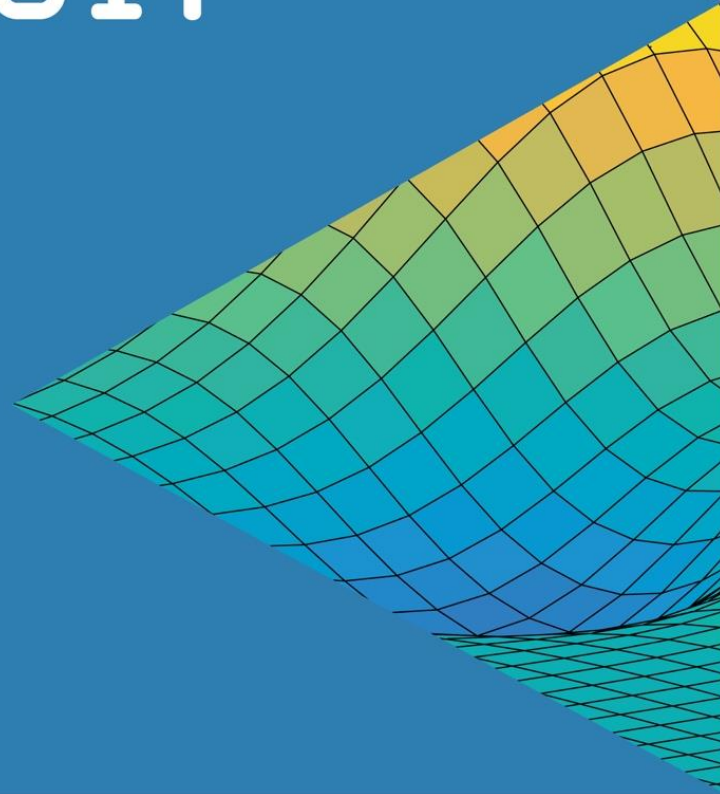
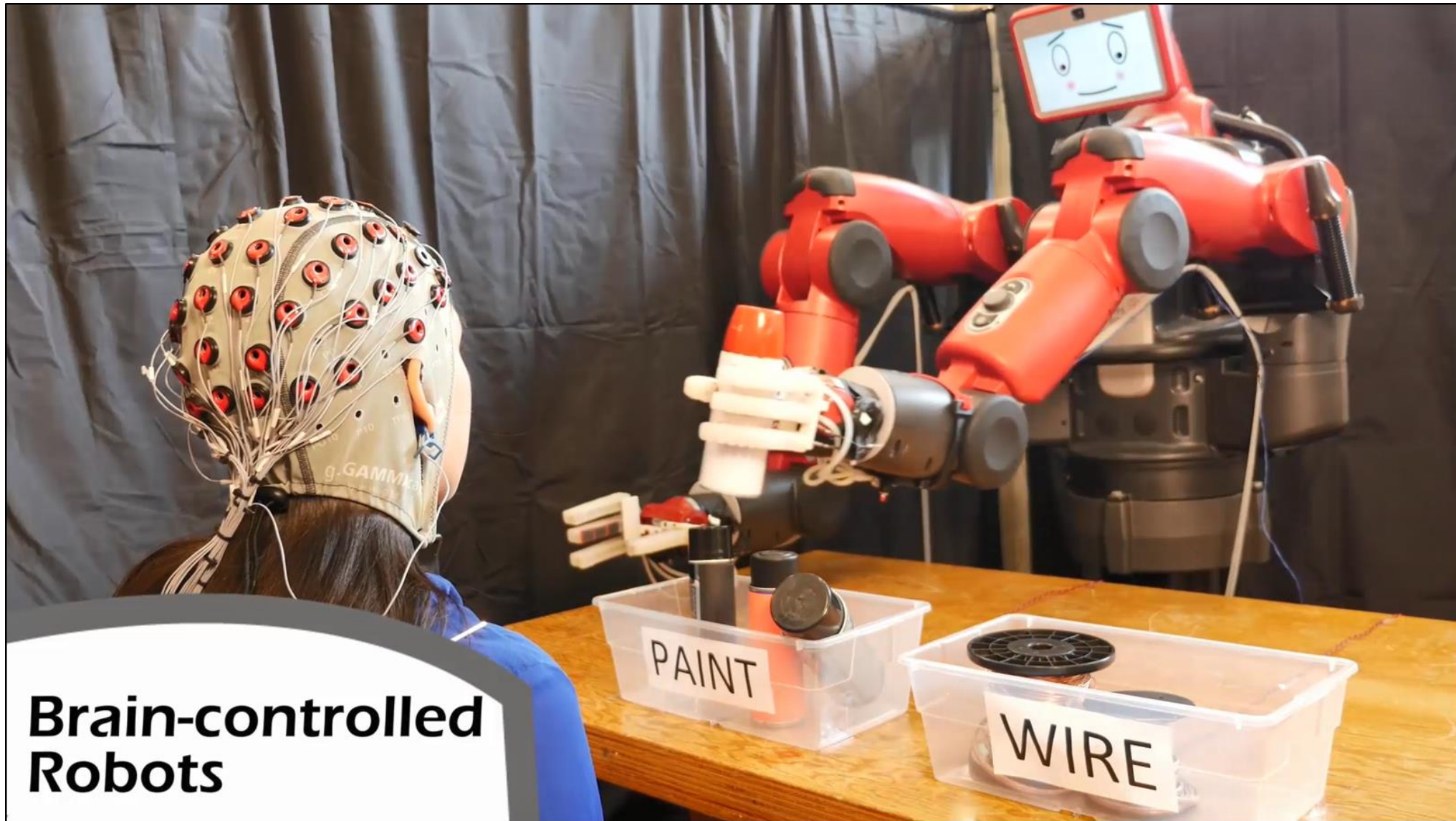


MATLAB EXPO 2017

Machine Learning Simplified

Paola Jaramillo





Brain-controlled Robots

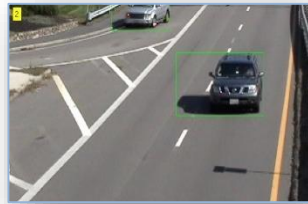
***New MATLAB framework makes machine learning
easy and accessible for Engineers***

Consider Machine Learning When

Solution is too complex for hand written rules or equations



Speech Recognition



Object Recognition



Engine Health Monitoring

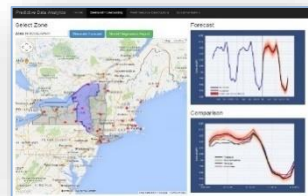
Because algorithms can

learn complex non-linear relationships

Solution needs to adapt with changing data



Weather Forecasting



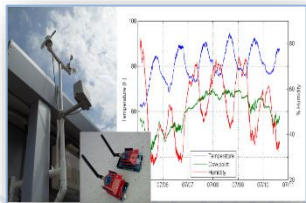
Energy Load Forecasting



Stock Market Prediction

update as more data becomes available

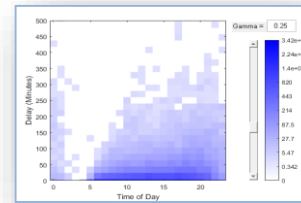
Solution needs to scale



IoT Analytics



Taxi Availability

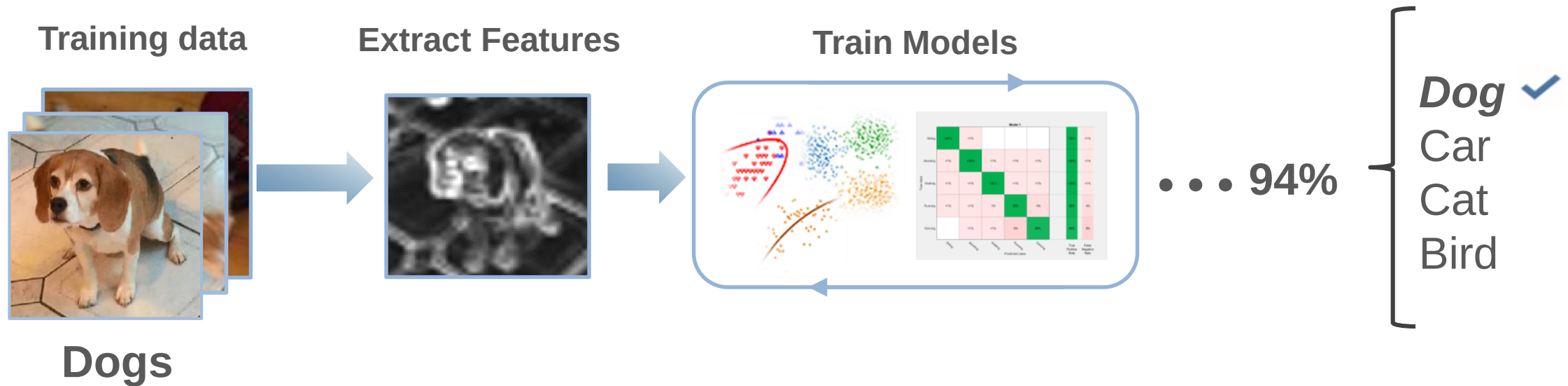


Airline Flight Delays

learn efficiently from very large data sets

What is Machine Learning?

Machine learning algorithms use computational methods to “**learn**” information *directly* from data without assuming a predetermined equation as a model

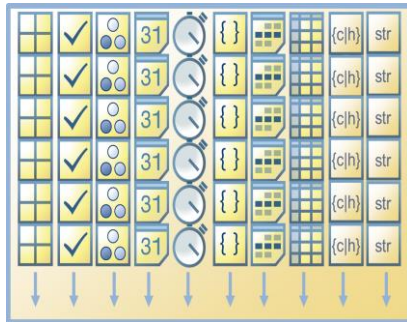


Challenges

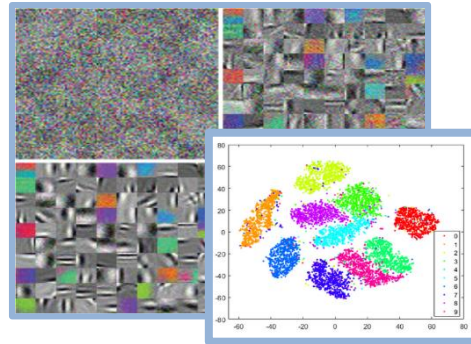
**Domain-
Expertise**

**Data-
Science**

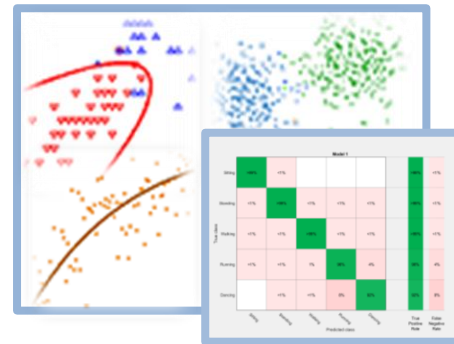
**Software
Engineering**



**Access
Data**



**Extract
Features**



**Develop
Models**



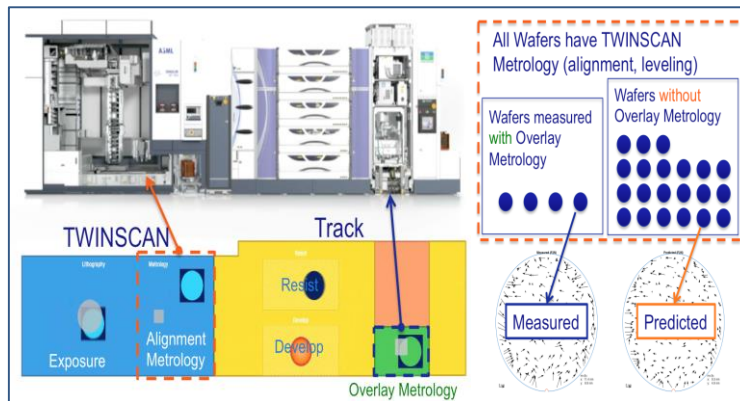
**Share
Models**

Challenges from our Customers



Goal: Develop a predictive maintenance system to reduce pump equipment **costs and downtime**.

- Convert **unreadable data** into a usable format.
- **Automate** filtering, spectral analysis, and transform steps for multiple trucks and regions.



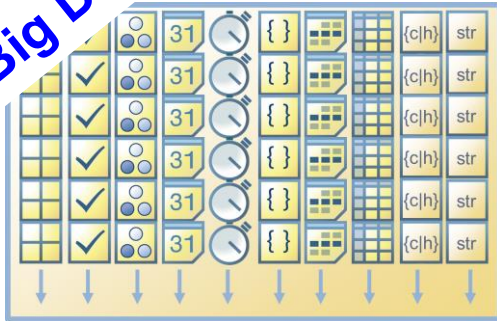
Goal: Develop a **prototype quickly**, relying on functions that have been deployed across ASML's large, **diverse user** base and **maintained** by dedicated professionals.

- **Lack of experience** with neural networks or machine learning.

***New* MATLAB framework makes machine learning
easy and **accessible** for Engineers**

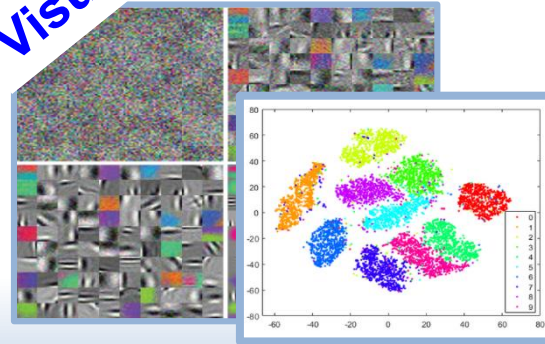
MATLAB makes Machine Learning Easy and Accessible...

Big Data



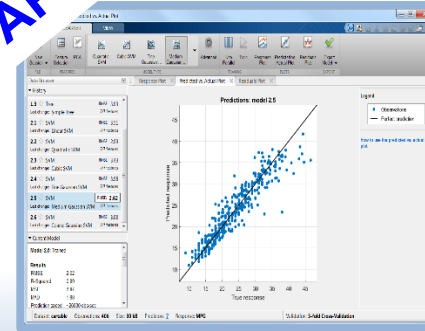
Access Data

Visuals



Extract Features

APPS



Develop Models

Enterprise



Integrate

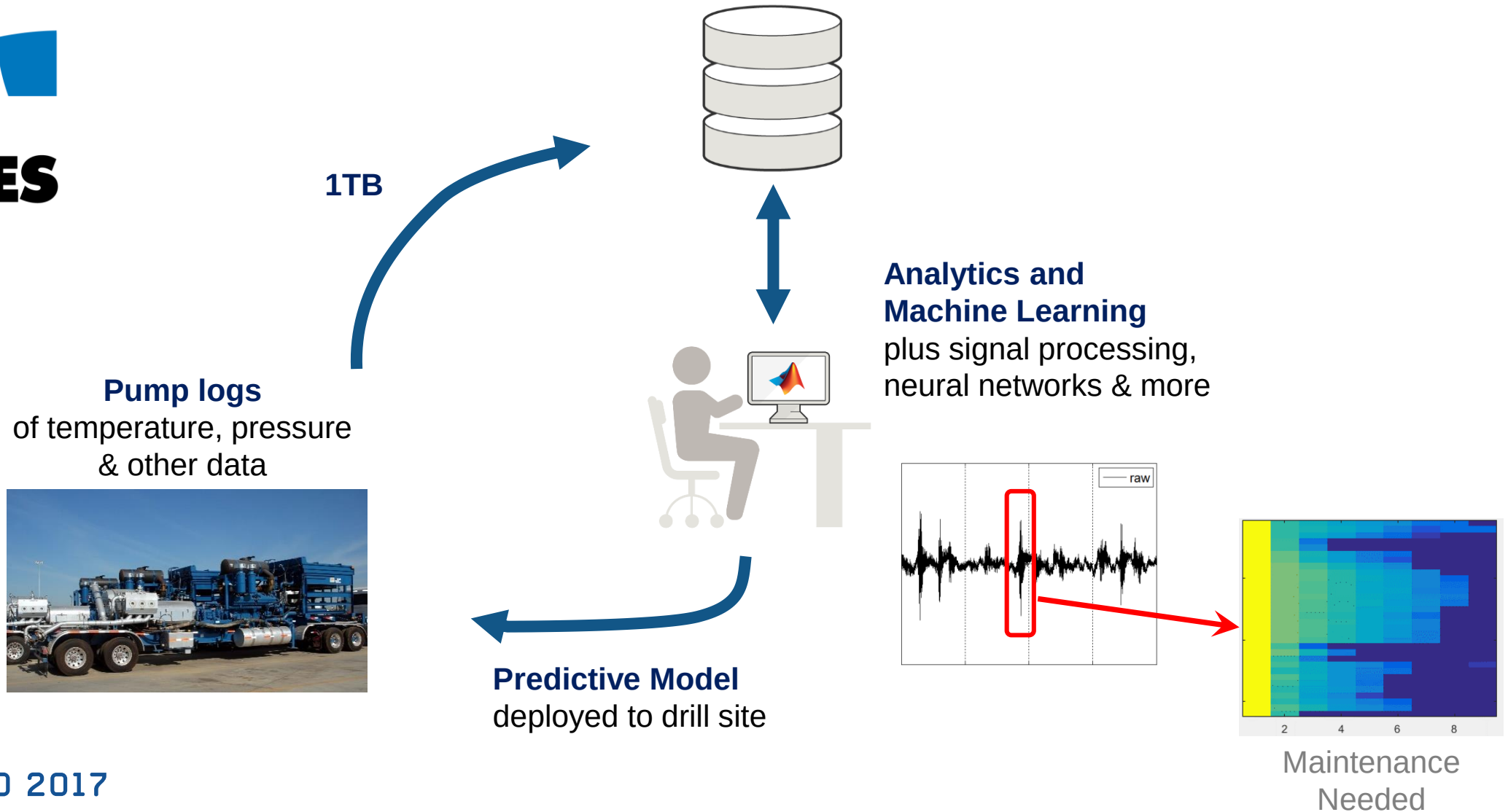
... with **industry**
proven solutions

... enabling **non-**
experts

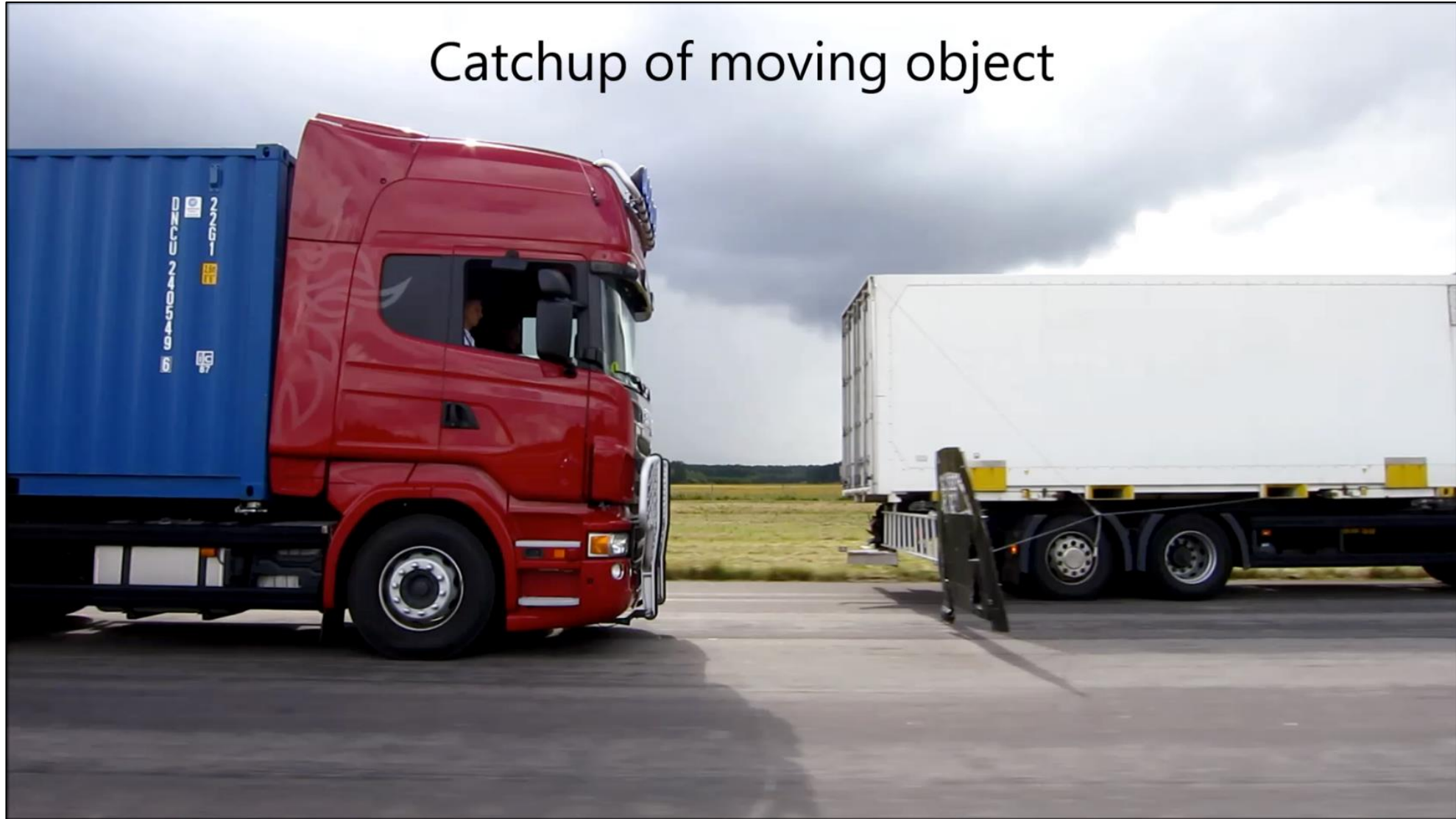
... from **idea**
to product

Using Machine Learning

to build and deploy a predictive maintenance system



Catchup of moving object

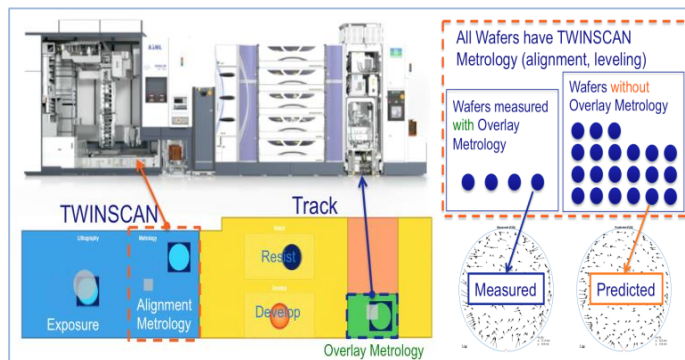


Our Customers Achievements



“**MATLAB gave us the ability** to convert previously **unreadable data into a usable format**; automate filtering, spectral analysis, and transform steps for multiple trucks and regions; and ultimately, **apply machine learning techniques in real time to predict** the ideal time to perform maintenance.”

Gulshan Singh
Baker Hughes



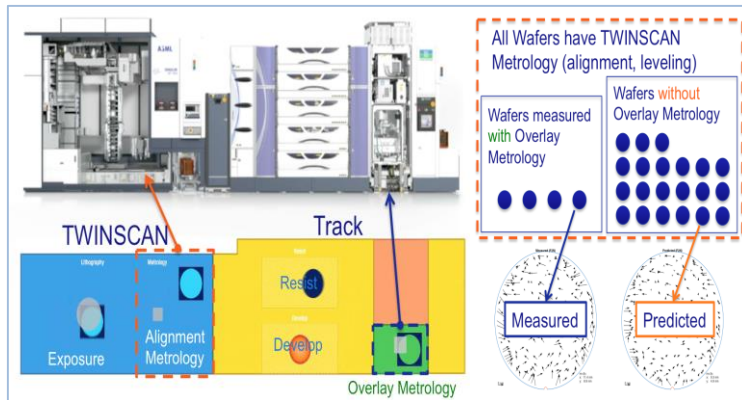
“As a process engineer I had no experience with neural networks or machine learning. I worked through the MATLAB examples to find the best machine learning functions for generating virtual metrology. **I couldn't have done this in C or Python—it would've taken too long to find, validate, and integrate** the right packages.”

Emil Schmitt-Weaver
ASML

Summary of Results

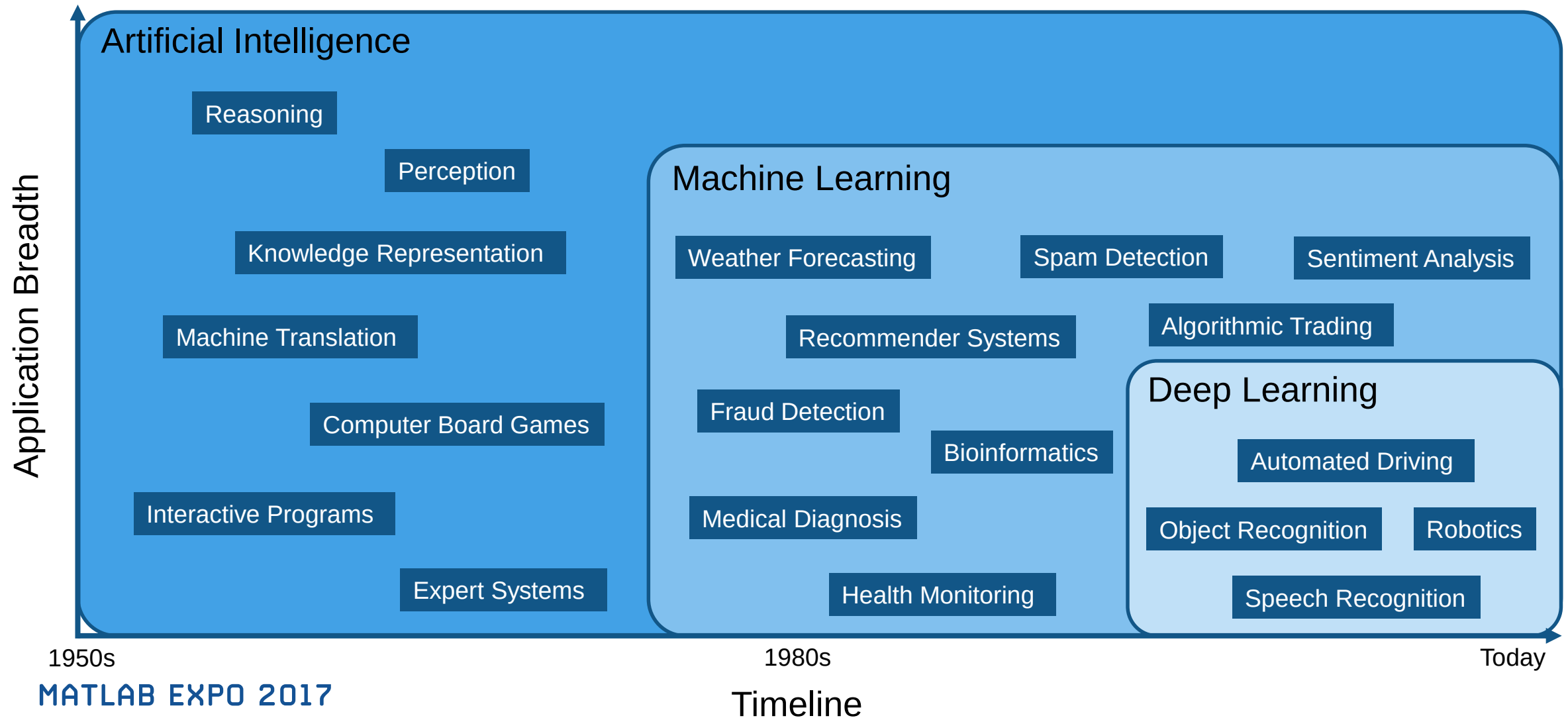


- **Savings** of more than \$10 million projected
- Development **time reduced** tenfold
- Multiple types of data **easily accessed**



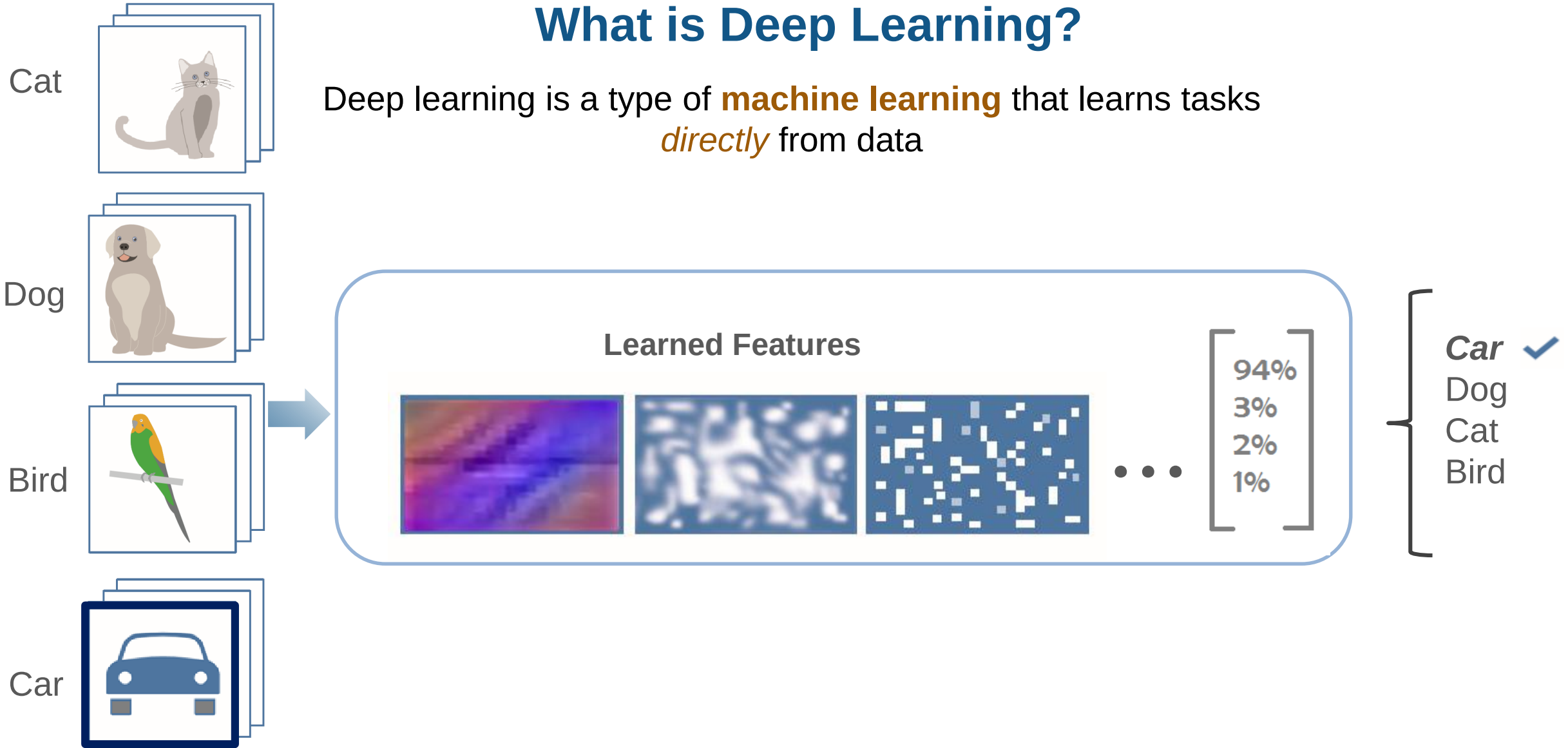
- Industry **leadership** established
- Potential manufacturing **improvements** identified
- Maintenance overhead **minimized**

Artificial Intelligence, Machine Learning and Deep Learning

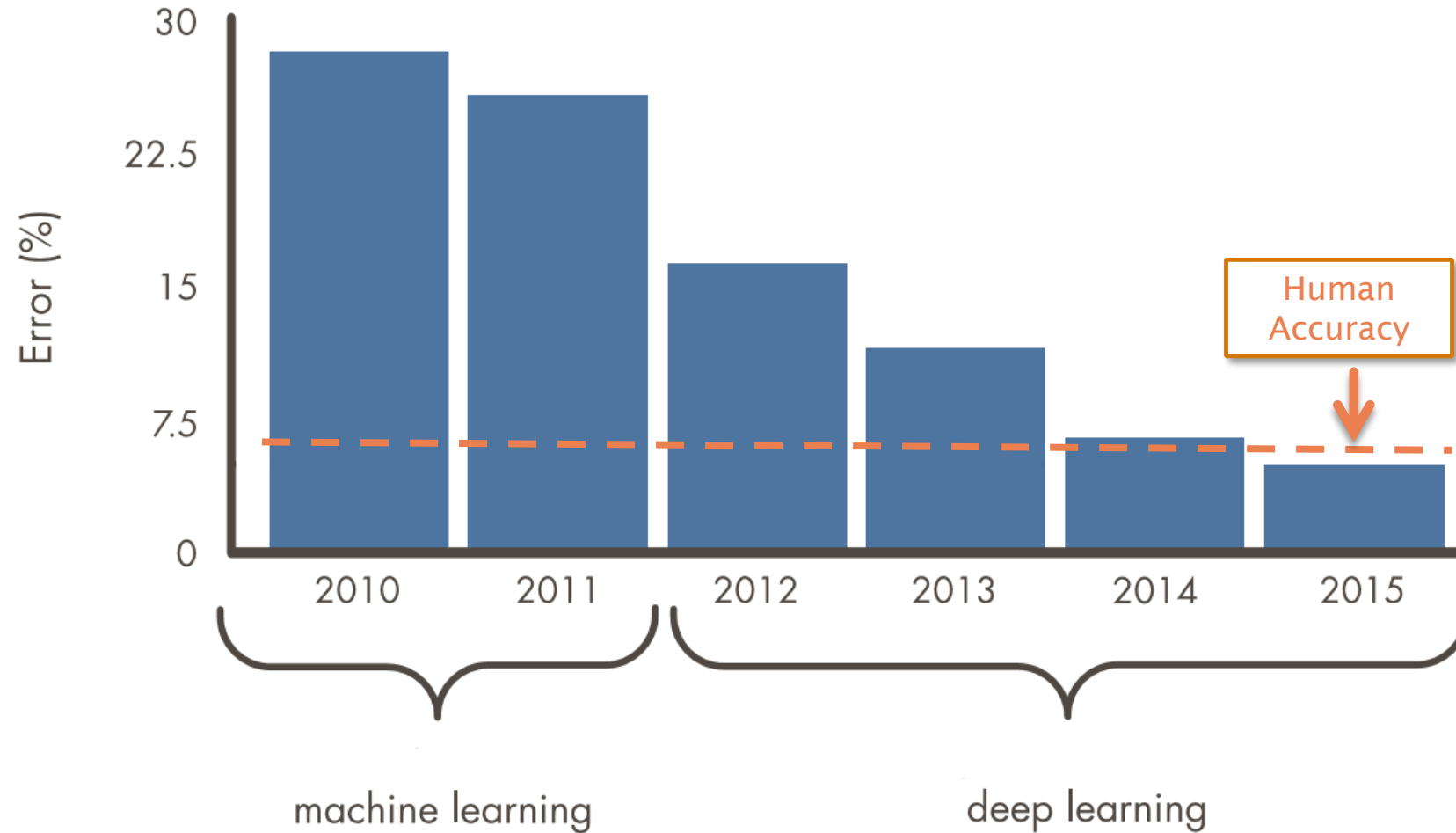


What is Deep Learning?

Deep learning is a type of **machine learning** that learns tasks *directly* from data

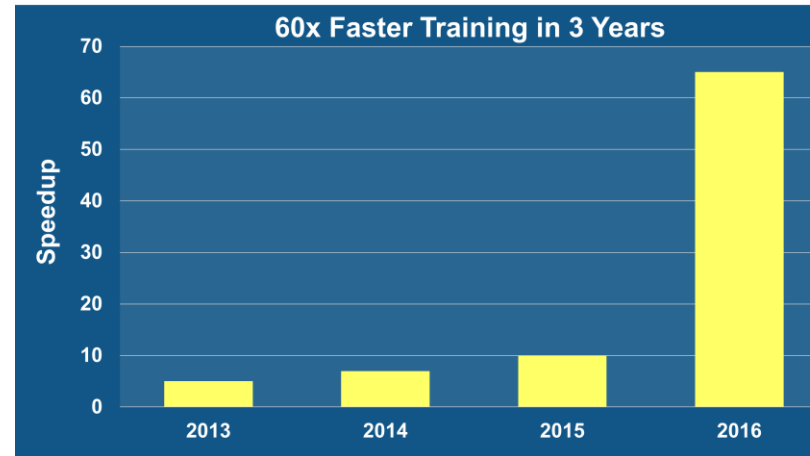


Why is Deep Learning So Popular Now?

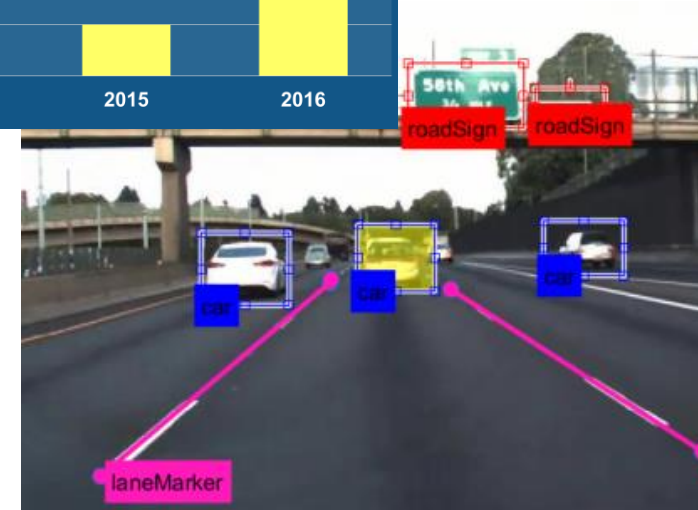


Deep Learning Enablers

Acceleration with GPUs



Massive sets of labeled data



Availability of state of the art models from experts

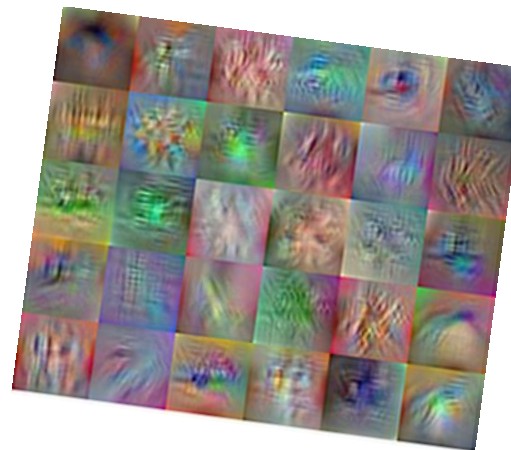
AlexNet
PRETRAINED MODEL

VGG-16
PRETRAINED MODEL

Caffe
MODELS

MATLAB makes Deep Learning Easy and Accessible

- Handle large images sets
- Accelerate with GPUs
- Visualize and debug networks
- Access pre-trained models



AlexNet
PRETRAINED MODEL
VGG-16
PRETRAINED MODEL
Caffe
MODELS

Making Deep Learning easy to use is Changing the World

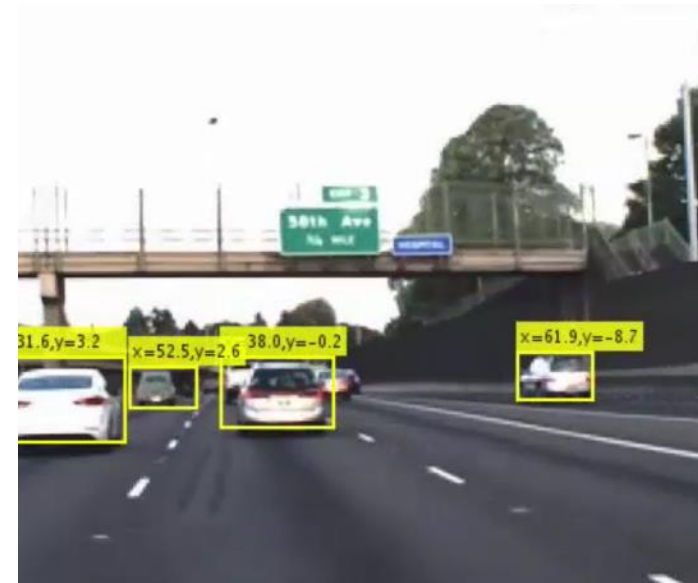
```
ple\CameraAndNetwork.m
clear

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
```



Train a Deep Learning Vehicle Detector

Train a vision-based vehicle detector using deep learning.

Training & Consulting



Data processing
Machine Learning
Computer Vision

MATLAB[®]

Data Analytics

Data Processing and Visualization
Statistics
Machine Learning
Optimization Techniques
Parallel Computing

Application-Specific

Control System Design
Signal Processing
Communication Systems
LTE Systems

Application Development

Programming Techniques
Building Interactive Applications
Object-Oriented Programming

Code Generation

MATLAB Coder
Interfacing with C-code

Computational Finance

Risk Management
Time-Series Modelling

Signal Processing

Using MATLAB
Using Simulink

Image and Video Processing

Image Processing
Computer Vision

SIMULINK[®]

Model-Based Design

Implementing MBD Workflow
Model Management and Architecture
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Code Generation

Rapid Prototyping and HiL-Simulation
Embedded Systems
FPGA Design
Generating HDL Code
Xilinx Zynq SoCs
AUTOSAR

STATEFLOW[®]

Event-Based Modeling

Code Integration

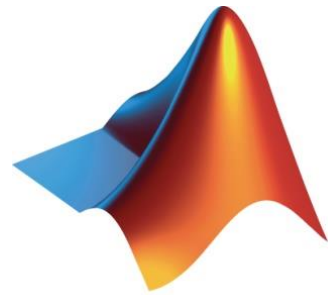
Integrating C and MATLAB

Simscape[™]

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