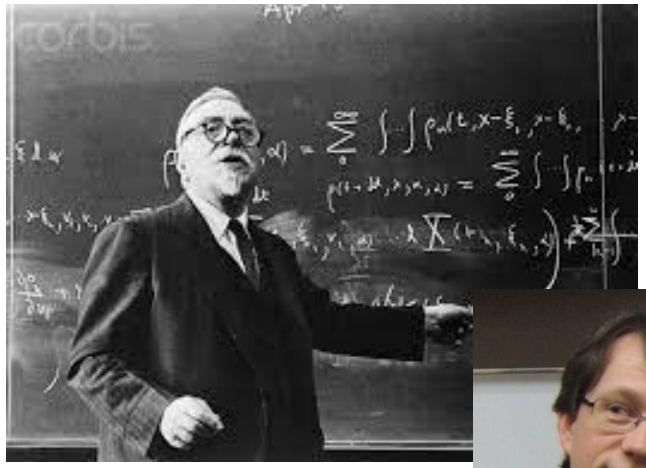
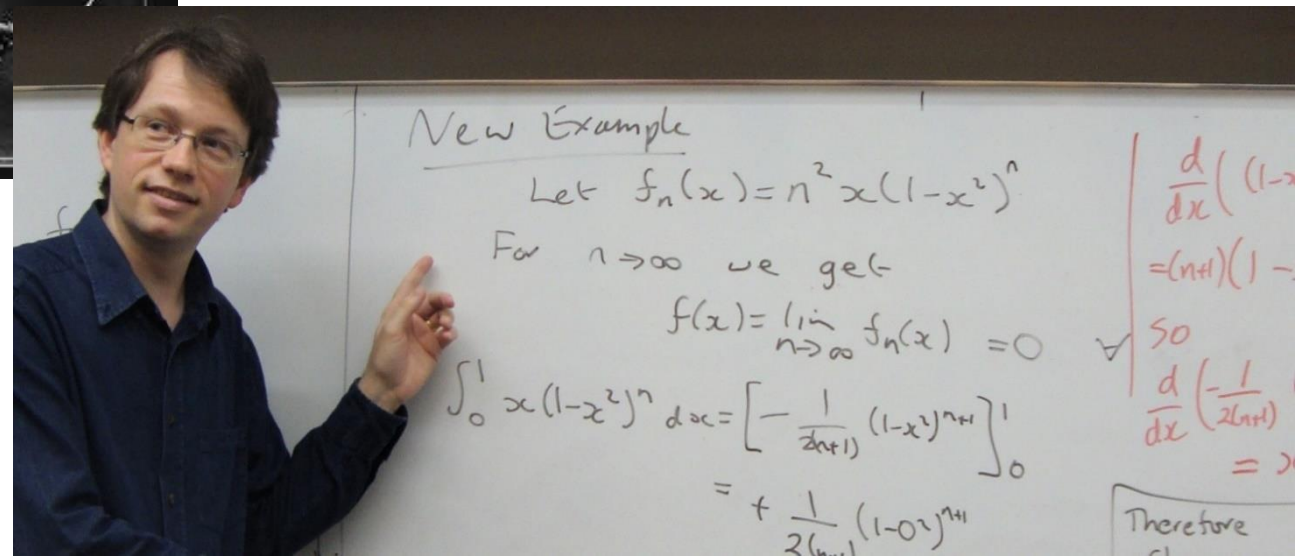
MATLAB EXPO 2017

# Problem-Based Learning: Data Analytics and Machine Learning Techniques for Solving Real-World Challenges

Dr Jasmina Lazić, MathWorks

# Teaching in the Classroom: Then and Now



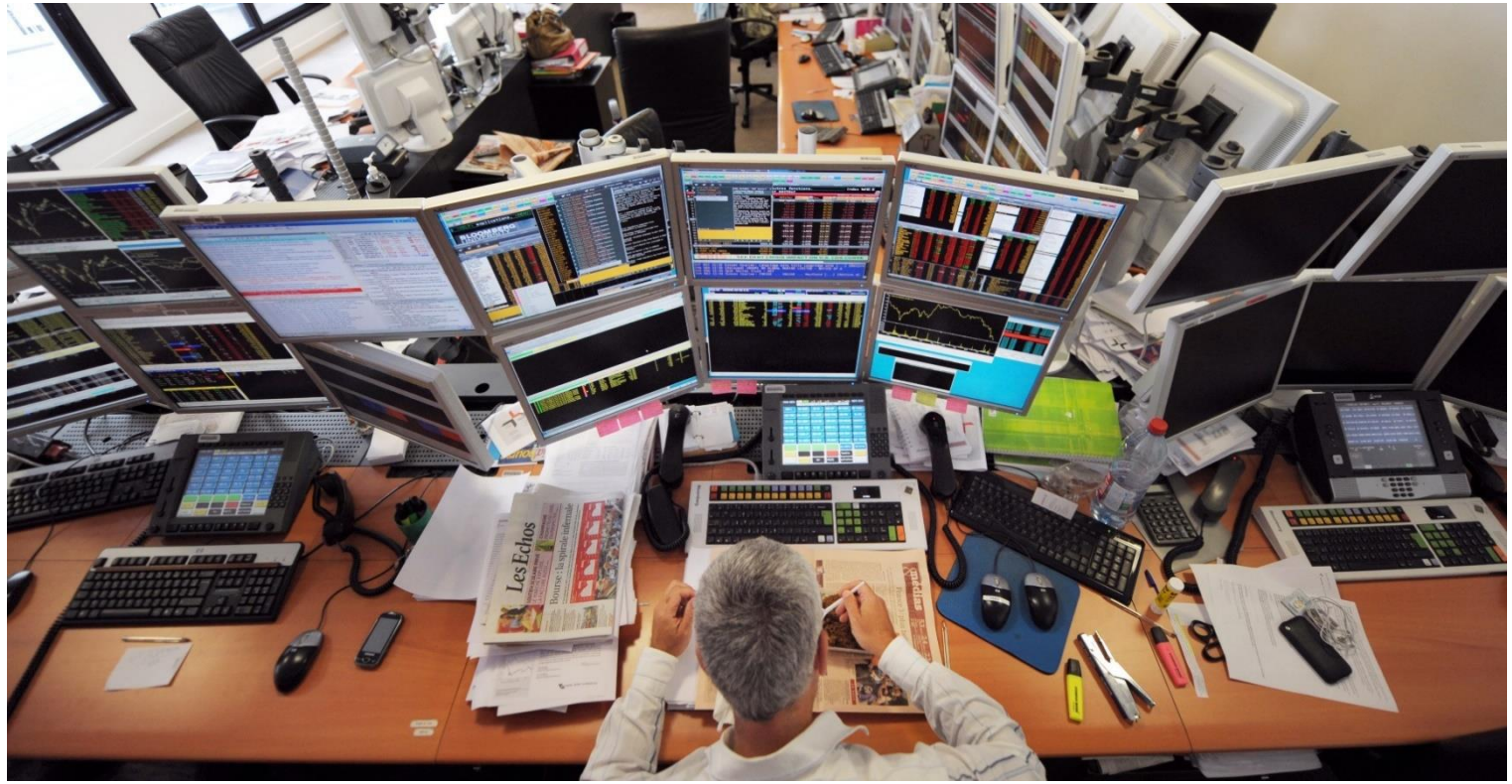


# Workplace: Then

The term “computer”, in use from early 17th century, meant “one who computes”: a person performing mathematical calculations, before electronic computers became commercially available. Teams of people were frequently used to undertake long and often tedious calculations.

*(Source: Wikipedia)*

# Workplace: Now



# Technology Trends

# Data Everywhere – Algorithms in Everything



Aeronautics

Railway Systems

Automotive

Retail

Finance

Off-highway vehicles


Condition Monitoring

Prognostics

Retail Analytics

Fleet Analytics

Data Analytics

Operational Analytics

Process Analytics

Risk Analysis

Health Monitoring

Supply Chain

Mfg Process Analytics

Asset Analytics

Healthcare Analytics

Internet

Industrial Automation

Logistics

Oil & Gas

Clean Energy

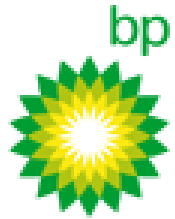
Medical Devices

Healthcare Management

# Companies using MathWorks products























# Why MATLAB?

BUSINESS INSIDER | Tech | Finance | Politics | Strategy | Life

## The One App You Need On Your Résumé If You Want A Job At Google

JIM EDWARDS

OCT. 17, 2014, 7:16 AM | 141,772 | 43

FACEBOOK | LINKEDIN | TWITTER | GOOGLE+ | PRINT | EM

Google has more than 50,000 employees right now, and they earn great salaries.

Average pay at Google is $141,000.

It's relatively easy to get a job at Google, too.

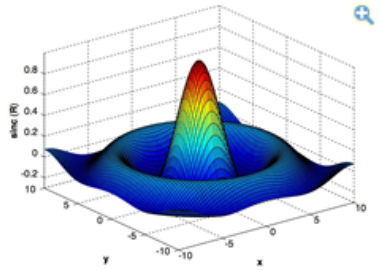
Jonathan Rosenberg.

The company is so large and has such a massive need for talent that hiring for Google is something of a headache, so if you have the right skills, Google is really enthusiastic to hear from you.

Especially if you know how to use MatLab, a code and data analysis and management tool.

We had never heard of MatLab, so we asked Rosenberg what it was.

For the uninitiated, MatLab lets developers code and arrange data and algorithms so that results are visual. (Yes, it's complicated). The key here is that data is produced visually or graphically, rather than in a spreadsheet. Here is an example:



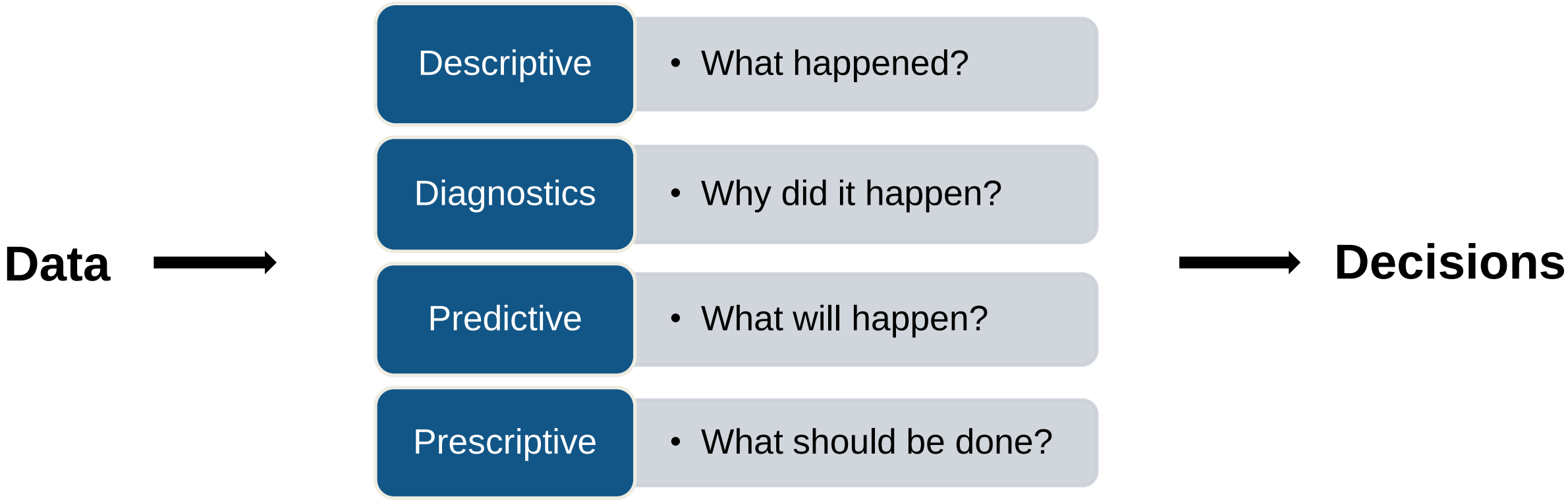
Wikipedia

This is a Matlab surface 3-D plot of a two-dimensional unnormalized sinc function (obviously!). We got it from Wikipedia.

MATLAB E

# What is Data Analytics?

***Turn large volumes of complex data into actionable information***



# Data Analytics Workflow

**Access and Explore Data**

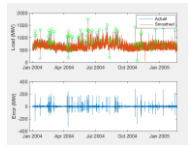
**Files**

**Databases**

**Sensors**

**Preprocess Data**

**Working with Messy Data**



**Data Reduction/ Transformation**

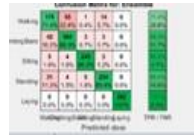
**Feature Extraction**

**Develop Predictive Models**

**Model Creation e.g. Machine Learning**

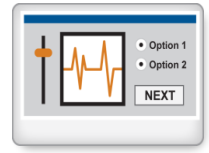

**Parameter Optimization**

**Model Validation**



**Integrate Analytics with Systems**

**Desktop Apps**

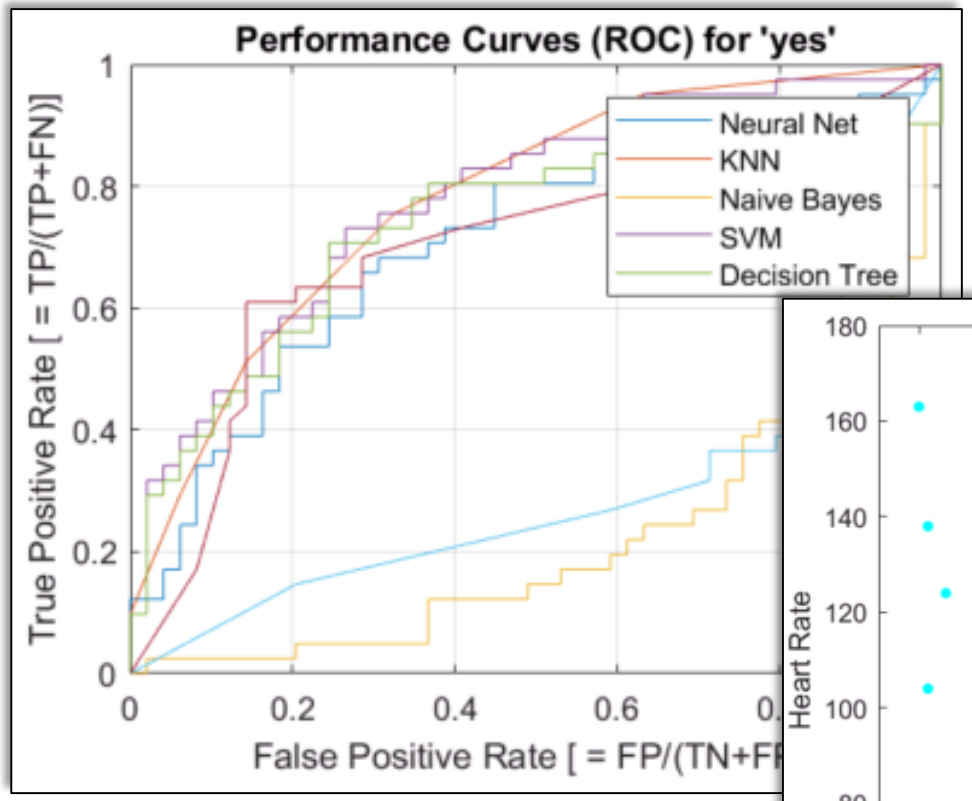


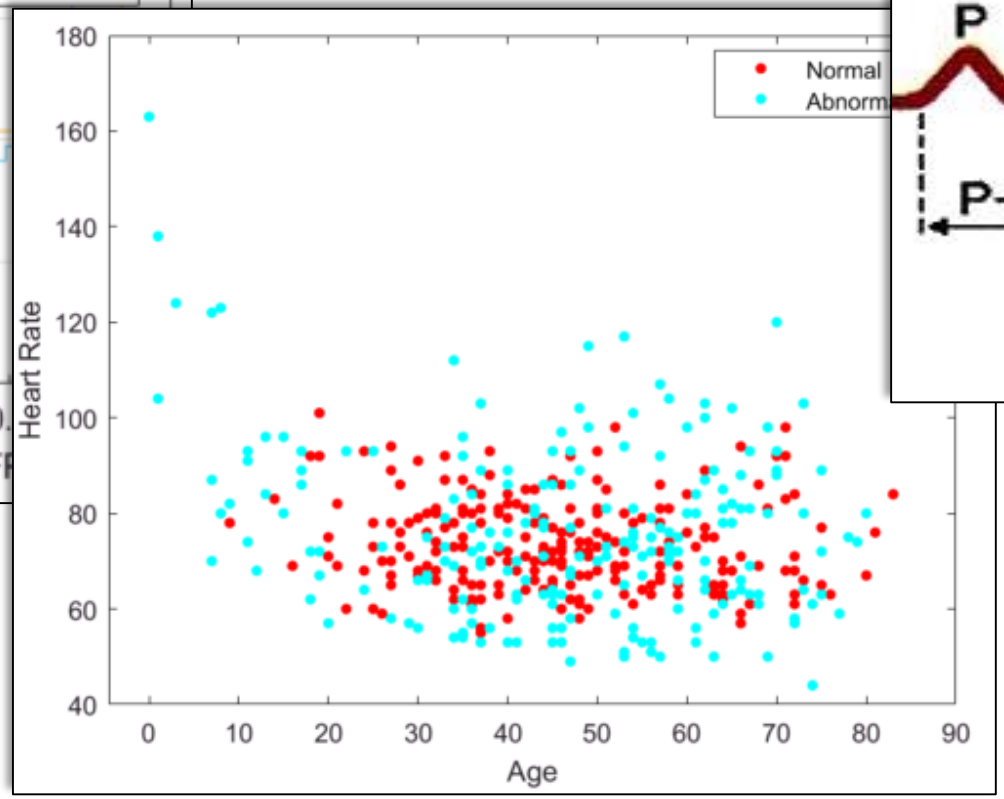

**Enterprise Scale Systems**

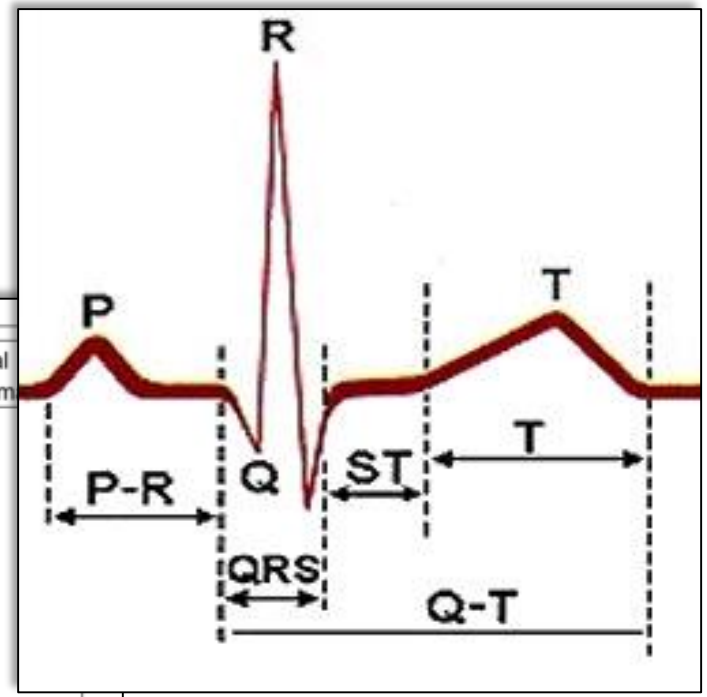
MATLAB Excel .NET C/C++ .exe Java .dll

**Embedded Devices and Hardware**

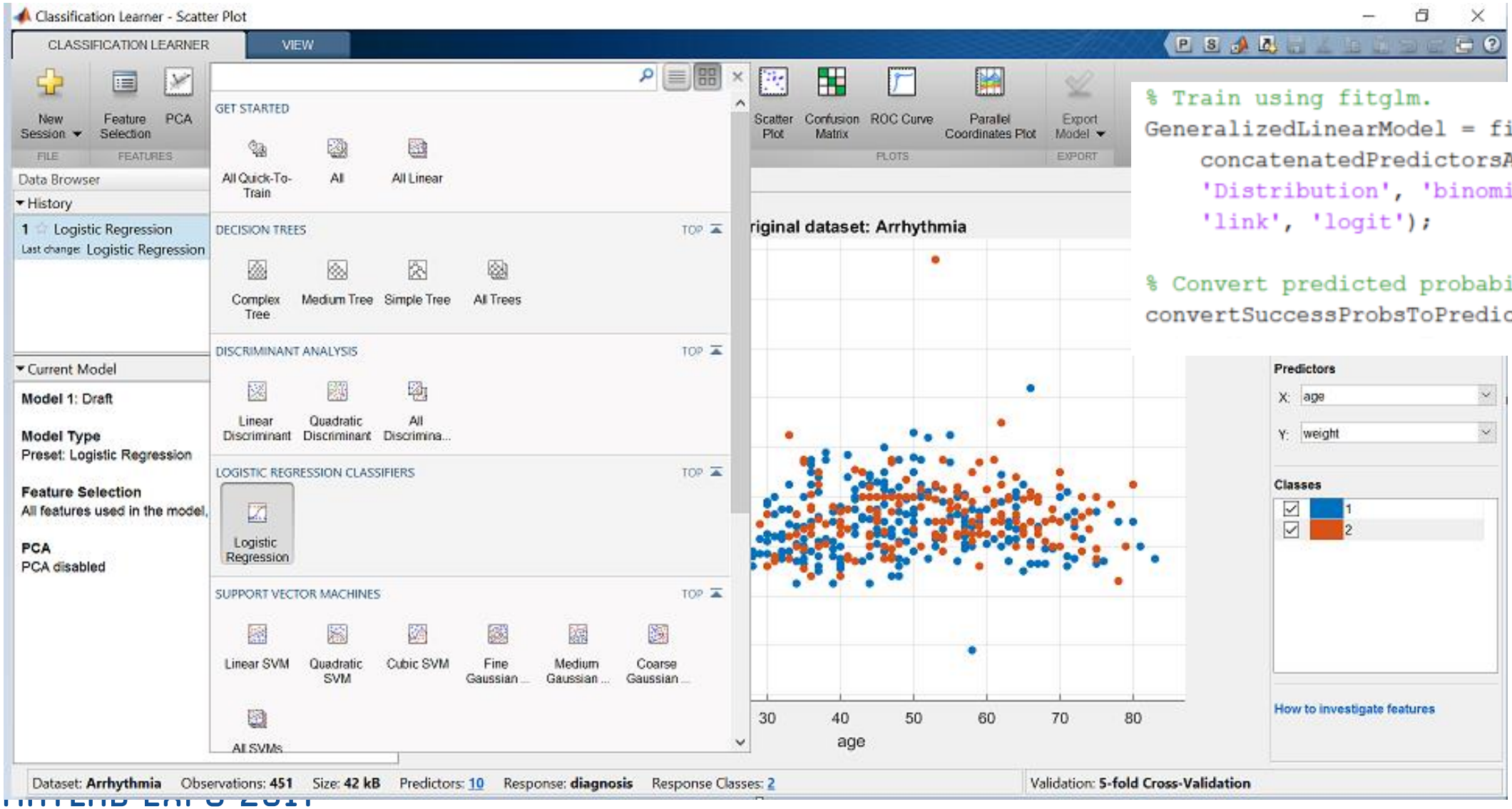
# Demo: Diagnosing Arrhythmia



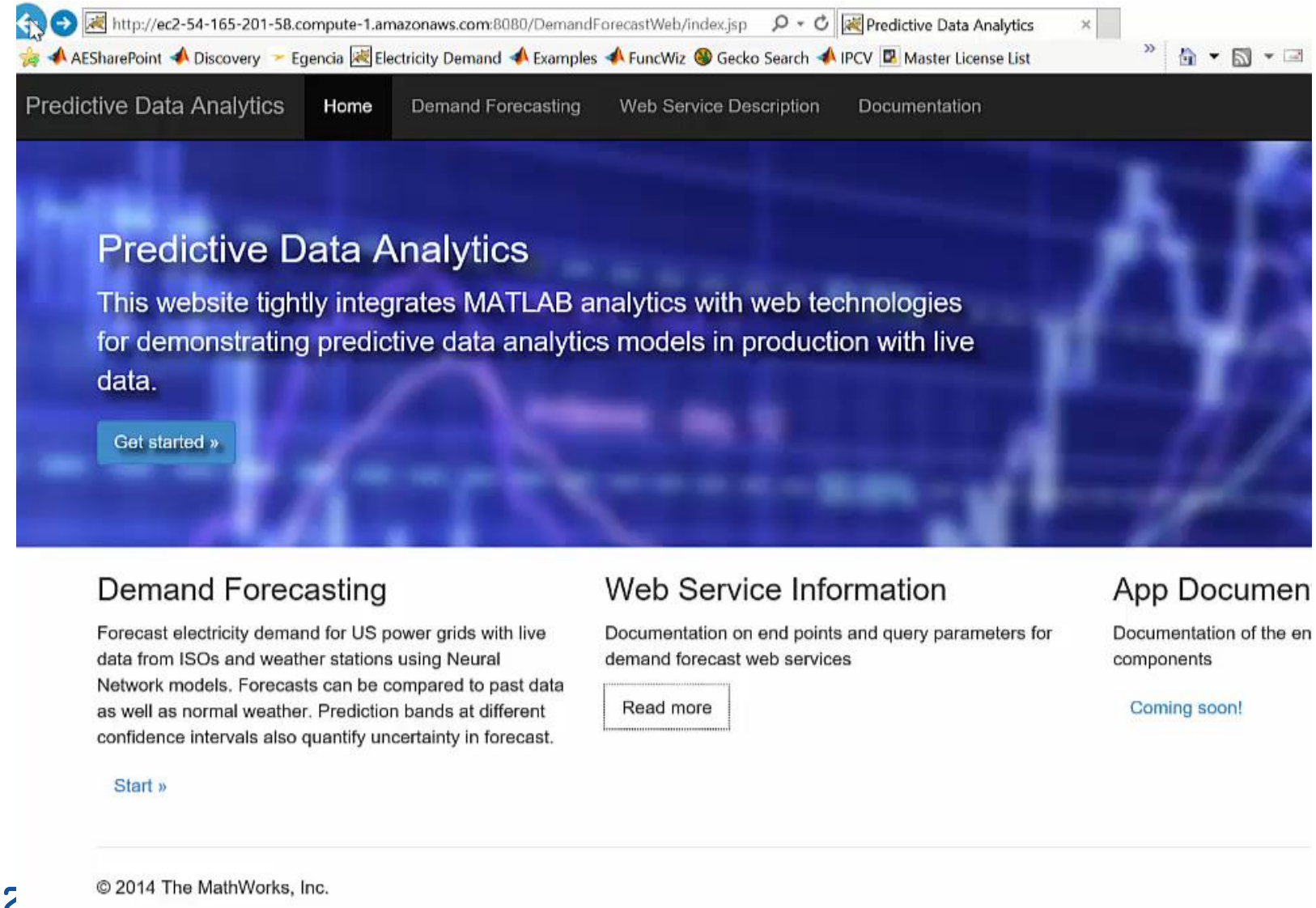



# Classification Learner App



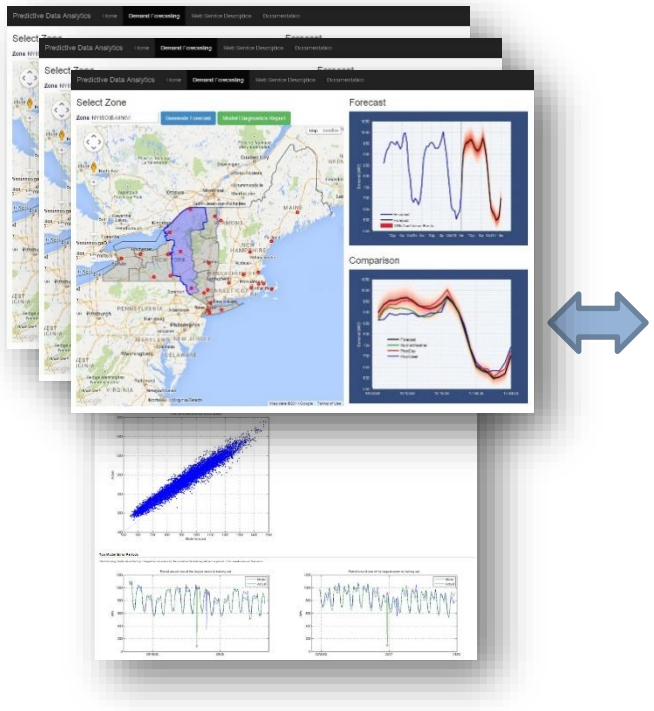

```
% Train using fitglm.
GeneralizedLinearModel = fitglm(...
    concatenatedPredictorsAndResponse,
    'Distribution', 'binomial', ...
    'link', 'logit');

% Convert predicted probabilities to pr
convertSuccessProbsToPredictions = @(p)
```

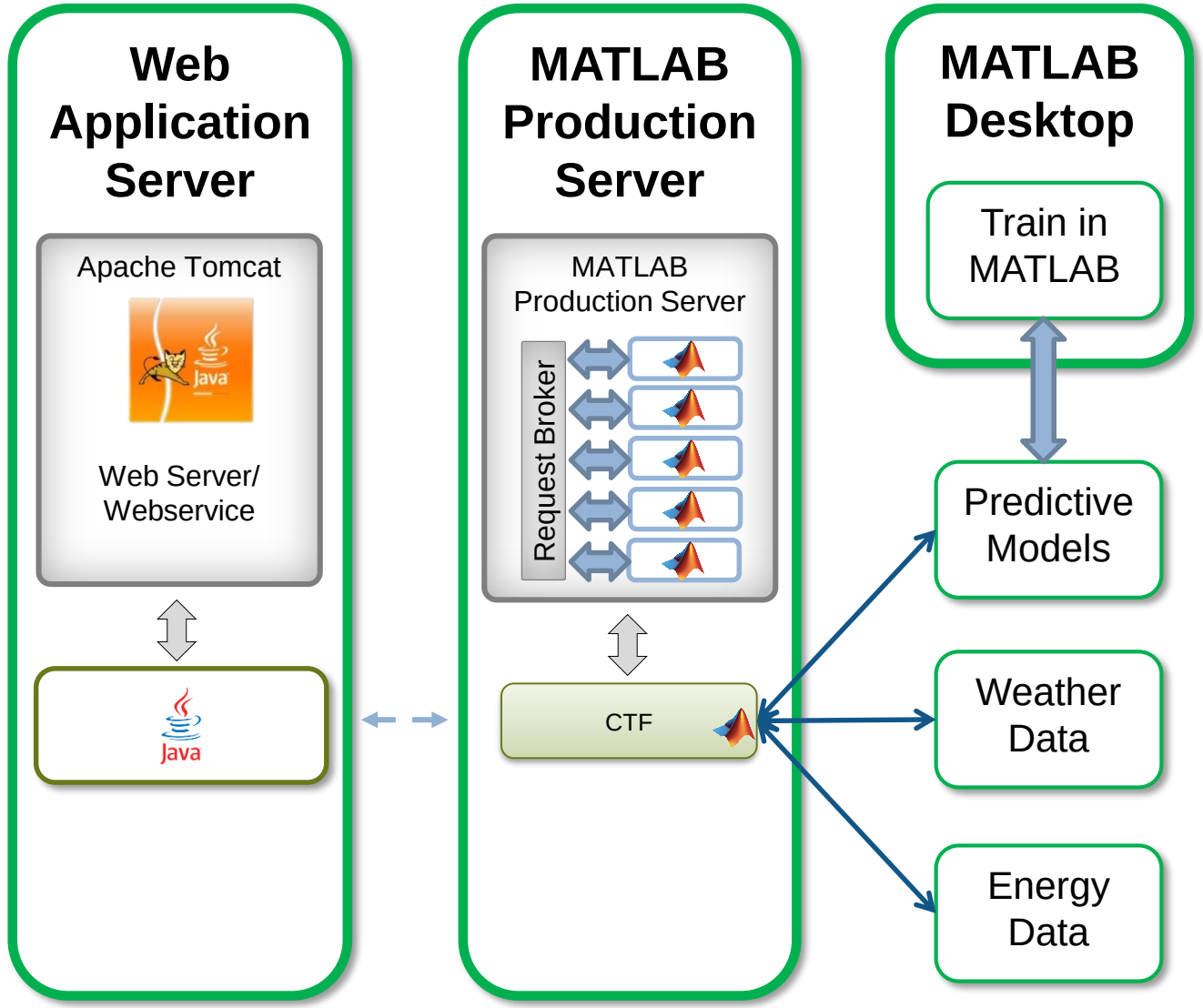
# Demo: Deployed Analytics – Energy Load Forecasting



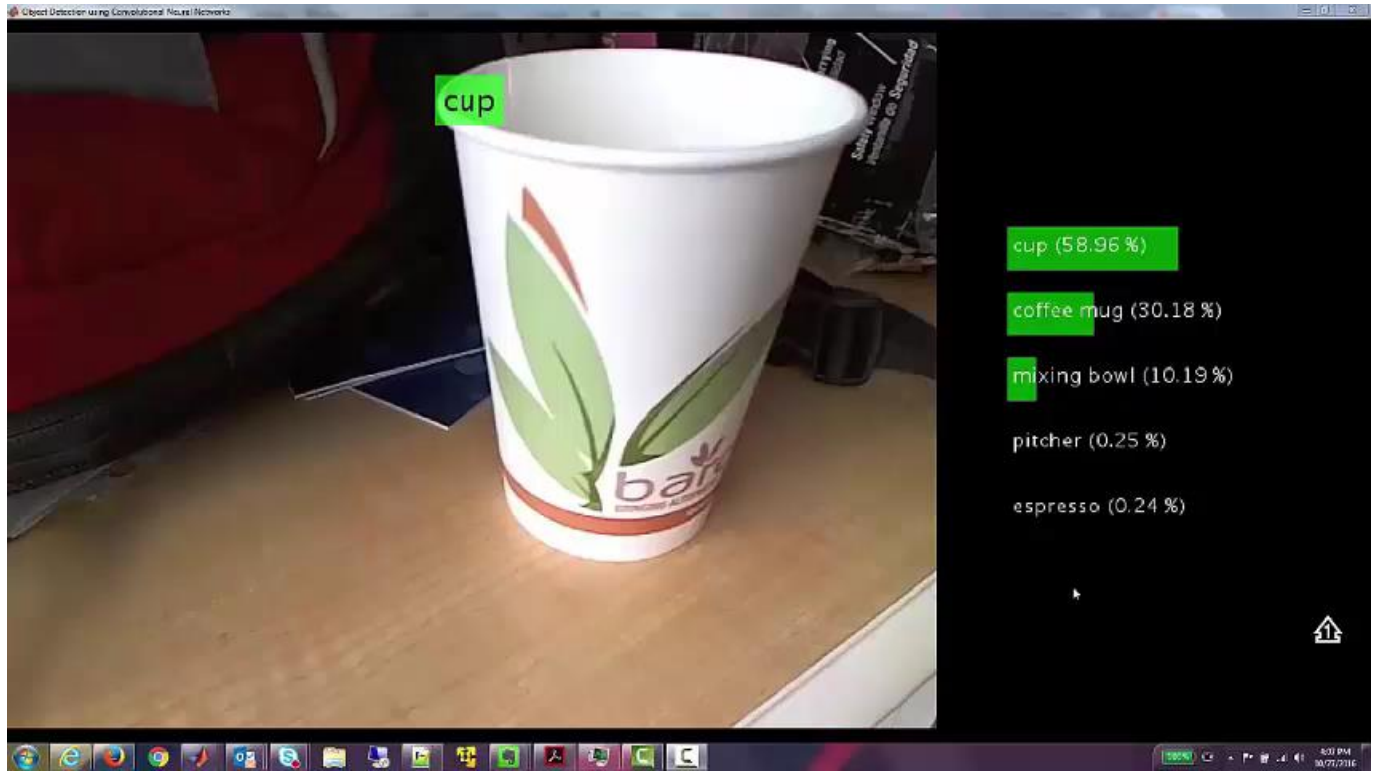
# Demo: Deployed Analytics – Energy Load Forecasting

*MATLAB  Production Server*



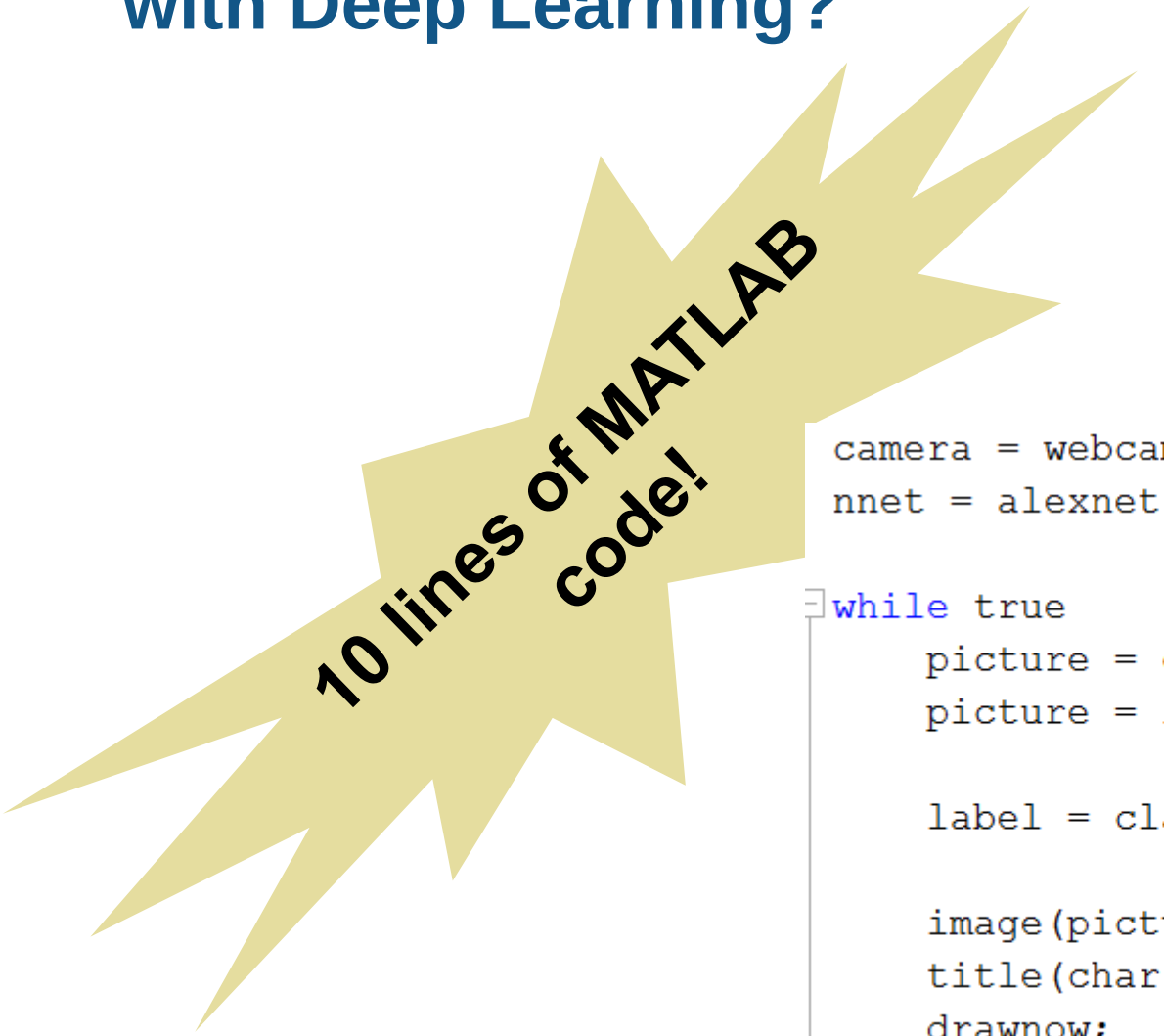



# Demo: Object Detection with Deep Learning



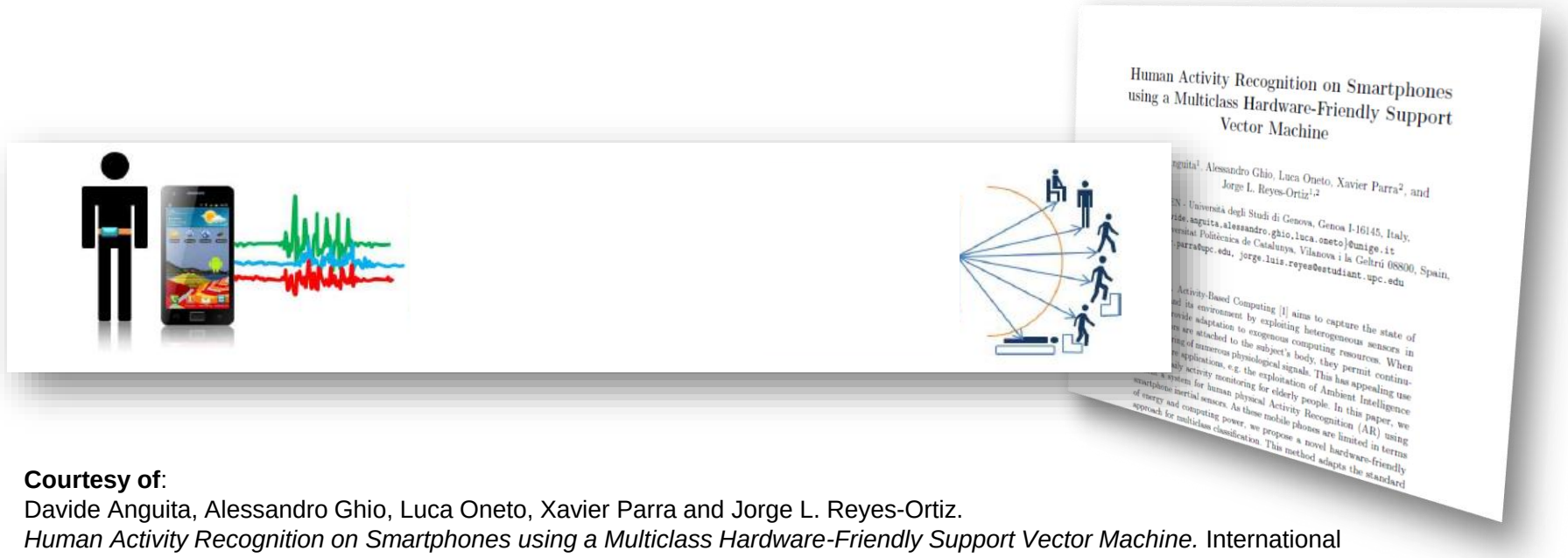

| | |
|---|---|
| Training | Millions of images from 1000 different categories |
| Prediction | Real-time object recognition using a webcam connected to a laptop |

# How Many Lines of Code Did We Use for Object Detection with Deep Learning?




```
camera = webcam; % Connect to the camera
nnet = alexnet;  % Load the neural net

while true
    picture = camera.snapshot;                % Take a picture.
    picture = imresize(picture, [227, 227]); % Resize the picture.

    label = classify(nnet, picture);          % Classify the picture.

    image(picture);      % Show the picture.
    title(char(label)); % Show the label.
    drawnow;
end
```

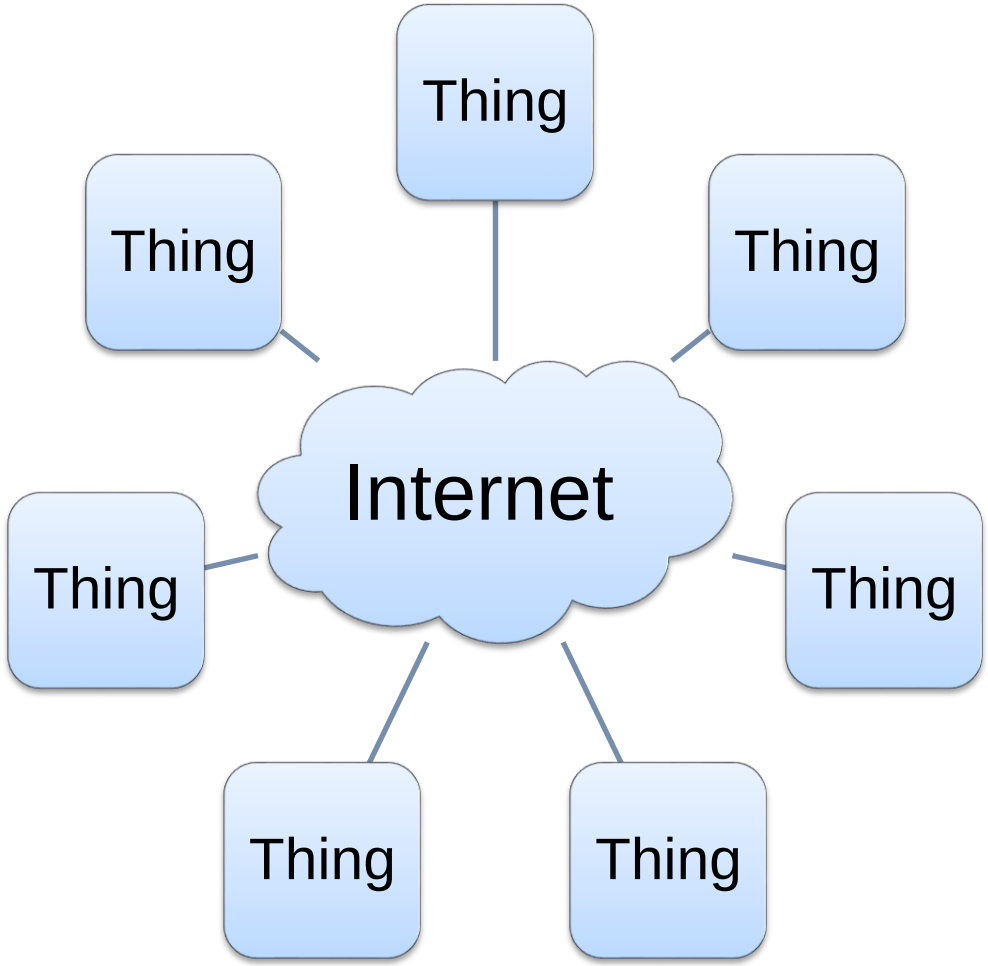
# Demo: Human Activity Analysis and Classification



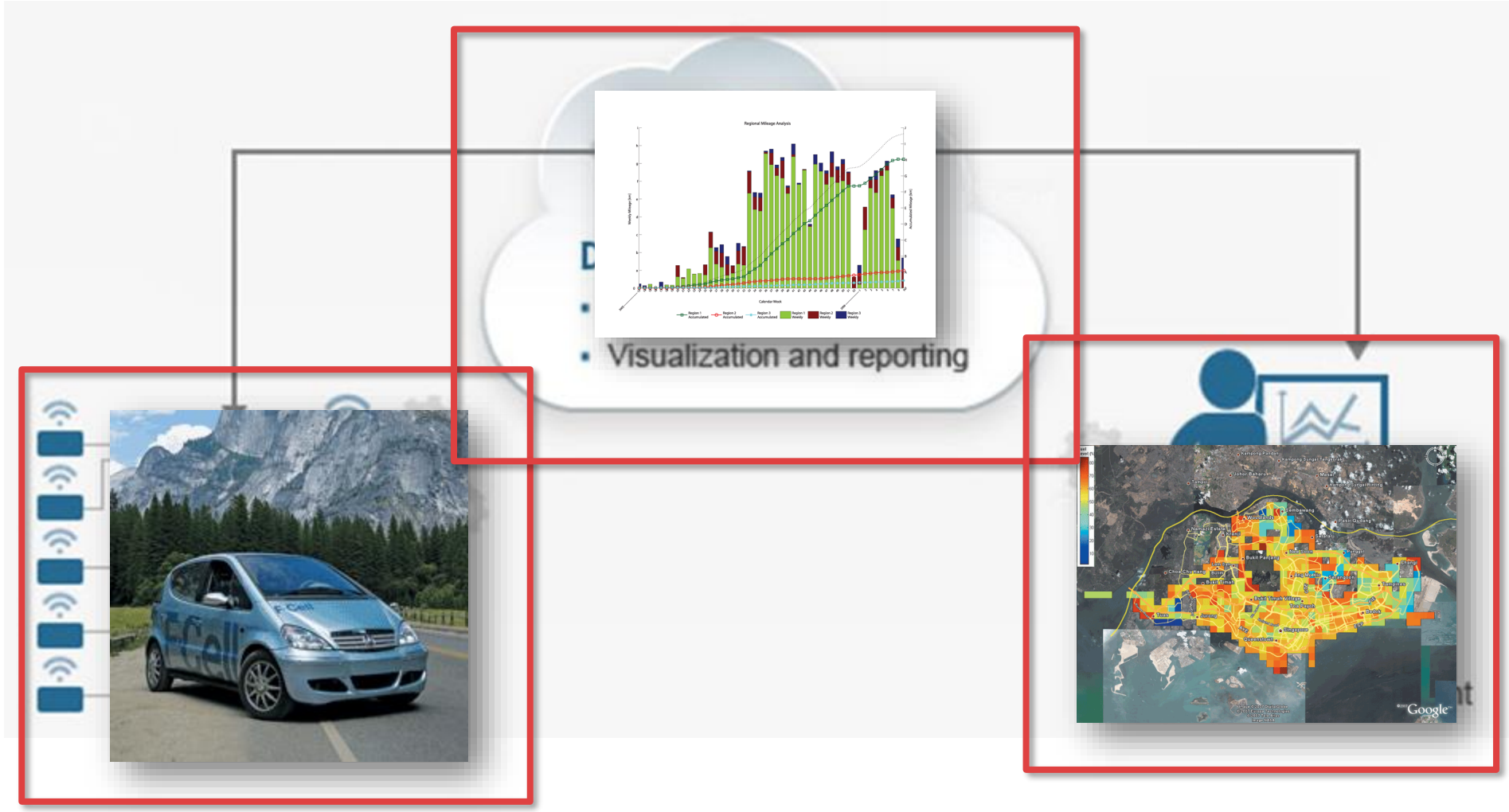

**Courtesy of**:
Davide Anguita, Alessandro Ghio, Luca Oneto, Xavier Parra and Jorge L. Reyes-Ortiz.
*Human Activity Recognition on Smartphones using a Multiclass Hardware-Friendly Support Vector Machine.* International Workshop of Ambient Assisted Living (IWAAL 2012). Vitoria-Gasteiz, Spain. Dec 2012

**Dataset available at:**
http://archive.ics.uci.edu/ml/datasets/Human+Activity+Recognition+Using+Smartphones

# Internet of Things



# Internet of Things



# University College London Improves Computational Literacy with Online and Onsite MATLAB Training

First-year students using MATLAB for mathematical modeling

## Challenge

Enrich student coursework with project-based learning while enabling instructors to focus on teaching core concepts

## Solution

Acquire a MathWorks Total Academic Headcount license and use MathWorks onsite training and online courses to accelerate student adoption of MATLAB campus-wide

## Results

- Program scalability enabled
- Faculty and students focused on addressing real-world problems
- Students equipped with required tools and skills

**"One advantage of teaching with MATLAB is that our students are exposed to a tool that is used in the commercial world. The quality of the learning materials delivered online and onsite was excellent, enabling me to focus on teaching analytics and working with students."**

**Daniel Hulme**

**University College London**

Link to user story

# Industry Links

"On one project, students used MATLAB to develop a solution that helped an energy company reduce costs by £59 million."

# MATLAB Enabled Campus for Everyone, Anywhere

MATLAB Courseware

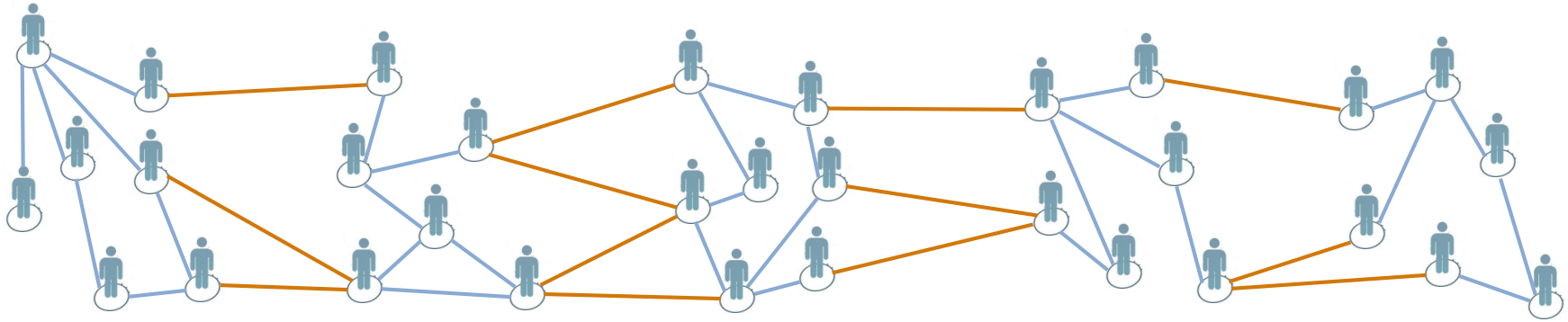
Cody Coursework Autograding

MATLAB Academy

Student Competitions

MATLAB Central

MATLAB Online



HPC

Big Data Support

Dedicated Engineers

Low-Cost Hardware Support

On-Campus Events

Ambassadors

Integration with Production Systems

Technical Support

Project-Based Learning

# Key Takeaways

- MATLAB is a learning tool for Data Analytics
- MATLAB is an Integrated Curriculum Platform
- MATLAB is a state-of-the-art industry software