How Data Analytics in MATLAB Facilitate Reliable Predictive Maintenance

MathWorks AUTOMOTIVE CONFERENCE 2016

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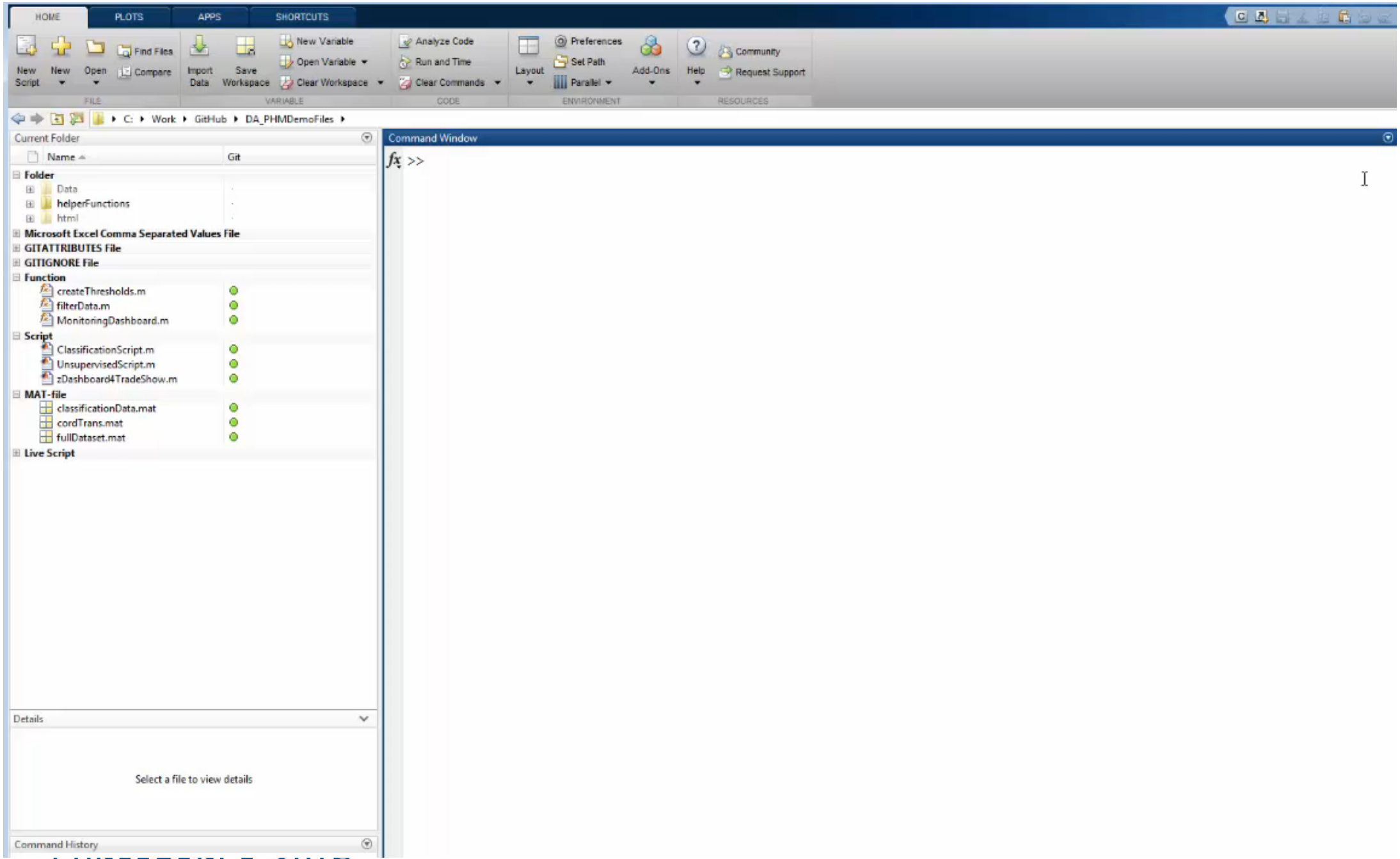
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Terminology – Timing Strategies for Maintenance

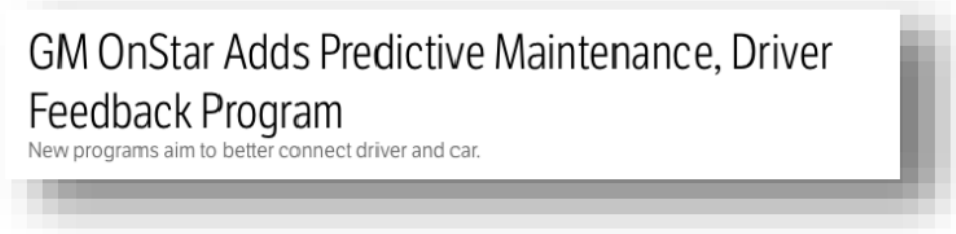
- **Reactive** – Do maintenance once there's a problem
  - – Example: replace car battery when it has a problem
  - – Challenge: unexpected failures can be expensive and potentially dangerous
- **Scheduled** – Do maintenance at a regular rate
  - – Example: change car's oil every 10,000 kilometers
  - – Challenge: unnecessary maintenance can be wasteful; may not eliminate all failures
- **Predictive** – Forecast when problems will arise
  - – Example: text message from your vehicle that warns that fuel pump is about to die
  - – Challenge: difficult to make accurate forecasts; requires complex algorithms

Focus of today's talk.

Predictive Maintenance in the Automotive Industry

- Heavy Equipment/Commercial Vehicles
  - – Hot topic in many companies for several years
  - – Meeting service agreements
  - – Additional services to sell to customers

- Passenger Vehicles
  - – Early programs already to market
  - – A lot of activities observed in the news


GM OnStar Adds Predictive Maintenance, Driver Feedback Program

New programs aim to better connect driver and car.


Ford brakes the mould with car maintenance prediction algorithm

Ford has developed an algorithm using readily available car data to predict when its brakes need maintaining – and will send a text to the driver to let them know.

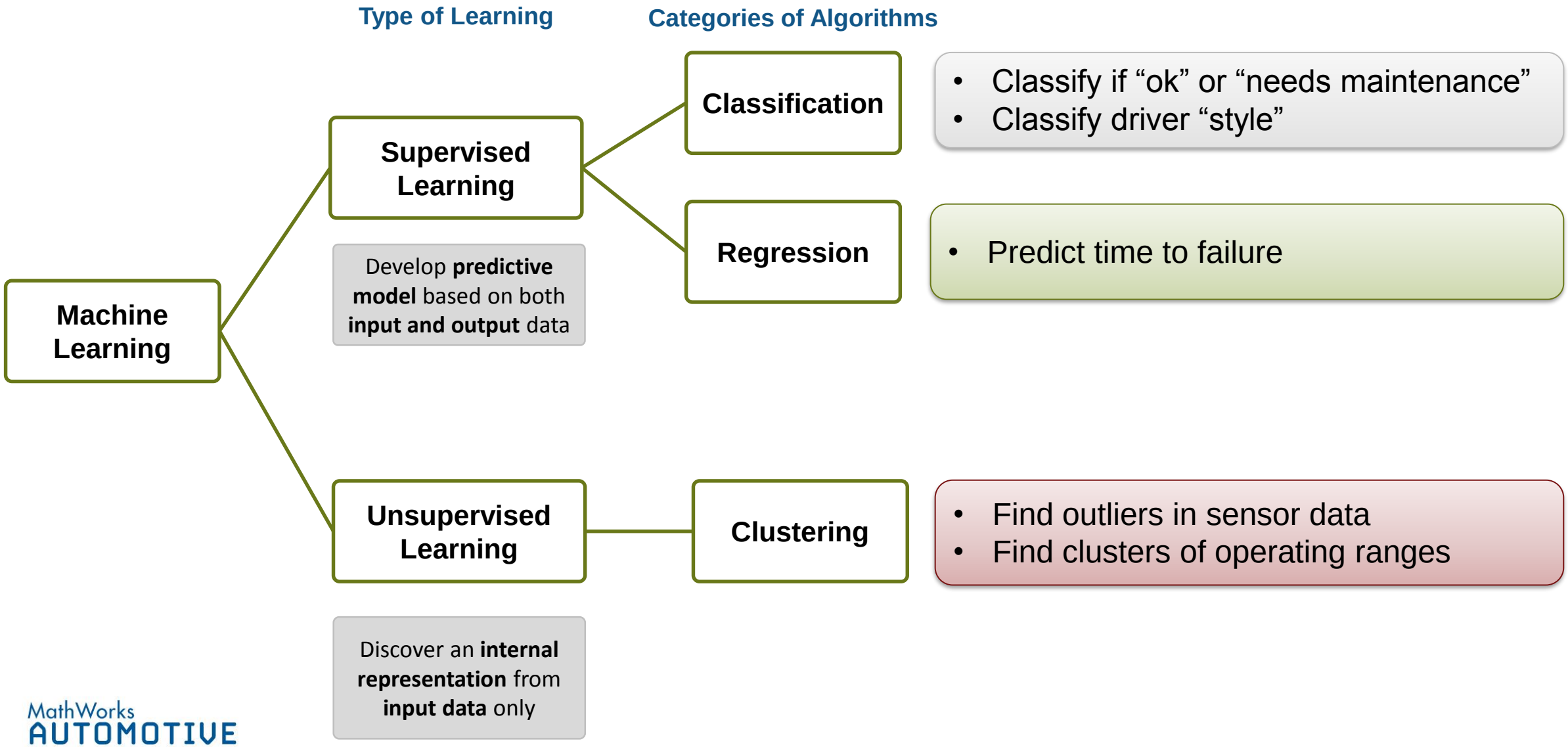

Big data analytics driving predictive car maintenance at BMW

Techniques for Diagnostics and Prognostics

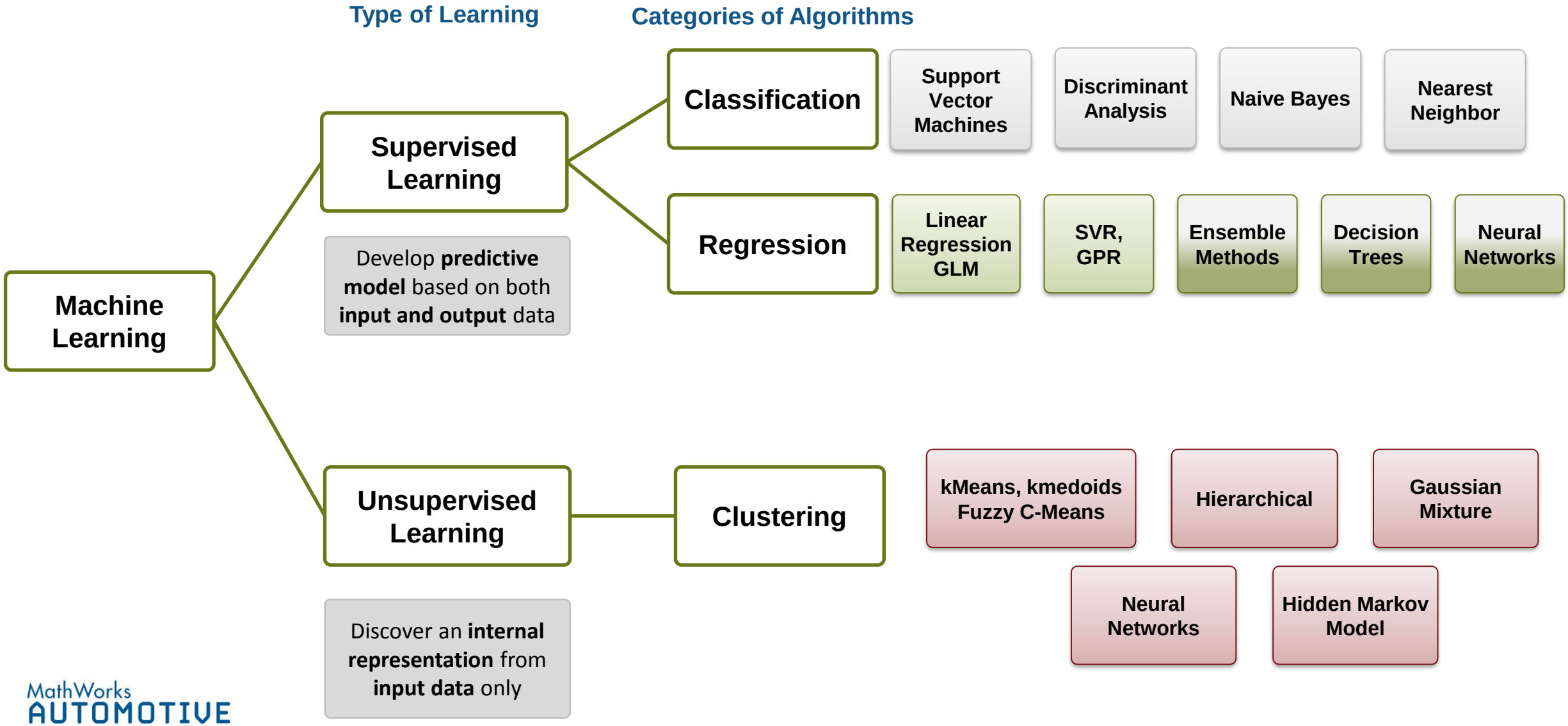
- Stochastic time-series modeling
  - AR (auto-regressive), ARMA (auto-regressive moving average), regression splines, Volterra series expansion
- Estimation and Controls
  - Kalman filters, extended Kalman filters, state-space models, transfer function models
- Machine Learning
  - Neural networks, nearest neighbors, decision trees

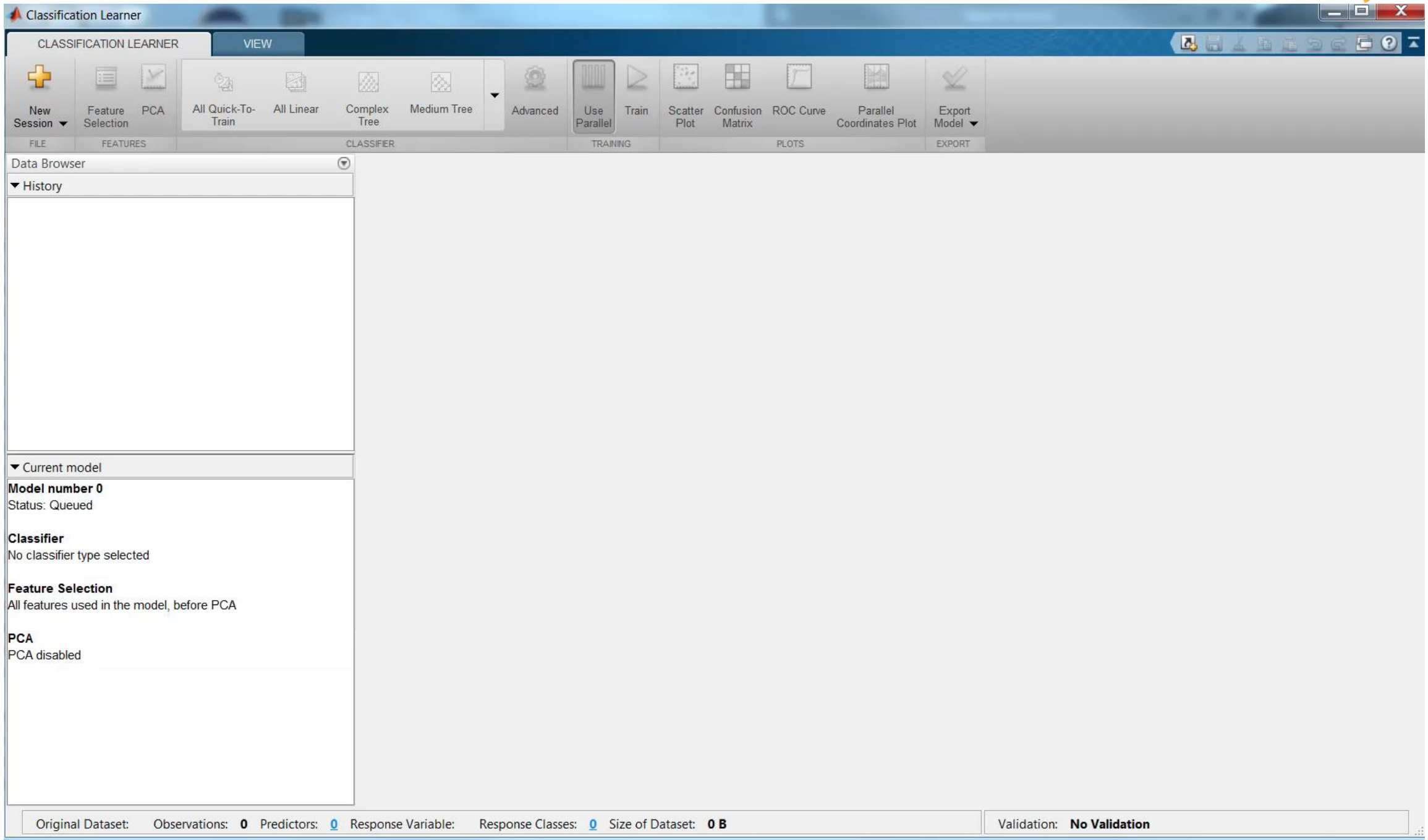
Focus of today's talk.

Different Types of Learning



Different Types of Learning

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PCA
All Quick-To-Train
All Linear
Complex Tree
Medium Tree
Advanced
Use Parallel
Train
Scatter Plot
Confusion Matrix
ROC Curve
Parallel Coordinates Plot
Export Model
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CLASSIFIER
TRAINING
PLOTS
EXPORT
Data Browser
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Model number 0
Status: Queued
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All features used in the model, before PCA
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PCA disabled
Original Dataset: Observations: 0 Predictors: 0 Response Variable: Response Classes: 0 Size of Dataset: 0 B
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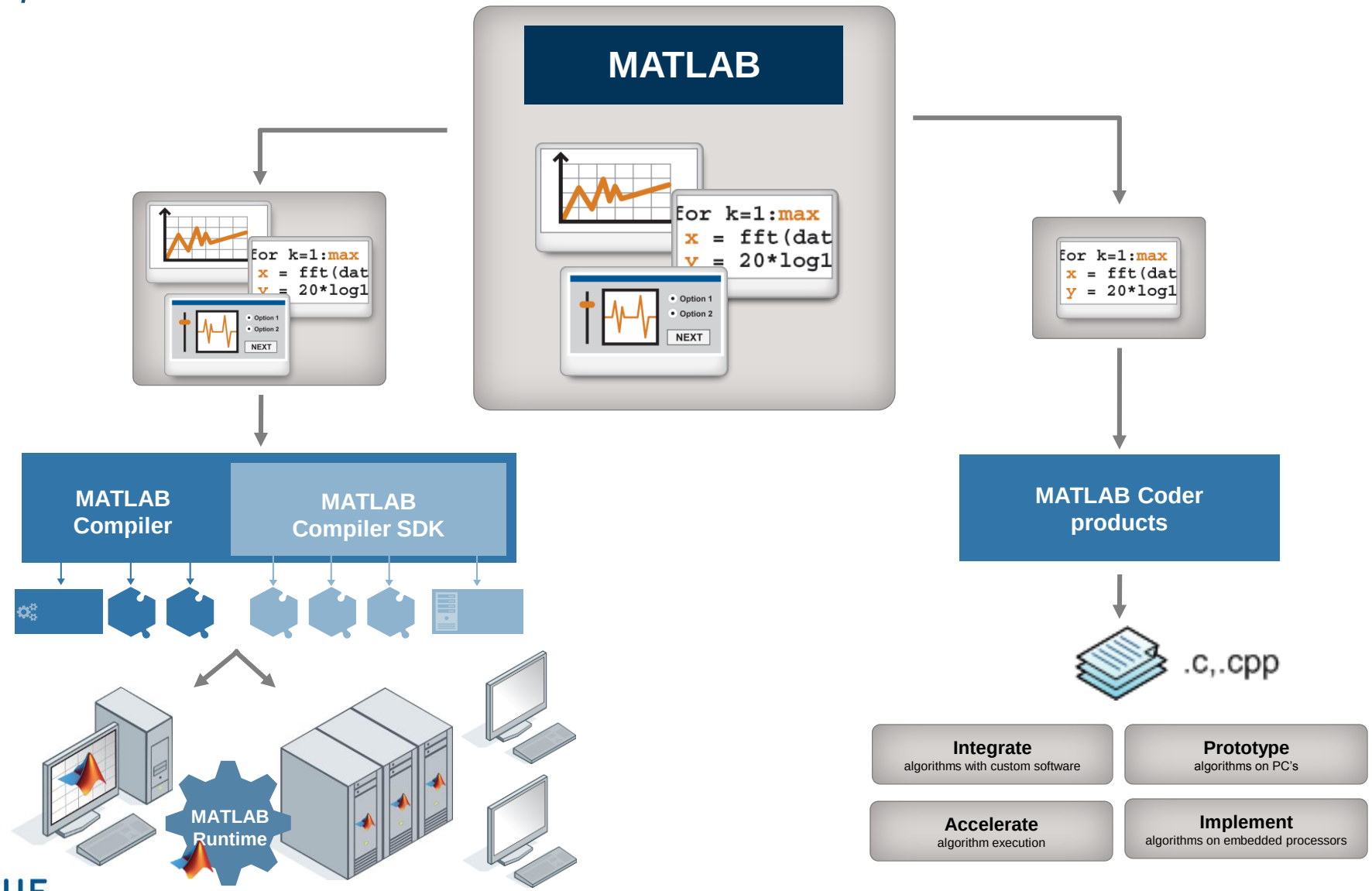
Integrate analytics with your enterprise systems

MATLAB Compiler and MATLAB Coder



Learn More

- Webinars:
  - Predictive Maintenance with MATLAB: A Prognostics Case Study
  - Signal Processing and Machine Learning for Sensor Data Analytics

- Web Pages:
  - Machine Learning
  - Statistics and Machine Learning Toolbox
  - Big Data with MATLAB discovery page
  - Neural Networks Toolbox
  - System Identification Toolbox

Key Takeaways

- MATLAB provides a wide variety of Machine Learning tools that are easy to get started with
- Deploy Prognostics and Diagnostics algorithms to where it makes sense, whether it is embedded, on the vehicle or in IT infrastructure
- Work with us and we can help you get started applying these techniques