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

Solution needs to adapt with changing data
- Weather Forecasting
- Energy Load Forecasting
- Stock Market Prediction

Solution needs to scale
- IoT Analytics
- Taxi Availability
- Airline Flight Delays

Because algorithms can
- learn complex non-linear relationships
- update as more data becomes available
- learn efficiently from very large data sets
What is Machine Learning?

Machine learning algorithms use computational methods to “learn” information \textit{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**
Using Machine Learning to build and deploy a predictive maintenance system

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

1TB

Pump logs of temperature, pressure & other data

Predictive Model deployed to drill site

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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

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

Machine Learning
- Weather Forecasting
- Spam Detection
- Sentiment Analysis
- Algorithmic Trading
- Recommender Systems
- Fraud Detection
- Bioinformatics
- Medical Diagnosis
- Health Monitoring

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

Application Breadth

Timeline
- 1950s
- 1980s
- Today

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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
Making Deep Learning easy to use is Changing the World
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

Computational Finance
Risk Management
Time-Series Modelling

Code Generation
MATLAB Coder
Interfacing with C-code

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

Stateflow®
Event-Based Modeling

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

Polyspace® Code Prover™

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https://nl.mathworks.com/services/training.html