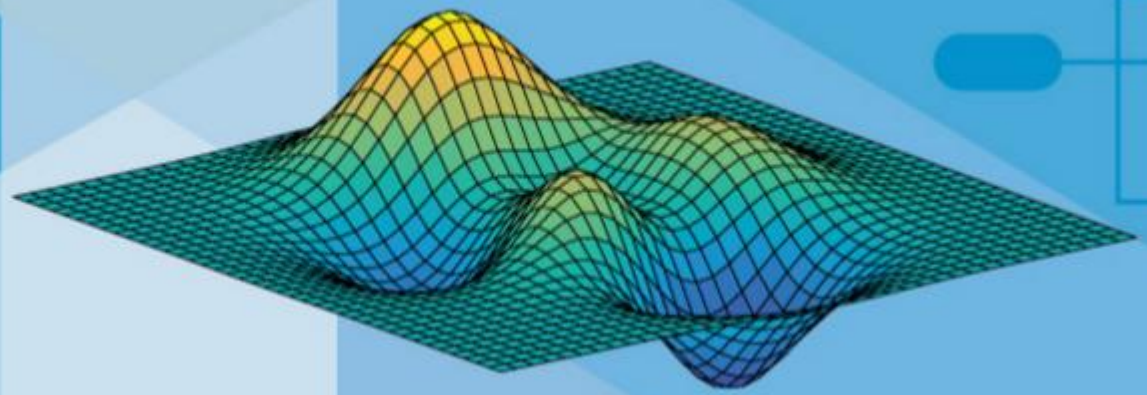
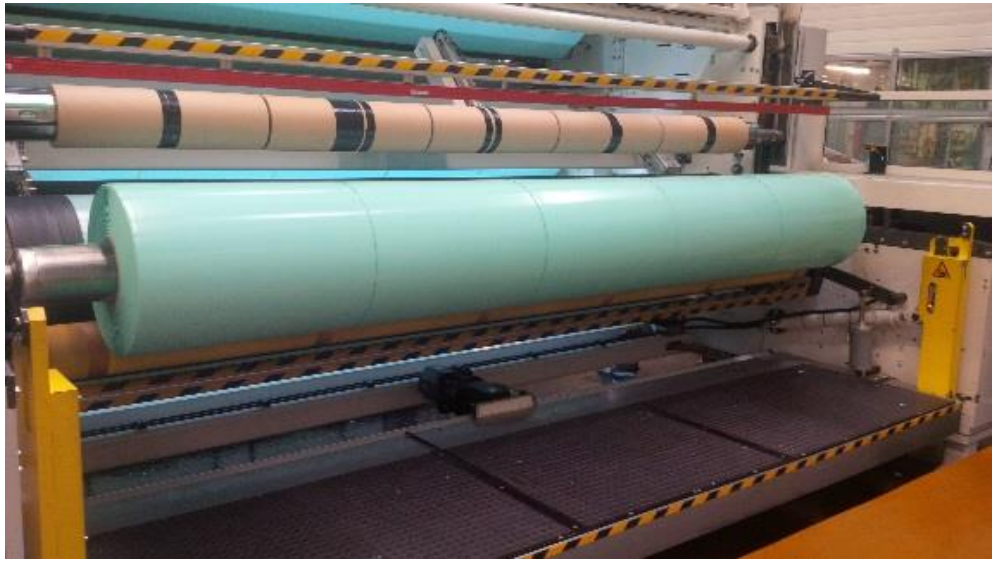


The Rise of Engineering-Driven Analytics

MATLAB EXPO 2016

David Rich
Director, MATLAB Product Marketing
MathWorks
David.Rich@mathworks.com

The Rise of Engineering-Driven Analytics



The Rise of Engineering-Driven Analytics

Analytics are now pervasive

Apply robust, statistically-motivated methods to data produced from complex systems to understand what has happened and why,

predict what will happen, and

suggest decisions or actions.

Analytics are now pervasive

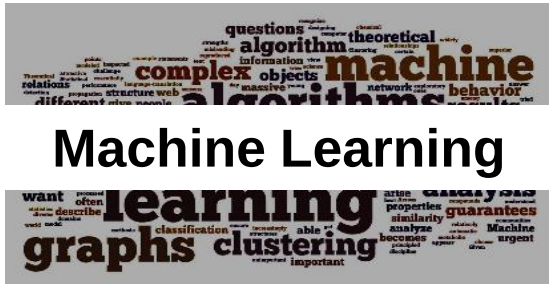
Apply robust, statistically-motivated methods to data produced from complex systems to understand what has happened and why,

predict what will happen, and

automate decisions or actions.

Big Data

Compute Power



Machine Learning

Analytics are pervasive – *Why Now?*

We have data

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

We have compute

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

We know how

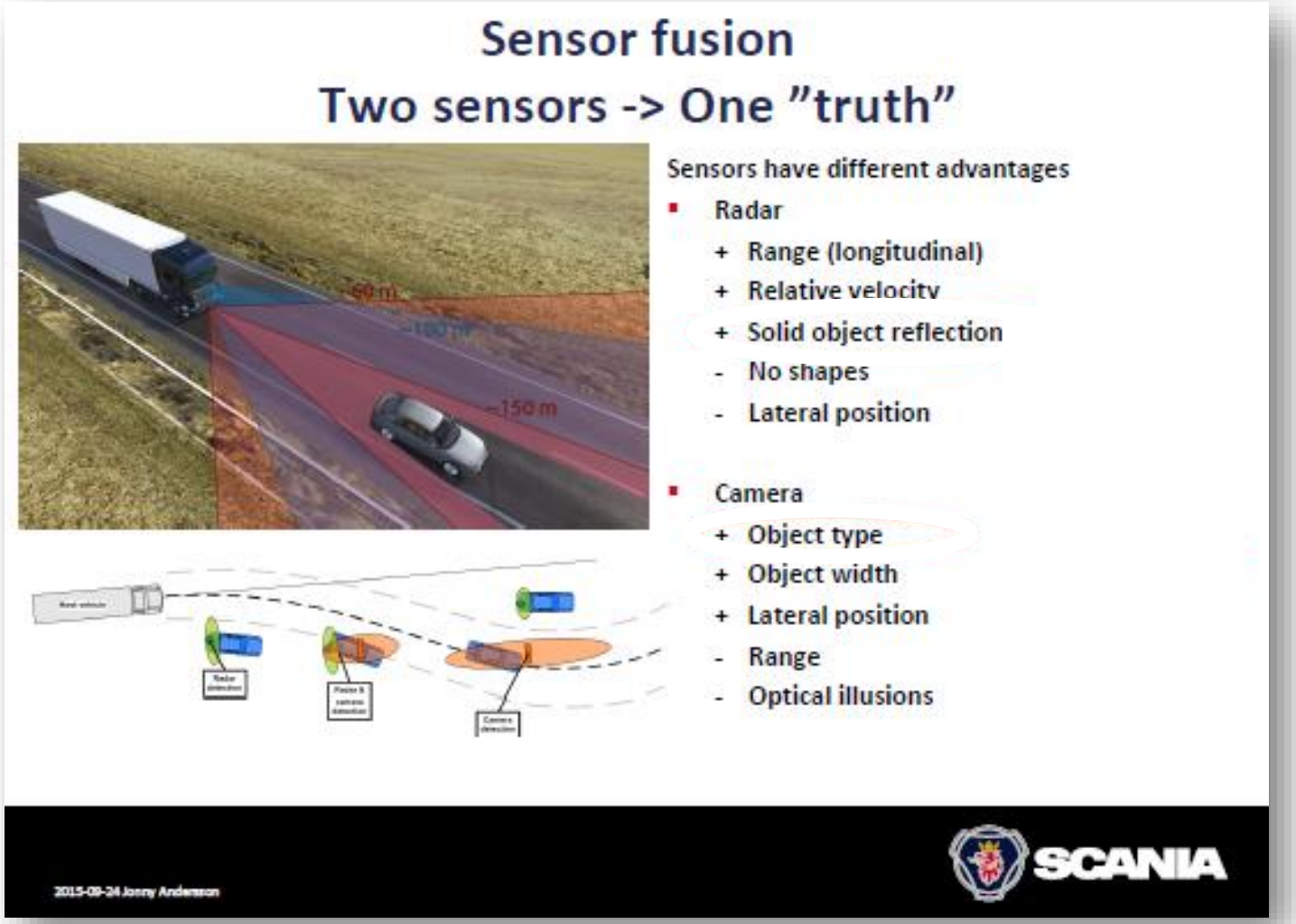
- **Neural Networks**
- **Classification**
- **Clustering**
- **Regression**
- **…and much more…**

The Rise of Engineering-Driven Analytics


50 km/h - sudden brake

Example – Scania

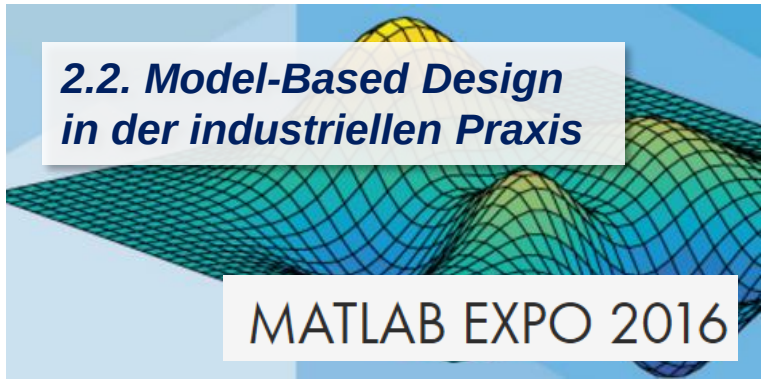
Automatic emergency braking using sensor fusion and analytics



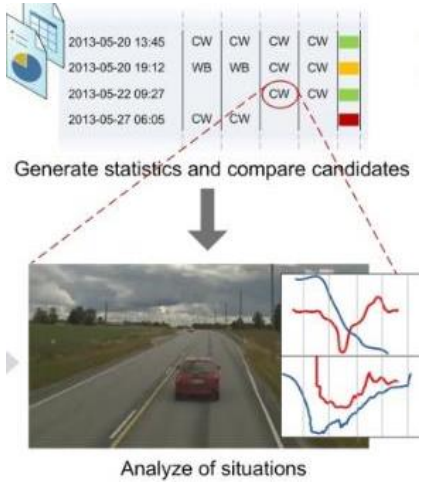
Model Based Design and Machine Learning Combined

Vehicle logs
of video and radar data

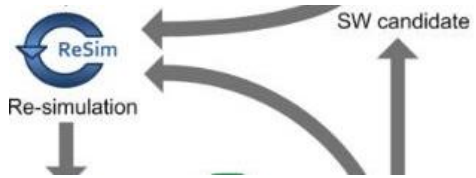
Predictive Model
deployed on vehicle



Machine learning
to develop fusion algorithms for situation detection



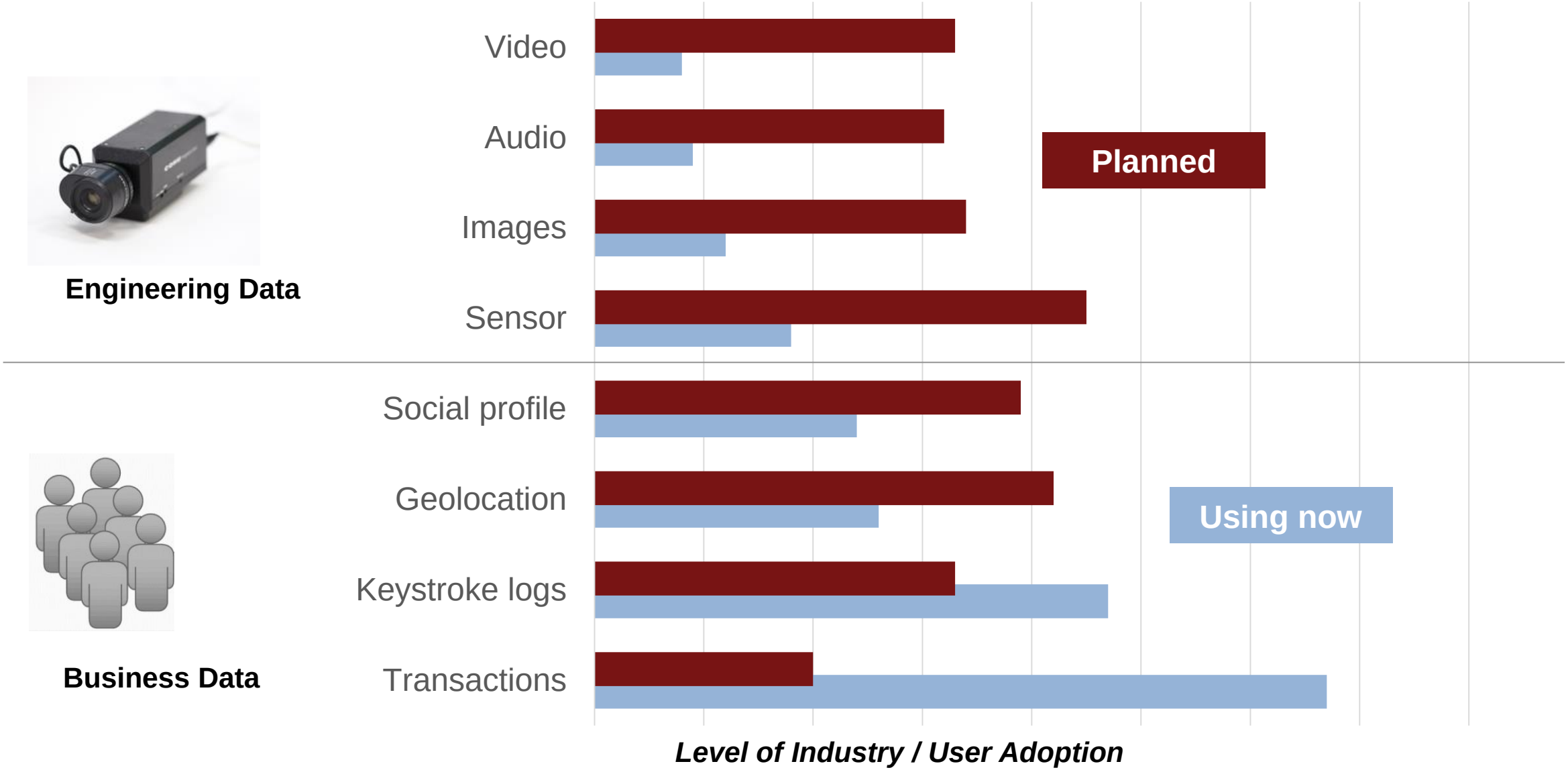
Model Based Design
to simulate, test and perfect the application



Consider the *Data* in Data Analytics

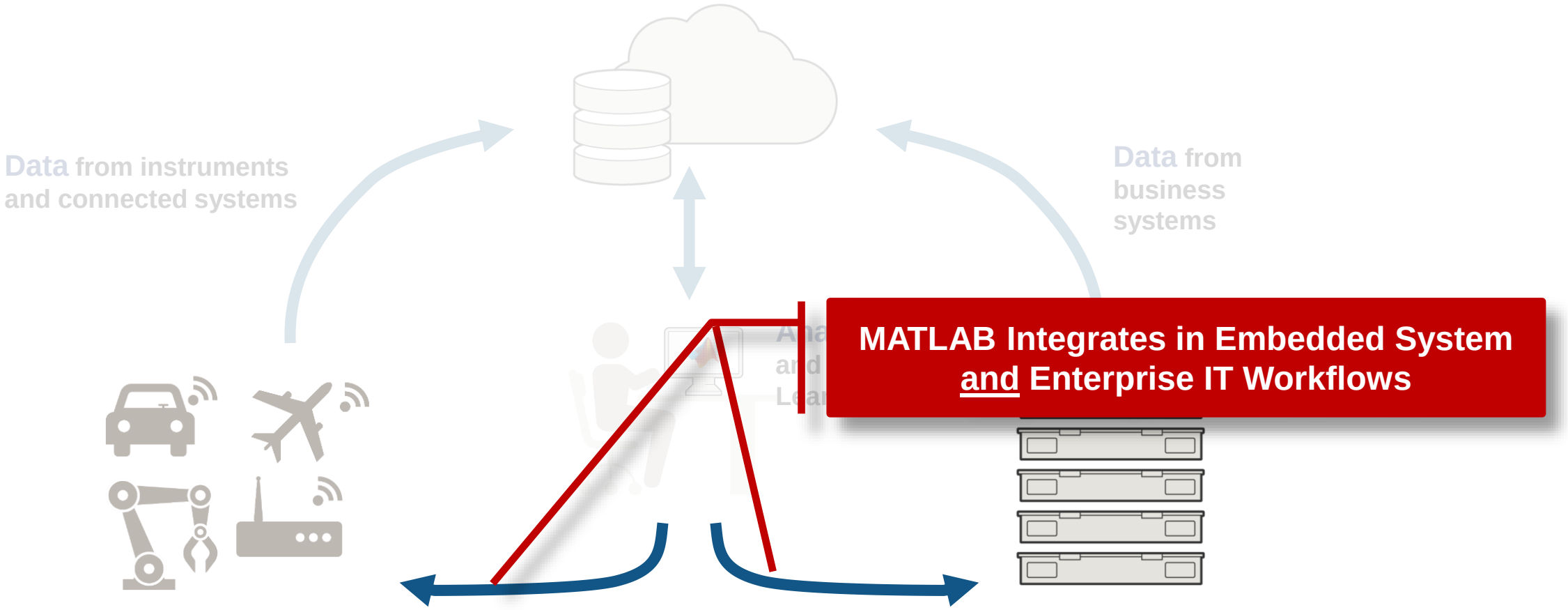
Engineering Data

Business Data



Source: Gartner Big Data Industry Insights, March 2016

Architecture of an analytics system

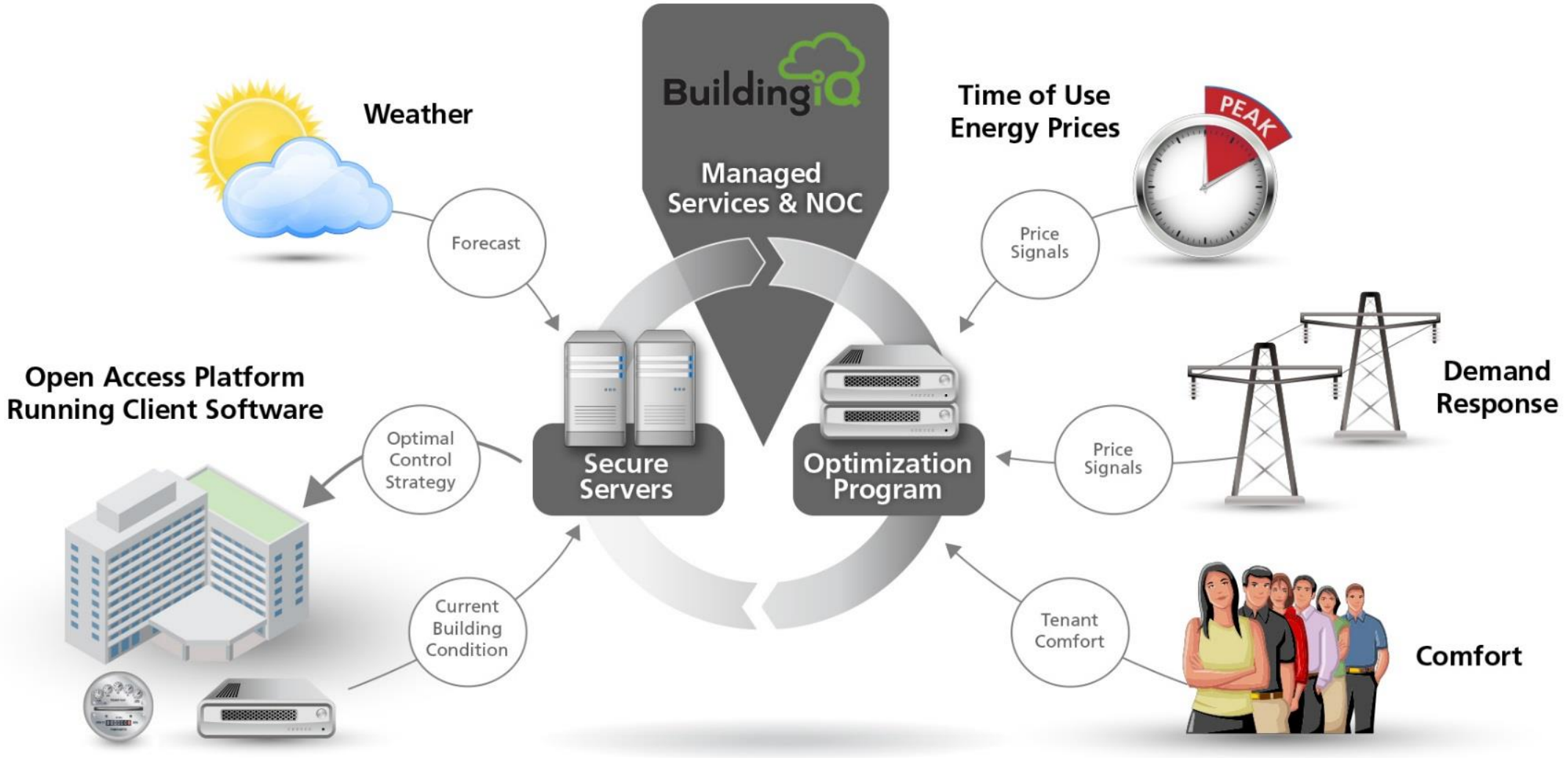


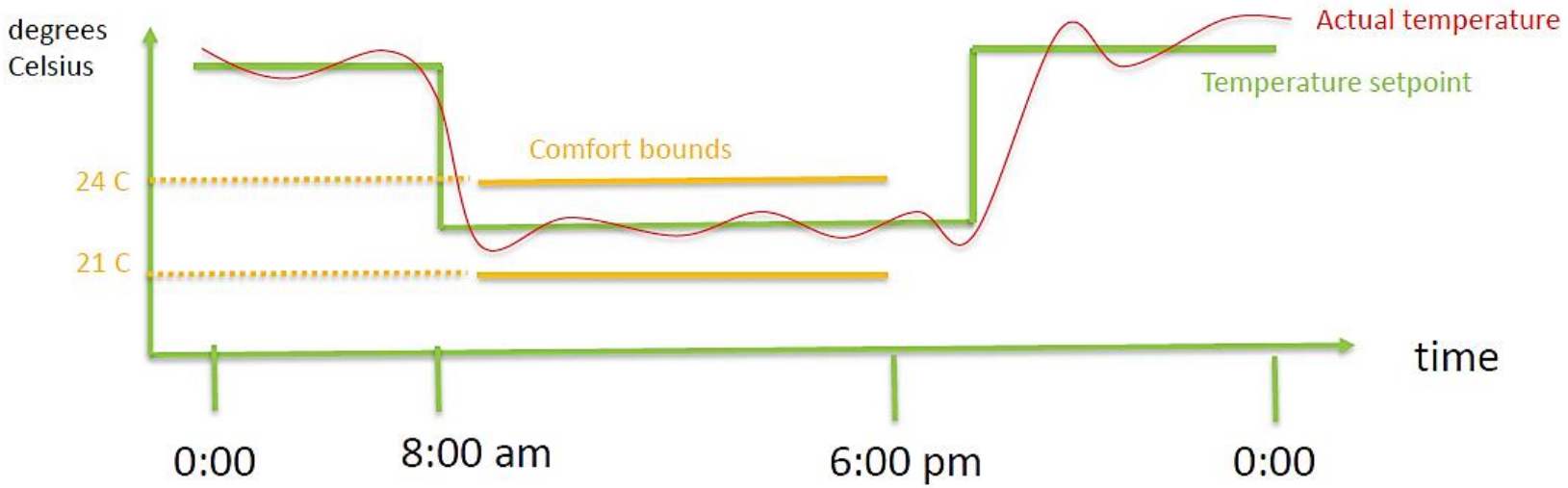
Predictive Model
deployed in smart systems using Model-Based Design

Predictive Model
deployed on cloud and business systems

Example – BuildingIQ

Adaptive building energy management

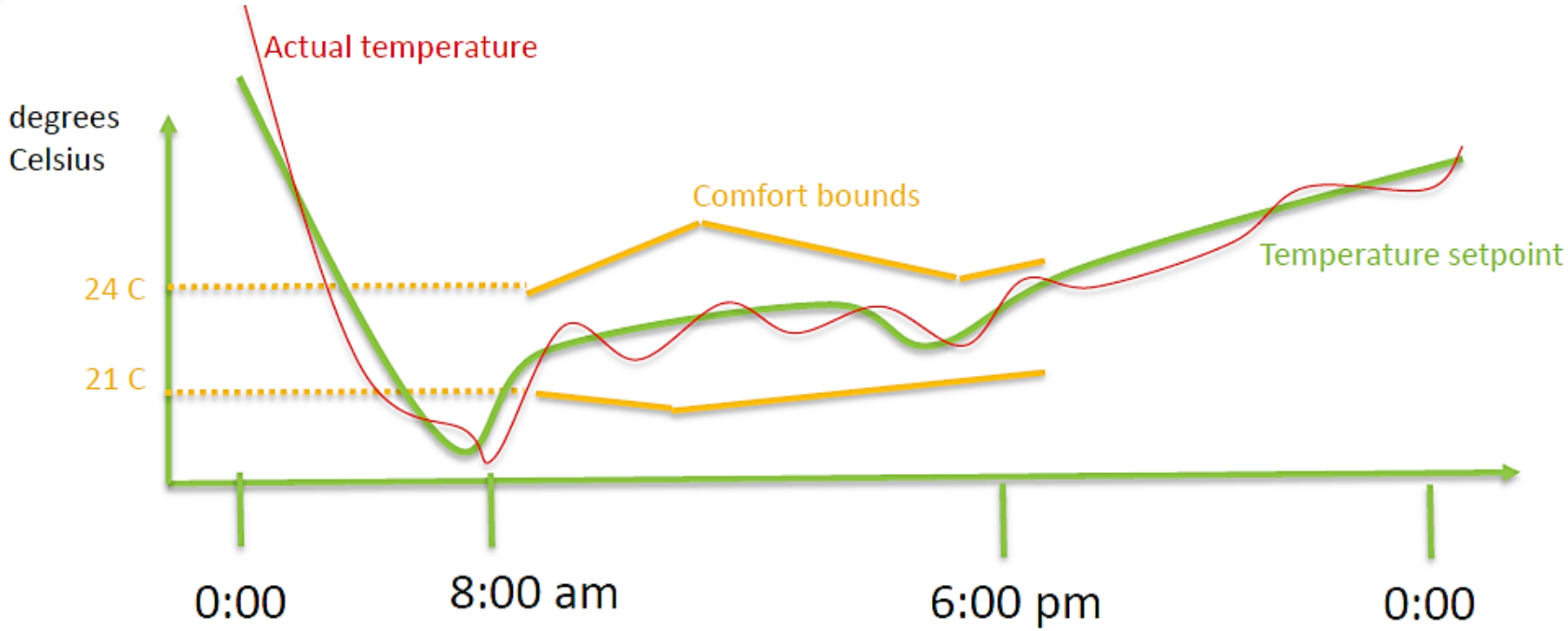


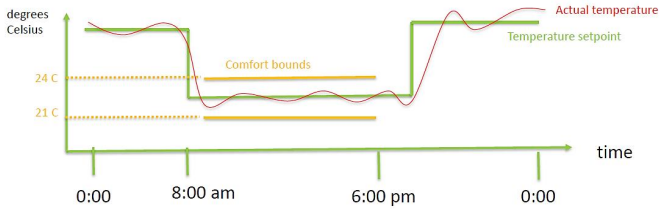

degrees
Celsius
Actual temperature
Temperature setpoint
Comfort bounds
24 C
21 C
time
0:00
8:00 am
6:00 pm
0:00

BuildingIQ

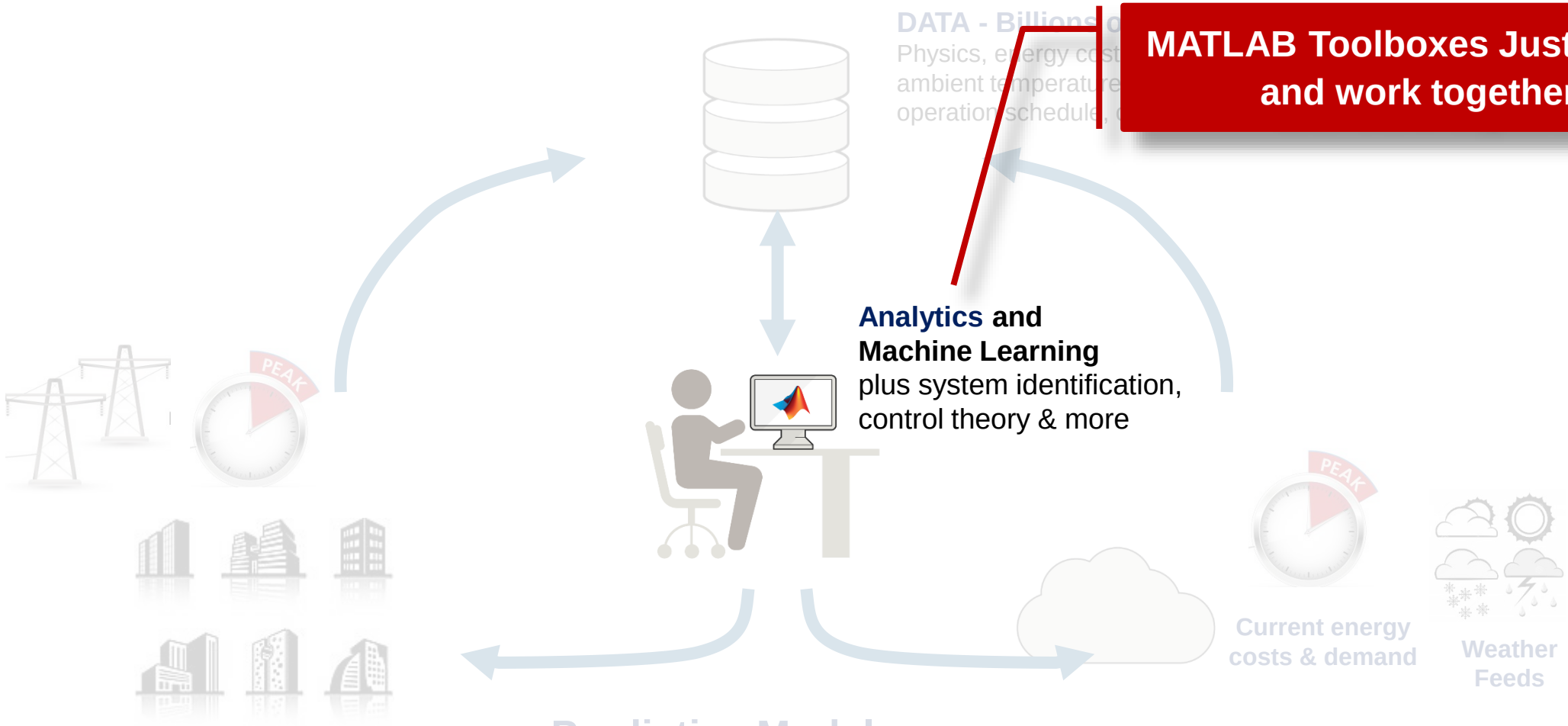
MathWorks

25% cost reduction





Real-time, closed-loop optimization algorithms



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

BuildingIQ

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

Borislav Savkovic, BuildingIQ

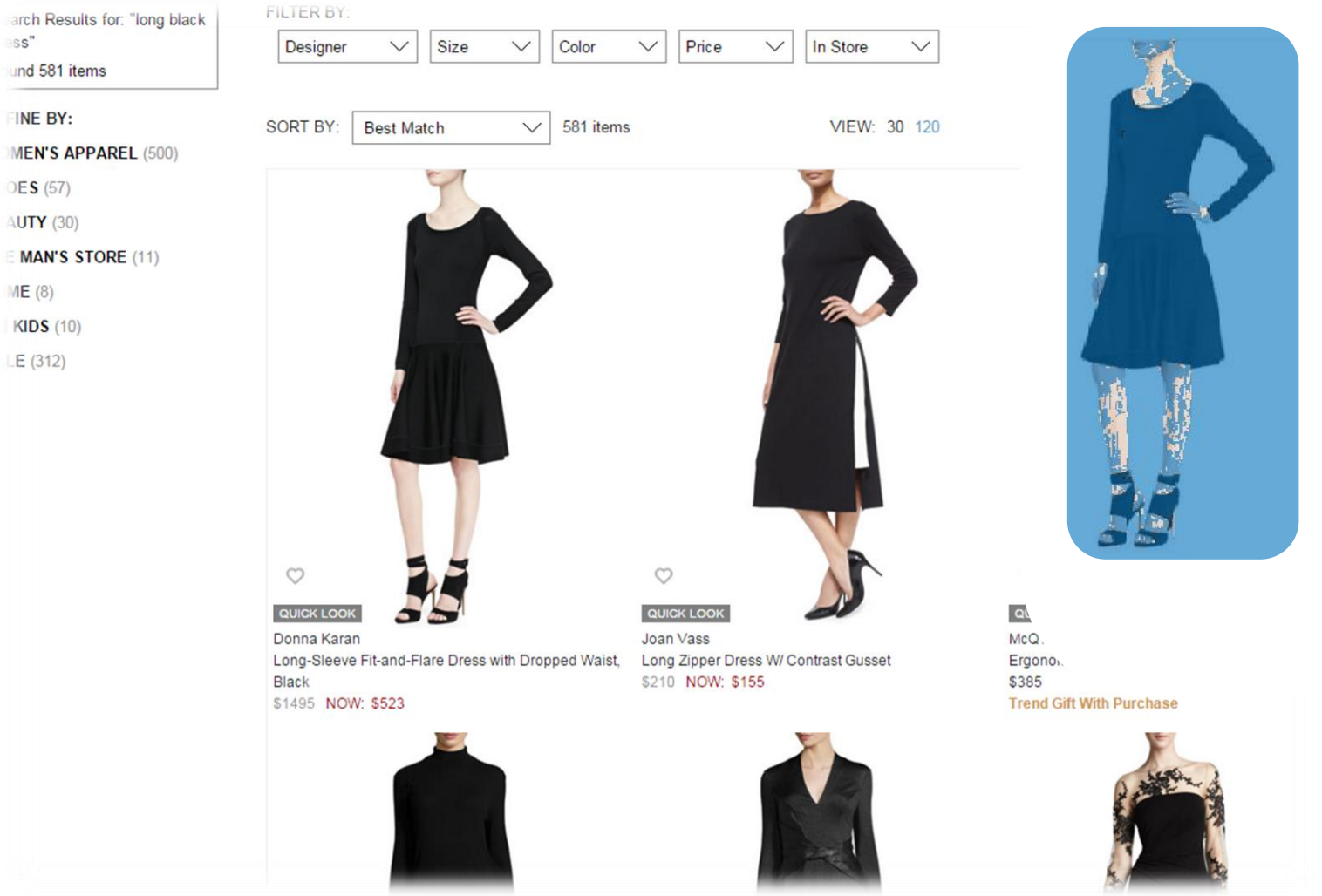
BuildingIQ

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

Borislav Savkovic, BuildingIQ

Analytics in e-commerce

Site makes recommendations using **Image Processing** techniques on the fashion photos



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

Automotive

Off-highway vehicles

Aeronautics

The Rise of Engineering-Driven Analytics

Retail

Finance

Healthcare management

Internet

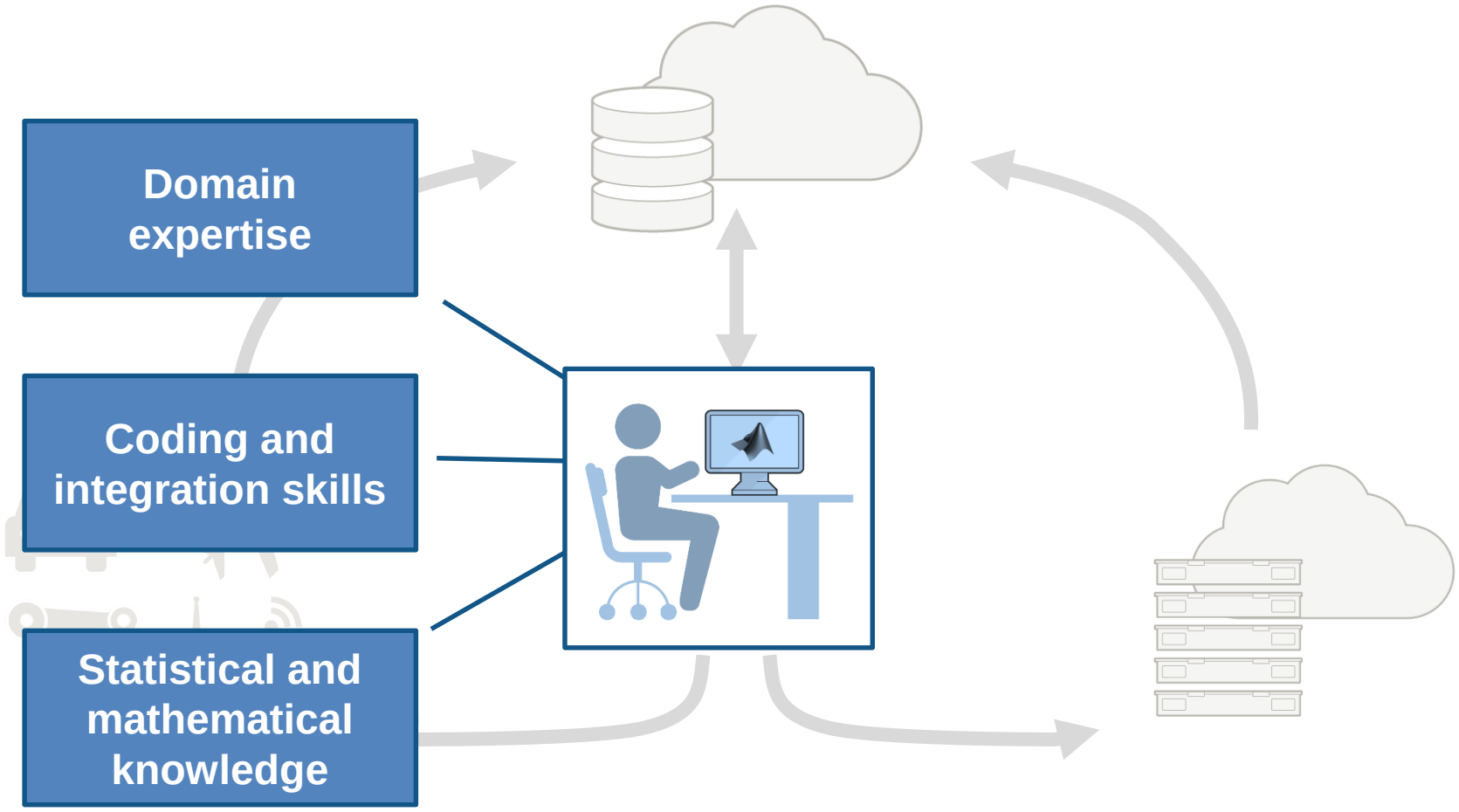
Industrial Automation

Oil & Gas

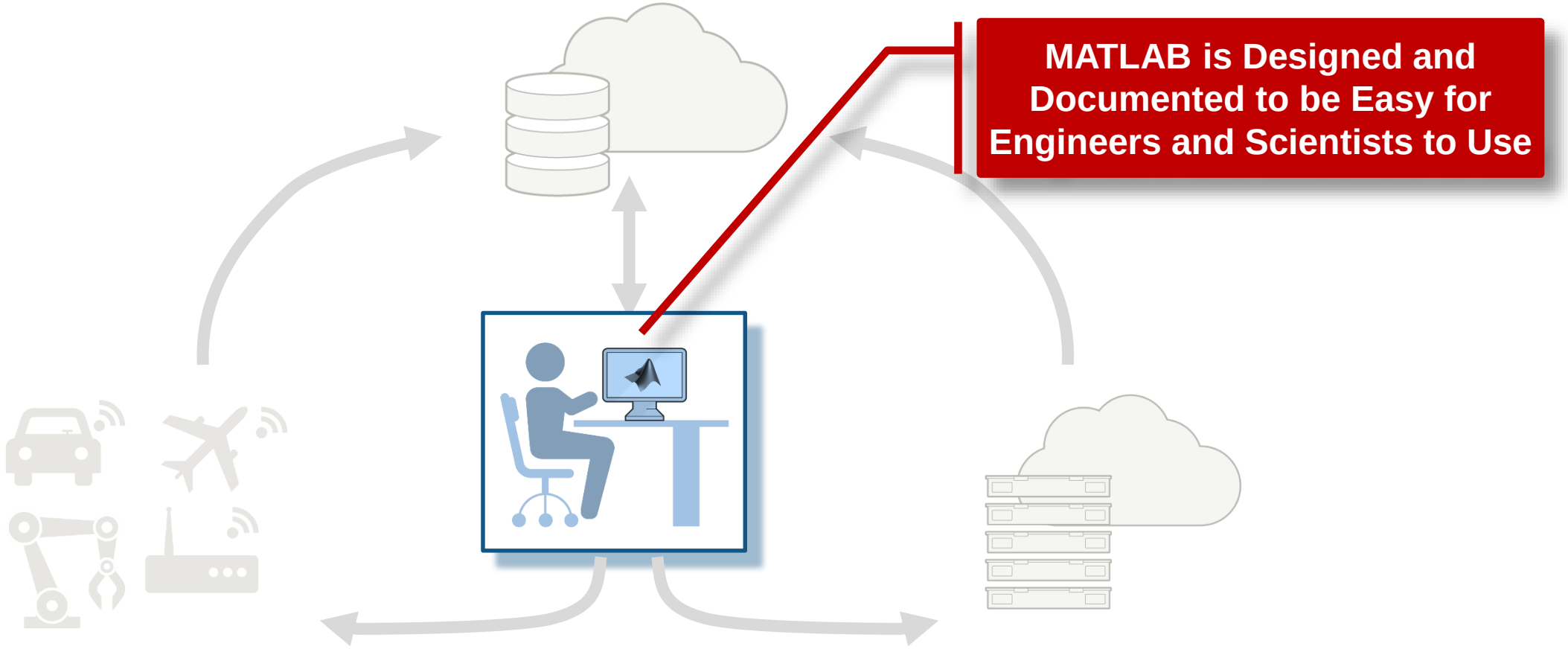
Medical Devices

Clean Energy

The Data Scientist

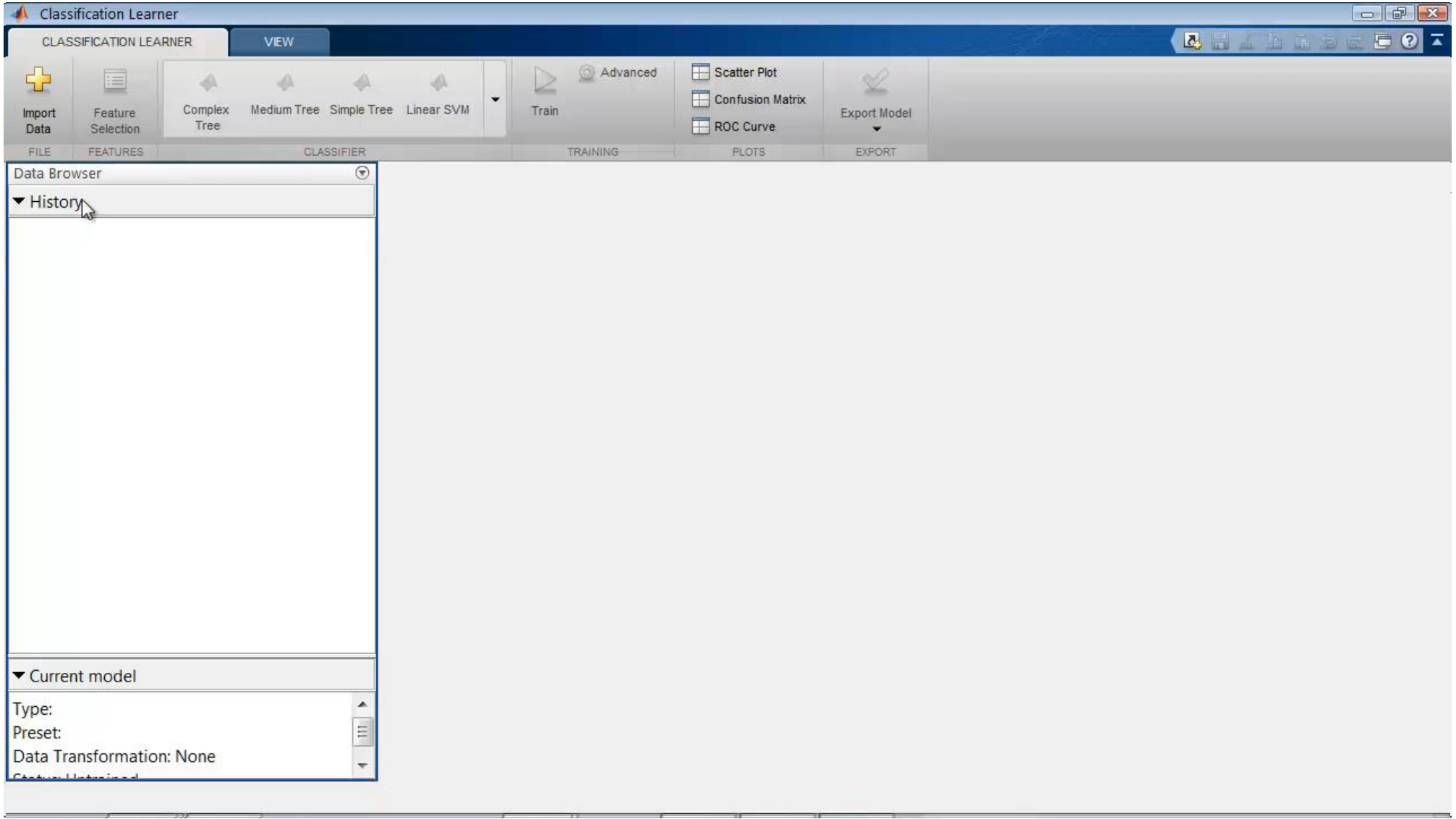


MATLAB lets you be your own data scientist



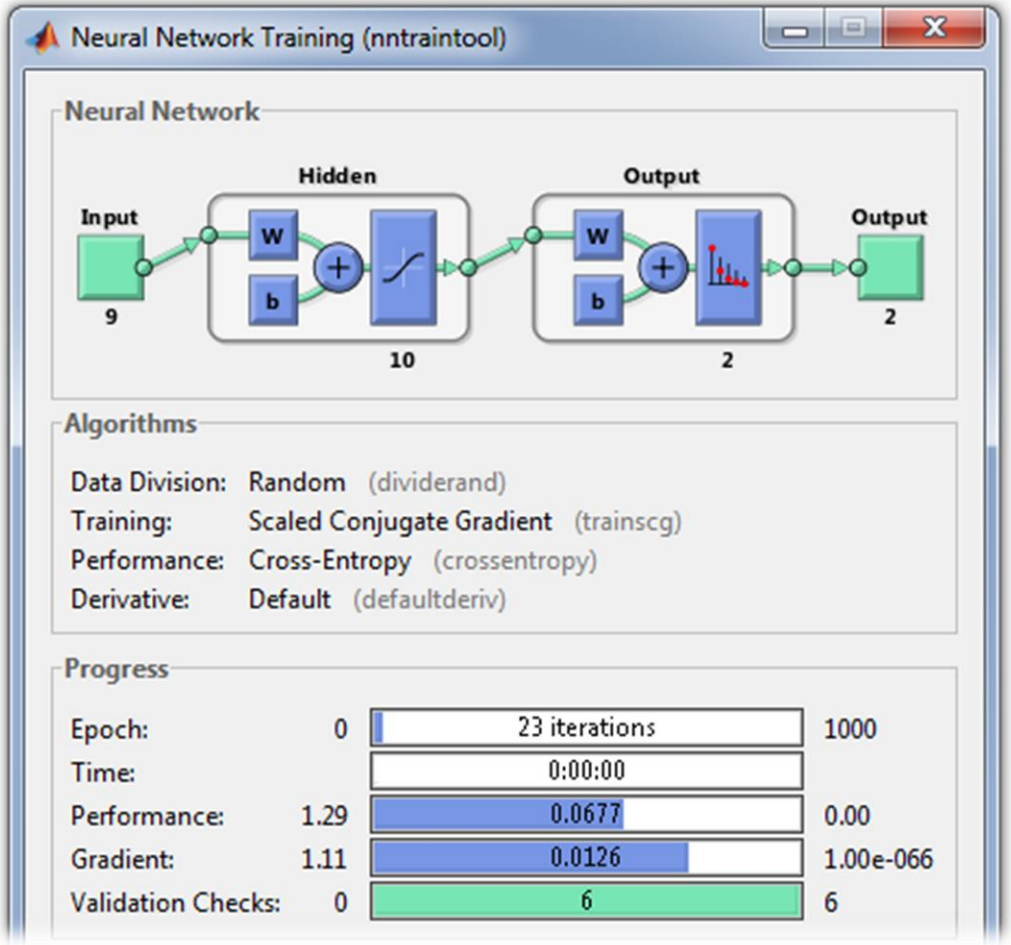
Classification Learner App

in Statistics and Machine Learning Toolbox



MATLAB Apps Enhance Productivity

- Apps help new users learn
- Save time and reduce errors by automating steps
- Remind experienced users of alternative options
- Generate code to support automation of common tasks

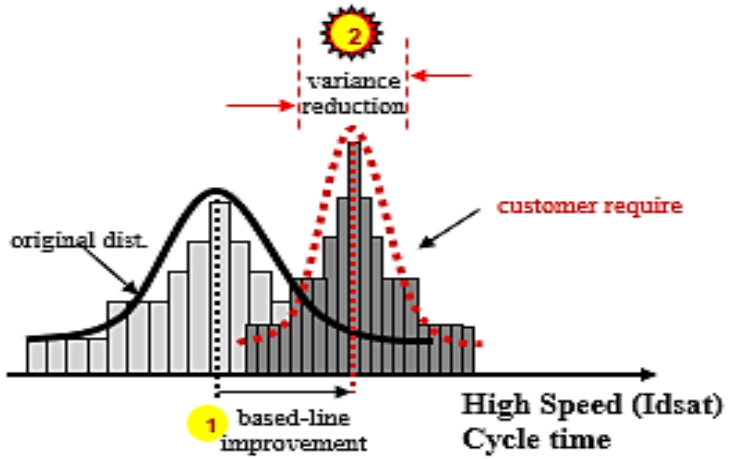


TSMC Data Analytics Student Contest

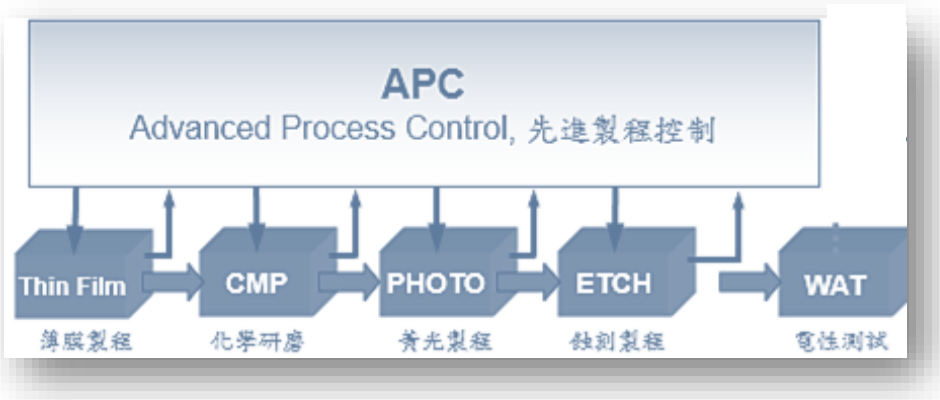
Use process control data to improve semiconductor yields

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

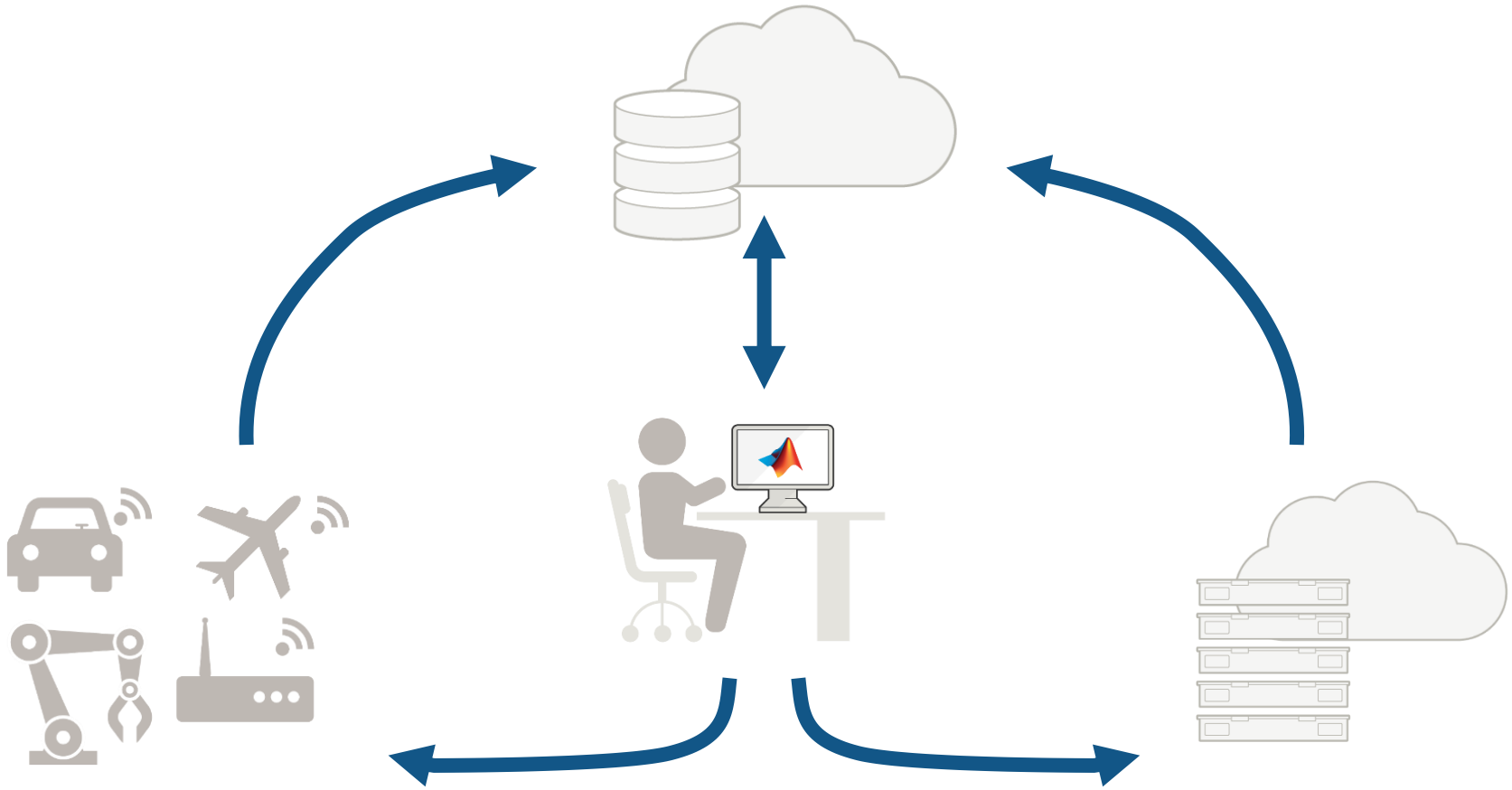
國立清華大學
NATIONAL TSING HUA UNIVERSITY



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



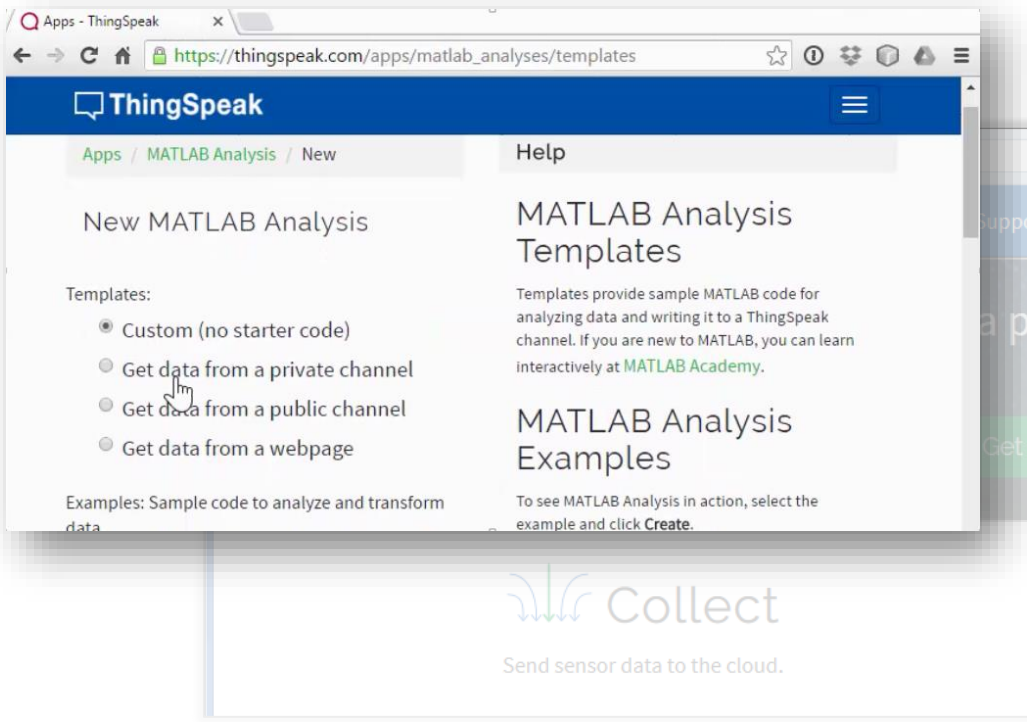
Taiwan Semiconductor Manufacturing Company (TSMC)

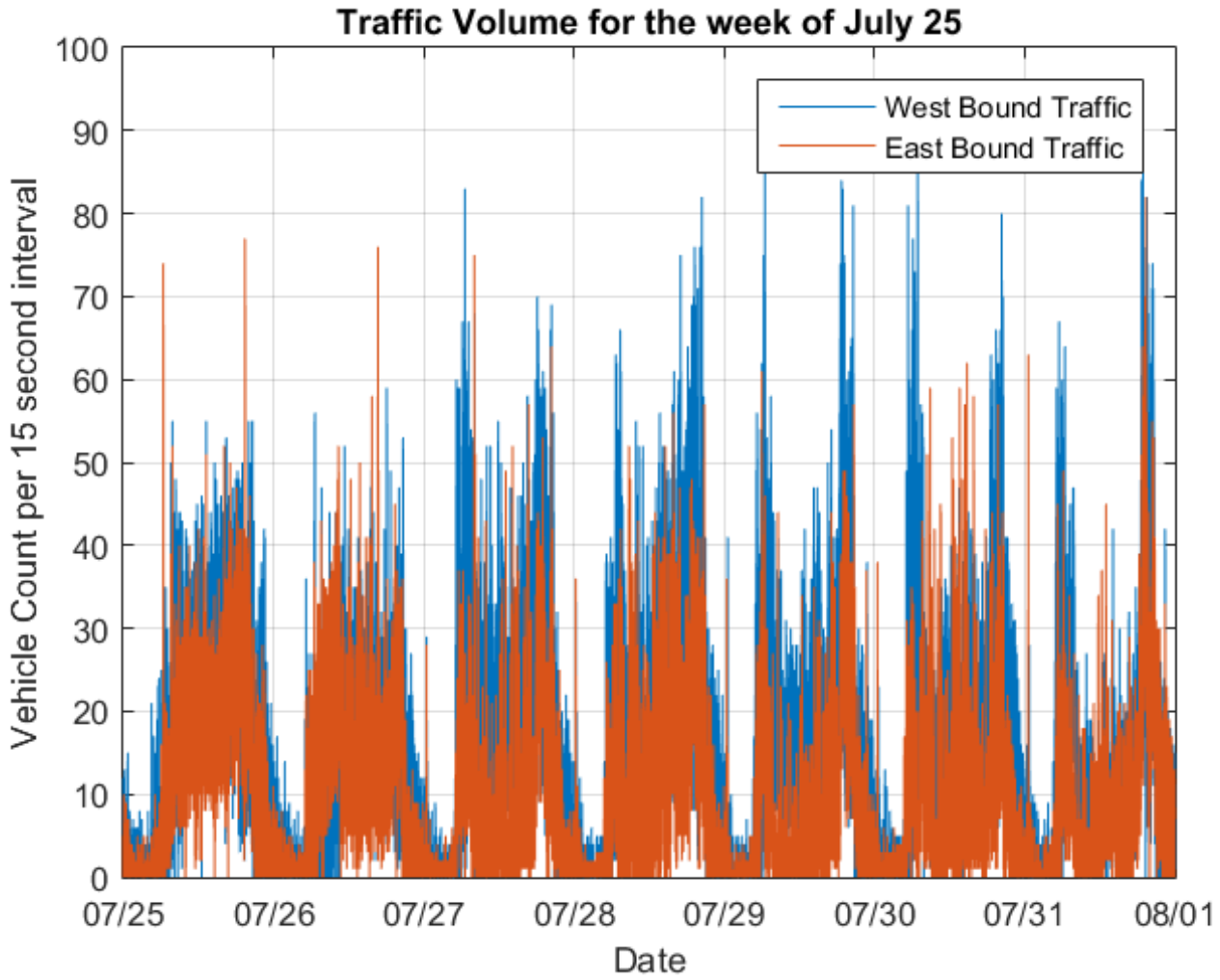


ThingSpeak

IoT open data platform for students and makers

Built-in MATLAB analysis





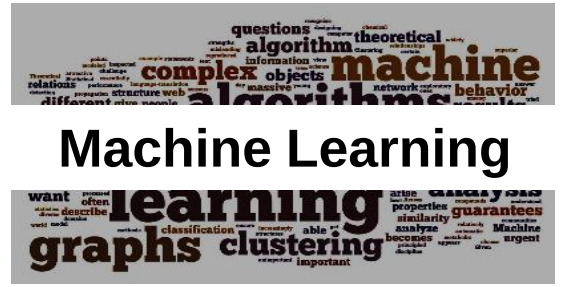
www.thingspeak.com

Big Data

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

Compute Power

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



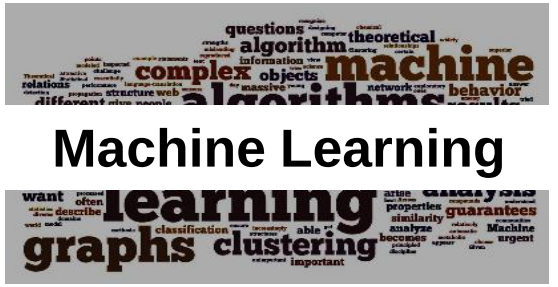
Machine Learning

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

How Does MATLAB Apply?

Big Data

Compute Power



Machine Learning

In MATLAB

- **Native support for engineering data**

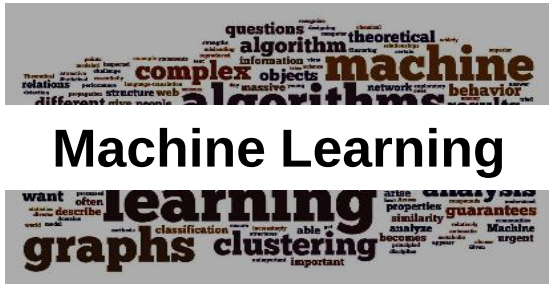
NEW for MATLAB

Audio System Toolbox R2016a

Vision HDL Toolbox R2015a

Big Data

Compute Power



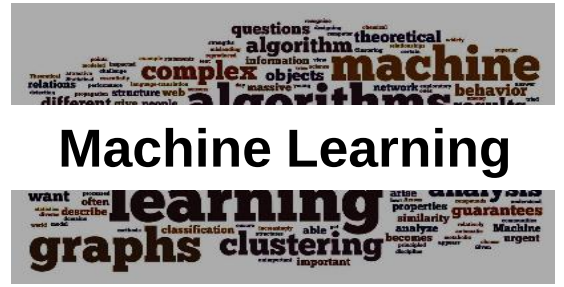
Machine Learning

In MATLAB

- **Datastore** R2014b
  text, image, video, Excel files, …
- **Mapreduce** R2014b
- **Database interfaces**
- **Streaming**

Big Data

Compute Power



Machine Learning

In MATLAB

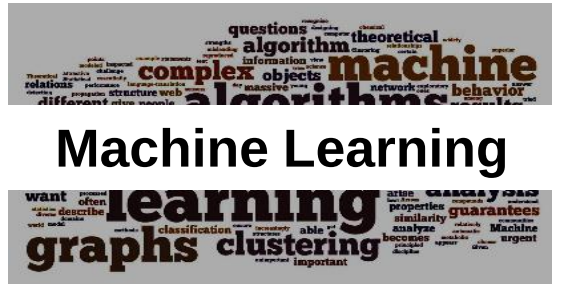
- **Datastore** R2014b
  text, image, video, Excel files, …
- **Mapreduce**
  R2014b

- **Hadoop support** R2014b
- **Multicore & GPU**
- **MATLAB Distributed Computing Server**
- **MATLAB Production Server**

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

Big Data

Compute Power



Machine Learning

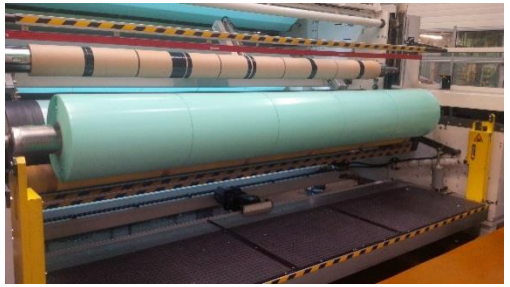
In MATLAB

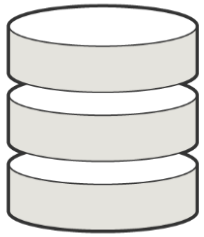
- **Datastore** R2014b
  text, image, video, Excel files, …
- **Mapreduce**
  R2014b

- **Hadoop support**
  R2014b
- **Scalable performance and production deployment**

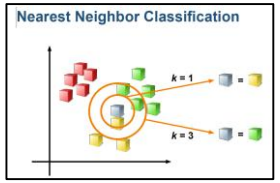
- **Classification Learner App** R2015a
- **CNNs for Deep learning** R2016a
- **Machine learning with code generation**

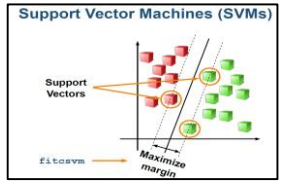
Predictive Maintenance for Polymer Production Machines

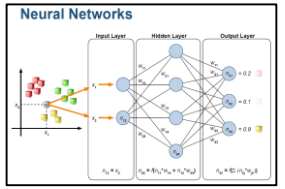




Classification using
Statistics, Machine Learning, and Neural Networks





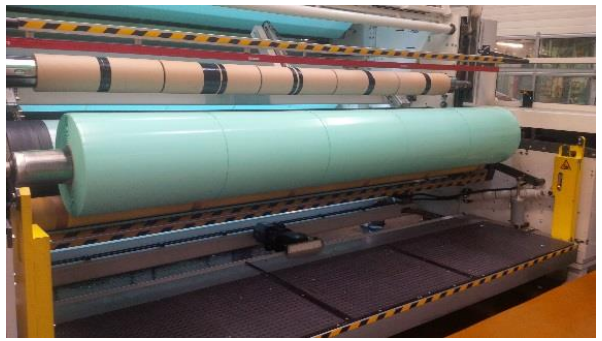


1 Big Opportunity for Analytics in Engineering and Science

- Autonomous Systems
- Predictive Maintenance
- Fleet and Asset Analytics
- Prognostics and Health Monitoring
- Internet Of Things (IoT)
- Operational Analytics
- Adaptive Control
- Supply Chain
- Risk Analysis

2 MATLAB Let's You Use Analytics in *Your* Workflow

- Familiar Environment
- Easy to Learn and Use
- Production Quality
- Integration with Simulink and Model Based Design
- Deployment to IT/Cloud



Can you make your _____ smarter?

The Rise of Engineering-Driven Analytics

Your Data has Value

Use it!