From Apps to Web Services:
Deploying Your MATLAB Algorithms and Applications

Marta Wilczkowiak
Why deploy your MATLAB algorithms?

- Raise awareness of your work
- Reduce duplication of efforts
- Serve your customers better
- Reduce errors caused by reimplementation
- Accelerate development cycle by avoiding recoding
Deployment considerations

- Where would the algorithm live and how it will interface with the world?
- Will the end user need and have access to MATLAB?
- Will the product be standalone or a part of larger system?
- Will many users need to access this functionality at the same time?
- What is the performance requirement?
- What product features are required?
Deployment options

- MATLAB Apps
- MATLAB Compiler
  - Standalone applications
  - Software modules
- MATLAB Production Server
- MATLAB Coder
Deployment options

- MATLAB Apps

- MATLAB Compiler
  - Standalone applications
  - Software modules

- MATLAB Production Server

- MATLAB Coder
MATLAB Apps: Custom interactive applications running in MATLAB

- Easy to package, install and find
- Support full MATLAB language
- Require MATLAB to run
Deployment options

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MATLAB Compiler and Builders

MATLAB Compiler™

MATLAB Builder™ EX
MATLAB Builder™ JA
MATLAB Builder™ NE

Generic CTF

.exe dll/.lib Excel Add-in Java WWW COM .NET
Application Virtual Machine Concept

Various language implementations

MATLAB Source Code

MATLAB Compiler

MATLAB Encrypted Code

Execute

MATLAB Compiler Runtime (MCR)

.NET Source Code

Visual Studio Compiler

.NET Byte Code

Execute

Microsoft Common Language Runtime (CLR)

Java Source Code

JAVAC

Java Byte Code

Execute

Java Runtime Environment (JRE)
MATLAB Compiler
Product Summary

- Automatically packages your MATLAB programs as standalone applications and software components
- Supports full MATLAB language and most toolboxes
- Allows royalty-free deployment
MATLAB Compiler and Builders
What’s new?

Improvements for all phases of application deployment

- **Compiling apps** … greatly improved usability provided by a toolstrip user interface

- **Distributing apps** … customization options create a more professional software experience

- **Installing apps** … faster and more reliable download and installation of MATLAB Compiler Runtime (MCR)
Compiling Apps

App and User Interface Changes

- Two new apps for deployment – *Application* and *Library*
  - Both apps utilize tool strip style user interface

- Automatic download of runtime (MCR)
  - Ensures end user has correct version for their platform
Distribution and Installation
Improved End Customer Experience

- Customizable Installer
- Splash Screen
- Application in Start Menu
Deployment options

- MATLAB Apps
- MATLAB Complier
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MATLAB Production Server

- Directly deploy MATLAB programs into production
  - Centrally manage multiple MATLAB programs & MCR versions
  - Automatically deploy updates without server restarts

- Scalable & reliable
  - Service large numbers of concurrent requests
  - Add capacity or redundancy with additional servers

- Use with web, database & application servers
  - Lightweight client library isolates MATLAB processing
  - Access MATLAB programs using native data types
MATLAB Compiler vs MATLAB Production Server

MATLAB Compiler Runtime (MCR)
What is MATLAB Production Server?

Enterprise class framework for running packaged MATLAB programs

- Lightweight client library *(for .NET & Java)*
  - Request MATLAB programs (functions)

- Server software
  - Manages packaged MATLAB programs & worker pool

- Runtime libraries
  - MATLAB Compiler™ Runtime (MCR)
Example: EXPO Conversations

Analysis Server

Java Application

Amazon Machine Instance

Web Server

Agent1
Agent2

results

.gif  .json  .csv
Example: EXPO Conversations

MATLAB

- Trigger
- Agent 1
- Agent 2

Java

- Trigger
- Executor

MPS

- MPS Worker
- Agent 1
- MPS Worker
- Agent 2
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MATLAB Coder

MATLAB code

```matlab
function [mean, stdev] = stats(vals)
  % #codegen
  % calculates a statistical mean and a standard

  stdev = sqrt(sum(((vals-avg(vals,len)).^2))/len);
  coder.extrinsic('plot');
  plot(vals,'--');
```

C code

```c
public static void Main()
{
    List<Circle> circleList = new List<Circle>();
    circleList.Add(new Circle(3, 0, 5));
    circleList.Add(new Circle(1, 4, 10));

    List<Rectangle> rectangleList = new List<Rectangle>();
    rectangleList.Add(new Rectangle(0, 0, 10, 20));
    rectangleList.Add(new Rectangle(1, 20, 10, 20));

    List<Triangle> triangleList = new List<Triangle>();
    triangleList.Add(new RightTriangle());
    triangleList.Add(new RightTriangle(20, 40, 1, 2));
    triangleList.Add(new RightTriangle(200, 400, 11, 21));
    triangleList.Add(new RightTriangle(70, 42, 17, 21));
}
```

Compiled C code (MEX)
## Deployment options and considerations

### Summary

<table>
<thead>
<tr>
<th>Using live MATLAB</th>
<th>Packaging</th>
<th>Simultaneous access</th>
<th>Latency</th>
<th>MATLAB feature support</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATLAB Apps</td>
<td>MATLAB App</td>
<td>exe, dll</td>
<td>Medium</td>
<td>Rich</td>
</tr>
<tr>
<td>MATLAB Compiler</td>
<td></td>
<td>java class, .NET assembly, Excel add-in</td>
<td>Medium</td>
<td>Rich</td>
</tr>
<tr>
<td>Builders</td>
<td></td>
<td>generic ctf calls over http</td>
<td></td>
<td>Rich</td>
</tr>
<tr>
<td>MATLAB Production Server</td>
<td></td>
<td>c/c++, dll, lib, exe</td>
<td></td>
<td>Subset of MATLAB and few toolboxes</td>
</tr>
<tr>
<td>MATLAB Coder</td>
<td></td>
<td></td>
<td>Yes</td>
<td>No</td>
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</tbody>
</table>
Use cases

- Clustering tool
- Medical image segmentation software
- Pension calculator
- Component of an industrial image-based quality inspection software
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