



# 2022 SPE EUROPE ENERGY GEOHACKATHON

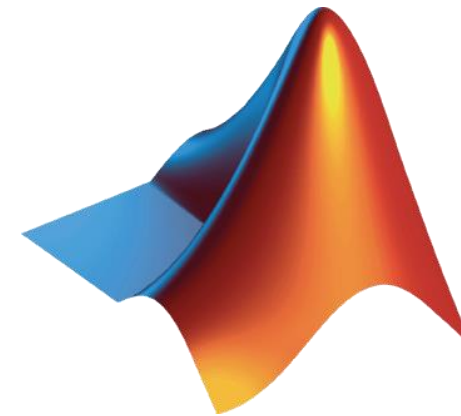
## 4. Introduction to MATLAB 1

Oscar Molina (MathWorks)

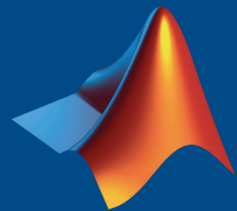
26<sup>th</sup> September 2022

*#DatafyingEnergy*

# Data Analysis & Visualization with MATLAB



**Mil Shastri**  
**Senior Application Engineer**  
**Energy & Automation**  
**MathWorks Inc**  
**Plano, TX, USA**



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is a **Leader** in the 2021 Gartner Magic Quadrant for Data Science and Machine Learning Platforms for the Second Year in a Row

Figure 1: Magic Quadrant for Data Science and Machine Learning Platforms



Source: Gartner (March 2021)

Gartner Magic Quadrant for Data Science and Machine Learning Platforms, Peter Krensky, Carlie Idoine, Erick Brethenoux, Pieter den Hamer, Farhan Choudhary, Afraz Jaffri, Shubhangi Vashisth, 1st March 2021.

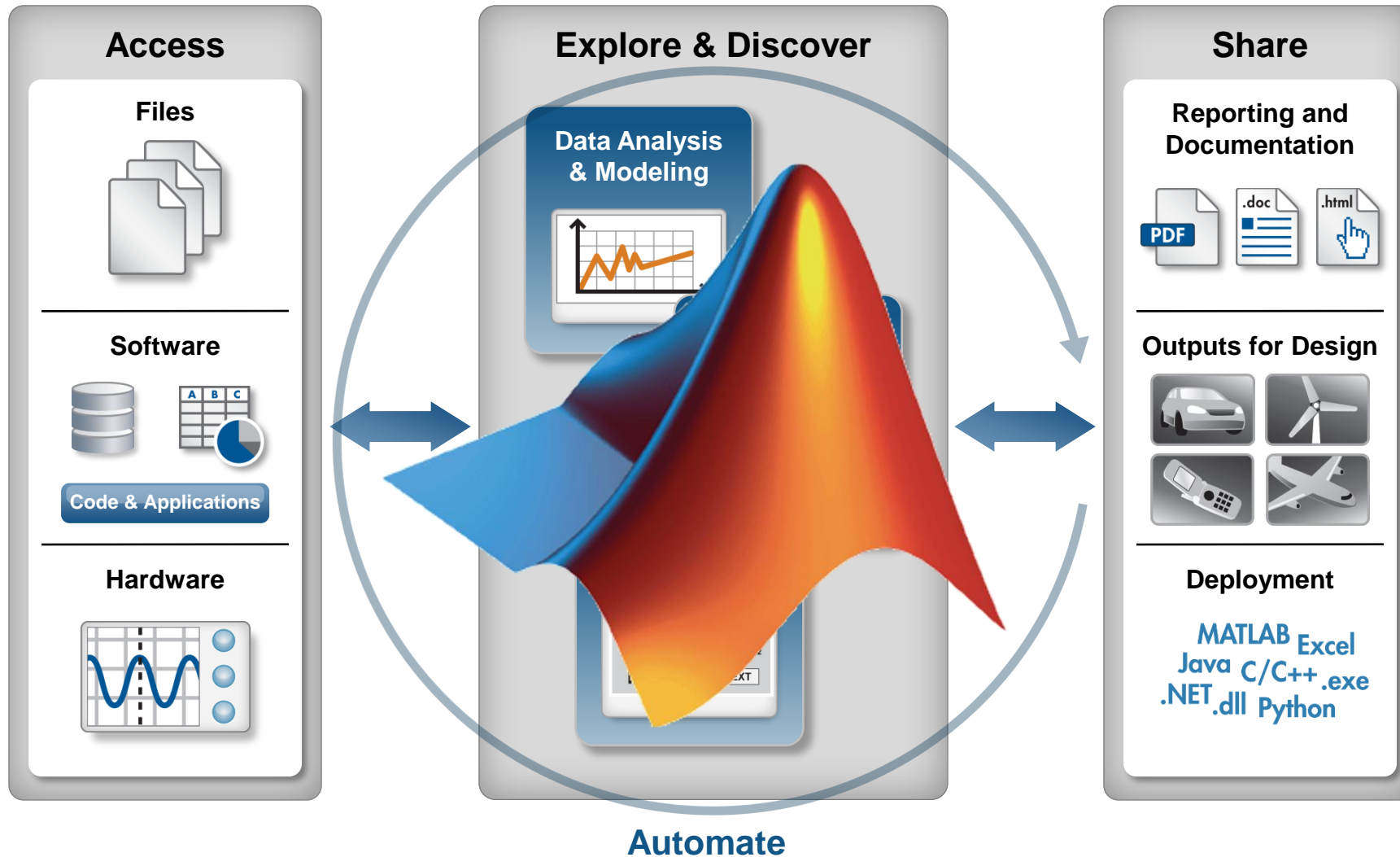
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# Agenda

- Data Analysis with MATLAB
- Demo
  - Introduction to MATLAB environment
  - Building analysis routines
  - Creating documentation
  - Deploying graphical applications
- Resources

# Data Analysis Workflow



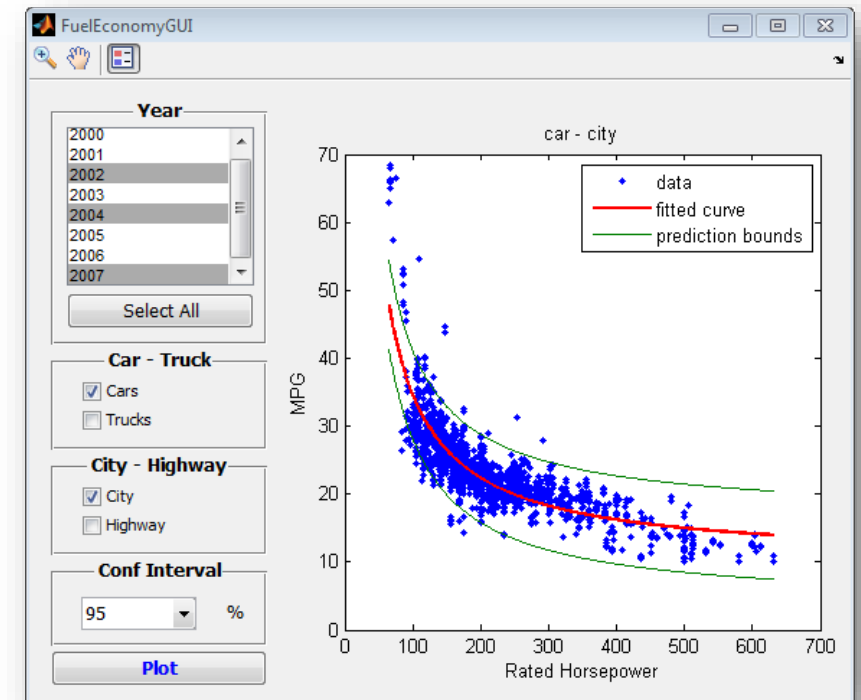
# Demo: Fuel Economy

## Data Analysis with MATLAB

Products Used

- MATLAB
- Curve Fitting Toolbox

- **Objective:**
  - Study the relationships between fuel economy, horsepower, and type of vehicle
- **Inputs:**
  - Historical fuel economy data for cars manufactured between 2000 and 2012 from Excel
- **Approach:**
  - Access data from Excel
  - Interactively visualize and explore trends
  - Create a model
  - Document results



$$MPG = b_1 + b_2 / RatedHP$$

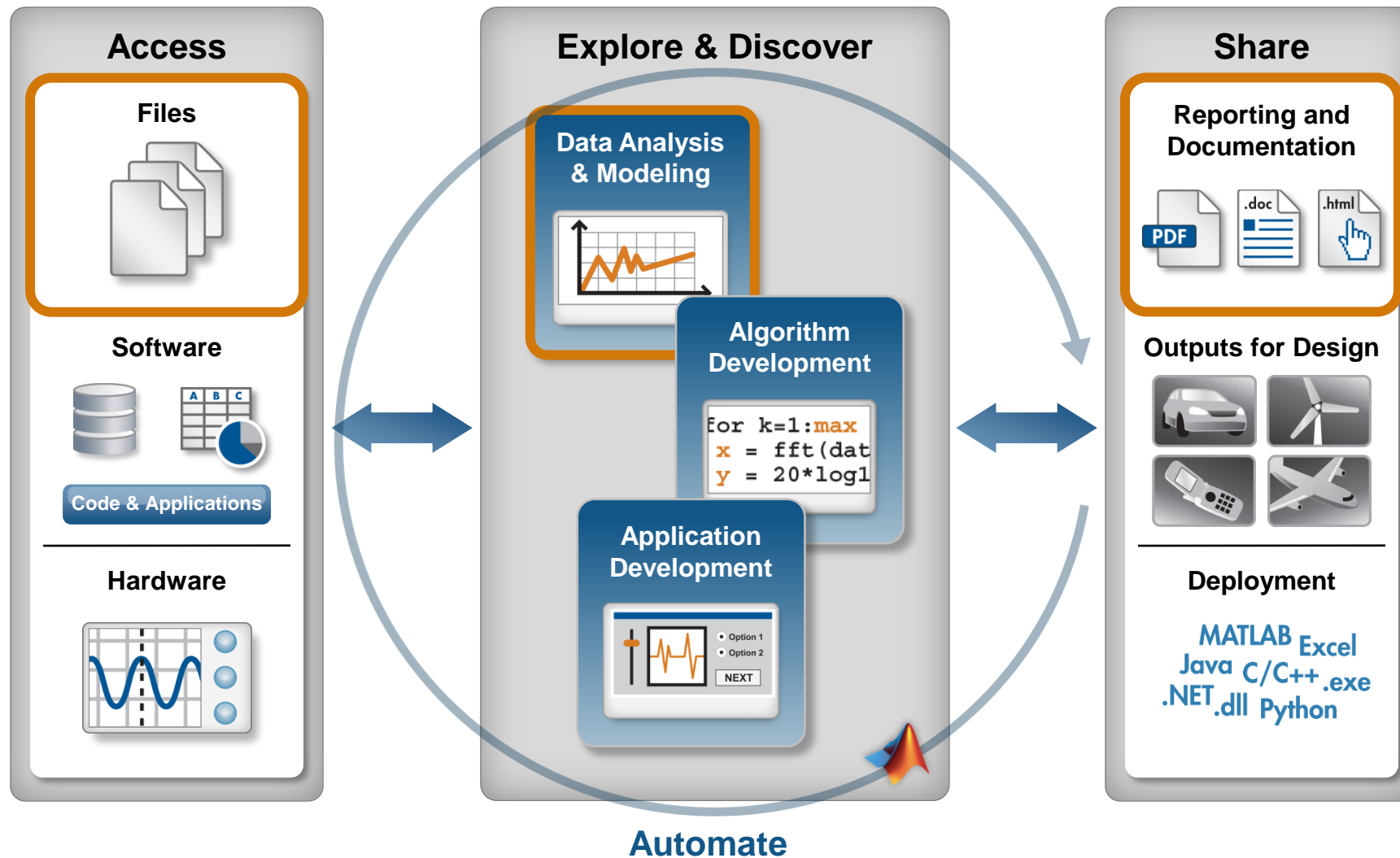


# Demo Summary

## Fuel Economy

Products Used

- MATLAB
- Curve Fitting Toolbox



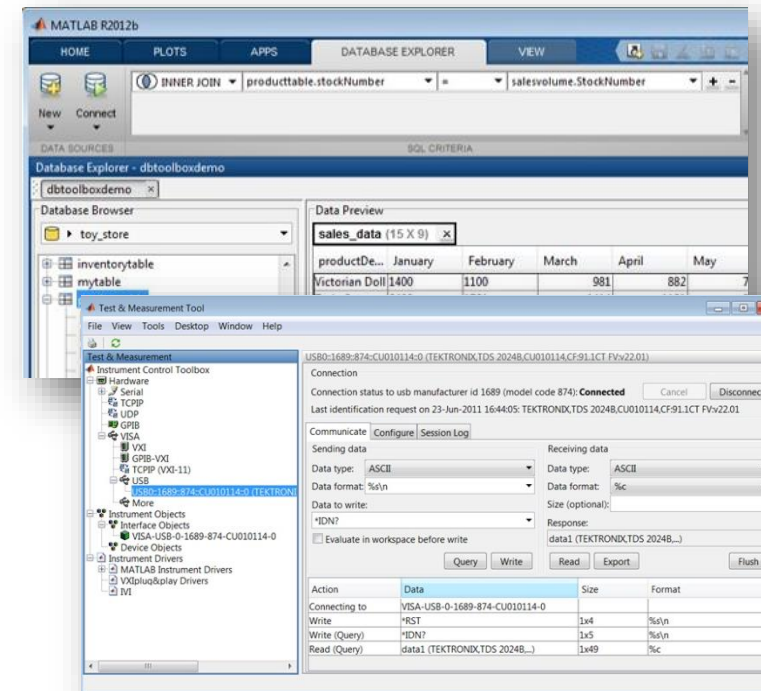
# Accessing Data from MATLAB

## Access

## Explore & Discover

## Share

- Files
  - Excel, text, or binary
  - Audio and video, image
  - Scientific formats and XML
- Web Services
  - JSON, CSV, and image data
- Applications and languages
  - C/C++, Java, FORTRAN, Python
  - COM, .NET, shared libraries
  - Databases (*Database Toolbox*)
- Measurement hardware
  - Data acquisition hardware (*Data Acquisition Toolbox*)
  - Stand-alone instruments and devices (*Instrument Control Toolbox*)



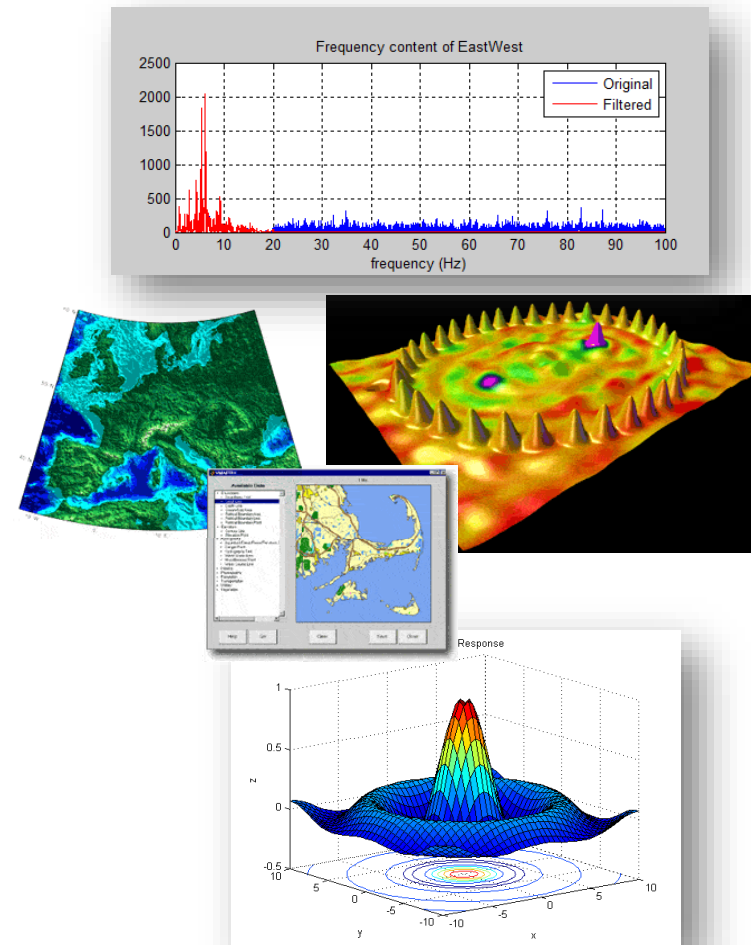
# Data Analysis and Visualization in MATLAB

Access

Explore & Discover

Share

- Data analysis
  - Manipulate, preprocess, and manage data
  - Fast, accurate analysis with pre-built math and engineering functions
- Visualization
  - Built in graphics functions for engineering and science (2D, 3D, volume visualization)
  - Interactive tools to annotate and customize graphics



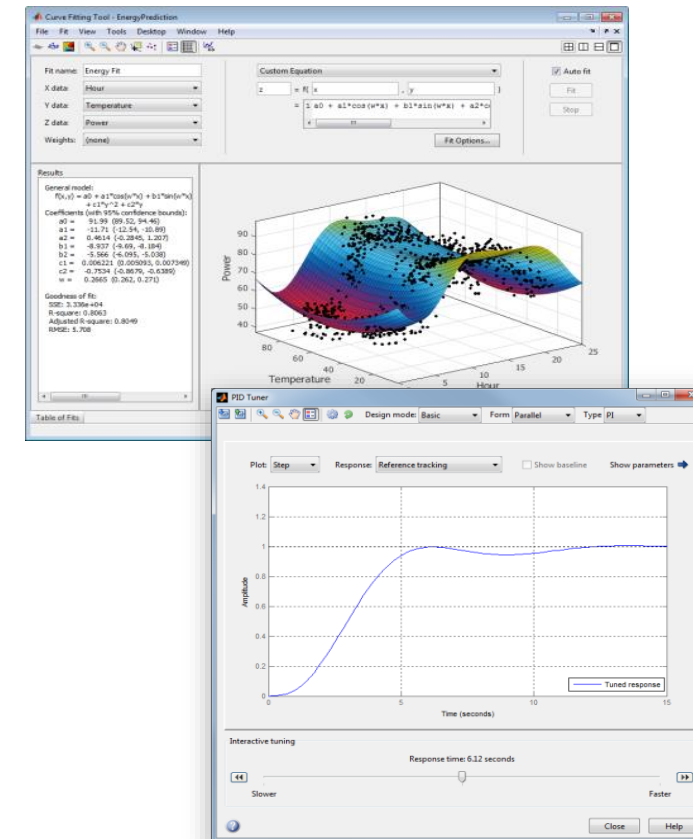
# Expanding the Capabilities of MATLAB

Access

Explore & Discover

Share

- MathWorks add-on tools for:
  - Math, statistics, and optimization
  - Control system design and analysis
  - Signal processing and communications
  - Image processing and computer vision
  - Parallel computing and more...
- Partner products provide:
  - Additional interfaces
  - Domain-specific analysis
  - Support for niche applications



# Sharing Results from MATLAB

Access

Explore & Discover

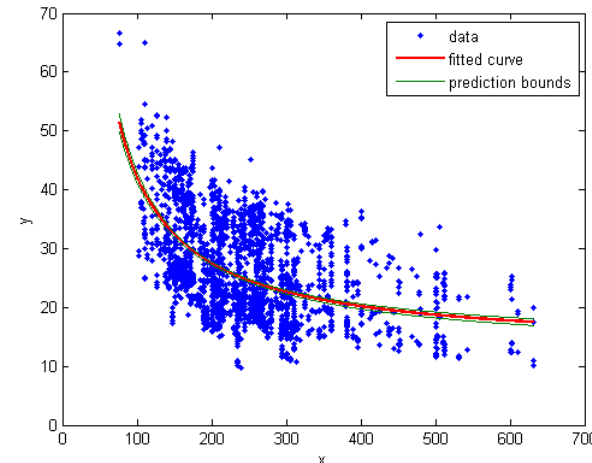
Share

- Automatically generate reports
  - Publish MATLAB files
  - Customize reports using MATLAB Report Generator
- Package as an app
- Deploy applications to other environments

## Plot Data and Model

The result from the Curve Fitting Toolbox has a `plot` method for displaying the result graphically. We can choose to display the prediction bounds for the fit.

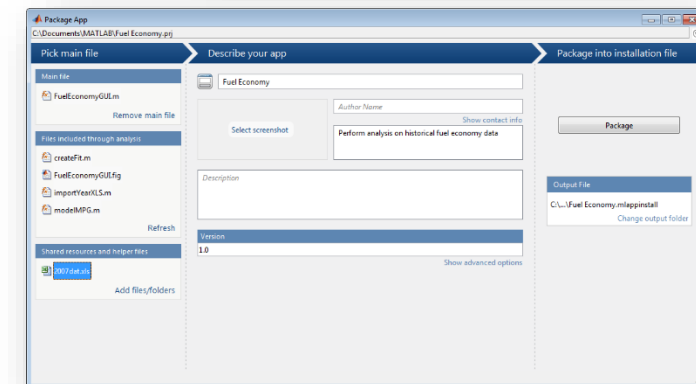
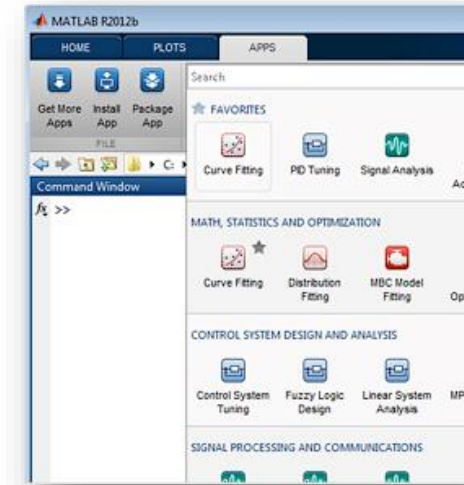
```
figure;  
hh = plot(cf, 'r', carDataDS.RatedHP, carDataDS.MPG, 'predfunc', 0.95);  
set(hh(2), 'LineWidth', 2);  
set(hh(3:4), 'LineStyle', '-', 'Color', [0 .5 0]);
```





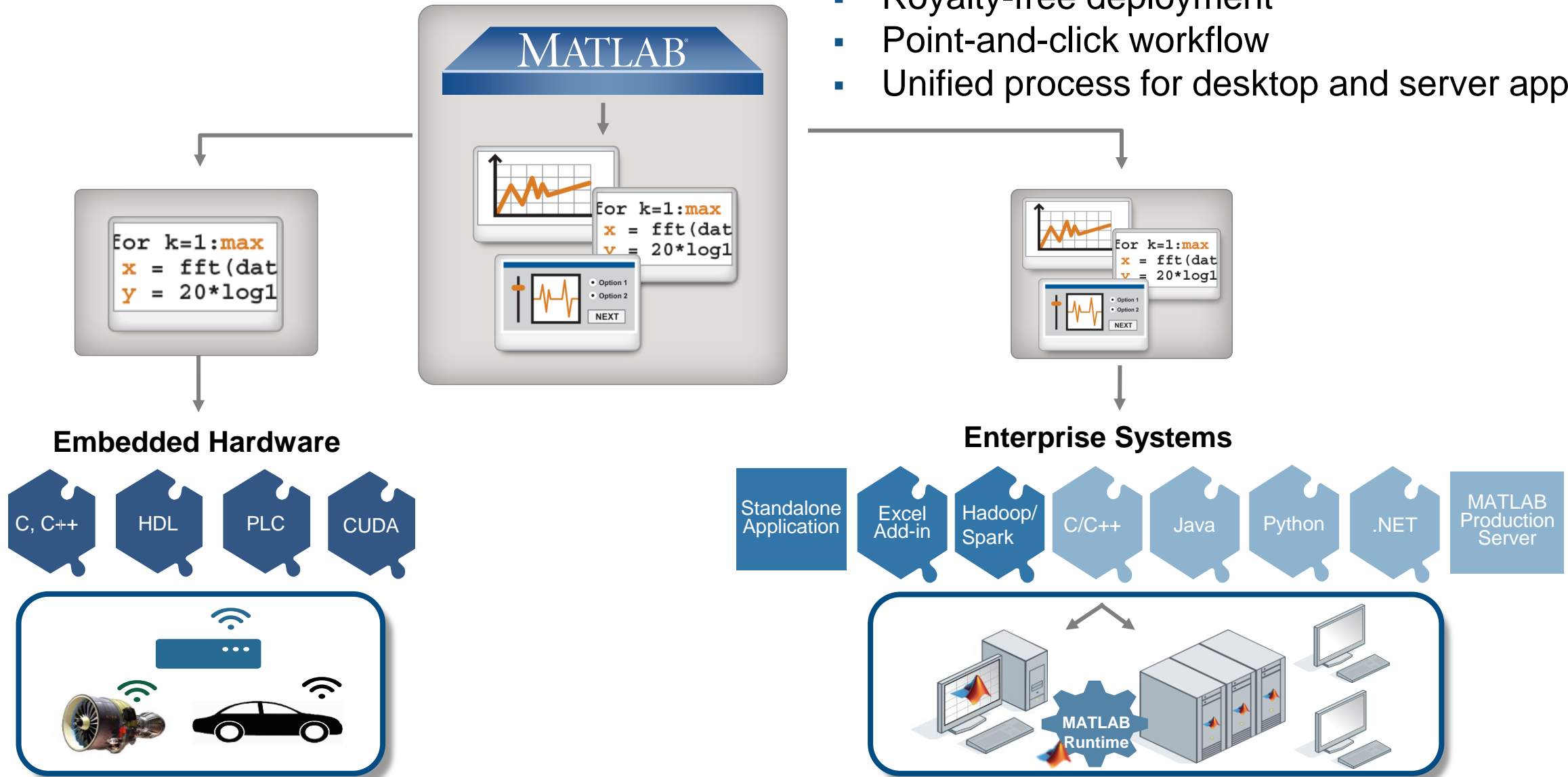
# Packaging and Sharing MATLAB Apps

- MATLAB apps
  - Interactive applications to perform technical computing tasks
  - Displayed in apps gallery
- Included in many MATLAB products
- Package your own app
  - Create single file for distribution and installation into gallery
  - Packaging tool:
    - Automatically includes all necessary files
    - Documents required products



# Deployment Highlights

- Royalty-free deployment
- Point-and-click workflow
- Unified process for desktop and server apps

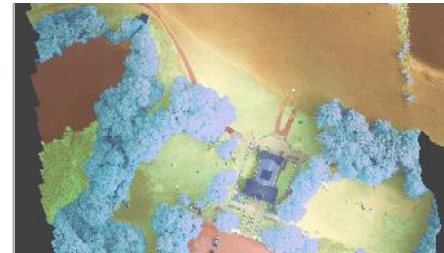


# Domain-specialized reference examples



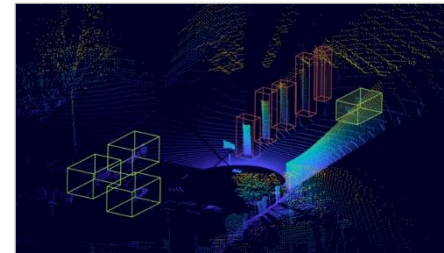
## Predictive Maintenance

Anomaly Detection and Condition Monitoring



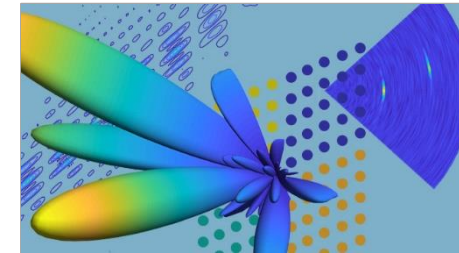
## Geospatial Analysis

Hyperspectral Image Classification



## Lidar

3-D Point Cloud Object Detection



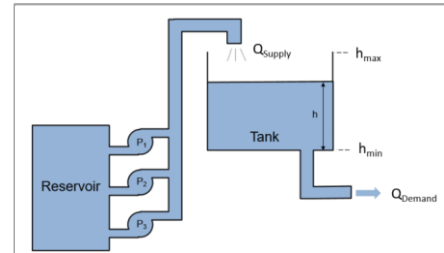
## Radar

Waveform Classification



## Wireless Comms

Data Synthesis for 5G Channel Estimation



## Controls Systems

PID Tuning & System Scheduling



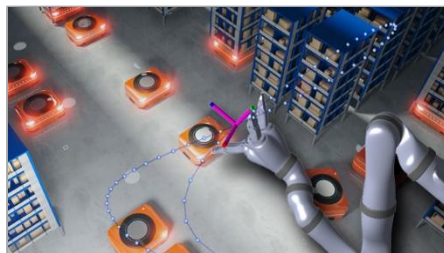
## Computational Finance

Trading & Risk Management



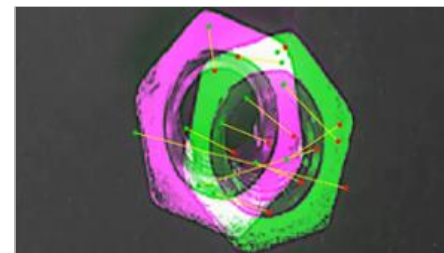
## Automated Driving

Pedestrian & Vehicle Detection



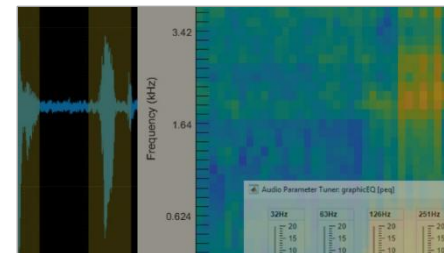
## Robotics

Path Planning & Process Optimization



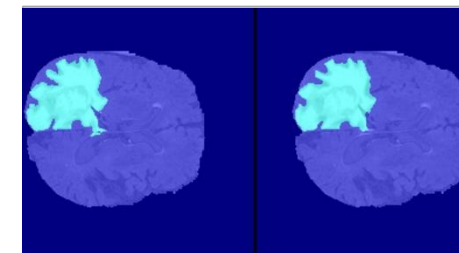
## Visual Inspection

Defect Detection



## Audio

Speech Recognition



## Medical Imaging

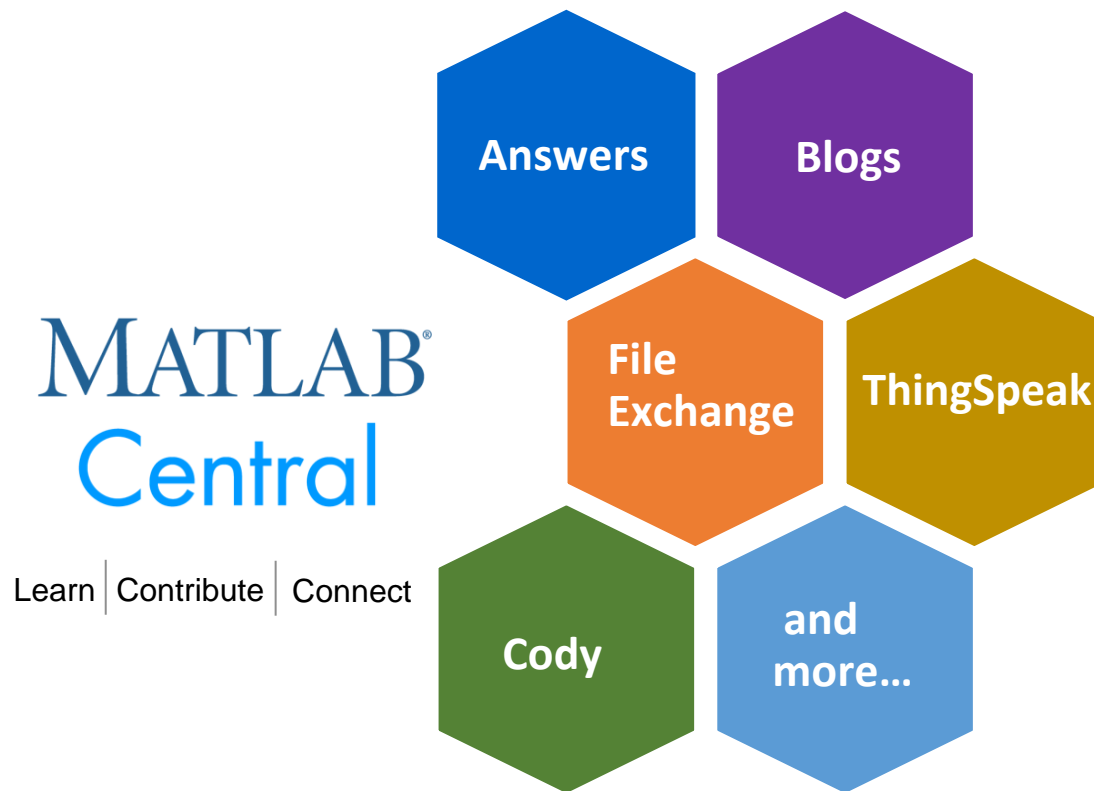
Tumor Detection

# Solutions page for the Oil and Gas industry

[URL here](#)

# MATLAB Central Community

Every month, over **2 million** MATLAB & Simulink users visit MATLAB Central to get questions answered, download code and improve programming skills.



[MATLAB Answers](#): Q&A forum; most questions get answered in only **60 minutes**

[File Exchange](#): Download code from a huge repository of free code including **tens of thousands** of open source community files

[Cody](#): Sharpen programming skills while having fun

[Blogs](#): Get the inside view from Engineers who build and support MATLAB & Simulink

[ThingSpeak](#): Explore IoT Data

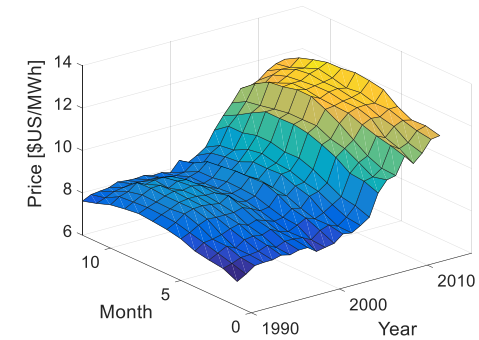
And more for you to explore...



# Training: *MATLAB Fundamentals*

After this 3-day course you will be able to:

- Import, analyze, and export data
- Write programs to automate complex tasks
- Perform calculations and analysis on data sets
- Create informative data visualizations



7.17	7.41	7.70	7.73
7.48	7.61	7.78	7.79
7.57	7.79	8.01	7.80
7.69	7.98	8.03	8.13
7.96	8.14	8.38	8.56
8.10	8.32	8.61	8.74
8.18	8.38	8.54	8.73
8.24	8.41	8.56	8.73

mean

7.8331	8.0397	8.2195	8.3236
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$n\text{-by-1}$        $n\text{-by-1}$        $n\text{-by-1}$

