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
A brief history of the automobile

1981

TODAY
The First Digital Transformation: Embedded Controls in Everything

Model-Based Design

Data Analysis

Engine Calibration
A brief history of the automobile

First Connected Cars

1996

GM OnStar
A brief history of the automobile

2000

First ADAS

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

2000

Today/Soon
The Second Digital Transformation: Artificial Intelligence Everywhere

Model-Based Design  Data-Driven Algorithms

OnStar®
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
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
- Machine Learning extract interesting events
- Visualize Sensor Data
- Sensor Fusion
- Generate statistics and compare candidates
- Analyze situations
- Re-simulate Refine Algorithm
- Log vehicle data
- Algorithms deployed on vehicle

Scania
Challenges of developing and integrating AI

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

MATLAB makes AI easy and accessible for Engineers
MATLAB makes big data easy and accessible for Engineers Working with Real-World Data

### Numeric
- double, single, ...
- logical
- categorical
- datetime
- duration
- calendarDuration

### Heterogeneous
- structure
- cell
- table
- timetable

### Text
- char
- cell string
- string
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
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
webcam; % Connect to the camera
aleXnet; % Load the neural net

picture = camera.snapshot; % Take the picture
picture = imresize(picture,[227,227]); % Resize the picture

label = classify(nnet, picture); % Classify the picture
show(picture); % Show the picture
show(char(label)); % Show the label
```

![Image of pineapple](image)
MATLAB makes deep learning easy and accessible for Engineers

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

**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

Each release makes AI easy and accessible.
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.