Transformation to Artificial Intelligence with MATLAB

Roy Lurie, PhD
Vice President of Engineering
MATLAB Products
A brief history of the automobile

First Commercial Gas Car

1885

Benz Patent Motor Car
A brief history of the automobile

First Affordable Car

1908

Ford Model T
A brief history of the automobile

1981

First ECU

GM Vehicles
A brief history of the automobile

1981

TODAY
The First Digital Transformation: Embedded Controls in Everything

Model-Based Design

Data Analysis

Engine Calibration

MathWorks®
A brief history of the automobile

First Connected Cars

1996

GM OnStar
A brief history of the automobile

First ADAS

2000

Mercedes-Benz Actros
Lane Departure Warning System
A brief history of the automobile

2000

Today/Soon
The Second Digital Transformation: Artificial Intelligence Everywhere
Using Machine Learning to build and deploy a predictive maintenance system

1TB Pump logs of temperature, pressure & other data

Predictive Model deployed to drill site

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

Maintenance Needed
Catchup of moving object
Using Model-Based Design and Data Analytics to design and verify an automated driving system

Vehicle Logs of video and radar data

80 TB

Sensor Fusion

Visualize Sensor Data

Machine Learning extract interesting events

Log vehicle data

Algorithms deployed on vehicle

Re-simulate Refine Algorithm
Challenges of developing and integrating AI

- Big Data Analytics
- Machine Learning and Deep Learning
- Cloud and Embedded Algorithm Deployment

MATLAB makes Al easy and accessible for Engineers
### MATLAB makes big data easy and accessible for Engineers

**Working with Real-World Data**

<table>
<thead>
<tr>
<th><strong>Numeric</strong></th>
<th><strong>Heterogeneous</strong></th>
<th><strong>Text</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>double, single, …</td>
<td>logical</td>
<td>char</td>
</tr>
<tr>
<td>categorical</td>
<td>datetime</td>
<td>cell string</td>
</tr>
<tr>
<td>duration</td>
<td>calendarDuration</td>
<td>string</td>
</tr>
<tr>
<td>timetable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MATLAB makes big data easy and accessible for Engineers

Working with Really Big Data
MATLAB makes big data easy and accessible for Engineers

Data Analysis Apps

Regression Learner
Deep Learning is changing the world
Deep Learning Tools are for Programmers

Caffe  TensorFlow

torch  theano
MATLAB makes **deep learning** easy and accessible for Engineers

```matlab
% Connect to the camera
camera = webcam;

% Load the neural net
net = alexnet;

% Take a picture
picture = camera.snapshot;

% Resize the picture
picture = imresize(picture,[227,227]);

% Classify the picture
label = classify(net, picture);

% Show the picture
image(picture);

% Show the label
disp(char(label));
```

camera = webcam;
img = snapshot(camera);

net = alexnet;
label = classify(net, img)
MATLAB makes deep learning easy and accessible for Engineers

Vehicle Detection with Deep Learning
Only MATLAB and Simulink get analytics to both embedded and enterprise systems
Each release makes AI easy and accessible

**R2016b**
- JSON
- Neo4j
- Mobile Sensors Cloud Logging
- Timetable
- String
- Preprocessing Functions
- Missing Data Functions
- Tall Arrays
- Big Data Algorithms
- Deep Learning
- Hyperparameter Optimization
- Spark
- MATLAB on ThingSpeak
- ThingSpeak Paid Options
- Machine Learning Code Generation
- MATLAB Production Server
- RESTful Interface
- Deep Learning on Amazon GPU
- Live Script Equation Editor
- Live Script Interactive Plots
- Live Scripts in MATLAB Online
- Live Scripts in MATLAB Examples
- App Designer UITable
- MATLAB Mobile Editor
- MATLAB Mobile Open Access
- MATLAB Online for All Named users
- AlexNet

**R2017a**
- Live Script Editable Figures
- App Designer full 2D plotting
- App Designer Interactive Tutorial
- MATLAB Drive
- Heatmap Charts
- Regression Learner app
- Machine Learning Classification Code Generation
- Deep Learning Regression
- Deep Learning on CPU and Multiple GPU
- VGG-16, VGG-19
- CAFFE Model Zoo
- Tall timetable
- Add-On Explorer Categories
- Live Legends
- Categorical Plotting
- Preprocessing Functions
- Faster Object Property Setting
- Object Property Typing
- Offline Mobile Sensing
- Bayesian Statistics
- Symbolic Variable Units
Unique Platform Combination

Powering New Applications

- Control Systems
- Verification & Validation
- Code Generation
- Big Data
- Machine Learning
- Signal and Image Processing

Model-Based Design

Data Analytics
This is not your father's Oldsmobile.