functions

Over time, refactor, streamline, and modularize MATLAB code containing non-compilable or non-deployable functions that use `isdeployed`. Your eventual goal is

"graceful degradation" of non-deployable code. In other words, the code must present the end user with as few obstacles to deployment as possible until it is practically eliminated.

Partition your code into design-time and run-time code sections:

- *Design-time code* is code that is currently evolving. Almost all code goes through a phase of perpetual rewriting, debugging, and optimization. In some toolboxes, such as the Neural Network Toolbox product, the code goes through a period of self-training as it reacts to various data permutations and patterns. Such code is almost never designed to be deployed.
- *Run-time code*, on the other hand, has solidified or become stable—it is in a finished state and is ready to be deployed by the end user.

Consider creating a separate directory for code that is not meant to be deployed or for code that calls undeployable code.

Do Not Create or Use Nonconstant Static State Variables

Avoid using the following:

- Global variables in MATLAB code
- Static variables in MEX-files
- Static variables in Java code

The state of these variables is persistent and shared with everything in the process.

When deploying applications, using persistent variables can cause problems because the MATLAB Runtime process runs in a single thread. You cannot load more than one of these non-constant, static variables into the same process. In addition, these static variables do not work well in multithreaded applications.

When programming against compiled MATLAB code, you should be aware that an instance of the MATLAB Runtime is created for each instance of a new class. If the same class is instantiated again using a different variable name, it is attached to the MATLAB Runtime created by the previous instance of the same class. In short, if an assembly contains n unique classes, there will be maximum of n instances of MATLAB Runtime created, each corresponding to one or more instances of one of the classes.

If you must use static variables, bind them to instances. For example, defining instance variables in a Java class is preferable to defining the variable as `static`.

Get Proper Licenses for Toolbox Functionality You Want to Deploy

You must have a valid MathWorks® license for toolboxes you use to create deployable MATLAB code.

Calling Shared Libraries in Deployed Applications

The `loadlibrary` function in MATLAB allows you to load shared library into MATLAB.

Loading libraries using header files is not supported in compiled applications. Therefore, to create an application that uses the `loadlibrary` function with a header file, follow these steps:

1. Create a prototype MATLAB file. Suppose thatyou call `loadlibrary` with the following syntax.

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

   Run the following command in MATLAB only once to create the prototype file:

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

   This creates *`mylibrarymfile`*`.m` in the current folder. If you are on Windows, another file named `library_thunk_pcwin64.dll` is also created in the current folder.
2. Change the call to `loadlibrary` in your MATLAB to the following:

   ```
   loadlibrary(library, @mylibrarymfile)
   ```
3. Compile and deploy the application.

   - If you are integrating the library into a deployed application, specify the library's `.dll` along with `library_thunk_pcwin64.dll`, if created, using the `-a` option of `mcc` command. If you are using Application Compiler or Library Compiler apps, add the `.dll` files to the **Files required for your application to run** section of the app.
   - If you are providing the library as an external file that is not integrated with the deployed application, place the library `.dll` file in the same folder as the compiled application. If you are on Windows, you must integrate `library_thunk_pcwin64.dll` into your compiled application.

     The benefit of this approach is that you can replace the library with an updated version without recompiling the deployed application. Replacing the library with a different version works only if the function signatures of the function in the library are not altered. This is because *`mylibrarymfile`*`.m` and `library_thunk_pcwin64.dll` are tied to the function signatures of the functions in the library.

Note: You cannot use `loadlibrary` inside MATLAB to load a shared library built with MATLAB. For more information on `loadlibrary`, see "Limitations to Shared Library Support" (MATLAB).

Note: Operating systems have a `loadlibrary` function, which loads specified Windows operating system module into the address space of the calling process.

See Also

`loadlibrary`

Related Examples

- "Call Functions in Shared Libraries" (MATLAB)

MATLAB Data Files in Compiled Applications

In this section...

"Explicitly Including MATLAB Data files Using the %#function Pragma" on page 4-16

"Load and Save Functions" on page 4-16

Explicitly Including MATLAB Data files Using the %#function Pragma

The compiler excludes MATLAB data files (MAT-files) from dependency analysis by default. See "Dependency Analysis" on page 4-4.

If you want the compiler to explicitly inspect data within a MAT file, you need to specify the `%#function` pragma when writing your MATLAB code.

For example, if you are creating a solution with Neural Network Toolbox, you need to use the `%#function` pragma within your code to include a dependency on the `gmdistribution` class, for instance.

Load and Save Functions

If your deployed application uses MATLAB data files (MAT-files), it is helpful to code `LOAD` and `SAVE` functions to manipulate the data and store it for later processing.

- Use `isdeployed` to determine if your code is running in or out of the MATLAB workspace.
- Specify the data file by either using `WHICH` (to locate its full path name) define it relative to the location of `ctfroot`.
- All MAT-files are unchanged after `mcc` runs. These files are not encrypted when written to the deployable archive.

For more information about deployable archives, see "Deployable Archive" on page 4-7.

See the `ctfroot` reference page for more information about `ctfroot`.

Use the following example as a template for manipulating your MATLAB data inside, and outside, of MATLAB.

Using Load/Save Functions to Process MATLAB Data for Deployed Applications

The following example specifies three MATLAB data files:

- `user_data.mat`
- `userdata\extra_data.mat`
- `..\externdata\extern_data.mat`

1. Navigate to *`matlab_root`*`\extern\examples\compiler\Data_Handling`.
2. Compile `ex_loadsave.m` with the following `mcc` command:

```
mcc -mv ex_loadsave.m -a 'user_data.mat' -a
      '.\userdata\extra_data.mat' -a
      '..\externdata\extern_data.mat'
```

ex_loadsave.m

```
function ex_loadsave
% This example shows how to work with the
% "load/save" functions on data files in
% deployed mode. There are three source data files
% in this example.
%    user_data.mat
%    userdata\extra_data.mat
%    ..\externdata\extern_data.mat
%
% Compile this example with the mcc command:
%     mcc -m ex_loadsave.m -a 'user_data.mat' -a
%     '.\userdata\extra_data.mat'
%         -a '..\externdata\extern_data.mat'
% All the folders under the current main MATLAB file directory will
%    be included as
% relative path to ctfroot; All other folders will have the
%    folder
% structure included in the deployable archive file from root of the
%     disk drive.
%
% If a data file is outside of the main MATLAB file path,
%     the absolute path will be
% included in deployable archive and extracted under ctfroot. For example:
%   Data file
%     "c:\$matlabroot\examples\externdata\extern_data.mat"
%     will be added into deployable archive and extracted to
%  "$ctfroot\$matlabroot\examples\externdata\extern_data.mat".
%
% All mat/data files are unchanged after mcc runs. There is
% no excryption on these user included data files. They are
% included in the deployable archive.
%
% The target data file is:
%   .\output\saved_data.mat
%   When writing the file to local disk, do not save any files
%    under ctfroot since it may be refreshed and deleted
%   when the application isnext started.
```

```
%==== load data file ============================
if isdeployed
    % In deployed mode, all file under CTFRoot in the path are loaded
    % by full path name or relative to $ctfroot.
    % LOADFILENAME1=which(fullfile(ctfroot,mfilename,'user_data.mat'));
    % LOADFILENAME2=which(fullfile(ctfroot,'userdata','extra_data.mat'));
    LOADFILENAME1=which(fullfile('user_data.mat'));
    LOADFILENAME2=which(fullfile('extra_data.mat'));
    % For external data file, full path will be added into deployable archive;
    % you don't need specify the full path to find the file.
    LOADFILENAME3=which(fullfile('extern_data.mat'));
else
    %running the code in MATLAB
    LOADFILENAME1=fullfile(matlabroot,'extern','examples','compiler',
                                    'Data_Handling','user_data.mat');
    LOADFILENAME2=fullfile(matlabroot,'extern','examples','compiler',
                             'Data_Handling','userdata','extra_data.mat');
    LOADFILENAME3=fullfile(matlabroot,'extern','examples','compiler',
                                     'externdata','extern_data.mat');
end

% Load the data file from current working directory
disp(['Load A from : ',LOADFILENAME1]);
load(LOADFILENAME1,'data1');
disp('A= ');
disp(data1);

% Load the data file from sub directory
disp(['Load B from : ',LOADFILENAME2]);
load(LOADFILENAME2,'data2');
disp('B= ');
disp(data2);

% Load extern data outside of current working directory
disp(['Load extern data from : ',LOADFILENAME3]);
load(LOADFILENAME3);
disp('ext_data= ');
disp(ext_data);

%==== multiple the data matrix by 2 ==============
result = data1*data2;
disp('A * B = ');
disp(result);

%==== save  the new data to a new file ===========
SAVEPATH=strcat(pwd,filesep,'output');
if ( ~isdir(SAVEPATH))
    mkdir(SAVEPATH);
end
SAVEFILENAME=strcat(SAVEPATH,filesep,'saved_data.mat');
disp(['Save the A * B result to : ',SAVEFILENAME]);
save(SAVEFILENAME, 'result');
```

5

Microsoft Excel Add-In Creation, Function Execution, and Deployment

- "Supported Compilation Targets" on page 5-2
- "The Library Compiler and the Command Line Interface" on page 5-4
- "Create Macros from MATLAB Functions" on page 5-5
- "Execute Add-In and Graphical Function" on page 5-11

Supported Compilation Targets

In this section...
"Microsoft Excel Add-In" on page 5-2
"What Are Excel Add-In Components and When Should You Create Them?" on page 5-2
"MATLAB Compiler Limitations" on page 5-3

Microsoft Excel Add-In

Using Excel add-in and the Deployment Tool (`deploytool` or `mcc`), you create deployable add-ins and Excel functions from MATLAB code that runs in Microsoft Excel applications. The Deployment Tool and `mcc` support the following function outputs:

- No outputs
- Figure (graphical) output
- Scalar output

Using the MATLAB Compiler Function Wizard, you create Excel macros that can be deployed as add-ins or workbooks.

MATLAB Compiler supports multidimensional matrix output(s).

Migration Considerations for 32-bit and 64-bit Microsoft Excel

Add-ins created with MATLAB Compiler are compatible with both 32–bit and 64–bit versions of Microsoft Excel. MATLAB Compiler itself is in 64–bit only.

What Are Excel Add-In Components and When Should You Create Them?

MATLAB Compiler generates two primary artifacts from your MATLAB code, using the Deployment Tool: a Microsoft Excel add-in and a COM component.

Existing MATLAB functions can be integrated into new or existing spreadsheet solutions, as add-ins, with the Function Wizard on page 3-2. You can also use the Function Wizard to create and test add-ins on page 3-22 for new MATLAB functions.

COM components created with either the Deployment Tool or the Function Wizard (`.bas` files) can be integrated into existing Microsoft Visual Basic applications.

MATLAB Compiler Components are ideal solutions for deploying MATLAB code to users of Microsoft Excel and large-scale enterprise financial applications written in Microsoft Visual Basic.

MATLAB Compiler Limitations

MATLAB objects are not supported as inputs or outputs for compiled or deployed functions with MATLAB Compiler for Excel add-ins.

The Library Compiler and the Command Line Interface

In this section...
“Using the Library Compiler” on page 5-4 “Using the mcc Command Line Interface” on page 5-4

Using the Library Compiler

For a complete example of how to use the Library Compiler app, see “Package Excel Add-In with Library Compiler App” on page 1-9. For information about how the graphical interface differs from the command line interface, read “Differences Between Compiler Apps and Command Line” on page 4-2 in “Write Deployable MATLAB Code” on page 4-10.

Using the mcc Command Line Interface

As an alternative to using the Library Compiler, you can use the command line to create your deployable executable, using the `mcc` command.

Create Macros from MATLAB Functions

In this section...
“Create Add-Ins and Macros with Single and Multiple Outputs” on page 5-5
“Work with Variable-Length Inputs and Outputs” on page 5-5

Create Add-Ins and Macros with Single and Multiple Outputs

The basic workflow for Microsoft Excel add-in and macro creation can be found in “Package Excel Add-In with Library Compiler App” on page 1-9 and “Integrate an Add-In and COM Component with Microsoft Excel” on page 1-13.

Work with Variable-Length Inputs and Outputs

This example shows you how to work with, and create macros from, functions having variable-length inputs and outputs

Overview

`myplot` takes a single integer input and plots a line from 1 to that number.

`mysum` takes an input of `varargin` of type `integer`, adds all the numbers, and returns the result.

`myprimes` takes a single integer input `n` and returns all the prime numbers less than or equal to `n`.

The Microsoft Excel file, `xlmulti.xls`, demonstrates these functions in several ways.

Where Is the Example Code?

See “Example File Copying” on page 3-24 for information about accessing the example code from within the product.

Create the Project

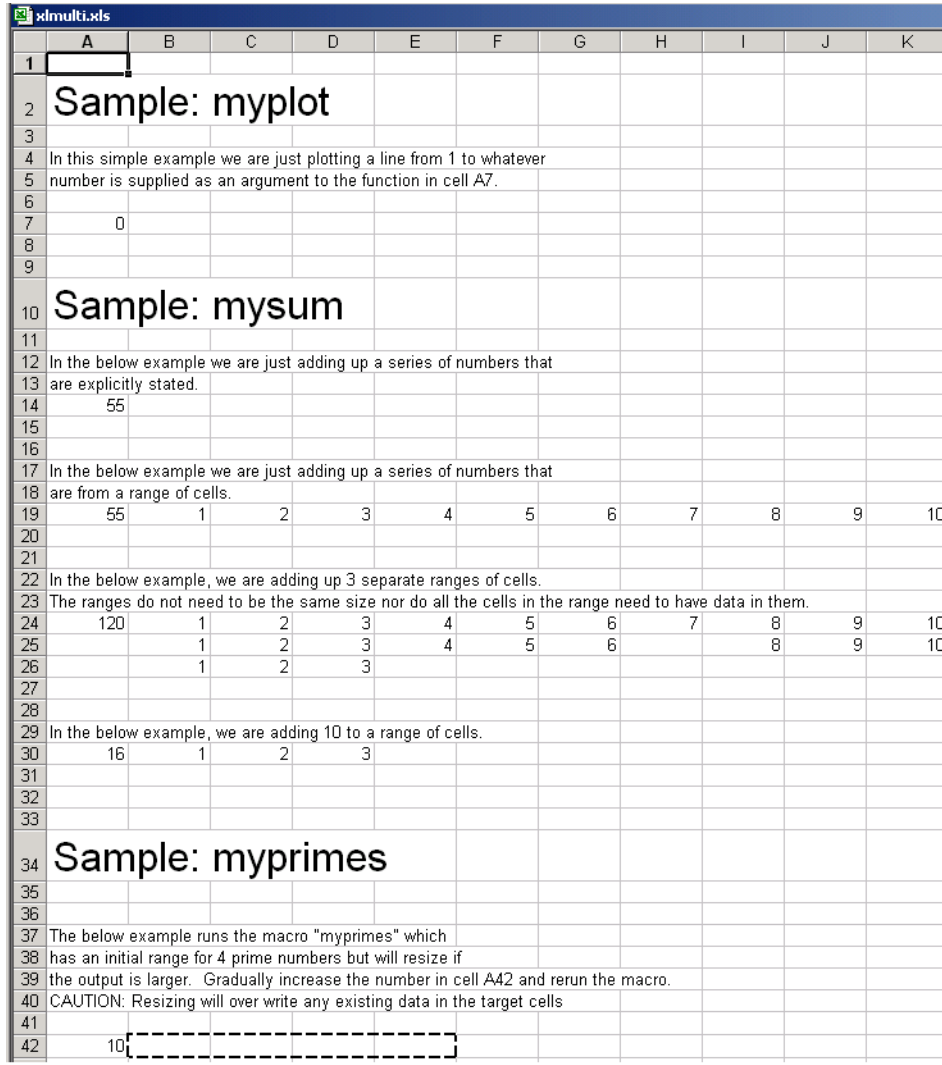
Use the following information as you work through this example using the instructions in “Package Excel Add-In with Library Compiler App” on page 1-9:

Project Name	`xlmulti`
Class Name	`xlmulticlass`
File to compile (in the `xlmulti` folder of `myfiles\work`)	myplot.m myprimes.m mysum.m

Add COM Function to Microsoft Excel Add-In

1. Start Microsoft Excel on your system.
2. Open the file `myfiles\work\xlmulti\xlmulti.xls`.

   The example appears as shown:



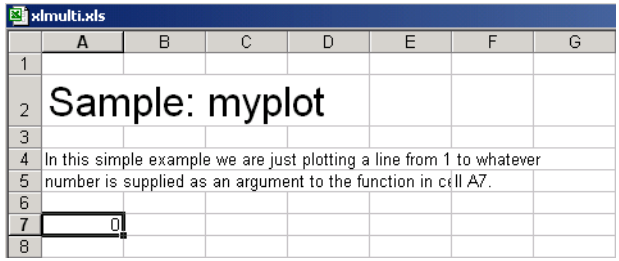
xlmulti.xls

	A	B	C	D	E	F	G	H	I	J	K
1											
2	Sample: myplot										
3											
4	In this simple example we are just plotting a line from 1 to whatever										
5	number is supplied as an argument to the function in cell A7.										
6											
7	0										
8											
9											
10	Sample: mysum										
11											
12	In the below example we are just adding up a series of numbers that										
13	are explicitly stated.										
14	55										
15											
16											
17	In the below example we are just adding up a series of numbers that										
18	are from a range of cells.										
19	55	1	2	3	4	5	6	7	8	9	10
20											
21											
22	In the below example, we are adding up 3 separate ranges of cells.										
23	The ranges do not need to be the same size nor do all the cells in the range need to have data in them.										
24	120	1	2	3	4	5	6	7	8	9	10
25		1	2	3	4	5	6		8	9	10
26		1	2	3							
27											
28											
29	In the below example, we are adding 10 to a range of cells.										
30	16	1	2	3							
31											
32											
33											
34	Sample: myprimes										
35											
36											
37	The below example runs the macro "myprimes" which										
38	has an initial range for 4 prime numbers but will resize if										
39	the output is larger. Gradually increase the number in cell A42 and rerun the macro.										
40	CAUTION: Resizing will over write any existing data in the target cells										
41											
42	10										

Note If an Excel prompt says that this file contains macros, click **Enable Macros** to run this example. See the Appendix B appendix in this User's Guide for details on enabling macros.

Call myplot

This illustration calls the function `myplot` with a value of 4. To execute the function, make A7 (`=myplot(4)`) the active cell. Press **F2** and then **Enter**.



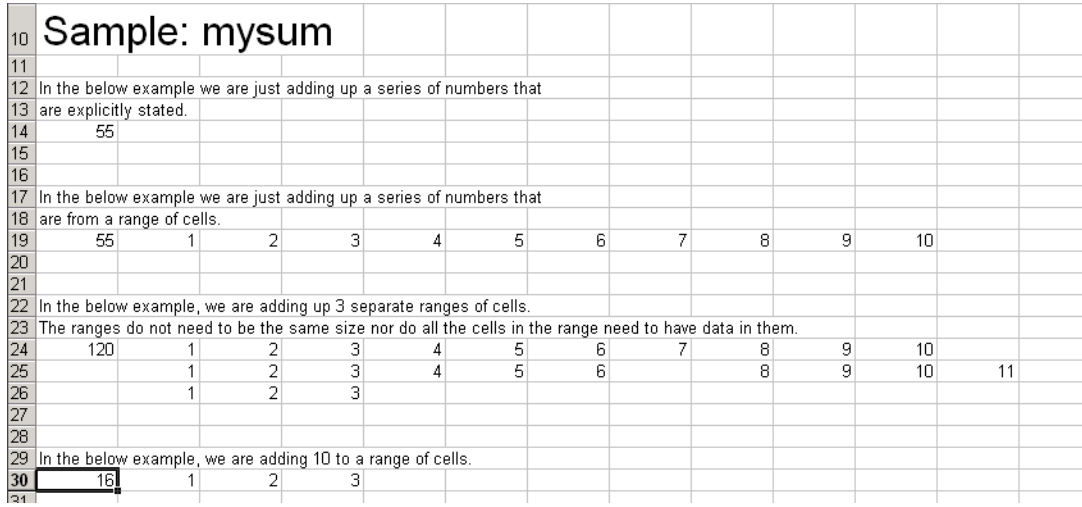
This procedure plots a line from 1 through 4 in a MATLAB Figure window. This graphic can be manipulated similarly to the way one would manipulate a figure in MATLAB. Some functionality, such as the ability to change line style or color, is not available.

The calling cell contains 0 because the function does not return a value.

Call mysum Four Different Ways

This illustration calls the function `mysum` in four different ways:

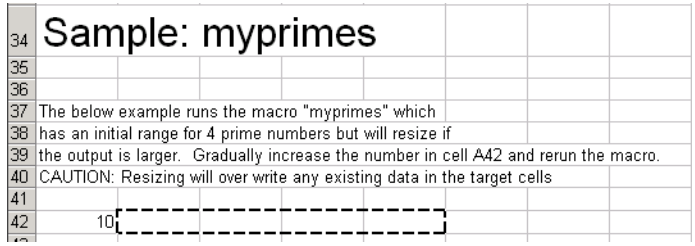
- The first (cell A14) takes the values 1 through 10, adds them, and returns the result of 55 (`=mysum(1,2,3,4,5,6,7,8,9,10)`).
- The second (cell A19) takes a range object that is a range of cells with the values 1 through 10, adds them, and returns the result of 55 (`=mysum(B19:K19)`).
- The third (cell A24) takes several range objects, adds them, and returns the result of 120 (`=mysum(B24:K24,B25:L25,B26:D26)`). This illustration demonstrates that the ranges do not need to be the same size and that all the cells do not need a value.
- The fourth (cell A30) takes a combination of a range object and explicitly stated values, adds them, and returns the result of 16 (`=mysum(10,B30:D30)`).



This illustration runs when the Excel file is opened. To reactivate the illustration, activate the appropriate cell. Then press **F2** followed by **Enter**.

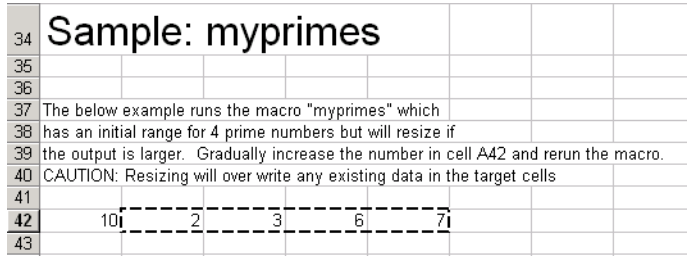
myprimes Macro

In this illustration, the macro `myprimes` calls the function myprimes.m with an initial value of 10 in cell A42. The function returns all the prime numbers less than 10 to cells B42 through E42.

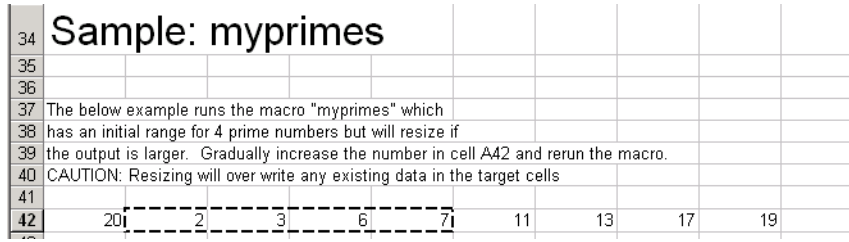


To execute the macro, from the main Excel window (not the Visual Basic Editor), open the Macro dialog box, by pressing the **Alt** and **F8** keys simultaneously, or by selecting **Tools** > **Macro** > **Macros**.

Select `myprimes` from the list and click **Run**.



This function automatically resizes if the returned output is larger than the output range specified. Change the value in cell A42 to a number larger than 10. Then rerun the macro. The output returns all prime numbers less than the number you entered in cell A42.



Inspect the Microsoft Visual Basic Code (Optional)

1. On the Microsoft Excel main window, select **Tools > Macro > Visual Basic Editor**.
2. On the Microsoft Visual Basic, in the Project - VBAProject window, double-click to expand `VBAProject (xlmulti.xls)`
3. Expand the `Modules` folder and double-click the `Module1` module. This opens the VB Code window with the code for this project.

For More Information

For more information about working with variable-length arguments, see “Program with Variable Arguments” on page 6-8.

Execute Add-In and Graphical Function

In this section...
“Execute an Add-In to Validate Nongraphical Function Output” on page 5-11
“Execute a Graphical Function” on page 5-11
“Create Dialog Box and Error Message Macros” on page 5-14

Execute an Add-In to Validate Nongraphical Function Output

If you have built your add-in and COM component using `deploytool` or `mcc` and are ready to begin validating your non-graphical function's output, see “Execute Functions and Create Macros” on page 3-2.

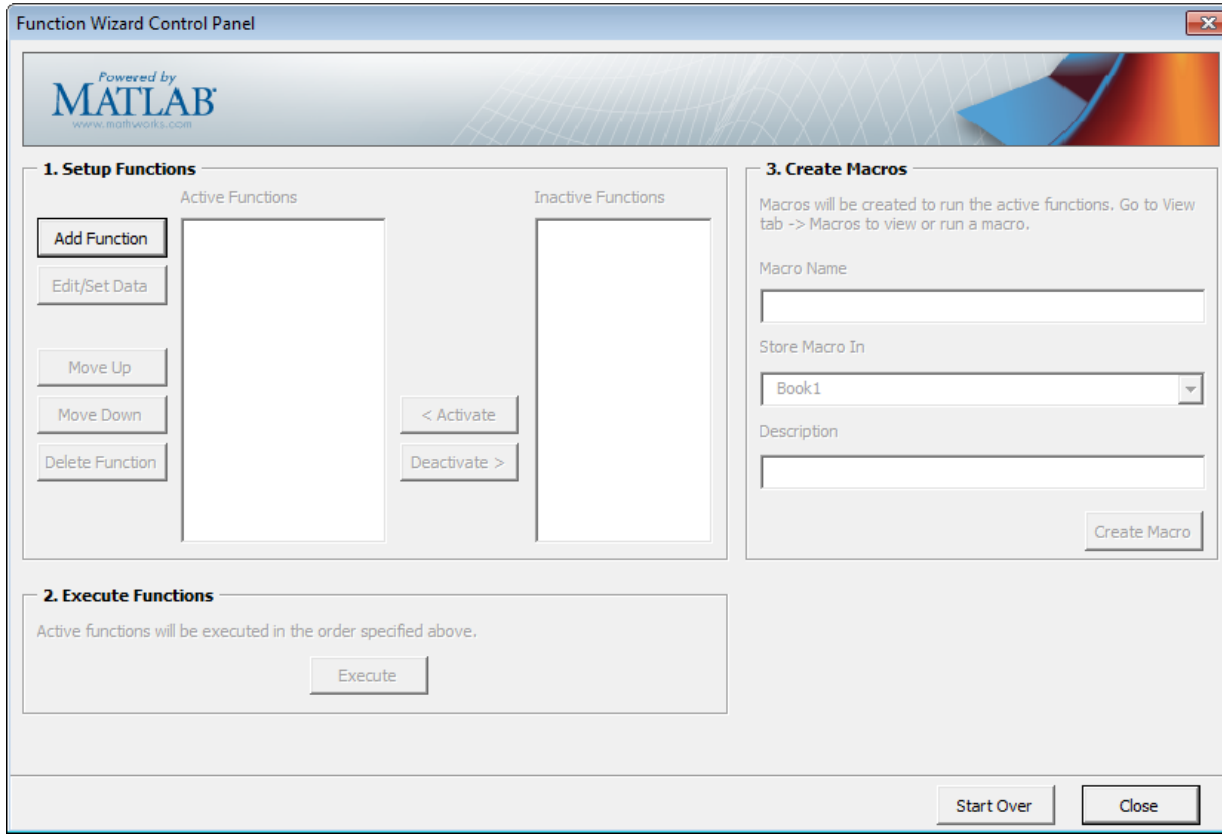
Functions Having Multiple Outputs

When working with functions having multiple outputs, simply define each specific output range with the Argument Properties For *y* dialog box. See the Argument Properties For *y* step in “Function Execution” on page 3-17 for details.

Execute a Graphical Function

Execute a graphical function on a Microsoft Excel spreadsheet by doing the following.

1. Install and start the Function Wizard using the procedures detailed in “Installation of the Function Wizard” on page 3-4 and “Function Wizard Start-Up” on page 3-5. Successfully completing each of these procedures causes the Function Wizard Control Panel to display.



2 Click **Add**.

3 Select a function with a graphical output, such as **mysurf** for example, from the **Functions for Class *`class_name`*** box.

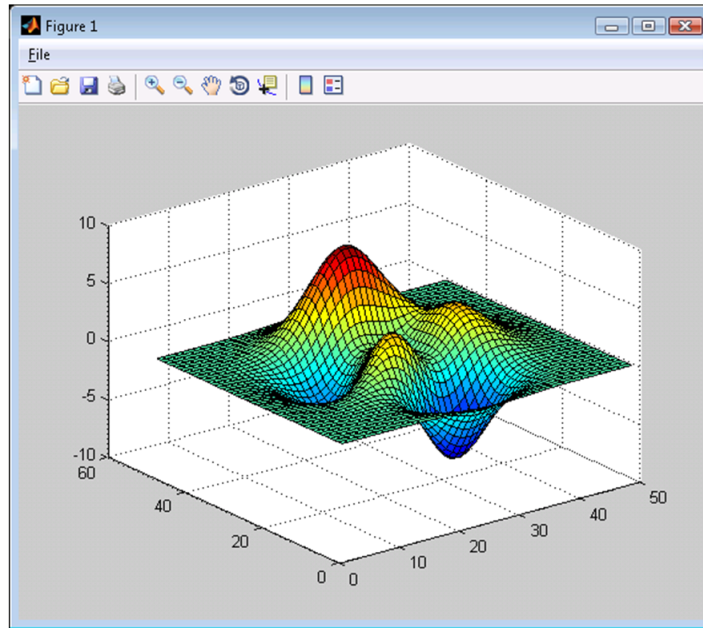
4 Click **Add**. The Function Properties dialog box appears.

5 Click **Done**. The Function Wizard Control Panel appears with `mysurf` selected in the list of **Active Functions**.

Note: Since `mysurf.m` does not have any inputs or outputs, there is no need to specify **Properties**.

---

6 In the Execute Functions area of the Function Wizard Control Panel, click **Execute**. The graphical output for `mysurf` appears in a separate window.



7 Test to ensure you can interact with the figure and that it is usable.

For example, try dragging the figure window, inserting color bars and legends in the toolbar, and so on.

If you encounter problems working with the figure, consult the person who created it.

Create a Macro Using a Graphical Function

Once you are satisfied your graphical figure is usable, do the following to create a macro to execute it at your convenience.

Caution: To create a macro, you must have already built your COM component and add-in with MATLAB Compiler.

For complete Function Wizard workflows, see “Execute Functions and Create Macros” on page 3-2 and “End-to-End Deployment of MATLAB Function” on page 3-22.

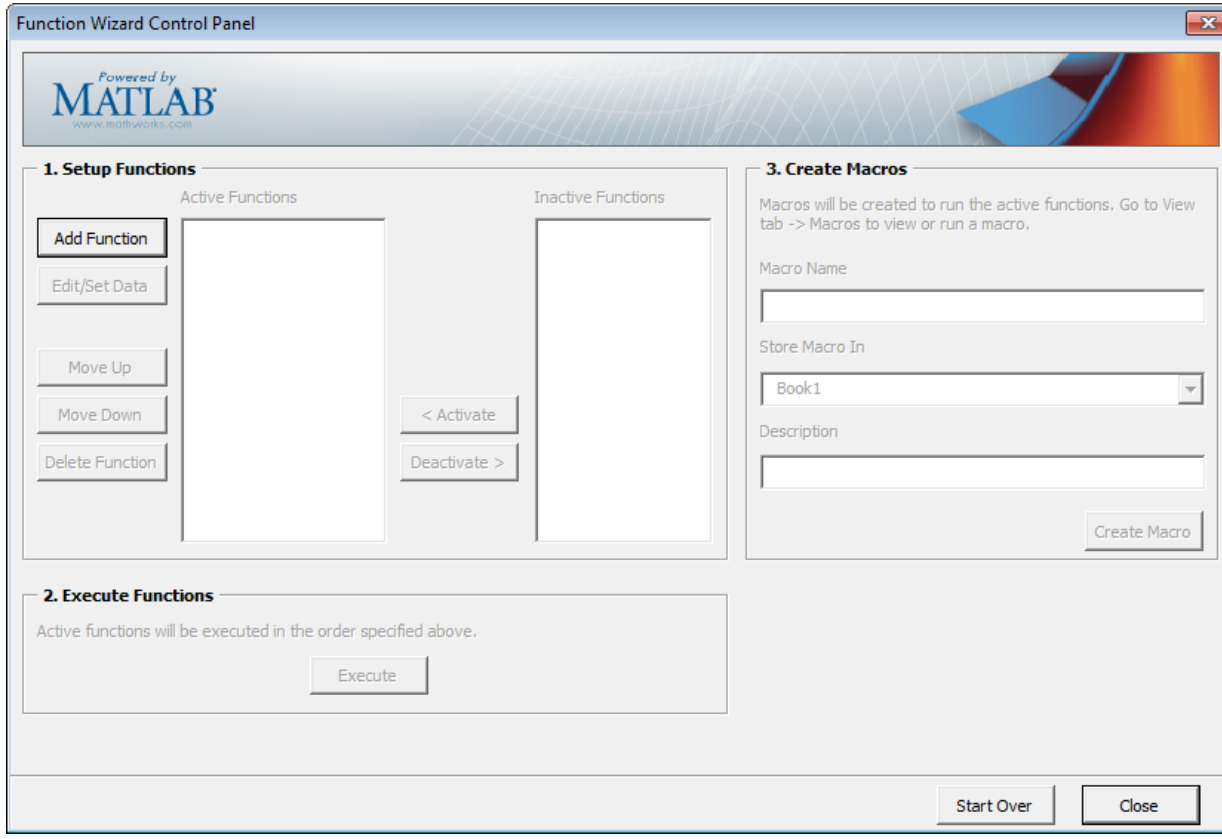
---

1. In the Function Wizard Control Panel, label the macro by entering `mysurf` in the **Macro Name** field of the Create Macros area.
2. If desired, change the default value **Book1** (for the default Excel sheet name) in the **Store Macro In** field.
3. Click **Create Macro**.
4. See "Macro Execution" on page 3-18 for details on executing macros with different versions of Microsoft Office. When the macro is **Run**, you should see output similar to the Surf Peaks image in "Execute a Graphical Function" on page 5-11 in this chapter.

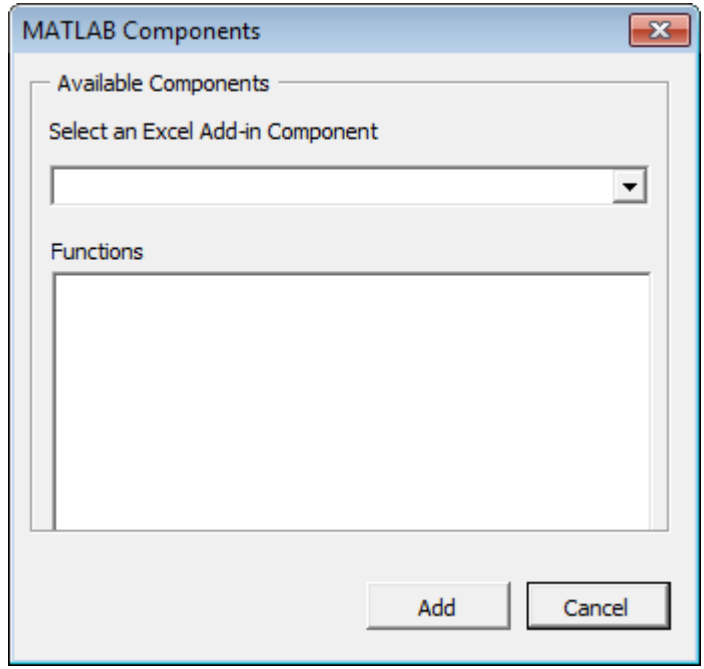
Create Dialog Box and Error Message Macros

Create a macro that displays a dialog box using this workflow, which is useful for error message presentation.

1. Install and start the Function Wizard using the procedures detailed in "Installation of the Function Wizard" on page 3-4 and "Function Wizard Start-Up" on page 3-5. Successfully completing each of these procedures causes the Function Wizard Control Panel to display.



2 Click **Add**. The MATLAB Components dialog box appears.



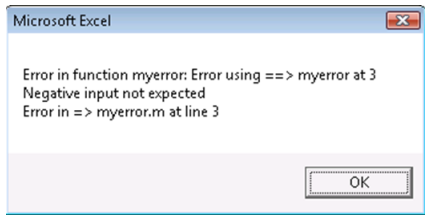
3. Select a function that displays a graphical error message, such as **myerror** for example, from the **Functions for Class *`class_name`*** box.
4. Click **Add**. The Function Properties dialog box appears.
5. Associate an input value of -1 with `myerror`.
   a. On the **Inputs** tab, click **Properties**. The Argument Properties for in dialog box appears.
   b. Select **Value** and enter `-1`.
   c. Click **Done**.
6. Define the output of `myerror`—any Excel spreadsheet cell, in this case.
   a. On the **Outputs** tab, click **Properties**. The Argument Properties For *`x`* dialog box appears, where *`x`* is the name of the output variable you are defining properties of.
   b. Select **Range** and enter and spreadsheet cell value, `=C13`, for example.

c Click **Done**. The Function Wizard Control Panel appears with `myerror` selected in the list of **Active Functions**.

Tip: If you have functions besides `myerror` listed in the **Active Functions** list that you don't want to execute when you test `myerror`, deactivate these functions by selecting them and clicking **Deactivate**.

---

7 Click **Execute**. The following will display.



Create a Macro That Displays an Error Message or Dialog Box

Create a macro to display your error message on demand.

1 In the Function Wizard Control Panel, label the macro by entering `myerror` in the **Macro Name** field of the Create Macros area.

2 If desired, change the default value **Book1** (for the default Excel sheet name) in the **Store Macro In** field.

3 Click **Create Macro**.

4 See “Macro Execution” on page 3-18 for details on executing macros with different versions of Microsoft Office.

6

Microsoft Excel Add-In Integration

- "Overview of the Integration Process " on page 6-2
- "Integrate Components using Visual Basic Application" on page 6-3
- "Build and Integrate Spectral Analysis Functions" on page 6-16
- "For More Information" on page 6-30

Overview of the Integration Process

Each MATLAB Compiler component is built as a COM object that you can access from Microsoft Excel through Microsoft Visual Basic for Applications (VBA). This topic provides general information on how to integrate the MATLAB Compiler components into Excel using VBA programming environment.

It assumes you have the skill set of a Microsoft Excel and have a working knowledge of VBA.

This section is not intended to teach you to program in Visual Basic. Refer to the VBA documentation provided with Excel for general programming information.

For a comprehensive example of building and integrating a COM component using Visual Basic programming, see “Build and Integrate Spectral Analysis Functions” on page 6-16.

Integrate Components using Visual Basic Application

In this section...

"When to Use a Formula Function or a Subroutine" on page 6-3
"Initialize MATLAB Compiler Libraries with Microsoft Excel" on page 6-3
"Create an Instance of a Class" on page 6-4
"Call the Methods of a Class Instance" on page 6-7
"Program with Variable Arguments" on page 6-8
"Modify Flags" on page 6-10
"Handle Errors During a Method Call" on page 6-15

When to Use a Formula Function or a Subroutine

VBA provides two basic procedure types: functions and subroutines.

You access a VBA function directly from a cell in a worksheet as a formula function. Use function procedures when the original MATLAB function takes one or more inputs and returns zero outputs.

You access a subroutine as a general macro. Use a subroutine procedure when the original MATLAB function returns an array of values or multiple outputs because you need to map these outputs into multiple cells/ranges in the worksheet.

When you create a component, MATLAB Compiler produces a VBA module (`.bas` file). This file contains simple call wrappers, each implemented as a function procedure for each method of the class.

Initialize MATLAB Compiler Libraries with Microsoft Excel

Before you use any MATLAB Compiler component, initialize the supporting libraries with the current instance of Microsoft Excel. Do this once for an Excel session that uses the MATLAB Compiler components.

To do this initialization, call the utility library function `MWInitApplication`, which is a member of the `MWUtil` class. This class is part of the `MWComUtil` library. See "Class MWUtil" on page 9-3 .

One way to add this initialization code into a VBA module is to provide a subroutine that does the initialization once, and simply exits for all subsequent calls. The following Microsoft Visual Basic code sample initializes the libraries with the current instance of Excel. A global variable of type `Object` named `MCLUtil` holds an instance of the `MWUtil` class, and another global variable of type `Boolean` named `bModuleInitialized` stores the status of the initialization process. The private subroutine `InitModule()` creates an instance of the `MWComUtil` class and calls the `MWInitApplication` method with an argument of `Application`. Once this function succeeds, all subsequent calls exit without reinitializing.

```
Dim MCLUtil As Object
Dim bModuleInitialized As Boolean

Private Sub InitModule()
   If Not bModuleInitialized Then
      On Error GoTo Handle_Error
      If MCLUtil Is Nothing Then
         Set MCLUtil = CreateObject("MWComUtil.MWUtil")
      End If
      Call MCLUtil.MWInitApplication(Application)
      bModuleInitialized = True
      Exit Sub
Handle_Error:
      bModuleInitialized = False
   End If
End Sub
```

This code is similar to the default initialization code generated in the VBA module created when the component is built. Each function that uses MATLAB Compiler components can include a call to `InitModule` at the beginning to ensure that the initialization always gets performed as needed.

Create an Instance of a Class

- "Overview" on page 6-5
- "CreateObject Function" on page 6-5
- "New Operator" on page 6-5
- "How the MATLAB Runtime Is Shared Among Classes" on page 6-6

Overview

Before calling a class method (compiled MATLAB function), you must create an instance of the class that contains the method. VBA provides two techniques for doing this:

- `CreateObject` function
- `New` operator

CreateObject Function

This method uses the Microsoft Visual Basic application programming interface (API) `CreateObject` function to create an instance of the class. Microsoft refers to calling CreateObject as *late binding* and using `new` as *early binding*.

To use this method, declare a variable of type `Object` using `Dim` to hold a reference to the class instance and call `CreateObject` using the class programmatic identifier (`ProgID`) as an argument, as shown in the next example:

```
Function foo(x1 As Variant, x2 As Variant) As Variant
       Dim aClass As Object

       On Error Goto Handle_Error
       Set aClass = CreateObject("mycomponent.myclass.1_0")
       ' (call some methods on aClass)
       Exit Function
Handle_Error:
   foo = Err.Description
End Function
```

New Operator

This method uses the Visual Basic `New` operator on a variable explicitly dimensioned as the class to be created. Before using this method, you must reference the type library containing the class in the current VBA project. Do this by selecting the **Tools** menu from the Visual Basic Editor, and then selecting **References** to display the **Available References** list. From this list, select the necessary type library.

The following example illustrates using the `New` operator to create a class instance. It assumes that you have selected **mycomponent 1.0 Type Library** from the **Available References** list before calling this function.

```
Function foo(x1 As Variant, x2 As Variant) As Variant
   Dim aClass As mycomponent.myclass
```

```
   On Error Goto Handle_Error
   Set aClass = New mycomponent.myclass
   ' (call some methods on aClass)
   Exit Function
Handle_Error:
   foo = Err.Description
End Function
```

In this example, the class instance can be dimensioned as simply `myclass`. The full declaration in the form `<component-name>.<class-name>` guards against name collisions that can occur if other libraries in the current project contain types named `myclass`.

Using both `CreateObject` and `New` produce a dimensioned class instance. The first method does not require a reference to the type library in the VBA project; the second results in faster code execution. The second method has the added advantage of enabling the **Auto-List-Members** and **Auto-Quick-Info** capabilities of the Microsoft Visual Basic editor to work with your classes. The default function wrappers created with each built component all use the first method for object creation.

In the previous two examples, the class instance used to make the method call was a local variable of the procedure. This creates and destroys a new class instance for each call. An alternative approach is to declare one single module-scoped class instance that is reused by all function calls, as in the initialization code of the previous example.

The following example illustrates this technique with the second method:

```
Dim aClass As mycomponent.myclass

Function foo(x1 As Variant, x2 As Variant) As Variant
   On Error Goto Handle_Error
   If aClass Is Nothing Then
      Set aClass = New mycomponent.myclass
   End If
   ' (call some methods on aClass)
   Exit Function
Handle_Error:
   foo = Err.Description
End Function
```

How the MATLAB Runtime Is Shared Among Classes

MATLAB Compiler creates a single MATLAB Runtime when the first Microsoft COM class is instantiated in an application. This MATLAB Runtime is reused and shared

among all subsequent class instances within the component, resulting in more efficient memory usage and eliminating the MATLAB Runtime startup cost in each subsequent class instantiation.

All class instances share a single MATLAB workspace and share global variables in the MATLAB files used to build the component. This makes properties of a COM class behave as static properties instead of instance-wise properties.

Call the Methods of a Class Instance

After you have created a class instance, you can call the class methods to access the compiled MATLAB functions. MATLAB Compiler applies a standard mapping from the original MATLAB function syntax to the method's argument list. See “Reference Utility Classes” on page 9-2 for a detailed description of the mapping from MATLAB functions to COM class method calls.

When a method has output arguments, the first argument is always `nargout`, which is of type `Long`. This input parameter passes the normal MATLAB `nargout` parameter to the compiled function and specifies how many outputs are requested. Methods that do not have output arguments do not pass a `nargout` argument. Following `nargout` are the output parameters listed in the same order as they appear on the left side of the original MATLAB function. Next come the input parameters listed in the same order as they appear on the right side of the original MATLAB function. All input and output arguments are typed as `Variant`, the default Visual Basic data type.

The `Variant` type can hold any of the basic VBA types, arrays of any type, and object references. See “Data Conversion Rules ” on page A-2 for a detailed description of how to convert `Variant` types of any basic type to and from MATLAB data types. In general, you can supply any Visual Basic type as an argument to a class method, with the exception of Visual Basic `UDT`s. You can also pass Microsoft Excel `Range` objects directly as input and output arguments.

When you pass a simple `Variant` type as an output parameter, the called method allocates the received data and frees the original contents of the `Variant`. In this case it is sufficient to dimension each output argument as a single `Variant`. When an object type (like an Excel `Range`) is passed as an output parameter, the object reference is passed in both directions, and the object's `Value` property receives the data.

The following examples illustrate the process of passing input and output parameters from VBA to the MATLAB Compiler component class methods.

The first example is a formula function that takes two inputs and returns one output. This function dispatches the call to a class method that corresponds to a MATLAB function of the form `function y = foo(x1,x2)`.

```
Function foo(x1 As Variant, x2 As Variant) As Variant
   Dim aClass As Object
   Dim y As Variant

   On Error Goto Handle_Error
   Set aClass = New mycomponent.myclass
   aClass = CreateObject("mycomponent.myclass.1_0")
   Call aClass.foo(1,y,x1,x2)
   foo = y
   Exit Function
Handle_Error:
   foo = Err.Description
End Function
```

The second example rewrites the same function as a subroutine and uses Excel ranges for input and output.

```
Sub foo(Rout As Range, Rin1 As Range, Rin2 As Range)
   Dim aClass As Object

   On Error Goto Handle_Error
   aClass = CreateObject("mycomponent.myclass.1_0")
   Call aClass.foo(1,Rout,Rin1,Rin2)
   Exit Sub
Handle_Error:
   MsgBox(Err.Description)
End Sub
```

Program with Variable Arguments

Process varargin and varargout Arguments

When `varargin` and/or `varargout` are present in the MATLAB function that you are using for the Excel component, these parameters are added to the argument list of the class method as the last input/output parameters in the list. You can pass multiple arguments as a `varargin` array by creating a `Variant` array, assigning each element of the array to the respective input argument.

The following example creates a `varargin` array to call a method resulting from a MATLAB function of the form `y = foo(varargin)`:

```
Function foo(x1 As Variant, x2 As Variant, x3 As Variant, _
             x4 As Variant, x5 As Variant) As Variant
   Dim aClass As Object
   Dim v As Variant
   Dim y As Variant
   Dim MCLUtil As Object

   On Error GoTo Handle_Error
   set aClass = CreateObject("mycomponent.myclass.1_0")
   Set MCLUtil = CreateObject("MWComUtil.MWUtil")
   Call MCLUtil.MWPack(v, x1, x2, x3, x4, x5)
   Call aClass.foo(1, y, v)
   foo = y
   Exit Function
Handle_Error:
   foo = Err.Description
End Function
```

The `MWUtil` class included in the `MWComUtil` utility library provides the `MWPack` helper function to create `varargin` parameters. See "Class MWUtil" on page 9-3 for more details.

The next example processes a `varargout` parameter into three separate Excel `Range`s. This function uses the `MWUnpack` function in the utility library. The MATLAB function used is `varargout = foo(x1,x2)`.

```
Sub foo(Rout1 As Range, Rout2 As Range, Rout3 As Range, _
        Rin1 As Range, Rin2 As Range)
   Dim aClass As Object
   Dim aUtil As Object
   Dim v As Variant

   On Error Goto Handle_Error
   aUtil = CreateObject("MWComUtil.MWUtil")
   aClass = CreateObject("mycomponent.myclass.1_0")
   Call aClass.foo(3,v,Rin1,Rin2)
   Call aUtil.MWUnpack(v,0,True,Rout1,Rout2,Rout3)
   Exit Sub
Handle_Error:
   MsgBox(Err.Description)
End Sub
```

Pass an Empty varargin from Microsoft Visual Basic Code

In MATLAB, `varargin` inputs to functions are optional, and may be present or omitted from the function call. However, from Microsoft Visual Basic, function signatures are more strict—if `varargin` is present among the MATLAB function inputs, the VBA call must include `varargin`, even if you want it to be empty. To pass in an empty `varargin`, pass the `Null` variant, which is converted to an empty MATLAB cell array when passed.

Pass an Empty varargin from VBA Code

The following example illustrates how to pass the null variant in order to pass an empty `varargin`:

```
Function foo(x1 As Variant, x2 As Variant, x3 As Variant, _
             x4 As Variant, x5 As Variant) As Variant
   Dim aClass As Object
   Dim v(1 To 5) As Variant
   Dim y As Variant

   On Error Goto Handle_Error
   v(1) = x1
   v(2) = x2
   v(3) = x3
   v(4) = x4
   v(5) = x5
   aClass = CreateObject("mycomponent.myclass.1_0")

   'Call aClass.foo(1,y,v)
   Call aClass.foo(1,y,Null)

   foo = y
   Exit Function
Handle_Error:
   foo = Err.Description
End Function
```

For More Information

For more information about working with variable-length arguments, see “Work with Variable-Length Inputs and Outputs” on page 5-5.

Modify Flags

• “Overview” on page 6-11

- "Array Formatting Flags" on page 6-11
- "Data Conversion Flags" on page 6-13

Overview

Each MATLAB Compiler component exposes a single read/write property named `MWFlags` of type `MWFlags`. The `MWFlags` property consists of two sets of constants: array formatting flags and data conversion flags. *Array formatting flags* affect the transformation of arrays, whereas *data conversion flags* deal with type conversions of individual array elements.

The data conversion flags change selected behaviors of the data conversion process from `Variant`s to MATLAB types and vice versa. By default, the MATLAB Compiler components allow setting data conversion flags at the class level through the `MWFlags` class property. This holds true for all Visual Basic types, with the exception of the MATLAB Compiler `MWStruct`, `MWField`, `MWComplex`, `MWSparse`, and `MWArg` types. Each of these types exposes its own `MWFlags` property and ignores the properties of the class whose method is being called. The `MWArg` class is supplied specifically for the case when a particular argument needs different settings from the default class properties.

This section provides a general discussion of how to set these flags and what they do. See "Class MWFlags" (MATLAB Compiler SDK) for a detailed discussion of the `MWFlags` type, as well as additional code samples.

Array Formatting Flags

Array formatting flags guide the data conversion to produce either a MATLAB cell array or matrix from general `Variant` data on input or to produce an array of `Variant`s or a single `Variant` containing an array of a basic type on output.

The following examples assume that you have referenced the `MWComUtil` library in the current project by selecting **Tools > References** and selecting **MWComUtil 7.5 Type Library** from the list:

```
Sub foo( )
   Dim aClass As mycomponent.myclass
   Dim var1(1 To 2, 1 To 2), var2 As Variant
   Dim x(1 To 2, 1 To 2) As Double
   Dim y1,y2 As Variant

   On Error Goto Handle_Error
   var1(1,1) = 11#
```

```
   var1(1,2) = 12#
   var1(2,1) = 21#
   var1(2,2) = 22#
   x(1,1) = 11
   x(1,2) = 12
   x(2,1) = 21
   x(2,2) = 22
   var2 = x
   Set aClass = New mycomponent.myclass
   Call aClass.foo(1,y1,var1)
   Call aClass.foo(1,y2,var2)
   Exit Sub
Handle_Error:
   MsgBox(Err.Description)
End Sub
```

In addition, these examples assume you have referenced the COM object created with MATLAB Compiler (`mycomponent`) as mentioned in "New Operator" on page 6-5.

Here, two `Variant` variables, `var1` and `var2` are constructed with the same numerical data, but internally they are structured differently: `var1` is a 2-by-2 array of `Variant`s with each element containing a 1-by-1 `Double`, while `var2` is a 1-by-1 `Variant` containing a 2-by-2 array of `Double`s.

In MATLAB Compiler, when using the default settings, both of these arrays will be converted to 2-by-2 arrays of `double`s. This does not follow the general convention listed in COM VARIANT to the MATLAB Conversion Rules. According to these rules, `var1` converts to a 2-by-2 cell array with each cell occupied by a 1-by-1 double, and `var2` converts directly to a 2-by-2 double matrix.

The two arrays both convert to double matrices because the default value for the `InputArrayFormat` flag is `mwArrayFormatMatrix`. The `InputArrayFormat` flag controls how arrays of these two types are handled. This default is used because array data originating from Excel ranges is always in the form of an array of `Variant`s (like `var1` of the previous example), and MATLAB functions most often deal with matrix arguments.

But what if you want a cell array? In this case, you set the `InputArrayFormat` flag to `mwArrayFormatCell`. Do this by adding the following line after creating the class and before the method call:

```
aClass.MWFlags.ArrayFormatFlags.InputArrayFormat =
mwArrayFormatCell
```

Setting this flag presents all array input to the compiled MATLAB function as cell arrays.

Similarly, you can manipulate the format of output arguments using the `OutputArrayFormat` flag. You can also modify array output with the `AutoResizeOutput` and `TransposeOutput` flags.

`AutoResizeOutput` is used for Excel `Range` objects passed directly as output parameters. When this flag is set, the target range automatically resizes to fit the resulting array. If this flag is not set, the target range must be at least as large as the output array or the data is truncated.

The `TransposeOutput` flag transposes all array output. This flag is useful when dealing with MATLAB functions that output one-dimensional arrays. By default, MATLAB realizes one-dimensional arrays as 1-by-n matrices (row vectors) that become rows in an Excel worksheet.

Tip: If your MATLAB function is specifically returning a row vector, for example, ensure you assign a similar row vector of cells in Excel.

You may prefer worksheet columns from row vector output. This example auto-resizes and transposes an output range:

```
Sub foo(Rout As Range, Rin As Range )
   Dim aClass As mycomponent.myclass

   On Error Goto Handle_Error
   Set aClass = New mycomponent.myclass
   aClass.MWFlags.ArrayFormatFlags.AutoResizeOutput = True
   aClass.MWFlags.ArrayFormatFlags.TransposeOutput = True
   Call aClass.foo(1,Rout,Rin)
   Exit Sub
Handle_Error:
   MsgBox(Err.Description)
End Sub
```

Data Conversion Flags

Data conversion flags deal with type conversions of individual array elements. The two data conversion flags, `CoerceNumericToType` and `InputDateFormat`, govern how numeric and date types are converted from VBA to MATLAB. Consider the example:

```
Sub foo( )
   Dim aClass As mycomponent.myclass
   Dim var1, var2 As Variant
   Dim y As Variant

   On Error Goto Handle_Error
   var1 = 1
   var2 = 2#
   Set aClass = New mycomponent.myclass
   Call aClass.foo(1,y,var1,var2)
   Exit Sub
Handle_Error:
   MsgBox(Err.Description)
End Sub
```

This example converts `var1` of type `Variant/Integer` to an `int16` and `var2` of type `Variant/Double` to a `double`.

If the original MATLAB function expects `double`s for both arguments, this code might cause an error. One solution is to assign a `double` to `var1`, but this may not be possible or desirable. In such a case set the `CoerceNumericToType` flag to `mwTypeDouble`, causing the data converter to convert all numeric input to `double`. In the previous example, place the following line after creating the class and before calling the methods:

```
aClass.MWFlags.DataConversionFlags.CoerceNumericToType =
mwTypeDouble
```

The `InputDateFormat` flag controls how the VBA `Date` type is converted. This example sends the current date and time as an input argument and converts it to a string:

```
Sub foo( )
   Dim aClass As mycomponent.myclass
   Dim today As Date
   Dim y As Variant

   On Error Goto Handle_Error
   today = Now
   Set aClass = New mycomponent.myclass
   aClass. MWFlags.DataConversionFlags.InputDateFormat =
mwDateFormatString
   Call aClass.foo(1,y,today)
   Exit Sub
Handle_Error:
   MsgBox(Err.Description)
```

```
End Sub
```

Handle Errors During a Method Call

Errors that occur while creating a class instance or during a class method create an exception in the current procedure. Microsoft Visual Basic provides an exception handling capability through the `On Error Goto <label>` statement, in which the program execution jumps to `<label>` when an error occurs. (`<label>` must be located in the same procedure as the `On Error Goto` statement). All errors are handled this way, including errors within the original MATLAB code. An exception creates a Visual Basic `ErrObject` object in the current context in a variable called `Err`. (See the Visual Basic for Applications documentation for a detailed discussion on VBA error handling.) All of the examples in this section illustrate the typical error trapping logic used in function call wrappers for MATLAB Compiler components.

Build and Integrate Spectral Analysis Functions

In this section...
"Overview" on page 6-16
"Building the Component" on page 6-16
"Integrate the Component Using VBA" on page 6-18
"Test the Add-In" on page 6-25
"Package and Distribute the Add-In" on page 6-27
"Install the Add-In" on page 6-29

Overview

This example illustrates the creation of a comprehensive Excel add-in to perform spectral analysis. It requires knowledge of Visual Basic forms and controls, as well as Excel workbook events. See the VBA documentation for a complete discussion of these topics.

The example creates an Excel add-in that performs a fast Fourier transform (FFT) on an input data set located in a designated worksheet range. The function returns the FFT results, an array of frequency points, and the power spectral density of the input data. It places these results into ranges you indicate in the current worksheet. You can also optionally plot the power spectral density.

You develop the function so that you can invoke it from the Excel **Tools** menu and can select input and output ranges through a GUI.

Creating the add-in requires four basic steps:

1. Build a standalone COM component from the MATLAB code.
2. Implement the necessary VBA code to collect input and dispatch the calls to your component.
3. Create the GUI.
4. Create an Excel add-in and package all necessary components for application deployment.

Building the Component

Your component will have one class with two methods:

- `computefft` — computes the FFT and power spectral density of the input data and computes a vector of frequency points based on the length of the data entered and the sampling interval
- `plotfft` — performs the same operations as `computefft`, but also plots the input data and the power spectral density in a MATLAB Figure window

---

Note: The MATLAB code for these two functions resides in two MATLAB files, computefft.m and plotfft.m.

The code for `computefft.m`:

```
function [fftdata, freq, powerspect] =
                                computefft(data, interval)
    if (isempty(data))
        fftdata = [];
        freq = [];
        powerspect = [];
        return;
    end
    if (interval <= 0)
        error('Sampling interval must be greater than zero');
        return;
    end
    fftdata = fft(data);
    freq = (0:length(fftdata)-1)/(length(fftdata)*interval);
    powerspect = abs(fftdata)/(sqrt(length(fftdata)));
```

The code for `plotfft.m.m`:

```
function [fftdata, freq, powerspect] = plotfft(data, interval)
    [fftdata, freq, powerspect] = computefft(data, interval);
    len = length(fftdata);
    if (len <= 0)
        return;
    end
    t = 0:interval:(len-1)*interval;
    subplot(2,1,1), plot(t, data)
    xlabel('Time'), grid on
    title('Time domain signal')
    subplot(2,1,2), plot(freq(1:len/2), powerspect(1:len/2))
    xlabel('Frequency (Hz)'), grid on
    title('Power spectral density')
```

Build the COM component using the Library Compiler app and the following settings.To proceed with the actual building of the component:

Setting	Value
Component name	`Fourier`
Class name	`Fourier`
Project folder	The name of your work folder followed by the component name
Show verbose output	Selected

See the instructions in “Package Excel Add-In with Library Compiler App” on page 1-9 for more information.

Where Is the Example Code?

See “Example File Copying” on page 3-24 for information about accessing the example code from within the product.

Integrate the Component Using VBA

Having built your component, you can implement the necessary VBA code to integrate it into Excel.

Note: To use `Fourier.xla` directly in the folder `xlspectral` (see “Example File Copying” on page 3-24) add references to **Fourier 1.0 Type Library** and **MWComUtil 7.*X* Type Library**.

Select the Libraries

To open Excel and select the libraries you need to develop the add-in:

1. Start Excel on your system.
2. From the Excel main menu, select **Tools > Macro > Visual Basic Editor**.
3. When the Visual Basic Editor starts, select **Tools > References** to open the Project References dialog box.
4. Select **Fourier 1.0 Type Library** and **MWComUtil 7.x Type Library** from the list.

Create the Main VB Code Module for the Application

The add-in requires some initialization code and some global variables to hold the application's state between function invocations. To achieve this, implement a Visual Basic code module to manage these tasks:

1. Right-click the **VBAProject** item in the project window and select **Insert** > **Module**.

   A new module appears under **Modules** in the **VBA Project**.
2. In the module's property page, set the `Name` property to `FourierMain`.
3. Enter the following code in the `FourierMain` module:

```
'
' FourierMain - Main module stores global state of controls
' and provides initialization code
'
Public theFourier As Fourier.Fourier 'Global instance of Fourier object
Public theFFTData As MWComplex   'Global instance of MWComplex to accept FFT
Public InputData As Range        'Input data range
Public Interval As Double        'Sampling interval
Public Frequency As Range        'Output frequency data range
Public PowerSpect As Range       'Output power spectral density range
Public bPlot As Boolean          'Holds the state of plot flag
Public theUtil As MWUtil         'Global instance of MWUtil object
Public bInitialized As Boolean   'Module-is-initialized flag

Private Sub LoadFourier()
'Initializes globals and Loads the Spectral Analysis form
    Dim MainForm As frmFourier
    On Error GoTo Handle_Error
    Call InitApp
    Set MainForm = New frmFourier
    Call MainForm.Show
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub

Private Sub InitApp()
'Initializes classes and libraries. Executes once
'for a given session of Excel
    If bInitialized Then Exit Sub
    On Error GoTo Handle_Error
    If theUtil Is Nothing Then
        Set theUtil = New MWUtil
        Call theUtil.MWInitApplication(Application)
    End If
    If theFourier Is Nothing Then
        Set theFourier = New Fourier.Fourierclass
    End If
    If theFFTData Is Nothing Then
        Set theFFTData = New MWComplex
```

```
    End If
    bInitialized = True
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub
```

Create the Visual Basic Form

The next step in the integration process develops a user interface for your add-in using the Visual Basic Editor. To create a new user form and populate it with the necessary controls:

1. Right-click **VBAProject** in the VBA project window and select **Insert** > **UserForm**.

   A new form appears under `Forms` in the VBA project window.
2. In the form's property page, set the `Name` property to `frmFourier` and the `Caption` property to `Spectral Analysis`.
3. Add a series of controls to the blank form to complete the dialog box, as summarized in the following table:

Controls Needed for Spectral Analysis Example

Control Type	Control Name	Properties	Purpose
`CheckBox`	`chkPlot`	Caption = `Plot time domain signal and power spectral density`	Plots input data and power spectral density.
`CommandButton`	`btnOK`	Caption = `OK` Default = True	Executes the function and dismisses the dialog box.
`CommandButton`	`btnCancel`	Caption = `Cancel` Cancel = True	Dismisses the dialog box without executing the function.
`Frame`	`Frame1`	Caption = `Input Data`	Groups all input controls.
`Frame`	`Frame2`	Caption = `Output Data`	Groups all output controls.

Control Type	Control Name	Properties	Purpose
`Label`	`Label1`	Caption = `Input Data:`	Labels the `RefEdit` for input data.
`TextBox`	`edtSample`	Not applicable	Not applicable
`Label`	`Label2`	Caption = `Sampling Interval`	Labels the `TextBox` for sampling interval.
`Label`	`Label3`	Caption = `Frequency:`	Labels the `RefEdit` for frequency output.
`Label`	`Label4`	Caption = `FFT - Real Part:`	Labels the `RefEdit` for real part of FFT.
`Label`	`Label5`	Caption = `FFT - Imaginary Part:`	Labels the `RefEdit` for imaginary part of FFT.
`Label`	`Label6`	Caption = `Power Spectral Density`	Labels the `RefEdit` for power spectral density.
`RefEdit`	`refedtInput`	Not applicable	Selects range for input data.
`RefEdit`	`refedtFreq`	Not applicable	Selects output range for frequency points.
`RefEdit`	`refedtReal`	Not applicable	Selects output range for real part of FFT of input data.
`RefEdit`	`refedtImag`	Not applicable	Selects output range for imaginary part of FFT of input data.
`RefEdit`	`refedtPowSpect`	Not applicable	Selects output range for power spectral density of input data.

4 When the form and controls are complete, right-click the form and select **View Code**.

The following code listing shows the code to implement. Notice that this code references the control and variable names listed in Controls Needed for Spectral Analysis Example. If you used different names for any of the controls or any global variable, change this code to reflect those differences.

```
'
'frmFourier Event handlers
'
Private Sub UserForm_Activate()
'UserForm Activate event handler. This function gets called before
'showing the form, and initializes all controls with values stored
'in global variables.
    On Error GoTo Handle_Error
    If theFourier Is Nothing Or theFFTData Is Nothing Then Exit Sub
    'Initialize controls with current state
    If Not InputData Is Nothing Then
        refedtInput.Text = InputData.Address
    End If
    edtSample.Text = Format(Interval)
    If Not Frequency Is Nothing Then
        refedtFreq.Text = Frequency.Address
    End If
    If Not IsEmpty (theFFTData.Real) Then
    If IsObject(theFFTData.Real) And TypeOf theFFTData.Real Is Range Then
            refedtReal.Text = theFFTData.Real.Address
        End If
    End If
    If Not IsEmpty (theFFTData.Imag) Then
    If IsObject(theFFTData.Imag) And TypeOf theFFTData.Imag Is Range Then
            refedtImag.Text = theFFTData.Imag.Address
        End If
    End If
    If Not PowerSpect Is Nothing Then
        refedtPowSpect.Text = PowerSpect.Address
    End If
    chkPlot.Value = bPlot
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub

Private Sub btnCancel_Click()
'Cancel button click event handler. Exits form without computing fft
'or updating variables.
    Unload Me
End Sub
Private Sub btnOK_Click()
'OK button click event handler. Updates state of all variables from controls
'and executes the computefft or plotfft method.
    Dim R As Range
```

```
    If theFourier Is Nothing Or theFFTData Is Nothing Then GoTo Exit_Form
    On Error Resume Next
    'Process inputs
    Set R = Range(refedtInput.Text)
    If Err <> 0 Then
        MsgBox ("Invalid range entered for Input Data")
        Exit Sub
    End If
    Set InputData = R
    Interval = CDbl(edtSample.Text)
    If Err <> 0 Or Interval <= 0 Then
        MsgBox ("Sampling interval must be greater than zero")
        Exit Sub
    End If
    'Process Outputs
    Set R = Range(refedtFreq.Text)
    If Err = 0 Then
        Set Frequency = R
    End If
    Set R = Range(refedtReal.Text)
    If Err = 0 Then
        theFFTData.Real = R
    End If
    Set R = Range(refedtImag.Text)
    If Err = 0 Then
        theFFTData.Imag = R
    End If
    Set R = Range(refedtPowSpect.Text)
    If Err = 0 Then
        Set PowerSpect = R
    End If
    bPlot = chkPlot.Value
    'Compute the fft and optionally plot power spectral density
    If bPlot Then
        Call theFourier.plotfft(3, theFFTData, Frequency, PowerSpect, _
     InputData, Interval)
    Else
        Call theFourier.computefft(3, theFFTData, Frequency, PowerSpect, _
     InputData, Interval)
    End If
    GoTo Exit_Form
Handle_Error:
    MsgBox (Err.Description)
Exit_Form:
    Unload Me
End Sub
```

Add the Spectral Analysis Menu Item to Excel

The last step in the integration process adds a menu item to Excel so that you can open the tool from the Excel **Tools** menu. To do this, add event handlers for the workbook's `AddinInstall` and `AddinUninstall` events that install and uninstall menu items. The menu item calls the `LoadFourier` function in the `FourierMain` module.

To implement the menu item:

1. Right-click the **ThisWorkbook** item in the VBA project window and select **View Code**.
2. Place the following code into `ThisWorkbook`.

```
Private Sub Workbook_AddinInstall()
'Called when Addin is installed
    Call AddFourierMenuItem
End Sub

Private Sub Workbook_AddinUninstall()
'Called when Addin is uninstalled
    Call RemoveFourierMenuItem
End Sub

Private Sub AddFourierMenuItem()
    Dim ToolsMenu As CommandBarPopup
    Dim NewMenuItem As CommandBarButton

    'Remove if already exists
    Call RemoveFourierMenuItem
    'Find Tools menu
    Set ToolsMenu = Application.CommandBars(1).FindControl(ID:=30007)
    If ToolsMenu Is Nothing Then Exit Sub
    'Add Spectral Analysis menu item
    Set NewMenuItem = ToolsMenu.Controls.Add(Type:=msoControlButton)
    NewMenuItem.Caption = "Spectral Analysis..."
    NewMenuItem.OnAction = "LoadFourier"
End Sub

Private Sub RemoveFourierMenuItem()
Dim CmdBar As CommandBar
Dim Ctrl As CommandBarControl
On Error Resume Next
'Find tools menu and remove Spectral Analysis menu item
Set CmdBar = Application.CommandBars(1)
Set Ctrl = CmdBar.FindControl(ID:=30007)
Call Ctrl.Controls("Spectral Analysis...").Delete
End Sub
```

3. Save the add-in into the `<project-folder>\for_testing` folder that Library Compiler created when building the project.

   `<project-folder>` refers to the project folder that Library Compiler used to save the Fourier project.

   Name the add-in `Spectral Analysis`.

   a. From the Excel main menu, select **File** > **Properties**.

b When the Workbook Properties dialog box appears, click the **Summary** tab, and enter `Spectral Analysis` as the workbook title.
c Click **OK** to save the edits.
d From the Excel main menu, select **File** > **Save As**.
e When the Save As dialog box appears, select `Microsoft Excel Add-In (*.xla)` as the file type, and browse to `<project-folder>\for_testing`.
f Enter `Fourier.xla` as the file name and click **Save** to save the add-in.

Test the Add-In

Before distributing the add-in, test it with a sample problem.

Spectral analysis is commonly used to find the frequency components of a signal buried in a noisy time domain signal. In this example you will create a data representation of a signal containing two distinct components and add to it a random component. This data along with the output will be stored in columns of an Excel worksheet, and you will plot the time-domain signal along with the power spectral density.

Create the Test Problem

Follow these steps to create the test problem:

1 Start a new session of Excel with a blank workbook.
2 From the main menu, select **Tools** > **Add-Ins**.
3 When the Add-Ins dialog box appears, click **Browse**.
4 Browse to the `<project-folder>\for_testing` folder, select `Fourier.xla`, and click **OK**.

   The **Spectral Analysis** add-in appears in the available **Add-Ins** list and is selected.
5 Click **OK** to load the add-in.

This add-in installs a menu item under the Excel **Tools** menu. You can display the Spectral Analysis GUI by selecting **Tools > Spectral Analysis**. Before invoking the add-in, create some data, in this case a signal with components at 15 and 40 Hz. Sample the signal for 10 seconds at a sampling rate of 0.01 s. Put the time points into column A and the signal points into column B.

Create the Data

To create the data:

1. Enter `0` for cell A1 in the current worksheet.
2. Click cell A2 and type the formula `"= A1 + 0.01"`.
3. Click and hold the lower-right corner of cell A2 and drag the formula down the column to cell A1001. This procedure fills the range A1:A1001 with the interval 0 to 10 incremented by 0.01.
4. Click cell B1 and type the following formula

   ```
   "= SIN(2*PI()*15*A1) + SIN(2*PI()*40*A1) + RAND()"
   ```

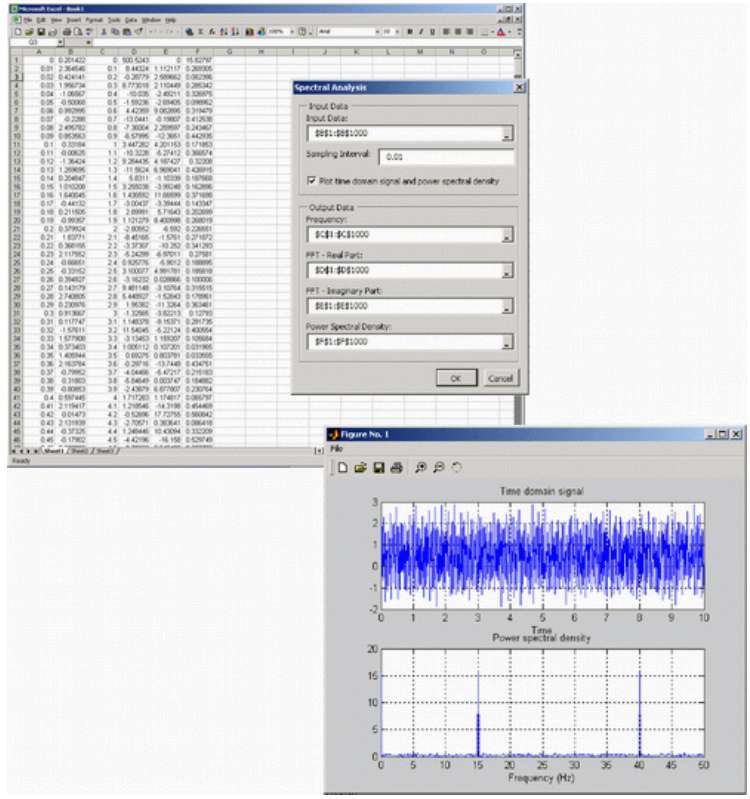
   Repeat the drag procedure to copy this formula to all cells in the range B1:B1001.

Run the Test

Using the column of data (column B), test the add-in as follows:

1. Select **Tools** > **Spectral Analysis** from the main menu.
2. Click the **Input Data** box.
3. Select the `B1:B1001` range from the worksheet, or type this address into the **Input Data** field.
4. In the **Sampling Interval** field, type `0.01`.
5. Select **Plot time domain signal and power spectral density**.
6. Enter `C1:C1001` for frequency output, and likewise enter `D1:D1001`, `E1:E1001`, and `F1:F1001` for the FFT real and imaginary parts, and spectral density.
7. Click **OK** to run the analysis.

The next figure shows the output.



The power spectral density reveals the two signals at 15 and 40 Hz.

Package and Distribute the Add-In

As a final step, package the add-in, the COM component, and all supporting libraries into a self-extracting executable. This package can be installed onto other computers that need to use the `Spectral Analysis` add-in.

1. On the **Main File** section of the tool strip choose one of the two options described in the following table.

Option	What Does This Option Do?	When Should I Use This Option?
Runtime downloaded from web	The MATLAB Runtime installer downloads the MATLAB Runtime from the MathWorks website.	• You have a large number of end users who deploy applications frequently • Your users have internet/ network access • Resources such as disk space, performance, and processing time are significant concerns for your organization
Runtime included in package	The MATLAB Runtime is included in the generated installer. The MATLAB Runtime installer uses the included MATLAB Runtime.	• You have a limited number of end users who deploy a small number of applications at sporadic intervals • Your users have no internet/ network access • Resources such as disk space, performance, and processing time are not significant concerns **Note:** Distributing the MATLAB Runtime with the application requires more resources.

For more information about the role the MATLAB Runtime plays in the deployment process, see “MATLAB Runtime” on page 1-15.

2 Add others files you feel may be useful to end users.

To package additional files or folders, add them to the **Files installed for your end user** field. See “Specify Files to Install with Application” on page 2-8.

3 Click Package.

Install the Add-In

To install this add-in onto another computer, copy the `Fourier_pkg.exe` package to that machine, run it from a command prompt, and follow the instructions in the `readme.txt` file that is automatically generated with your packaged output.

For More Information

For more information about...	See...
Functions available through MATLAB Compiler	Function reference in MATLAB Compiler documentation
Utility functions you can use to customize COM components created with MATLAB Compiler	“Reference Utility Classes” on page 9-2

7

Distribution to End Users

- "Distribute Your Add-Ins and COM Components to End Users" on page 7-2
- "Distribute Visual Basic Application" on page 7-4
- "For More Information" on page 7-15

Distribute Your Add-Ins and COM Components to End Users

MATLAB Runtime

The *MATLAB Runtime* is an execution engine made up of the same shared libraries MATLAB uses to enable execution of MATLAB files on systems without an installed version of MATLAB.

The MATLAB Runtime is available for downloading from the web to simplify the distribution of your applications created using the MATLAB Compiler or the MATLAB Compiler SDK. Download the MATLAB Runtime from the MATLAB Runtime product page.

The MATLAB Runtime installer does the following:

1. Install the MATLAB Runtime.
2. Install the component assembly in the folder from which the installer is run.
3. Copy the `MWArray` assembly to the Global Assembly Cache (GAC), as part of installing the MATLAB Runtime.

MATLAB Runtime Prerequisites

1. The MATLAB Runtime installer requires administrator privileges to run.
2. The version of the MATLAB Runtime that runs your application on the target computer must be compatible with the version of MATLAB Compiler or MATLAB Compiler SDK that built the deployed code.
3. Do not install the MATLAB Runtime in MATLAB installation directories.
4. The MATLAB Runtime installer requires approximately 2 GB of disk space.

Add the MATLAB Runtime Installer to the Installer

This example shows how to include the MATLAB Runtime in the generated installer, using one of the compiler apps. The generated installer contains all files needed to run the standalone application or shared library built with MATLAB Compiler or MATLAB Compiler SDK and properly lays them out on a target system.

1. On the **Packaging Options** section of the compiler interface, select one or both of the following options:

- **Runtime downloaded from web** — This option builds an installer that invokes the MATLAB Runtime installer from the MathWorks website.
- **Runtime included in package** — The option includes the MATLAB Runtime installer into the generated installer.

2. Click **Package**.
3. Distribute the installer as needed.

Install the MATLAB Runtime

This example shows how to install the MATLAB Runtime on a system.

If you are given an installer containing the compiled artifacts, then the MATLAB Runtime is installed along with the application or shared library. If you are given just the raw binary files, download the MATLAB Runtime installer from the web and run the installer.

Note: If you are running on a platform other than Windows, modify the path on the target machine. Setting the paths enables your application to find the MATLAB Runtime. For more information on setting the path, see "MATLAB Runtime Path Settings for Run-Time Deployment" (MATLAB Compiler SDK).

Windows paths are set automatically. On Linux and Mac, you can use the run script to set paths. See "Using MATLAB Compiler on Mac or Linux" for detailed information on performing all deployment tasks specifically with UNIX variants such as Linux and Mac.

Distribute Visual Basic Application

In this section...
“Calling Compiled MATLAB Functions from Microsoft Excel” on page 7-4
“Improve Data Access Using the MATLAB Runtime User Data Interface and COM Components” on page 7-6
“MATLAB Runtime Component Cache and Deployable Archive Embedding” on page 7-11
“MATLAB Runtime Options” on page 7-13

Calling Compiled MATLAB Functions from Microsoft Excel

In order to call compiled MATLAB functions from within a Microsoft Excel spreadsheet, perform the following from the Development and Deployment machines, as specified.

Note: In order for a function to be called using the Microsoft Excel function syntax (`=myfunction(input)`), the MATLAB function must return a single scalar output argument.

Perform the following steps on the Development machine:

1. Create the following MATLAB functions in three separate files named `doubleit.m`, `incrementit.m`, and `powerit.m`, respectively:

```
function output = doubleit(input)
  output = input * 2;

function output = incrementit(input1, input2)
   output = input1 + input2;

function output = powerit(input1, input2)
  output = power(input1, input2);
```

2. Start the Library Compiler.
3. Use the following information as you work through this example using the instructions in “Package Excel Add-In with Library Compiler App” on page 1-9:

Application Name	`myexcelfunctions`

Class Name	`myexcelfunctionsclass`
Exported Functions	`doubleit.m incrementit.m powerit.m`

Perform the following steps on the Deployment machine:

1. Copy the contents of `for_redistribution_files_only` to the deployment machine(s). Copy the file to a standard place for use with Microsoft Excel, such as *`Office_Installation_folder`*`\Library\MATLAB` where *`Office_Installation_folder`* is a folder such as `C:\Program Files \Microsoft Office\OFFICE11`.
2. Install the MATLAB Runtime.
3. Register `myexcelfunctions_1_0.dll`.

Caution: You need to re-register your DLL file if you move it following its creation. Unlike DLL files, Excel files can be moved anywhere at anytime.

---

4. Start Microsoft Excel. The spreadsheet `Book1` should be open by default.
5. In Excel, select **Tools > Visual Basic Editor**. The Microsoft Visual Basic Editor starts.
6. In the Microsoft Visual Basic Editor, select **File > Import File**.
7. Browse to `myexcelfunctions.bas` and click **Open**. In the Project Explorer, **Module1** appears under the **Modules** node beneath **VBAProject (Book1)**.
8. In the Microsoft Visual Basic Editor, select **View > Microsoft Excel**. You can now use the `doubleit`, `incrementit`, and `powerit` functions in your **Book1** spreadsheet.
9. Test the functions, by doing the following:

   a. Enter `=doubleit(2.5)` in cell A1.

   b. Enter `=incrementit(11,17)` in cell A2.

   c. Enter `=powerit(7,2)` in cell A3.

   You should see values **5**, **28**, and **49** in cells **A1**, **A2**, and **A3** respectively.
10. To use the `doubleit`, `powerit`, and `incrementit` functions in all your new Microsoft Excel spreadsheets, do the following:

    a. Select **File > Save As**.

b Change the **Save as type** option to **.xlt (Template)**.

c Browse to the *`Office_Installation_folder`*`\XLSTART` folder.

d Save the file as *`Office_Installation_folder`*`\XLSTART\Book.xlt`.

Note: Your Microsoft Excel Macro Security level must be set at **Medium** or **Low** to save this template.

Where Is the Example Code?

See "Example File Copying" on page 3-24 for information about accessing the example code from within the product.

Improve Data Access Using the MATLAB Runtime User Data Interface and COM Components

- "Overview" on page 7-6
- "Supply Run-Time Profile Information for Parallel Computing Toolbox Applications" on page 7-7

Overview

This feature provides a lightweight interface for easily accessing the MATLAB Runtime data. It allows data to be shared between the MATLAB Runtime instance, the MATLAB code running on that the MATLAB Runtime, and the wrapper code that created the MATLAB Runtime. Through calls to the MATLAB Runtime User Data interface API, you access the MATLAB Runtime data by creating a per MATLAB Runtime instance associative array of `mxArray`s, consisting of a mapping from string keys to `mxArray` values. Reasons for doing this include, but are not limited to:

- You need to supply run-time profile information to a client running an application created with the Parallel Computing Toolbox™. Profile information may be supplied (and change) on a per-execution basis. For example, two instances of the same application may run simultaneously with different profiles.
- You want to initialize the MATLAB Runtime with constant values that can be accessed by all your MATLAB applications.
- You want to set up a global workspace — a global variable or variables that the MATLAB and your client can access.
- You want to store the state of any variable or group of variables.

MATLAB Compiler supports per the MATLAB Runtime instance state access through an object-oriented API. Unlike MATLAB Compiler, access to per the MATLAB Runtime instance state is optional, rather than on by default. You can access this state by adding `setmcruserdata.m` and `getmcruserdata.m` to your deployment project or by specifying them on the command line. Alternately, you use a helper function to call these methods, as shown in "Supply Run-Time Profile Information for Parallel Computing Toolbox Applications" on page 7-7.

For more information, see the MATLAB Compiler User's Guide.

Supply Run-Time Profile Information for Parallel Computing Toolbox Applications

Following is a complete example of how you can use the MATLAB Runtime User Data Interface as a mechanism to specify a profile for Parallel Computing Toolbox applications.

Note: Standalone executables and shared libraries generated from MATLAB Compiler or MATLAB Compiler SDK for parallel applications can now launch up to twelve local workers without MATLAB Distributed Computing Server™.

Step 1: Write Your Parallel Computing Toolbox Code

1 Compile `sample_pct.m` in MATLAB.

This example code uses the cluster defined in the default profile.

The output assumes that the default profile is `local`.

```
function speedup = sample_pct (n)
warning off all;
tic
if(ischar(n))
    n=str2double(n);
end
for ii = 1:n
   (cov(sin(magic(n)+rand(n,n))));
end
time1 =toc;
parpool;
tic
parfor ii = 1:n
```

```
   (cov(sin(magic(n)+rand(n,n))));
end
time2 =toc;
disp(['Normal loop times: ' num2str(time1) ...
    ',parallel loop time: ' num2str(time2) ]);
disp(['parallel speedup:  ' num2str(1/(time2/time1)) ...
    ' times faster than normal']);
delete(gcp);
disp('done');
speedup = (time1/time2);
```

2 Run the code as follows after changing the default profile to `local`, if needed.

```
a = sample_pct(200)
```

3 Verify that you get the following results:

```
Starting parallel pool (parpool) using the 'local' profile ... connected to 4 worke
Normal loop times: 0.7587,parallel loop time: 2.9988
parallel speedup:  0.253 times faster than normal
Parallel pool using the 'local' profile is shutting down.
done

a =

    0.2530
```

Step 2: Set the Parallel Computing Toolbox Profile

In order to compile MATLAB code to a COM component and utilize the Parallel Computing Toolbox, the `mcruserdata` must be set directly from MATLAB. There is no API available to access the `MCRUserdata` as there is for C and C++ applications built with MATLAB Compiler.

To set the `mcruserdata` from MATLAB, create an `init` function in your COM class. This is a separate MATLAB function that uses `setmcruserdata` to set the Parallel Computing Toolbox profile once. You then call your other functions to utilize the Parallel Computing Toolbox functions.

Create the following `init` function:

```
function init_sample_pct
% Set the Parallel Profile:
if(isdeployed)
    [profile] = uigetfile('*.settings');
```

```
                        % let the USER select file
    setmcruserdata('ParallelProfile',[profile]);
end
```

Step 3: Compile Your Function with the Deploytool or the Command Line

You can compile your function from the command line by entering the following:

```
mcc -B 'cexcel:exPctComp,exPctClass,1.0' init_sample_pct.m sample_pct.m
```

Alternately, you can use the deploytool as follows:

1 Follow the steps in "Package Excel Add-In with Library Compiler App" on page 1-9 to compile your application.

When the compilation finishes, a new folder (with the same name as the project) is created.

Project Name	`exPctComp`
Class Name	`exPctClass`
File to compile	`sample_pct.m` and `init_sample_pct.m`

Note: If you are using the GPU feature of Parallel Computing Toolbox, you need to manually add the PTX and CU files.

If you are using the Library Compiler app, click **Add files/directories** on the **Build** tab.

If you are using the `mcc` command, use the `-a` option.

---

2 To deploy the compiled application, copy the `for_redistribution_files_only` folder, which contains the following, to your end users.

- `exPctComp.dll`
- VBA module (`.bas` file)
- MCR installer
- Cluster profile

Note: The end-user's target machine must have access to the cluster.

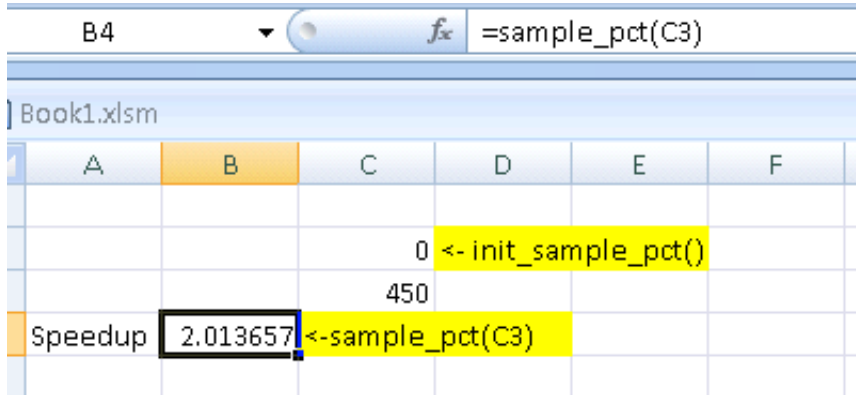
Step 4: Modify the generated VBA Driver Application (the BAS File)

After registering the COM DLL on the deployment machine and importing the BAS file into Excel, modify the generated BAS file code as needed.

```
Dim MCLUtil As Object
Dim bModuleInitialized As Boolean
Dim exPctClass As Object

Private Sub InitModule()
  If Not bModuleInitialized Then
    On Error GoTo Handle_Error
    If MCLUtil Is Nothing Then
      Set MCLUtil = CreateObject("MWComUtil.MWUtil7.10")
    End If
    Call MCLUtil.MWInitApplication(Application)
    bModuleInitialized = True
    Exit Sub
Handle_Error:
    bModuleInitialized = False
  End If
End Sub

Function init_sample_pct() As Variant

  On Error GoTo Handle_Error
  Call InitModule
  If exPctClass Is Nothing Then
    Set exPctClass = CreateObject("exPctComp.exPctClass.1_0")
  End If
  Call exPctClass.init_sample_pct
  init_sample_pct = Empty

  Exit Function
Handle_Error:
  init_sample_pct = "Error in " &
                        Err.Source & ": " & Err.Description
End Function


Function sample_pct(Optional pelle As Variant) As Variant
  Dim speedup As Variant

  On Error GoTo Handle_Error
  Call InitModule
```

```
  If exPctClass Is Nothing Then
    Set exPctClass = CreateObject("exPctComp.exPctClass.1_0")
  End If
  Call exPctClass.sample_pct(1, speedup, pelle)
  sample_pct = speedup

  Exit Function
Handle_Error:
  sample_pct = "Error in " & Err.Source
                           & ": " & Err.Description
End Function
```

The output is as follows:



MATLAB Runtime Component Cache and Deployable Archive Embedding

- "Overriding Default Behavior" on page 7-13
- "For More Information" on page 7-13

deployable archive data is automatically embedded directly in MATLAB Compiler components by default and extracted to a temporary folder.

Automatic embedding enables usage of MATLAB Runtime Component Cache features through environment variables.

These variables allow you to specify the following:

- Define the default location where you want the deployable archive to be automatically extracted

- Add diagnostic error printing options that can be used when automatically extracting the deployable, for troubleshooting purposes
- Tuning the MATLAB Runtime 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 deployable archive to be extracted, this variable overrides the default per-user component cache location.	Does not apply
MCR_CACHE_VERBOSE	When set to any value, this variable prints logging details about the component cache for diagnostic reasons. This can be very helpful if problems are encountered during deployable archive extraction.	Logging details are turned off by default (for example, when this variable has no value).
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.

You can override this automatic embedding and extraction behavior by compiling with the `-C` option. See “Overriding Default Behavior” on page 7-13 for details.

Note: If you run `mcc` specifying conflicting wrapper and target types, the deployable archive 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 deployable archive embedded in it, as if you had specified a `-C` option to the command line.

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.

Overriding Default Behavior

To extract the deployable archive in a manner prior to R2008b, alongside the compiled COM component, compile using the `mcc -c` option.

You can also implement this override by adding the `-c` flag in the **Settings** section of the compiler app.

You might want to use this option to troubleshoot problems with the deployable archive, for example, as the log and diagnostic messages are much more visible.

For More Information

For more information about the deployable archive, see "Deployable Archive" on page 4-7.

MATLAB Runtime Options

What MATLAB Runtime Options are Supported by MATLAB Compiler?

- `-logfile` — Creates a named log file.

How Do I Specify MATLAB Runtime Options?

If You Compiled the Add-In in MATLAB or used mcc

If you are building your add-in using the MATLAB Library Compiler, select **Create log file** under **Additional Runtime Settings**.

If you are building your add-in using `mcc`, simply specify `-logfile` with the `mcc -R` command

If You Created a Function From Scratch Using the Function Wizard

If you created a function from scratch using the Function Wizard, and want to specify MATLAB Runtime options, you have to manually modify the `.bas` file code.

You do this by invoking the following `MWUtil` API calls, detailed with examples in "Class MWUtil" on page 9-3:

- `Sub MWInitApplicationWithMCROptions(pApp As Object, [mcrOptionList])` on page 9-5
- `Function IsMCRJVMEnabled() As Boolean` on page 9-6
- `Function IsMCRInitialized() As Boolean` on page 9-6

For More Information

For more information about...	See...
Functions available through MATLAB Compiler	Function Reference pages in MATLAB Compiler documentation
Utility functions you can use to customize COM components created with MATLAB Compiler	“Reference Utility Classes” on page 9-2

8

Function Reference

componentinfo

Query system registry about component created with MATLAB Compiler

Syntax

```
info = componentinfo
info = componentinfo(component_name)
info = componentinfo(component_name, major_revision_number)
info = componentinfo(component_name, major_revision_number,
minor_revision_number)
```

Arguments

component_name	The MATLAB character vector providing the name of a MATLAB Compiler component. Names are case sensitive. If this argument is not supplied, the function returns information on all installed components.
major_revision_number	Component major revision number. If this argument is not supplied, the function returns information on all major revisions.
minor_revision_number	Component minor revision number. Default value is `0`.

Description

`info = componentinfo` returns information for all components installed on the system.

`info = componentinfo(`*component_name*`)` returns information for all revisions of *component_name*.

`info = componentinfo(`*component_name*`, `*major_revision_number*`)` returns information for the most recent minor revision corresponding to *major_revision_number* of *component_name*.

`info = componentinfo(component_name, major_revision_number, minor_revision_number)` returns information for the specific major and minor version of `component_name`.

The return value is an array of structures representing all the registry and type information needed to load and use the component.

When you supply a component name, `major_revision_number` and `minor_revision_number` are interpreted as shown below.

Value	Information Returned
> 0	Information on a specific major and minor revision
0	Information on the most recent revision. When omitted, `minor_revision_number` is assumed to be equal to 0.
< 0	Information on all versions

Note: Although properties and events may appear in the output for `componentinfo`, they are not supported by MATLAB Compiler SDK.

Registry Information

The information about a component has the fields shown in the following table.

Registry Information Returned by componentinfo

Field	Description
Name	Component name.
TypeLib	Component type library.
LIBID	Component type library GUID.
MajorRev	Major version number.
MinorRev	Minor version number.
FileName	Type library file name and path. Since all the MATLAB Compiler components have the type library bound into the DLL, this file name is the same as the DLL name and path.

Field	Description
`Interfaces`	An array of structures defining all interface definitions in the type library. Each structure contains two fields: • `Name` - Interface name. • `IID` - Interface GUID.

Registry Information Returned by componentinfo (Continued)

`CoClasses`	An array of structures defining all COM classes in the component. Each structure contains these fields:
	• Name - Class name.
	• CLSID - GUID of the class.
	• ProgID - Version-dependent program ID.
	• VerIndProgID - Version-independent program ID.
	• InprocServer32 - Full name and path to component DLL.
	• Methods - A structure containing function prototypes of all class methods defined for this interface. This structure contains four fields:
	  • IDL - An array of Interface Description Language function prototypes.
	  • M - An array of MATLAB function prototypes.
	  • C - An array of C-language function prototypes.
	  • VB - An array of VBA function prototypes.
	• Properties - A cell array containing the names of all class properties.
	• Events - A structure containing function prototypes of all events defined for this class. This structure contains four fields:
	  • IDL - An array of Interface Description Language function prototypes.
	  • M - An array of MATLAB function prototypes.
	  • C - An array of C-language function prototypes.
	  • VB - An array of VBA function prototypes.

Examples

Function Call	Returns
`Info = componentinfo`	Information for all installed components.
`Info = componentinfo('mycomponent')`	Information for all revisions of `mycomponent`.
`Info = componentinfo('mycomponent',1,0)`	Information for revision 1.0 of `mycomponent`.

Introduced in R2015a

deploytool

Compile and package functions for external deployment

Syntax

```
deploytool
deploytool project_name
deploytool -build project_name
deploytool -package project_name
```

Description

`deploytool` opens a list of the compiler apps.

`deploytool project_name` opens the appropriate compiler app with the project preloaded.

`deploytool -build project_name` runs the appropriate compiler app to build the specified project. The installer is not generated.

`deploytool -package project_name` runs the appropriate compiler app to build and package the specified project. The installer is generated.

Examples

Create a New Compiler Project

Open the compiler to create a new project.

```
deploytool
```

Package an Application using an Existing Project

Open the compiler to build a new application using an existing project.

```
deploytool -package my_magic
```

Input Arguments

`project_name` — name of the project to be compiled

character array or string

Specify the name of a previously saved project. The project must be on the current path.

Introduced in R2006b

libraryCompiler

Build and package functions for use in external applications

Syntax

```
libraryCompiler
libraryCompiler project_name
libraryCompiler -build project_name
libraryCompiler -package project_name
```

Description

`libraryCompiler` opens the Library Compiler app for the creation of a new compiler project

`libraryCompiler project_name` opens the Library Compiler app with the project preloaded.

`libraryCompiler -build project_name` runs the Library Compiler app to build the specified project. The installer is not generated.

`libraryCompiler -package project_name` runs the Library Compiler app to build and package the specified project. The installer is generated.

Examples

Create a New Project

Open the Library Compiler app to create a new project.

```
libraryCompiler
```

Package a Function using an Existing Project

Open the Library Compiler app using an existing project.

```
libraryCompiler -package my_magic
```

Input Arguments

`project_name` — name of the project to be compiled

character array or string

Specify the name of a previously saved project. The project must be on the current path.

Introduced in R2013b

mcc

Compile MATLAB functions for deployment

Syntax

```
mcc options mfilename1,...,mfilenameN

mcc -m options mfilename
mcc -e options mfilename

mcc -W 'excel:addin_name,className,version' -T link:lib options
mfilename1,...,mfilenameN

mcc -H -W hadoop:archiveName,CONFIG:configFile
```

Description

`mcc options mfilename1,...,mfilenameN` compiles the functions as specified by the options.

The options used depend on the intended results of the compilation. For information on compiling:

- C/C++ shared libraries, .NET assemblies, Java packages, or Python® packages see `mcc` for MATLAB Compiler SDK
- MATLAB Production Server™ deployable archives or Excel add-ins for MATLAB Production Server see `mcc` for MATLAB Compiler SDK

`mcc -m options mfilename` compiles the function into a standalone application.

This is equivalent to `-W main -T link:exe`.

`mcc -e options mfilename` compiles the function into a standalone application that does not open an MS-DOS® command window.

This syntax is equivalent to `-W WinMain -T link:exe`.

`mcc -W 'excel:addin_name,className,version' -T link:lib options mfilename1,...,mfilenameN` creates a Microsoft Excel add-in from the specified files.

- *`addin_name`* — Specifies the name of the addin and its namespace, which is a period-separated list, such as `companyname.groupname.component`.
- *`className`* — Specifies the name of the class to be created. If you do not specify the class name, `mcc` uses the *`addin_name`* as the default. If specified, *`className`*, needs to be different from *`mfilename`*.
- *`version`* — Specifies the version of the add-in specified as *`major.minor`*.
  - *`major`* — Specifies the major version number. If you do not specify a version number, `mcc` uses the latest version.
  - *`minor`* — Specifies the minor version number. If you do not specify a version number, `mcc` uses the latest version.

Note: Excel add-ins can only be created in MATLAB running on Windows.

Note: Remove the single quotes around `'excel:addin_name,className,version'` when executing the `mcc` command from a DOS prompt.

`mcc -H -W hadoop:archiveName,CONFIG:configFile` generates a deployable archive that can be run as a job by Hadoop®.

- *`archiveName`* — Specifies the name of the generated archive.
- *`configFile`* — Specifies the path to the Hadoop settings file. See “Hadoop Settings File”.

Tip: You can issue the `mcc` command either at the MATLAB command prompt or the DOS or UNIX command line.

Examples

Compile a standalone application

```
mcc -m magic.m
```

Compile a standalone Windows application

Compile a standalone application that does not open a command prompt on Windows.

```
mcc -e magic.m
```

Compile an Excel add-in

```
mcc -W 'excel:myAddin,myClass,1.0' -T link:lib magic.m
```

Input Arguments

`mfilename` — File to be compiled

filename

File to be compiled specified as a character vector.

`mfilename1,...,mfilenameN` — Files to be compiled

list of filenames

One, or more, files to be compiled, specified as a comma-separated list of filenames.

`options` — Options for customizing the output

-a | -b | -B | -C | -d | -f | -g | -G | -I | -K | -m | -M | -N | -o | -p | -R | -S | -T | -u | -v | -w | -W | -Y

Options for customizing the output, specified as a list of character vectors.

- `-a`

  Add files to the deployable archive using `-a path` to specify the files to be added. Multiple `-a` options are permitted.

  If a file name is specified with `-a`, the 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 a folder name is specified with the `-a` option, the entire contents of that folder are added recursively to the deployable archive. For example

  ```
  mcc -m hello.m -a ./testdir
  ```

specifies that all files in `testdir`, as well as all files in its subfolders, are added to the deployable archive. The folder subtree in `testdir` is preserved in the deployable archive.

If the filename includes a wildcard pattern, only the files in the folder that match the pattern are added to the deployable archive and subfolders of the given path are not processed recursively. For example

```
mcc -m hello.m -a ./testdir/*
```

specifies that all files in `./testdir` are added to the deployable archive and subfolders under `./testdir` are not processed recursively.

```
mcc -m hello.m -a ./testdir/*.m
```

specifies that all files with the extension `.m` under `./testdir` are added to the deployable archive and subfolders of `./testdir` are not processed recursively.

Note: `*` is the only supported wildcard.

When you add files to the archive using `-a` that do not appear on the MATLAB path at the time of compilation, a path entry is added to the application's run-time path so that they appear on the path when the deployed code executes.

When you include files, the absolute path for the DLL and header files changes. The files are placed in the `.\`*`exe`*`_mcr\` folder when the archive is expanded. The file is not placed in the local folder. This folder is created from the deployable archive the first time the application 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.

Caution: If you use the `-a` flag to include a file that is not on the MATLAB path, the folder containing the file is added to the MATLAB dependency analysis path. As a result, other files from that folder might be included in the compiled application.

Note: If you use the `-a` flag to include custom Java classes, standalone applications 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 MATLAB code needs to make an appropriate call to `javaaddpath` to update the `classpath` with the parent folder of the package.

- `-b`

  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.

- `-B`

  Replace the file on the `mcc` command line with the contents of the specified file. Use

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

  The bundle `filename` should contain only `mcc` command-line options and corresponding arguments and/or other file names. The file might contain other `-B` options. A bundle can include replacement parameters for compiler options that accept names and version numbers. See “Using Bundles to Build MATLAB Code” (MATLAB Compiler SDK).

- `-C`

  Do not embed the deployable archive in binaries.

- `-d`

  Place output in a specified folder. Use

  ```
  -d outFolder
  ```

  to direct the generated files to *`outFolder`*.

- `-f`

  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 lets you use different ANSI compilers for different invocations of the compiler. This option is a direct pass-through to `mbuild`.

- `-g`, `-G`

  Include debugging symbol information for the C/C++ code generated by MATLAB Compiler SDK. It also causes `mbuild` to pass appropriate debugging flags to the system C/C++ compiler. The debug option lets you backtrace up to the point where you can identify if the failure occurred in the initialization of MATLAB Runtime, the function call, or the termination routine. This option does not let you debug your MATLAB files with a C/C++ debugger.

- `-I`

  Add a new folder path to the list of included folders. Each `-I` option adds a folder to the beginning of the list of paths to search. For example,

  ```
  -I <directory1> -I <directory2>
  ```

  sets up the search path so that `directory1` is searched first for MATLAB files, followed by `directory2`. This option is important for standalone compilation where the MATLAB path is not available.

  If used in conjunction with the `-N` option, the `-I` option adds the folder to the compilation path in the same position where it appeared in the MATLAB path rather than at the head of the path.

- `-K`

  Direct `mcc` not to delete output files if the compilation ends prematurely, due to error.

  The default behavior of `mcc` is to dispose of any partial output if the command fails to execute successfully.

- `-m`

  Direct `mcc` to generate a standalone application.

- `-M`

  Define compile-time options. Use

  ```
  -M string
  ```

to pass `string` directly to `mbuild`. 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`

  Passing `-N` clears the path of all folders except the following core folders (this list is subject to change over time):

  - *`matlabroot`*`\toolbox\matlab`
  - *`matlabroot`*`\toolbox\local`
  - *`matlabroot`*`\toolbox\compiler`

  Passing `-N` also retains all subfolders in this list that appear on the MATLAB path at compile time. Including `-N` on the command line lets you replace folders from the original path, while retaining the relative ordering of the included folders. All subfolders of the included folders that appear on the original path are also included. In addition, the `-N` option retains all folders that you included on the path that are not under *`matlabroot`*`\toolbox`.

  When using the –`N` option, use the –`I` option to force inclusion of a folder, which is placed at the head of the compilation path. Use the –`p` option to conditionally include folders and their subfolders; if they are present in the MATLAB path, they appear in the compilation path in the same order.

- `-o`

  Specify the name of the final executable (standalone applications only). Use

  ```
  -o outputfile
  ```

  to name the final executable output of MATLAB Compiler. A suitable platform-dependent extension is added to the specified name (e.g., `.exe` for Windows standalone applications).

- `-p`

  Use in conjunction with the option `-N` to add specific folders and subfolders under *`matlabroot`*`\toolbox` to the compilation MATLAB path. The files are added in the same order in which they appear in the MATLAB path. Use the syntax

```
-N -p directory
```

where `directory` is the folder to be included. If `directory` is not an absolute path, it is assumed to be under the current working folder.

- If a folder is included with `-p` that is on the original MATLAB path, the folder and all its subfolders that appear on the original path are added to the compilation path in the same order.
- If a folder is included with `-p` that is not on the original MATLAB path, that folder is ignored. (You can use `-I` to force its inclusion.)

- `-R`

Provides MATLAB Runtime options. This option is only relevant when building standalone applications using MATLAB Compiler. The syntax is as follows:

```
-R option
```

Option	Description	Target
`-logfile,`	Specify a log file name.	MATLAB Compiler
`-nodispla`	Suppress the MATLAB `nodisplay` run-time warning.	MATLAB Compiler
`-nojvm`	Do not use the Java Virtual Machine (JVM).	MATLAB Compiler
`-startmsg`	Customizable user message displayed at initialization time.	MATLAB Compiler Standalone Applications
`-complete`	Customizable user message displayed when initialization is complete.	MATLAB Compiler Standalone Applications

Caution: When running on Mac OS X, if you use `-nodisplay` as one of the options included in `mclInitializeApplication`, then the call to `mclInitializeApplication` must occur before calling `mclRunMain`.

Note: If you specify the `-R` option for libraries created from MATLAB Compiler SDK, `mcc` will still compile without errors and generate the results. But the `-R` option doesn't apply to these libraries and won't do anything.

- `-S`

  The standard behavior for the MATLAB Runtime is that every instance of a class gets its own MATLAB Runtime context. The context includes a global MATLAB workspace for variables, such as the path and a base workspace for each function in the class. If multiple instances of a class are created, each instance gets an independent context. This ensures that changes made to the global, or base, workspace in one instance of the class does not affect other instances of the same class.

  In a singleton MATLAB Runtime, all instances of a class share the context. If multiple instances of a class are created, they use the context created by the first instance. This saves startup time and some resources. However, any changes made to the global workspace or the base workspace by one instance impacts all class instances. For example, if `instance1` creates a global variable `A` in a singleton MATLAB Runtime, then `instance2` can use variable `A`.

  Singleton MATLAB Runtime is only supported by the following products on these specific targets:

Target supported by Singleton MATLAB Runtime	Create a Singleton MATLAB Runtime by....
Excel add-in	Default behavior for target is singleton MATLAB Runtime. You do not need to perform other steps.
.NET assembly	Default behavior for target is singleton MATLAB Runtime. You do not need to perform other steps.
COM component	• Using the Library Compiler app, click **Settings** and add `-S` to the **Additional parameters passed to MCC** field. • Using `mcc`, pass the `-S` flag.
Java package	

- `-T`

  Specify the output target phase and type.

Use the syntax `-T target` to define the output type.

Target	Description
`compile:exe`	Generate a C/C++ wrapper file and compile C/C++ files to an object form suitable for linking into a standalone application.
`compile:lib`	Generate a C/C++ wrapper file and compile C/C++ files to an object form suitable for linking into a shared library or DLL.
`link:exe`	Same as `compile:exe`, and also links object files into a standalone application.
`link:lib`	Same as `compile:lib`, and also links object files into a shared library or DLL.

- `-u`

  Register COM component for the current user only on the development machine. The argument applies only to the generic COM component and Microsoft Excel add-in targets.

- `-v`

  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`.

- `-w`

  Display warning messages. Use the syntax

  ```
  -w option [:<msg>]
  ```

to control the display of warnings.

Syntax	Description
`-w list`	List all of the possible warning that `mcc` can generate.
`-w enable`	Enable complete warnings.
`-w disable[:<string>]`	Disable specific warnings associated with *<string>*. See "Warning Messages" for a list of the *<string>* values. Omit the optional *<string>* to apply the `disable` action to all warnings.
`-w enable[:<string>]`	Enable specific warnings associated with *<string>*. See "Warning Messages" for a list of the *<string>* values. Omit the optional *<string>* to apply the `enable` action to all warnings.
`-w error[:<string>]`	Treat specific warnings associated with *<string>* as an error. Omit the optional *<string>* to apply the `error` action to all warnings.
`-w off[:<string>] [<filename>]`	Turn warnings off for specific error messages defined by *<string>*. You can also narrow scope by specifying warnings be turned off when generated by specific *<filename>*s.
`-w on[:<string>] [<filename>]`	Turn warnings on for specific error messages defined by *<string>*. You can also narrow scope by specifying warnings be turned on when generated by specific *<filename>*s.

You can also turn warnings on or off in your MATLAB code.

For example, to turn warnings off for deployed applications (specified using `isdeployed`) in your `startup.m`, you write:

```
if isdeployed
    warning off
end
```

To turn warnings on for deployed applications, you write:

```
if isdeployed
    warning on
end
```

- `-W`

  Control the generation of function wrappers. Use the syntax

  `-W` *`type`*

  to control the generation of function wrappers for a collection of MATLAB files generated by the compiler. You provide a list of functions and the compiler generates the wrapper functions and any appropriate global variable definitions.

- `-Y` Use

  ```
  -Y license.lic
  ```

  to override the default license file with the specified argument.

Note: The `-Y` flag works only with the command-line mode.

```
>>!mcc -m foo.m -Y license.lic
```

See Also

Introduced before R2006a

Utility Library for Microsoft COM Components

- "Reference Utility Classes" on page 9-2
- "Class MWUtil" on page 9-3
- "Class MWFlags" on page 9-12
- "Class MWStruct" on page 9-18
- "Class MWField" on page 9-25
- "Class MWComplex" on page 9-27
- "Class MWSparse" on page 9-30
- "Class MWArg" on page 9-34
- "Enum mwArrayFormat" on page 9-36
- "Enum mwDataType" on page 9-37
- "Enum mwDateFormat" on page 9-38

Reference Utility Classes

This section describes the `MWComUtil` library. This library is freely distributable and includes several functions used in array processing, as well as type definitions used in data conversion. This library is contained in the file `mwcomutil.dll`. It must be registered once on each machine that uses Microsoft COM components created by MATLAB Compiler or MATLAB Compiler SDK.

Register the `MWComUtil` library at the DOS command prompt with the command:

```
mwregsvr mwcomutil.dll
```

The `MWComUtil` library includes seven classes and three enumerated types. Before using these types, you must make explicit references to the `MWComUtil` type libraries in the Microsoft Visual Basic IDE.

Note: You must specify the full path of the component when calling `mwregsvr`, or make the call from the folder in which the component resides.

Class MWUtil

The `MWUtil` class contains a set of static utility methods used in array processing and application initialization. This class is implemented internally as a singleton (only one global instance of this class per instance of Microsoft Excel). It is most efficient to declare one variable of this type in global scope within each module that uses it. The methods of `MWUtil` are:

In this section...
"Sub MWInitApplication(pApp As Object)" on page 9-3
"Sub MWInitApplicationWithMCROptions(pApp As Object, [mcrOptionList])" on page 9-5
"Function IsMCRJVMEnabled() As Boolean" on page 9-6
"Function IsMCRInitialized() As Boolean" on page 9-6
"Sub MWPack(pVarArg, [Var0], [Var1], ... ,[Var31])" on page 9-7
"Sub MWUnpack(VarArg, [nStartAt As Long], [bAutoResize As Boolean = False], [pVar0], [pVar1], ..., [pVar31])" on page 9-8
"Sub MWDate2VariantDate(pVar)" on page 9-10

The function prototypes use Visual Basic syntax.

Sub MWInitApplication(pApp As Object)

Initializes the library with the current instance of Microsoft Excel.

Parameters

Argument	Type	Description
`pApp`	`Object`	A valid reference to the current Excel application

Return Value

None.

Remarks

This function must be called once for each session of Excel that uses COM components created by MATLAB Compiler. An error is generated if a method call is made to a member class of any MATLAB Compiler SDK COM component, and the library has not been initialized.

Example

This Visual Basic sample initializes the `MWComUtil` library with the current instance of Excel. A global variable of type `Object` named `MCLUtil` holds an instance of the `MWUtil` class, and another global variable of type `Boolean` named `bModuleInitialized` stores the status of the initialization process. The private subroutine `InitModule()` creates an instance of the `MWComUtil` class and calls the `MWInitApplication` method with an argument of `Application`. Once this function succeeds, all subsequent calls exit without recreating the object.

```
Dim MCLUtil As Object
Dim bModuleInitialized As Boolean

Private Sub InitModule()
    If Not bModuleInitialized Then
        On Error GoTo Handle_Error
        If MCLUtil Is Nothing Then
            Set MCLUtil = CreateObject("MWComUtil.MWUtil")
        End If
        Call MCLUtil.MWInitApplication(Application)
        bModuleInitialized = True
        Exit Sub
Handle_Error:
        bModuleInitialized = False
    End If
End Sub
```

Note: If you are developing concurrently with multiple versions of MATLAB and `MWComUtil.dll`, for example, using this syntax:

```
Set MCLUtil = CreateObject("MWComUtil.MWUtil")
```

requires you to recompile your COM modules every time you upgrade. To avoid this, make your call to the `MWUtil` module version-specific, for example:

```
Set MCLUtil = CreateObject("MWComUtil.MWUtilx.x")
```

where *`x.x`* is the specific version number.

Sub MWInitApplicationWithMCROptions(pApp As Object, [mcrOptionList])

Start MATLAB Runtime with MATLAB Runtime options. Similar to mclInitializeApplication (MATLAB Compiler SDK).

Parameters

Argument	Type	Description
`pApp`	`Object`	A valid reference only when called from an Excel application Non Excel COM clients pass in `Empty`.

Return Value

None.

Remarks

Call this function to pass in MATLAB Runtime options (`nojvm`, `logfile`, etc.). Call this function once per process.

Example

This Visual Basic sample initializes the `MWComUtil` library with the current instance of Excel. A global variable of type `Object` named `MCLUtil` holds an instance of the `MWUtil` class, and another global variable of type `Boolean` named `bModuleInitialized` stores the status of the initialization process. The private subroutine `InitModule()` creates an instance of the `MWComUtil` class and calls the `MWInitApplicationWithMCROptions` method with an argument of `Application` and a string array that contains the options. Once this function succeeds, all subsequent calls exit without recreating the object. When this function successfully executes, the MATLAB Runtime starts up with no JVM™ and a logfile named `logfile.txt`.

```
Dim MCLUtil As Object
Dim bModuleInitialized As Boolean

Private Sub InitModule()
    If Not bModuleInitialized Then
        On Error GoTo Handle_Error
```

```
        If MCLUtil Is Nothing Then
            Set MCLUtil = CreateObject("MWComUtil.MWUtil")
        End If
    Dim mcrOptions(1 To 3) as String
    mcrOptions(1) = "-nojvm"
    mcrOptions(2) = "-logfile"
    mcrOptions(3) = "logfile.txt"
        Call MCLUtil.MWInitApplicationWithMCROptions(Application, mcrOptions)
        bModuleInitialized = True
        Exit Sub
Handle_Error:
        bModuleInitialized = False
    End If
End Sub
```

Note: If you are not using Excel, pass in `Empty` instead of `Application` to `MWInitApplicationWithMCROptions`.

Function IsMCRJVMEnabled() As Boolean

Returns `true` if MATLAB Runtime is launched with JVM; otherwise returns `false`.

Parameters

None.

Return Value

`Boolean`

Function IsMCRInitialized() As Boolean

Returns `true` if MATLAB Runtime is initialized; otherwise returns `true`

Parameters

None.

Return Value

`Boolean`

Sub MWPack(pVarArg, [Var0], [Var1], ... ,[Var31])

Packs a variable length list of `Variant` arguments into a single `Variant` array. This function is typically used for creating a `varargin` cell from a list of separate inputs. Each input in the list is added to the array only if it is not empty or missing. (In Visual Basic, a missing parameter is denoted by a `Variant` type of `vbError` with a value of `&H80020004`.)

Parameters

Argument	Type	Description
`pVarArg`	`Variant`	Receives the resulting array
`[Var0], [Var1], ...`	`Variant`	Optional list of `Variant`s to pack into the array. From 0 to 32 arguments can be passed.

Return Value

None.

Remarks

This function always frees the contents of `pVarArg` before processing the list.

Example

This example uses `MWPack` in a formula function to produce a `varargin` cell to pass as an input parameter to a method compiled from a MATLAB function with the signature

```
function y = mysum(varargin)
    y = sum([varargin{:}]);
```

The function returns the sum of the elements in `varargin`. Assume that this function is a method of a class named `myclass` that is included in a component named `mycomponent` with a version of 1.0. The Visual Basic function allows up to 10 inputs, and returns the result `y`. If an error occurs, the function returns the error message. This function assumes that `MWInitApplication` has been previously called.

```
Function mysum(Optional V0 As Variant, _
```

```
                Optional V1 As Variant, _
                Optional V2 As Variant, _
                Optional V3 As Variant, _
                Optional V4 As Variant, _
                Optional V5 As Variant, _
                Optional V6 As Variant, _
                Optional V7 As Variant, _
                Optional V8 As Variant, _
                Optional V9 As Variant) As Variant
Dim y As Variant
Dim varargin As Variant
Dim aClass As Object
Dim aUtil As Object

    On Error Goto Handle_Error
    Set aClass = CreateObject("mycomponent.myclass.1_0")
    Set aUtil = CreateObject("MWComUtil.MWUtil")
    Call aUtil.MWPack(varargin,V0,V1,V2,V3,V4,V5,V6,V7,V8,V9)
    Call aClass.mysum(1, y, varargin)
    mysum = y
    Exit Function
Handle_Error:
    mysum = Err.Description
End Function
```

Sub MWUnpack(VarArg, [nStartAt As Long], [bAutoResize As Boolean = False], [pVar0], [pVar1], ..., [pVar31])

Unpacks an array of `Variant`s into individual `Variant` arguments. This function provides the reverse functionality of `MWPack` and is typically used to process a `varargout` cell into individual `Variant`s.

Parameters

Argument	Type	Description
`VarArg`	`Variant`	Input array of `Variant`s to be processed
`nStartAt`	`Long`	Optional starting index (zero-based) in the array to begin processing. Default = `0`.

Argument	Type	Description
bAutoResize	Boolean	Optional auto-resize flag. If this flag is True, any Excel range output arguments are resized to fit the dimensions of the Variant to be copied. The resizing process is applied relative to the upper left corner of the supplied range. Default = False.
[pVar0],[pVar1], ...	Variant	Optional list of Variants to receive the array items contained in VarArg. From 0 to 32 arguments can be passed.

Return Value

None.

Remarks

This function can process a Variant array in one single call or through multiple calls using the nStartAt parameter.

Example

This example uses MWUnpack to process a varargout cell into several Excel ranges, while auto-resizing each range. The varargout parameter is supplied from a method that has been compiled from the MATLAB function.

```
function varargout = randvectors
    for i=1:nargout
        varargout{i} = rand(i,1);
    end
```

This function produces a sequence of nargout random column vectors, with the length of the ith vector equal to i. Assume that this function is included in a class named myclass that is included in a component named mycomponent with a version of 1.0. The Visual Basic subroutine takes no arguments and places the results into Excel columns starting

at A1, B1, C1, and D1. If an error occurs, a message box displays the error text. This function assumes that `MWInitApplication` has been previously called.

```
Sub GenVectors()
    Dim aClass As Object
    Dim aUtil As Object
    Dim v As Variant
    Dim R1 As Range
    Dim R2 As Range
    Dim R3 As Range
    Dim R4 As Range

    On Error GoTo Handle_Error
    Set aClass = CreateObject("mycomponent.myclass.1_0")
    Set aUtil = CreateObject("MWComUtil.MWUtil")
    Set R1 = Range("A1")
    Set R2 = Range("B1")
    Set R3 = Range("C1")
    Set R4 = Range("D1")
    Call aClass.randvectors(4, v)
    Call aUtil.MWUnpack(v,0,True,R1,R2,R3,R4)
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub
```

Sub MWDate2VariantDate(pVar)

Converts output dates from MATLAB to `Variant` dates.

Parameters

Argument	Type	Description
`pVar`	`Variant`	`Variant` to be converted

Return Value

None.

Remarks

MATLAB handles dates as double-precision floating-point numbers with 0.0 representing 0/0/00 00:00:00. By default, numeric dates that are output parameters from compiled

MATLAB functions are passed as `Double`s that need to be decremented by the COM date bias as well as coerced to COM dates. The `MWDate2VariantDate` method performs this transformation and additionally converts dates in character vector form to COM date types.

Example

This example uses `MWDate2VariantDate` to process numeric dates returned from a method compiled from the following MATLAB function.

```
function x = getdates(n, inc)
    y = now;
    for i=1:n
        x(i,1) = y + (i-1)*inc;
    end
```

This function produces an `n`-length column vector of numeric values representing dates starting from the current date and time with each element incremented by `inc` days. Assume that this function is included in a class named `myclass` that is included in a component named `mycomponent` with a version of 1.0. The subroutine takes an Excel range and a `Double` as inputs and places the generated dates into the supplied range. If an error occurs, a message box displays the error text. This function assumes that `MWInitApplication` has been previously called.

```
Sub GenDates(R As Range, inc As Double)
    Dim aClass As Object
    Dim aUtil As Object

    On Error GoTo Handle_Error
    Set aClass = CreateObject("mycomponent.myclass.1_0")
    Set aUtil = CreateObject("MWComUtil.MWUtil")
    Call aClass.getdates(1, R, R.Rows.Count, inc)
    Call aUtil.MWDate2VariantDate(R)
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub
```

Class MWFlags

The `MWFlags` class contains a set of array formatting and data conversion flags (See "Rules for Data Conversion Between .NET and MATLAB" (MATLAB Compiler SDK) for more information on conversion between MATLAB and COM Automation types.) All MATLAB Compiler SDK COM components contain a reference to an `MWFlags` object that can modify data conversion rules at the object level. This class contains these properties and method:

In this section...
"Property ArrayFormatFlags As MWArrayFormatFlags" on page 9-12
"Property DataConversionFlags As MWDataConversionFlags" on page 9-15
"Sub Clone(ppFlags As MWFlags)" on page 9-17

Property ArrayFormatFlags As MWArrayFormatFlags

The `ArrayFormatFlags` property controls array formatting (as a matrix or a cell array) and the application of these rules to nested arrays. The `MWArrayFormatFlags` class is a noncreatable class accessed through an `MWFlags` class instance. This class contains six properties:

- "Property InputArrayFormat As mwArrayFormat" on page 9-12
- "Property InputArrayIndFlag As Long" on page 9-13
- "Property OutputArrayFormat As mwArrayFormat" on page 9-13
- "Property OutputArrayIndFlag As Long" on page 9-14
- "Property AutoResizeOutput As Boolean" on page 9-14
- "Property TransposeOutput As Boolean" on page 9-14

Property InputArrayFormat As mwArrayFormat

This property of type `mwArrayFormat` controls the formatting of arrays passed as input parameters to MATLAB Compiler SDK class methods. The default value is `mwArrayFormatMatrix`. The behaviors indicated by this flag are listed in the next table.

Array Formatting Rules for Input Arrays

Value	Behavior
`mwArrayFormatAsIs`	Converts arrays according to the default conversion rules listed in "Rules for Data Conversion Between .NET and MATLAB" (MATLAB Compiler SDK).
`mwArrayFormatCell`	Coerces all arrays into cell arrays. Input scalar or numeric array arguments are converted to cell arrays with each cell containing a scalar value for the respective index.
`mwArrayFormatMatrix`	Coerces all arrays into matrices. When an input argument is encountered that is an array of `Variant`s (the default behavior is to convert it to a cell array), the data converter converts this array to a matrix if each `Variant` is single valued, and all elements are homogeneous and of a numeric type. If this conversion is not possible, creates a cell array.

Property InputArrayIndFlag As Long

This property governs the level at which to apply the rule set by the `InputArrayFormat` property for nested arrays (an array of `Variant`s is passed and each element of the array is an array itself). It is not necessary to modify this flag for `varargin` parameters. The data conversion code automatically increments the value of this flag by 1 for `varargin` cells, thus applying the `InputArrayFormat` flag to each cell of a `varargin` parameter. The default value is `0`.

Property OutputArrayFormat As mwArrayFormat

This property of type `mwArrayFormat` controls the formatting of arrays passed as output parameters to class methods. The default value is `mwArrayFormatAsIs`. The behaviors indicated by this flag are listed in the next table.

Array Formatting Rules for Output Arrays

Value	Behavior
`mwArrayFormatAsIs`	Converts arrays according to the default conversion rules listed in "Rules for Data

Value	Behavior
	Conversion Between .NET and MATLAB" (MATLAB Compiler SDK).
`mwArrayFormatMatrix`	Coerces all arrays into matrices. When an output cell array argument is encountered (the default behavior converts it to an array of `Variant`s), the data converter converts this array to a `Variant` that contains a simple numeric array if each cell is single valued, and all elements are homogeneous and of a numeric type. If this conversion is not possible, an array of `Variant`s is created.
`mwArrayFormatCell`	Coerces all output arrays into arrays of `Variant`s. Output scalar or numeric array arguments are converted to arrays of `Variant`s, each `Variant` containing a scalar value for the respective index.

Property OutputArrayIndFlag As Long

This property is similar to the `InputArrayIndFalg` property, as it governs the level at which to apply the rule set by the `OutputArrayFormat` property for nested arrays. As with the input case, this flag is automatically incremented by 1 for a `varargout` parameter. The default value of this flag is `0`.

Property AutoResizeOutput As Boolean

This flag applies to Excel ranges only. When the target output from a method call is a range of cells in an Excel worksheet, and the output array size and shape is not known at the time of the call, setting this flag to `True` instructs the data conversion code to resize each Excel range to fit the output array. Resizing is applied relative to the upper left corner of each supplied range. The default value for this flag is `False`.

Property TransposeOutput As Boolean

Setting this flag to `True` transposes the output arguments. This flag is useful when processing an output parameter from a method call on a COM component, where the MATLAB function returns outputs as row vectors, and you desire to place the data into columns. The default value for this flag is `False`.

Property DataConversionFlags As MWDataConversionFlags

The `DataConversionFlags` property controls how input variables are processed when type coercion is needed. The `MWDataConversionFlags` class is a noncreatable class accessed through an `MWFlags` class instance. This class contains these properties:

- "Property CoerceNumericToType As mwDataType" on page 9-15
- "PropertyDateBias As Long" on page 9-15
- "Property InputDateFormat As mwDateFormat" on page 9-16
- "PropertyOutputAsDate As Boolean" on page 9-17
- "ReplaceMissing As mwReplaceMissingData" on page 9-17

Property CoerceNumericToType As mwDataType

This property converts all numeric input arguments to one specific MATLAB type. This flag is useful is when variables maintained within the Visual Basic code are different types, e.g., `Long`, `Integer`, etc., and all variables passed to the compiled MATLAB code must be doubles. The default value for this property is `mwTypeDefault`, which uses the default rules in "Rules for Data Conversion Between .NET and MATLAB" (MATLAB Compiler SDK).

PropertyDateBias As Long

This property sets the date bias for performing COM to MATLAB numeric date conversions. The default value of this property is 693960, representing the difference between the COM `Date` type and MATLAB numeric dates. This flag allows existing MATLAB code that already performs the increment of numeric dates by 693960 to be used unchanged with COM components. To process dates with such code, set this property to `0`.

This example uses data conversion flags to reshape the output from a method compiled from a MATLAB function that produces an output vector of unknown length.

```
function p = myprimes(n)
if length(n)~=1, error('N must be a scalar'); end
if n < 2, p = zeros(1,0); return, end
p = 1:2:n;
q = length(p);
p(1) = 2;
for k = 3:2:sqrt(n)
    if p((k+1)/2)
        p(((k*k+1)/2):k:q) = 0;
```

```
    end
end
p = (p(p>0));
```

This function produces a row vector of all the prime numbers between 0 and `n`. Assume that this function is included in a class named `myclass` that is included in a component named `mycomponent` with a version of 1.0. The subroutine takes an Excel range and a `Double` as inputs, and places the generated prime numbers into the supplied range. The MATLAB function produces a row vector, although you want the output in column format. It also produces an unknown number of outputs, and you do not want to truncate any output. To handle these issues, set the `TransposeOutput` flag and the `AutoResizeOutput` flag to `True`. In previous examples, the Visual Basic `CreateObject` function creates the necessary classes. This example uses an explicit type declaration for the `aClass` variable. As with previous examples, this function assumes that `MWInitApplication` has been previously called.

```
Sub GenPrimes(R As Range, n As Double)
    Dim aClass As mycomponent.myclass

    On Error GoTo Handle_Error
    Set aClass = New mycomponent.myclass
    aClass.MWFlags.ArrayFormatFlags.AutoResizeOutput = True
    aClass.MWFlags.ArrayFormatFlags.TransposeOutput = True
    Call aClass.myprimes(1, R, n)
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub
```

Property InputDateFormat As mwDateFormat

This property converts dates passed as input parameters to method calls on MATLAB Compiler SDK classes. The default value is `mwDateFormatNumeric`. The behaviors indicated by this flag are shown in the following table.

Conversion Rules for Input Dates

Value	Behavior
`mwDateFormatNumeric`	Convert dates to numeric values as indicated by the rule listed in "Rules for Data Conversion Between .NET and MATLAB" (MATLAB Compiler SDK).

Value	Behavior
mwDateFormatString	Convert input dates to strings.

PropertyOutputAsDate As Boolean

This property processes an output argument as a date. By default, numeric dates that are output parameters from compiled MATLAB functions are passed as Doubles that need to be decremented by the COM date bias (693960) as well as coerced to COM dates. Set this flag to True to convert all output values of type Double.

ReplaceMissing As mwReplaceMissingData

This property is an enumeration and can have two possible values: mwReplaceNaN and mwReplaceZero.

To treat empty cells referenced by input parameters as zeros, set the value to mwReplaceZero. To treat empty cells referenced by input parameters as NaNs (Not a Number), set the value to mwReplaceNaN.

By default, the value is mwReplaceZero.

Sub Clone(ppFlags As MWFlags)

Creates a copy of an MWFlags object.

Parameters

Argument	Type	Description
ppFlags	MWFlags	Reference to an uninitialized MWFlags object that receives the copy

Return Value

None

Remarks

Clone allocates a new MWFlags object and creates a deep copy of the object's contents. Call this function when a separate object is required instead of a shared copy of an existing object reference.

Class MWStruct

The `MWStruct` class passes or receives a `Struct` type to or from a compiled class method. This class contains seven properties/methods:

In this section...
“Sub Initialize([varDims], [varFieldNames])” on page 9-18
“Property Item([i0], [i1], ..., [i31]) As MWField” on page 9-19
“Property NumberOfFields As Long” on page 9-22
“Property NumberOfDims As Long” on page 9-22
“Property Dims As Variant” on page 9-22
“Property FieldNames As Variant” on page 9-22
“Sub Clone(ppStruct As MWStruct)” on page 9-23

Sub Initialize([varDims], [varFieldNames])

This method allocates a structure array with a specified number and size of dimensions and a specified list of field names.

Parameters

Argument	Type	Description
`varDims`	`Variant`	Optional array of dimensions
`varFieldNames`	`Variant`	Optional array of field names

Return Value

None.

Remarks

When created, an `MWStruct` object has a dimensionality of 1-by-1 and no fields. The `Initialize` method dimensions the array and adds a set of named fields to each element. Each time you call `Initialize` on the same object, it is redimensioned. If you do not supply the `varDims` argument, the existing number and size of the array's dimensions unchanged. If you do not supply the `varFieldNames` argument, the existing list of fields is not changed. Calling `Initialize` with no arguments leaves the array unchanged.

Example

The following Visual Basic code illustrates use of the `Initialize` method to dimension struct arrays.

```
Sub foo ()
    Dim x As MWStruct
    Dim y As MWStruct

    On Error Goto Handle_Error
    'Create 1X1 struct arrays with no fields for x, and y
    Set x = new MWStruct
    Set y = new MWStruct

    'Initialize x to be 2X2 with fields "red", "green",
    '                                    and "blue"
    Call x.Initialize(Array(2,2), Array("red", "green", "blue"))
    'Initialize y to be 1X5 with fields "name" and "age"
    Call y.Initialize(5, Array("name", "age"))

    'Re-dimension x to be 3X3 with the same field names
    Call x.Initialize(Array(3,3))

    'Add a new field to y
    Call y.Initialize(, Array("name", "age", "salary"))

    Exit Sub
Handle_Error:
    MsgBox(Err.Description)
End Sub
```

Property Item([i0], [i1], ..., [i31]) As MWField

The `Item` property is the default property of the `MWStruct` class. This property is used to set/get the value of a field at a particular index in the structure array.

Parameters

Argument	Type	Description
`i0`,`i1`, ..., `i31`	`Variant`	Optional index arguments. Between 0 and 32 index arguments can be entered. To reference an element of

Argument	Type	Description
		the array, specify all indexes as well as the field name.

Remarks

When accessing a named field through this property, you must supply all dimensions of the requested field as well as the field name. This property always returns a single field value, and generates a bad index error if you provide an invalid or incomplete index list. Index arguments have four basic formats:

- Field name only

  This format may be used only in the case of a 1-by-1 structure array and returns the named field's value. For example:

  ```
  x("red") = 0.2
  x("green") = 0.4
  x("blue") = 0.6
  ```

  In this example, the name of the `Item` property was neglected. This is possible since the `Item` property is the default property of the `MWStruct` class. In this case the two statements are equivalent:

  ```
  x.Item("red") = 0.2
  x("red") = 0.2
  ```

- Single index and field name

This format accesses array elements through a single subscripting notation. A single numeric index `n` followed by the field name returns the named field on the `n`th array element, navigating the array linearly in column-major order. For example, consider a 2-by-2 array of structures with fields `"red"`, `"green"` , and `"blue"` stored in a variable `x`. These two statements are equivalent:

```
y = x(2, "red")
y = x(2, 1, "red")
```

- All indices and field name

This format accesses an array element of an multidimensional array by specifying `n` indices. These statements access all four of the elements of the array in the previous example:

```
For I From 1 To 2
       For J From 1 To 2
              r(I, J) = x(I, J, "red")
              g(I, J) = x(I, J, "green")
              b(I, J) = x(I, J, "blue")
       Next
Next
```

- Array of indices and field name

This format accesses an array element by passing an array of indices and a field name. The next example rewrites the previous example using an index array:

```
Dim Index(1 To 2) As Integer

For I From 1 To 2
       Index(1) = I
       For J From 1 To 2
              Index(2) = J
              r(I, J) = x(Index, "red")
              g(I, J) = x(Index, "green")
              b(I, J) = x(Index, "blue")
       Next
Next
```

With these four formats, the `Item` property provides a very flexible indexing mechanism for structure arrays. Also note:

- You can combine the last two indexing formats. Several index arguments supplied in either scalar or array format are concatenated to form one index set. The combining stops when the number of dimensions has been reached. For example:

  ```
  Dim Index1(1 To 2) As Integer
  Dim Index2(1 To 2) As Integer

  Index1(1) = 1
  Index1(2) = 1
  Index2(1) = 3
  Index2(2) = 2
  x(Index1, Index2, 2, "red") = 0.5
  ```

The last statement resolves to

```
x(1, 1, 3, 2, 2, "red") = 0.5
```

- The field name must be the last index in the list. The following statement produces an error:

  ```
  y = x("blue", 1, 2)
  ```

- Field names are case sensitive.

Property NumberOfFields As Long

The read-only `NumberOfFields` property returns the number of fields in the structure array.

Property NumberOfDims As Long

The read-only `NumberOfDims` property returns the number of dimensions in the struct array.

Property Dims As Variant

The read-only `Dims` property returns an array of length `NumberOfDims` that contains the size of each dimension of the struct array.

Property FieldNames As Variant

The read-only `FieldNames` property returns an array of length `NumberOfFields` that contains the field names of the elements of the structure array.

Example

The next Visual Basic code sample illustrates how to access a two-dimensional structure array's fields when the field names and dimension sizes are not known in advance.

```
Sub foo ()
      Dim x As MWStruct
      Dim Dims as Variant
      Dim FieldNames As Variant


      On Error Goto Handle_Error
      '
      '... Call a method that returns an MWStruct in x
```

```
      '
      Dims = x.Dims
      FieldNames = x.FieldNames
      For I From 1 To Dims(1)
            For J From 1 To Dims(2)
                  For K From 1 To x.NumberOfFields
                        y = x(I,J,FieldNames(K))
                        ' ... Do something with y
                  Next
            Next
      Next
Exit Sub
Handle_Error:
      MsgBox(Err.Description)
End Sub
```

Sub Clone(ppStruct As MWStruct)

Creates a copy of an `MWStruct` object.

Parameters

Argument	Type	Description
`ppStruct`	`MWStruct`	Reference to an uninitialized `MWStruct` object to receive the copy

Return Value

None

Remarks

`Clone` allocates a new `MWStruct` object and creates a deep copy of the object's contents. Call this function when a separate object is required instead of a shared copy of an existing object reference.

Example

The following Visual Basic example illustrates the difference between assignment and `Clone` for `MWStruct` objects.

```
Sub foo ()
    Dim x1 As MWStruct
    Dim x2 As MWStruct
    Dim x3 As MWStruct

    On Error Goto Handle_Error
    Set x1 = new MWStruct
    x1("name") = "John Smith"
    x1("age") = 35

   'Set reference of x1 to x2
    Set x2 = x1
   'Create new object for x3 and copy contents of x1 into it
    Call x1.Clone(x3)
   'x2's "age" field is
   'also modified 'x3's "age" field unchanged
    x1("age") = 50
        .
        .
        .
    Exit Sub
Handle_Error:
    MsgBox(Err.Description)
End Sub
```

Class MWField

The `MWField` class holds a single field reference in an `MWStruct` object. This class is noncreatable and contains four properties/methods:

In this section...
“Property Name As String” on page 9-25
“Property Value As Variant” on page 9-25
“Property MWFlags As MWFlags” on page 9-25
“Sub Clone(ppField As MWField)” on page 9-25

Property Name As String

The name of the field (read only).

Property Value As Variant

Stores the field's value (read/write). The `Value` property is the default property of the `MWField` class. The value of a field can be any type that is coercible to a `Variant`, as well as object types.

Property MWFlags As MWFlags

Stores a reference to an `MWFlags` object. This property sets or gets the array formatting and data conversion flags for a particular field. Each field in a structure has its own `MWFlags` property. This property overrides the value of any flags set on the object whose methods are called.

Sub Clone(ppField As MWField)

Creates a copy of an `MWField` object.

Parameters

Argument	Type	Description
`ppField`	`MWField`	Reference to an uninitialized `MWField` object to receive the copy

Return Value

None.

Remarks

`Clone` allocates a new `MWField` object and creates a deep copy of the object's contents. Call this function when a separate object is required instead of a shared copy of an existing object reference.

Class MWComplex

The `MWComplex` class passes or receives a complex numeric array into or from a compiled class method. This class contains four properties/methods:

In this section...
“Property Real As Variant” on page 9-27
“Property Imag As Variant” on page 9-27
“Property MWFlags As MWFlags” on page 9-28
“Sub Clone(ppComplex As MWComplex)” on page 9-28

Property Real As Variant

Stores the real part of a complex array (read/write). The `Real` property is the default property of the `MWComplex` class. The value of this property can be any type coercible to a `Variant`, as well as object types, with the restriction that the underlying array must resolve to a numeric matrix (no cell data allowed). Valid Visual Basic numeric types for complex arrays include `Byte`, `Integer`, `Long`, `Single`, `Double`, `Currency`, and `Variant/vbDecimal`.

Property Imag As Variant

Stores the imaginary part of a complex array (read/write). The `Imag` property is optional and can be `Empty` for a pure real array. If the `Imag` property is not empty and the size and type of the underlying array do not match the size and type of the `Real` property's array, an error results when the object is used in a method call.

Example

The following Visual Basic code creates a complex array with the following entries:

```
    x = [ 1+i 1+2i
          2+i 2+2i ]
Sub foo()
    Dim x As MWComplex
    Dim rval(1 To 2, 1 To 2) As Double
    Dim ival(1 To 2, 1 To 2) As Double
```

```
    On Error Goto Handle_Error
    For I = 1 To 2
        For J = 1 To 2
                rval(I,J) = I
                ival(I,J) = J
        Next
    Next
    Set x = new MWComplex
    x.Real = rval
    x.Imag = ival
        .
        .
        .
    Exit Sub
Handle_Error:
    MsgBox(Err.Description)
End Sub
```

Property MWFlags As MWFlags

Stores a reference to an `MWFlags` object. This property sets or gets the array formatting and data conversion flags for a particular complex array. Each `MWComplex` object has its own `MWFlags` property. This property overrides the value of any flags set on the object whose methods are called.

Sub Clone(ppComplex As MWComplex)

Creates a copy of an `MWComplex` object.

Parameters

Argument	Type	Description
`ppComplex`	`MWComplex`	Reference to an uninitialized `MWComplex` object to receive the copy

Return Value

None

Remarks

`Clone` allocates a new `MWComplex` object and creates a deep copy of the object's contents. Call this function when a separate object is required instead of a shared copy of an existing object reference.

Class MWSparse

The `MWSparse` class passes or receives a two-dimensional sparse numeric array into or from a compiled class method. This class has seven properties/methods:

In this section...
“Property NumRows As Long” on page 9-30
“Property NumColumns As Long” on page 9-30
“Property RowIndex As Variant” on page 9-30
“Property ColumnIndex As Variant” on page 9-31
“Property Array As Variant” on page 9-31
“Property MWFlags As MWFlags” on page 9-31
“Sub Clone(ppSparse As MWSparse)” on page 9-31

Property NumRows As Long

Stores the row dimension for the array. The value of `NumRows` must be nonnegative. If the value is zero, the row index is taken from the maximum of the values in the `RowIndex` array.

Property NumColumns As Long

Stores the column dimension for the array. The value of `NumColumns` must be nonnegative. If the value is zero, the row index is taken from the maximum of the values in the `ColumnIndex` array.

Property RowIndex As Variant

Stores the array of row indices of the nonzero elements of the array. The value of this property can be any type coercible to a `Variant`, as well as object types, with the restriction that the underlying array must resolve to or be coercible to a numeric matrix of type `Long`. If the value of `NumRows` is nonzero and any row index is greater than `NumRows`, a bad-index error occurs. An error also results if the number of elements in the `RowIndex` array does not match the number of elements in the `Array` property's underlying array.

Property ColumnIndex As Variant

Stores the array of column indices of the nonzero elements of the array. The value of this property can be any type coercible to a `Variant`, as well as object types, with the restriction that the underlying array must resolve to or be coercible to a numeric matrix of type `Long`. If the value of `NumColumns` is nonzero and any column index is greater than `NumColumns`, a bad-index error occurs. An error also results if the number of elements in the `ColumnIndex` array does not match the number of elements in the `Array` property's underlying array.

Property Array As Variant

Stores the nonzero array values of the sparse array. The value of this property can be any type coercible to a `Variant`, as well as object types, with the restriction that the underlying array must resolve to or be coercible to a numeric matrix of type `Double` or `Boolean`.

Property MWFlags As MWFlags

Stores a reference to an `MWFlags` object. This property sets or gets the array formatting and data conversion flags for a particular sparse array. Each `MWSparse` object has its own `MWFlags` property. This property overrides the value of any flags set on the object whose methods are called.

Sub Clone(ppSparse As MWSparse)

Creates a copy of an `MWSparse` object.

Parameters

Argument	Type	Description
`ppSparse`	`MWSparse`	Reference to an uninitialized `MWSparse` object to receive the copy

Return Value

None.

Remarks

`Clone` allocates a new `MWSparse` object and creates a deep copy of the object's contents. Call this function when a separate object is required instead of a shared copy of an existing object reference.

Example

The following Visual Basic sample creates a 5-by-5 tridiagonal sparse array with the following entries:

```
X = [ 2 -1  0   0   0
     -1  2 -1   0   0
      0 -1  2  -1   0
      0  0 -1   2  -1
      0  0  0  -1   2 ]
```

```
Sub foo()
    Dim x As MWSparse
    Dim rows(1 To 13) As Long
    Dim cols(1 To 13) As Long
    Dim vals(1 To 13) As Double
    Dim I As Long, K As Long

    On Error GoTo Handle_Error
    K = 1
    For I = 1 To 4
        rows(K) = I
        cols(K) = I + 1
        vals(K) = -1
        K = K + 1
        rows(K) = I
        cols(K) = I
        vals(K) = 2
        K = K + 1
        rows(K) = I + 1
        cols(K) = I
        vals(K) = -1
        K = K + 1
    Next
    rows(K) = 5
    cols(K) = 5
    vals(K) = 2
    Set x = New MWSparse
```

```
    x.NumRows = 5
    x.NumColumns = 5
    x.RowIndex = rows
    x.ColumnIndex = cols
    x.Array = vals
        .
        .
        .
    Exit Sub
Handle_Error:
    MsgBox (Err.Description)
End Sub
```

Class MWArg

The `MWArg` class passes a generic argument into a compiled class method. This class passes an argument for which the data conversion flags are changed for that one argument. This class has three properties/methods:

In this section...
“Property Value As Variant” on page 9-34
“Property MWFlags As MWFlags” on page 9-34
“Sub Clone(ppArg As MWArg)” on page 9-34

Property Value As Variant

The `Value` property stores the actual argument to pass. Any type that can be passed to a compiled method is valid for this property.

Property MWFlags As MWFlags

Stores a reference to an `MWFlags` object. This property sets or gets the array formatting and data conversion flags for a particular argument. Each `MWArg` object has its own `MWFlags` property. This property overrides the value of any flags set on the object whose methods are called.

Sub Clone(ppArg As MWArg)

Creates a copy of an `MWArg` object.

Parameters

Argument	Type	Description
`ppArg`	`MWArg`	Reference to an uninitialized `MWArg` object to receive the copy

Return Value

None.

Remarks

Clone allocates a new `MWArg` object and creates a deep copy of the object's contents. Call this function when a separate object is required instead of a shared copy of an existing object reference.

Enum mwArrayFormat

The `mwArrayFormat` enumeration is a set of constants that denote an array formatting rule for data conversion.

mwArrayFormat Values

Constant	Numeric Value	Description
`mwArrayFormatAsIs`	0	Do not reformat the array.
`mwArrayFormatMatrix`	1	Format the array as a matrix.
`mwArrayFormatCell`	2	Format the array as a cell array.

Enum mwDataType

The `mwDataType` enumeration is a set of constants that denote a MATLAB numeric type.

mwDataType Values

Constant	Numeric Value	MATLAB Type
`mwTypeDefault`	0	Not applicable
`mwTypeLogical`	3	`logical`
`mwTypeChar`	4	`char`
`mwTypeDouble`	6	`double`
`mwTypeSingle`	7	`single`
`mwTypeInt8`	8	`int8`
`mwTypeUint8`	9	`uint8`
`mwTypeInt16`	10	`int16`
`mwTypeUint16`	11	`uint16`
`mwTypeInt32`	12	`int32`
`mwTypeUint32`	13	`uint32`

Enum mwDateFormat

The `mwDateFormat` enumeration is a set of constants that denote a formatting rule for dates.

mwDateFormat Values

Constant	Numeric Value	Description
`mwDateFormatNumeric`	0	Format dates as numeric values
`mwDateFormatString`	1	Format dates as strings

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Apps — Alphabetical List

Library Compiler

Package MATLAB programs for deployment as shared libraries and components

Description

The **Library Compiler** app packages MATLAB functions to include MATLAB functionality in applications written in other languages.

Open the Library Compiler App

- MATLAB Toolstrip: On the **Apps** tab, under **Application Deployment**, click the app icon.
- MATLAB command prompt: Enter `libraryCompiler`.

Examples

- "Create a C/C++ Shared Library with MATLAB Code" (MATLAB Compiler SDK)
- "Package Excel Add-In with Library Compiler App" on page 1-9
- "Create a .NET Application with MATLAB Code" (MATLAB Compiler SDK)
- "Package a Deployable COM Component" (MATLAB Compiler SDK)
- "Create a Java Application with MATLAB Code" (MATLAB Compiler SDK)
- "Compile Python Packages with Library Compiler App" (MATLAB Compiler SDK)

Parameters

`type` — type of library generated

C Shared Library | C++ Shared Library | Excel Add-in | Generic COM Component | Java Package | .NET Assembly | Python Package

Type of library to generate.

`exported functions` — functions to package

list of character vectors

Functions to package as a list of character vectors.

`packaging options` — method for installing the MATLAB Runtime with the compiled library
MATLAB Runtime downloaded from web (default) | MATLAB Runtime included in package

Method for installing the MATLAB Runtime as a radio button. Including MATLAB Runtime in the package significantly increases the size of the package.

`files required for your library to run` — files that must be included with library
list of files

Files that must be included with library as a list of files.

`files installed for your end user` — optional files installed with library
list of files

Optional files installed with library as a list of files.

Settings

`Additional parameters passed to MCC` — flags controlling the behavior of the compiler
character vector

Flags controlling the behavior of the compiler as a character vector.

`testing files` — folder where files for testing are stored
character vector

Folder where files for testing are stored as a character vector.

`end user files` — folder where files for building a custom installer are stored
character vector

Folder where files for building a custom installer are stored are stored as a character vector.

`packaged installers` — folder where generated installers are stored
character vector

Folder where generated installers are stored as a character vector.

Library Information

`library name` — name of the installed library
character vector

Name of the installed library as a character vector.

The default value is the name of the first function listed in the **Exported Functions** field of the app.

`version` — version of the generated library
character vector

Version of the generated library as a character vector.

`splash screen` — image displayed on installer
image

Image displayed on installer as an image.

`author name` — name of the library author
character vector

Name of the library author as a character vector.

`e-mail` — e-mail address used to contact library support
character vector

E-mail address used to contact library support as a character vector.

`summary` — brief description of library
character vector

Brief description of library as a character vector.

`description` — detailed description of library
character vector

Detailed description of library as a character vector.

Additional Installer Options

`default installation folder` — folder where artifacts are installed
character vector

Folder where artifacts are installed as a character vector.

`installation notes` — notes about additional requirements for using artifacts
character vector

Notes about additional requirements for using artifacts as a character vector.

Programmatic Use

```
libraryCompiler
```

See Also

Topics

"Create a C/C++ Shared Library with MATLAB Code" (MATLAB Compiler SDK)
"Package Excel Add-In with Library Compiler App" on page 1-9
"Create a .NET Application with MATLAB Code" (MATLAB Compiler SDK)
"Package a Deployable COM Component" (MATLAB Compiler SDK)
"Create a Java Application with MATLAB Code" (MATLAB Compiler SDK)
"Compile Python Packages with Library Compiler App" (MATLAB Compiler SDK)

Introduced in R2013b

A

Data Conversion

Data Conversion Rules

This topic describes the data conversion rules for the MATLAB Compiler components. These components are dual interface Microsoft COM objects that support data types compatible with Automation.

Note: *Automation* (formerly called OLE Automation) is a technology that allows software packages to expose their unique features to scripting tools and other applications. Automation uses the Component Object Model (COM), but may be implemented independently from other OLE features, such as in-place activation.

When a method is invoked on a MATLAB Compiler component, the input parameters are converted to the MATLAB internal array format and passed to the compiled MATLAB function. When the function exits, the output parameters are converted from the MATLAB internal array format to COM Automation types.

The COM client passes all input and output arguments in the compiled MATLAB functions as type `VARIANT`. The COM `VARIANT` type is a union of several simple data types. A type `VARIANT` variable can store a variable of any of the simple types, as well as arrays of any of these values.

The Win32 application program interface (API) provides many functions for creating and manipulating `VARIANT`s in C/C++, and Visual Basic provides native language support for this type.

Note: This discussion of data refers to both `VARIANT` and `Variant` data types. `VARIANT` is the C++ name and `Variant` is the corresponding data type in Visual Basic.

See the Visual Studio® documentation for definitions and API support for COM `VARIANT`s. `VARIANT` variables are self describing and store their type code as an internal field of the structure.

The following table lists the `VARIANT` type codes supported by the MATLAB Compiler components.

VARIANT Type Codes Supported

VARIANT Type Code (C/C++)	C/C++ Type	Variant Type Code (Visual Basic)	Visual BasicType	Definition
VT_EMPTY	—	vbEmpty	—	Uninitialized VARIANT
VT_I1	char	—	—	Signed one-byte character
VT_UI1	unsigned char	vbByte	Byte	Unsigned one-byte character
VT_I2	short	vbInteger	Integer	Signed two-byte integer
VT_UI2	unsigned short	—	—	Unsigned two-byte integer
VT_I4	long	vbLong	Long	Signed four-byte integer
VT_UI4	unsigned long	—	—	Unsigned four-byte integer
VT_R4	float	vbSingle	Single	IEEE® four-byte floating-point value
VT_R8	double	vbDouble	Double	IEEE eight-byte floating-point value
VT_CY	CY+	vbCurrency	Currency	Currency value (64-bit integer, scaled by 10,000)
VT_BSTR	BSTR+	vbString	String	String value
VT_ERROR	SCODE+	vbError	—	An HRESULT (signed four-byte integer representing a COM error code)
VT_DATE	DATE+	vbDate	Date	Eight-byte floating point value representing date and time
VT_INT	int	—	—	Signed integer; equivalent to type int

VARIANT Type Code (C/C++)	C/C++ Type	Variant Type Code (Visual Basic)	Visual BasicType	Definition
VT_UINT	unsigned int	—	—	Unsigned integer; equivalent to type unsigned int
VT_DECIMAL	DECIMAL+	vbDecimal	—	96-bit (12-byte) unsigned integer, scaled by a variable power of 10
VT_BOOL	VARIANT_BOOL+	vbBoolean	Boolean	Two-byte Boolean value (0xFFFF = True; 0x0000 = False)
VT_DISPATCH	IDispatch*	vbObject	Object	IDispatch* pointer to an object
VT_VARIANT	VARIANT+	vbVariant	Variant	VARIANT (can only be specified if combined with VT_BYREF or VT_ARRAY)
<*anything*>|VT_ARRAY	—	—	—	Bitwise combine VT_ARRAY with any basic type to declare as an array
<*anything*>|VT_BYREF	—	—	—	Bitwise combine VT_BYREF with any basic type to declare as a reference to a value
+ Denotes Windows-specific type. Not part of standard C/C++.				

The following table lists the rules for converting from MATLAB to COM.

MATLAB to COM VARIANT Conversion Rules

MATLAB Data Type	VARIANT Type for Scalar Data	VARIANT Type for Array Data	Comments
cell	A 1-by-1 cell array converts to a single	A multidimensional cell array converts	

MATLAB Data Type	VARIANT Type for Scalar Data	VARIANT Type for Array Data	Comments
	VARIANT with a type conforming to the conversion rule for the MATLAB data type of the cell contents.	to a VARIANT of type VT_VARIANT|VT_ARRAY with the type of each array member conforming to the conversion rule for the MATLAB data type of the corresponding cell.	
structure	VT_DISPATCH	VT_DISPATCH	A MATLAB struct array is converted to an MWStruct object. (See "Class MWStruct" (MATLAB Compiler SDK)) This object is passed as a VT_DISPATCH type.
char	A 1-by-1 char matrix converts to a VARIANT of type VT_BSTR with string length = 1.	A 1-by-L char matrix is assumed to represent a character vector of length L in MATLAB. This case converts to a VARIANT of type VT_BSTR with a string length = L. char matrices of more than one row, or of a higher dimensionality convert to a VARIANT of type VT_BSTR|VT_ARRAY. Each string in the converted array is of length 1 and corresponds to each character in the original matrix.	Arrays of character vectors are not supported as char matrices. To pass an array of character vectors, use a cell array of 1-by-L char matrices.

MATLAB Data Type	VARIANT Type for Scalar Data	VARIANT Type for Array Data	Comments
sparse	VT_DISPATCH	VT_DISPATCH	A MATLAB sparse array is converted to an MWSparse object. (See "Class MWSparse" (MATLAB Compiler SDK)) This object is passed as a VT_DISPATCH type.
double	A real 1-by-1 double matrix converts to a VARIANT of type VT_R8. A complex 1-by-1 double matrix converts to a VARIANT of type VT_DISPATCH.	A real multidimensional double matrix converts to a VARIANT of type VT_R8|VT_ARRAY. A complex multidimensional double matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)
single	A real 1-by-1 single matrix converts to a VARIANT of type VT_R4. A complex 1-by-1 single matrix converts to a VARIANT of type VT_DISPATCH.	A real multidimensional single matrix converts to a VARIANT of type VT_R4|VT_ARRAY. A complex multidimensional single matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)
int8	A real 1-by-1 int8 matrix converts to a VARIANT of type VT_I1. A complex 1-by-1 int8 matrix converts to a VARIANT of type VT_DISPATCH.	A real multidimensional int8 matrix converts to a VARIANT of type VT_I1|VT_ARRAY. A complex multidimensional int8 matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)

MATLAB Data Type	VARIANT Type for Scalar Data	VARIANT Type for Array Data	Comments
uint8	A real 1-by-1 uint8 matrix converts to a VARIANT of type VT_UI1. A complex 1-by-1 uint8 matrix converts to a VARIANT of type VT_DISPATCH.	A real multidimensional uint8 matrix converts to a VARIANT of type VT_UI1|VT_ARRAY.A complex multidimensional uint8 matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)
int16	A real 1-by-1 int16 matrix converts to a VARIANT of type VT_I2. A complex 1-by-1 int16 matrix converts to a VARIANT of type VT_DISPATCH.	A real multidimensional int16 matrix converts to a VARIANT of type VT_I2|VT_ARRAY. A complex multidimensional int16 matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)
uint16	A real 1-by-1 uint16 matrix converts to a VARIANT of type VT_UI2. A complex 1-by-1 uint16 matrix converts to a VARIANT of type VT_DISPATCH.	A real multidimensional uint16 matrix converts to a VARIANT of type VT_UI2|VT_ARRAY. A complex multidimensional uint16 matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)
int32	A 1-by-1 int32 matrix converts to a VARIANT of type VT_I4. A complex 1-by-1 int32 matrix converts to a VARIANT of type VT_DISPATCH.	A multidimensional int32 matrix converts to a VARIANT of type VT_I4|VT_ARRAY. A complex multidimensional int32 matrix converts	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)

MATLAB Data Type	VARIANT Type for Scalar Data	VARIANT Type for Array Data	Comments
		to a VARIANT of type VT_DISPATCH.	
uint32	A 1-by-1 uint32 matrix converts to a VARIANT of type VT_UI4. A complex 1-by-1 uint32 matrix converts to a VARIANT of type VT_DISPATCH.	A multidimensional uint32 matrix converts to a VARIANT of type VT_UI4|VT_ARRAY. A complex multidimensional uint32 matrix converts to a VARIANT of type VT_DISPATCH.	Complex arrays are passed to and from compiled MATLAB functions using the MWComplex class. (See "Class MWComplex" on page 9-27)
Function handle	VT_EMPTY	VT_EMPTY	Not supported
Java class	VT_EMPTY	VT_EMPTY	Not supported
User class	VT_EMPTY	VT_EMPTY	Not supported
logical	VT_Bool	VT_Bool|VT_ARRAY	

The following table lists the rules for conversion from COM to MATLAB.

COM VARIANT to MATLAB Conversion Rules

VARIANT Type	MATLAB Data Type (scalar or array data)	Comments
VT_EMPTY	Not applicable	Empty array created.
VT_I1	int8	
VT_UI1	uint8	
VT_I2	int16	
VT_UI2	uint16	
VT_I4	int32	
VT_UI4	uint32	
VT_R4	single	
VT_R8	double	
VT_CY	double	

VARIANT Type	MATLAB Data Type (scalar or array data)	Comments
VT_BSTR	char	A VARIANT of type VT_BSTR converts to a 1-by-L MATLAB char array, where L = the length of the character vector to be converted. A VARIANT of type VT_BSTR|VT_ARRAY converts to a MATLAB cell array of 1-by-L char arrays.
VT_ERROR	int32	
VT_DATE	double	1. VARIANT dates are stored as doubles starting at midnight Dec. 31, 1899. The MATLAB dates are stored as doubles starting at 0/0/00 00:00:00. Therefore, a VARIANT date of 0.0 maps to a MATLAB numeric date of 693960.0. VARIANT dates are converted to MATLAB double types and incremented by 693960.0. 2. VARIANT dates can be optionally converted to character vectors. See "Data Conversion Flags" on page A-13 for more information on type coercion.
VT_INT	int32	
VT_UINT	uint32	
VT_DECIMAL	double	
VT_BOOL	logical	
VT_DISPATCH	(*varies*)	IDispatch* pointers are treated within the context of what they point to. Objects must be supported types with known data extraction and conversion rules, or expose a generic Value property that points to a single VARIANT type. Data extracted from an object is converted based upon the rules for the particular VARIANT obtained. Currently, support exists for Excel Range objects as well as the MATLAB Compiler

VARIANT Type	MATLAB Data Type (scalar or array data)	Comments
		types MWStruct, MWComplex, MWSparse, and MWArg.
<*anything*>|VT_BYREF	(*varies*)	Pointers to any of the basic types are processed according to the rules for what they point to. The resulting MATLAB array contains a deep copy of the values.
<*anything*>|VT_ARRAY	(*varies*)	Multidimensional VARIANT arrays convert to multidimensional MATLAB arrays, each element converted according to the rules for the basic types. Multidimensional VARIANT arrays of type VT_VARIANT|VT_ARRAY convert to multidimensional cell arrays, each cell converted according to the rules for that specific type.

Array Formatting Flags

The MATLAB Compiler components have flags that control how array data is formatted in both directions. Generally, you should develop client code that matches the intended inputs and outputs of the MATLAB functions with the corresponding methods on the compiled COM objects, in accordance with the rules listed in MATLAB to COM VARIANT Conversion Rules and COM VARIANT to MATLAB Conversion Rules. In some cases this is not possible, for example, when existing MATLAB code is used in conjunction with a third-party product like Excel.

The following table shows the array formatting flags.

Array Formatting Flags

Flag	Description
`InputArrayFormat`	Defines the array formatting rule used on input arrays. An input array is a `VARIANT` array, created by the client, sent as an input parameter to a method call on a compiled COM object. Valid values for this flag are `mwArrayFormatAsIs`, `mwArrayFormatMatrix`, and `mwArrayFormatCell`. `mwArrayFormatAsIs` passes the array unchanged. `mwArrayFormatMatrix` (default) formats all arrays as matrices. When the input `VARIANT` is of type `VT_ARRAY|`*`type`*, where *`type`* is any numeric type, this flag has no effect. When the input `VARIANT` is of type `VT_VARIANT|VT_ARRAY`, `VARIANT`s in the array are examined. If they are single-valued and homogeneous in type, a MATLAB matrix of the appropriate type is produced instead of a cell array. `mwArrayFormatCell` interprets all arrays as MATLAB cell arrays.
`InputArrayIndFlag`	Sets the input array indirection level used with the `InputArrayFormat` flag (applicable only to nested arrays, i.e., `VARIANT` arrays of `VARIANT`s, which themselves are arrays). The default value for this flag is zero, which applies the `InputArrayFormat` flag to the outermost

Flag	Description
	array. When this flag is greater than zero, e.g., equal to N, the formatting rule attempts to apply itself to the Nth level of nesting.
`OutputArrayFormat`	Defines the array formatting rule used on output arrays. An output array is a MATLAB array, created by the compiled COM object, sent as an output parameter from a method call to the client. The values for this flag, `mwArrayFormatAsIs`, `mwArrayFormatMatrix`, and `mwArrayFormatCell`, cause the same behavior as the corresponding `InputArrayFormat` flag values.
`OutputArrayIndFlag`	(Applies to nested cell arrays only.) Output array indirection level used with the `OutputArrayFormat` flag. This flag works exactly like `InputArrayIndFlag`.
`AutoResizeOutput`	(Applies to Excel ranges only.) When the target output from a method call is a range of cells in an Excel worksheet and the output array size and shape is not known at the time of the call, set this flag to `True` to resize each Excel range to fit the output array.
`TransposeOutput`	Set this flag to `True` to transpose the output arguments. Useful when calling a MATLAB Compiler component from Excel where the MATLAB function returns outputs as row vectors, and you want the data in columns.

Data Conversion Flags

In this section...
“CoerceNumericToType” on page A-13
“InputDateFormat” on page A-14
“OutputAsDate As Boolean” on page A-15
“DateBias As Long” on page A-15

CoerceNumericToType

This flag tells the data converter to convert all numeric `VARIANT` data to one specific MATLAB type.

`VARIANT` type codes affected by this flag are

`VT_I1`

`VT_UI1`

`VT_I2`

`VT_UI2`

`VT_I4`

`VT_UI4`

`VT_R4`

`VT_R8`

`VT_CY`

`VT_DECIMAL`

`VT_INT`

`VT_UINT`

VT_ERROR

VT_BOOL

VT_DATE

Valid values for this flag are

mwTypeDefault

mwTypeChar

mwTypeDouble

mwTypeSingle

mwTypeLogical

mwTypeInt8

mwTypeUint8

mwTypeInt16

mwTypeUint16

mwTypeInt32

mwTypeUint32

The default for this flag, mwTypeDefault, converts numeric data according to the rules listed in “Data Conversion Rules ” on page A-2.

InputDateFormat

This flag tells the data converter how to convert VARIANT dates to the MATLAB dates. Valid values for this flag are mwDateFormatNumeric (default) and mwDateFormatString. The default converts VARIANT dates according to the rule listed in VARIANT Type Codes Supported . The mwDateFormatString flag converts a VARIANT date to its character vector representation. This flag only affects VARIANT type code VT_DATE.

OutputAsDate As Boolean

This flag instructs the data converter to process an output argument as a date. By default, numeric dates that are output parameters from compiled MATLAB functions are passed as `Double`s that need to be decremented by the COM date bias (693960) as well as coerced to COM dates. Set this flag to `True` to convert all output values of type `Double`.

DateBias As Long

This flag sets the date bias for performing COM to the MATLAB numeric date conversions. The default value of this property is 693960, which represents the difference between the COM `Date` type and the MATLAB numeric dates. This flag allows existing MATLAB code that already performs the increment of numeric dates by 693960 to be used unchanged with the MATLAB Compiler components. To process dates with such code, set this property to `0`.

B

Troubleshooting

Errors and Solutions

In this section...
“Excel Add-Ins Errors and Suggested Solutions” on page B-3
“Required Locations to Develop and Use Components” on page B-6
“Microsoft Excel Errors and Suggested Solutions” on page B-7
“Function Wizard Problems” on page B-9

This appendix provides a table showing errors you may encounter using MATLAB Compiler, probable causes for these errors, and suggested solutions.

Note: See the MATLAB Compiler documentation for more information about those messages.

Excel Add-Ins Errors and Suggested Solutions

Errors, Warnings, Cause and Suggested Solutions

Message	Probable Cause	Suggested Solution
`MBUILD.BAT: Error: The chosen compiler does not support building COM objects.`	The chosen compiler does not support building COM objects.	Rerun `mbuild -setup -client mbuild_com` and choose a supported compiler.
`Error in component_name.class_name Error getting data conversion flags.`	Usually caused by `mwcomutil.dll` not being registered.	Open a DOS window, change folders to *`matlabroot`*`\bin\win32` (*matlabroot* represents the location of MATLAB on your system), and run the command `mwregsvr mwcomutil.dll`. See "Add-In and COM Component Registration" on page 1-14 for full details.
`Error in VBAProject: ActiveX component can't create object.`	• Project DLL is not registered. • An incompatible MATLAB DLL exists somewhere on the system path.	If the DLL is not registered, open a DOS window, change folders to `<projectdir>\distrib` (`<projectdir>` represents the location of your project files), and run the command: `mwregsvr <projectdll>.dll`. See "Add-In and COM Component Registration" on page 1-14 for full details.
`Error in VBAProject: Automation error The specified module could not be found.`	This usually occurs if MATLAB is not on the system path. This error message occurs if you have more than one version of MATLAB on your system path.	Anytime you have multiple versions of MATLAB, ensure that the newest version of MATLAB appears on your path first. You can verify that the newest version of MATLAB is on the path first by typing `path` at the DOS prompt. See the table "Required Locations to Develop and Use Components" on page B-6.

Message	Probable Cause	Suggested Solution
`LoadLibrary ("component_name.dll") failed - The specified module could not be found.`	You may get this error message while registering the project DLL from the DOS prompt. This usually occurs if MATLAB is not on the system path.	See the table "Required Locations to Develop and Use Components" on page B-6.
`Cannot recompile the M file xxxx because it is already in the library libmmfile.mlib.`	The name you have chosen for your MATLAB file duplicates the name of a MATLAB file already in the library of precompiled MATLAB files.	Rename the MATLAB file, choosing a name that does not duplicate the name of a MATLAB file already in the library of precompiled MATLAB files.
`Arguments may only be defaulted at the end of an argument list.`	You have modified the VB script generated for MATLAB Compiler and have not provided one or more arguments used in the modified script.	Provide a value for any argument that requires an explicit value. Arguments that accept defaults appear at the end of the argument list.

Unable to use accessibility screen-readers or assistive technologies, such as JAWS®,	Required files `JavaAccessBridge.dll` and `WindowsAccessBridge.d` no longer added automatically to your Windows path.	Add the following DLLs to your Windows path:
		`JavaAccessBridge.dll`
		`WindowsAccessBridge.dll`

`Error in class.method.version`	This is a generic message, but is sometimes seen when there are conflicts in architecture versions of MATLAB and Microsoft Excel.	See "Deployment Target Architectures and Compatibility" on page 1-5 for detailed information.
`Error: Error IMWDispatchDriver "Method Load of object`	Different versions of the MATLAB Runtime and MATLAB results in the	Check for the current versions of MATLAB and the MATLAB Runtime. Verify the MATLAB version by typing

Message	Probable Cause	Suggested Solution
`IMWDispatchDriver failed"`	IMWDispatchDriver error.	the MATLAB path in DOS prompt. If the versions do not match update and install the new version of the MATLAB Runtime that matches the current MATLAB version.
`Error in VBA project: Method` *`xxx`* `of object 'IClass1' failed`	Multiple versions of MATLAB running on the system results in this error.	Register the mwcomutil.dll and mwcommgr.dll registry files. Open a DOS window, cd to *`matlabroot`*`\bin\win64 or win32` (*matlabroot* represents the location of MATLAB on your system), and run the command `mwregsvr mwcomutil.dll` `mwregsvr mwcommgr.dll`
`Warning: File not found. Excel primary interop assembly is not found.`	Visual Studio does not have Visual Studio Tools	Install Visual Studio Tools while installing Visual Studio to access all the files and package deployable archive with Excel Integration target.

Required Locations to Develop and Use Components

Component and Target Machine

Component	Development Machine	Target Machine
The MATLAB Runtime	Make sure that *matlabroot*\bin\win32 appears on your system path ahead of any other MATLAB installations. (*matlabroot* is your root MATLAB folder.)	Verify that *mcr_root*\ver\runtime\win32 appears on your system path. (*mcr_root* is your root the MATLAB Runtime folder.)

Microsoft Excel Errors and Suggested Solutions

Error, Cause, and Solutions

Message	Probable Cause	Suggested Solution
The macros in this project are disabled. Please refer to the online help or documentation of the host application to determine how to enable macros. Note: Wording may vary depending upon the version of Excel you are running.	The macro security for Excel is set to `High`.	Set Excel macro security to `Medium` on the **Security Level** tab by doing the following: • For Microsoft Office 2003: 1 Click **Tools > Macro > Security**. 2 For **Security Level**, select **Medium**. • For Microsoft Office 2007: 1 Click the 2007 Office button on the Microsoft Office ribbon ( ). 2 Click **Excel Options > Trust Center > Trust Center Settings > Macro Settings**. 3 In **Developer Macro Settings**, select **Trust access to the VBA project object model**. • For Microsoft Office 2010: 1 Click **File > Options > Trust Center > Trust Center Settings > Macro Settings**. 2 In **Developer Macro Settings**, select **Trust**

Message	Probable Cause	Suggested Solution
		access to the VBA project object model.

Function Wizard Problems

Problems, Cause, and Suggested Solutions

Problem	Probable Cause	Suggested Solution
The Function Wizard Help does not appear.	The Function Wizard Help file (`mlfunction.chm`) is not in the same folder as the Function Wizard add-in (`mlfunction.xla`).	Copy the Help file (`mlfunction.chm`) into the same folder as the add-in.
The Function Wizard did not automatically import your `.bas` file, and you have to create your macro manually	The Function Wizard has malfunctioned with an unspecified error	**1** Open Excel **2** Do one of the following: • If you use Microsoft Office 2007 or 2010, click **Developer > Macros**. • If you use Microsoft Office 2003, click **Tools > Macros > Macro**. **Tip:** You may need to enable the **Developer** menu item before performing this step. To do this:
You get an error when trying to create a macro with the Function Wizard		

Problem	Probable Cause	Suggested Solution
		a Click the 2007 Office button on the Microsoft Office ribbon ( ) or, in Office 2010, click **File** to display the Office Backstage View. b Click **Excel Options**. c In the **Top Options for Working With Excel** area, select **Show Developer tab in the Ribbon**. 3 From the Visual Basic Editor, select **File > Import** and select the created VBA file from the `<project_dir>\distrib` folder.
The message `Failed to start MATLAB` appears instead of `Starting MATLAB...` when MATLAB is invoked by the Function Wizard.	This message may appear if you manually terminate the MATLAB session that is invoked from the Function Wizard. As a result, you can no longer use the wizard's MATLAB related features in your current Excel session.	Save your work and restart Microsoft Excel.
When I use CTRL + arrow keys to select ranges with the	This behavior results from a bug in Microsoft Excel.	If you must use arrow keys to select ranges, apply

Problem	Probable Cause	Suggested Solution
Function Wizard, once I select a function and begin to select the function inputs, keyboard navigation no longer works in excel.		the following fix from the Microsoft Web site: http://support.microsoft.com/kb/291110.

Deployment Product Terms

A

Add-in — A Microsoft Excel add-in is an executable piece of code that can be actively integrated into a Microsoft Excel application. Add-ins are front-ends for COM components, usually written in some form of Microsoft Visual Basic.

Application program interface (API) — A set of classes, methods, and interfaces that is used to develop software applications. Typically an API is used to provide access to specific functionality. See `MWArray`.

Application — An end user-system into which a deployed functions or solution is ultimately integrated. Typically, the end goal for the deployment customer is integration of a deployed MATLAB function into a larger enterprise environment application. The deployment products prepare the MATLAB function for integration by wrapping MATLAB code with enterprise-compatible source code, such as C, C++, C# (.NET), F#, and Java code.

Assembly — An executable bundle of code, especially in .NET.

B

Binary — See *Executable*.

Boxed Types — Data types used to wrap opaque C structures.

Build — See *Compile*.

C

Class — A user-defined type used in C++, C#, and Java, among other object-oriented languages, that is a prototype for an object in an object-oriented language. It is analogous to a derived type in a procedural language. A class is a set of objects which share a common structure and behavior. Classes relate in a class hierarchy. One class is a specialization (a *subclass*) of another (one of its *superclasses*) or comprises other classes. Some classes use other classes in a client-server relationship. Abstract classes have no members, and concrete classes have one or more members. Differs from a *MATLAB class*

Compile — In MATLAB Compiler and MATLAB Compiler SDK, to compile MATLAB code involves generating a binary that wraps around MATLAB code, enabling it to execute in various computing environments. For example, when MATLAB code is

compiled into a Java package, a Java wrapper provides Java code that enables the MATLAB code to execute in a Java environment.

COM component — In MATLAB Compiler, the executable back-end code behind a Microsoft Excel add-in. In MATLAB Compiler SDK, an executable component, to be integrated with Microsoft COM applications.

Console application — Any application that is executed from a system command prompt window.

D

Data Marshaling — Data conversion, usually from one type to another. Unless a MATLAB deployment customer is using type-safe interfaces, data marshaling—as from mathematical data types to MathWorks data types such as represented by the `MWArray` API—must be performed manually, often at great cost.

Deploy — The act of integrating MATLAB code into a larger-scale computing environment, usually to an enterprise application, and often to end users.

Deployable archive — The deployable archive is embedded by default in each binary generated by MATLAB Compiler or MATLAB Compiler SDK. It houses the deployable package. All MATLAB-based content in the deployable archive uses the Advanced Encryption Standard (AES) cryptosystem. See “Additional Details”.

DLL — Dynamic link library. Microsoft's implementation of the shared library concept for Windows. Using DLLs is much preferred over the previous technology of static (or non-dynamic) libraries, which had to be manually linked and updated.

E

Empties — Arrays of zero (`0`) dimensions.

Executable — An executable bundle of code, made up of binary bits (zeros and ones) and sometimes called a *binary*.

F

Fields — For this definition in the context of MATLAB Data Structures, see *Structs*.

Fields and Properties — In the context of .NET, *Fields* are specialized classes used to hold data. *Properties* allow users to access class variables as if they were accessing member fields directly, while actually implementing that access through a class method.

I

Integration — Combining deployed MATLAB code's functionality with functionality that currently exists in an enterprise application. For example, a customer creates a mathematical model to forecast trends in certain commodities markets. In order to use this model in a larger-scale financial application (one written with the Microsoft .NET Framework, for instance) the deployed financial model must be integrated with existing C# applications, run in the .NET enterprise environment.

Instance — For the definition of this term in context of MATLAB Production Server software, see *MATLAB Production Server Server Instance*.

J

JAR — Java archive. In computing software, a JAR file (or Java ARchive) aggregates many files into one. Software developers use JARs to distribute Java applications or libraries, in the form of classes and associated metadata and resources (text, images, etc.). Computer users can create or extract JAR files using the `jar` command that comes with a Java Development Kit (JDK).

Java-MATLAB Interface — Known as the *JMI Interface*, this is the Java interface built into MATLAB software.

JDK — The *Java Development Kit* is a free Oracle® product which provides the environment required for programming in Java.

JMI Interface — see *Java-MATLAB Interface*.

JRE — *Java Run-Time Environment* is the part of the Java Development Kit (JDK) required to run Java programs. It comprises the Java Virtual Machine, the Java platform core classes, and supporting files. It does not include the compiler, debugger, or other tools present in the JDK™. The JRE™ is the smallest set of executables and files that constitute the standard Java platform.

M

Magic Square — A square array of integers arranged so that their sum is the same when added vertically, horizontally, or diagonally.

MATLAB Runtime — An execution engine made up of the same shared libraries. MATLAB uses these libraries to enable the execution of MATLAB files on systems without an installed version of MATLAB.

MATLAB Runtime singleton — See *Shared MATLAB Runtime instance*.

MATLAB Runtime workers — A MATLAB Runtime session. Using MATLAB Production Server software, you have the option of specifying more than one MATLAB Runtime session, using the `--num-workers` options in the server configurations file.

MATLAB Production Server Client — In the MATLAB Production Server software, clients are applications written in a language supported by MATLAB Production Server that call deployed functions hosted on a server.

MATLAB Production Server Configuration — An instance of the MATLAB Production Server containing at least one server and one client. Each configuration of the software usually contains a unique set of values in the server configuration file, `main_config` (MATLAB Production Server).

MATLAB Production Server Server Instance — A logical server configuration created using the `mps-new` command in MATLAB Production Server software.

MATLAB Production Server Software — Product for server/client deployment of MATLAB programs within your production systems, enabling you to incorporate numerical analytics in enterprise applications. When you use this software, web, database, and enterprise applications connect to MATLAB programs running on MATLAB Production Server via a lightweight client library, isolating the MATLAB programs from your production system. MATLAB Production Server software consists of one or more servers and clients.

Marshaling — See *Data Marshaling*.

mbuild — MATLAB Compiler SDK command that compiles and links C and C++ source files into standalone applications or shared libraries. For more information, see the `mbuild` function reference page.

`mcc` — The MATLAB command that invokes the compiler. It is the command-line equivalent of using the compiler apps.

Method Attribute — In the context of .NET, a mechanism used to specify declarative information to a .NET class. For example, in the context of client programming with MATLAB Production Server software, you specify method attributes to define MATLAB structures for input and output processing.

`mxArray` interface — The MATLAB data type containing all MATLAB representations of standard mathematical data types.

`MWArray` interface — A proxy to `mxArray`. An application program interface (API) for exchanging data between your application and MATLAB. Using `MWArray`, you marshal data from traditional mathematical types to a form that can be processed and understood by MATLAB data type `mxArray`. There are different implementations of the `MWArray` proxy for each application programming language.

P

Package — The act of bundling the deployed MATLAB code, along with the MATLAB Runtime and other files, into an installer that can be distributed to others. The compiler apps place the installer in the `for_redistribution` subfolder. In addition to the installer, the compiler apps generate a number of lose artifacts that can be used for testing or building a custom installer.

PID File — See *Process Identification File (PID File)*.

Pool — A pool of threads, in the context of server management using MATLAB Production Server software. Servers created with the software do not allocate a unique thread to each client connection. Rather, when data is available on a connection, the required processing is scheduled on a *pool*, or group, of available threads. The server configuration file option `--num-threads` sets the size of that pool (the number of available request-processing threads) in the master server process.

Process Identification File (PID File) — A file that documents informational and error messages relating to a running server instance of MATLAB Production Server software.

Program — A bundle of code that is executed to achieve a purpose. Programs usually are written to automate repetitive operations through computer processing. Enterprise system applications usually consist of hundreds or even thousands of smaller programs.

Properties — For this definition in the context of .NET, see *Fields and Properties*.

Proxy — A software design pattern typically using a class, which functions as an interface to something else. For example, `MWArray` is a proxy for programmers who need to access the underlying type `mxArray`.

S

Server Instance — See MATLAB Production Server Server Instance.

Shared Library — Groups of files that reside in one space on disk or memory for fast loading into Windows applications. Dynamic-link libraries (DLLs) are Microsoft's implementation of the shared library concept for Microsoft Windows.

Shared MATLAB Runtime instance — When using MATLAB Compiler SDK, you can create a shared MATLAB Runtime instance, also known as a *singleton*. When you invoke MATLAB Compiler with the `-S` option through the compiler (using either `mcc` or a compiler app), a single MATLAB Runtime instance is created for each COM component or Java package in an application. You reuse this instance by sharing it among all subsequent class instances. Such sharing results in more efficient memory usage and eliminates the MATLAB Runtime startup cost in each subsequent class instantiation. All class instances share a single MATLAB workspace and share global variables in the deployed MATLAB files. MATLAB Compiler SDK creates singletons by default for .NET assemblies. MATLAB Compiler creates singletons by default for the COM components used by the Excel add-ins.

State — The present condition of MATLAB, or the MATLAB Runtime. MATLAB functions often carry state in the form of variable values. The MATLAB workspace itself also maintains information about global variables and path settings. When deploying functions that carry state, you must often take additional steps to ensure state retention when deploying applications that use such functions.

Structs — MATLAB Structures. Structs are MATLAB arrays with elements that you access using textual field designators. Fields are data containers that store data of a specific MATLAB type.

System Compiler — A key part of Interactive Development Environments (IDEs) such as Microsoft Visual Studio.

T

Thread — A portion of a program that can run independently of and concurrently with other portions of the program. See *pool* for additional information on managing the number of processing threads available to a server instance.

Type-safe interface — An API that minimizes explicit type conversions by hiding the `MWArray` type from the calling application.

W

Web Application Archive (WAR) —In computing, a Web Application Archive is a JAR file used to distribute a collection of `JavaServer` pages, servlets, Java classes, XML files, tag libraries, and static web pages that together constitute a web application.

Webfigure — A MathWorks representation of a MATLAB figure, rendered on the web. Using the WebFigures feature, you display MATLAB figures on a website for graphical

manipulation by end users. This enables them to use their graphical applications from anywhere on the web, without the need to download MATLAB or other tools that can consume costly resources.

Windows Communication Foundation (WCF) — The Windows Communication Foundation™ is an application programming interface in the .NET Framework for building connected, service-oriented, web-centric applications. WCF is designed in accordance with service oriented architecture principles to support distributed computing where services are consumed by client applications.