MATLAB EXPO 2017
Machine Learning Simplified

Graham Dudgeon, PhD
Principal Industry Manager
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

- **80% effort**
- **Time consuming for non-data science experts**
- **Requires hand coding, programming skills**

**Access Data**

**Extract Features**

**Develop Models**

**Share Models**
Challenges from our Customers

- Convert **unreadable data** into a usable format.
- **Automate** filtering, spectral analysis, and transform steps for multiple trucks and regions.
- Develop a predictive maintenance system to reduce pump equipment **costs and downtime**.

- **Lack of experience** with neural networks or machine learning.
- Develop a **prototype quickly**, relying on functions that have been deployed across ASML’s large, **diverse user** base and **maintained** by dedicated professionals.
New MATLAB framework makes machine learning easy and accessible for Engineers
MATLAB makes Machine Learning **Easy** and **Accessible**…

- **Access**
- **Preprocess**
- **Develop Models**
- **Share, Integrate**

**Big Data**, **Visuals**, **APPs**, **Enterprise**

... with **industry proven** solutions  
... enabling **non-experts**  
... from **idea** to **product**
MATLAB makes Machine Learning **Easy** and **Accessible**…

... with **industry proven** solutions

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Using Machine Learning to build and deploy a predictive maintenance system

Pump logs of temperature, pressure & other data

1TB

Predictive Model deployed to drill site

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

Maintenance Needed
Using Machine Learning
to build and deploy a predictive maintenance system

Pump logs
of temperature, pressure
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1TB

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deployed to drill site

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Machine Learning
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MathWorks
MATLAB EXPO 2017
Catchup of moving object
AI, Machine Learning and Deep Learning

Timeline

1950s
1980s
Today

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

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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
New MATLAB framework makes deep learning easy and accessible for Engineers
MATLAB makes Deep Learning Easy and Accessible

• Handle large images sets

• Accelerate with GPUs

• Visualize and debug networks

• Access pre-trained models
Deep Learning is Changing the World

Transfer learning in 10 lines of code!

Train from scratch!
Deep Learning is changing the world

Transfer learning in 10 lines of code!

Train from scratch!
“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**
How to get started?

- Data Processing
- Machine Learning
- Computer Vision
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- 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

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

Application Development
- Programming Techniques
- Building Interactive Applications
- Object-Oriented Programming

Computational Finance
- Risk Management
- Time-Series Modelling

Code Integration
- Integrating C and MATLAB

Signal Processing
- Using MATLAB
- Using Simulink

Polyspace®
- Polyspace Code Prover™

Image and Video Processing
- Image Processing
- Computer Vision

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