

The background features a dark blue field on the left and a grey field on the right, separated by a diagonal line. In the center-right, there is a 3D wireframe plot with a color gradient from yellow at the top to blue at the bottom. On the far right, there are faint, light blue circuit-like patterns.

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

The screenshot shows a web browser window with the URL `ec2-54-165-201-58.compute-1.amazonaws.com:8080/DemandForecastWeb/demandForecast.jsp`. The page has a navigation bar with links for "Predictive Data Analytics", "Home", "Demand Forecasting", "Web Service Description", and "Documentation". The main content area is divided into two sections: "Select Zone" and "Forecast".

The "Select Zone" section features a "Zone" input field, a "Generate Forecast" button, and a "Model Diagnostics Report" button. Below this is a map of the Northeastern United States and parts of Canada, showing various cities and regions. The "Forecast" section contains a large light blue box with the text "Select zone & generate forecast". Below the map, there is a "Comparison" section which is currently empty.

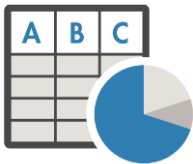
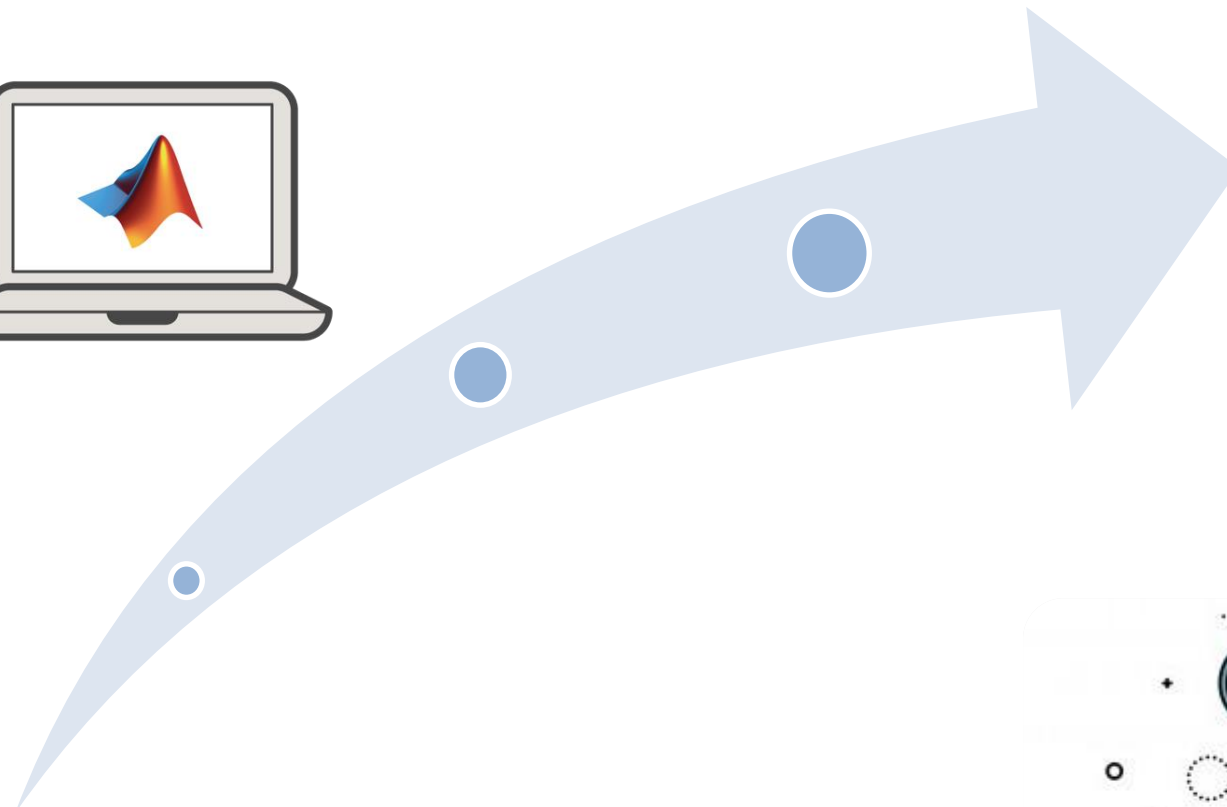
Easy and **accurate** day-ahead system load forecast

Requirements:

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

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

Deployment Scenarios



Sharing Reports

MATLAB EXPO 2017

MATLAB Excel
.NET C/C++
.exe Java .dll



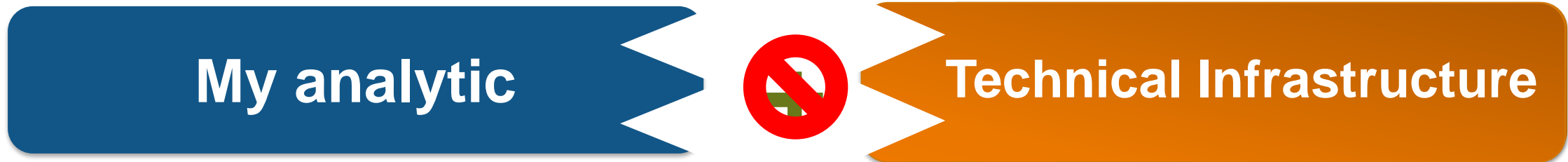
Sharing & Integrating Algorithms



Enterprise scale analytics

Deploying Industrial Analytics

Why is Deployment challenging?

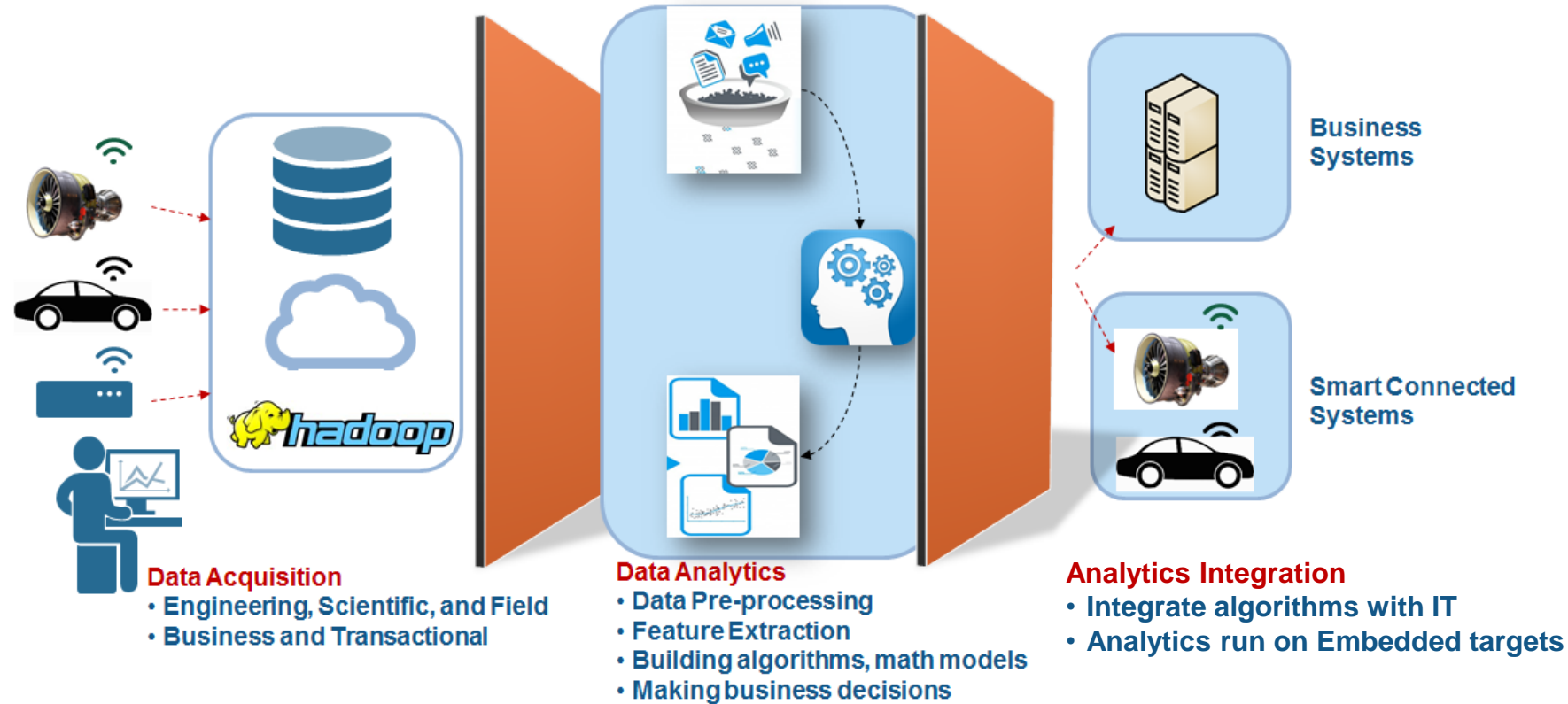


- Multiple internal and external consumers of MATLAB algorithms
- Algorithm integration in different IT Applications and Workflows
- Scaling up model for multiple (simultaneous) users and big data

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.

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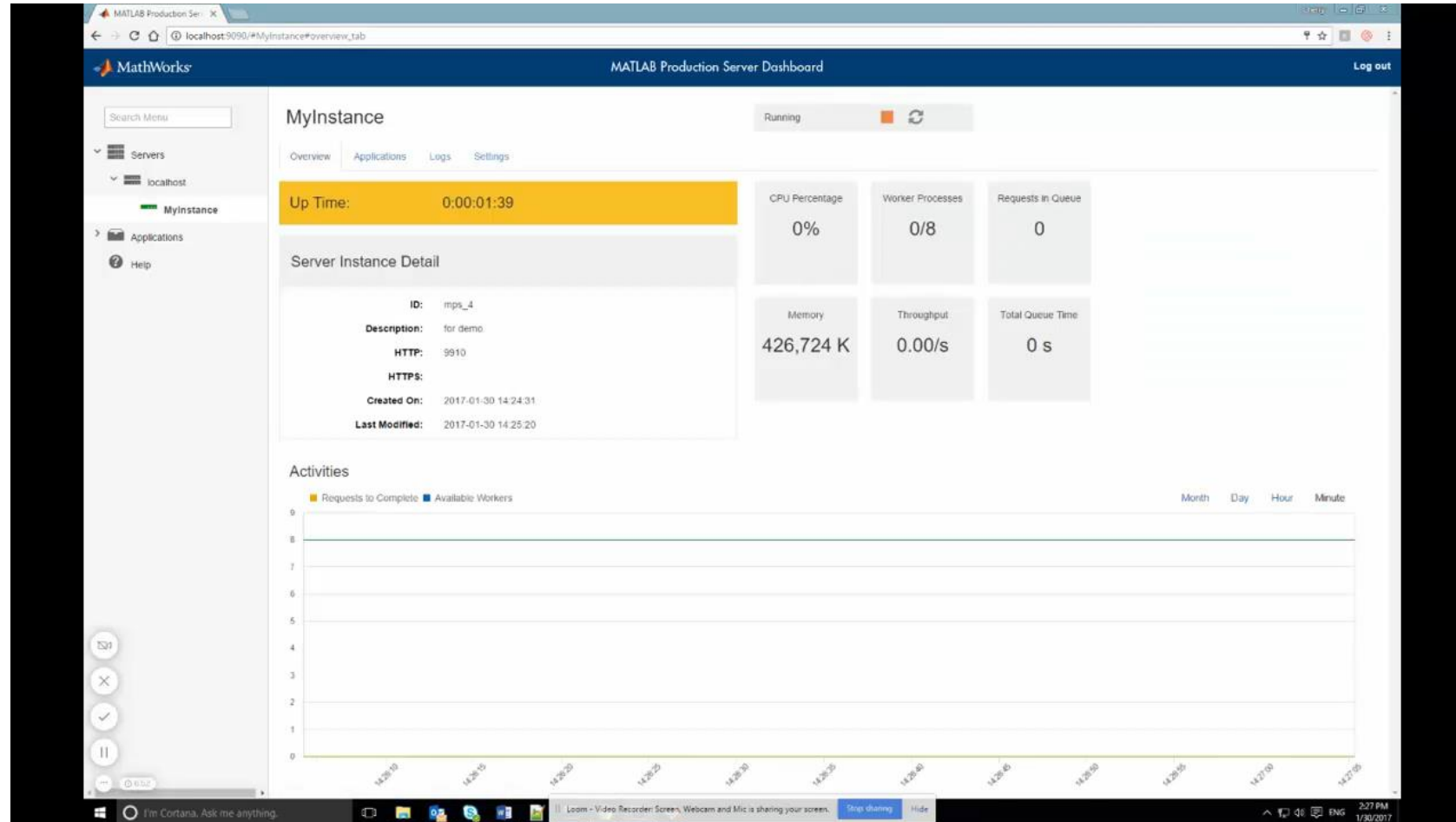
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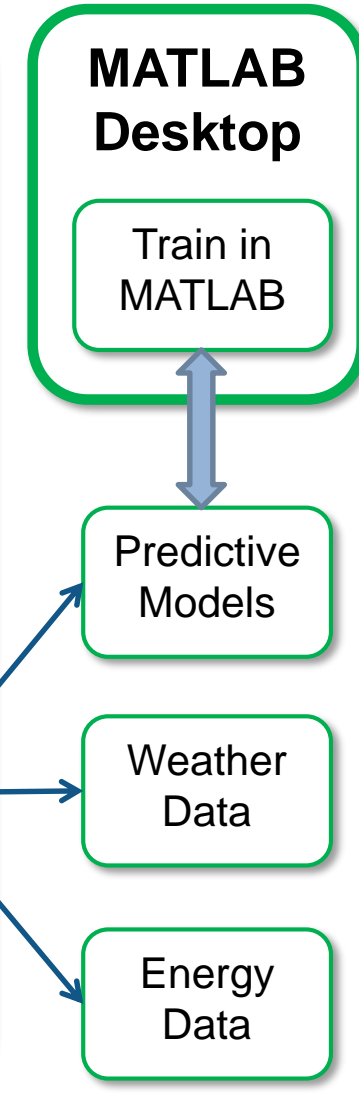
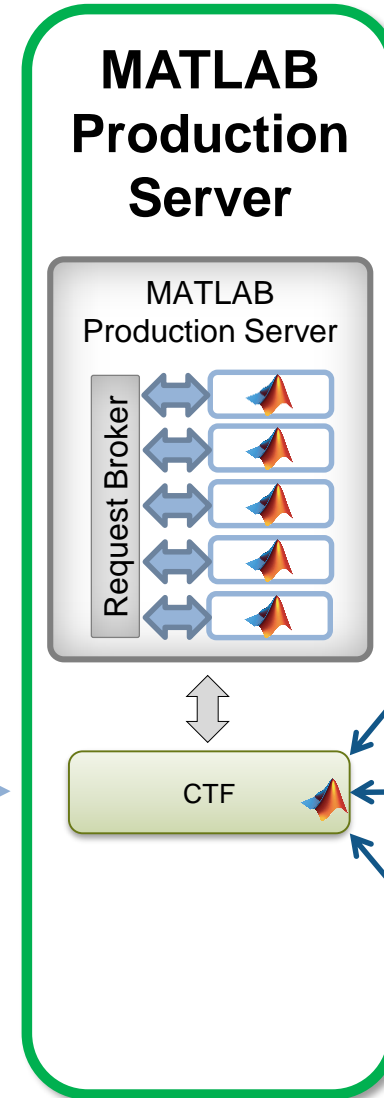
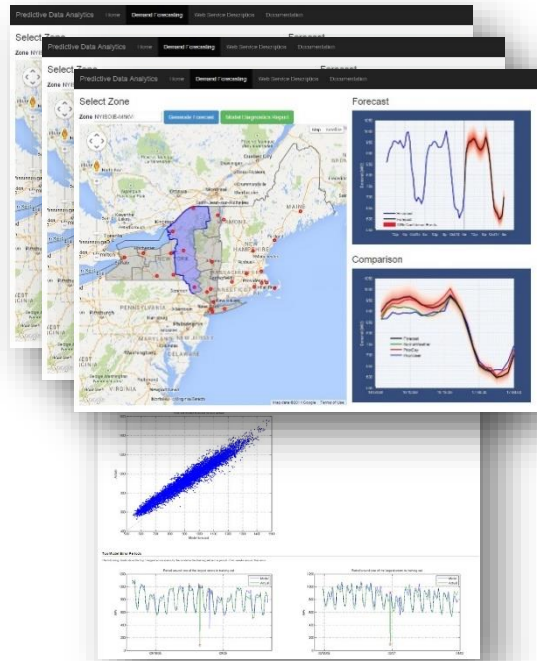
<http://54.165.201.58:8080/DemandForecastWeb/demandForecast.jsp>

Enterprise scale deployment of an Analytic

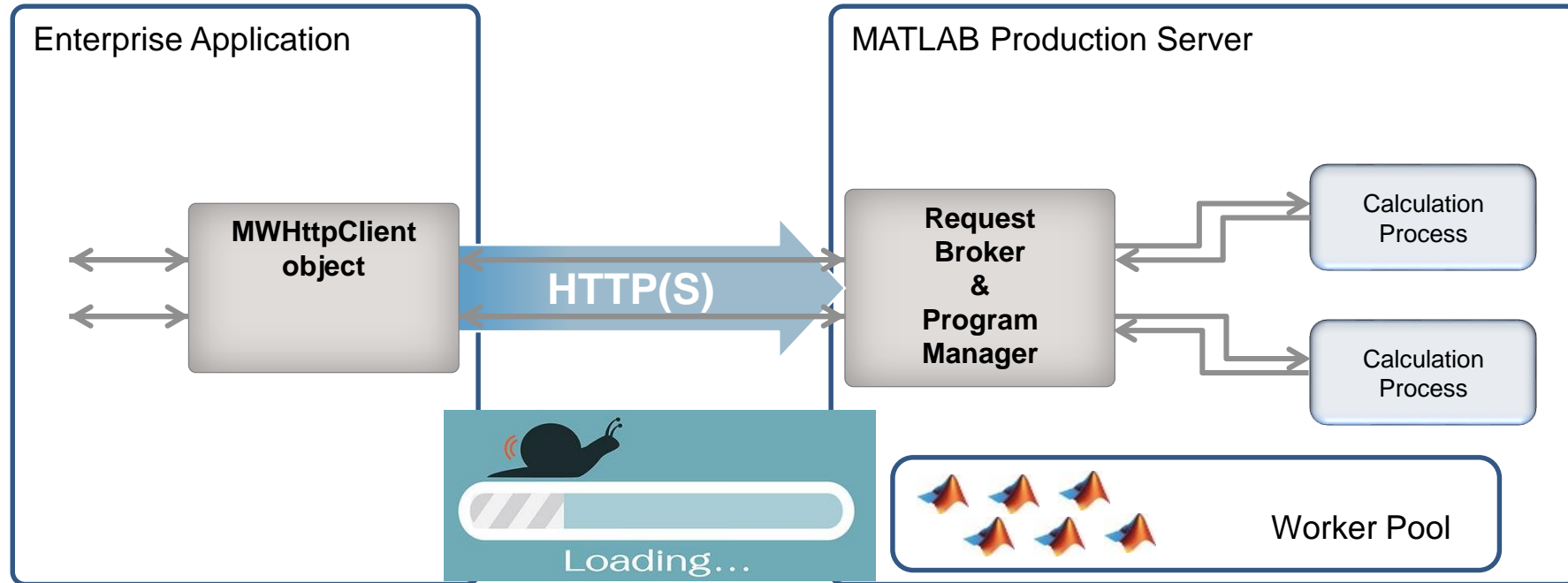


Deployed Analytics

MATLAB Production Server

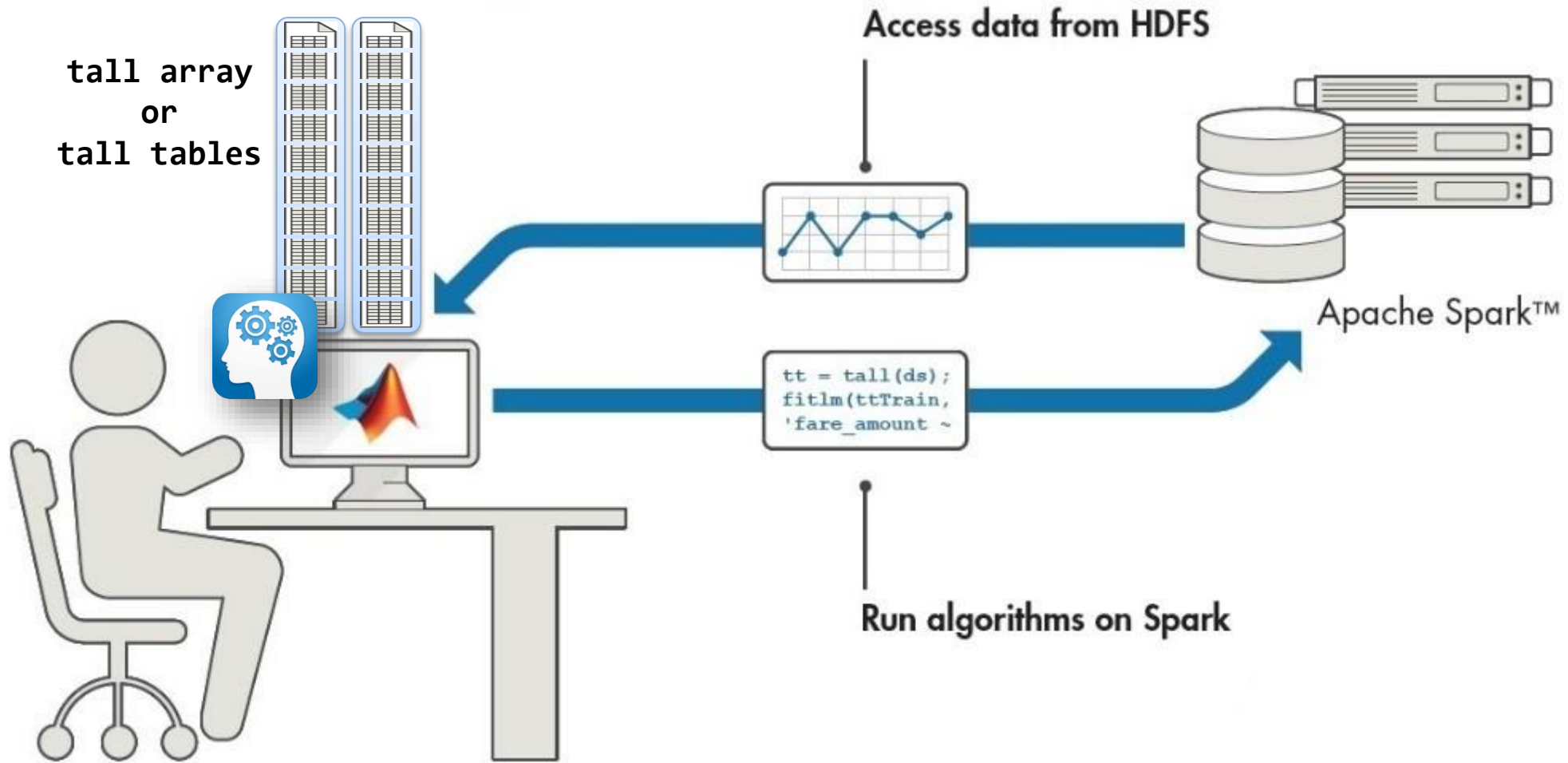


Request Management



Data is too big to process!

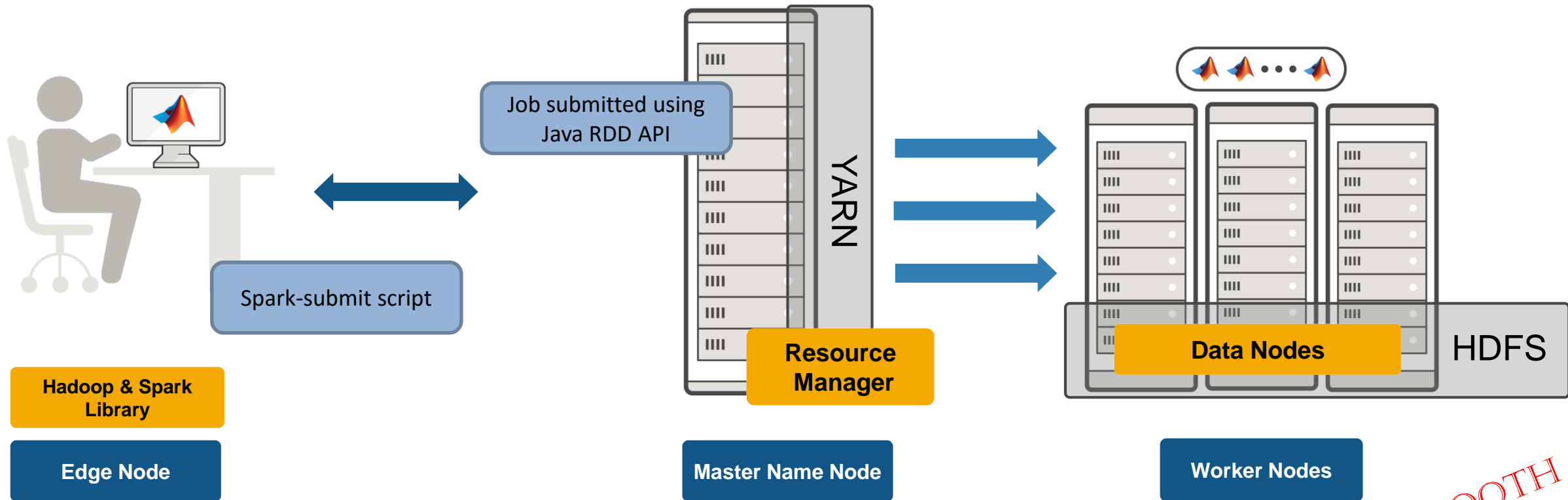
Use MATLAB with Spark on Clusters



Run MATLAB scripts on SPARK & HADOOP

MATLAB workers on worker nodes in the cluster

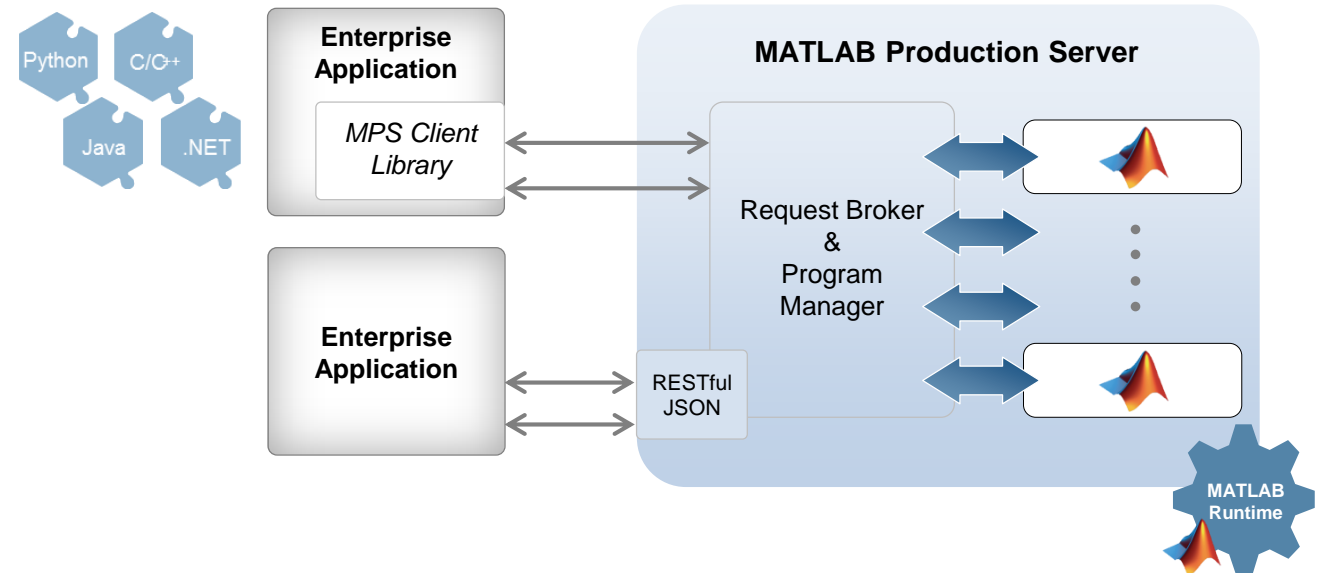
- MDCS workers (working from MATLAB)



MATLAB Production Server

Enterprise Class Framework For Running Packaged MATLAB Programs

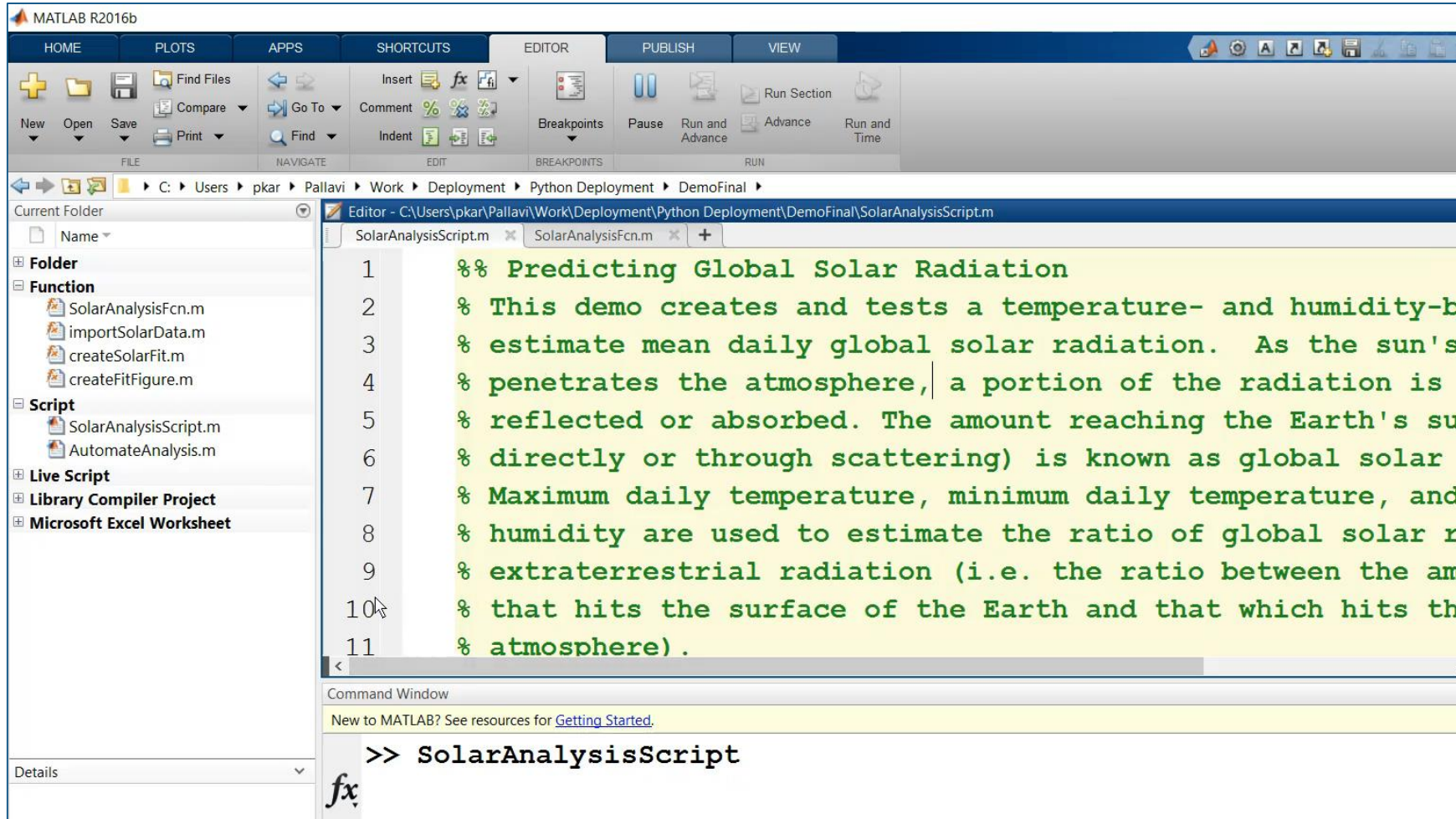
- Server software
 - Manages packaged MATLAB programs and worker pool
- MATLAB Runtime libraries
 - Single server can use runtimes from different releases
- RESTful JSON interface and lightweight client library (C/C++, .NET, Python, and Java)



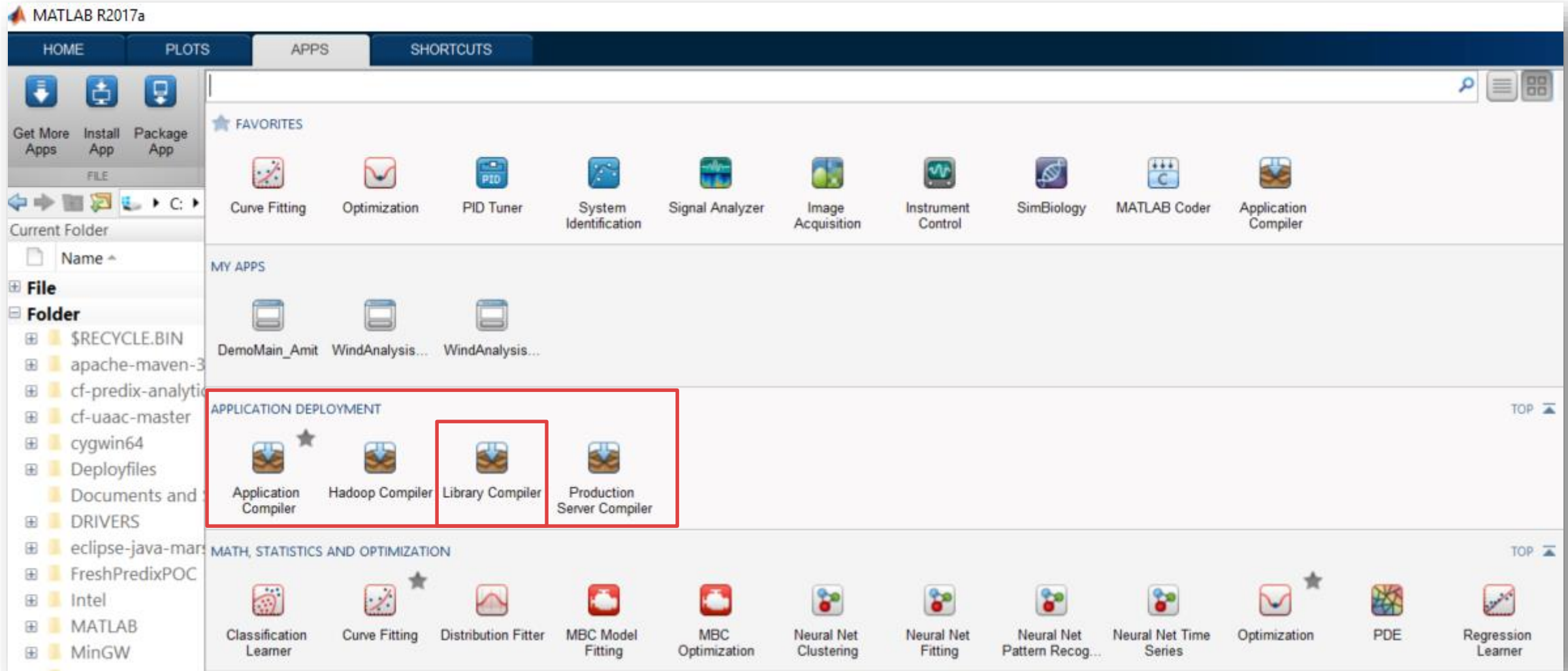
Key Takeaways

1. Distribute applications to MATLAB users royalty-free.
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Sharing Solar Analysis with Python users



Compiling Libraries



Calling MATLAB Compiled Package from Python

```
*Python 2.7.8 Shell*
File Edit Shell Debug Options Windows Help
Python 2.7.8 (default, Jun 30 2014, 16:08:48) [MSC v.1500 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>> import CompiledSolarAnalysisFcn
```

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

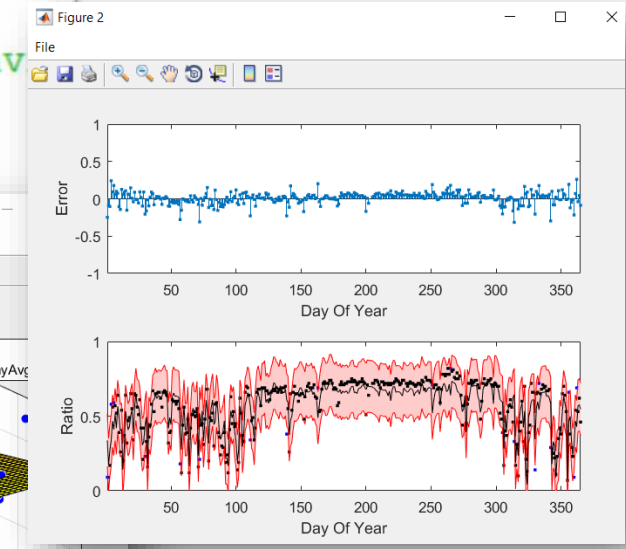
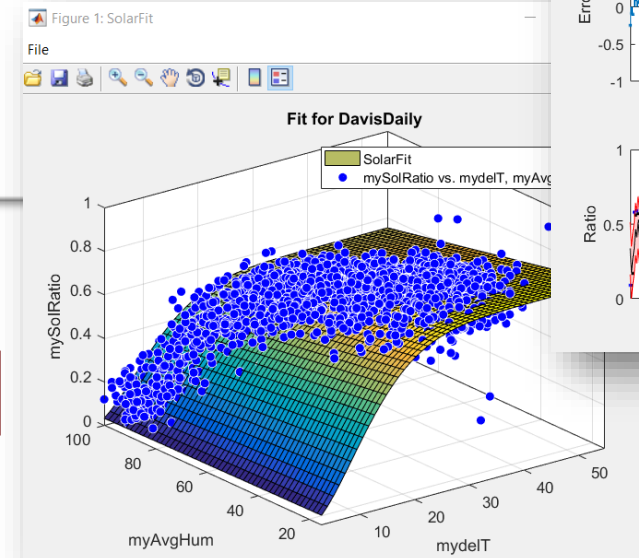
# Provide input path to MATLAB script from Python
filepath="C:\Users\pkar\Pallavi\Work\Deployment\Python Deployment\DemoFinal\Dav

type(filepath)

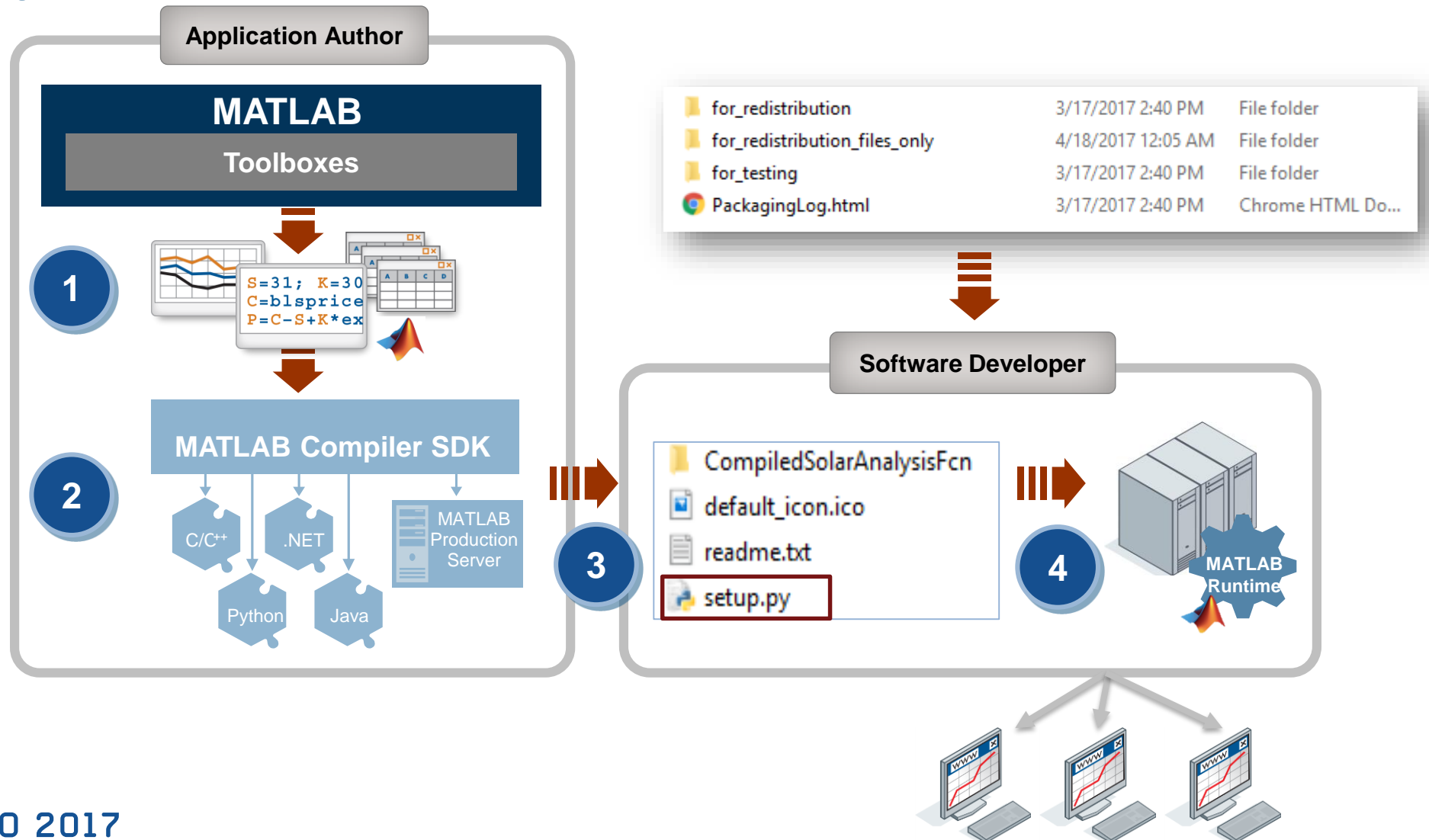
# Evaluate or call the MATLAB function
mySolarfunc.SolarAnalysisFcn(filepath)

```

Retain MATLAB's capability



Integrate MATLAB-based Components With Your Own Software



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Documentation

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⏪ Documentation Home

⏪ MATLAB i

- ⏪ Advanced Software Development
- ⏪ MATLAB API for Other Languages
- ⏪ MATLAB Engine API for Python

Pass Data to MATLAB from Python

ON THIS PAGE

- Python Type to MATLAB Scalar Type Mapping
- Python Container to MATLAB Array Type Mapping
- Unsupported Python Types
- Related Topics

Pass Data to MATLAB from Python R20

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

cellscope® Consumer otoscope in a mobile device





MATLAB to iPhone and Android Made Easy

Generating **readable** and **portable** C code from your MATLAB algorithms for your iPhone, iPad, or Android app

Bill Chou

WEBINAR

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 feedback

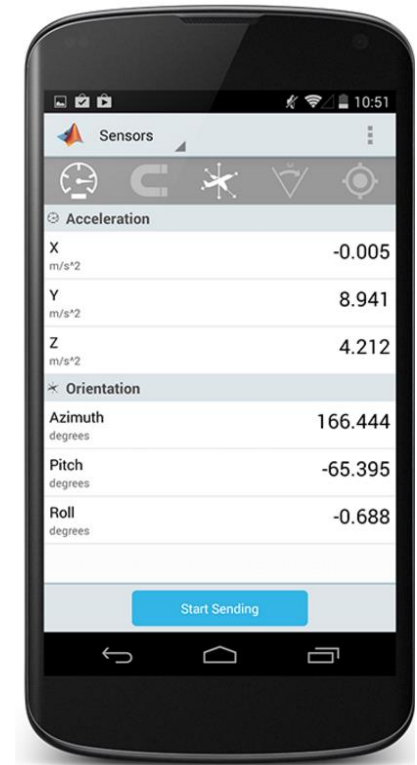
MATLAB to iPhone and Android Made Easy

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>



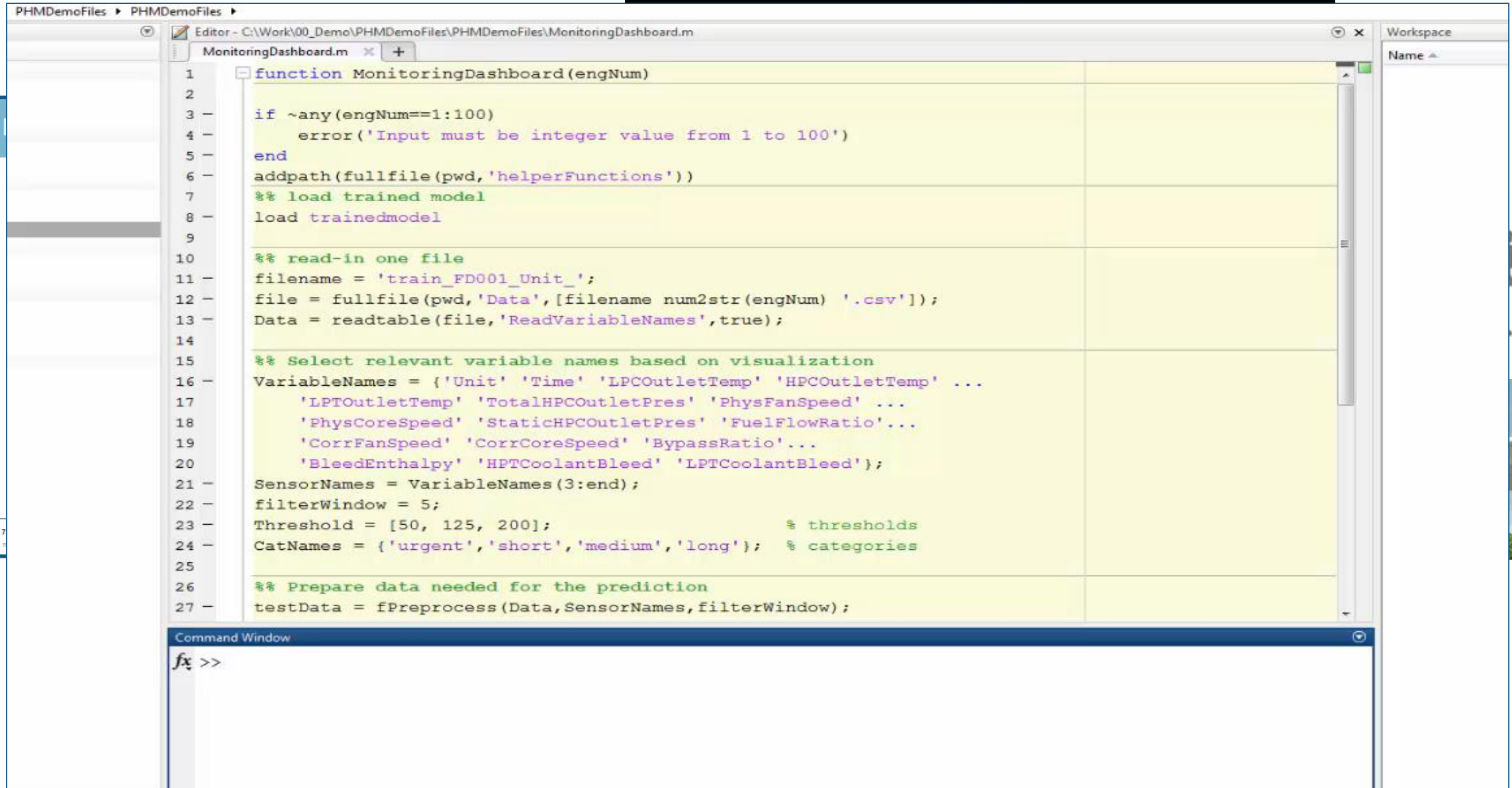
Resources:

<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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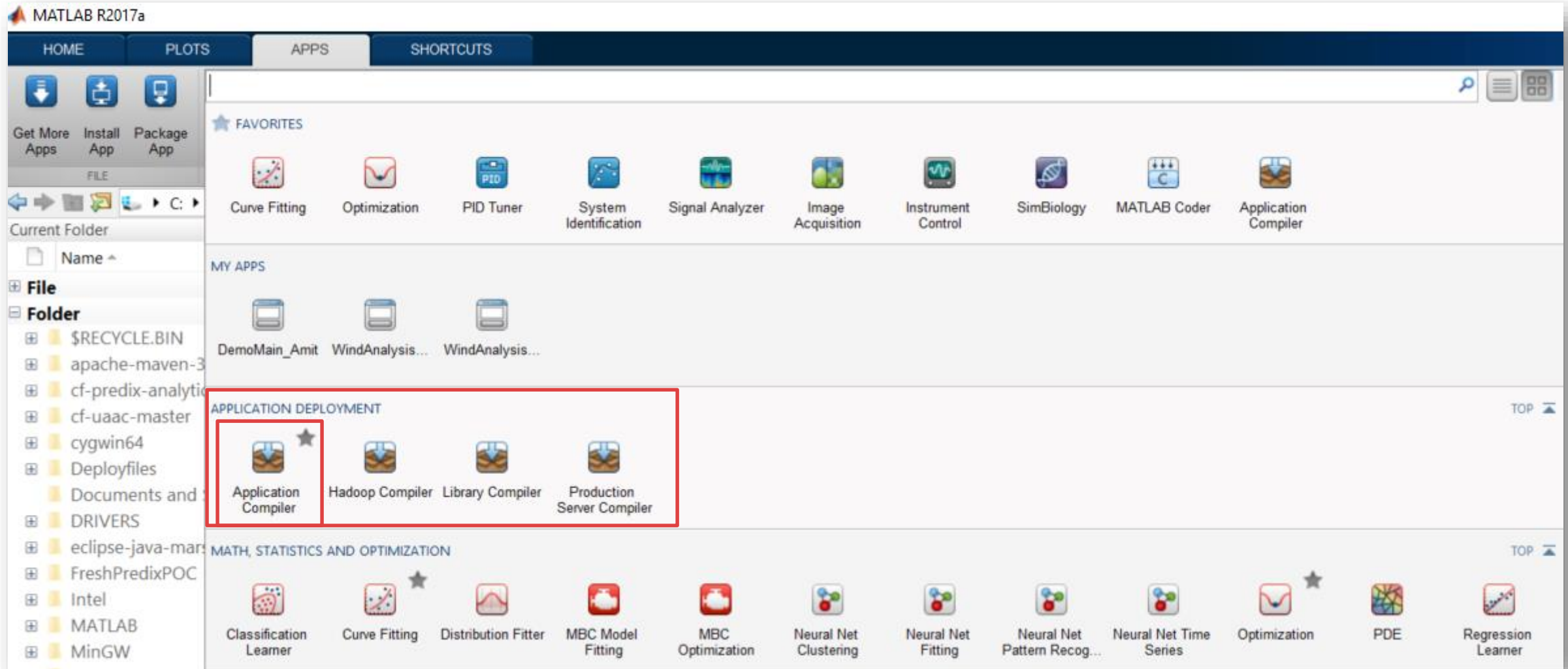


The screenshot displays the MATLAB Editor interface with the following code in the `MonitoringDashboard.m` file:

```
1 function MonitoringDashboard(engNum)
2
3 if ~any(engNum==1:100)
4     error('Input must be integer value from 1 to 100')
5 end
6 addpath(fullfile(pwd, 'helperFunctions'))
7 %% load trained model
8 load trainedmodel
9
10 %% read-in one file
11 filename = 'train_FD001_Unit_';
12 file = fullfile(pwd, 'Data', [filename num2str(engNum) '.csv']);
13 Data = readtable(file, 'ReadVariableNames', true);
14
15 %% Select relevant variable names based on visualization
16 VariableNames = {'Unit' 'Time' 'LPCOutletTemp' 'HPCOutletTemp' ...
17     'LPTOutletTemp' 'TotalHPCOutletPres' 'PhysFanSpeed' ...
18     'PhysCoreSpeed' 'StaticHPCOutletPres' 'FuelFlowRatio' ...
19     'CorrFanSpeed' 'CorrCoreSpeed' 'BypassRatio' ...
20     'BleedEnthalpy' 'HPTCoolantBleed' 'LPTCoolantBleed'};
21 SensorNames = VariableNames(3:end);
22 filterWindow = 5;
23 Threshold = [50, 125, 200]; % thresholds
24 CatNames = {'urgent', 'short', 'medium', 'long'}; % categories
25
26 %% Prepare data needed for the prediction
27 testData = fPreprocess(Data, SensorNames, filterWindow);
```

The Command Window at the bottom shows the prompt `fx >>`.

Application Deployment



Compiling MATLAB functions

The screenshot shows the MATLAB Compiler interface for a project named "MonitoringDashboard_new.pj". The main window displays "Application information" for "MonitoringDashboard_new" version 1.0. A "Package" dialog box is open, showing three icons: a yellow box with "101 010", a brown box with three green arrows, and a yellow folder icon, all with green checkmarks below them. The dialog includes a link "Open output folder" and a checkbox "Open output folder when process completes" which is checked. The "Additional installer options" section is also visible.

Application information

- MonitoringDashboard_new 1.0
- Author Name
- Email
- Company
- Summary
- Description

Additional installer options

- Open output folder when process completes

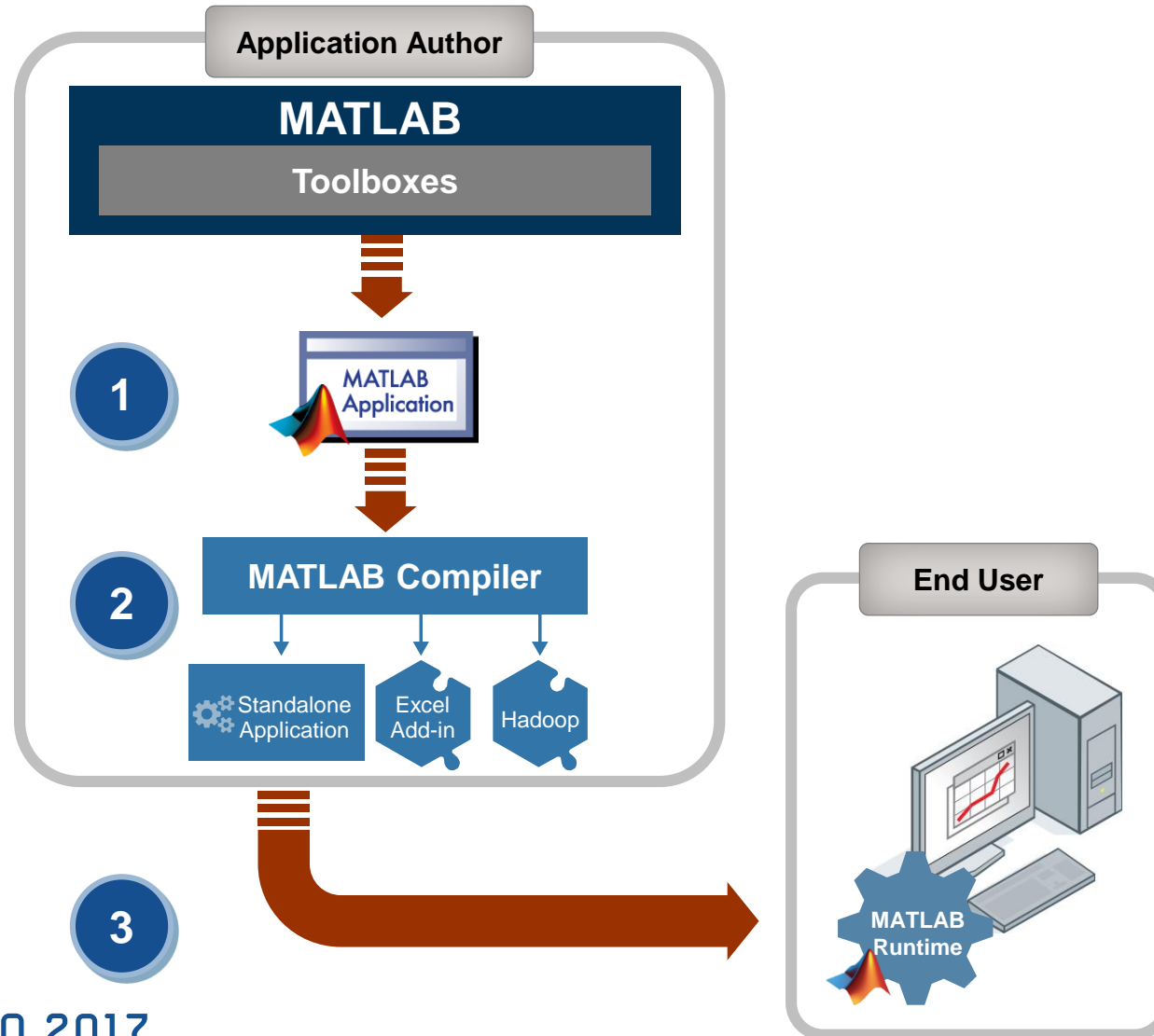
Files required for your application to run

- fLabel.m
- fSendOutlookMail...
- fTrafLight.m
- fPreprocess.m
- fTabRealTime.m
- trainedmodel.mat

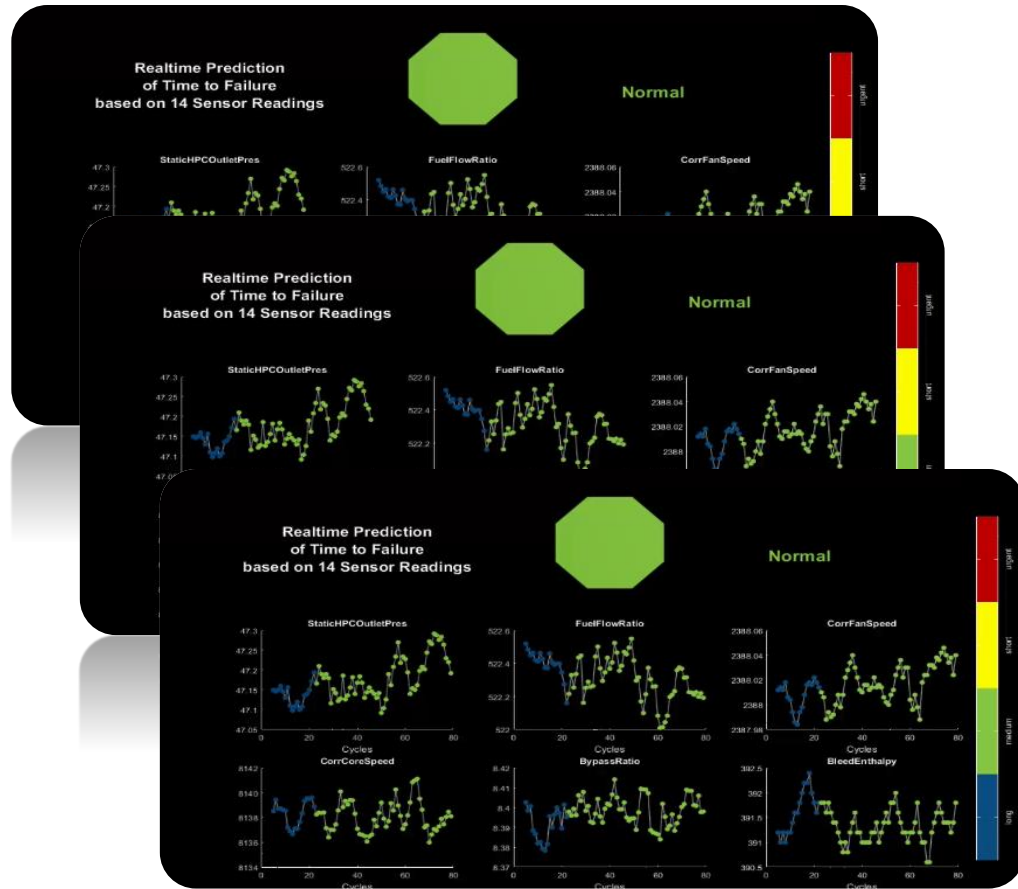
Files installed for your end user

- MonitoringDashb...
- readme.txt
- splash.png

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



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

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

“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

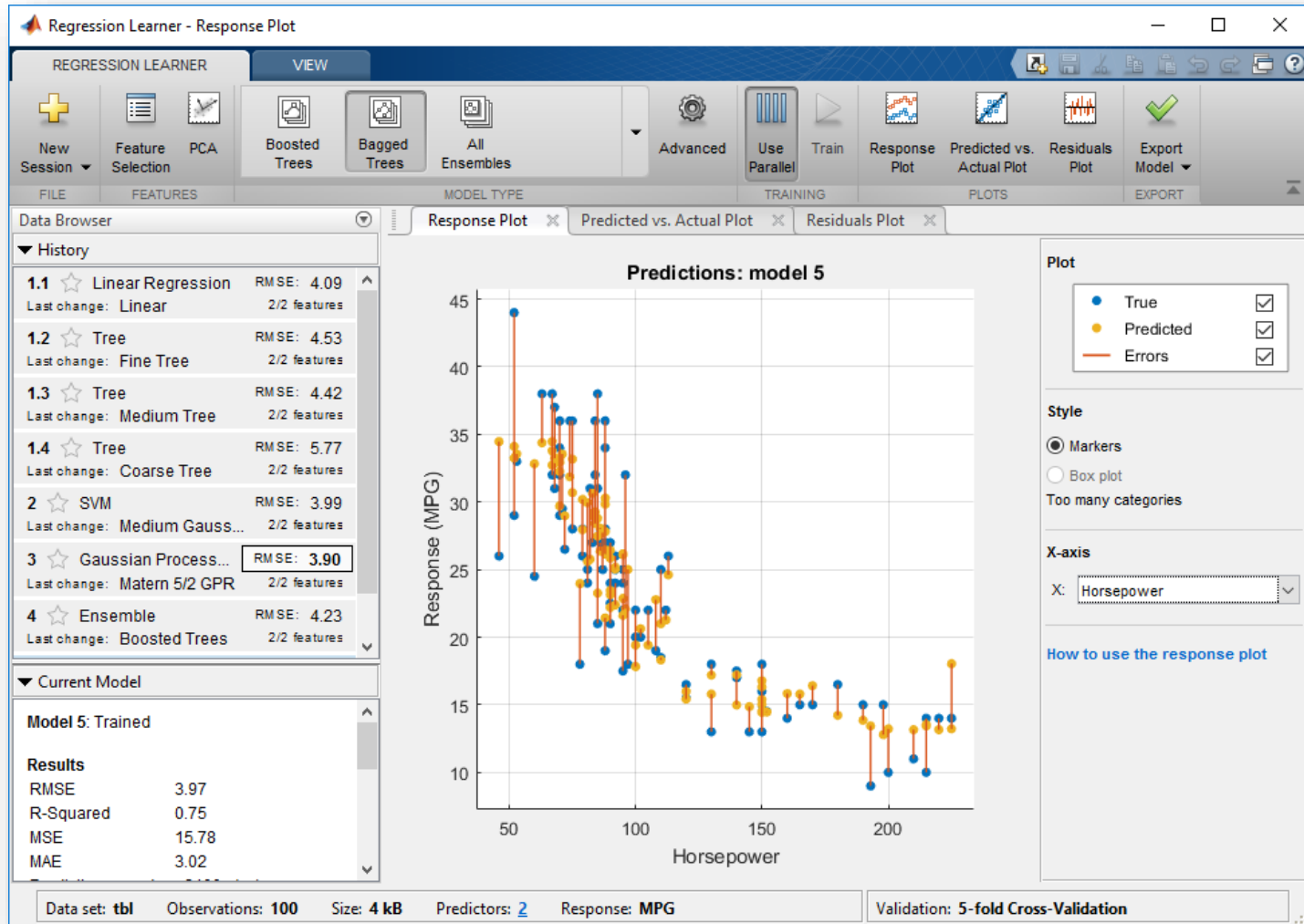
[Link to user story](#)

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Key Takeaways

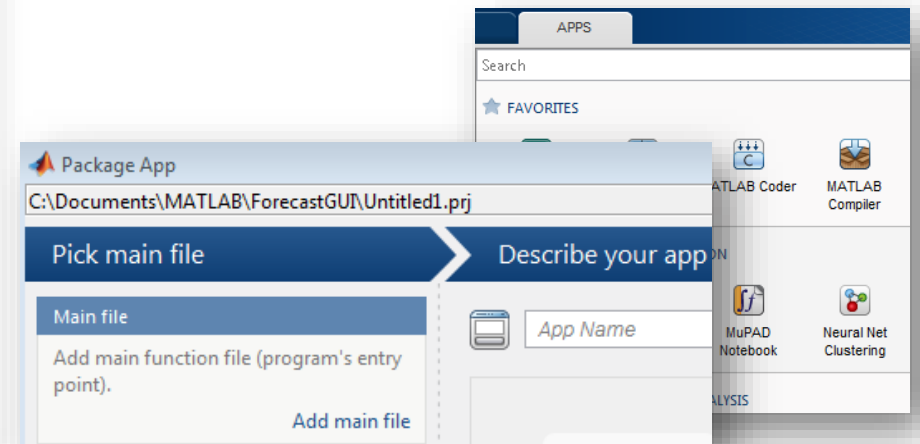
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MATLAB Apps to share algorithms with MATLAB users



- 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?

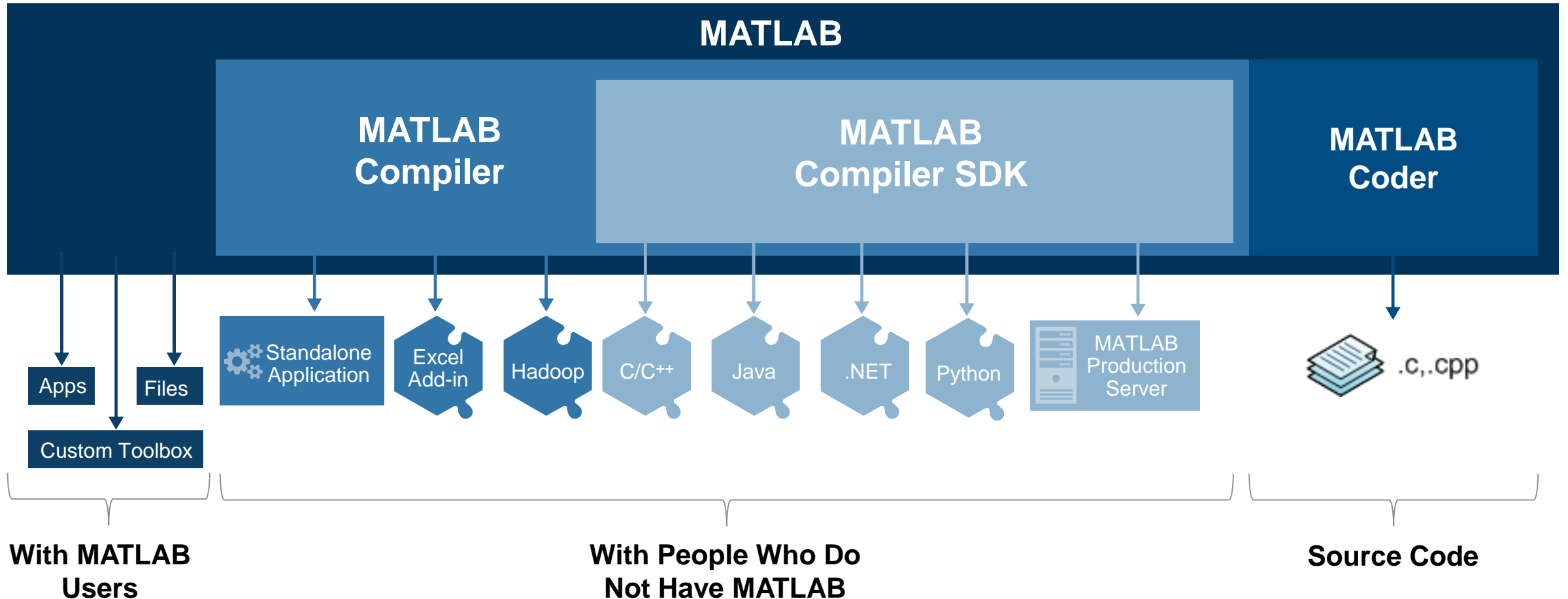


Key Takeaways

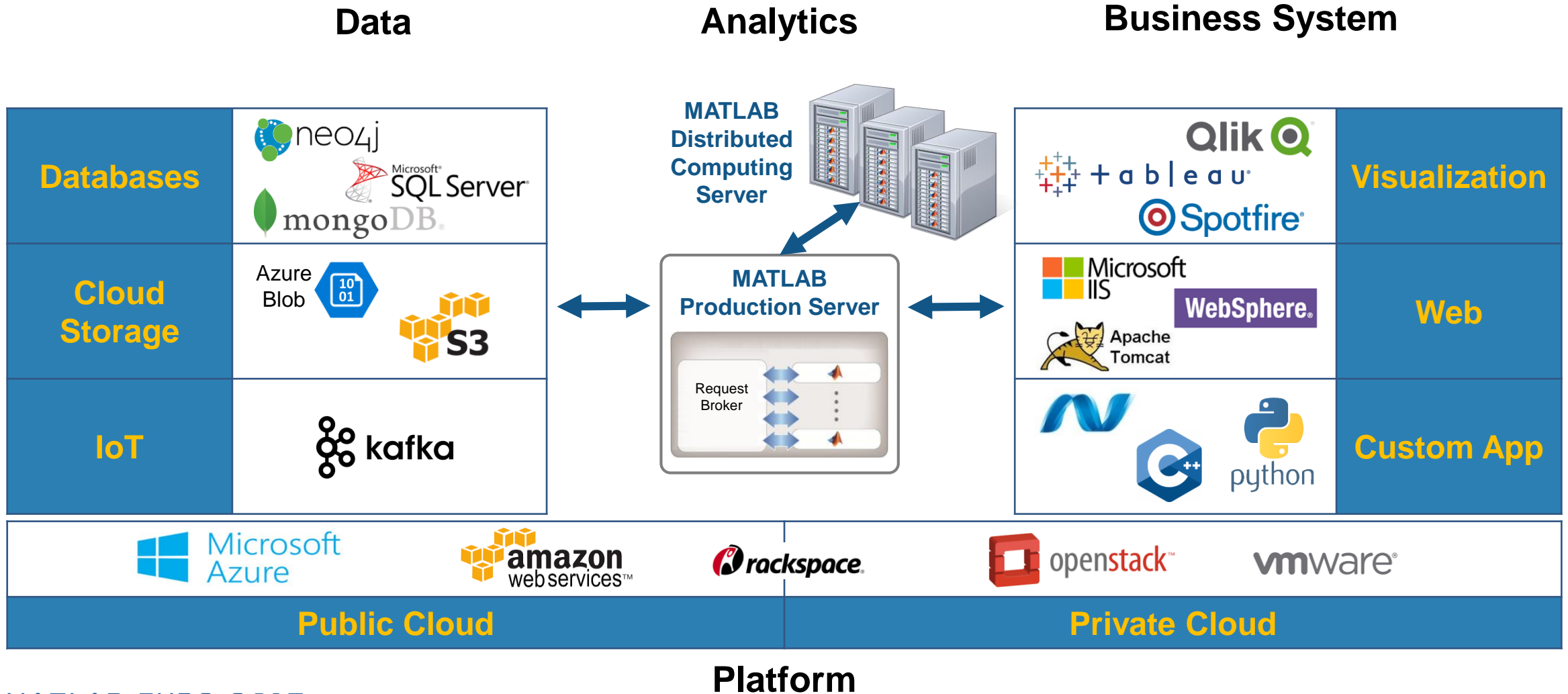
What have we learnt?

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

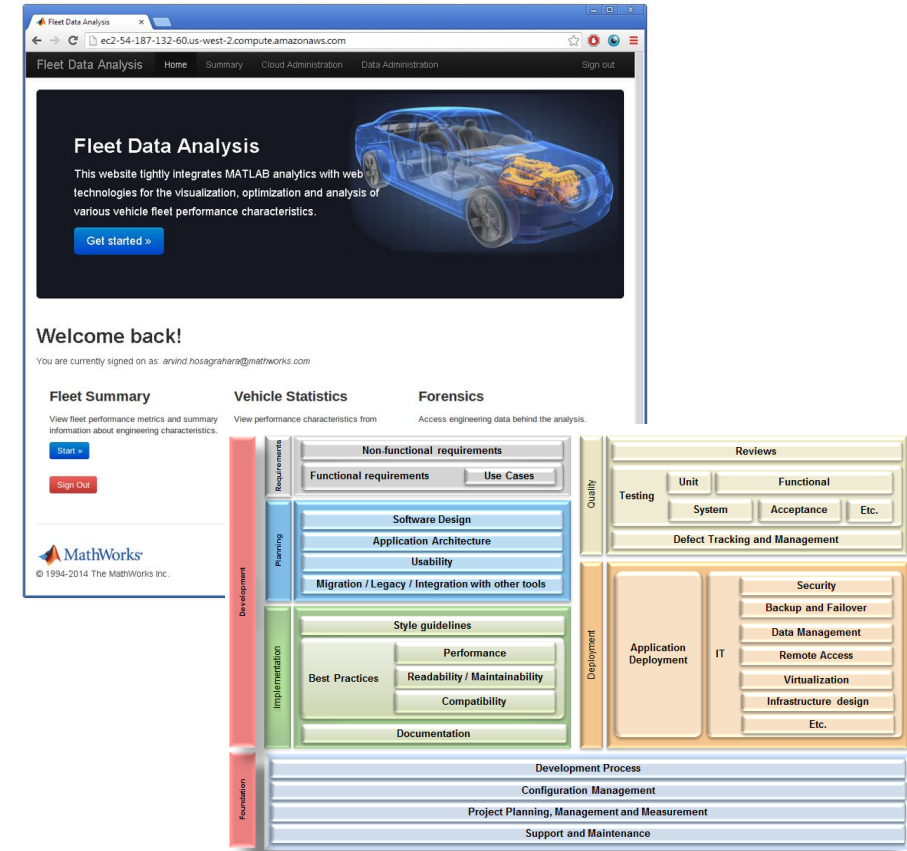
- Integration
- Data analysis/visualization
- Unify workflows, models, data

www.mathworks.com/services/consulting/

- Training

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

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Online Resources

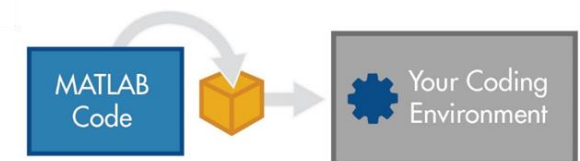
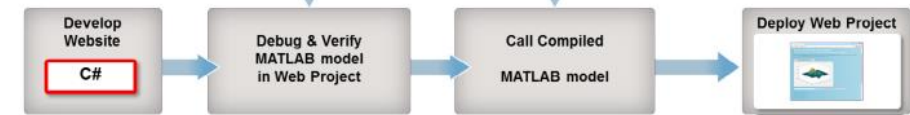
Call to action

- 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](#)

MATLAB developer:



Web developer:





Accelerating the pace of engineering and science

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Twitter: [@PallaviKar2512](https://twitter.com/PallaviKar2512)

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