MATLAB EXPO 2017
Integrate MATLAB Analytics into Enterprise Applications

Ionut Barbu, Application Engineer
Data Analytics Workflow

Access and Explore Data

Preprocess Data

Develop Predictive Models

Integrate Analytics with Systems

Business Data

Sensor Data

Data Reduction/Transformation

Feature Extraction

Model Creation

Model Validation

Enterprise Systems

Embedded Devices

MATLAB: Single Platform
Data Analytics Workflow

Access and Explore Data
- Business Data
- Sensor Data

Preprocess Data
- Data Reduction/Transformation
- Feature Extraction

Develop Predictive Models
- Model Creation
- Model Validation

Integrate Analytics with Systems
- Enterprise Systems
- Embedded Devices

MATLAB: Single Platform
Challenges

- Bridge the gap between multiple disciplines
- Integrate solutions to enterprise scale frameworks
- Deliver fast results with large volumes of data
Different tools for development and productization

Application → Manual translation → Enterprise solution

Domain Expert → Solution Architect
What if you speed up the integration process?

with automatic deployment

Domain Expert

Solution Architect

Enterprise solution
Sharing and Deploying MATLAB Applications
Write Your Programs Once, Then Share to Different Targets

MATLAB

Compilers

With
MATLAB
Users

With People Who
Do Not Have
MATLAB

Coders

MATLAB Runtime
Share with People Who Do Not Have MATLAB

MATLAB Compiler

- Standalone Application
- Excel Add-in
- Hadoop, Spark
- C/C++ shared library
- Java
- .NET
- Python
- MATLAB Production Server

Share Applications with No Additional Programming

Integrate MATLAB-based Components With Your Own Software

- Royalty-free Sharing
- IP Protection via Encryption

MATLAB Compiler SDK
Integrate MATLAB-based Components With Your Own Software
Using MATLAB Compiler SDK to create Java Classes
Using MATLAB Compiler SDK to create Java Classes
MATLAB and MATLAB Production Server is the easiest and most productive environment to take your enterprise analytics or Internet of Things solution from idea to production.
Energy Load Forecast

Select Zone

Forecast

Plattsburgh International Airport
Station ID: KBPG
Contributes to zones: NYISO D-North (100%) NYISO F-Cap (3%)
Weather forecast
Energy Load Forecast

MATLAB Desktop
- Train in MATLAB
- Predictive Models

MATLAB Runtime
- LIBRARY
- Energy Data
- Weather Data

Web Application Server
- Apache Tomcat
- Web Server/Webservice

Web Application

Energy Load Forecast
Energy Load Forecast

MATLAB Desktop
- Train in MATLAB
- Predictive Models

MATLAB Runtime
- LIBRARY
- Energy Data
- Weather Data

Web Application Server
- Apache Tomcat
- Web Server/Webservice

Multiple users
Energy Load Forecast

MATLAB Desktop
Train in MATLAB
Predictive Models

MATLAB Production Server
MATLAB Production Server
LIBRARY

Web Application Server
Apache Tomcat
Web Server/Webservice

Energy Data
Weather Data

Request Broker
LIBRARY

Web Server/Webservice

Weather Data
Energy Data

MATLAB Production Server
Enterprise Class Framework For Running Packaged MATLAB Programs

- Server software
  - Manages packaged MATLAB programs and worker pool

- MATLAB Runtime libraries
  - Single server can use runtimes from different releases

- RESTful JSON interface and lightweight client library (C/C++, .NET, Python, and Java)
Manage Your Server Instances Using a Dashboard Interface
Manage Your Server Instances Using a Dashboard Interface
Building Automation IoT Analytics on Azure

Building/HVAC automation control system
- Variety of sensors and controls
- Networked communication
- Data reduction

MATLAB Production Server

- Azure EventHub
- Azure Blob
- Azure SQL
- MATLAB Compiler SDK

Global heavy duty electrical equipment manufacturer

Business Systems

Users

Algorithm Developers

Algorithm Developers

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Technology Stack

Data
- Databases
  - neo4j
  - MongoDB
  - SQL Server

- Cloud Storage
  - Azure Blob
  - S3

- IoT
  - ThingSpeak

Analytics
- MATLAB Distributed Computing Server
- MATLAB Production Server
- Request Broker

Business System
- Visualization
  - Qlik Sense
  - Spotfire

- Web
  - Microsoft IIS
  - WebSphere
  - Apache Tomcat

- Custom App
  - R
  - Python

Platform
- Public Cloud
- Private Cloud

- Microsoft Azure
- Amazon Web Services
- OpenStack
- VMware
Front-end Scalability

Application server for MATLAB

- Manage large numbers of requests to run deployed MATLAB programs

Back-end Scalability

Cluster framework for MATLAB

- Speed up computationally intensive programs on computer clusters, clouds, and grids
Parallel Computing Paradigm
Clusters
Speed-up using Multiple Cores on the Cloud
High Resolution Image Processing

Serial computation
Parallel computation on 12 workers

Computation time 79.28 seconds
Computation time 13.85 seconds
Big Data Workflow

Process out-of-memory data on your Desktop to explore, analyze, gain insights and to develop analytics.

Use Parallel Computing Toolbox for increased performance.

Run on Compute Clusters or Spark + Hadoop (HDFS), for large scale analysis.

MATLAB Distributed Computing Server, Spark+Hadoop
Scale your Applications Beyond the Desktop

<table>
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<tr>
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<tbody>
<tr>
<td>Description</td>
<td>Explicit desktop scaling</td>
<td>Single-user, basic scaling to cloud</td>
<td>Scale to EC2 with some customization</td>
<td>Scale to custom cloud</td>
<td>Scale to clusters</td>
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<td>Maximum workers</td>
<td>No limit</td>
<td>16</td>
<td>256</td>
<td>No limit</td>
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<td>MathWorks Compute Cloud</td>
<td>Amazon EC2</td>
<td>Amazon EC2, Microsoft Azure, Others</td>
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<td>Availability</td>
<td>Worldwide</td>
<td>United States and Canada</td>
<td>United States, Canada and other select countries in Europe</td>
<td>Worldwide</td>
<td>Worldwide</td>
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</tbody>
</table>

Learn More: [Parallel Computing on the Cloud](#)
Customer Example: Financial Customer Advisory Service

Global financial institution with European HQ

- Saved €2 million annually for an external system
- Quicker implementation of adjustments in source code by the quantitative analysts
- Knowledge + MATLAB = Build your own systems

Global financial institution with European HQ

Customer Example: Financial Customer Advisory Service

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How to get started?

- Data Analytics
- Application Development
- Code Generation
## MATLAB®

### Data Analytics
- Data Processing and visualization
- Statistics
- Machine Learning
- Optimization Techniques
- Parallel Computing

### Application-Specific
- Control System Design
- Signal Processing
- Communication Systems
- LTE Systems

### Computational Finance
- Risk Management
- Time-Series Modelling

### Signal Processing
- Using MATLAB
- Using Simulink

### Image and Video Processing
- Image Processing
- Computer Vision

### Code Generation
- MATLAB Coder
- Interfacing with C-code

### Application Development
- Programming Techniques
- Building Interactive Applications
- Object-Oriented Programming

### Model-Based Design
- Implementing MBD Workflow
- Model Management and Architecture
- Verification and Validation

### Code Generation
- Rapid Prototyping and HIL-Simulation
- Embedded Systems
- FPGA Design
- Generating HDL Code
- Xilinx Zynq SoCs
- AUTOSAR

### Code Integration
- Integrating C and MATLAB

### Polyspace
- Polyspace Code Prover™

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[https://nl.mathworks.com/services/training.html](https://nl.mathworks.com/services/training.html)