The Rise of Engineering-Driven Advanced Analytics

MATLAB EXPO 2016

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The Rise of Engineering-Driven Advanced Analytics
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Advanced 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.
Analytics are now pervasive

Apply robust, statistically-motivated methods to data produced from complex systems to understand what has happened and predict what will happen.
Analytics in e-commerce

Use **Image Processing** to add image data to the model, improving performance

**IMPROVED Predictive Model**

- Images
- Social profile
- Geolocation
- Keystroke logs
- Transactions

**Engineering Data**

**Business Data**

**Offer to Customer**
Using now

Planned

Engineering Data

Business Data

Transactions
Keystroke logs
Geolocation
Social profile
Sensor
Images
Audio
Video

Source: Gartner Big Data Industry Insights, March 2016
The Rise of Engineering-Driven Advanced Analytics
Architecture of an analytics system

Data from instruments and connected systems

Data from business systems

Predictive Model deployed in smart systems using Model-Based Design

Predictive Model deployed on cloud and business systems

MATLAB Integrates in Embedded System and Enterprise IT Workflows
Example – BuildingIQ
Adaptive building energy management
25% cost reduction
Real-time, closed-loop optimization algorithms

DATA - Billions of data points:
- Physics, energy costs, ambient temperature, operation schedule, etc.

Analytics and Machine Learning:
- Plus system identification, control theory & more

Predictive Model:
- Deployed on cloud with client system and real-time data feeds

MATLAB Toolboxes Just Work – and work together!
Why MATLAB?

- Robust numerical algorithms
- Extensive visualization and analytics tools
- Industry-robust and reliable mathematical optimization routines
- Good object-oriented framework
- Ability to interface with Java (for backend work)
- Running MATLAB in the cloud in production
- Unit-testing framework

MATLAB Impeccable Numerics for Trusted Results

We could rapidly translate our prototypes into production algorithms that deal reliably with real-world noise and uncertainty.

Borislav Savkovic, BuildingiQ
Example – Scania

Automatic emergency braking using sensor fusion and analytics
50 km/h - sudden brake
Using Model-Based Design

A proven way to build and deploy the analytics in an embedded control system

MATLAB Integrates Analytics and Model-Based Design
Implementing Sensor Fusion at Scania

Vehicle logs of video and radar data

Predictive Model deployed on vehicle

Machine learning to develop fusion algorithms for situation detection

Control System Track

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11:00 Keynote Presentation

“The Road towards Autonomous Transport”
Daniel Frylmark, Scania

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The Rise of Engineering-Driven Analytics

- Automotive
- Off-highway vehicles
- Aeronautics
- Retail
- Finance
- Healthcare
- Internet
- Industrial Automation
- Oil & Gas
- Medical Devices
- Clean Energy
Sensor Data (~1 minute)  
10-100 sensors/machine  
Quality State (~40 minutes) 

Classification using  
Statistics, Machine Learning, and Neural Networks 

Predictive Maintenance  
for polymer-based production machines
Deployment – a MATLAB App used by machine operators
The need for data scientists
What they say

- Expand university programs
- Train existing analysts
Core Concepts in Data Analysis

Learn both theory and application for basic methods that have been invented either for developing new concepts - principal components or clusters, or for finding interesting correlations - regression and classification. This is preceded by a thorough analysis of 1D and 2D data.

Teaching with MATLAB and Simulink Track

Machine Learning

Stanford University

Big Data Science with the BD2K-LINCS Data Coordination and Integration Center

Learn various methods of analysis including: unsupervised clustering, gene-set enrichment analysis, Bayesian integration, network visualization, and supervised machine learning applications to LINCS data and other relevant Big Data from high-content molecular and phenotype profiling of human cells.

Computational Methods for Data Analysis

Exploratory and objective data analysis methods applied to the physical, engineering, and biological sciences.
IoT open data platform for students and makers

Built-in MATLAB analysis

Simulink support via Raspberry Pi
Student Contest
use process control data
to improve semiconductor yields

- 21 teams competed
- Wafer Big Data in Hadoop
- MATLAB used by winning team and 2nd place team
MATLAB lets you be your own data scientist

MATLAB is Designed and Documented to be Easy for Engineers and Scientists to Use
In MATLAB

- Native support for engineering data
- Database interfaces
- Streaming

Limited users, scope, & technology

Big Data

- Engineering
- Business
- Transactional

Compute Power

- Desktop - Multicore, GPU
- Clusters
- Cloud computing
- Hadoop

Machine Learning

- Neural Networks
- Classification
- Clustering
- Regression
- ...and much more...

Pervasive users, scope, & technology

“What's New in MATLAB and Simulink for Signal Processing”

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12:45 Signal Processing Track
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- Regression

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- Native support for engineering data
- Database interfaces
- Streaming
- **Datastore** R2014b
text, image, video, Excel files, ...
- **Mapreduce** R2014b
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- Mapreduce R2014b

MATLAB is fast:
- heavily optimized libraries
- JIT compiled
- takes advantage of the compute power you have

In MATLAB
- Multicore & GPU
- MATLAB Distributed Computing Server and EC2 Support
- Hadoop support R2014b
- MATLAB Production Server

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Pervasive users, scope, & technology
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**Hadoop support** R2014b
- MATLAB Production Server

NEW from MathWorks

The open data platform for the Internet of Things

 ThingSpeak

Analytics

MATLAB Analysis
Explore and transform data.

MATLAB Visualizations
Visualize data in MATLAB plots.
In MATLAB

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- Multicore & GPU
- Statistics and Machine Learning Toolbox
- **Classification Learner App** R2015a
- Neural Network Toolbox
- **CNNs for Deep learning** R2016a
- Machine learning with code generation
Classification Learner App in Statistics and Machine Learning Toolbox
MATLAB Apps for Data Analytics

Distribution Fitting
System Identification
Signal Analysis
Wavelet Design and Analysis
Neural Net Fitting
Neural Net Pattern Recognition
Training Image Labeler

and many more...

With MATLAB Apps, you can complete data science tasks more quickly and easily than custom programming
Using MATLAB R2016a

App Designer

“What’s New in MATLAB for Technical Computing”
Using MATLAB R2016a

App Designer
Deep Learning with Neural Network Toolbox - New in R2016a
Deep Learning with Neural Network Toolbox - New in R2016a

Demonstration Booths

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Example – **cellscope**
First consumer otoscope in a mobile device
machine learning and computer vision
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Be your own Data Scientist!