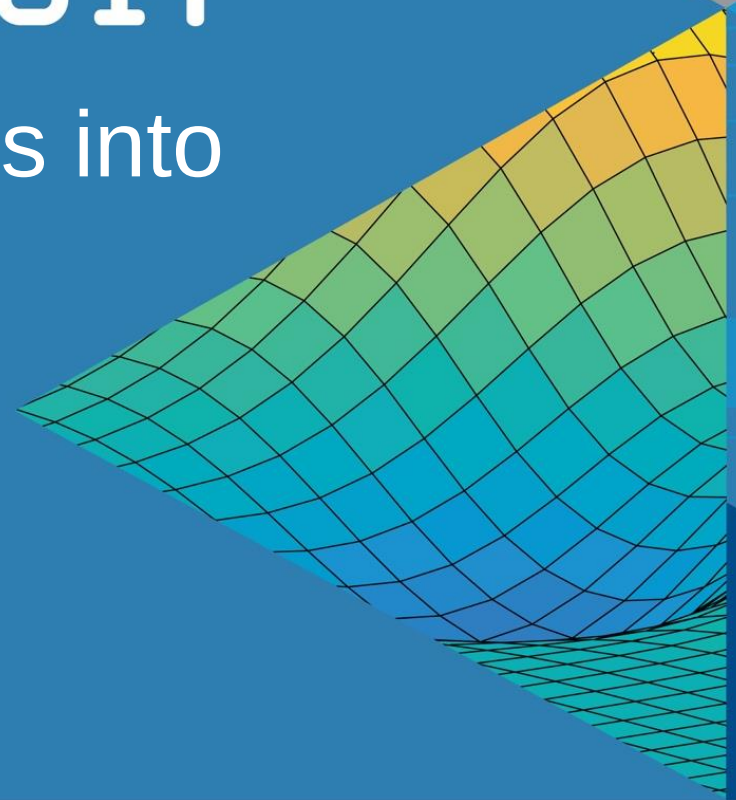
MATLAB EXPO 2017

Integrating MATLAB Analytics into Enterprise Applications

Pallavi Kar
Application Engineer



Analytics

Apply robust, statistically-motivated methods to data produced from complex systems to

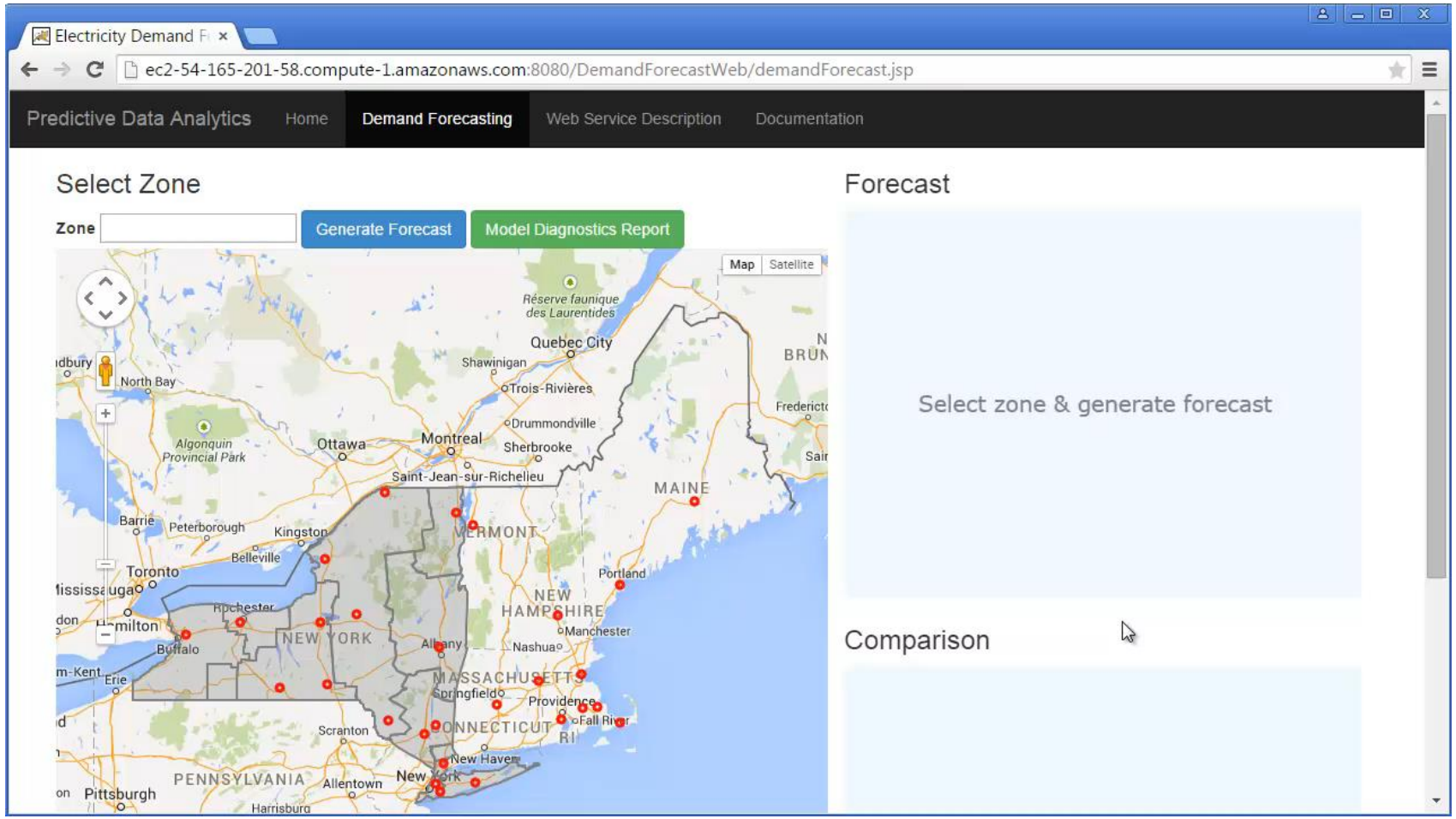
understand what has happened,

predict what will happen, and

suggest decisions or actions.

Enterprise Integration – Forecasting Model

Forecast electricity demand for US power grids with live data from ISOs and weather stations using Neural Network



http://54.165.201.58:8080/DemandForecastWeb/demandForecast.jsp

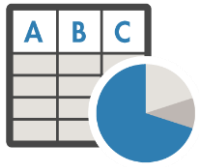
Easy and ***accurate*** day-ahead system load forecast

Requirements:

- Acquire and clean data from multiple sources
- Serve Multiple requests
- Deploy to production environment

Deployment Scenarios

Enterprise scale analytics

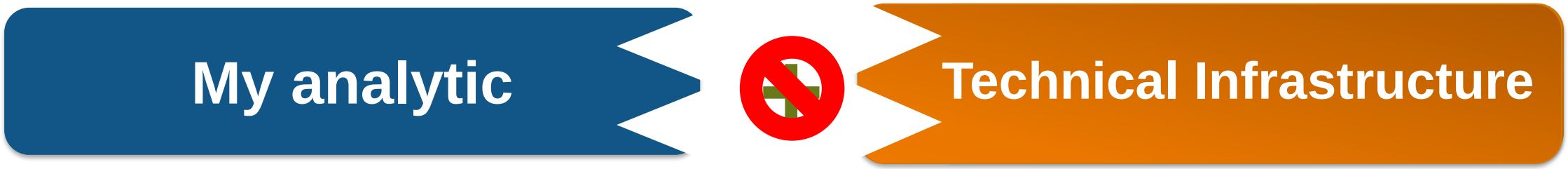


Sharing Reports

Sharing & Integrating Algorithms

Deploying Industrial Analytics

Why is Deployment challenging?

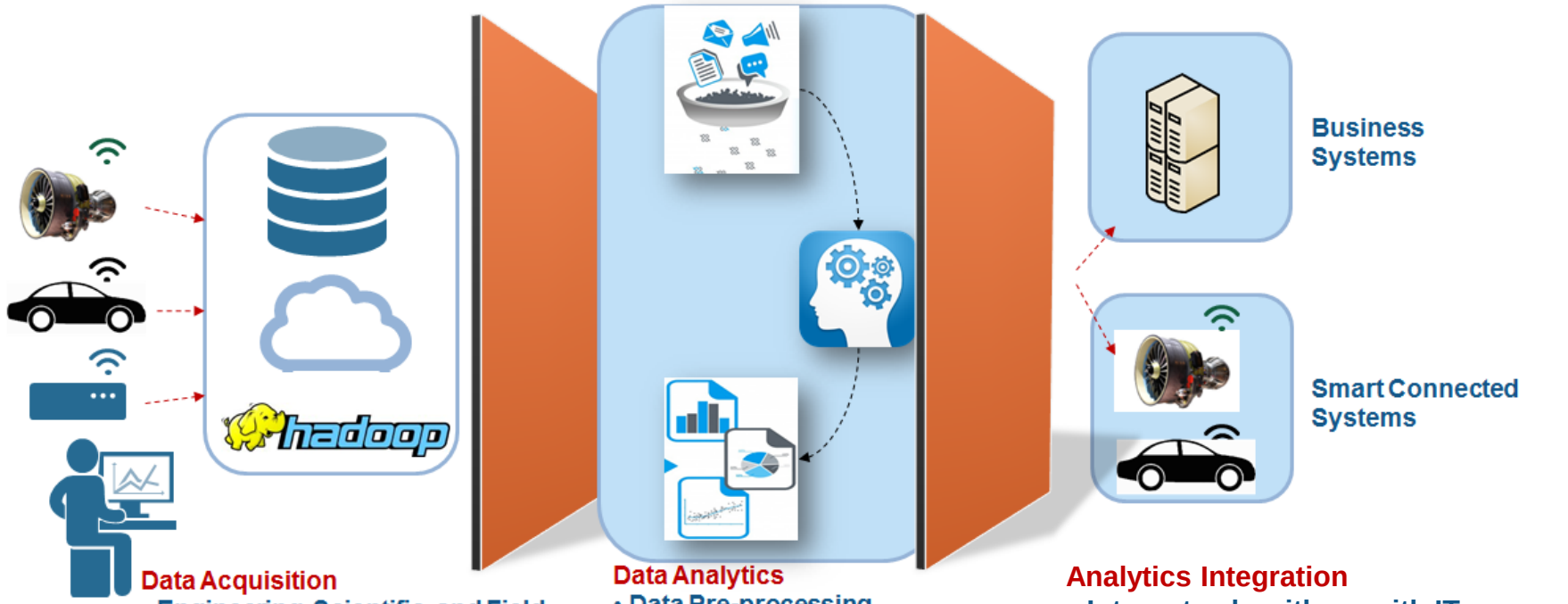


- Multiple internal and external consumers of MATLAB algorithms
- Algorithm integration in different IT Applications and Workflows
- Scaling up model for multiple (simultaneous) users and big data

A Developer's challenge to solve …

How MATLAB can ease the challenges?

- What about an end to end solution on one single platform!!!



MATLAB: Single Platform

Key Takeaways for Today's Session

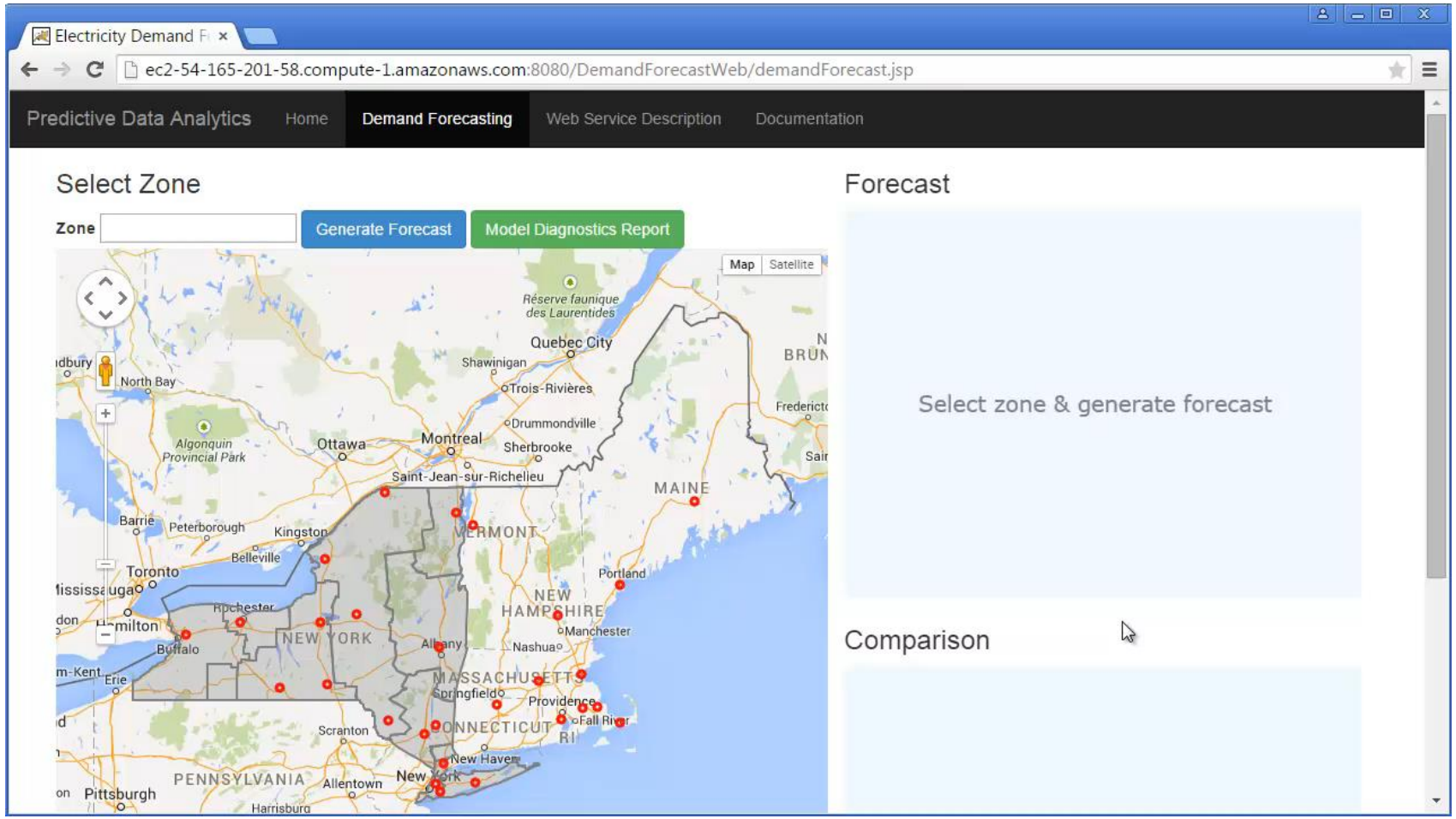
1. Distribute applications to MATLAB users with Apps.
2. Distribute applications to non-MATLAB users as standalone applications.
3. Integrate MATLAB functions into existing workflows and development platforms.
4. Deploy MATLAB applications to service simultaneous user requests enterprise-wide.

Let's solve them one by one…

1. Deploy MATLAB applications to service simultaneous user requests enterprise-wide
2. Integrate MATLAB functions into existing workflows and development platforms.
3. Distribute applications to non-MATLAB users as standalone applications.
4. Distribute applications to MATLAB users with Apps.

Enterprise Integration – Forecasting Model

Forecast electricity demand for US power grids with live data from ISOs and weather stations using Neural Network



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Easy and ***accurate*** day-ahead system load forecast

Requirements:

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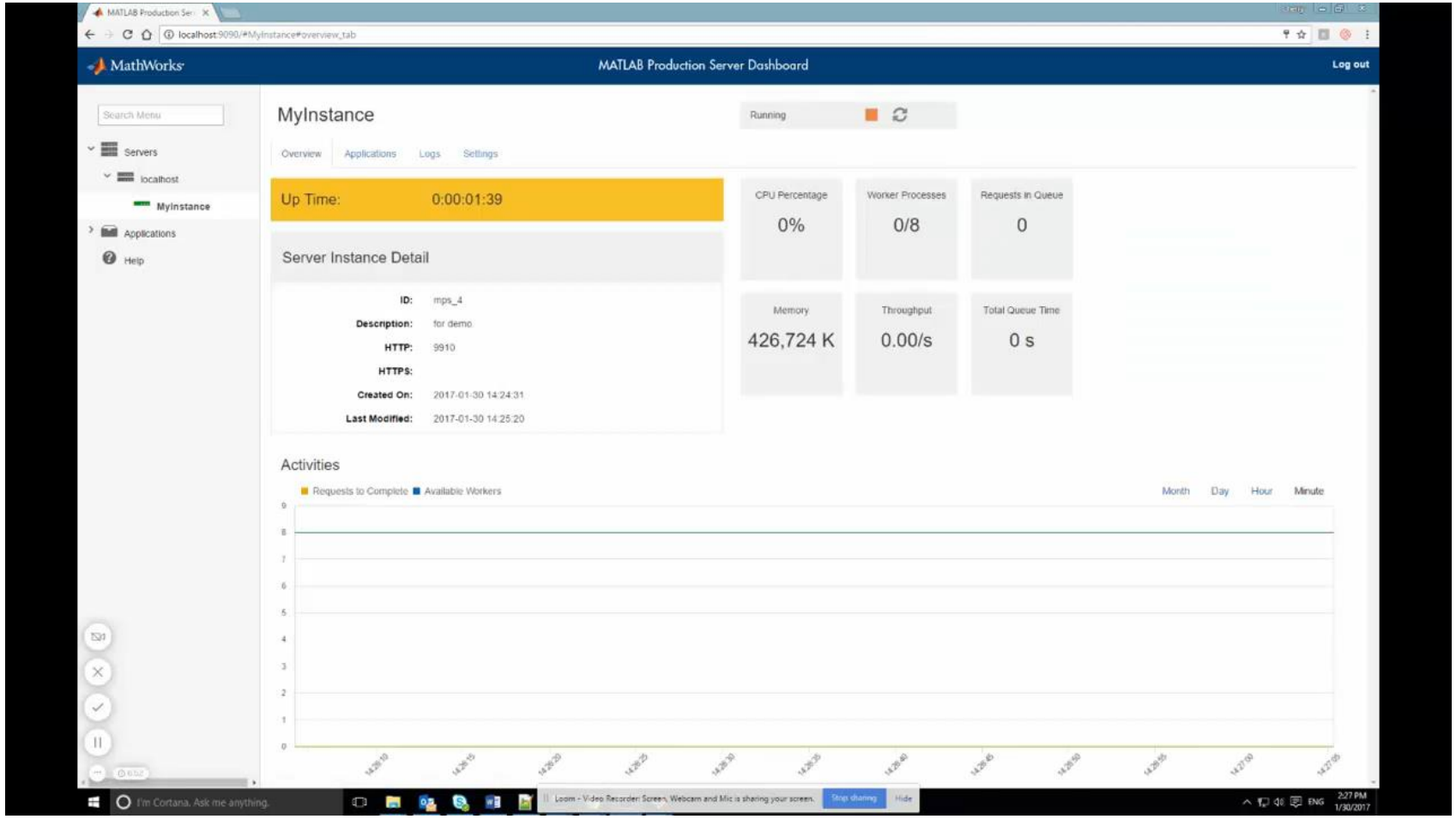
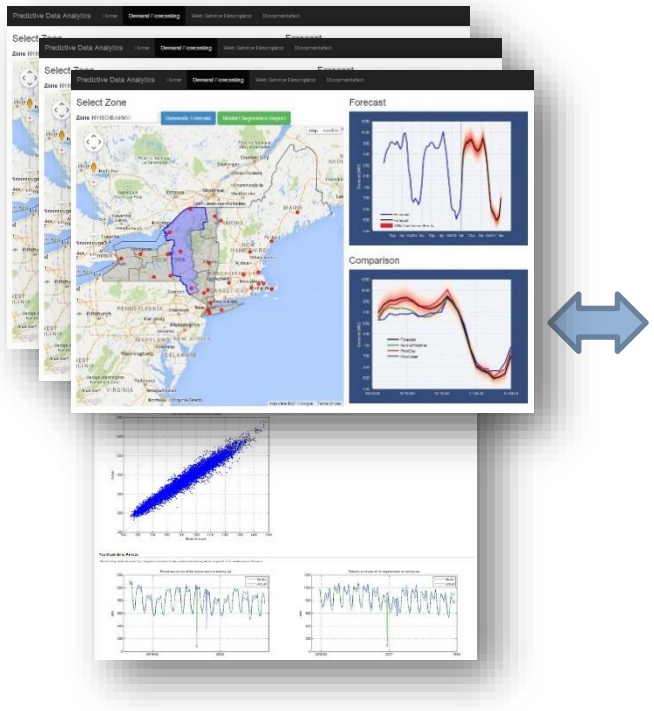
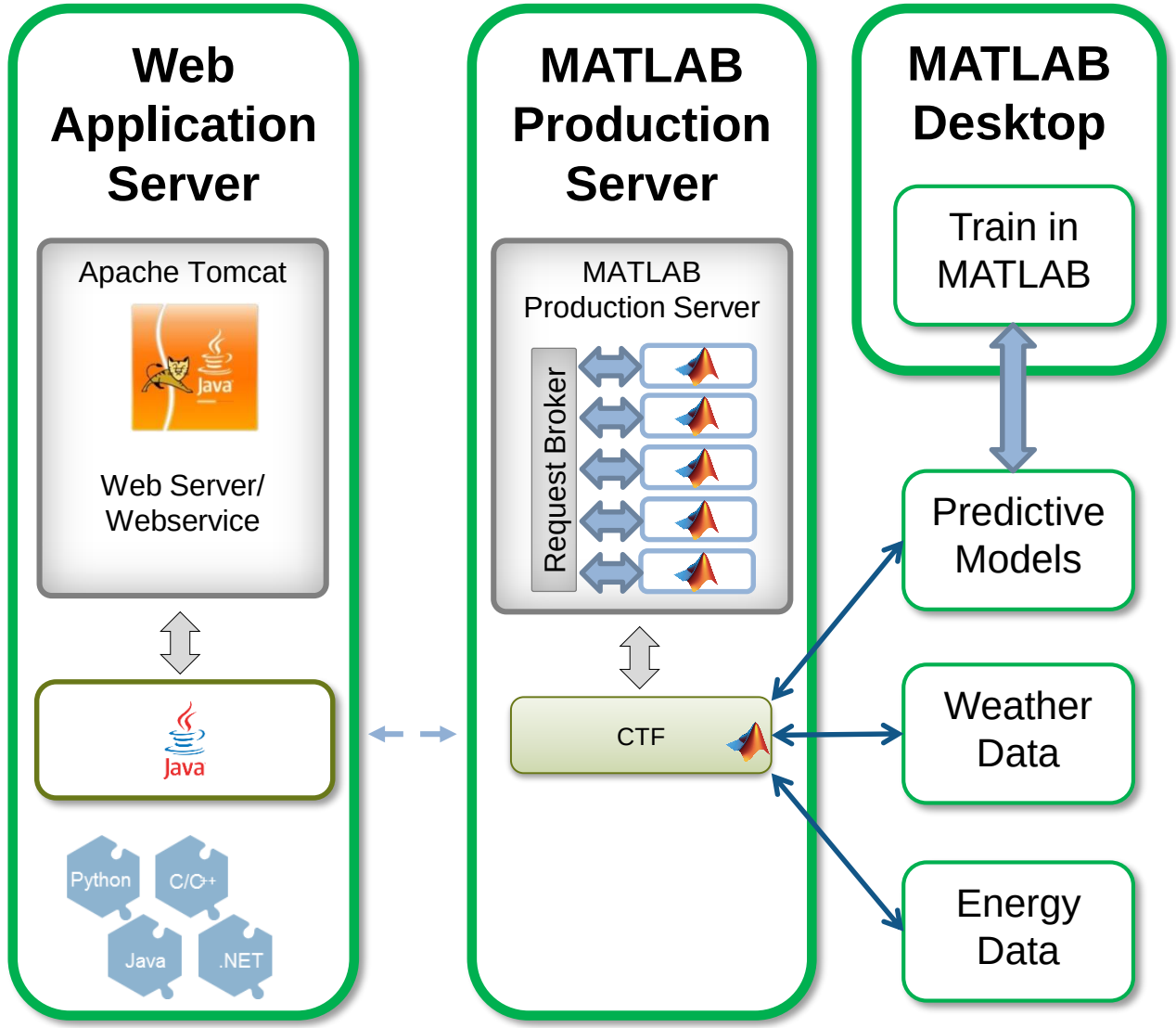
Enterprise scale deployment of an Analytic



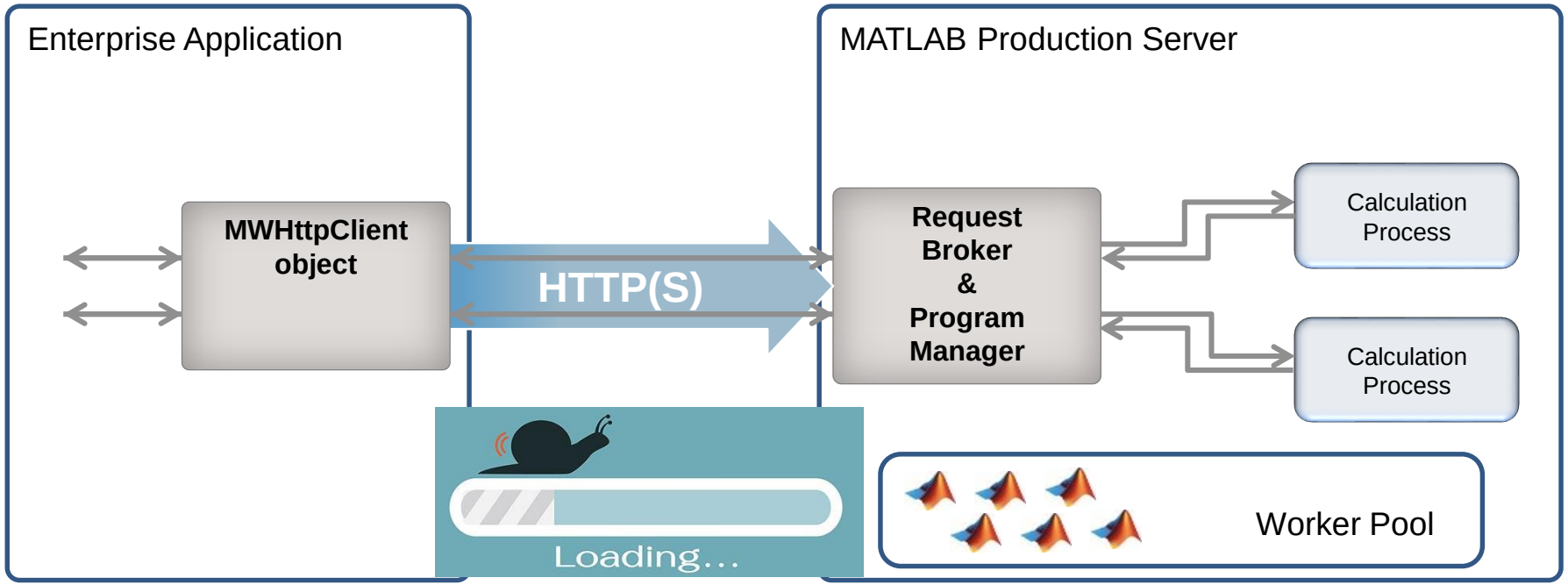
Deployed Analytics

MATLAB Production Server



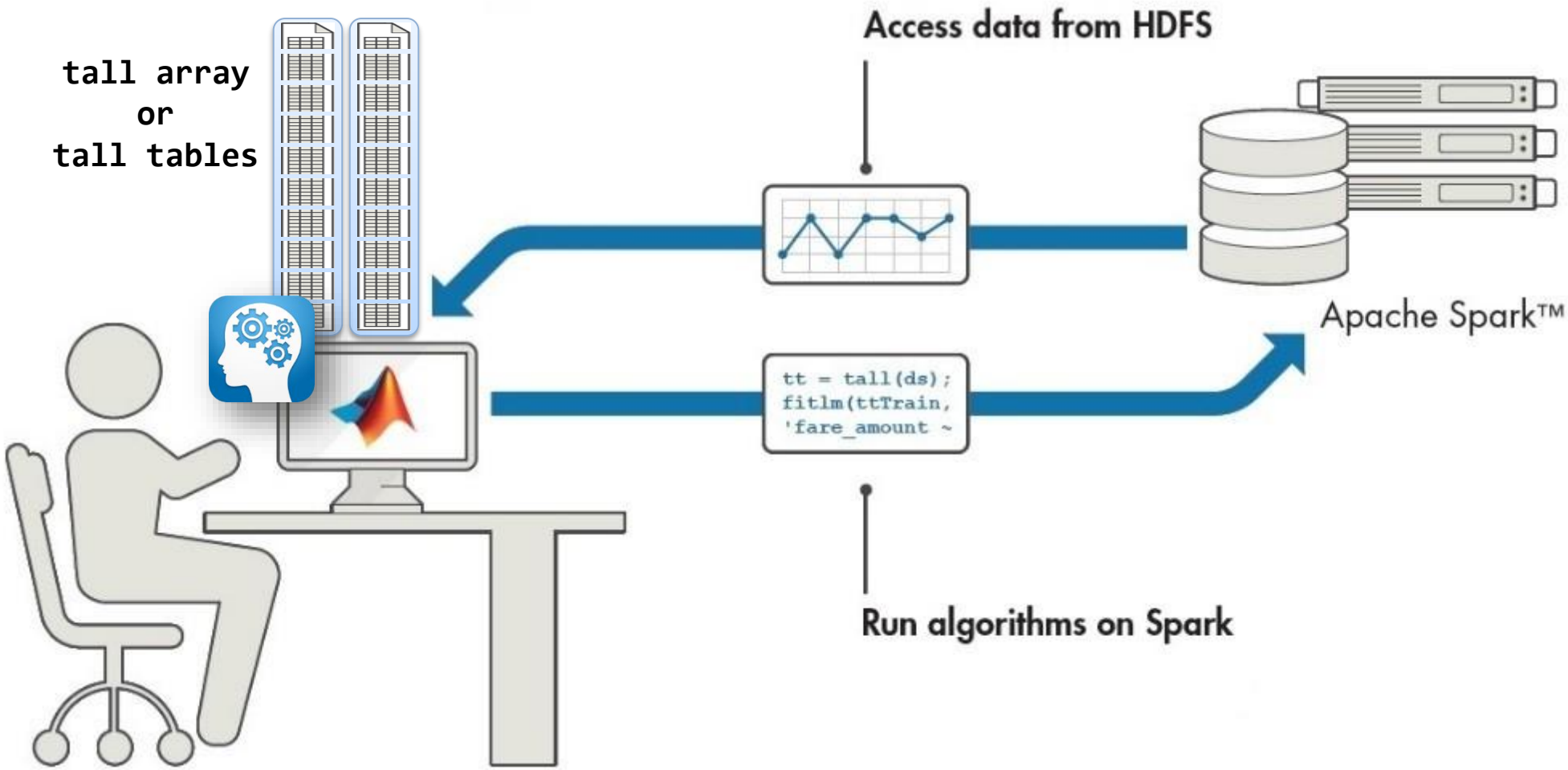


Request Management



Data is too big to process!

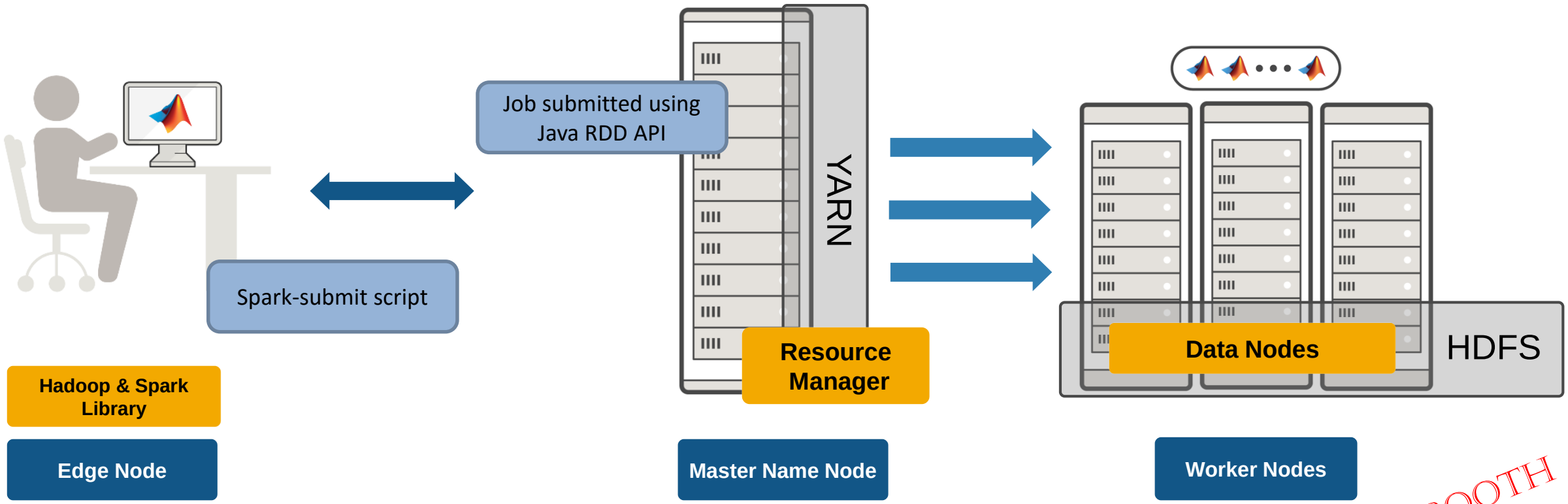
Use MATLAB with Spark on Clusters



Run MATLAB scripts on SPARK & HADOOP

MATLAB workers on worker nodes in the cluster

- MDCS workers (working from MATLAB)



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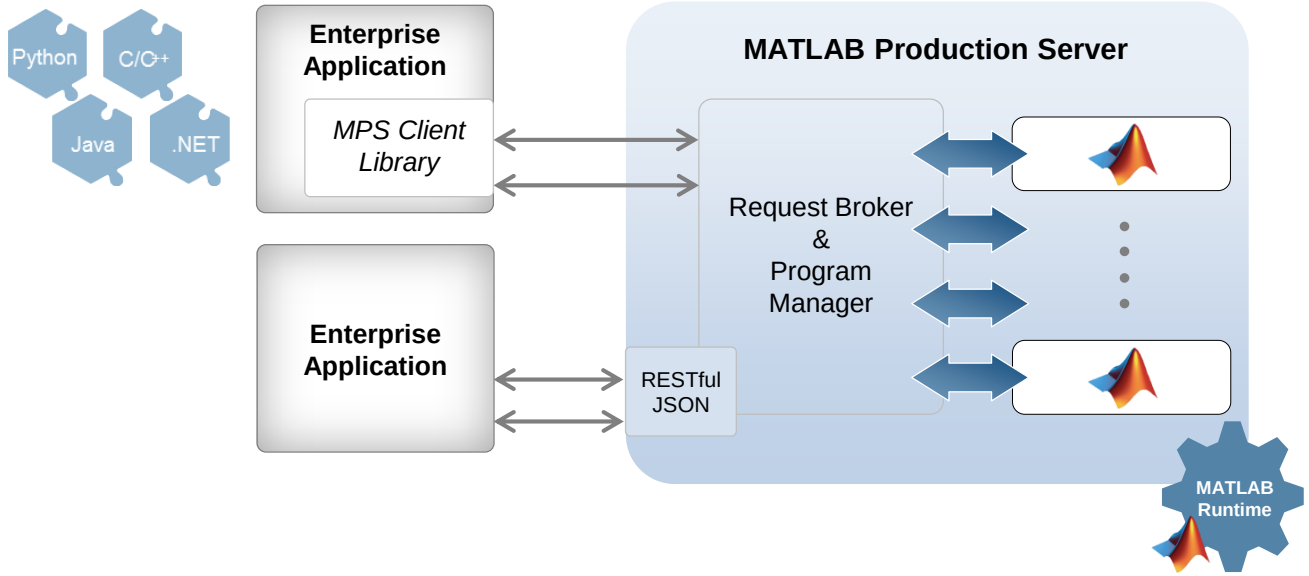
DEMO BOOTH

MATLAB Production Server

Enterprise Class Framework For Running Packaged MATLAB Programs

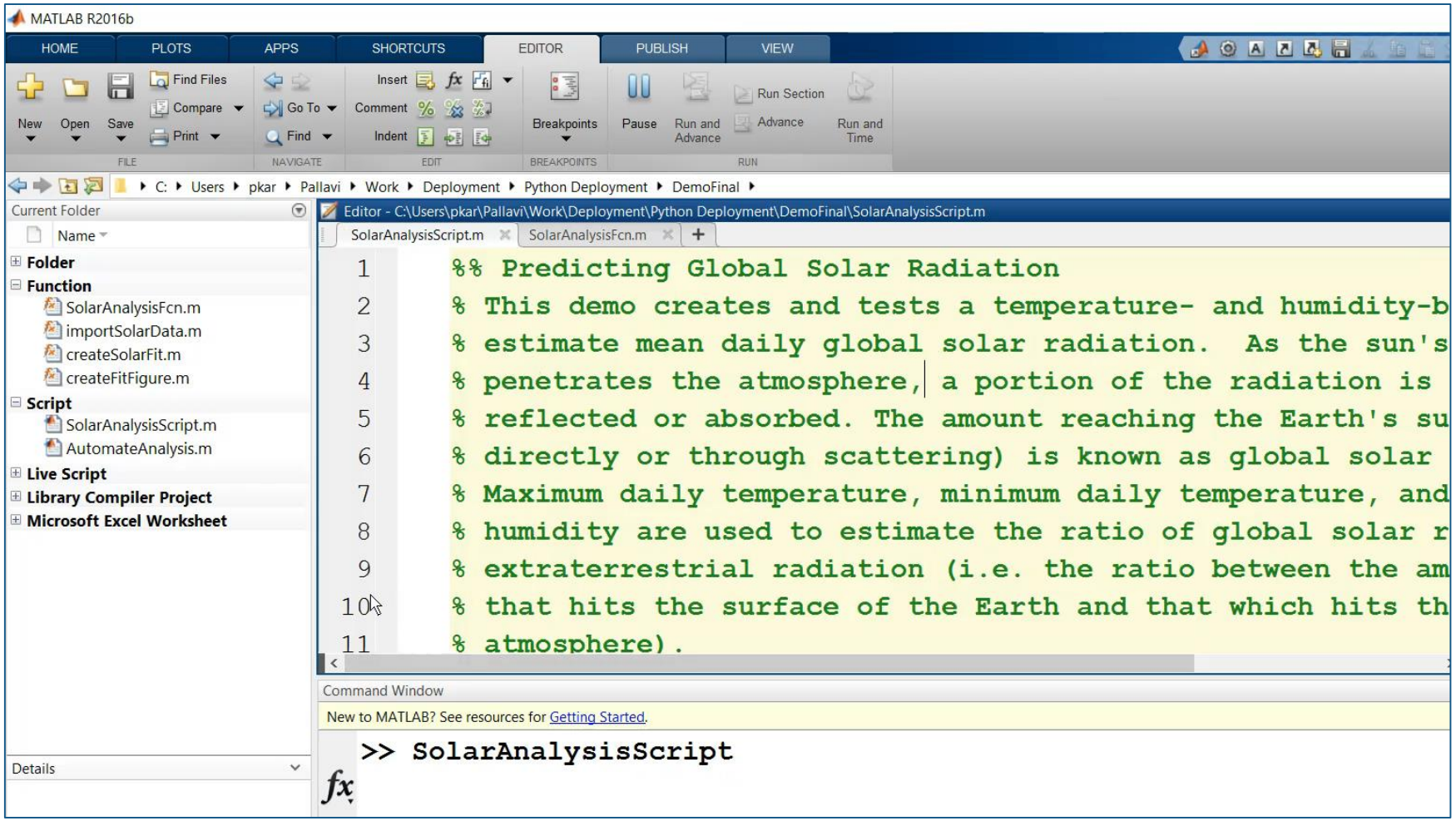
- Server software
  - Manages packaged MATLAB programs and worker pool
- MATLAB Runtime libraries
  - Single server can use runtimes from different releases
- RESTful JSON interface and lightweight client library (C/C++, .NET, Python, and Java)



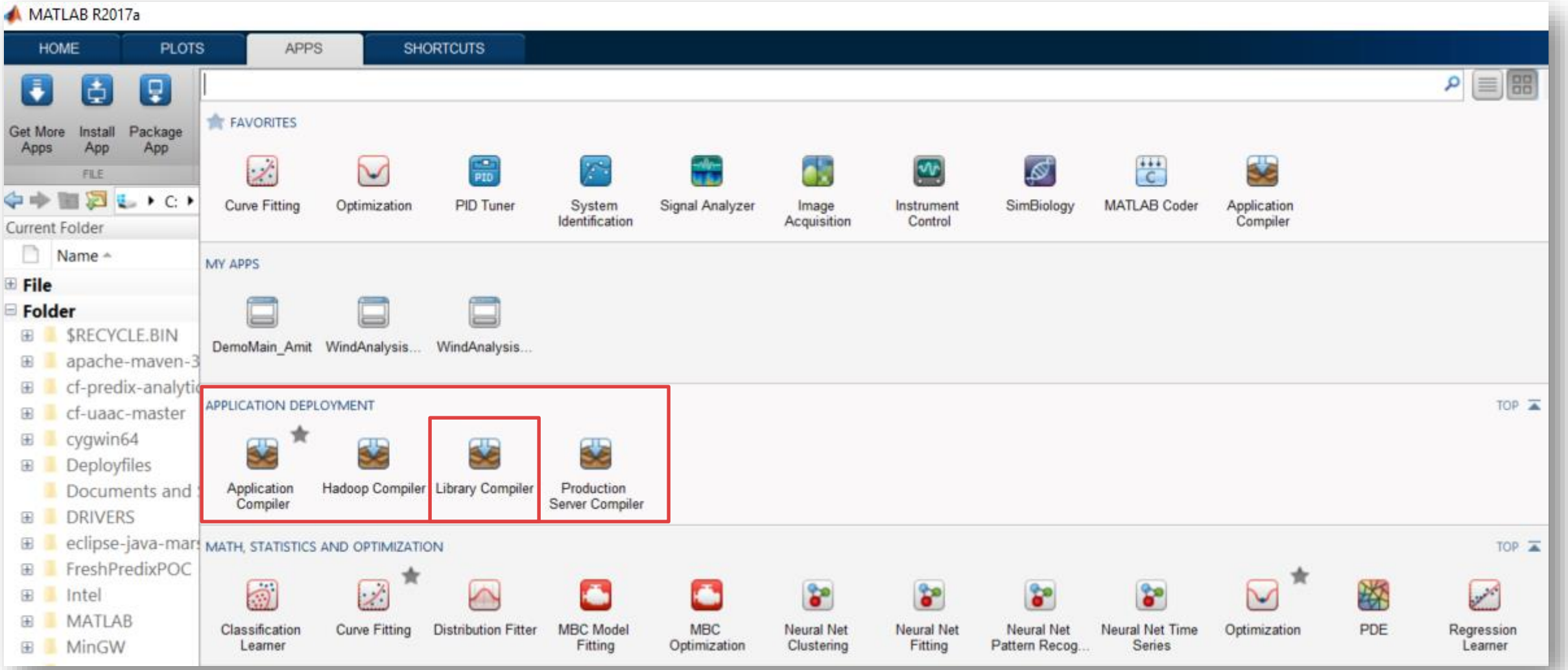
Key Takeaways

1. Distribute applications to MATLAB users royalty-free.
2. Distribute applications to non-MATLAB users royalty-free
3. Integrate MATLAB functions into existing workflows and development platforms.
4. Deploy MATLAB applications to service simultaneous user requests enterprise-wide.

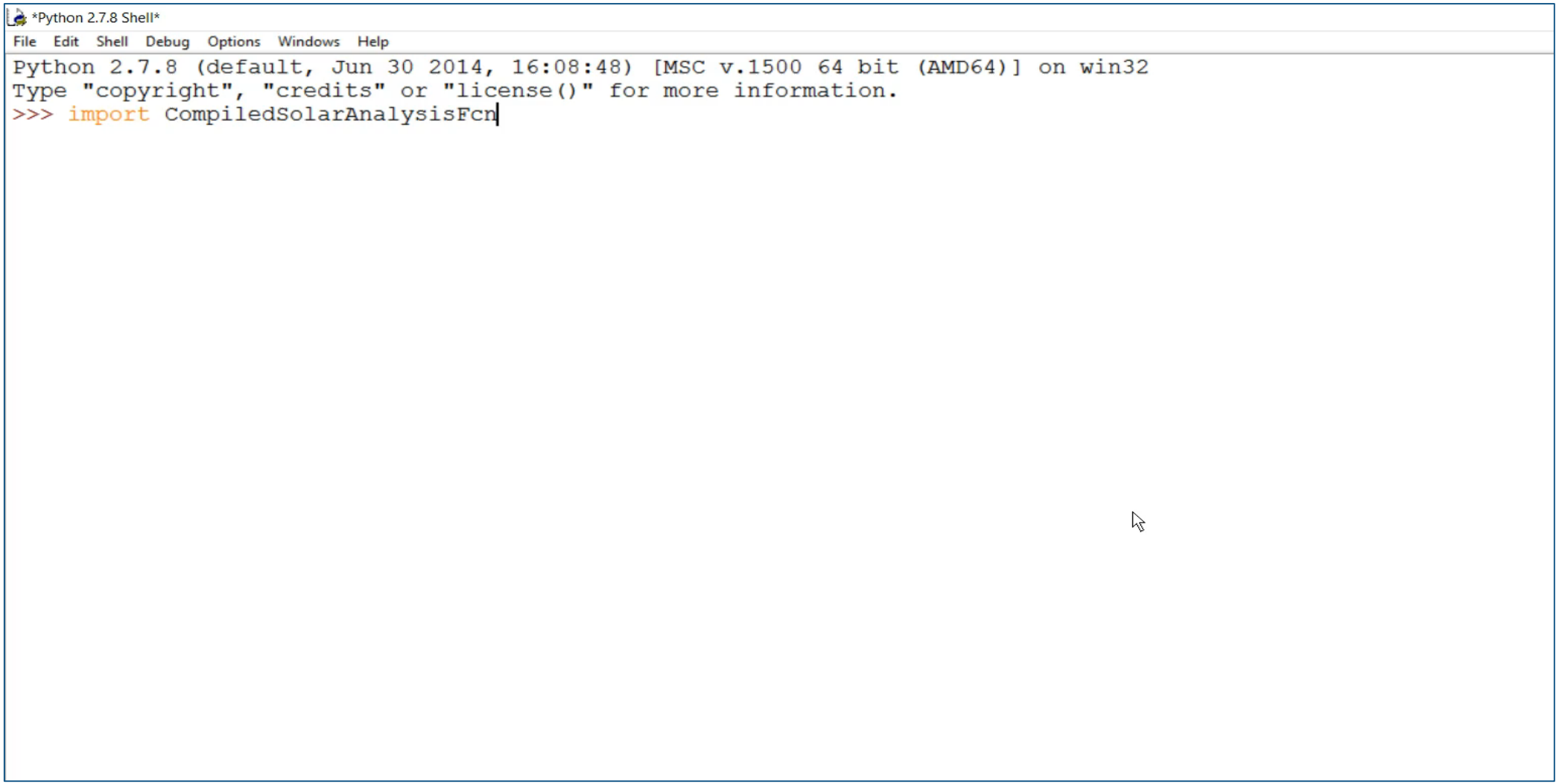
Sharing Solar Analysis with Python users



Compiling Libraries



Calling MATLAB Compiled Package from Python

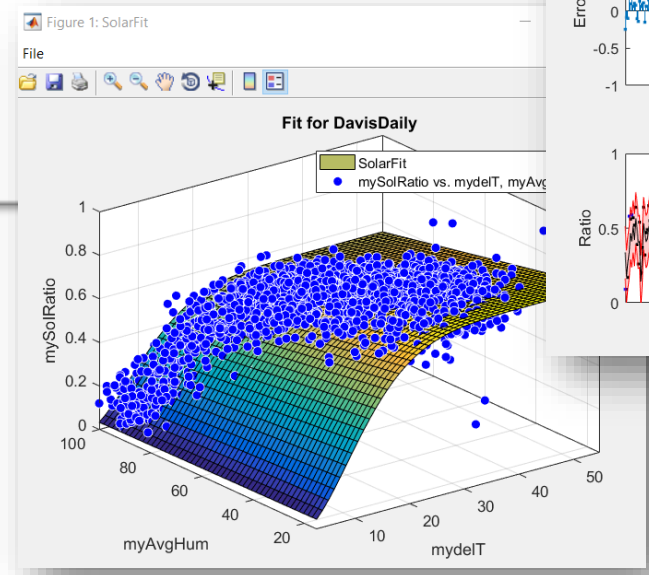


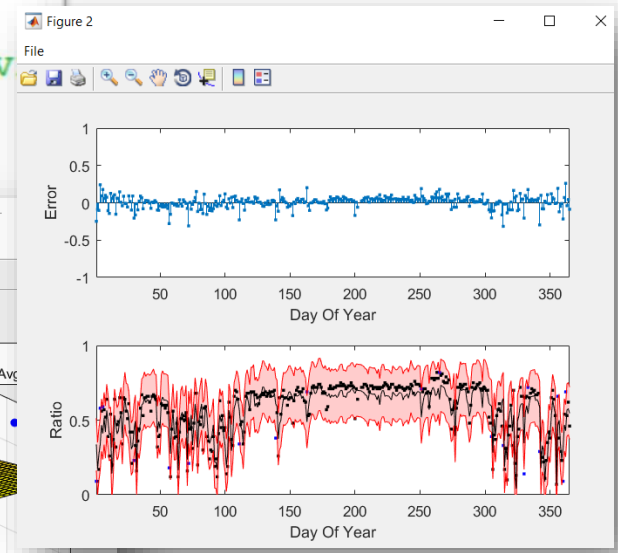
MATLAB library leveraged in Python

Python 2.7.8: Solar_Demo_python_matlab_script.py - C:\Users\pkar\Pallavi\Work\Deployment\Python Deployment\Solar_Demo_python_mat...

File Edit Format Run Options Windows Help

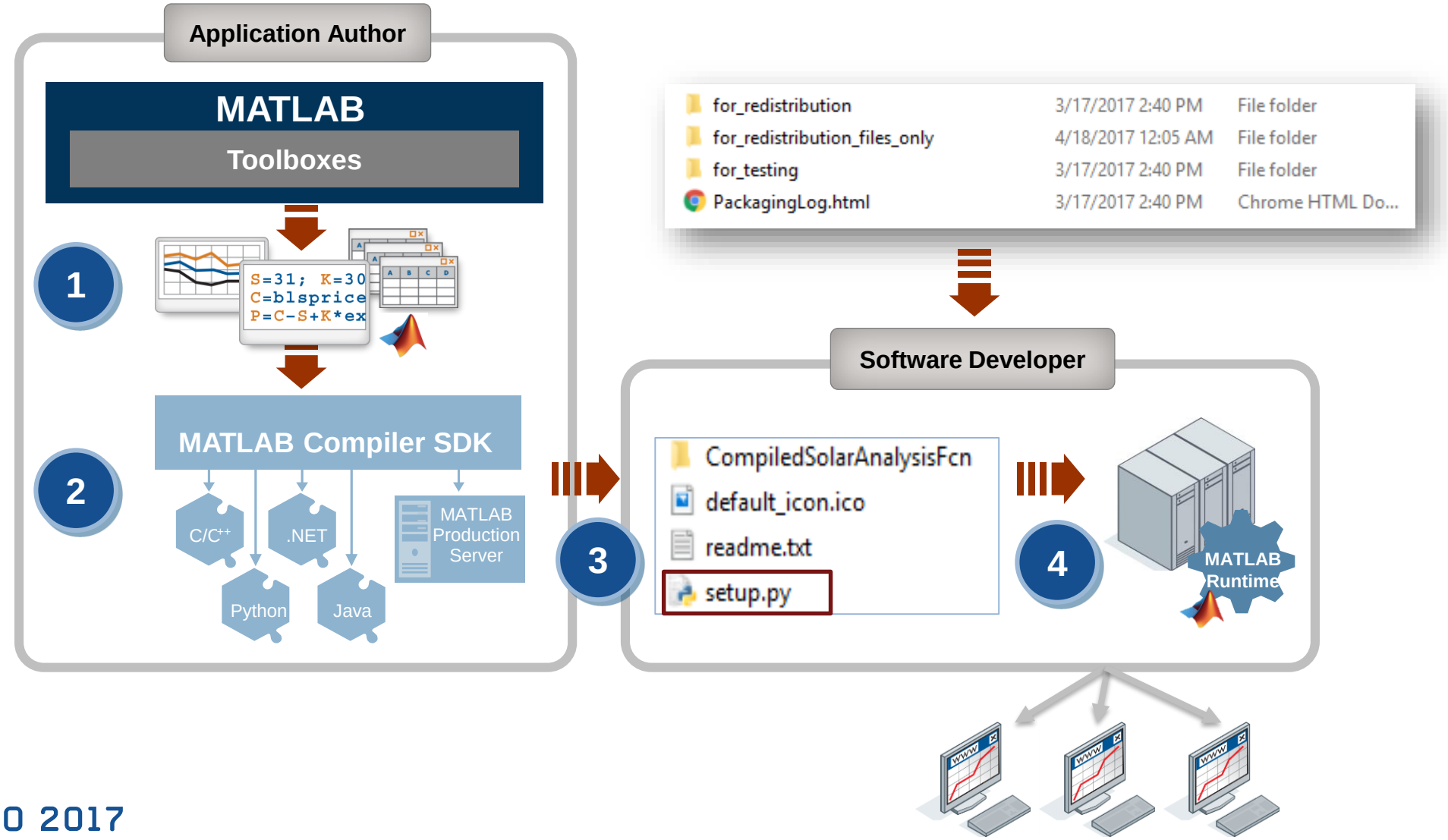
```
import CompiledSolarAnalysisFcn

mySolarfunc = CompiledSolarAnalysisFcn.initialize() #initialize the MCR

# import library for datatype integration between MATLAB and Python
import matlab

# Provide input path to MATLAB script from Python
filepath="C:\Users\pkar\Pallavi\Work\Deployment\Python Deployment\DemoFinal\Dav

type(filepath)

# Evaluate or call the MATLAB function
mySolarfunc.SolarAnalysisFcn(filepath)
```



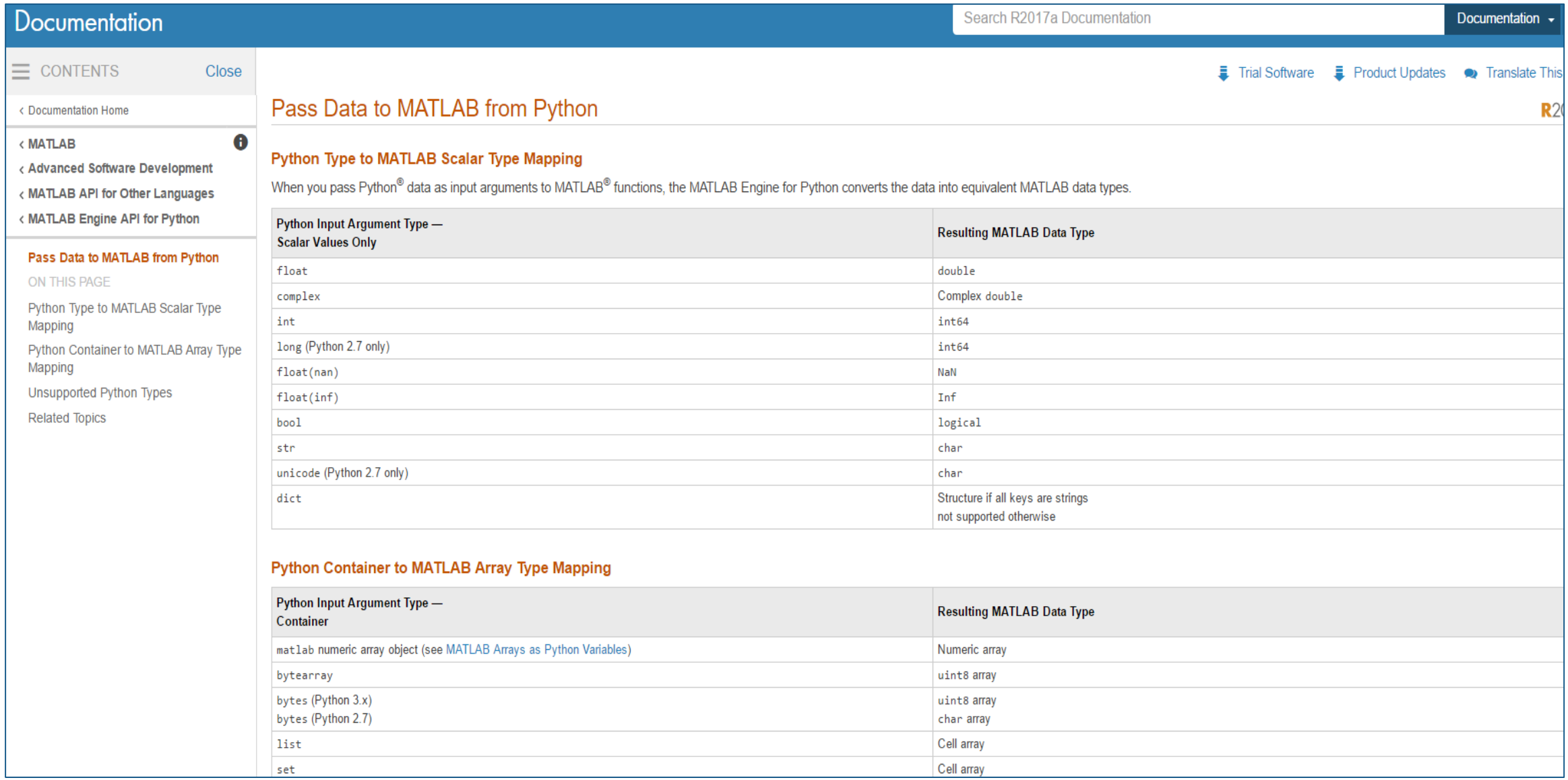


Retain MATLAB's capability

Integrate MATLAB-based Components With Your Own Software



Learn More



Documentation

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Documentation

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‹ MATLAB Engine API for Python

Pass Data to MATLAB from Python

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Python Container to MATLAB Array Type Mapping

Unsupported Python Types

Related Topics

Trial Software Product Updates Translate This

Pass Data to MATLAB from Python

Python Type to MATLAB Scalar Type Mapping

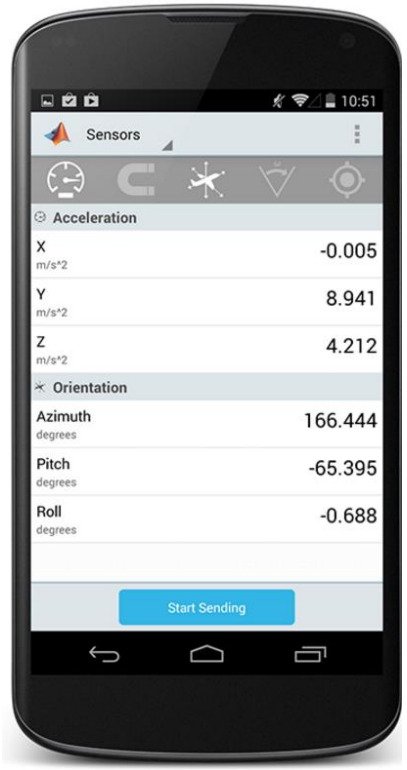
When you pass Python® data as input arguments to MATLAB® functions, the MATLAB Engine for Python converts the data into equivalent MATLAB data types.

Python Input Argument Type — Scalar Values Only	Resulting MATLAB Data Type
`float`	`double`
`complex`	Complex `double`
`int`	`int64`
`long` (Python 2.7 only)	`int64`
`float(nan)`	`NaN`
`float(inf)`	`Inf`
`bool`	`logical`
`str`	`char`
`unicode` (Python 2.7 only)	`char`
`dict`	Structure if all keys are strings not supported otherwise

Python Container to MATLAB Array Type Mapping

Python Input Argument Type — Container	Resulting MATLAB Data Type
`matlab` numeric array object (see MATLAB Arrays as Python Variables)	Numeric array
`bytearray`	`uint8` array
`bytes` (Python 3.x) `bytes` (Python 2.7)	`uint8` array `char` array
`list`	Cell array
`set`	Cell array

Consumer otoscope in a mobile device



feedback

MATLAB to iPhone and Android Made Easy

Bill Chou, MathWorks

Learn how to generate readable and portable C code from your MATLAB algorithms using MATLAB Coder™,

MATLAB EXPO 2017

https://www.mathworks.com/videos/matlab-to-iphone-and-android-made-easy-107779.html

Resources:

https://www.mathworks.com/matlabcentral/fileexchange/53027-matlab-to-android-made-easy-example-files

https://www.mathworks.com/matlabcentral/fileexchange/48954-matlab-to-iphone-made-easy-example-files

Key Takeaways

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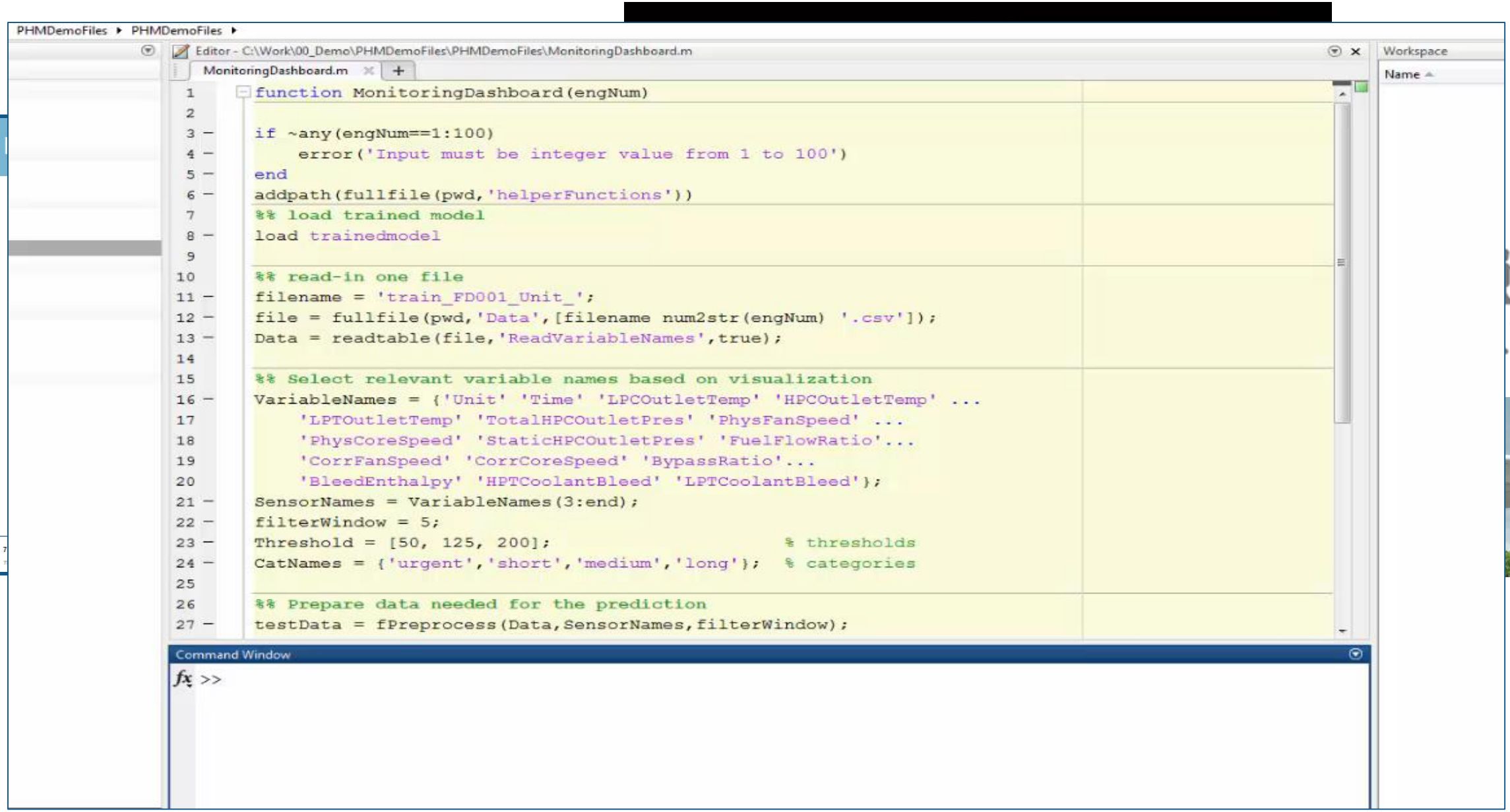
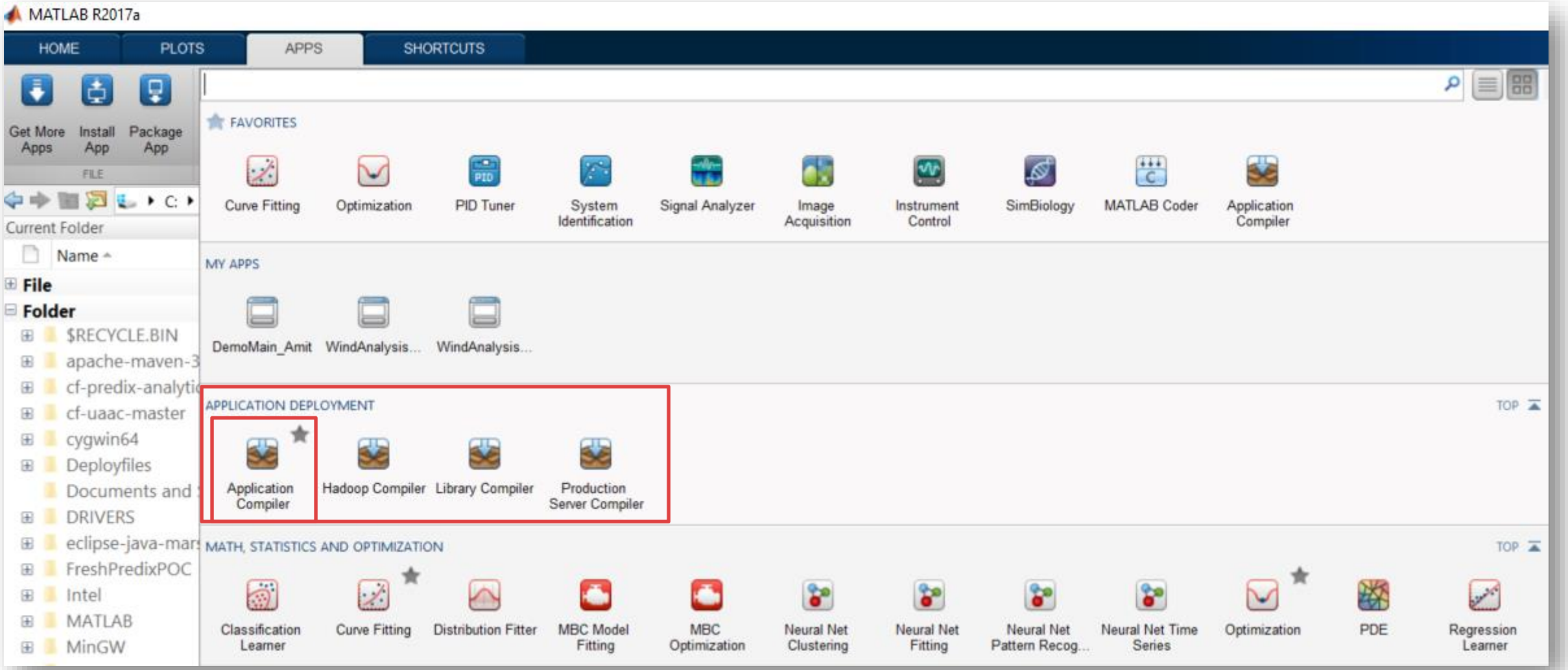
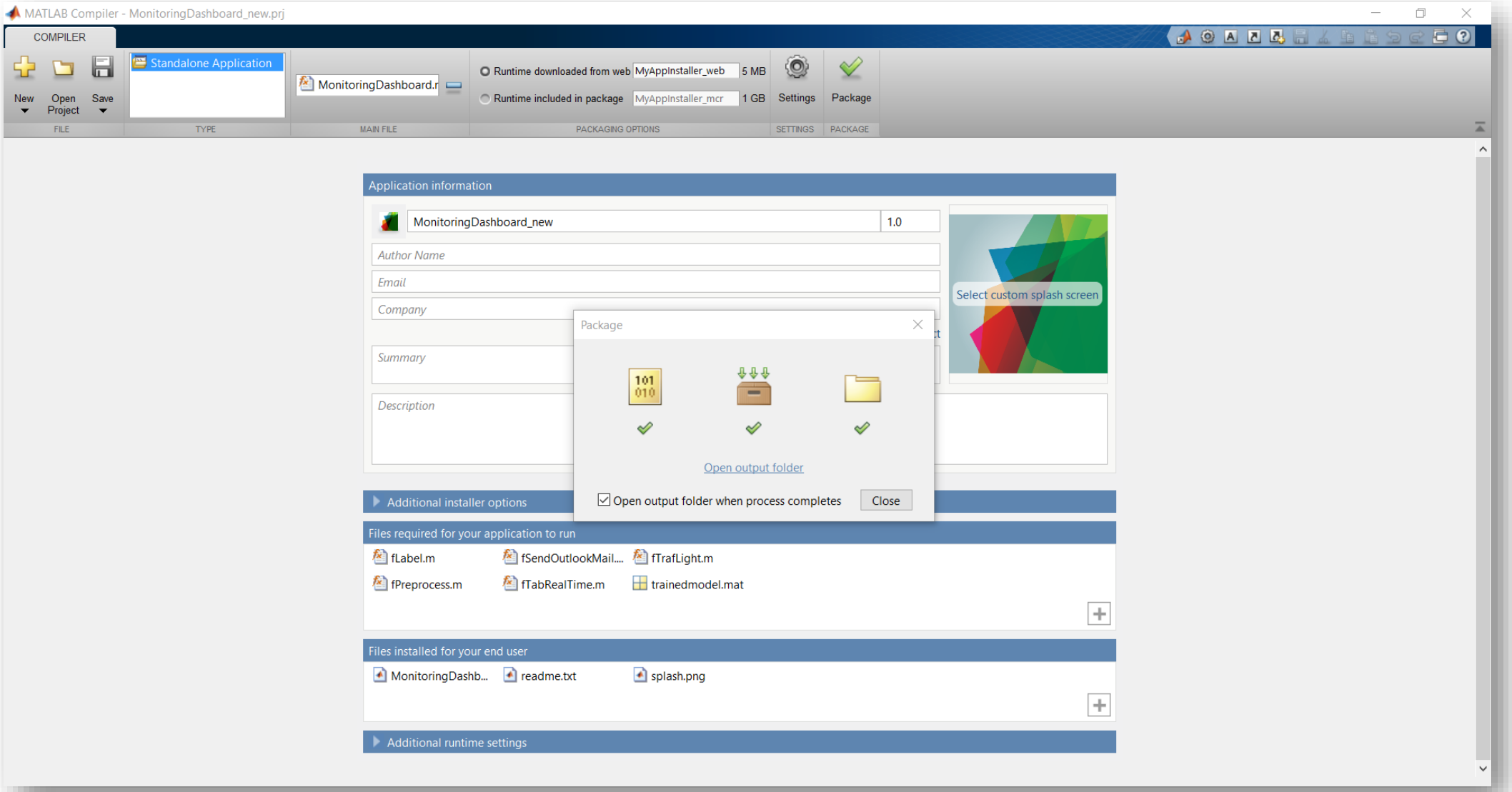

PHMDemoFiles ▸ PHMDemoFiles ▸
Editor - C:\Work\00_Demo\PHMDemoFiles\PHMDemoFiles\MonitoringDashboard.m
MonitoringDashboard.m
Workspace
Name
function MonitoringDashboard(engNum)
if ~any(engNum==1:100)
error('Input must be integer value from 1 to 100')
end
addpath(fullfile(pwd,'helperFunctions'))
%% load trained model
load trainedmodel
%% read-in one file
filename = 'train_FD001_Unit_';
file = fullfile(pwd,'Data',[filename num2str(engNum) '.csv']);
Data = readtable(file,'ReadVariableNames',true);
%% Select relevant variable names based on visualization
VariableNames = {'Unit' 'Time' 'LPCOutletTemp' 'HPCOutletTemp' ...
'LPTOutletTemp' 'TotalHPCOutletPres' 'PhysFanSpeed' ...
'PhysCoreSpeed' 'StaticHPCOutletPres' 'FuelFlowRatio'...
'CorrFanSpeed' 'CorrCoreSpeed' 'BypassRatio'...
'BleedEnthalpy' 'HPTCoolantBleed' 'LPTCoolantBleed'};
SensorNames = VariableNames(3:end);
filterWindow = 5;
Threshold = [50, 125, 200];
% thresholds
CatNames = {'urgent','short','medium','long'};
% categories
%% Prepare data needed for the prediction
testData = fPreprocess(Data,SensorNames,filterWindow);
Command Window
>>

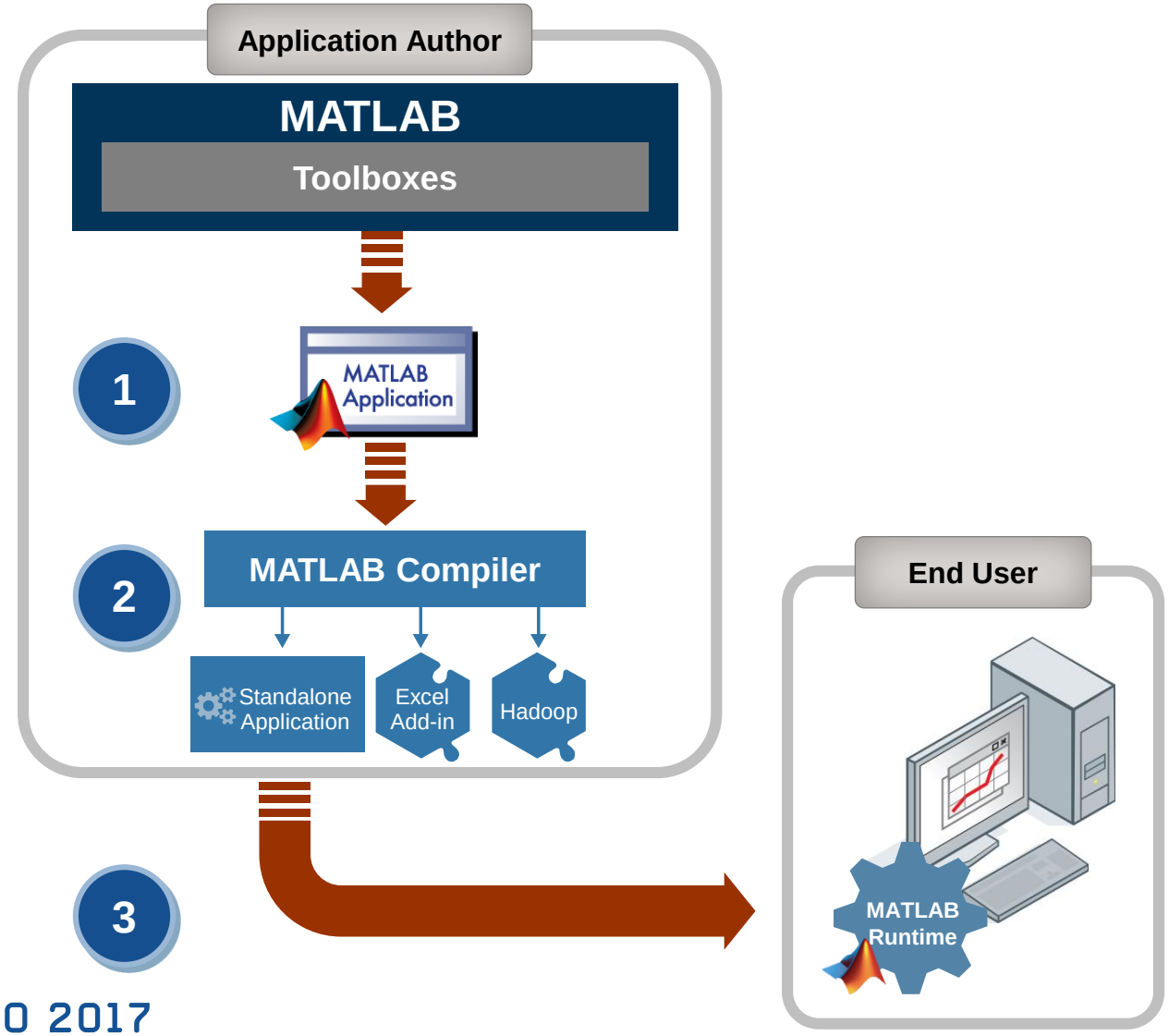
Application Deployment



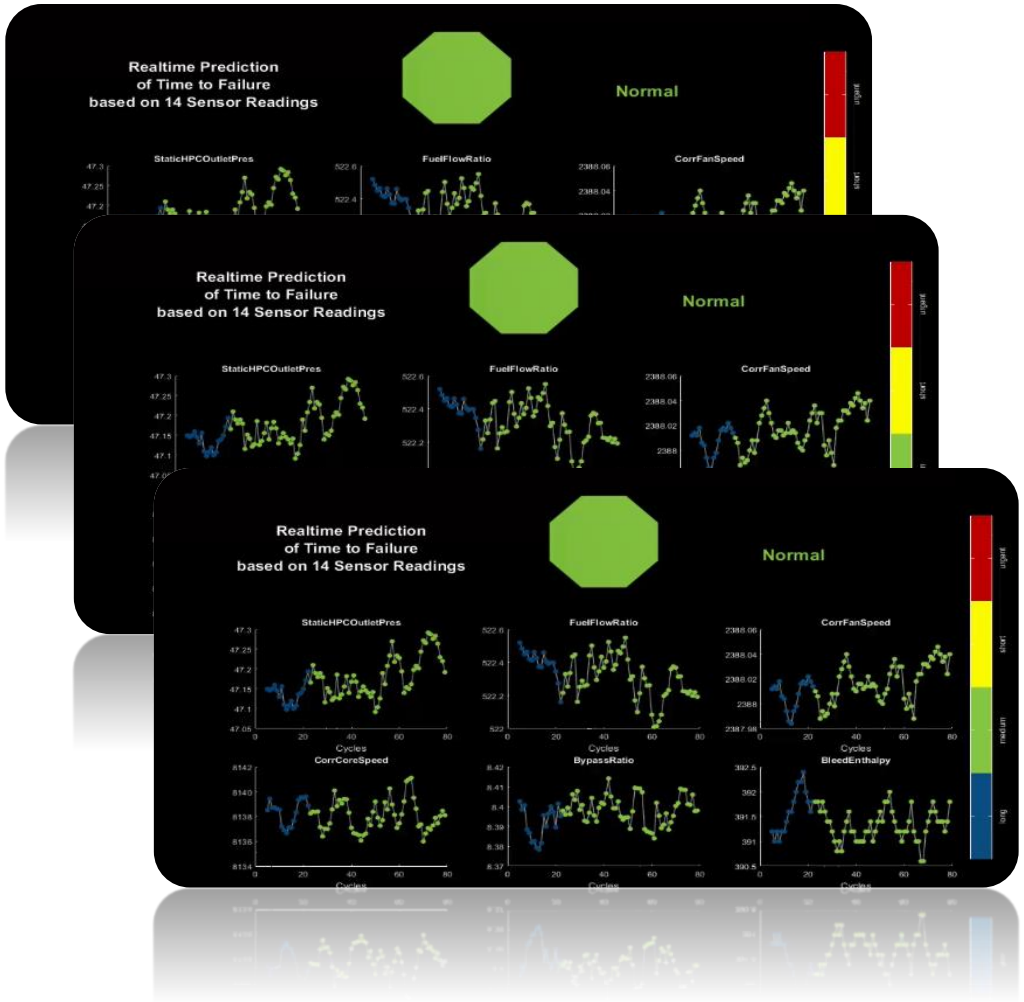
Compiling MATLAB functions



Share Applications Built Completely in MATLAB



Can I run multiple analysis through multiple .exes?



- Do they run in parallel or serial?
- What if they need to run for different datasets?

Resource Management??

MATLAB has solutions designed for production environments:

- MATLAB Production Server
- MATLAB Distributed Computing Server

Mondi Implements Statistics-Based Health Monitoring and Predictive Maintenance for Manufacturing Processes with Machine Learning

Challenge

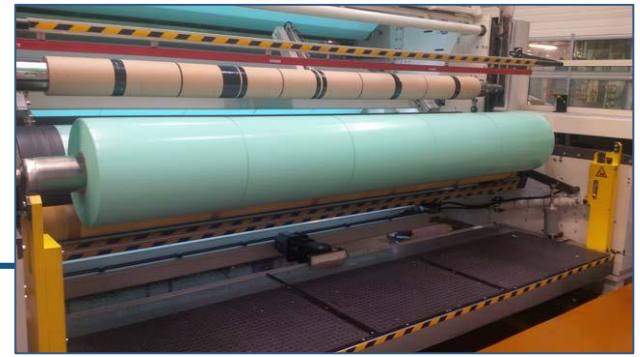
Reduce waste and machine downtime in plastics manufacturing plants

Solution

Use MATLAB to develop and deploy monitoring and predictive maintenance software that uses machine learning algorithms to predict machine failures

Results

- More than 50,000 euros saved per year
- Prototype completed in six months
- Production software run 24/7



One of Mondi Gronau's plastic production machines, which deliver about 18 million tons of plastic and thin film products annually.

"MathWorks Consulting's support is among the best I've seen; the consultants are fast and exceptionally knowledgeable. We've already seen a positive return on investment from cost savings, and now we have more budget and time to complete more machine learning projects that will provide similar benefits."

Dr. Michael Kohlert
Mondi

Link to user story

Key Takeaways

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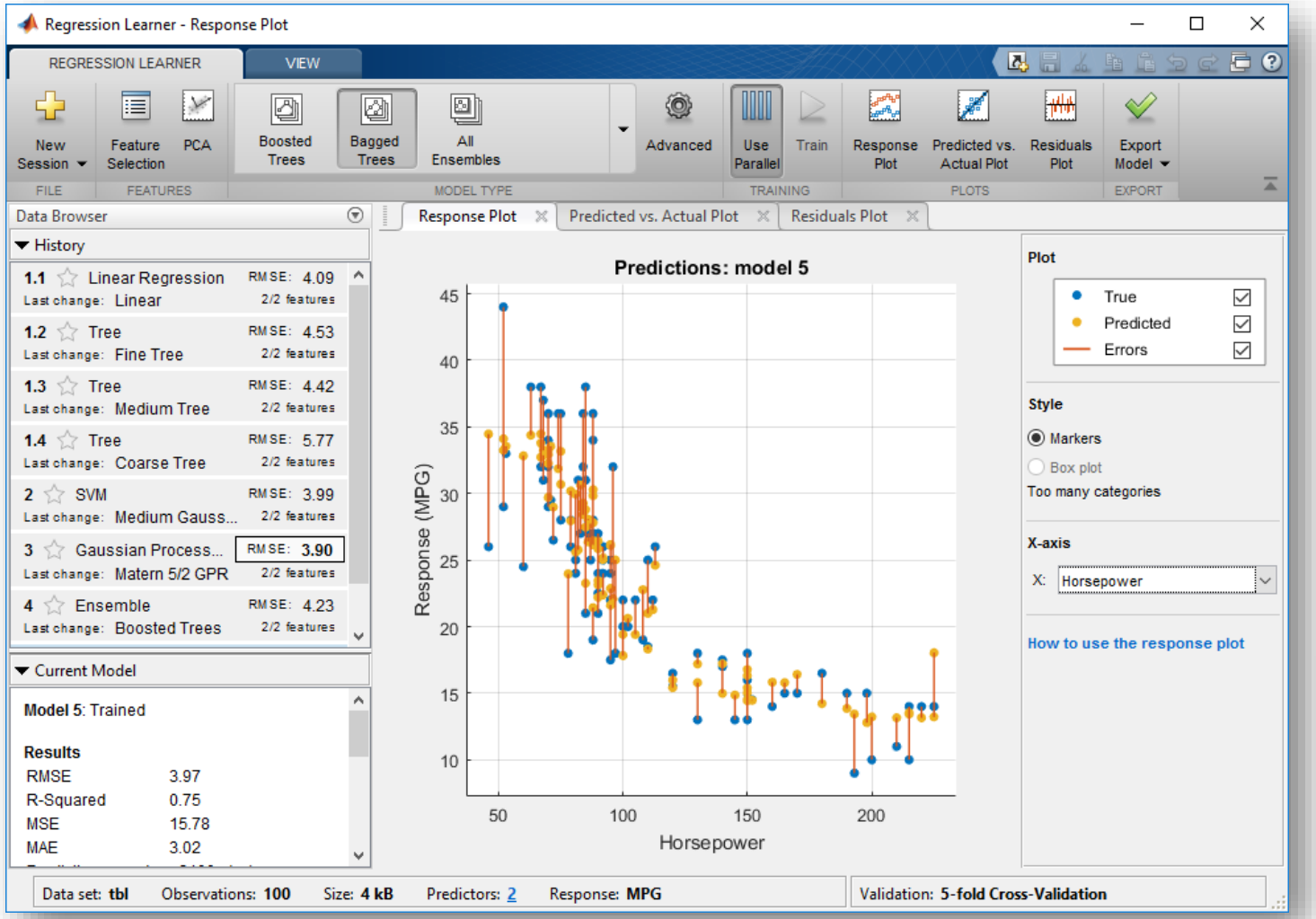
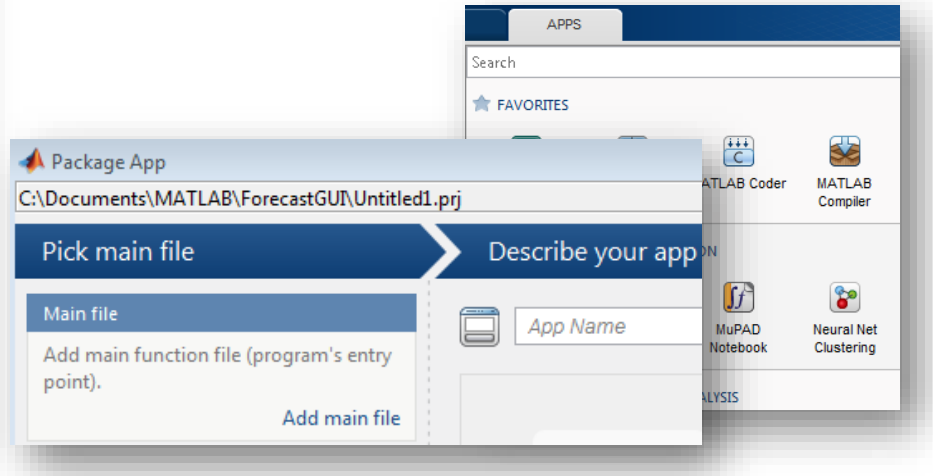
MATLAB Apps to share algorithms with MATLAB users



- MATLAB Apps helps users prototype algorithms faster.
- You can use Apps with parallel .
- Automate or generate code from Apps.

How to package my own app?



Key Takeaways

What have we learnt?

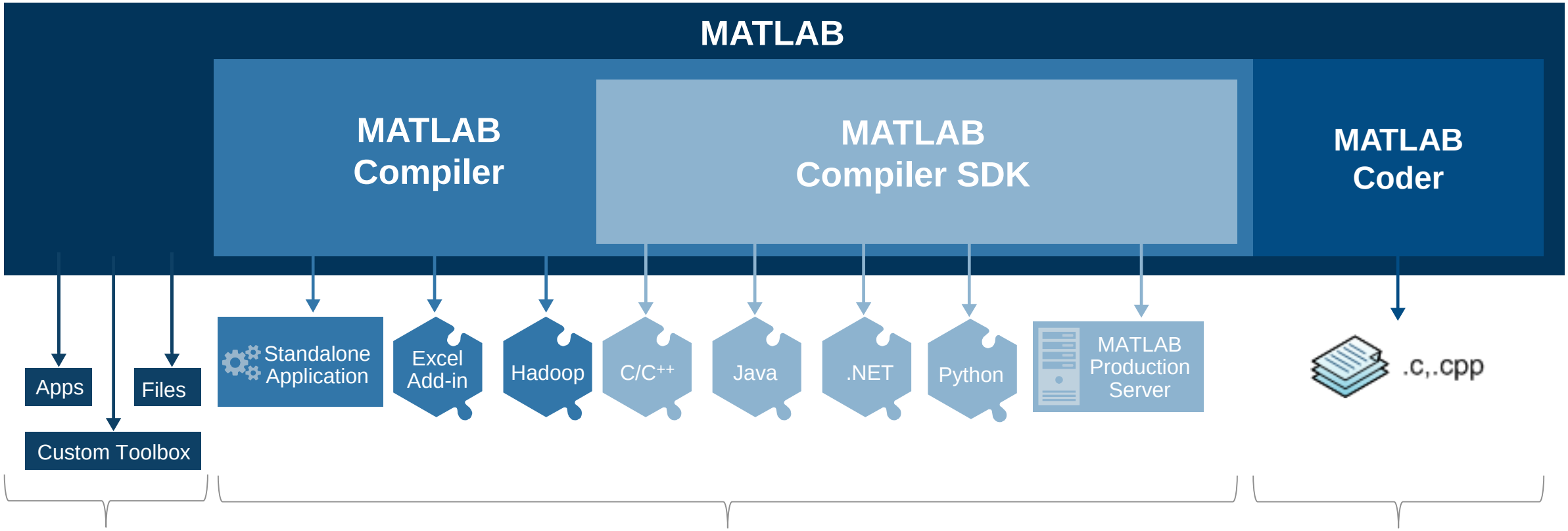
1. Distribute applications to non-MATLAB users royalty-free.

2. Integrate MATLAB functions into existing workflows and development platforms.

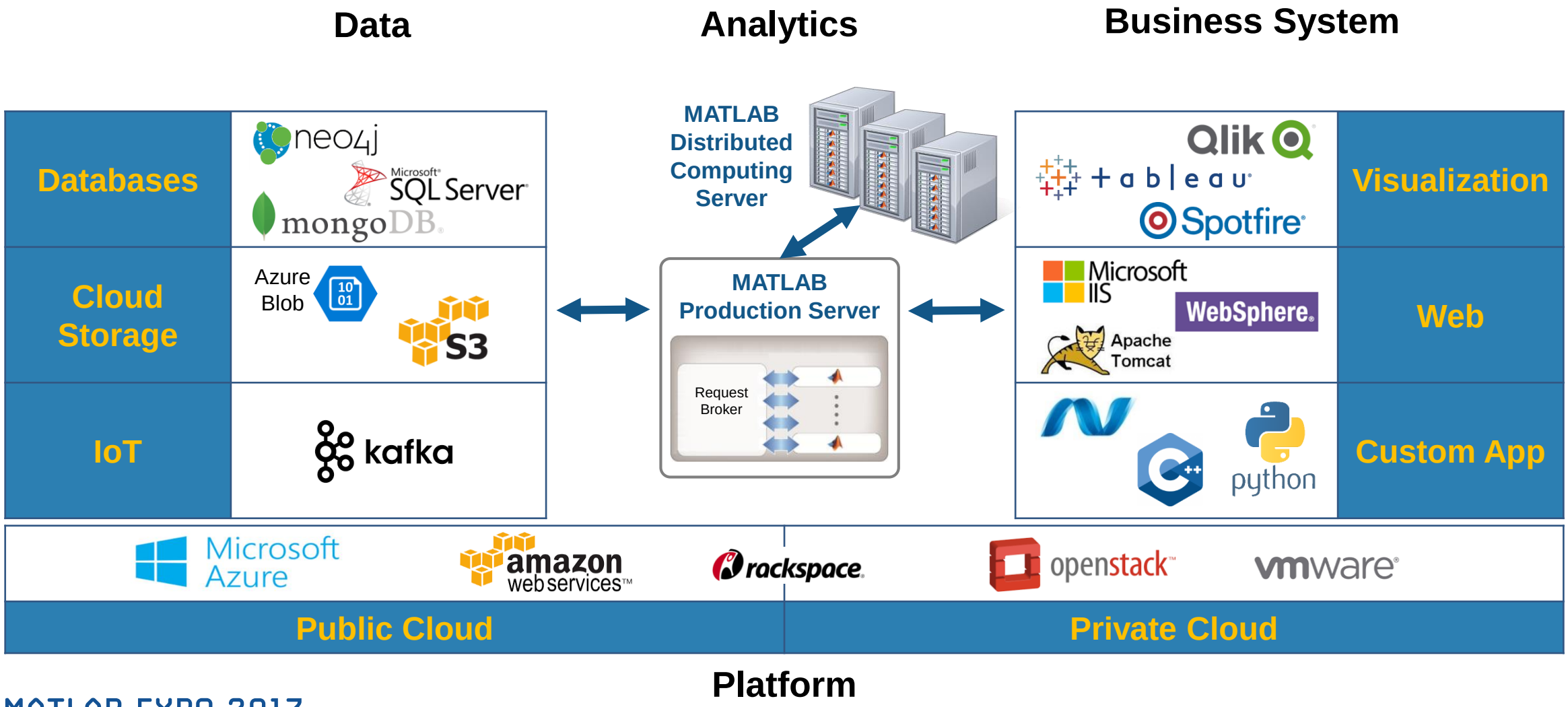
3. Deploy MATLAB Analytics for Big Data on Hadoop enabled Spark Clusters.

4. Deploy MATLAB applications to service simultaneous user requests enterprise-wide via web or cloud frameworks.

Write Your Programs Once
Then Share To Different Targets



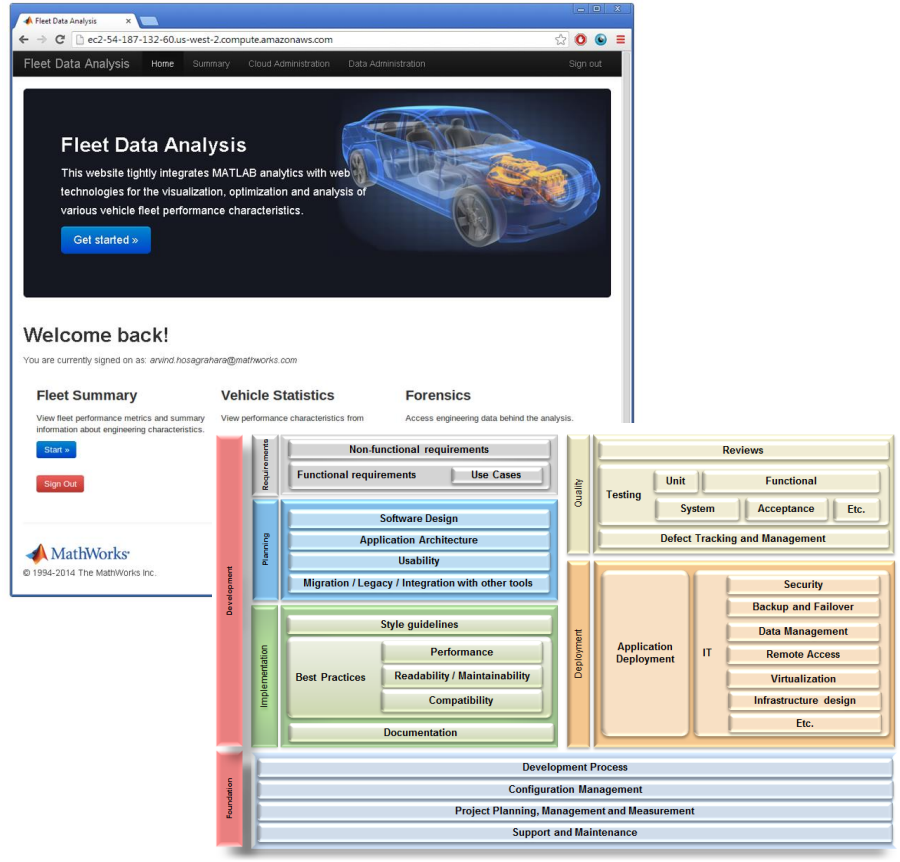
Technology Stack



MathWorks Services

- Consulting
  - Integration
  - Data analysis/visualization
  - Unify workflows, models, data

www.mathworks.com/services/consulting/



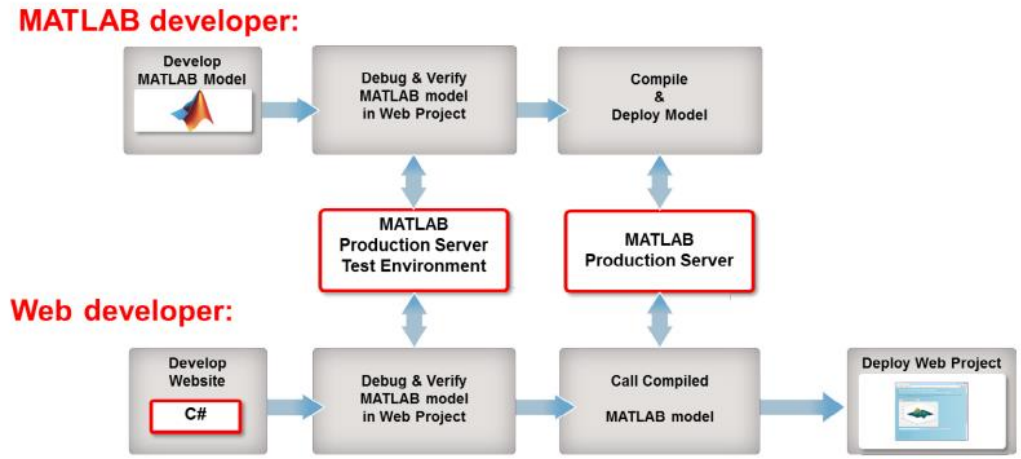
- Training
  - Classroom, online, on-site
  - Data Processing, Visualization, Deployment, Parallel Computing, Machine Learning

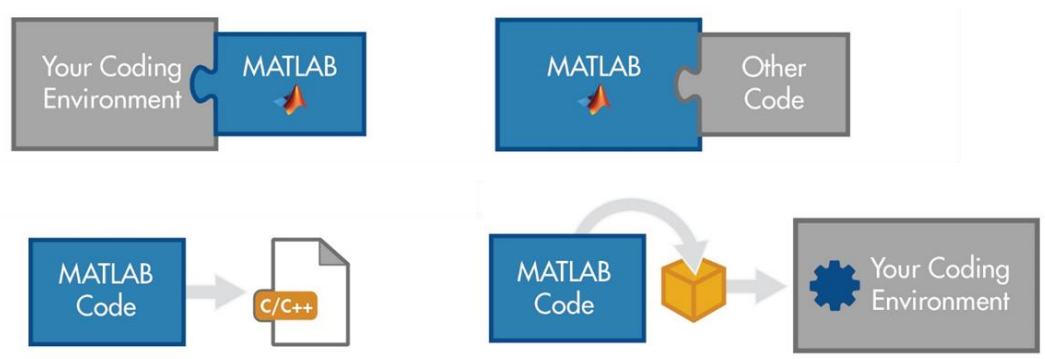
www.mathworks.com/services/training/

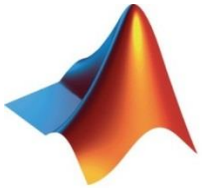
Online Resources

Call to action

- Documentation – MATLAB Production Server
- Technical Newsletter - Data-Driven Insights with MATLAB Analytics: An Energy Load Forecasting Case Study
- Free White Paper – Building a Website with MATLAB Analytics
- Website – Using MATLAB With Other Programming Languages
- Website – MATLAB for Enterprise scale Applications







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