MATLAB EXPO 2018

Are you ready for AI?
Is AI ready for you?

Sameer M. Prabhu, Ph. D.
MathWorks Industry Marketing Director
Alexa –
Write my Expo keynote for me
Alexa –
Play soothing jazz
Artificial Intelligence Is in Early Adoption

Percentage of Respondents

- 14% No interest
- 35% On the radar, no action planned
- 25% In medium- or long-term planning
- 21% In short-term planning/actively experimenting
- 4% Have already invested and deployed

Source: Gartner, *Real Truth of Artificial Intelligence* by Whit Andrews
Presented at Gartner Data & Analytics Summit 2018, March 2018
Artificial Intelligence

The capability of a machine to imitate intelligent human behavior
Artificial Intelligence

The capability of a machine to match or exceed intelligent human behavior
Artificial Intelligence Today

The capability of a machine to match or exceed intelligent human behavior

by training a machine to learn the desired behavior
There are two ways to get a computer to do what you want

Traditional Programming

Data → COMPUTER → Output

Program
There are two ways to get a computer to do what you want

Machine Learning

Data → COMPUTER → Program

Output
There are two ways to get a computer to do what you want

Machine Learning

Data → COMPUTER → Model

Output

Artificial Intelligence  Machine Learning
Are you ready for AI?
Are you ready for AI?

Data

Output

Model
Are you ready for AI?

Access Data

Analyze Data

Data

Output

Model
Are you ready for AI?

Data

Model

Access Data

Analyze Data

Develop

Deploy
Are you ready for AI?

- Access Data
- Develop
- Analyze Data
- Deploy

Data
Output
Model

EVERYTHING ELSE
<table>
<thead>
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Caffe

TensorFlow
Do you need AI?
AI for Predictive Maintenance

- Measure the wear of each robot
- Predict and fix failures before they happen
- AI handles uncertainty and variability
Are you ready for AI if …

You’ve never used machine learning?
What is crispiness?

Crushing Sound + Crushing Force = Crispy Enough

Crispy
Crispy Enough
Soggy
Replicating human perception with machine learning
Technical University of Munich

Machine Learning Workflow

Data → Feature extraction → Classification

- Crispy
- Crispy enough
- Soggy

Crispy 👍ly enough

Data

Feature extraction

Classification

Crispy
Crispy enough
Soggy
Replicating human perception with machine learning
Technical University of Munich

Classification Learner
True Class

Fresh

93%

91%

91%

91%

89%

95%

Predicted Class

Fresh

Soggy

Soggy
Are you ready for AI if you’ve never used machine learning?

- No experience required
- Use apps to try out all possible models
- Use domain expertise and familiar tools to prepare data
Are you ready for AI if …

You can’t identify features in your data?
Use deep learning to identify features automatically

Machine Learning Workflow

Data -> Feature extraction -> Classification

- Crispy
- Crispy enough
- Soggy
Use deep learning to identify features automatically

Machine Learning Workflow

Data → Feature extraction → Classification

Deep Learning Workflow

Data → Deep neural network → Classification

Crispy ✓

Crispy enough

Soggy

Deep neural network

95%

3%

2%
Mikusa Tunnel
Japan
Traditional Approach
- Geologists assess seven different metrics
- Can take hours to analyze one site
- Critical shortage of geologists

New Approach
- Use deep learning to automatically recognize metrics based on images
- On-site evaluators decide with support from deep learning

Mikusa Tunnel Japan
Efficient tunnel drilling with deep learning
Obayashi Corporation

Split into sub-images

Label each sub-image

<table>
<thead>
<tr>
<th>Image</th>
<th>Weathering Alteration (1-4)</th>
<th>Fracture Spacing (1-5)</th>
<th>Fracture State (1-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
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<td>4</td>
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Efficient tunnel drilling with deep learning
Obayashi Corporation

Transfer learning

AlexNet
PRETRAINED MODEL

Ice cream  Teapot  Goose

Custom Network

Weathering alteration: 4
Fracture spacing: 3
Fracture state: 2
Efficient tunnel drilling with deep learning
Obayashi Corporation

Transfer learning

MATLAB Production Server

AlexNet
PRETRAINED MODEL

Ice cream  Teapot  Goose

Custom Network

Weathering alteration: 4
Fracture spacing: 3
Fracture state: 2
Are you ready for AI if you can’t identify features in your data?

- Deep learning

```matlab
nnet = alexnet;

cam = webcam;
picture = snapshot(cam);
picture = imresize(picture,[227 227]);

label = classify(nnet, picture)
```
Are you ready for AI if you can’t identify features in your data?

- Deep learning
- Transfer learning

Deep learning in 5 lines of code
Are you ready for AI if you can’t identify features in your data?

- Deep learning
- Transfer learning
- Automation and AI to label data

Classification

<table>
<thead>
<tr>
<th></th>
<th>Car</th>
<th>Truck</th>
<th>Background</th>
<th>Ground</th>
</tr>
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<tbody>
<tr>
<td>Color</td>
<td>Red</td>
<td>Orange</td>
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Point cloud semantic segmentation
Are you ready for AI if you can’t identify features in your data?

- Deep learning
- Transfer learning
- Automation and AI to label data

Classification

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Are you ready for AI if you can’t identify features in your data?

- Deep learning

Find out more:

Track C: Engineering Data Analytics and Image Processing for Enterprise Applications

11:30: Demystifying Deep Learning: A Practical Approach in MATLAB – Abhijit Bhattacharjee (深度學習揭密：MATLAB最佳實務及影像篇)

15:00: Demystifying Deep Learning: Signal Focus – Abhijit Bhattacharjee (深度學習揭密：訊號篇)
Are you ready for AI if …

If you don’t have the right data?
AI for Predictive Maintenance

- Measure the wear of each blade
- Predict and fix failures before they happen
- Can’t rely on failures in the field
Predictive maintenance with synthetic failure data with MATLAB & Simulink
Predictive maintenance with synthetic failure data with MATLAB & Simulink

- Measured data
- Refine model
- Failure characteristics
- Simulink model
- Modify model
- Failure signals
Predictive maintenance with synthetic failure data with MATLAB & Simulink

Find out more:
Track C: Engineering Data Analytics and Image Processing for Enterprise Applications

14:10: Demystifying Industry 4.0, Digital Twin, and Predictive Maintenance – Sameer M. Prabhu
(工業4.0、數位分身(Digital Twin)、與預測性維護大解密)
Are you ready for AI if you don’t have the right data?

- Generate difficult to obtain data with simulations
- Use that data to train your AI system
Low-carbon homes

- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage
Low-carbon homes

- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage

Goals

- Minimize energy cost
- Use EV battery for additional storage
Optimizing home energy management system

Denso

Generated and consumed power

Home Energy Controller

Battery command

Stored energy

Home
Optimizing home energy management system
Denso

- Electricity prices
- Predicted vehicle use
- Generated and consumed power
- Battery command
- Stored energy

Model predictive control
Mixed integer linear programming
Simscape Electrical
Optimizing home energy management system
Denso

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<tr>
<td>1000 CSV Files</td>
<td>Preprocessing</td>
<td>Classification Learner</td>
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<td>Parallel computing</td>
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Optimizing home energy management system
Denso

Access Data
- 1000 CSV Files

Analyze Data
- Preprocessing
- Parallel computing

Develop
- Classification Learner
- Simulink
- Simscape Power Systems
- Control algorithms
- Optimization

Deploy
- Embedded devices
"The effort would have taken significantly longer if we had used disparate tools. [MATLAB] enabled our team of domain experts, who lacked formal training in data science, machine learning, and parallel computing, to incorporate all these areas in our design process."

Akira Ito and Ryu Matsumoto
Exceeding human capabilities with a robotic drumming prosthesis

Georgia Tech Center for Music Technology
Exceeding human capabilities with a robotic drumming prosthesis
Georgia Tech Center for Music Technology

Host computer
Prosthesis

Microphone
EMG

Processing laptop

AI algorithms
PID controller

Drummer

Music
Exceeding human capabilities with a robotic drumming prosthesis
Georgia Tech Center for Music Technology

Find out more:

Track B: Autonomous Systems and Model Based Design

13:20: Sensor Fusion and Tracking for Automated Driving – Abhijit Bhattacharjee (自動駕駛系統的感測器融合與追蹤設計)
14:10: Model-Based Design for Advanced Driver Assistance System – Weber Lee (ADAS主動安全系統開發)
15:00: Model-based Design of an LCD Panel Test Automation System with a Delta Robot - Prof. Chen Chwan Hsen (運用模型設計的Delta機械臂車用觸控電腦自動化測試系統)
Are you ready for AI?

Is AI ready for you?
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AI handles uncertainty and variability
Are you ready for AI if …
Are you ready for AI if …

You’ve never used machine learning?  Easy programming
   Apps
   Domain expertise to prepare data
Are you ready for AI if …

You’ve never used machine learning? Easy programming
Apps
Domain expertise to prepare data

You can’t identify features in your data? Deep learning identifies features for you
Transfer learning works with less data
Use AI to label data
Are you ready for AI if …

You’ve never used machine learning?  
- Easy programming
- Apps
- Domain expertise to prepare data

You can’t identify features in your data?  
- Deep learning identifies features for you
- Transfer learning works with less data
- Use AI to label data

You don’t have the right data?  
- Generate synthetic data with simulations
- Use that data to train your AI
With MATLAB and Simulink, you ARE ready for AI!