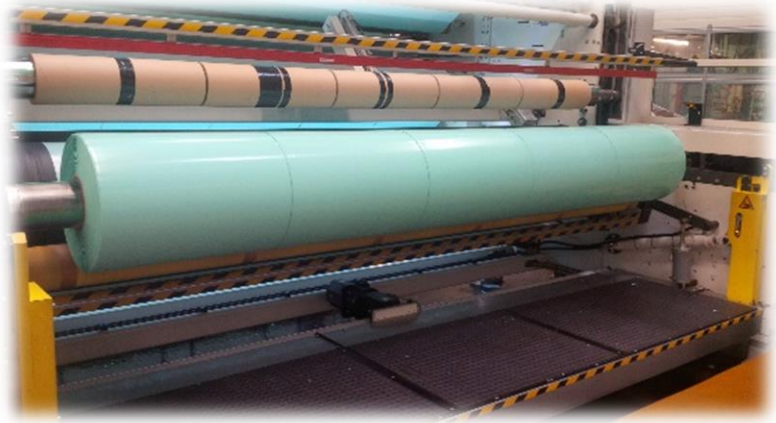
MATLAB EXPO 2016

The Rise of Engineering-Driven Analytics

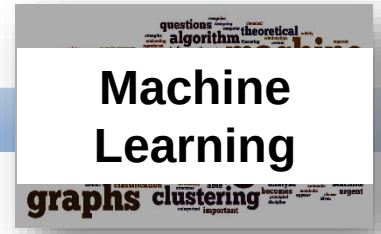
Roy Lurie, Ph.D.
Vice President Engineering,
MATLAB Products



The Rise of Engineering-Driven Analytics

The Rise of Engineering-Driven Analytics

Limited users, scope & technology



Pervasive users, scope, & technology

Analytics are now pervasive

- Descriptive & Diagnostic
- Predictive
- Prescriptive

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.

Engineering
Business
Transactional

- **Desktop** - Multicore, GPU
- **Clusters**
- **Cloud computing**
- **Hadoop with Spark**

- **Neural Networks**
- **Classification**
- **Clustering**
- **Regression**
- **…and much more…**

Analytics in e-commerce

Engineering Data

Images

Social profile

Geolocation

Keystroke logs

Transactions

Business Data

Use Image Processing

to add image data to the model,

improving performance

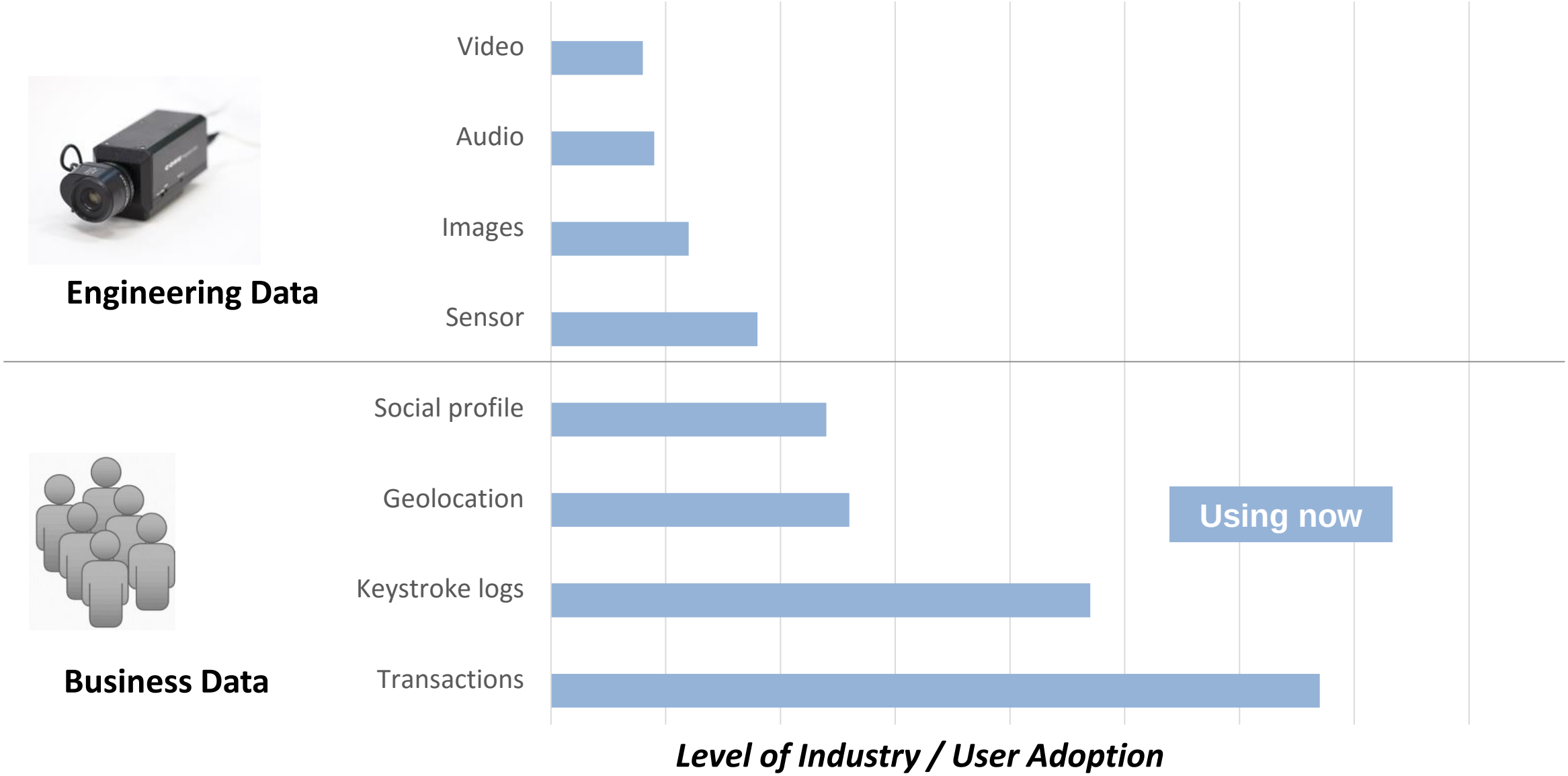
IMPROVED Predictive Model

Offer to Customer

Consider the *Data* in Data Analytics

Engineering Data

Business Data

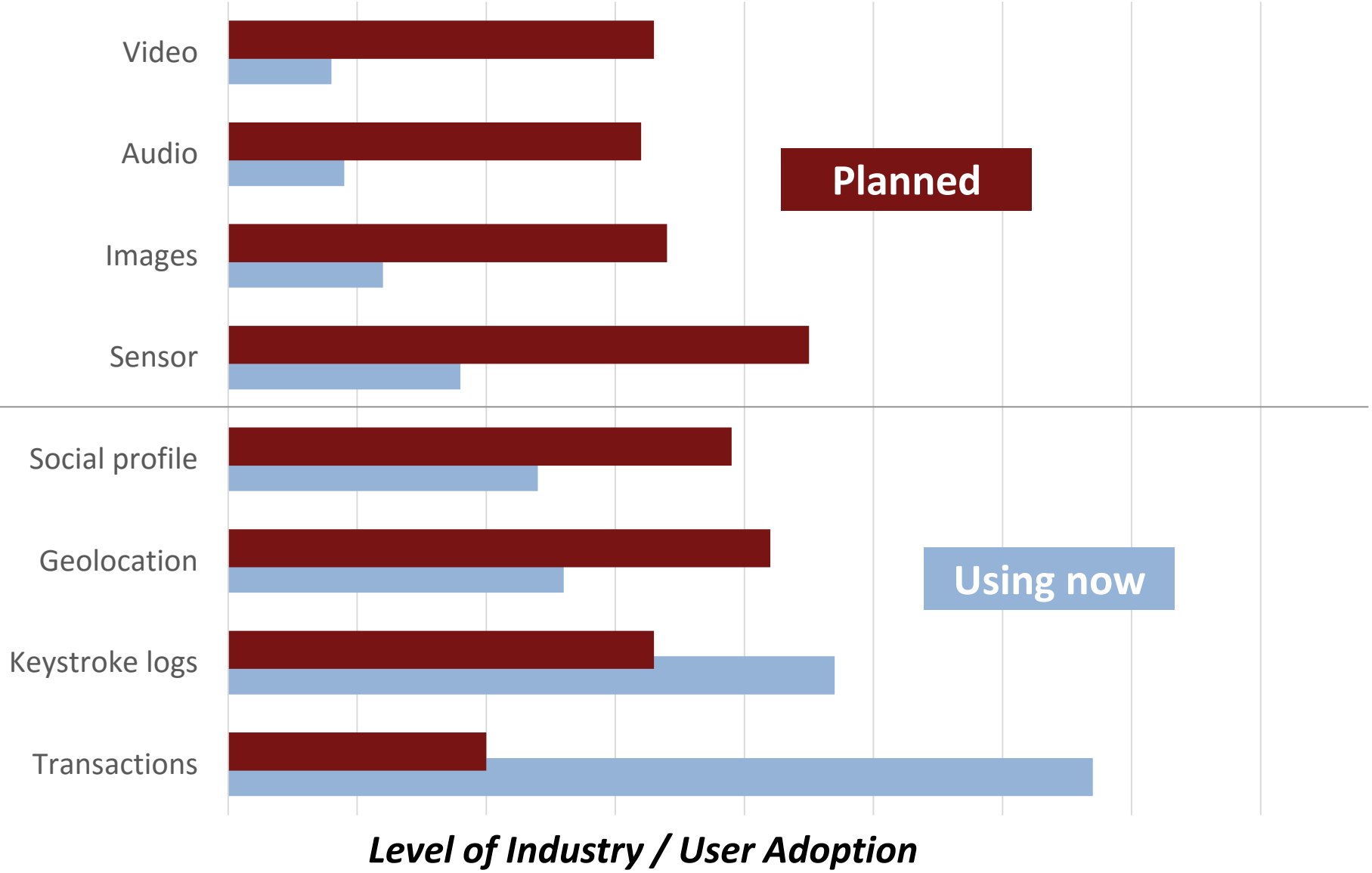


Source: Gartner Big Data Industry Insights, March 2016

Consider the *Data* in Data Analytics

Engineering Data

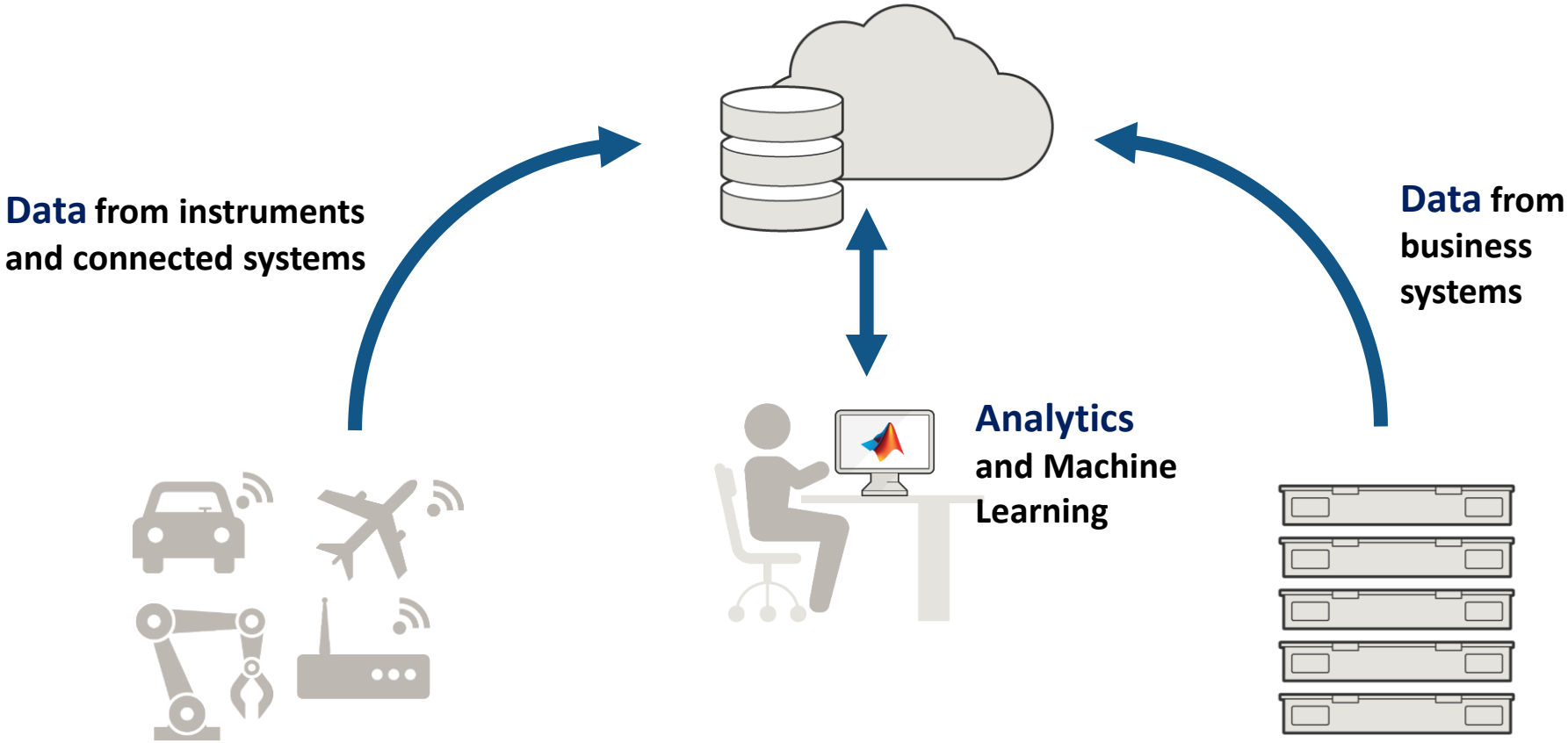
Business Data



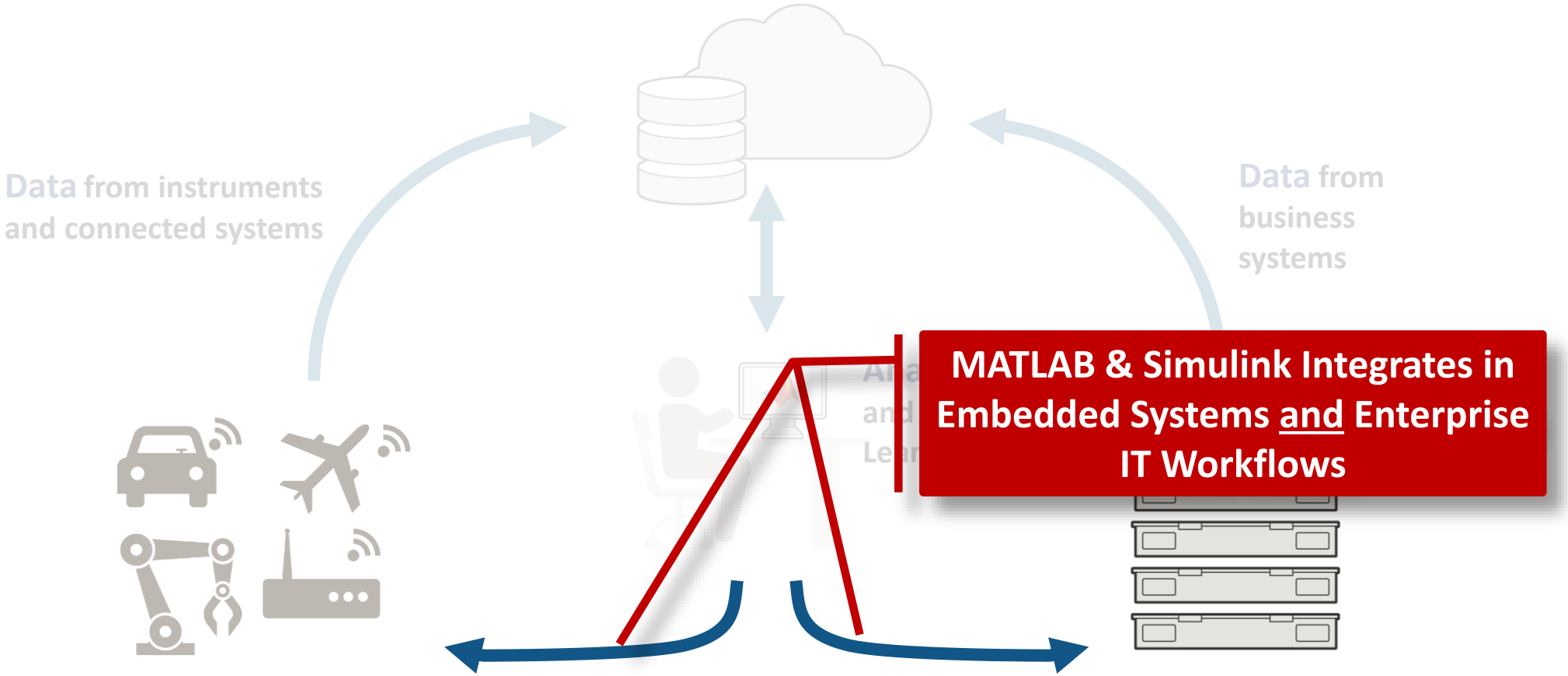
Source: Gartner Big Data Industry Insights, March 2016

The Rise of Engineering-Driven Analytics

Architecture of an analytics system



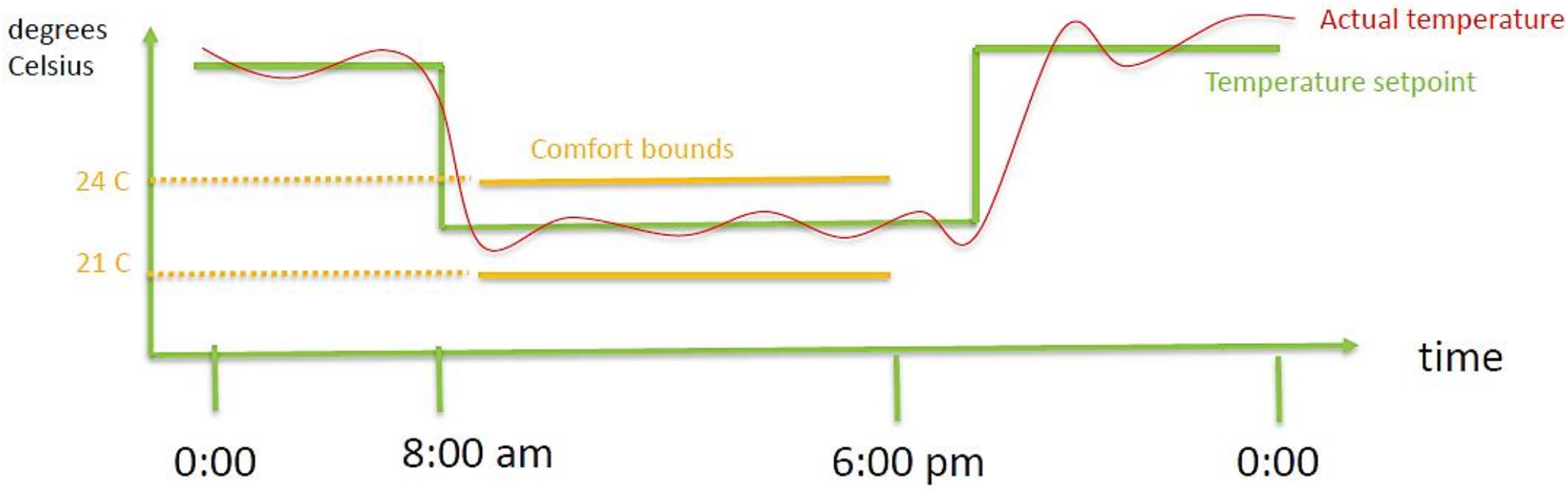
Architecture of an analytics system



Predictive Model
deployed in smart and embedded systems

Predictive Model
deployed on cloud and business systems

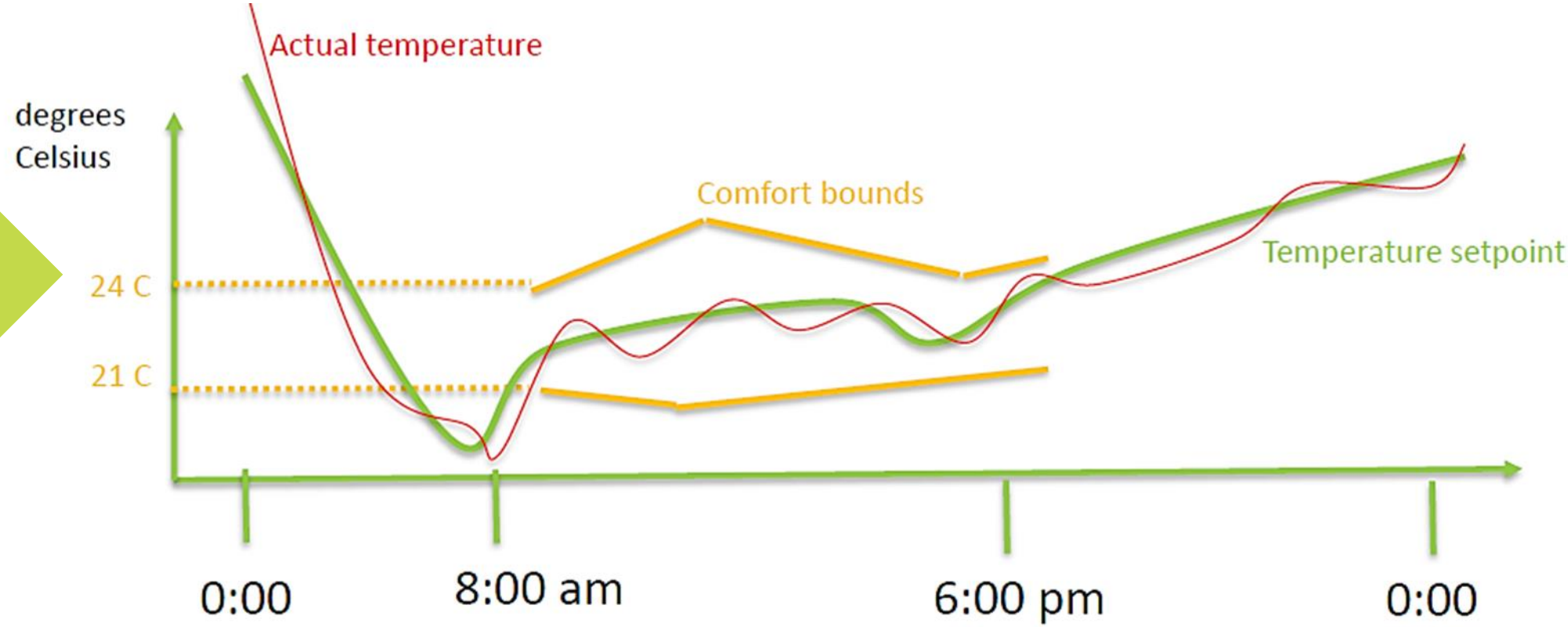
BuildingIQ


degrees
Celsius
Actual temperature
Temperature setpoint
Comfort bounds
24 C
21 C
time
0:00
8:00 am
6:00 pm
0:00

BuildingIQ

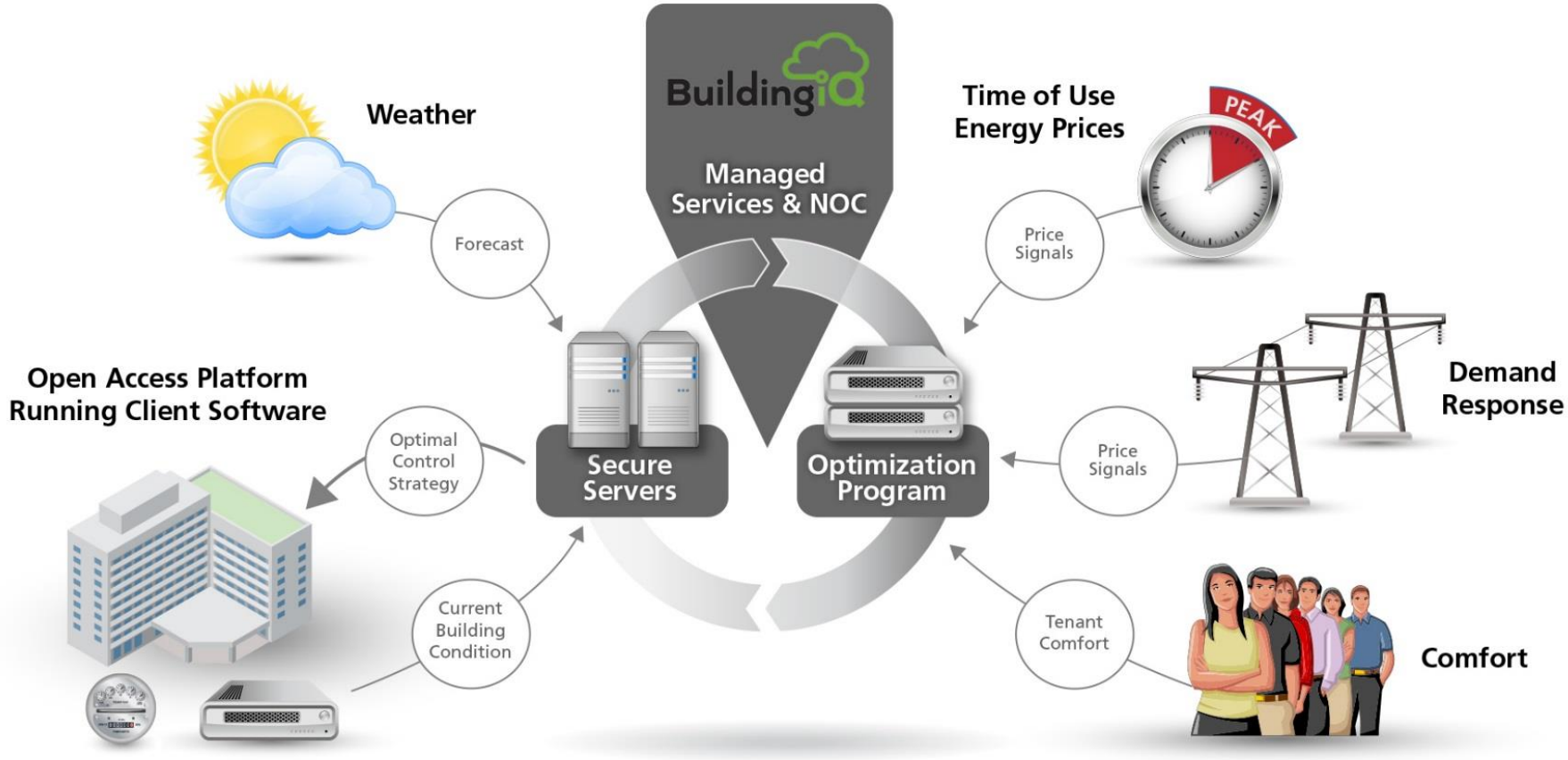
MathWorks

25% cost reduction

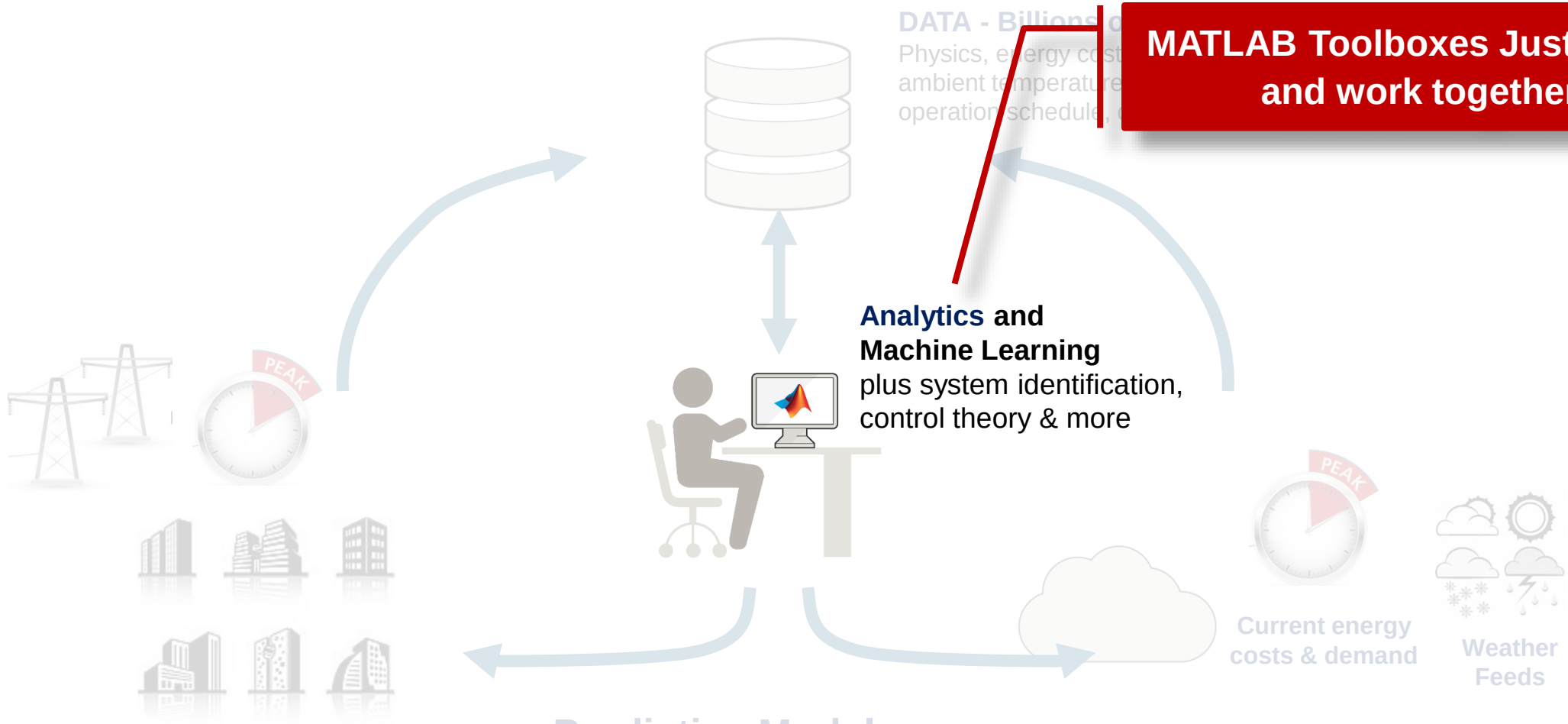


Example – BuildingIQ

Adaptive building energy management



Optimizing Energy Costs and Consumption at Building IQ



Why MATLAB?

MATLAB Impeccable Numerics for Trusted Results

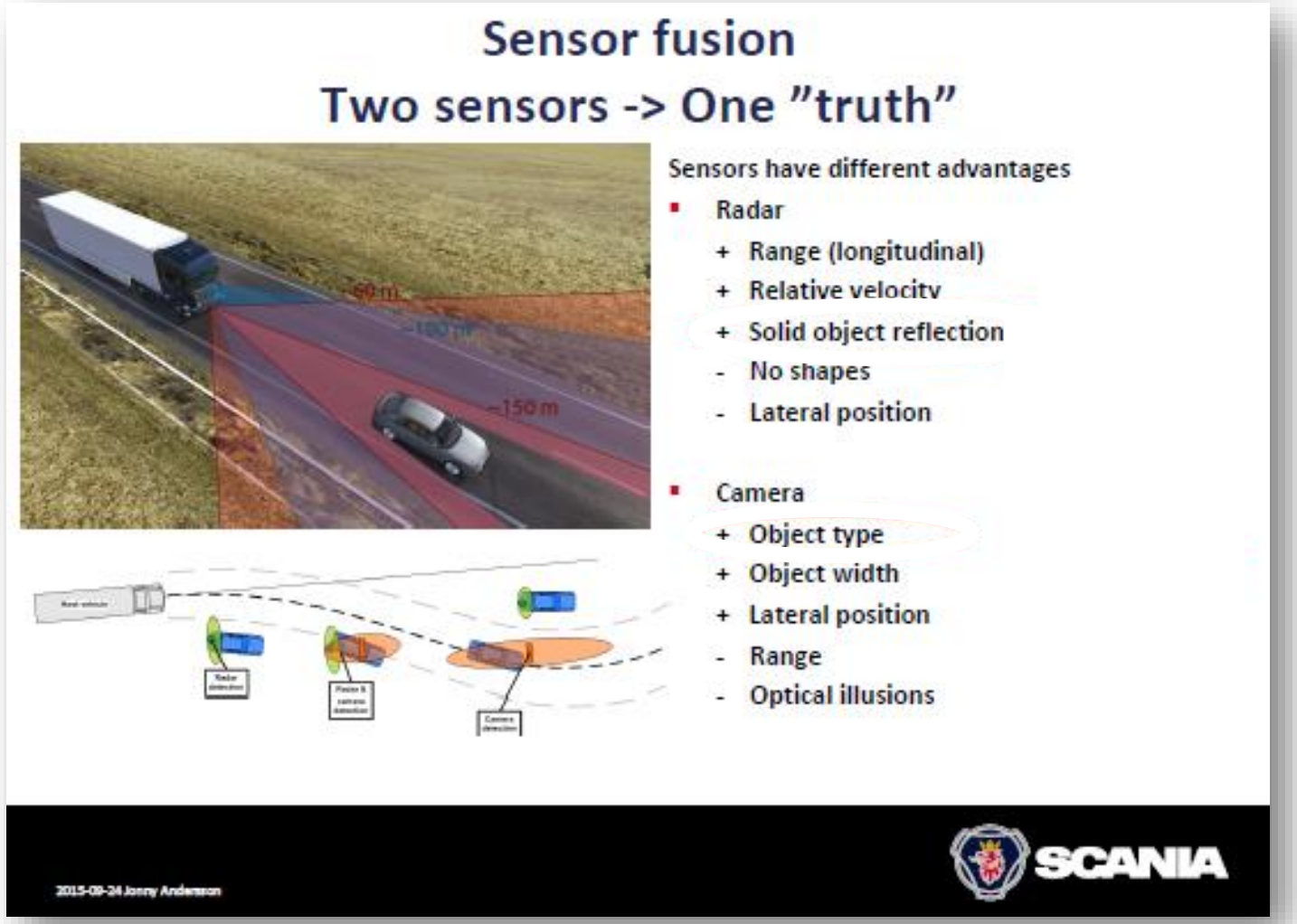
- **Robust numerical algorithms**
- Extensive visualization and analytics tools
- Industry-robust and **reliable mathematical optimization** routines
- Good object-oriented framework
- Ability to interface with Java (for backend work)
- Running MATLAB in the cloud in **production**
- Unit-testing framework

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

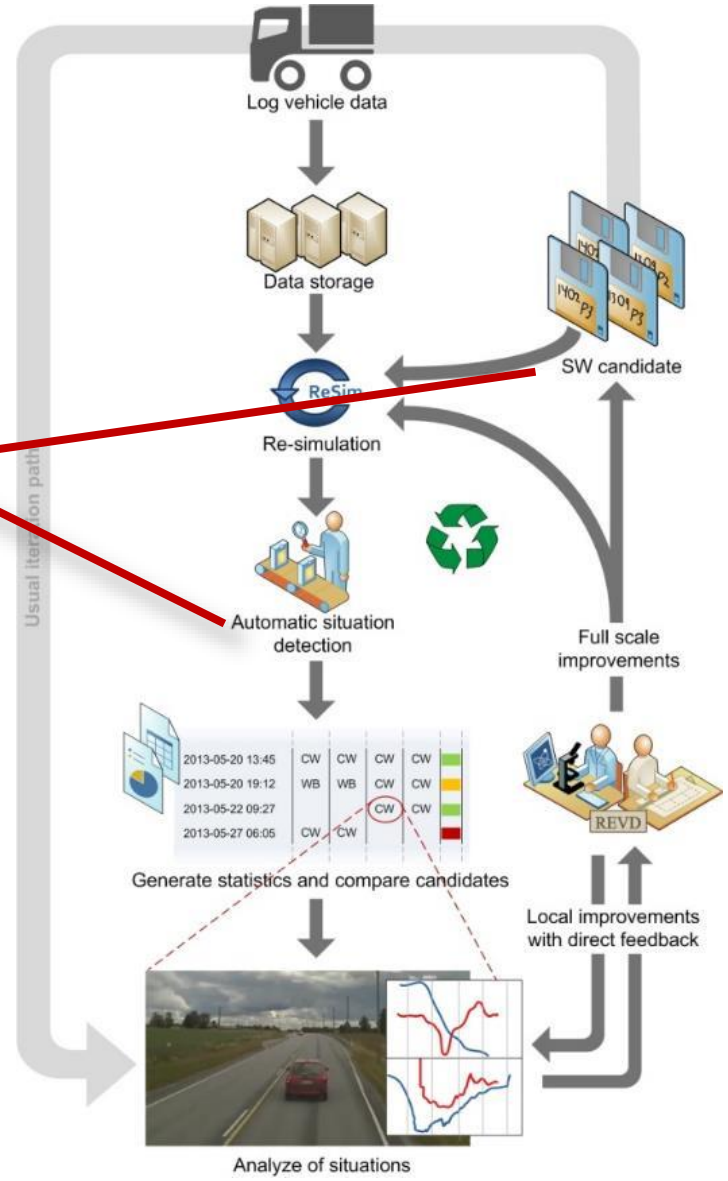


50 km/h - sudden brake

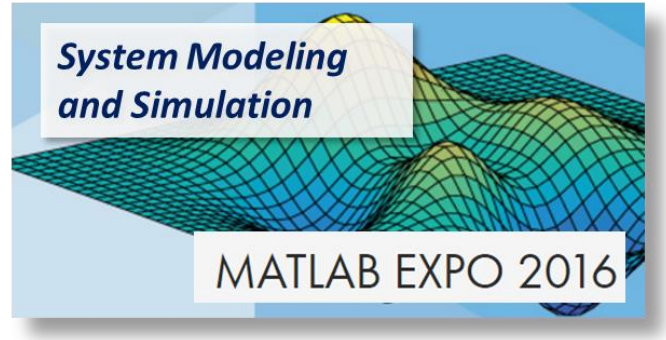
Using Model-Based Design

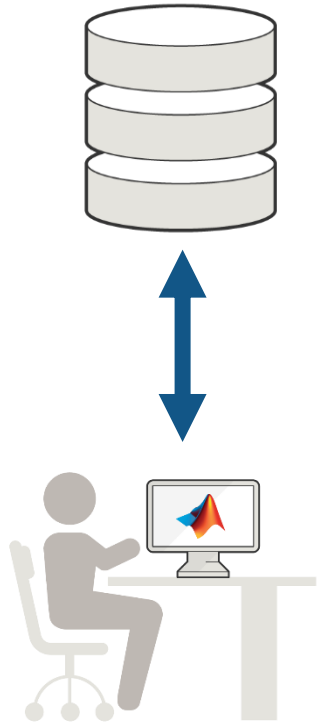
to build and deploy the analytics in an embedded control system

MATLAB Integrates Analytics and Model-Based Design



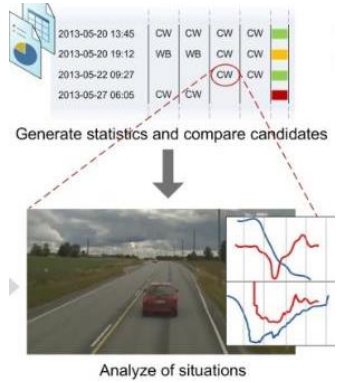
Implementing Sensor Fusion at Scania





Machine learning
to develop fusion algorithms
for situation detection

Vehicle logs
of video and radar data



Predictive Model
deployed on vehicle

Automotive

Off-highway vehicles

Aeronautics

The Rise of Engineering-Driven Analytics

Retail

Finance

Healthcare management

Internet

Industrial Automation

Oil & Gas

Medical Devices

Clean Energy

Predictive Maintenance for polymer-based production machines

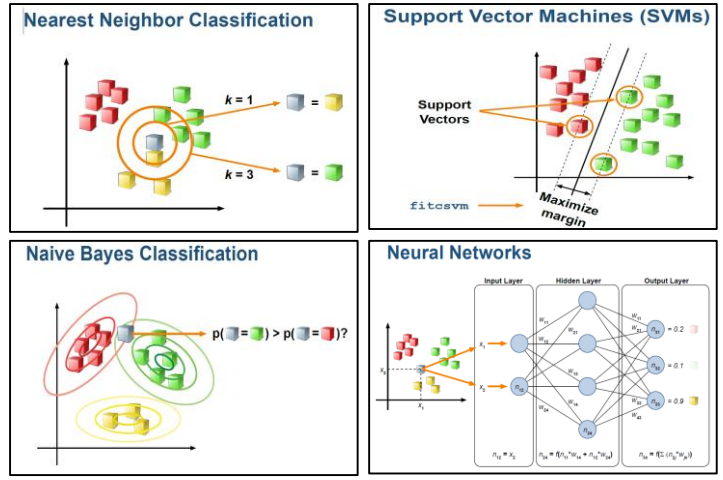
Sensor Data (~1 minute)

10-100 sensors/machine

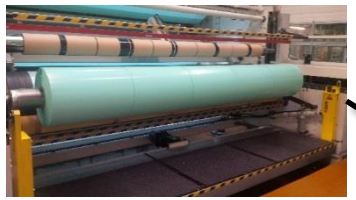
Quality State (~40 minutes)

1 TIMESTAMP	2 PARAMETER										3 STATE
'2015-07-14 00:49:12.0'	160	160	160	160	1000	7	1000	9	33	32	1
'2015-07-14 00:50:12.0'	160	160	160	160	1000	8	1000	10	33	32	1
'2015-07-14 00:51:13.0'	160	160	160	160	1000	8	1000	10	33	32	1
'2015-07-14 00:52:12.0'	160	160	160	160	1000	8	1000	10	33	32	1
'2015-07-14 00:53:12.0'	160	160	160	160	1000	8	1000	11	33	32	2
'2015-07-14 00:54:12.0'	160	160	160	160	1000	8	1000	12	33	32	2
'2015-07-14 00:55:12.0'	160	160	160	160	1000	8	1000	10	33	32	2

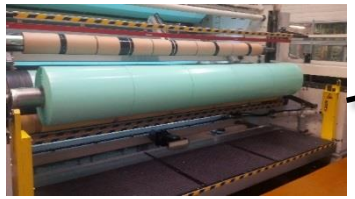
Classification using Statistics, Machine Learning, and Neural Networks



Deployment – a MATLAB App used by machine operators



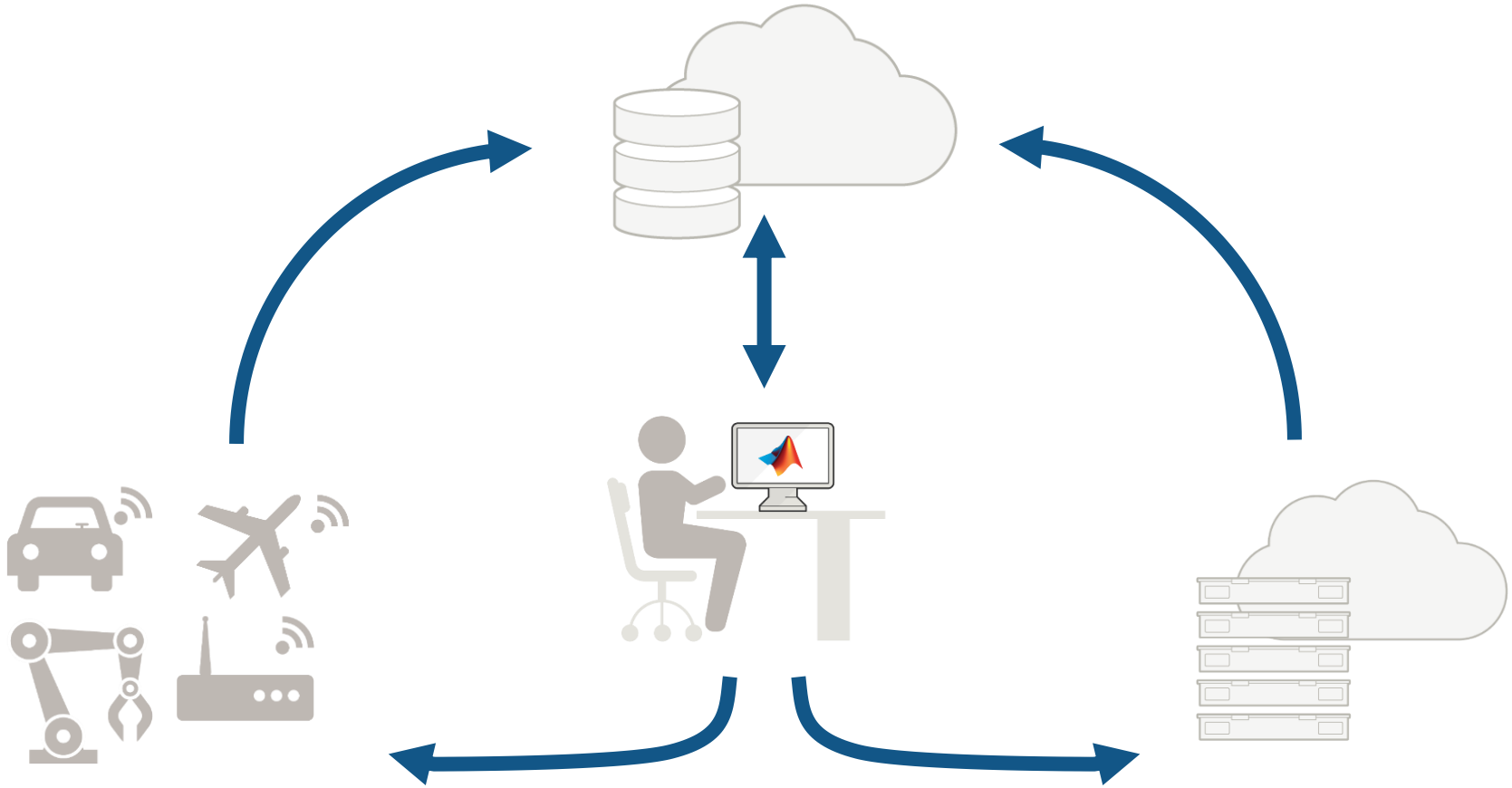
M153



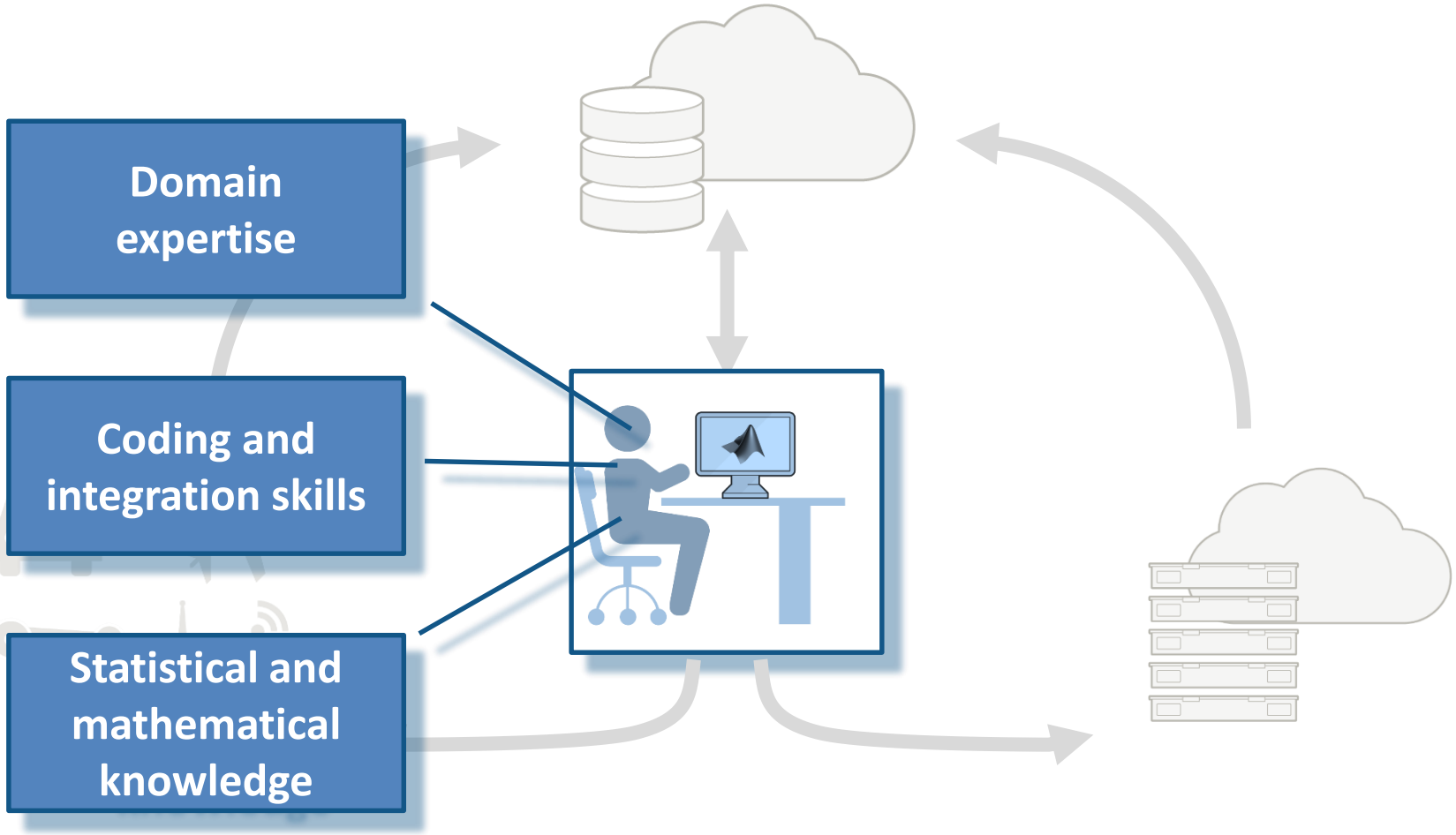
M157

State NOT OK

State OK



The need for data scientists

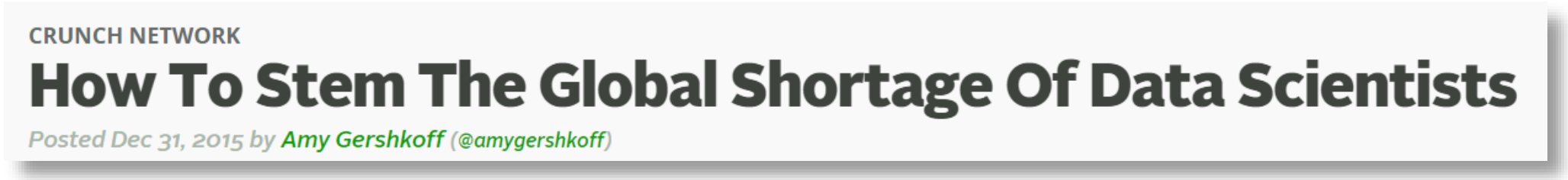


Essential Guide

IoT analytics guide: Understanding Internet of Things data

A comprehensive collection of articles, videos and more, hand-picked by our editors

Shortage of data scientists, big data pros vexes IoT efforts


CRUNCH NETWORK

How To Stem The Global Shortage Of Data Scientists

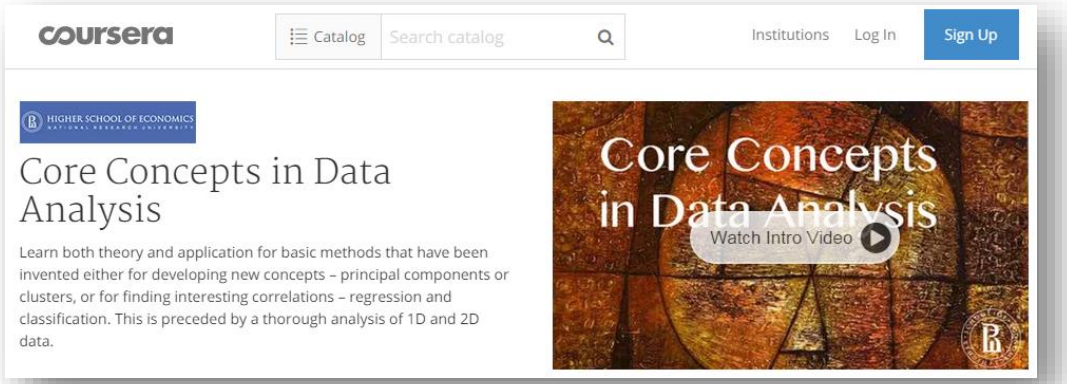
Posted Dec 31, 2015 by Amy Gershkoff (@amygershkoff)

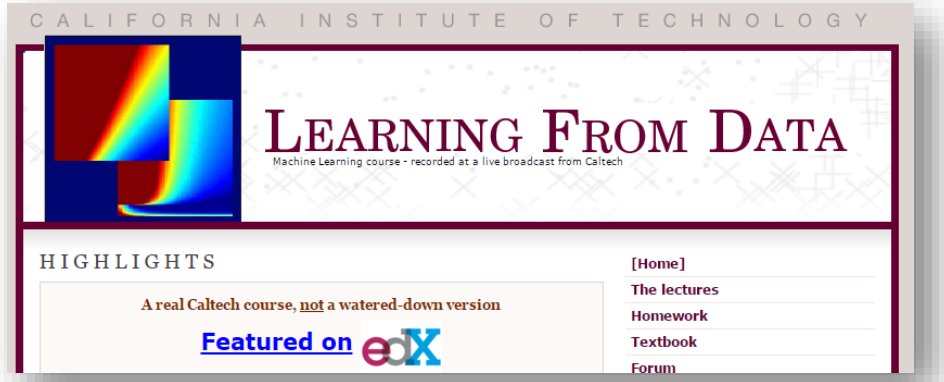
Big data talent shortage: How to bridge the gap?

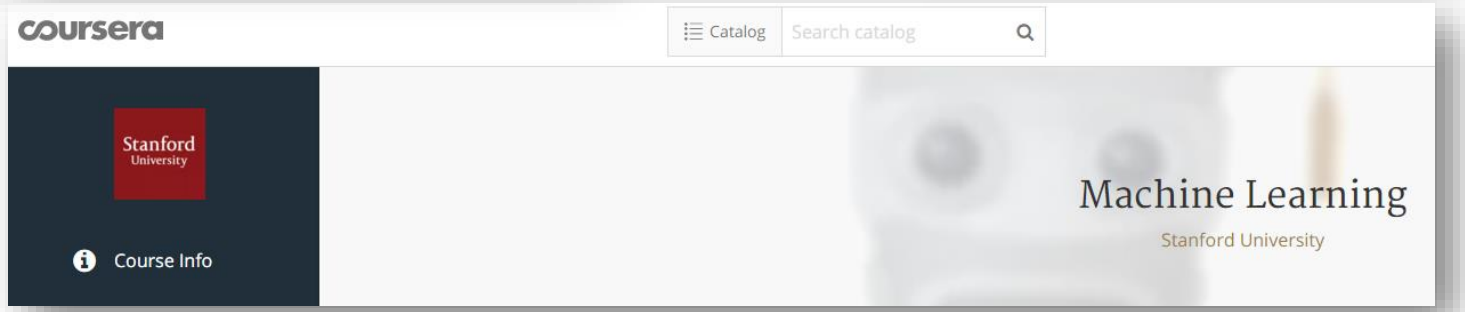
By Abhishek Raval on May 29, 2015

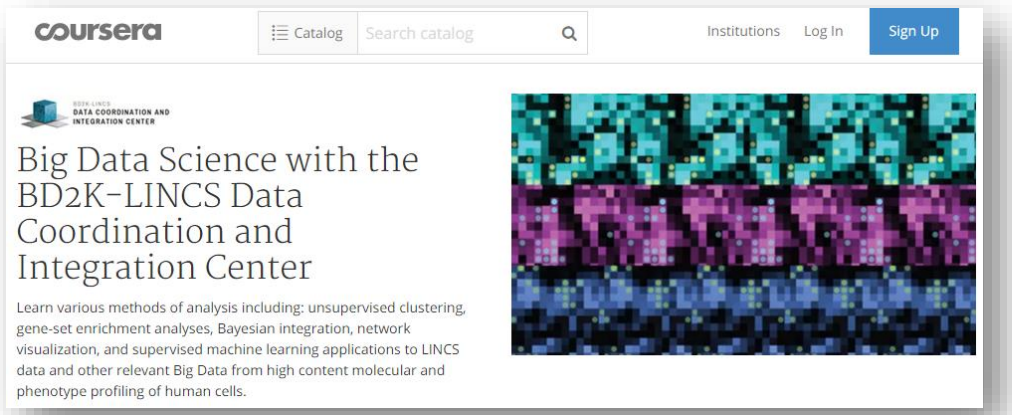
What they say

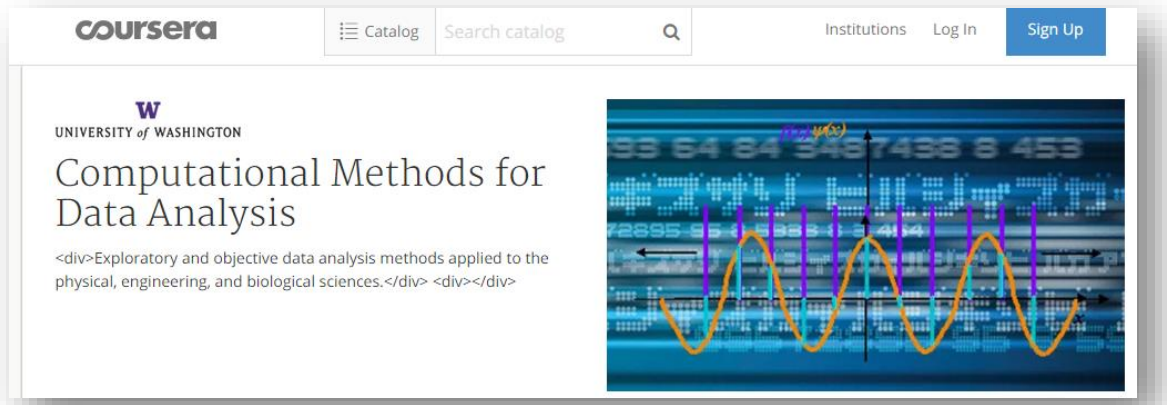
- Expand university programs
- Train existing analysts


coursera
Catalog
Search catalog
Institutions
Log In
Sign Up
HIGHER SCHOOL OF ECONOMICS
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.
Core Concepts in Data Analysis
Watch Intro Video


CALIFORNIA INSTITUTE OF TECHNOLOGY
LEARNING FROM DATA
Machine Learning course - recorded at a live broadcast from Caltech
HIGHLIGHTS
A real Caltech course, not a watered-down version
Featured on edX
[Home]
The lectures
Homework
Textbook
Forum


coursera
Catalog
Search catalog
Stanford University
Course Info
Machine Learning
Stanford University

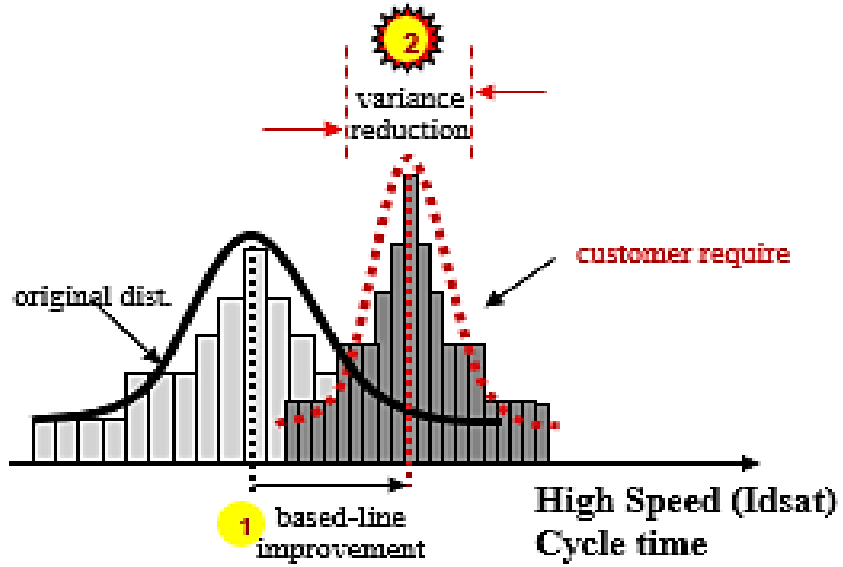

coursera
Catalog
Search catalog
Institutions
Log In
Sign Up
DATA COORDINATION AND INTEGRATION CENTER
Big Data Science with the BD2K-LINCS Data Coordination and Integration Center
Learn various methods of analysis including: unsupervised clustering, gene-set enrichment analyses, Bayesian integration, 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.


coursera
Catalog
Search catalog
Institutions
Log In
Sign Up
UNIVERSITY of WASHINGTON
Computational Methods for Data Analysis
Exploratory and objective data analysis methods applied to the physical, engineering, and biological sciences.

TSMC Student Contest

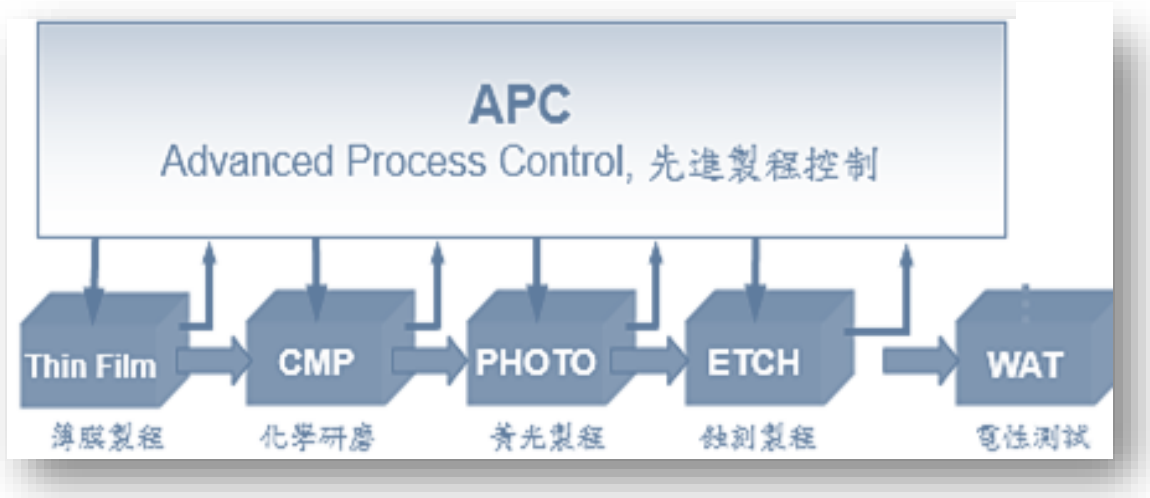
use process control data to improve semiconductor yields

- 21 teams competed
- Wafer Big Data in Hadoop
- MATLAB used by winning team ***and*** 2nd place team



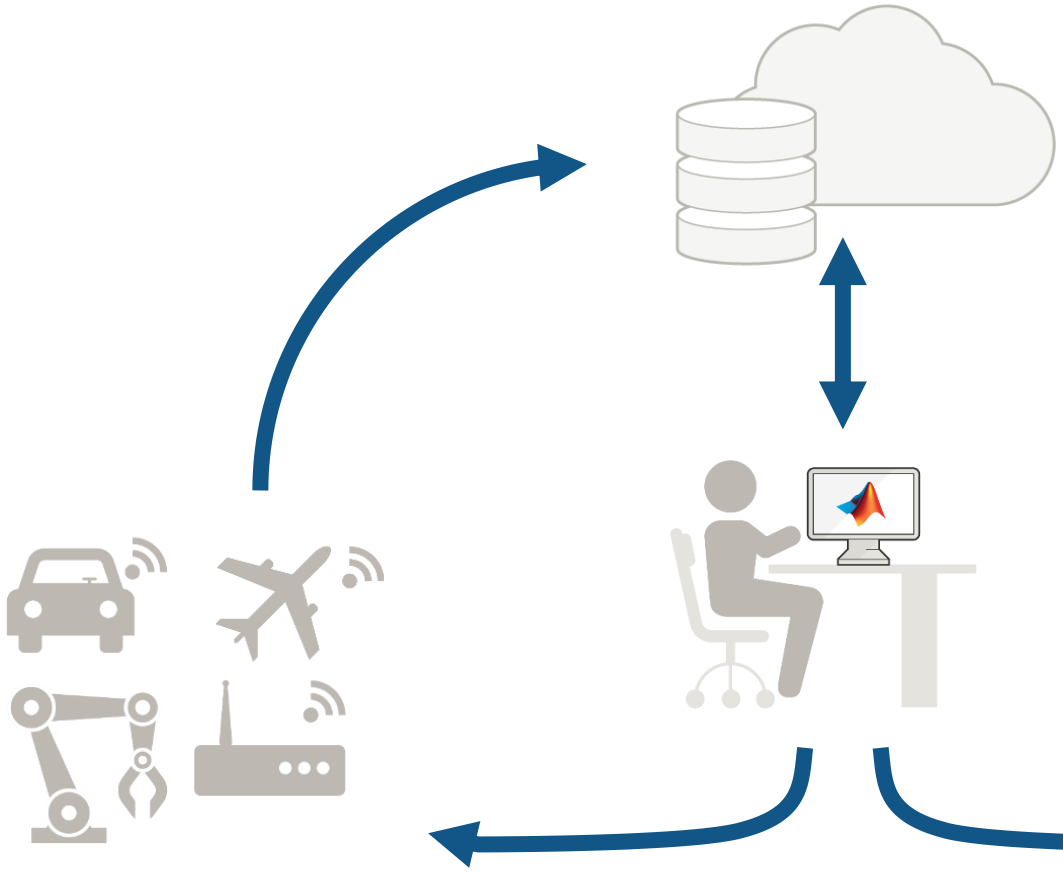
國立清華大學
NATIONAL TSING HUA UNIVERSITY

清華-台積電卓越製造中心
NTHU-TSMC Center for Manufacturing Excellence



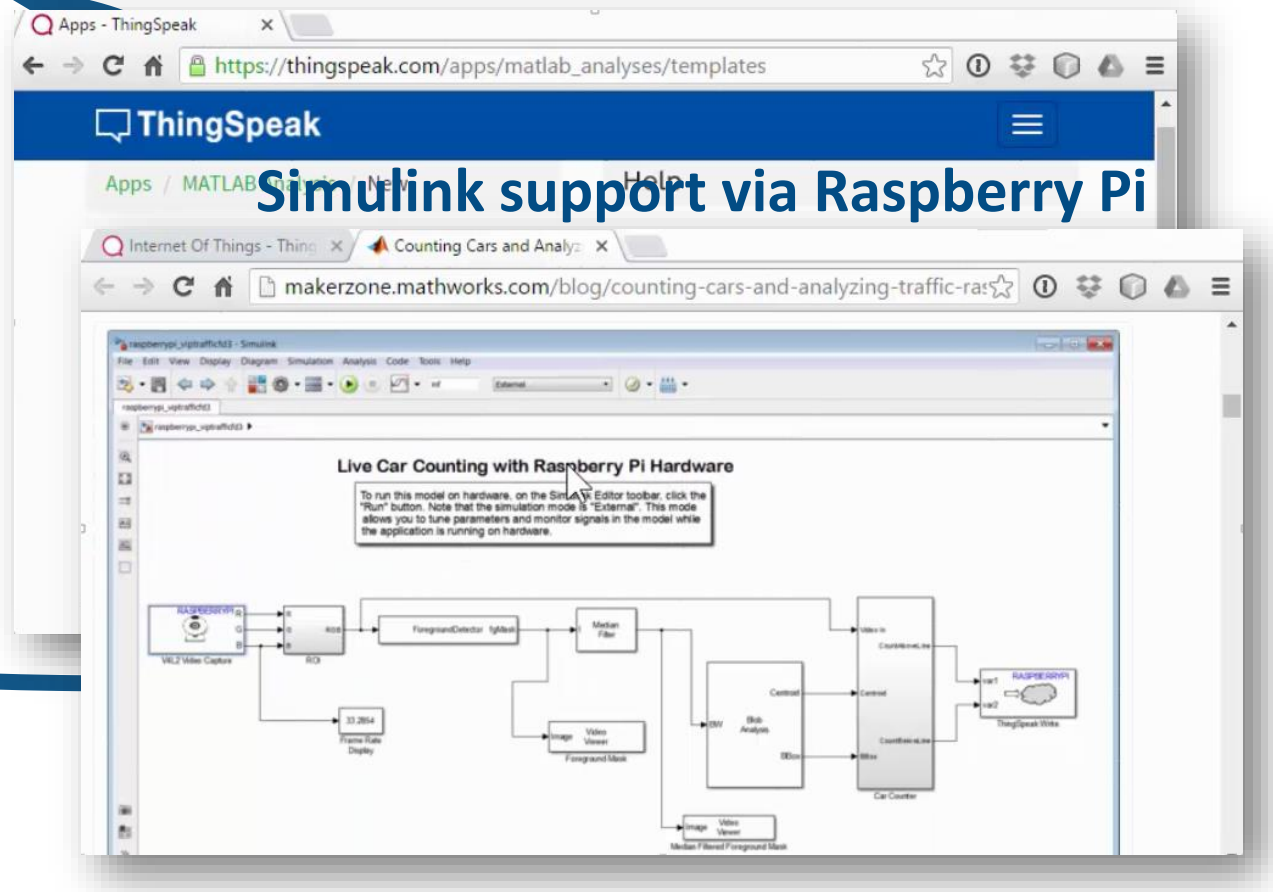
ThingSpeak

IoT open data platform for students and makers

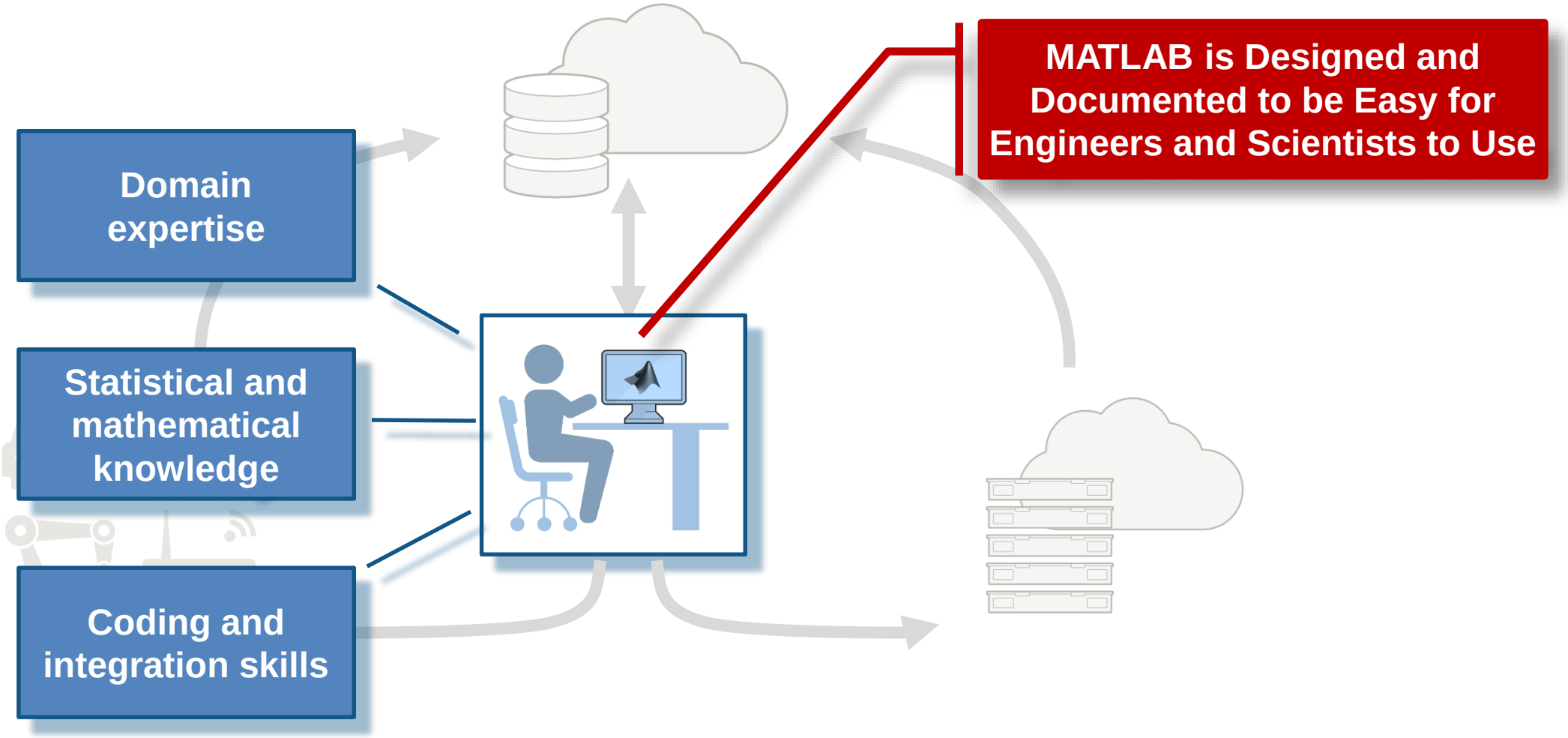


Built-in MATLAB analysis

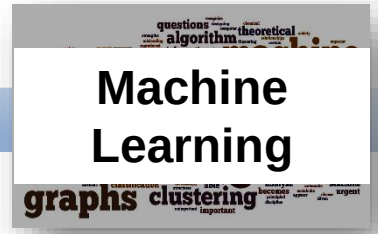
Simulink support via Raspberry Pi



MATLAB lets you be your own data scientist



Limited users, scope, & technology



Pervasive users, scope, & technology

- **Engineering**
- **Business**
- **Transactional**

- **Desktop**
  Multicore, GPU
- **Clusters**
- **Cloud computing**
- **Hadoop with Spark**

- **Neural Networks**
- **Classification**
- **Clustering**
- **Regression**
- **…and much more…**

In MATLAB

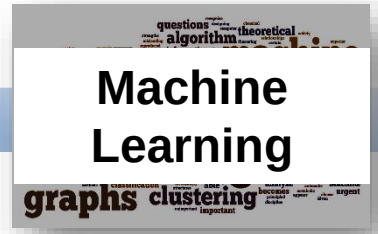
- **Native support for engineering data**
- **Database interfaces**
- **Streaming**

NEW for MATLAB

Audio System Toolbox R2016a

Vision HDL Toolbox R2015a

Limited users, scope, & technology



Pervasive users, scope, & technology

- **Engineering**
- **Business**
- **Transactional**

- **Desktop**
  Multicore, GPU
- **Clusters**
- **Cloud computing**
- **Hadoop with Spark**

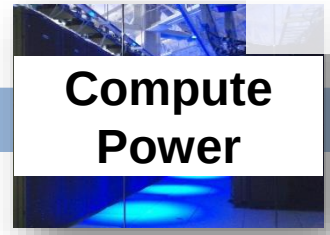
- **Neural Networks**
- **Classification**
- **Clustering**
- **Regression**

In MATLAB

- **Native support for engineering data**
- **Database interfaces**
- **Streaming**
- **Datastore**
  text, image, video, Excel files
- **Timetable, string, and tall arrays** 2016b

Limited users, scope, & technology

Big Data



Machine Learning

Pervasive users, scope, & technology

- Engineering
- Business
- Transactional

- **Desktop** Multicore, GPU
- **Clusters**
- **Cloud computing**
- **Hadoop with Spark**

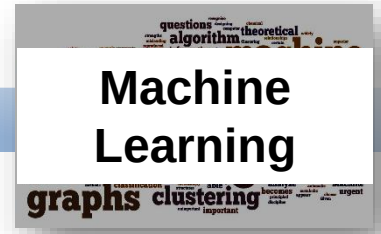
MATLAB is fast:
- **heavily optimized libraries**
- **JIT compiled**
- **takes advantage of the compute power you have**

In MATLAB

- Native support for engineering data
- Database interfaces
- Streaming
- Datastore text, image, video, Excel files
- Timetable, string, and tall arrays 2016b

- **Multicore & GPU**
- **MATLAB Distributed Computing Server and EC2 Support**
- **Hadoop with Spark support** R2016b
- **MATLAB Production Server**

Limited users, scope, & technology



Pervasive users, scope, & technology

- **Engineering**
- **Business**
- **Transactional**

- **Desktop** Multicore, GPU
- **Clusters**
- **Cloud computing**
- **Hadoop with Spark**

- **Neural Networks**
- **Classification**
- **Clustering**
- **Regression**

In MATLAB

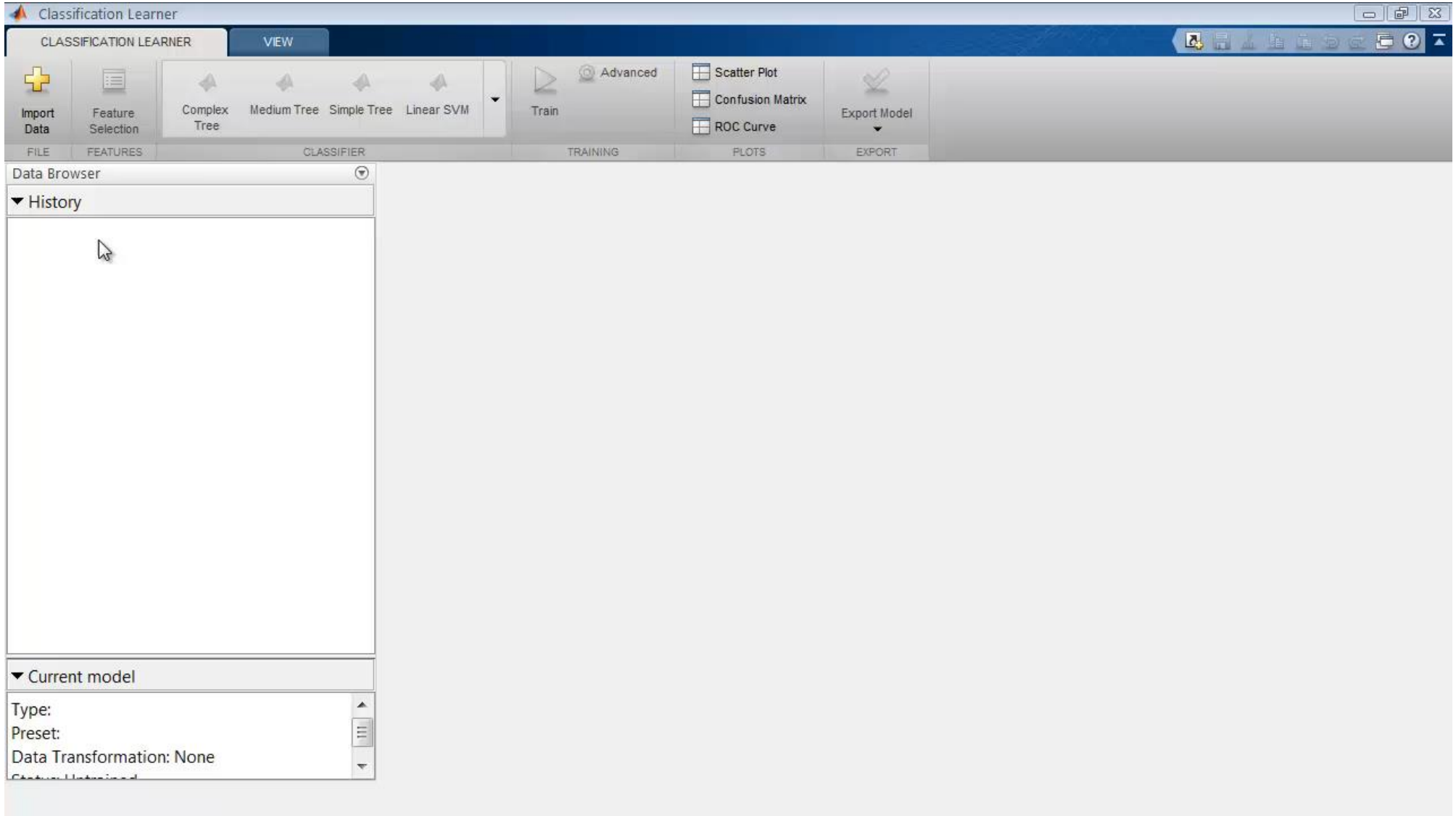
- **Native support for engineering data**
- **Database interfaces**
- **Streaming**
- **Datastore** text, image, video, Excel files
- **Timetable, string, and tall arrays** 2016b

- **Multicore & GPU**
- **MATLAB Distributed Computing Server and EC2 Support**
- **Hadoop with Spark support** R2016b
- **MATLAB Production Server**

- **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



Deep Learning with Neural Network Toolbox - New in R2016a

Object Detector using Convolutional Neural Networks

```
camera = webcam;
img = snapshot(camer

net = alexnet;
label = classify(net,img)
```

Example – cellscope®

First consumer otoscope in a mobile device using machine learning and computer vision

The Rise of Engineering-Driven Analytics

Be your own Data Scientist!