MATLAB EXPO 2017
Machine Learning Simplified

Graham Dudgeon, PhD
Principal Industry Manager
Brain-controlled Robots
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 directly from data without assuming a predetermined equation as a model.
Challenges

- **Access Data**
- **Extract Features**
- **Develop Models**
- **Share Models**

**80% effort**

**Time consuming for non-data science experts**

**Requires hand coding, programming skills**
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...

... with **industry proven** solutions

... enabling **non-experts**

... from **idea to product**

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Using Machine Learning to build and deploy a predictive maintenance system

Pump logs of temperature, pressure & other data

1TB

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

Predictive Model deployed to drill site

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

Pump logs
of temperature, pressure
& other data

1TB

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

Predictive Model
deployed to drill site

Maintenance
Needed
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
- 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.

Learned Features

Car
Dog
Cat
Bird
Why is Deep Learning So Popular Now?

![Graph showing the improvement in error rate from 2010 to 2015, with deep learning showing a lower error rate than machine learning.](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

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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!

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Deep Learning is changing the world

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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**
How to get started?

- Data Processing
- Machine Learning
- Computer Vision
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