Excel, .NET 및 JAVA 환경에서 사용 가능한 MATLAB Application 개발

성호현 과장
MathWorks Korea
Application Deployment Process

Requirements

Research & Design

- Explore and discover
- Gain insight into problem
- Evaluate options, trade-offs

Implementation

Test & Verification

Algorithms and Applications for Desktop or Web
- MATLAB
- Excel
- .NET
- .exe
- C/C++
- Java
- .dll

Embedded software and digital electronics
- Verilog
- PLC
- C/C++
- FPGA
- VHDL
- PAC
Deploying Algorithms and Applications

- Algorithmic Components
- Web Deployment
Desktop Applications

Energy Forecasting Stand Alone Application

[Image of a 3D data visualization interface for energy forecasting, with options to load data, select day of week, and create a model to predict power demand. The interface displays a graph with coordinates for thisPower, thisTemp, and thisHour, and fields to input hour, temperature (in F), and predict power demand, resulting in a power demand of 76.33 MW.]
Deploying Applications with MATLAB

MATLAB Desktop

MATLAB Compiler

End-User Machine

1

MATLAB Application

2

.exe

3

MATLAB Compiler Runtime (MCR)
Deploying Desktop Applications with MATLAB

- Give MATLAB code to other users
- Share applications with end users who do not need MATLAB
  - Stand-alone executables
  - Shared libraries
- Royalty-Free Distribution
Halliburton Makes Oil Exploration Safer Using MATLAB and Neural Network Toolbox

Challenge
To improve the ability to detect detonation of explosives used to perforate the well bore

Solution
Use MathWorks products to develop an adaptive, predictive neural network filter that cleanses the detonation signal of contaminating noise from onsite machinery

Results
- Authentic simulation on the desktop
- An accurate, production-standard algorithm
- Dramatic time savings

“Using MATLAB and MATLAB Compiler, I can develop an application at least 100 times faster than I could with Visual Basic or C. The time we saved on the very first application that we wrote in MATLAB more than paid for the software.”

Roger Schultz
Halliburton Energy Services

Link to user story
Deploying Algorithms and Applications

- Desktop Applications
- Algorithmic Components
- Web Deployment
Software Components
Creating an Excel Add-In
Deploying Applications with MATLAB

- Give MATLAB code to other users
- Share applications with end users who do not need MATLAB
  - Stand-alone executables
  - Shared libraries
  - Components
- Royalty-Free Distribution
Deploying MATLAB Components

- Create MATLAB application

- Build component
  - MATLAB Compiler
  - MATLAB Builder JA for Java
  - MATLAB Builder NE for .NET

- Deploy against MATLAB Compiler Runtime (MCR)
  - One per process
  - Loaded in-process
  - Single threaded
  - Thread safe
Component Process Architectures

- In process model
  - MCR in application process

- Scalable model
  - MCR in separate processes
HKM Optimizes Just-in-Time Steel Manufacturing Schedule

Challenge
Optimize a steel production process to enable consistent, just-in-time delivery

Solution
Use MATLAB, global optimization, and parallel computing to maximize throughput of more than 5 million tonnes of steel annually

Results
- Algorithm development accelerated by a factor of 10
- Optimization time cut from 1 hour to 5 minutes
- Customer satisfaction increased

“C++, Java, or third-party optimization solutions would have required us to spend significantly more time in development or to simplify our constraints. Only MATLAB provided the flexibility, scalability, development speed, and level of optimization that we required.”

Alexey Nagaytsev
Hüttenwerke Krupp Mannesmann

Manually reviewed plant schedule (left) and plant schedule automatically optimized with MATLAB genetic algorithms (right). The optimized schedule minimizes schedule conflicts (in red), meets delivery dates, and achieves the target utilization rate.

[Link to user story]
Deploying Algorithms and Applications

- Desktop Applications
- Algorithmic Components

Web Deployment
Web Applications

Deployed Functions
- Servers

Communication
- HTML
- XML
- WCF
- SOAP

User Interface
- Web Pages
- Thick Clients
- Thin Clients
- Mobile Devices

Servers

User Interfaces
Web Applications

Quiz

Where is MCR(s) Running?

a. Server
b. User interface
c. Both
d. Somewhere else
e. No where
Web Applications

Quiz

If the MCR executes:

>> a = rand(10)

Where is the data stored?

a. Server
b. User interface
c. Both
d. Somewhere else
e. No where

Data is stored in the MCR’s memory. The MCR runs on the servers.
Web Applications
Quiz

If the MCR executes:

>> plot(a)

Where would the plot appear?

a. Server
b. User interface
c. Both
d. Somewhere else
e. No where
Web Applications

Quiz

How do we get graphics or data to the user interface?

Graphics:
• WebFigures
• Streaming Images

Data:
• Standard web interfaces
• e.g. XML, WCF, SOAP, etc.
Web Deployment
MATLAB Builder NE
Web Deployment Example

*Single User*

**In-Process Model**

- Web Server
- MATLAB Component
- MATLAB Compiler Runtime (MCR)
- Single Process

**Server**

**Single User**
Web Deployment Example

Scalable Number of Users

MATLAB Component

MATLAB Compiler Runtime (MCR)

Web Server

Java RMI

.NET Remoting

Main Process

Servers

Multiple Users
# Web Architectures

<table>
<thead>
<tr>
<th>Interface</th>
<th>Web Servers and Web Pages</th>
<th>Web Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Browser</td>
<td>Web Browser or Thick Client</td>
<td></td>
</tr>
<tr>
<td>Web Figures or Streaming Image</td>
<td>Streaming Image</td>
<td></td>
</tr>
</tbody>
</table>

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<th></th>
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</tr>
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<td>HTML</td>
<td>WCF, XML, SOAP, etc.</td>
<td></td>
</tr>
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<th>Communication</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Active Server Pages (ASP or ASP.NET)</td>
<td>.NET Web Service</td>
<td></td>
</tr>
<tr>
<td>Java Server Pages (JSP), Java Servlets</td>
<td>Java Web Service</td>
<td></td>
</tr>
</tbody>
</table>
UniCredit Bank Austria Develops and Rapidly Deploys a Consistent, Enterprise-Wide Market Data Engine

Challenge
Improve risk management operations throughout a multinational financial institution

Solution
Use MATLAB, MATLAB Compiler, and MATLAB Builder JA to build and rapidly deploy a consistent enterprise-wide data warehouse into J2EE Web Architecture

Results
- Development time reduced by 50%
- Risk management improved across the bank
- Operational, audit, and maintenance costs reduced

“With MATLAB, we can focus on business logic instead of implementation details. We can deploy an algorithm in a Java environment the same day, without any additional coding. This approach enabled us to cut our development time in half, if not more weeks, instead of months.”

Peter W. Schweighofer
UniCredit Bank Austria

Link to user story
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Deploying Algorithms and Applications

- Desktop Applications
  - MATLAB Compiler

- Software Components
  - MATLAB Builders
  - MATLAB Compiler

- Web Deployment
  - MATLAB Builder NE
  - MATLAB Builder JA
MATLAB Builder EX for Microsoft® Excel®

- Deploy MATLAB code to Microsoft Excel
- Integrate MATLAB applications into Excel workbooks
- Provides a Visual Basic interface
- Royalty-free deployment

Update
- Should these product slides come after the “Builder” demo?
- Should we have product specific slides or a more general builder overview slide?
- Idea: have an Excel slide and then another slide for Builder NE and JA

Update
- Function Wizard image
- Spreadsheet image with controls & graphics
- Notes need to be updated
MATLAB Builder JA for Java language

- Deploy MATLAB code as Java classes
- Integrate with desktop or Web applications
- Provides client-side controls for interactive Web graphics
- Royalty-free deployment
MATLAB Builder NE for Microsoft .NET Framework

- Deploy MATLAB code as .NET and COM components
- Integrate with desktop or Web applications
- Provides client-side controls for interactive Web graphics
- Royalty-free deployment

Update?
- See previous slides
Desktop and Web Deployment

- MATLAB Builder NE
  - Support for .NET Remoting (for interfacing with a distributed .NET Framework)
  - Ability to manipulate MATLAB figures over the Web
- Enhanced readme.txt file
  - Customized to MATLAB Compiler deployment requirements
  - Generated with each build
- Redesigned Deployment Tool facilitates navigation
  - Cancellable progress dialog
  - Fast loading of projects
  - Ability to add supporting files as folders
- Command-line version of Deployment Tool, providing programmatic control over building and packaging options
Application Virtual Machine Concept

Various language implementations
Online Information on Compiler Support for Toolboxes

www.mathworks.com/products/compiler/compiler_support.html

Link from MATLAB Compiler main page
Component Runtime Lifecycle Management

- **Startup Time**
  - First instantiation starts MCR (equivalent to starting MATLAB)
  - Additional instances start much faster

- **Ways to Mitigate**
  - Instantiate first component with application startup
  - Create a Web Service / Web Application that is already running
Required Files for Deployment

- MATLAB Compiler Runtime (MCR)
  - Enables the execution of generated applications
  - Deployed and installed only once on end-user desktop

- Standalone executables, libraries, or components
  - Generated each time MATLAB Compiler runs
  - Contains all supporting files

Note: MATLAB does not need to be available on the target user’s desktop.
Understanding the Web

Use

Web Browser

Web Service

Web Server

Deploy

Here be Dragons (INTERWEB)

Web Client Application
Web Applications

- Computational Resources
- Centralized Services
- MATLAB Algorithms

Servers

Internet

Access Points

- Web pages
- Thin/thick clients
- Mobile apps

HTML, XML, WCF, SOAP, etc.
Web Deployment

*How to Scale*

Web Clients

Web Server

MATLAB Component

MATLAB Compiler Runtime (MCR)

Java RMI

.NET Remoting

Servers

Main Process
Web Deployment

What we did
Component Process Architectures

In-Process Model
- Single Process
- MATLAB Component
- MATLAB Compiler Runtime (MCR)
- .NET or Java Application

Scalable Model
- Main Process
- Other Process
- MATLAB Component
- MATLAB Compiler Runtime (MCR)
- .NET or Java Application
- .NET Remoting
- Java RMI