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**…

... with **industry proven** solutions

... enabling **non-experts**

... from **idea to product**

MATLAB EXPO 2017
Using Machine Learning to build and deploy a predictive maintenance system

Predictive Model deployed to drill site

1TB Pump logs of temperature, pressure & other data

Analytics and Machine Learning plus signal processing, neural networks & more

Maintenance Needed
Autonomous Braking System, Scania
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

Timeline

1950s
- Artificial Intelligence
  - Reasoning
  - Perception
  - Knowledge Representation
  - Machine Translation
  - Computer Board Games
  - Interactive Programs
  - Expert Systems

1980s
- Machine Learning
  - Weather Forecasting
  - Spam Detection
  - Sentiment Analysis
  -Algorithmic Trading
  - Recommander Systems
  - Fraud Detection
  - Biometrics
  - Medical Diagnosis
  - Health Monitoring

Today
- Deep Learning
  - Automated Driving
  - Object Recognition
  - Robotics
  - Speech Recognition

Application Breadth
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?

Source: ILSVRC Top-5 Error on ImageNet
Deep Learning Enablers

Acceleration with GPUs

Massive sets of labeled data

Availability of state of the art models from experts
MATLAB makes Deep Learning Easy and Accessible

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

MATLAB EXPO 2017
Making Deep Learning easy to use is Changing the World

MATLAB EXPO 2017
Training & Consulting

Public

Data processing
Machine Learning
Computer Vision

On-Site
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

**Computational Finance**
- Risk Management
- Time-Series Modelling

**Signal Processing**
- Using MATLAB
- Using Simulink

**Image and Video Processing**
- Image Processing
- Computer Vision

**Model-Based Design**
- Implementing MBD Workflow
- Model Management and Architecture
- Verification and Validation

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

**Code Integration**
- Integrating C and MATLAB

**Polyspace**
- Polyspace Code Prover™

**MATLAB EXPO 2017**

[https://nl.mathworks.com/services/training.html](https://nl.mathworks.com/services/training.html)