Machine Learning with MATLAB

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Application Engineer

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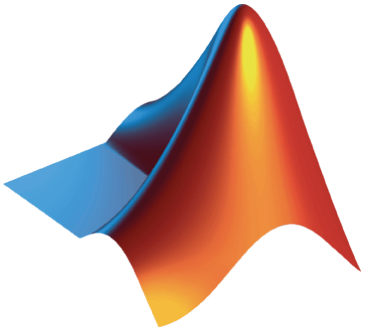
Goals

- Overview of machine learning
- Machine learning models & techniques available in MATLAB
- Streamlining the machine learning workflow with MATLAB

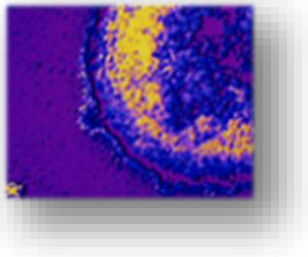


Motivation

- Do you want to create a model of a system?
  - Understand dynamics
  - Predict Outputs
- How do you create a model?
  - Develop an equation
    - Takes time to develop, sometimes even years
    - Unknown if there is actually an equation at all
  - Another option, Machine Learning

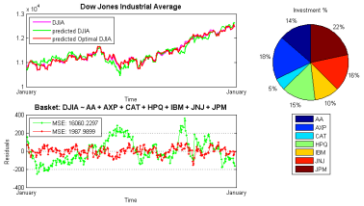
Used Across Many Application Areas

Biology



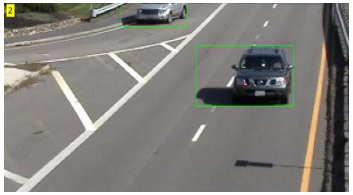
Tumor Detection, Drug Discovery

Financial Services



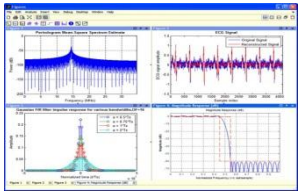
Credit Scoring, Algorithm Trading, Bond Classification

Image & Video Processing



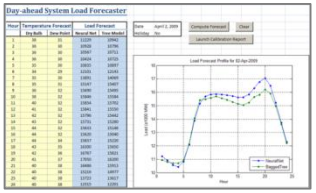
Pattern Recognition

Audio Processing



Speech Recognition

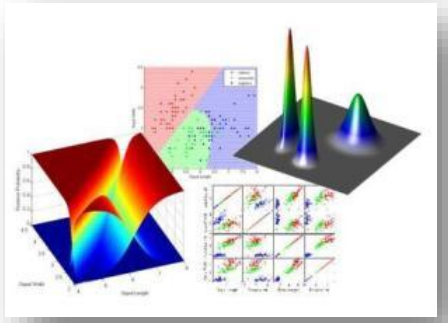
Energy



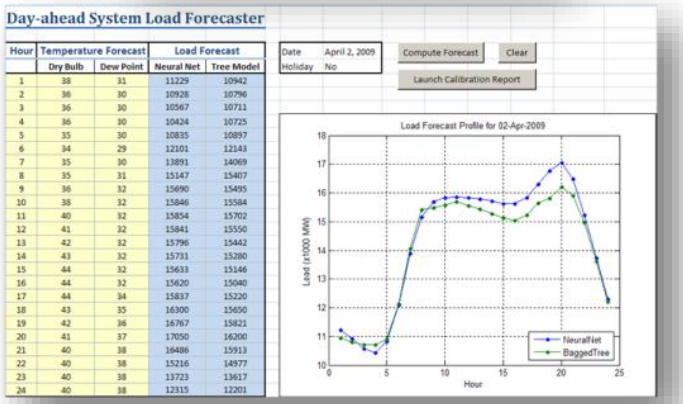
Load, Price Forecasting, Trading

Machine Learning

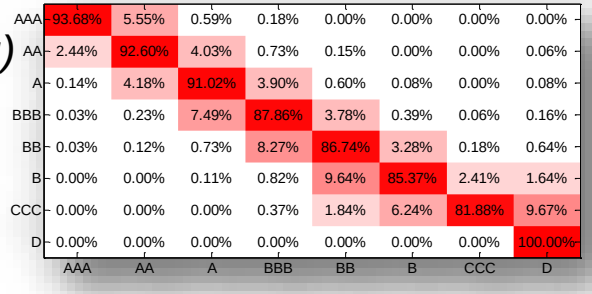
Characteristics and Examples



- Characteristics
  - Lots of data (many variables)
  - System too complex to know the governing equation *(e.g., black-box modeling)*



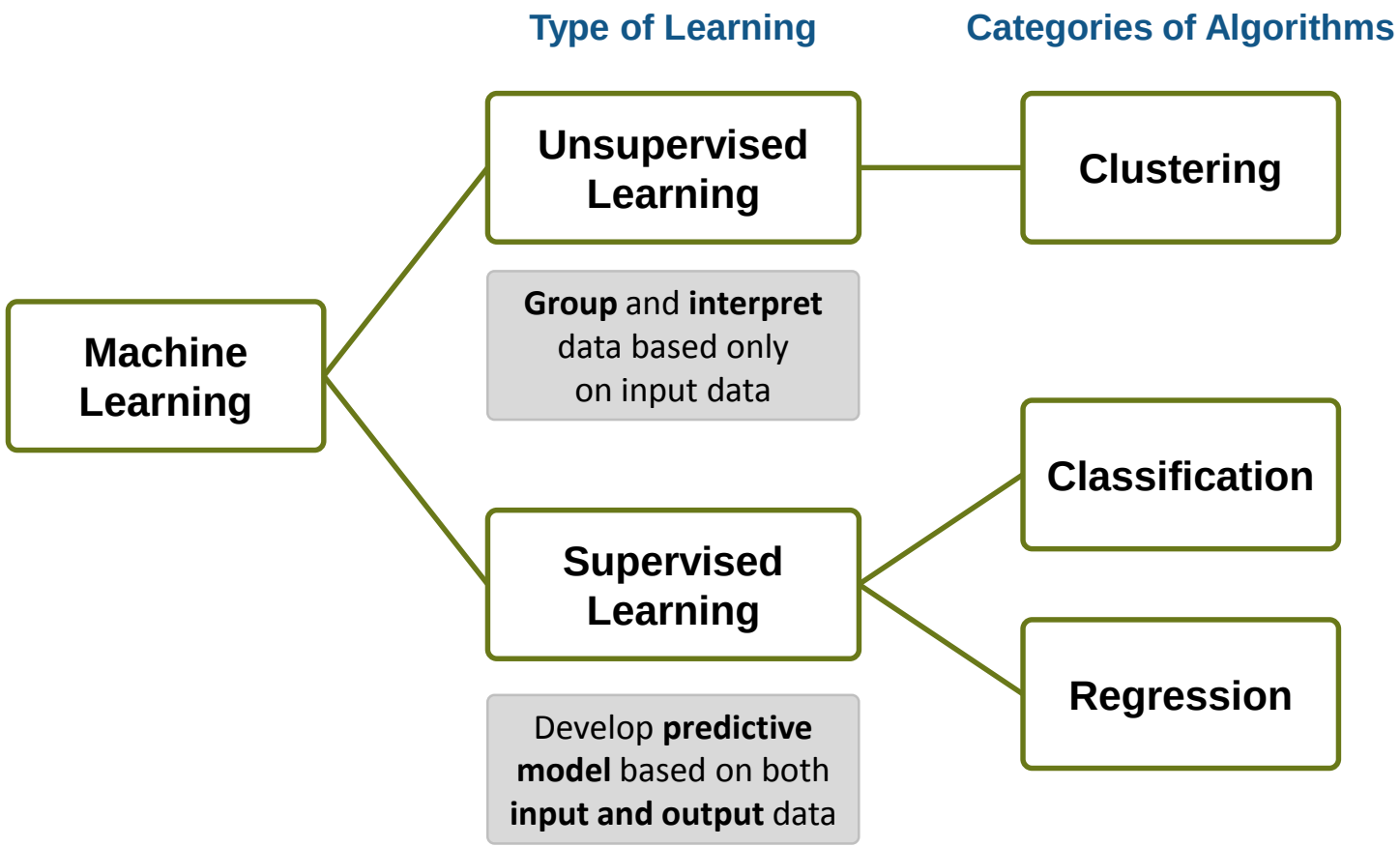
- Examples
  - Pattern recognition *(speech, images)*
  - Financial algorithms *(credit scoring, algo trading)*
  - Energy forecasting *(load, price)*
  - Biology *(tumor detection, drug discovery)*



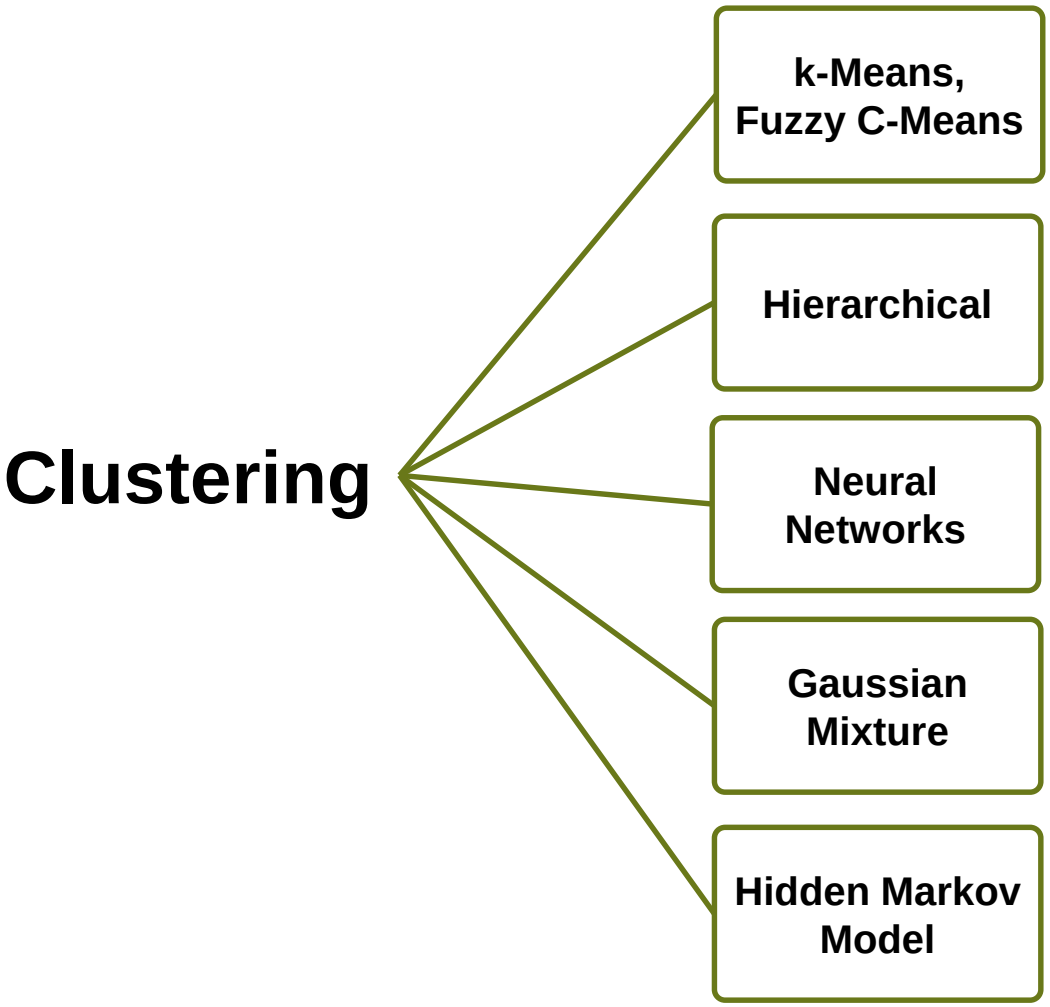
Challenges – Machine Learning

- Significant technical expertise required
- No “one size fits all” solution
- Locked into Black Box solutions
- Time required to conduct the analysis

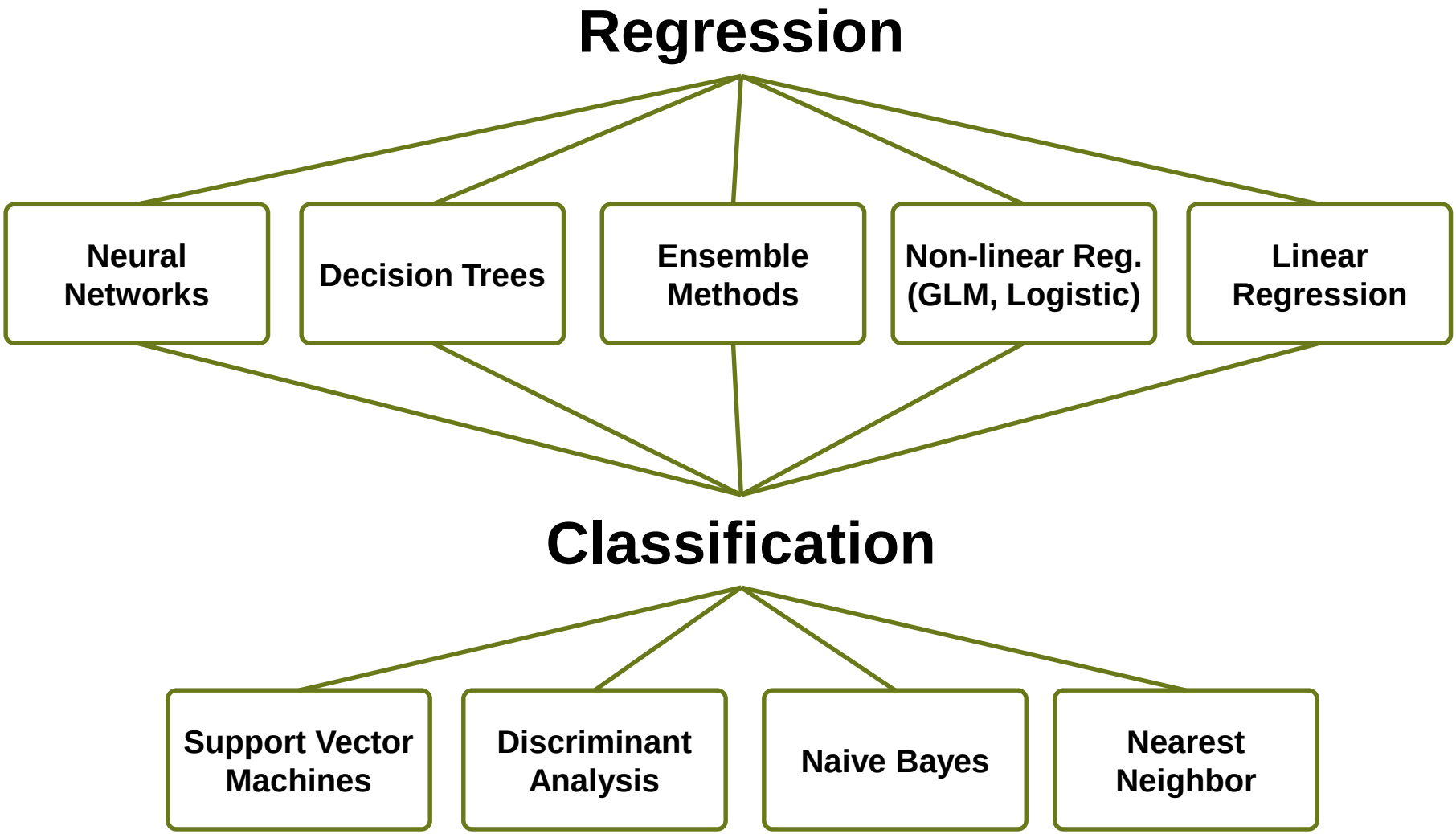
Overview – Machine Learning



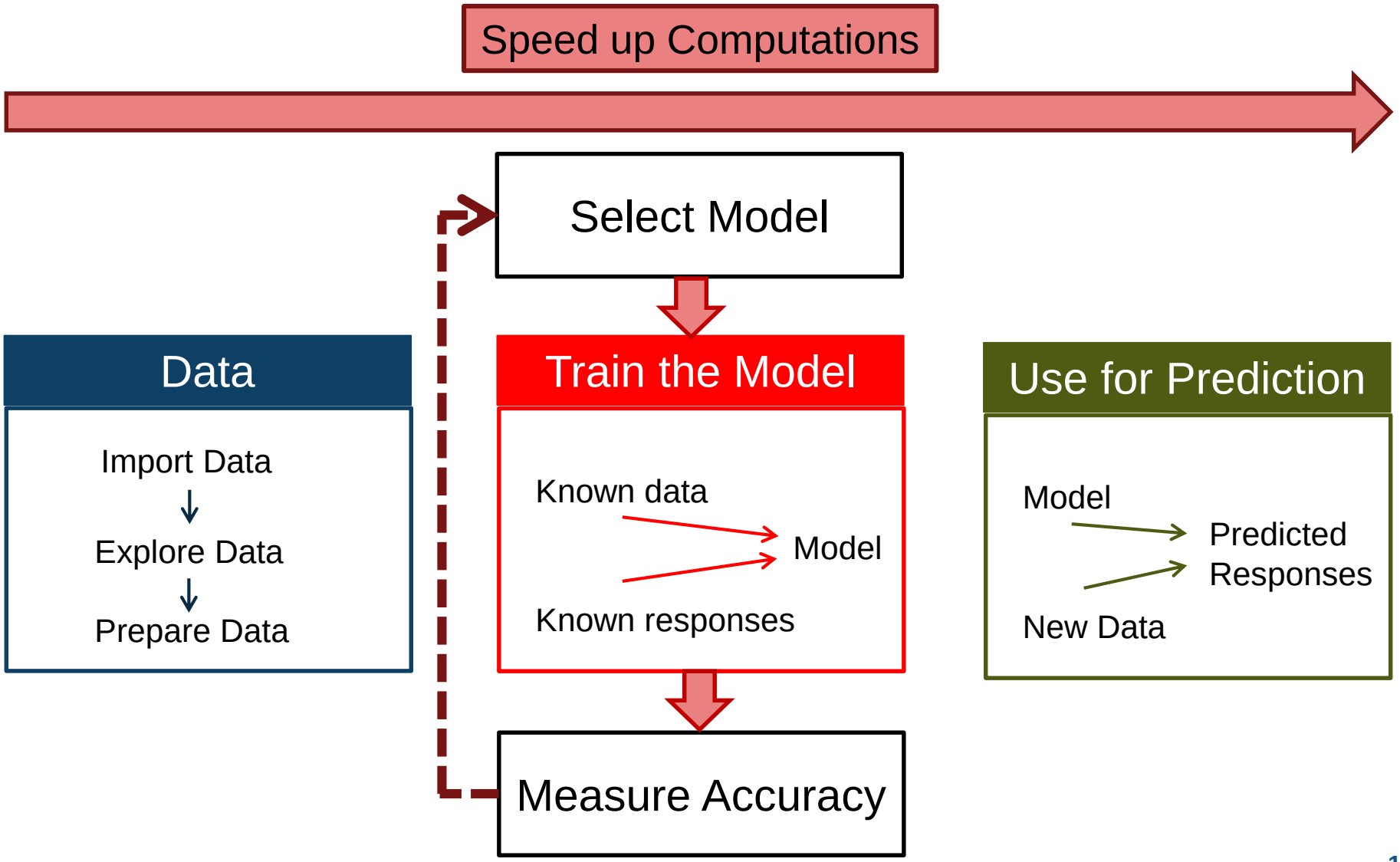
Unsupervised Learning



Supervised Learning



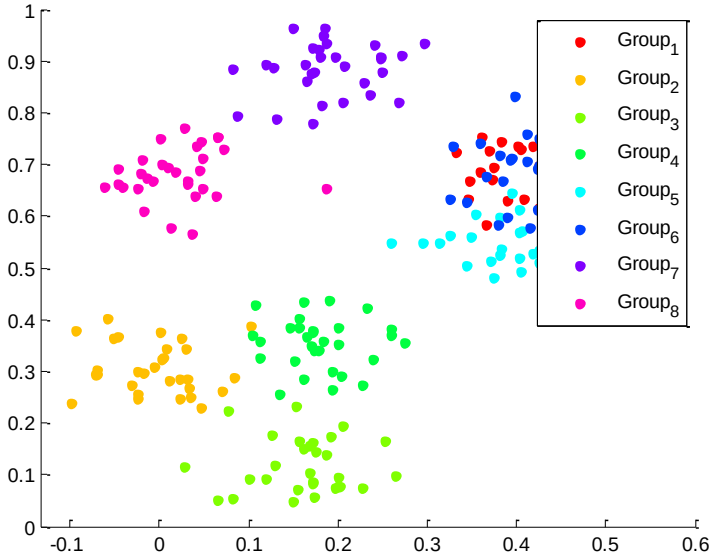
Supervised Learning - Workflow



Classification

Overview

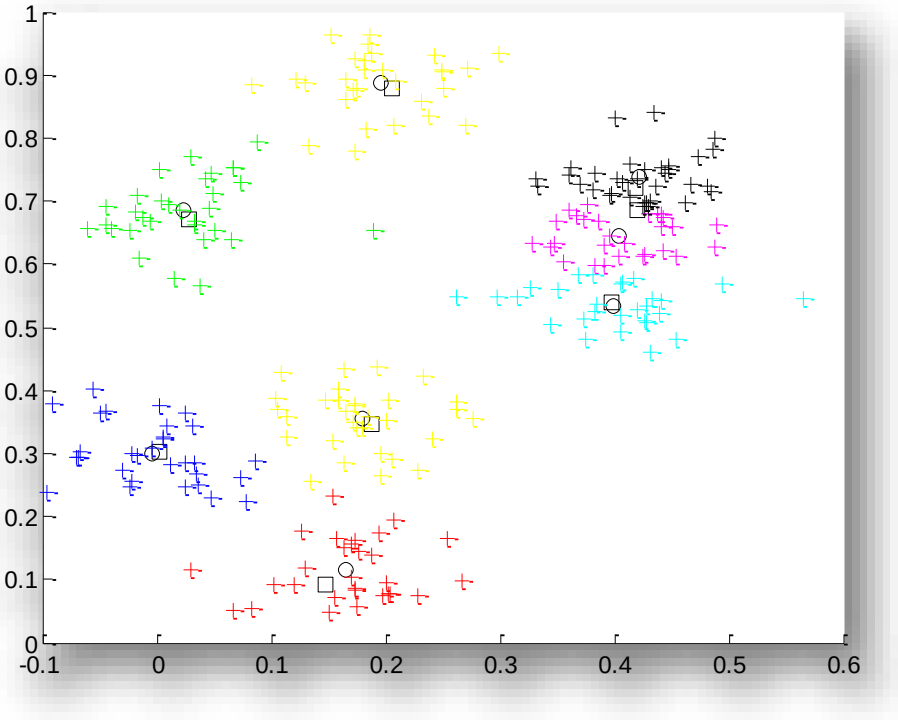
- What is classification?
  - Predicting the best group for each point
  - “Learns” from labeled observations
  - Uses input features
- Why use classification?
  - Accurately group data never seen before
- How is classification done?
  - Can use several algorithms to build a predictive model
  - Good training data is critical



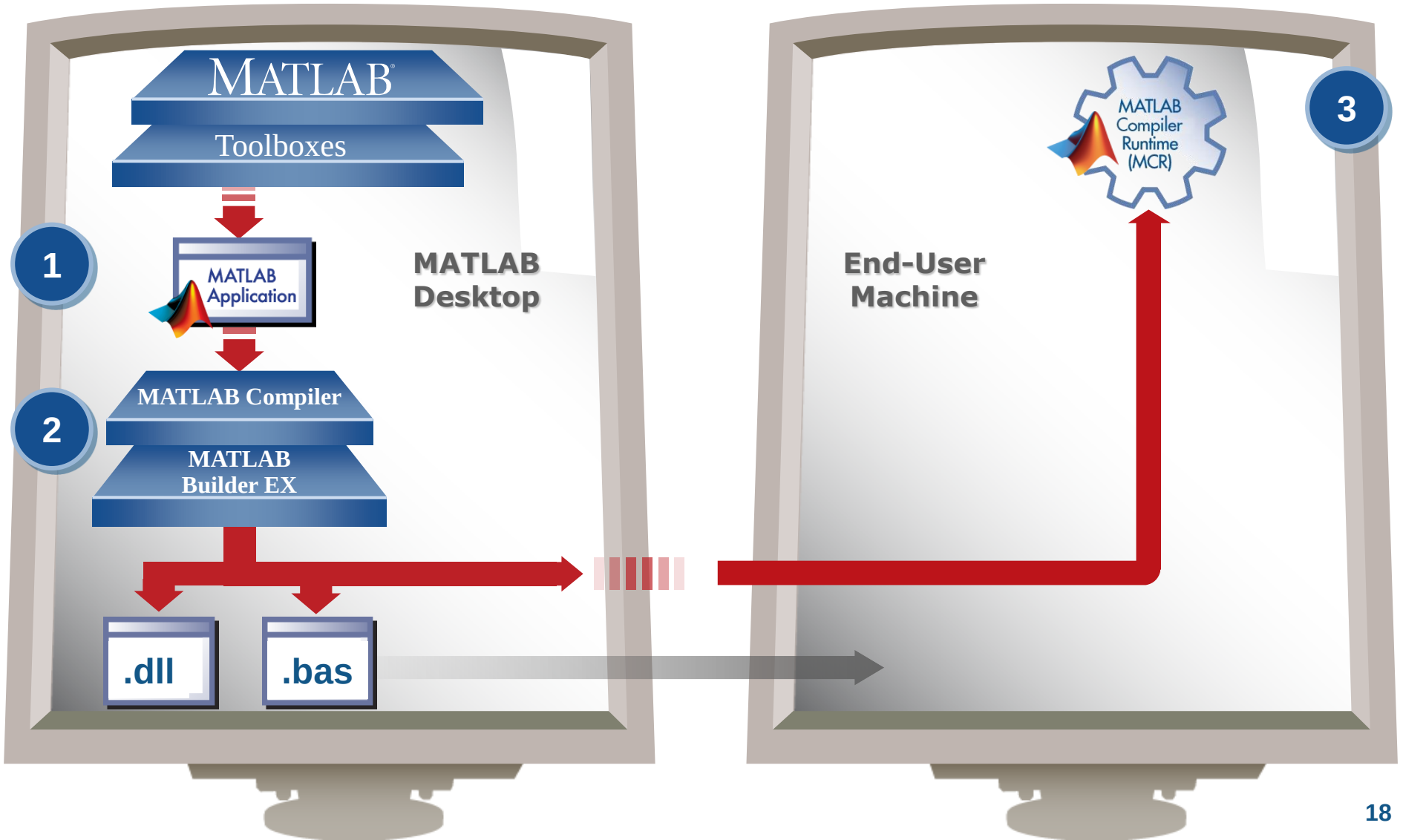
Clustering

Overview

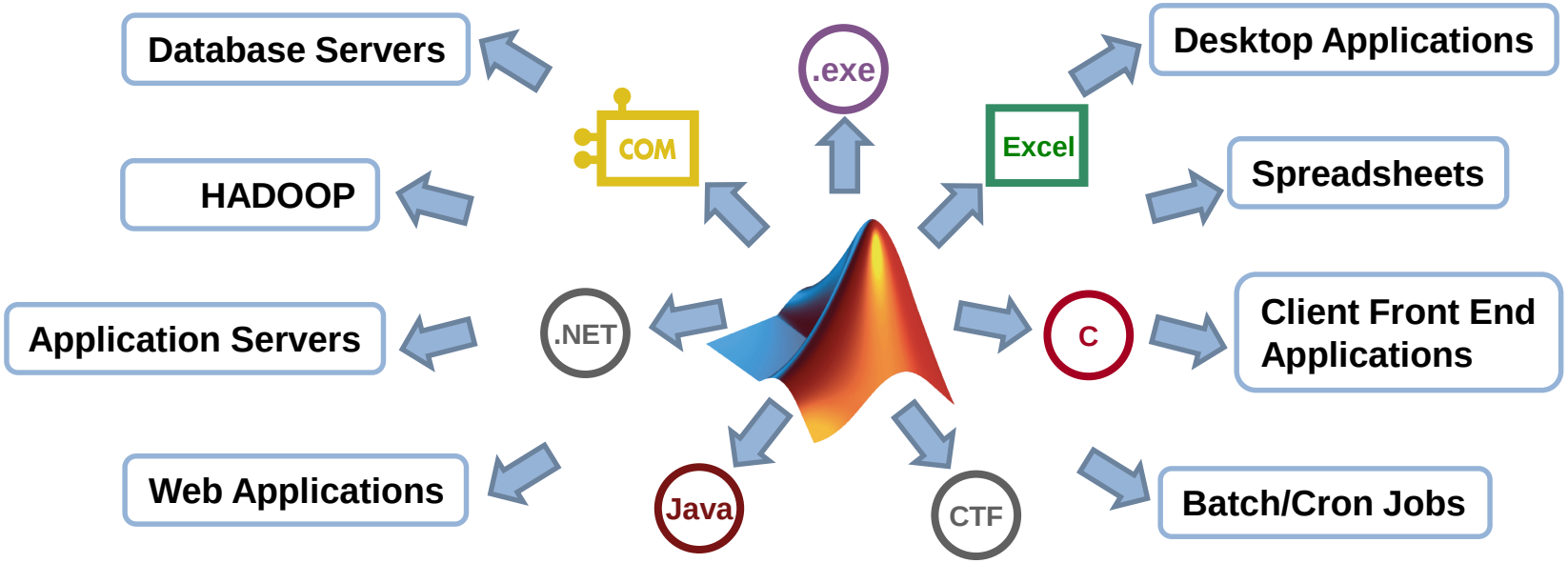
- What is clustering?
  - Segment data into groups, based on data similarity
- Why use clustering?
  - Identify outliers
  - Resulting groups may be the matter of interest
- How is clustering done?
  - Can be achieved by various algorithms
  - It is an iterative process *(involving trial and error)*



Deploying MATLAB Applications to Excel



Deployment Highlights



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

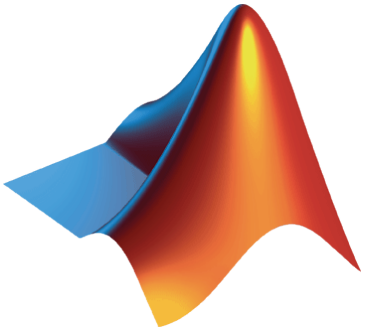
MATLAB for Machine Learning

Challenges	MATLAB Solution
Time (loss of productivity)	**Rapid analysis and application development** High productivity from data preparation, interactive exploration, visualizations.
Extract value from data	**Machine learning, Video, Image, and Financial** Depth and breadth of algorithms in classification, clustering, and regression
Computation speed	**Fast training and computation** Parallel computation, Optimized libraries
Time to deploy & integrate	**Ease of deployment and leveraging enterprise** Push-button deployment into production
Technology risk	**High-quality libraries and support** Industry-standard algorithms in use in production Access to support, training and advisory services when needed

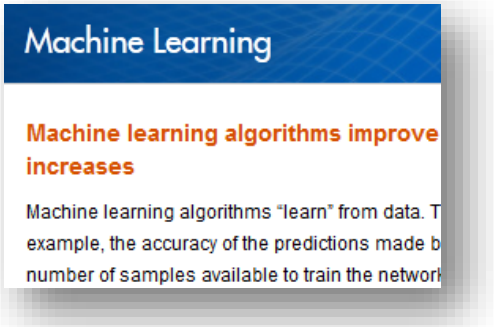
Machine Learning with MATLAB

- Interactive environment
  - Visual tools for exploratory data analysis
  - Easy to evaluate and choose best algorithm
  - Apps available to help you get started
    (e.g,. neural network tool, curve fitting tool)

- Multiple algorithms to choose from
  - Clustering
  - Classification
  - Regression

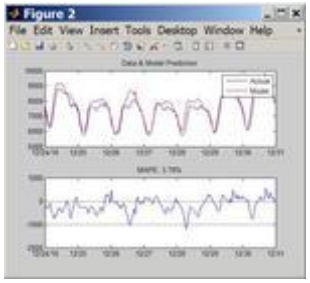


Learn More : Machine Learning with MATLAB

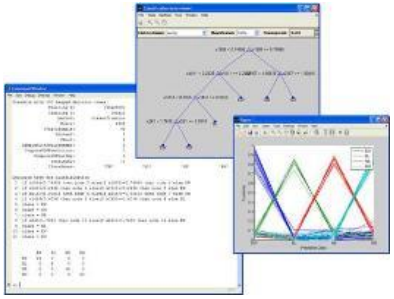


http://www.mathworks.com/discovery/machine-learning.html

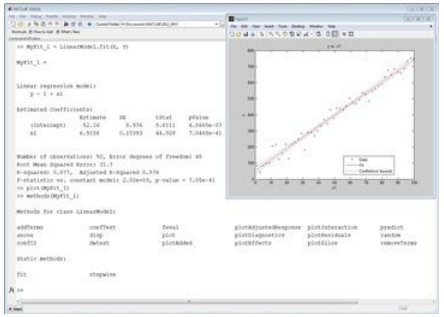
Data Driven Fitting with MATLAB



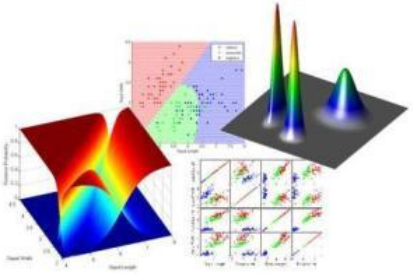
Classification with MATLAB



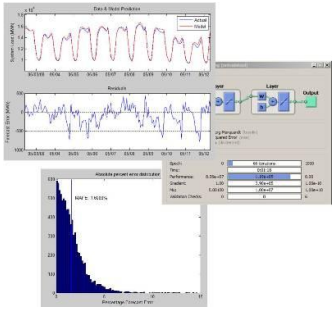
Regression with MATLAB



Multivariate Classification in the Life Sciences



Electricity Load and Price Forecasting



Credit Risk Modeling with MATLAB

Training Services

Exploit the full potential of MathWorks products

Flexible delivery options:

- Public training available worldwide
- Onsite training with standard or customized courses
- Web-based training with live, interactive instructor-led courses
- Self-paced interactive online training

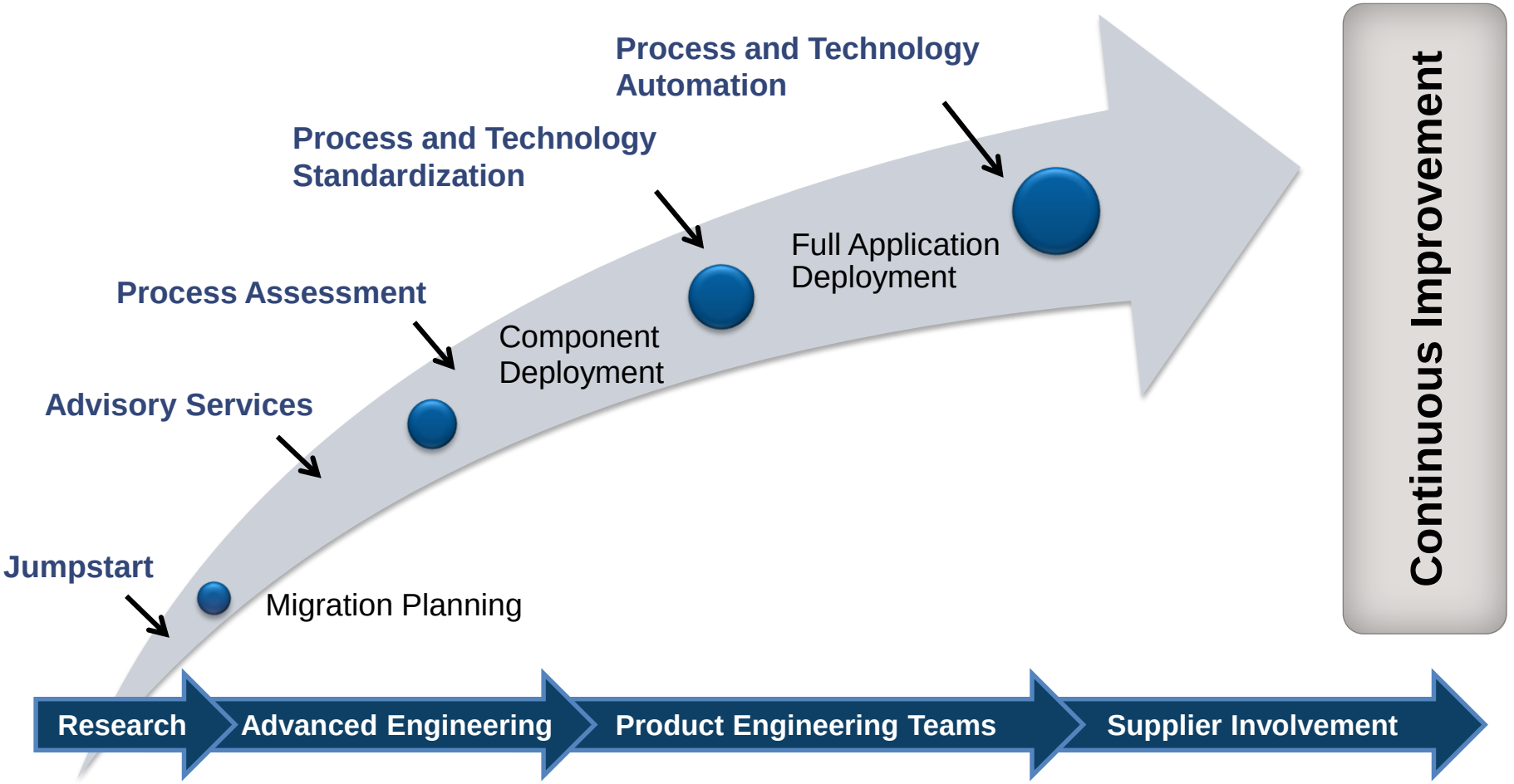
More than 30 course offerings:

- Introductory and intermediate training on MATLAB, Simulink, Stateflow, code generation, and Polyspace products
- Specialized courses in control design, signal processing, parallel computing, code generation, communications, financial analysis, and other areas

Consulting Services

Accelerating return on investment

A global team of experts supporting every stage of tool and process integration



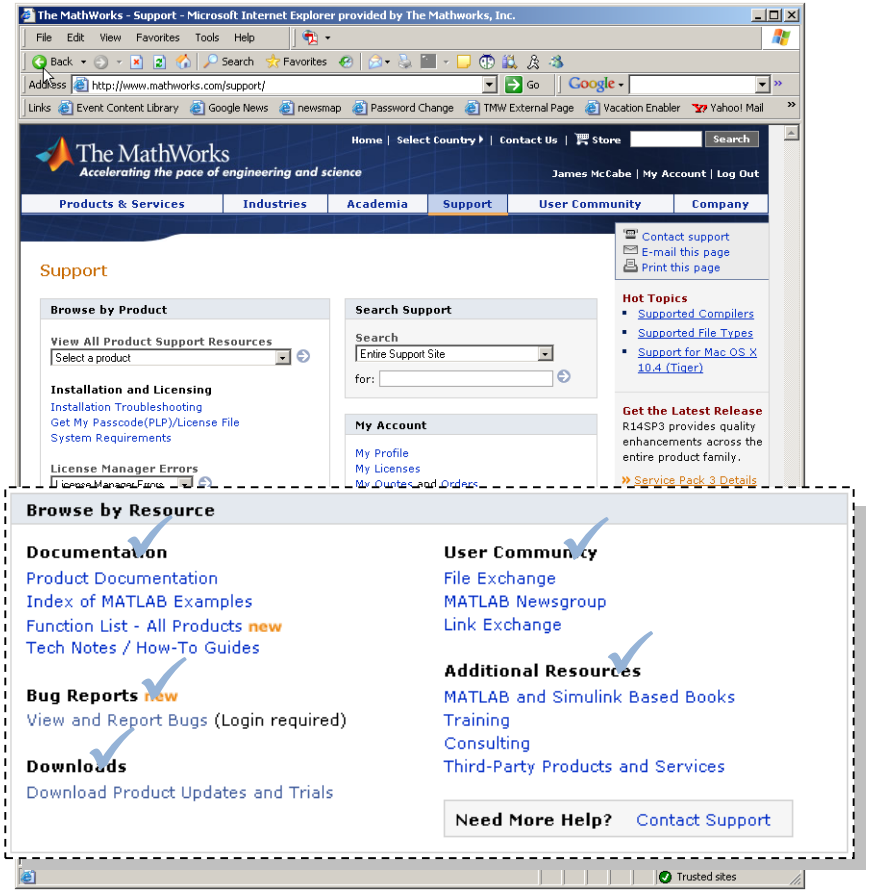
Technical Support

Resources

- Over 100 support engineers
  - All with MS degrees (EE, ME, CS)
  - Local support in North America, Europe, and Asia
- Comprehensive, product-specific Web support resources

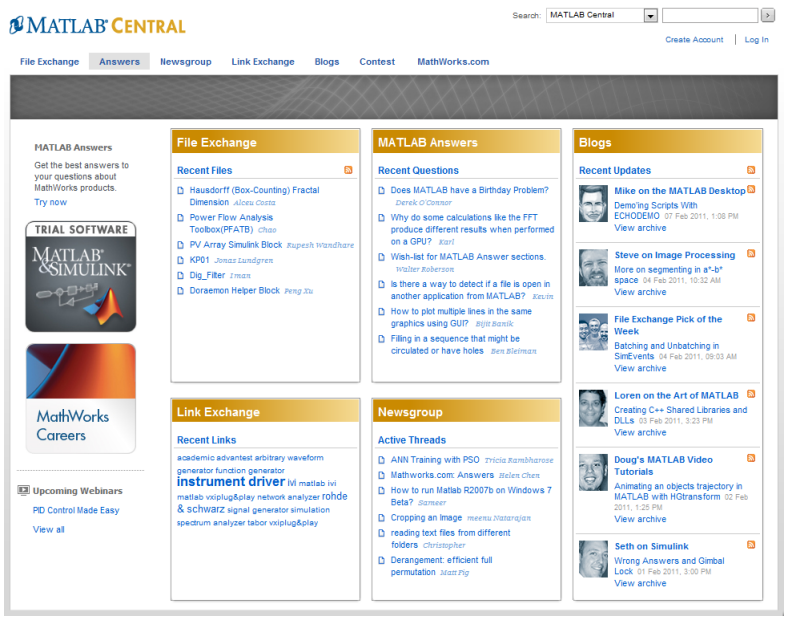
High customer satisfaction

- 95% of calls answered within three minutes
- 70% of issues resolved within 24 hours
- 80% of customers surveyed rate satisfaction at 80–100%



MATLAB Central

- Community for MATLAB and Simulink users
- Over 1 million visits per month
- File Exchange
  - Upload/download access to free files including MATLAB code, Simulink models, and documents
  - Ability to rate files, comment, and ask questions
  - More than 12,500 contributed files, 300 submissions per month, 50,000 downloads per month
- Newsgroup
  - Web forum for technical discussions about MathWorks products
  - More than 300 posts per day
- Blogs
  - Commentary from engineers who design, build, and support MathWorks products
  - Open conversation at blogs.mathworks.com



Based on February 2011 data

Questions?