


MATLAB EXPO 2018

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

Loren Shure





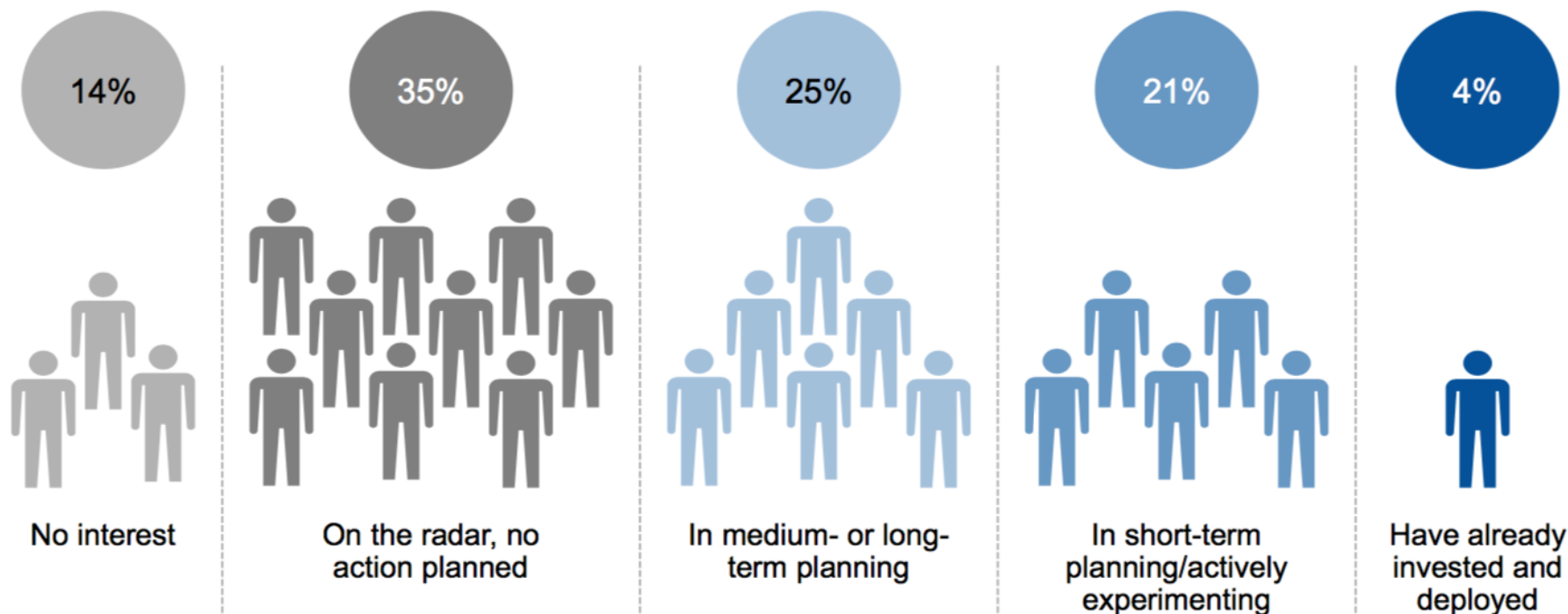
Alexa –
Write my Expo
keynote for me



Alexa –
Play soothing jazz

Artificial Intelligence Is in Early Adoption

Percentage of Respondents



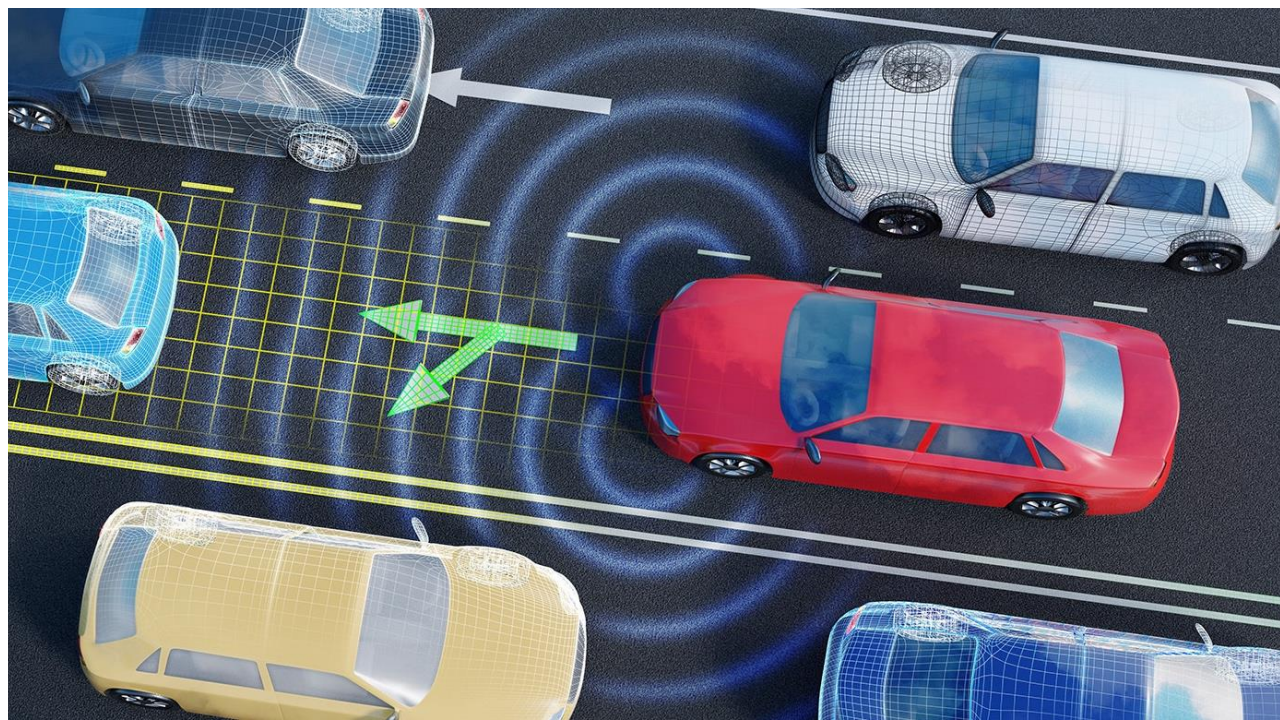
Q: What are your organization's plans in terms of artificial intelligence?

Base: All Answering, n = 3,138

Source: Gartner 2018 CIO Survey

1 © 2018 Gartner, Inc. and/or its affiliates. All rights reserved.

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



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

Machine Learning



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

Machine Learning



Artificial Intelligence

Machine Learning

Are you ready for AI?



Data



Output



Model



Are you ready for AI?



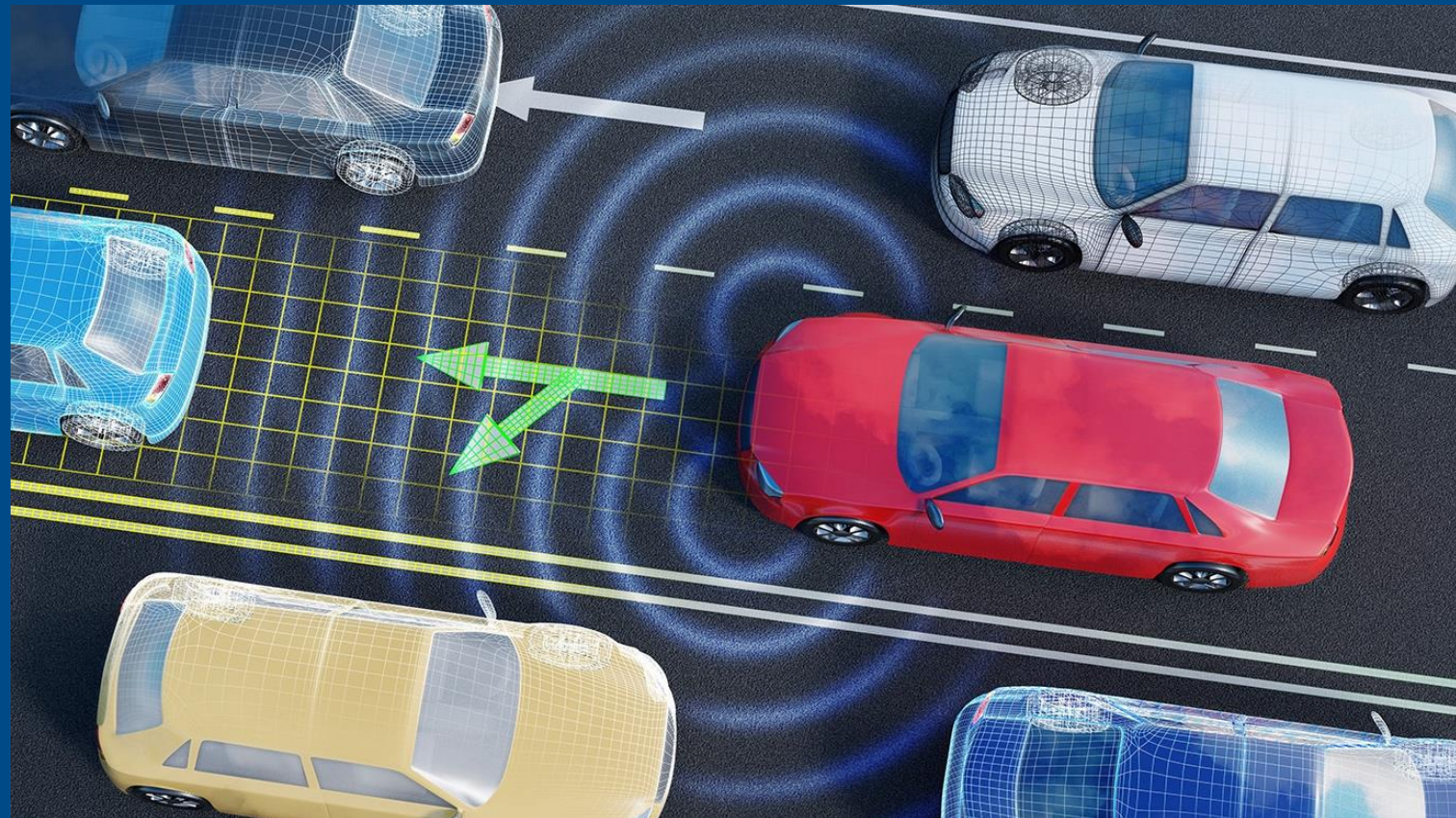
Data



Output



Model



Are you ready for AI?

Access Data

Analyze Data



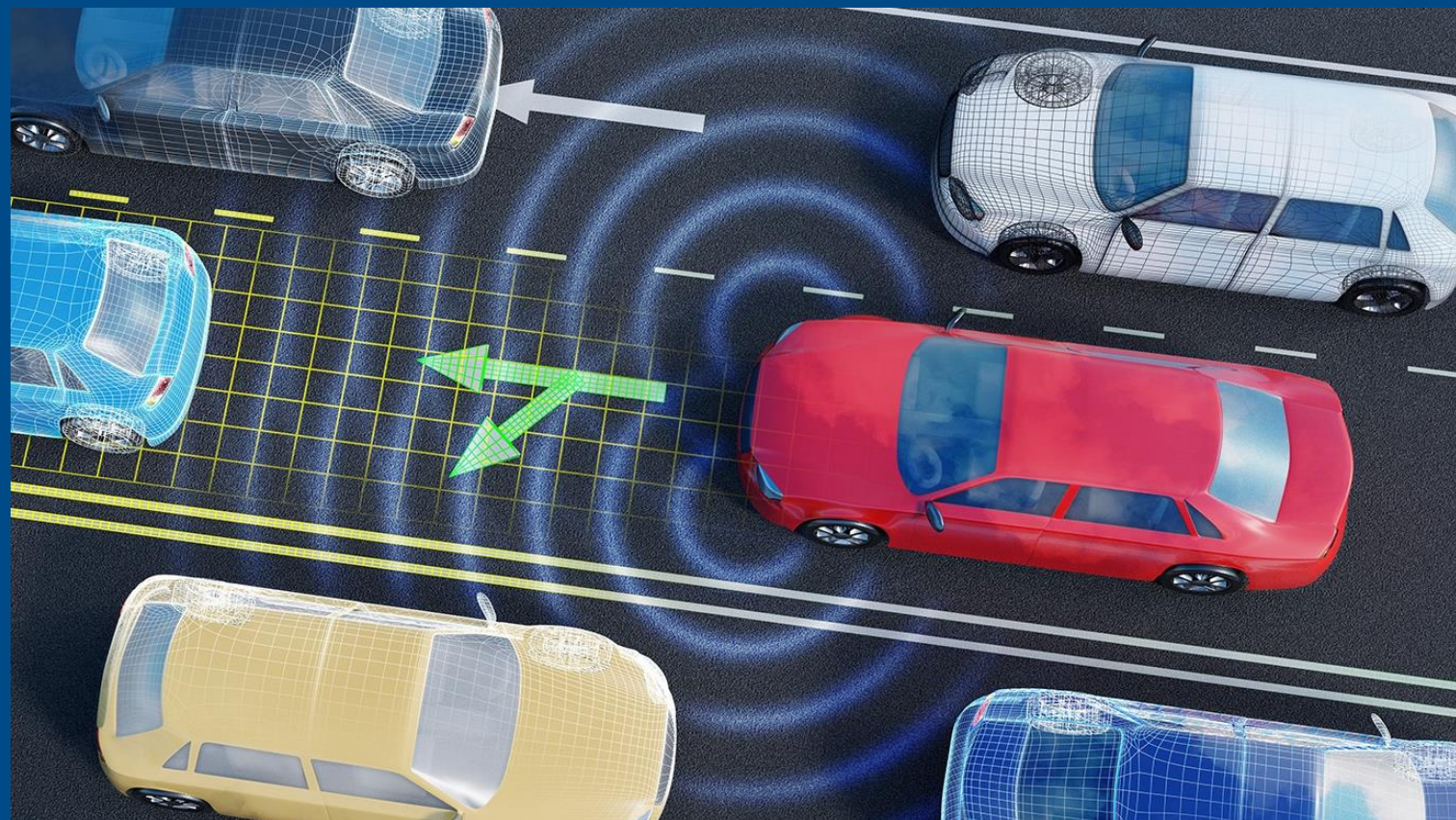
Data



Output



Model



Are you ready for AI?

Access Data

Analyze Data

Develop

Deploy



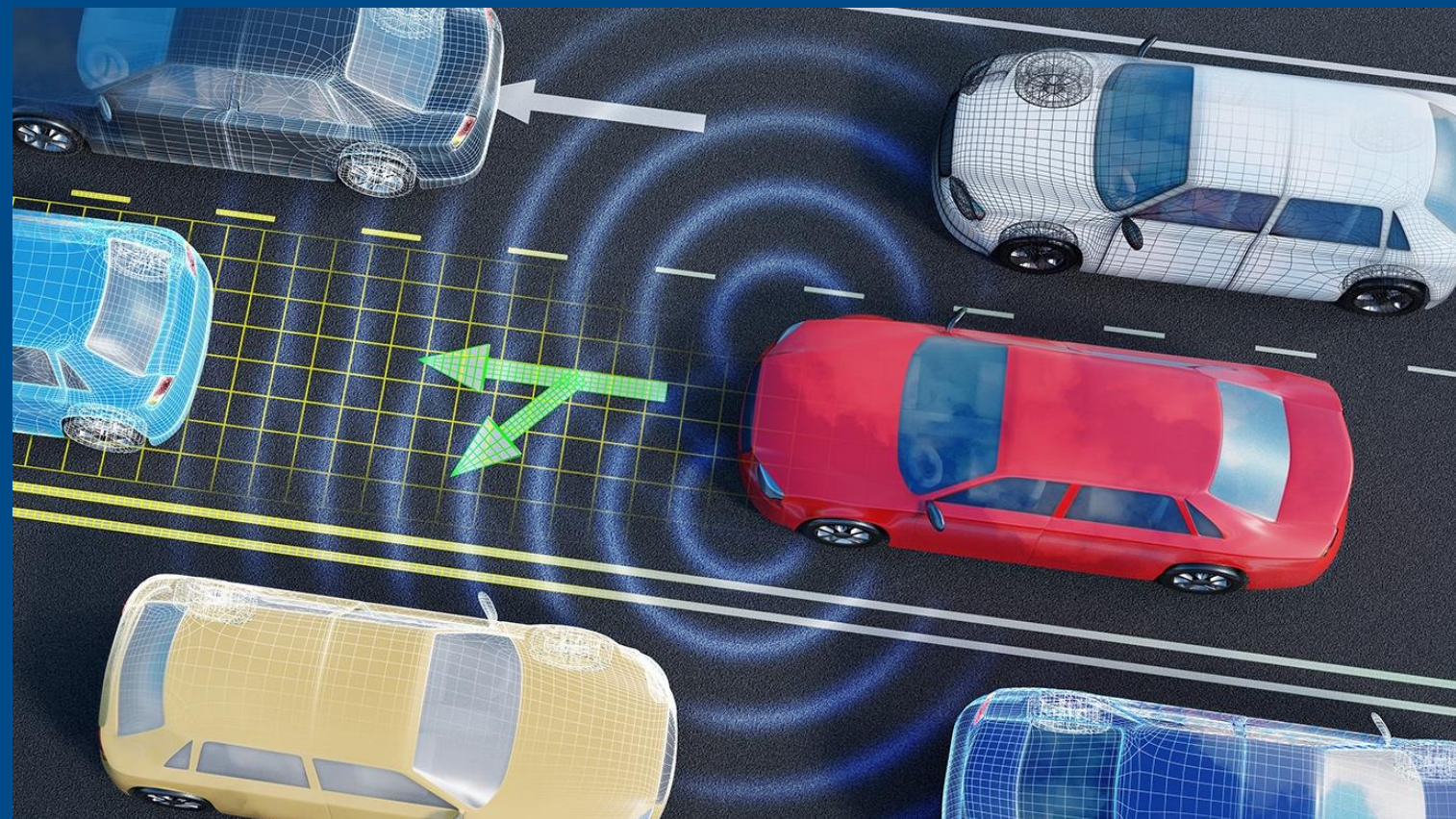
Data



Output



Model



Are you ready for AI?

Access Data

Develop

Analyze Data

Deploy



Data



Output



Model

EVERYTHING

ELSE

Are you ready for AI?

Access Data

Analyze Data

Develop

Deploy



AI model



Algorithm
development



Modeling &
simulation

Are you ready for AI?

Access Data



Sensors



Files



Databases

Analyze Data



Data exploration



Preprocessing



Domain-specific algorithms

Develop



AI model



Algorithm development



Modeling & simulation

Deploy

Are you ready for AI?

Access Data



Sensors



Files



Databases

Analyze Data



Data exploration



Preprocessing



Domain-specific algorithms

Develop



AI model



Algorithm development



Modeling & simulation

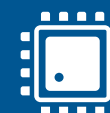
Deploy



Desktop apps

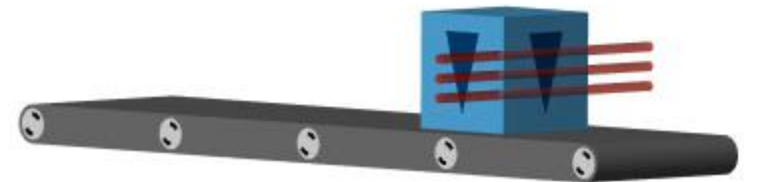


Enterprise systems



Embedded devices

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?

Twisties

Cheese

Twisties

Chicken



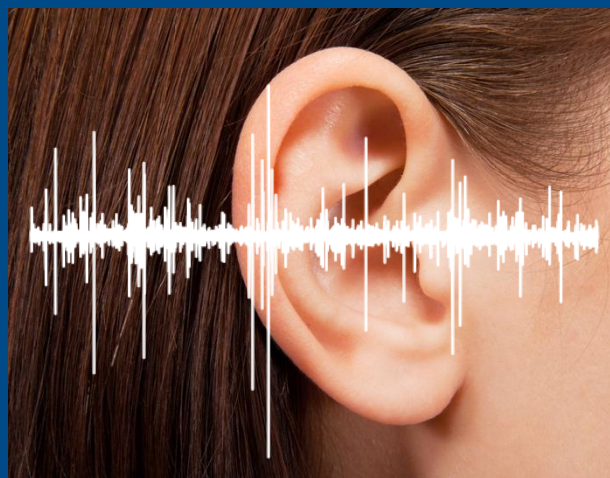
FAT 16.5 g 32%
SAT FAT 3.1 g 13%
SUGARS 1.6 g 2%
SODIUM 245 mg 11%

90g e NET
Flavoured snack

FAT 7.4 g 11%
SAT FAT 3.6 g 15%
SUGARS 0.7 g 1%
SODIUM 213 mg 9%

90g e NET
Flavoured snack

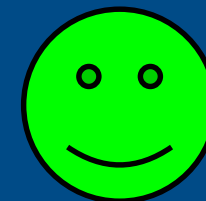
What is crispiness?



Crushing Sound



Crushing Force



Crispy



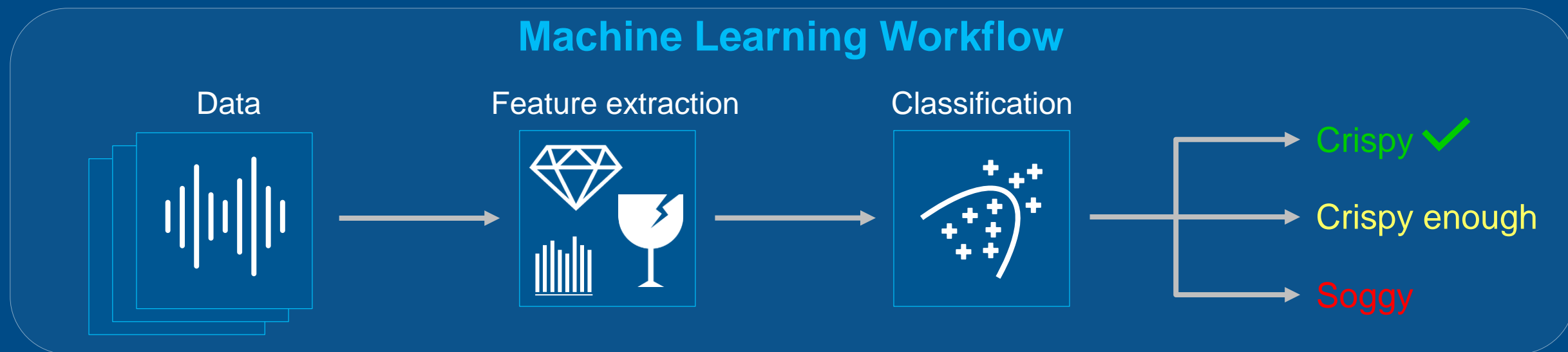
Crispy Enough



Soggy

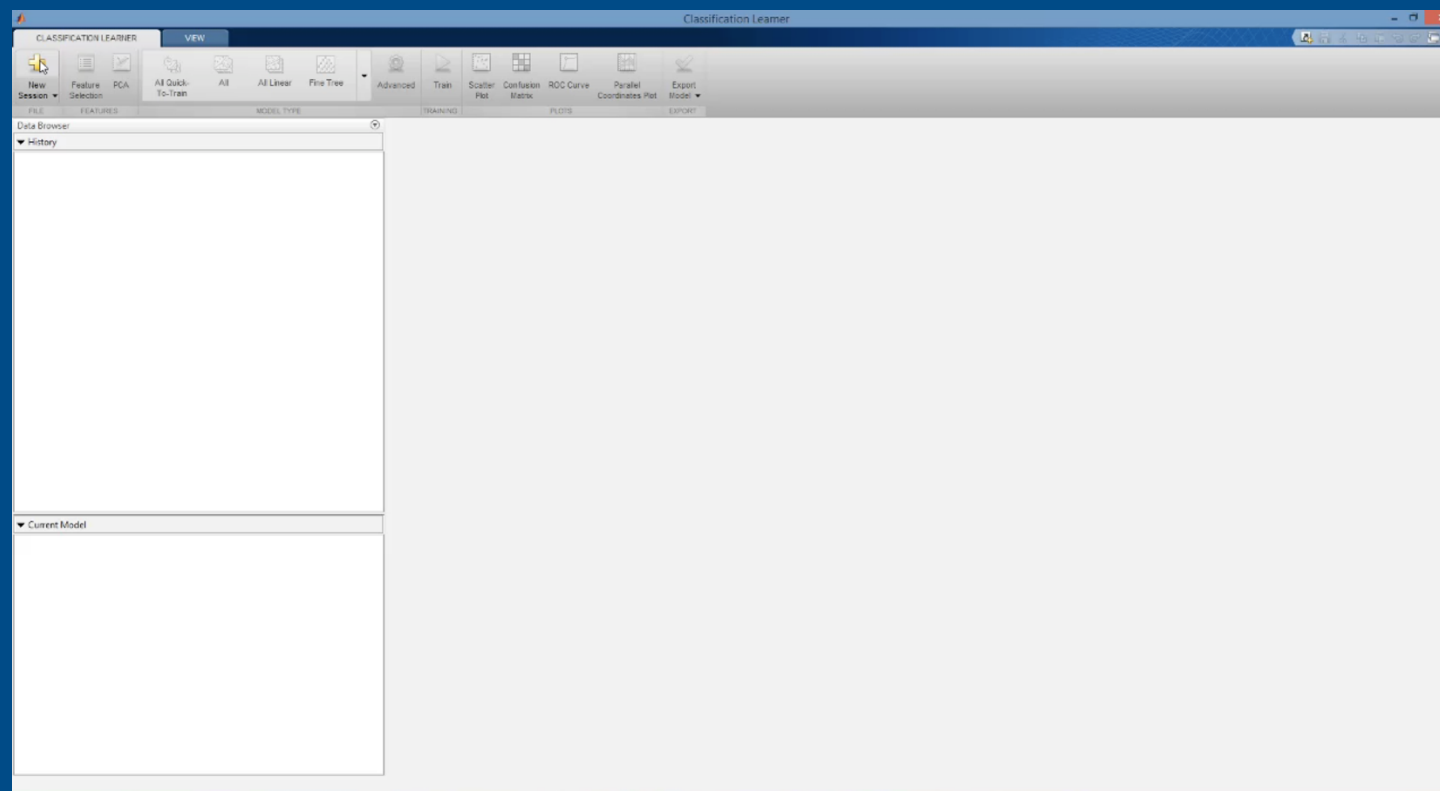
Replicating human perception with machine learning

Technical University of Munich

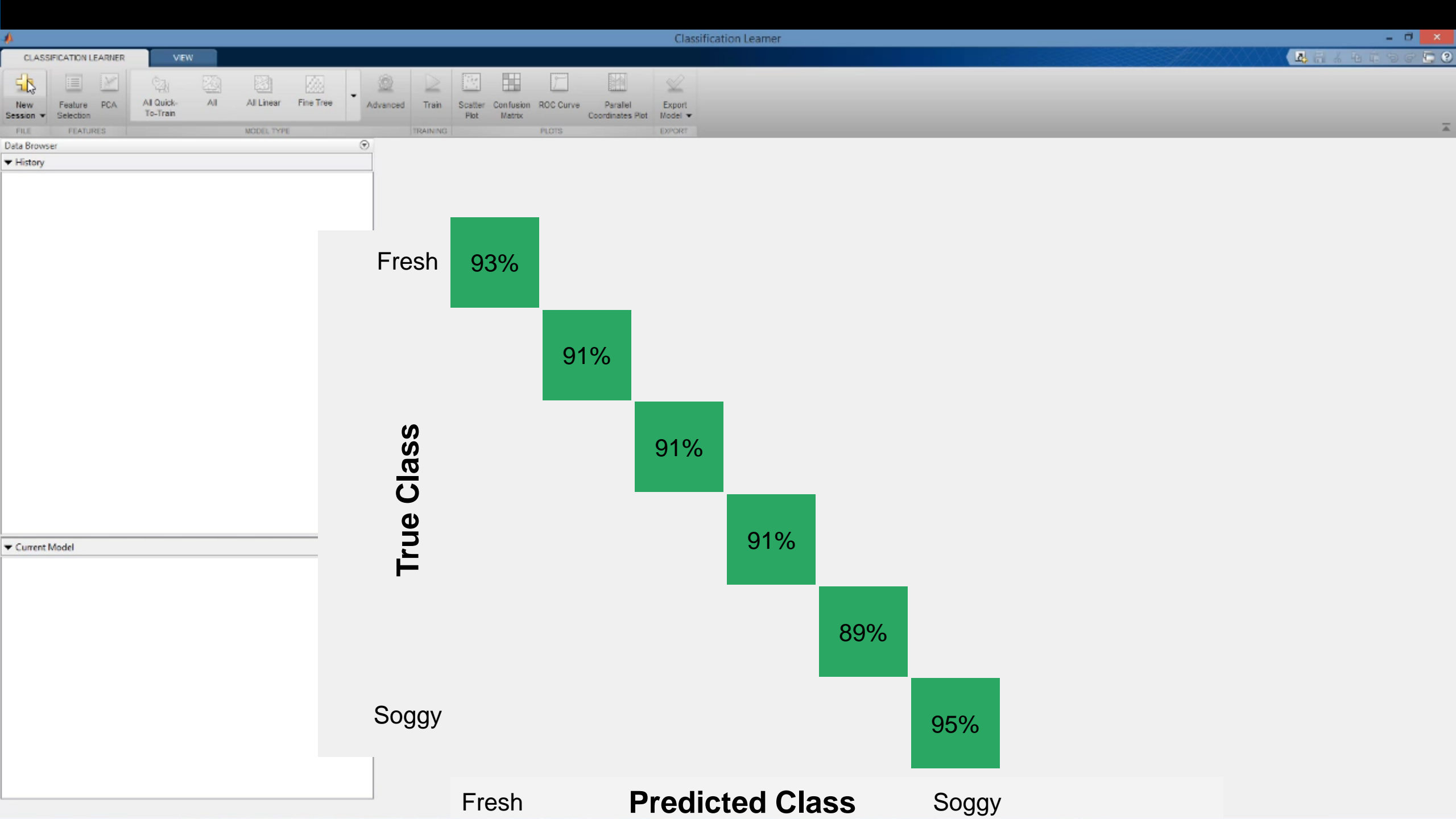


Replicating human perception with machine learning

Technical University of Munich



Classification Learner

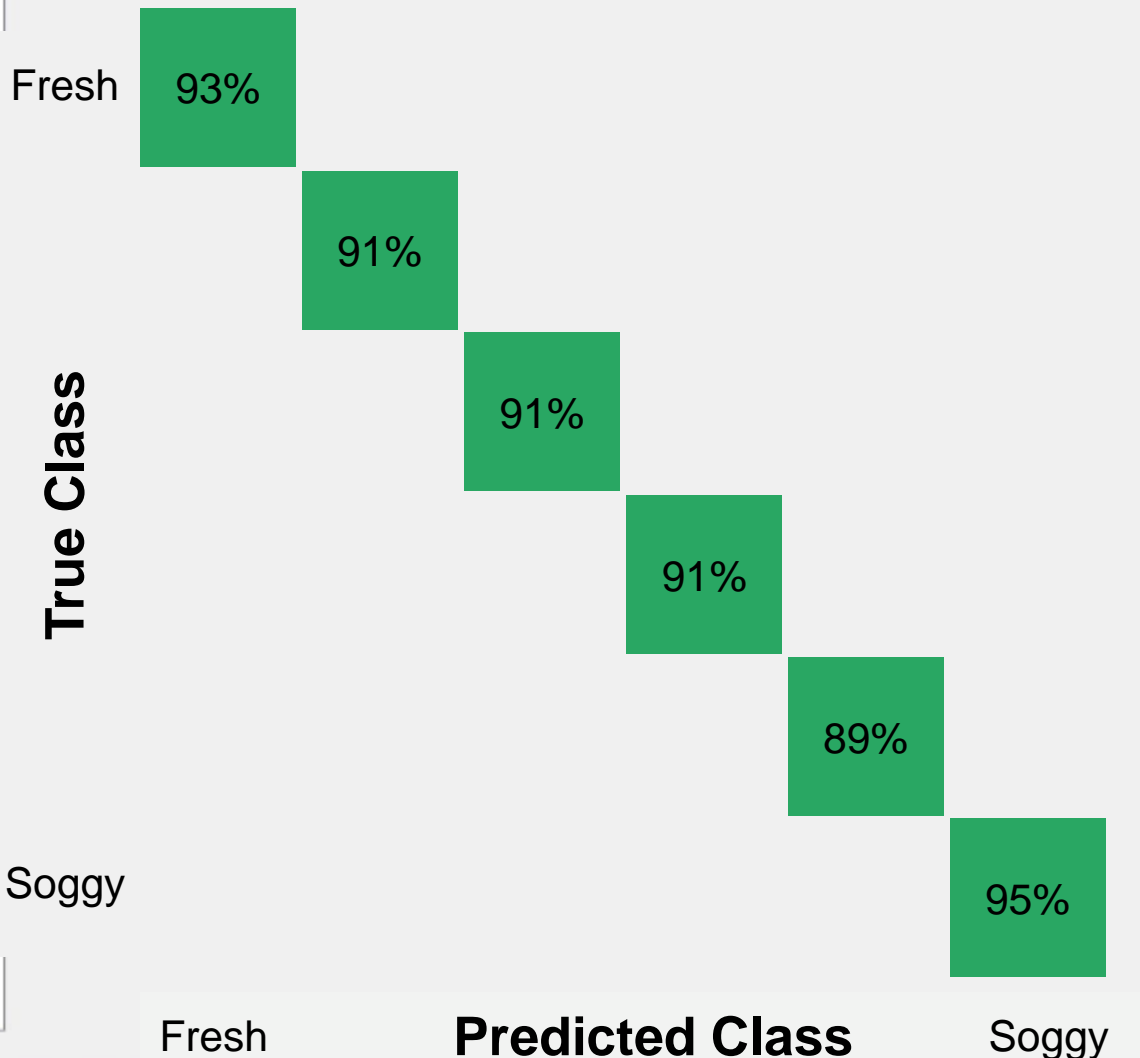


Navigation and toolbars including: New Session, Feature Selection, PCA, All Quick-To-Train, All, All Linear, Fine Tree, Advanced, Train, Scatter Plot, Confusion Matrix, ROC Curve, Parallel Coordinates Plot, Export Model.

Data Browser

▼ History

▼ Current Model



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

- Use domain expertise to identify relevant features
- Use familiar tools to load and process data
- Use apps to explore possible machine learning models

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



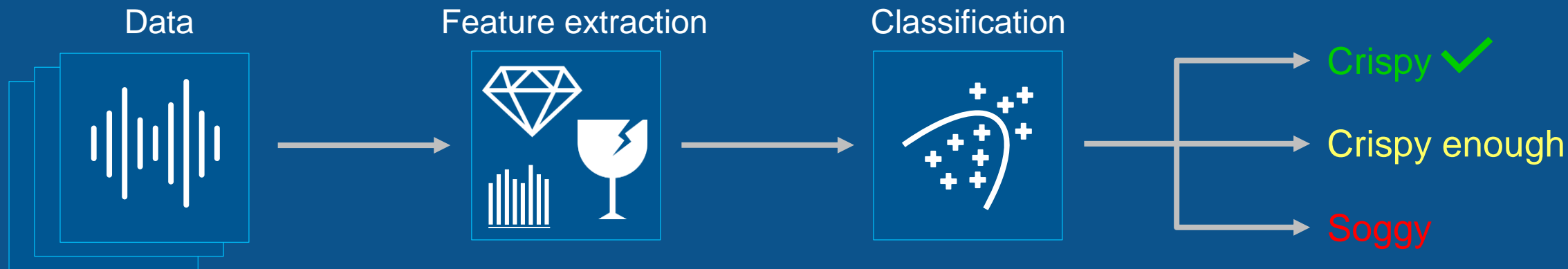
Crispy ✓

Crispy enough

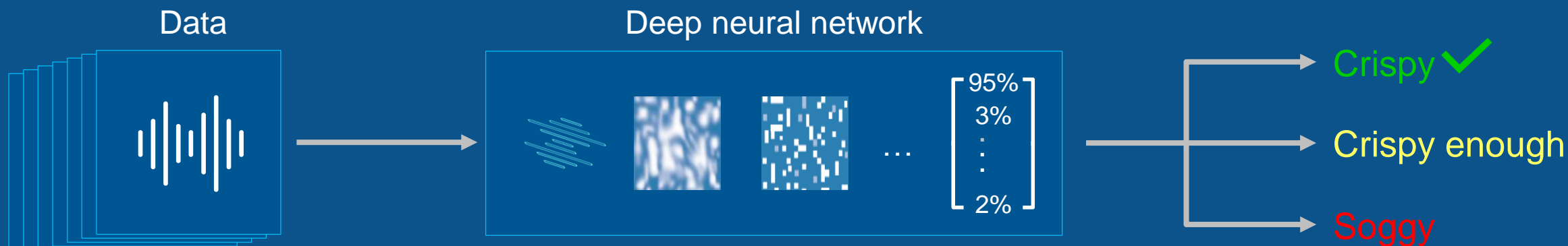
Soggy

Use deep learning to identify features automatically

Machine Learning Workflow



Deep Learning Workflow



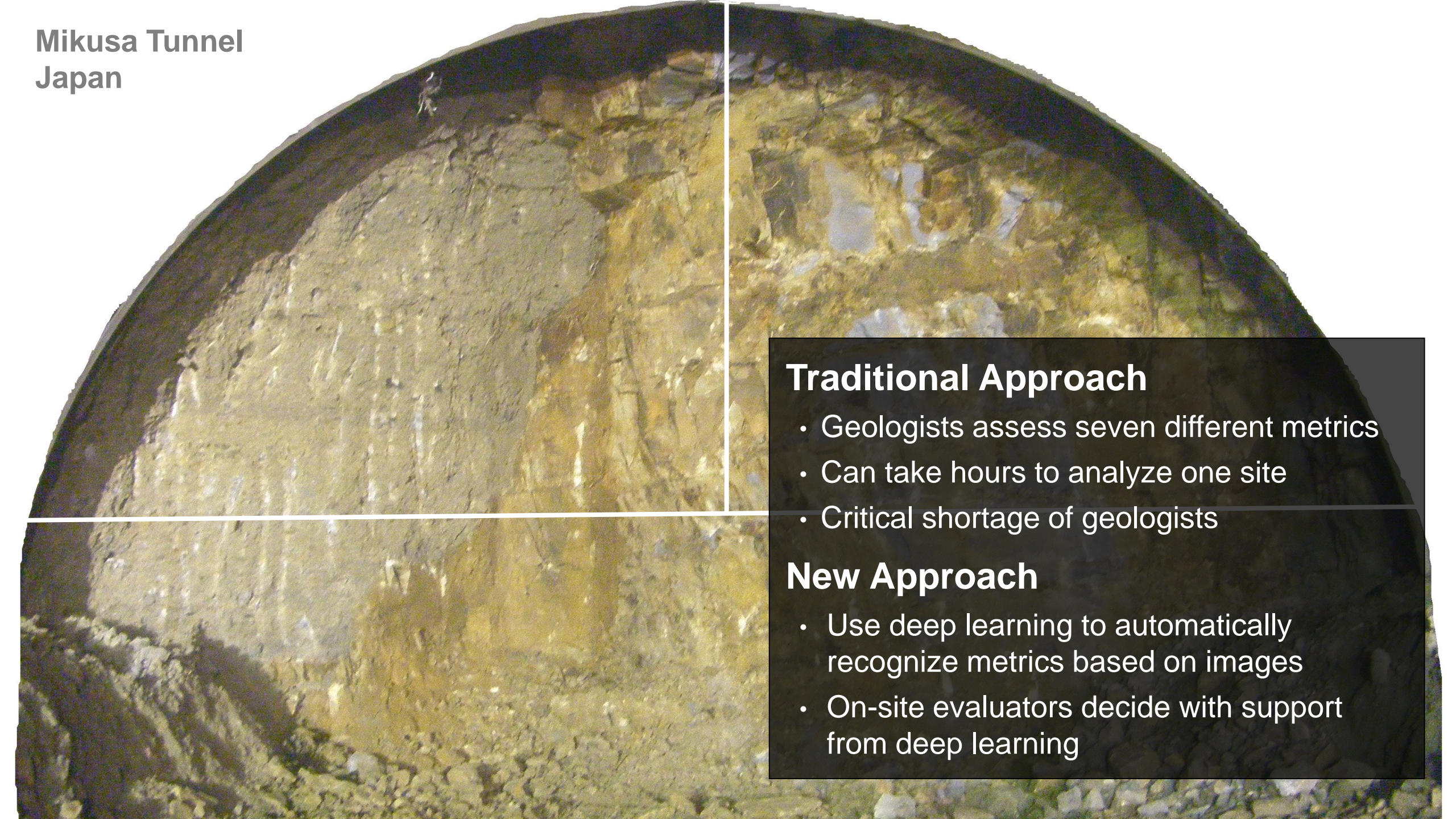


SPEED
LIMIT
45



Mikusa Tunnel
Japan





**Mikusa Tunnel
Japan**

Traditional Approach

- Geologists assess seven different metrics
- Can take hours to analyze one site
- Critical shortage of geologists

New Approach

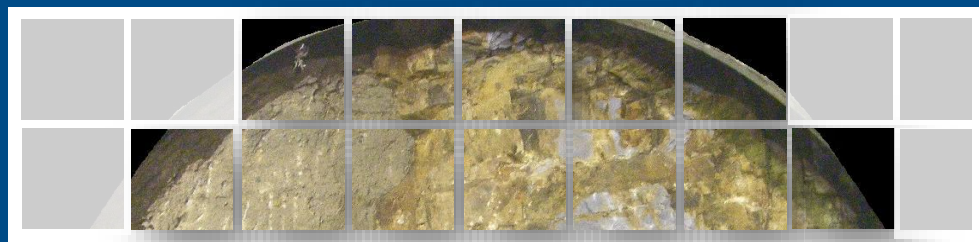
- Use deep learning to automatically recognize metrics based on images
- On-site evaluators decide with support from deep learning

Efficient tunnel drilling with deep learning

Obayashi Corporation



Split into
sub-images



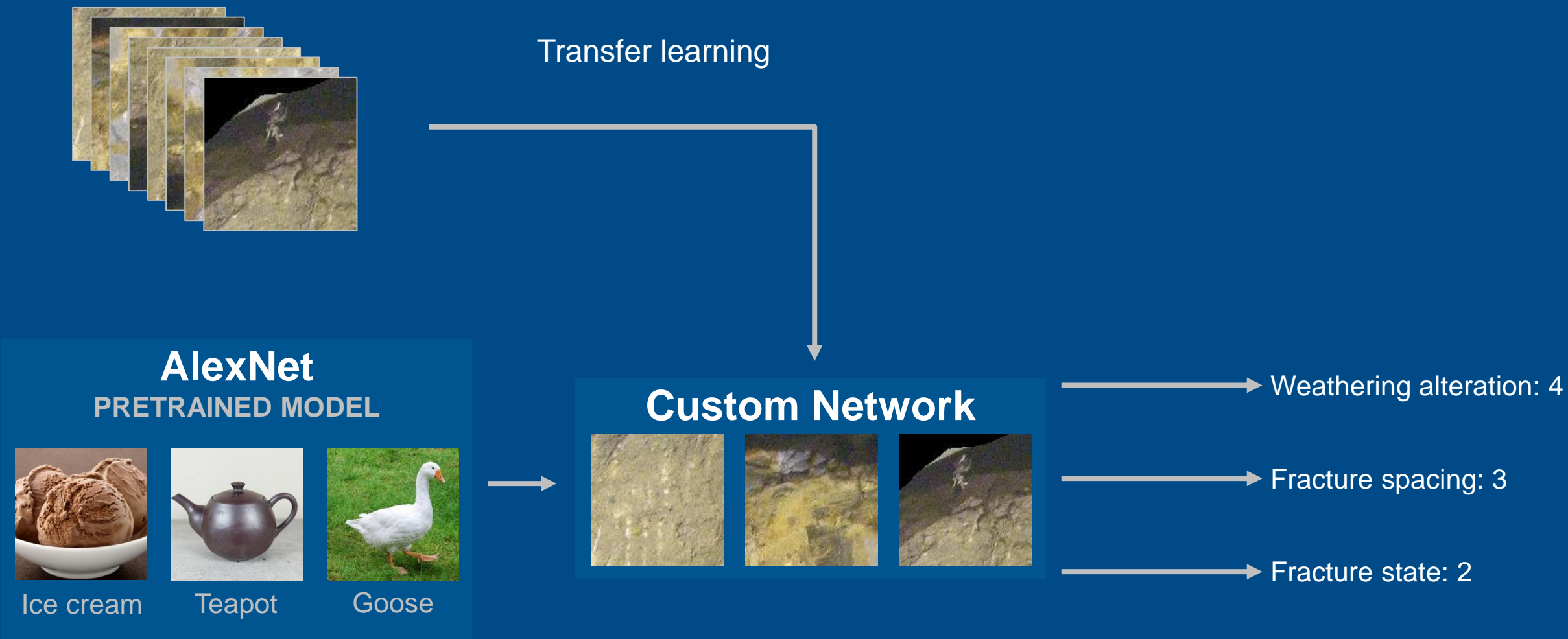
Label each
sub-image



Image	Weathering Alteration (1-4)	Fracture Spacing (1-5)	Fracture State (1-5)
	3	3	2
	4	1	1
	2	3	2
	3	3	2
⋮	⋮	⋮	⋮

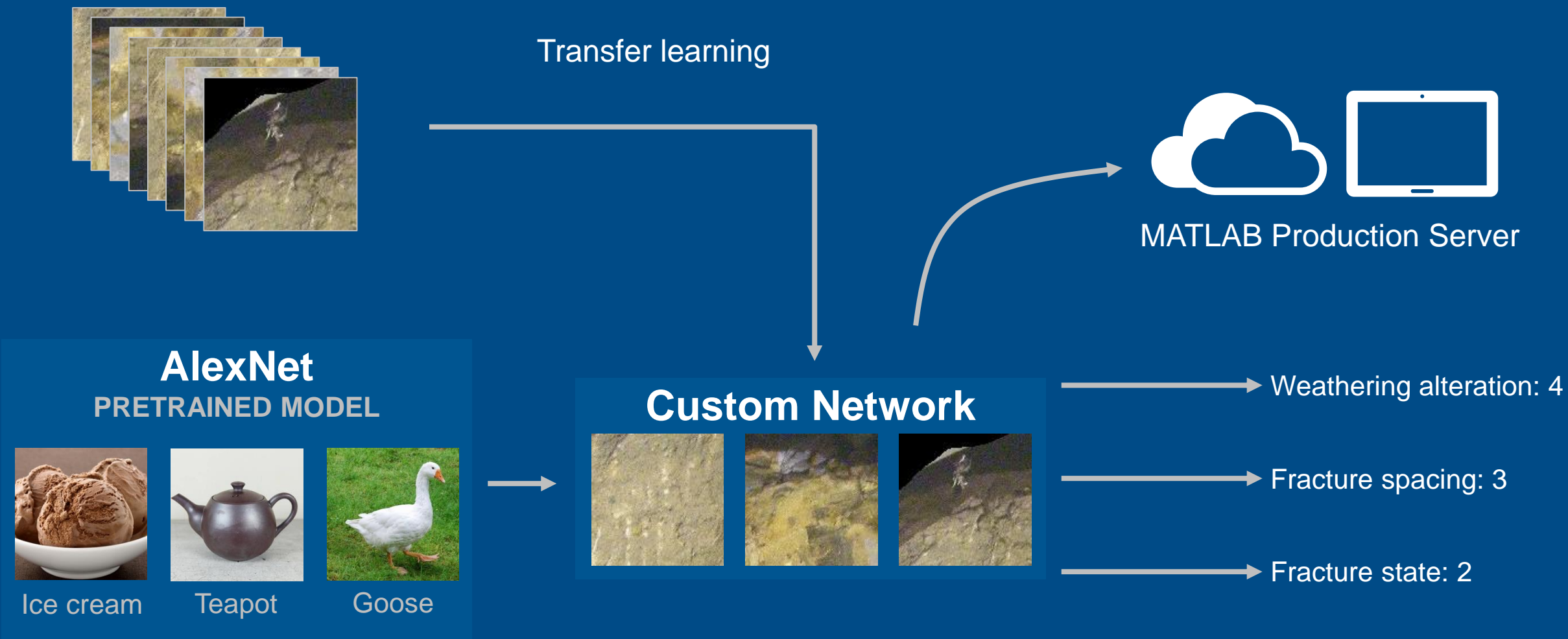
Efficient tunnel drilling with deep learning

Obayashi Corporation



Efficient tunnel drilling with deep learning

Obayashi Corporation



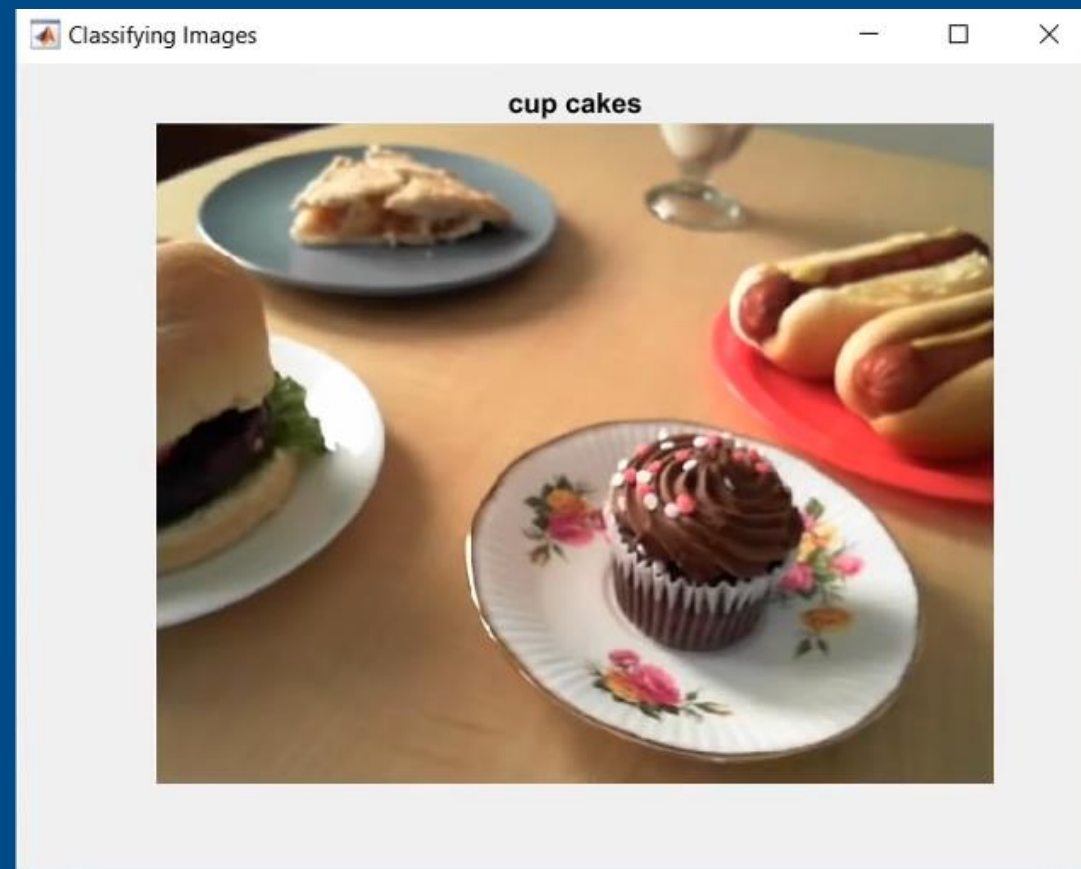
Are you ready for AI if you can't identify features in your data?

- Deep learning

```
nnet = alexnet;  
  
cam = webcam;  
picture = snapshot(cam);  
picture = imresize(picture,[227 227]);  
  
label = classify(nnet, picture)
```



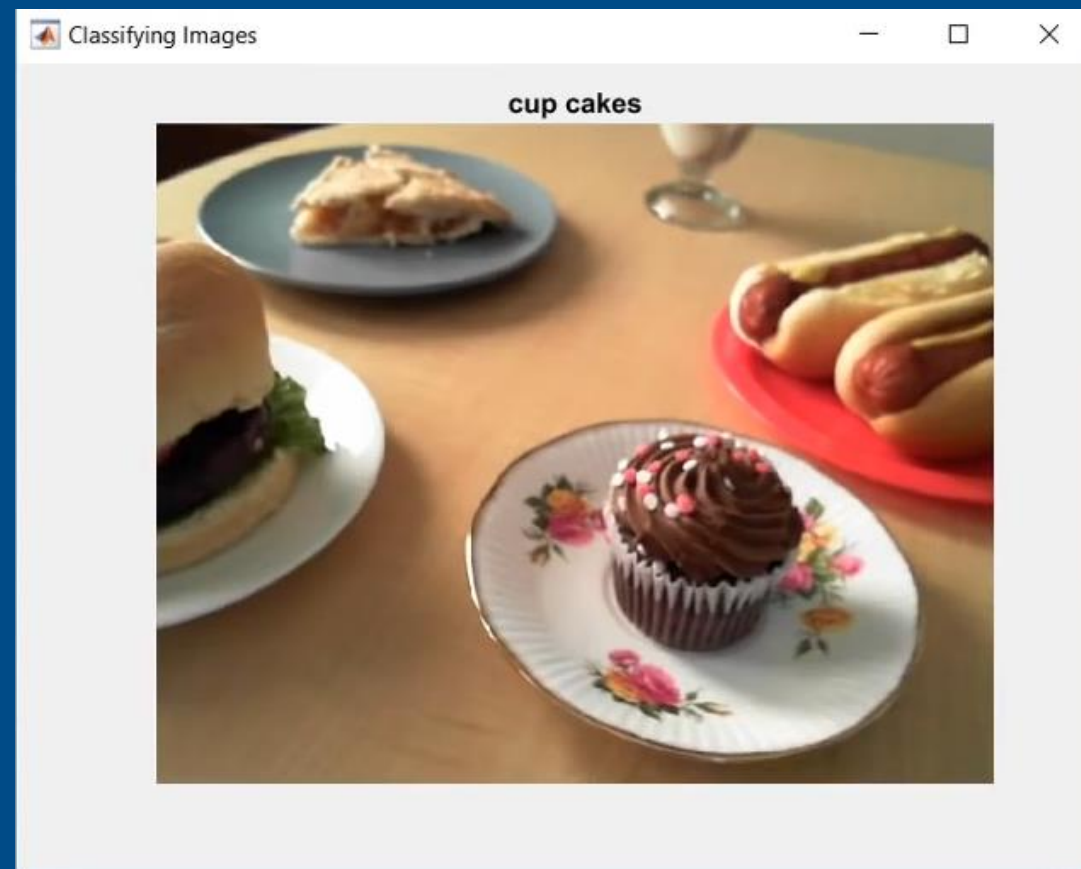
Deep learning in 5 lines of code



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

- Deep learning
- Transfer learning





Deep learning in 5 lines of code

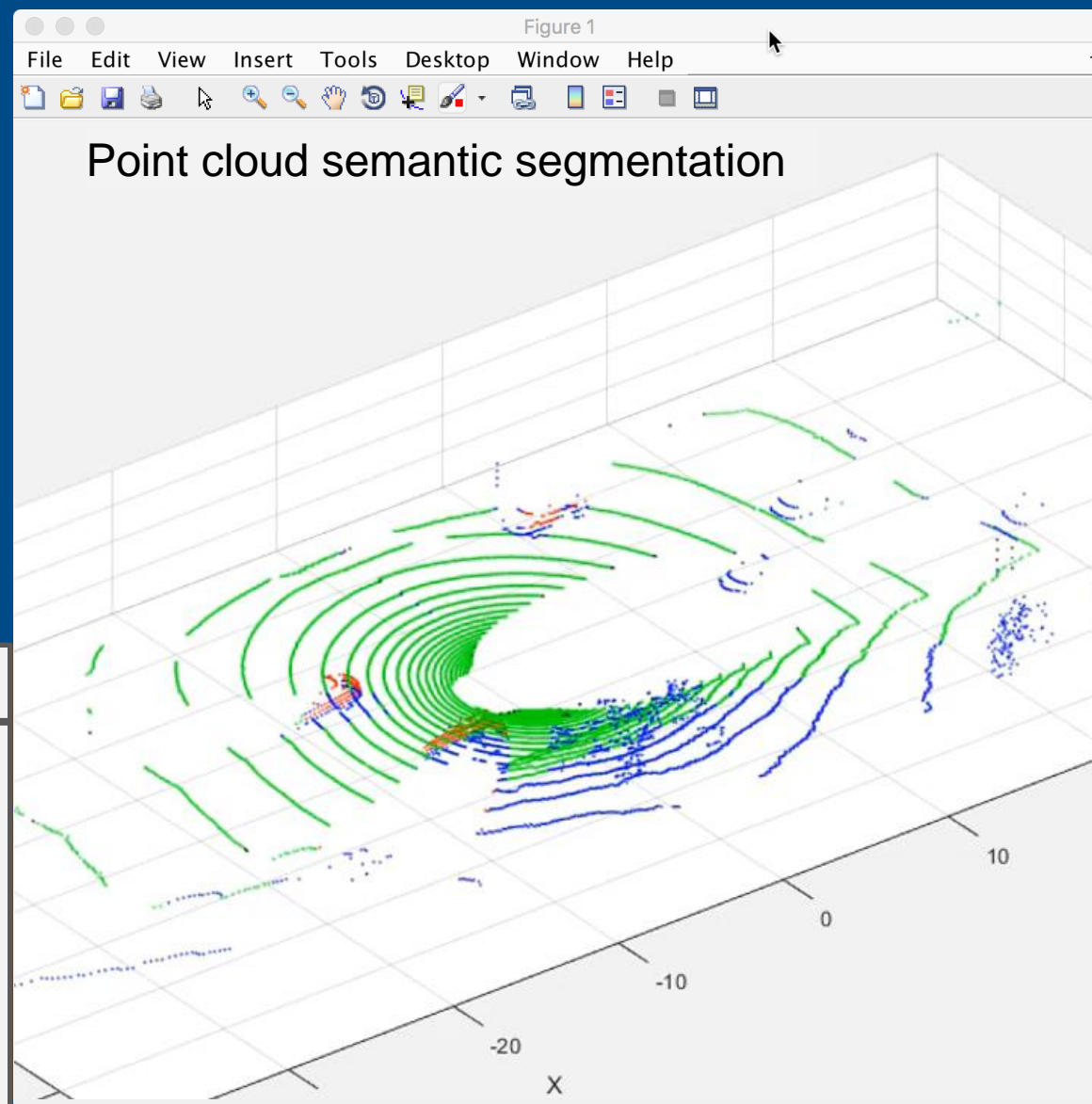


Are you ready for AI if you can't identify features in your data?

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



Classification	
Car	
Truck	
Background	
Ground	



Are you ready for AI if ...

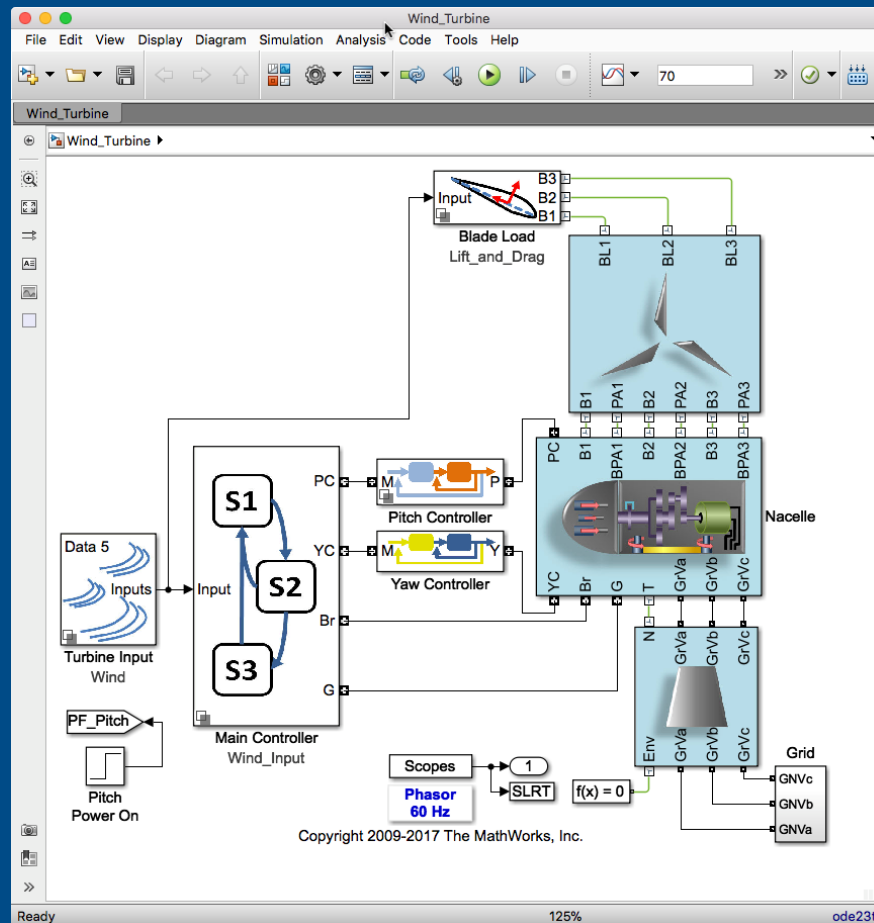
If you don't have the right data?



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



Simulink model

Predictive maintenance with synthetic failure data with MATLAB & Simulink



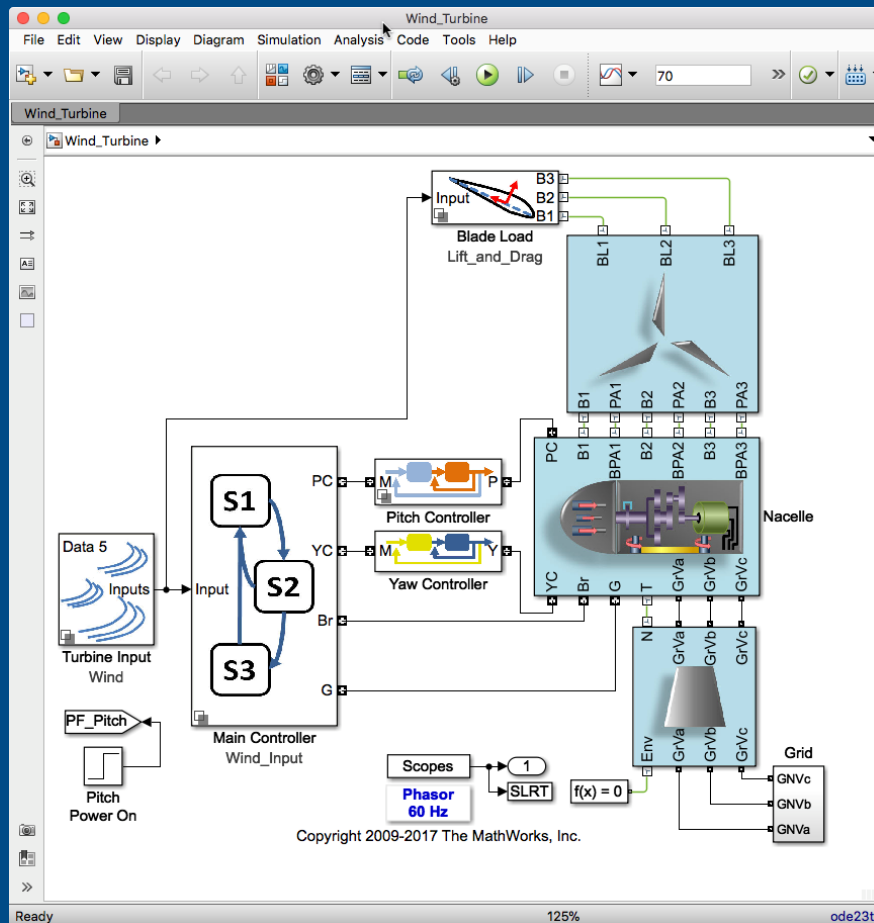
Measured data

Refine model

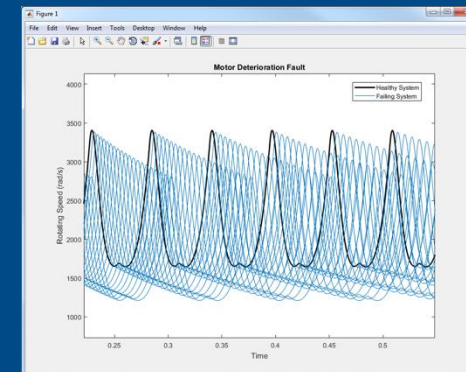


Failure conditions

Inject failures



Simulink model



Failure data

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

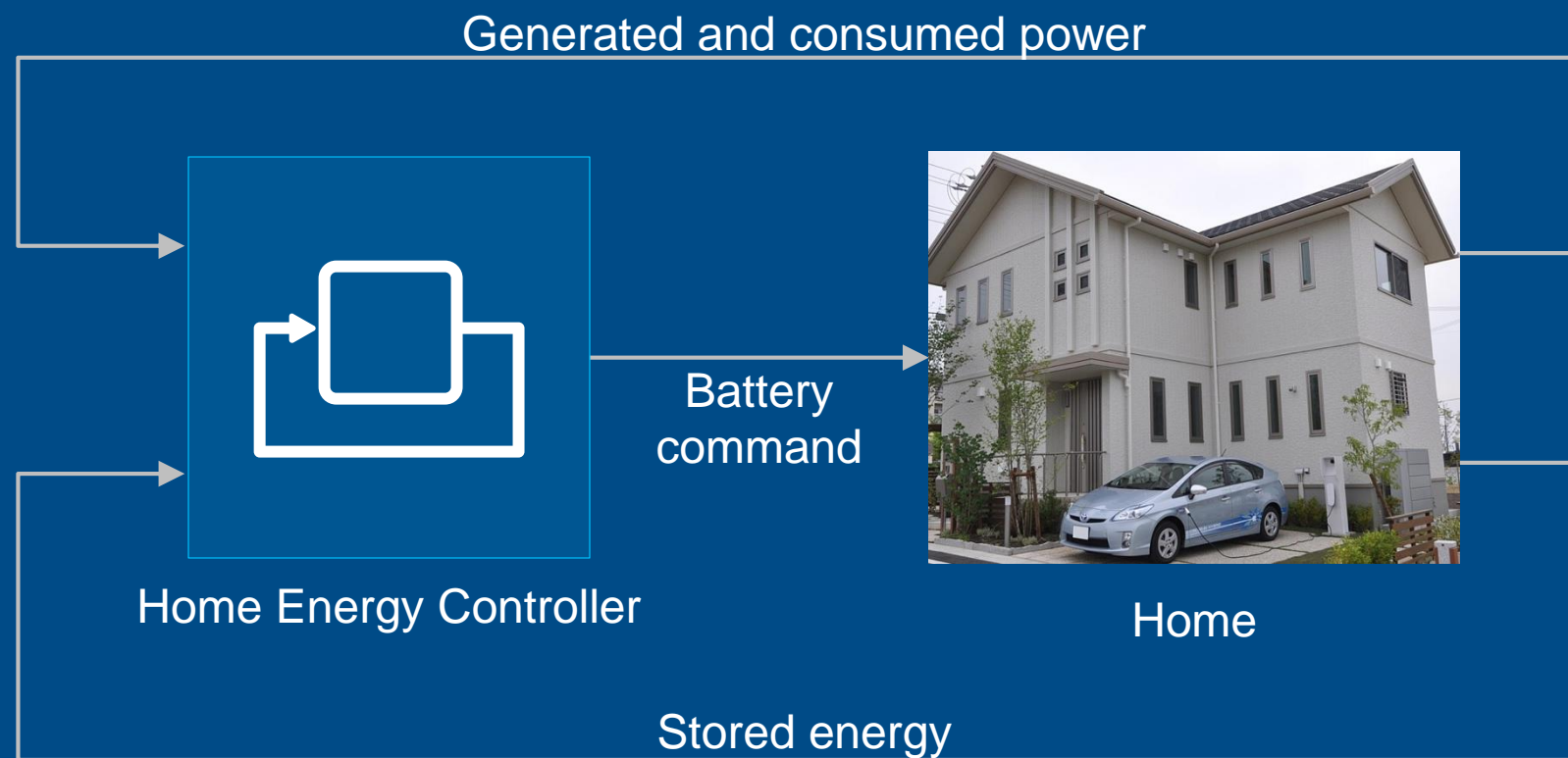
- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage

Goals

- Minimize energy cost
- Use EV battery for additional storage

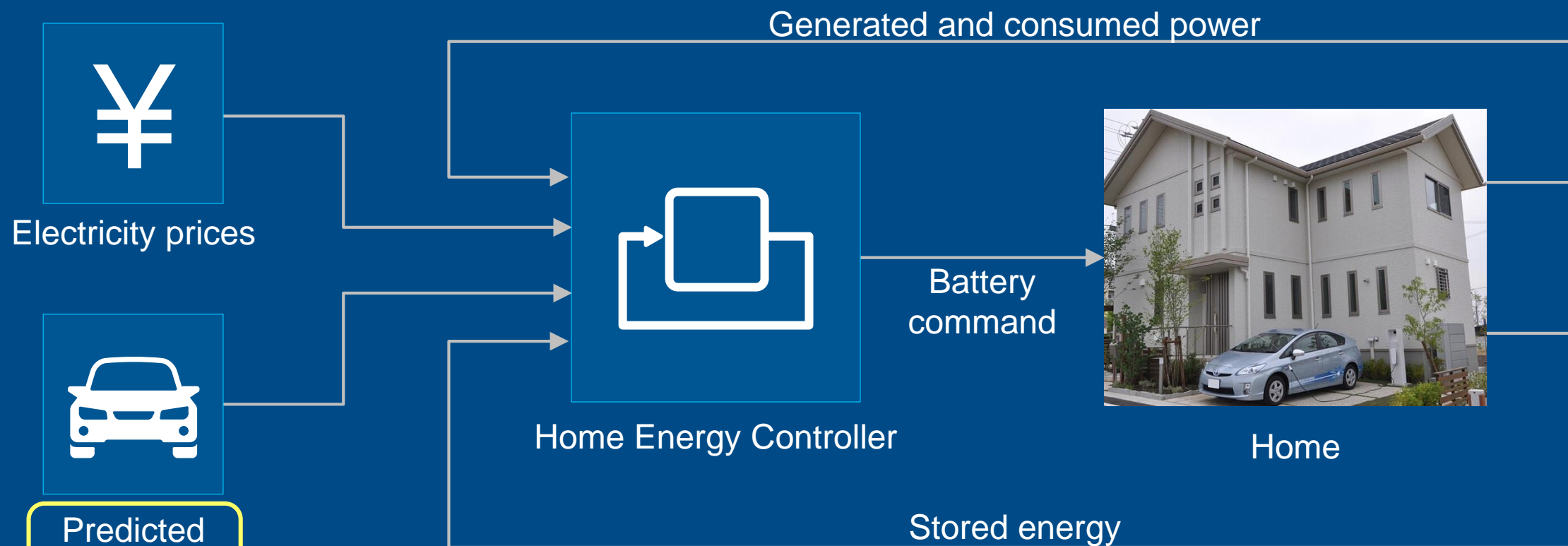
Optimizing home energy management system

Denso



Optimizing home energy management system

Denso



Predicted
vehicle use

Model predictive control
Mixed integer linear programming

Simscape Power Systems

Optimizing home energy management system

Denso

Access Data

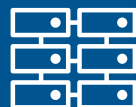


1000 CSV Files

Analyze Data



Preprocessing



Parallel
computing

Develop



Classification
Learner

Deploy

Optimizing home energy management system

Denso

Access Data

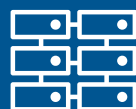


1000 CSV Files

Analyze Data



Preprocessing



Parallel
computing

Develop



Classification
Learner



Simulink



Simscape Power
Systems

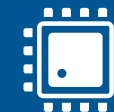


Control
algorithms



Optimization

Deploy



Embedded
devices

Optimizing home energy management system

Denso

The DENSO logo is displayed in a bold, italicized, red sans-serif font.

Akira Ito and Ryu Matsumoto

“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.”



Control
algorithms



Optimization



Primary

Autonomous



EMG (Muscle) Control

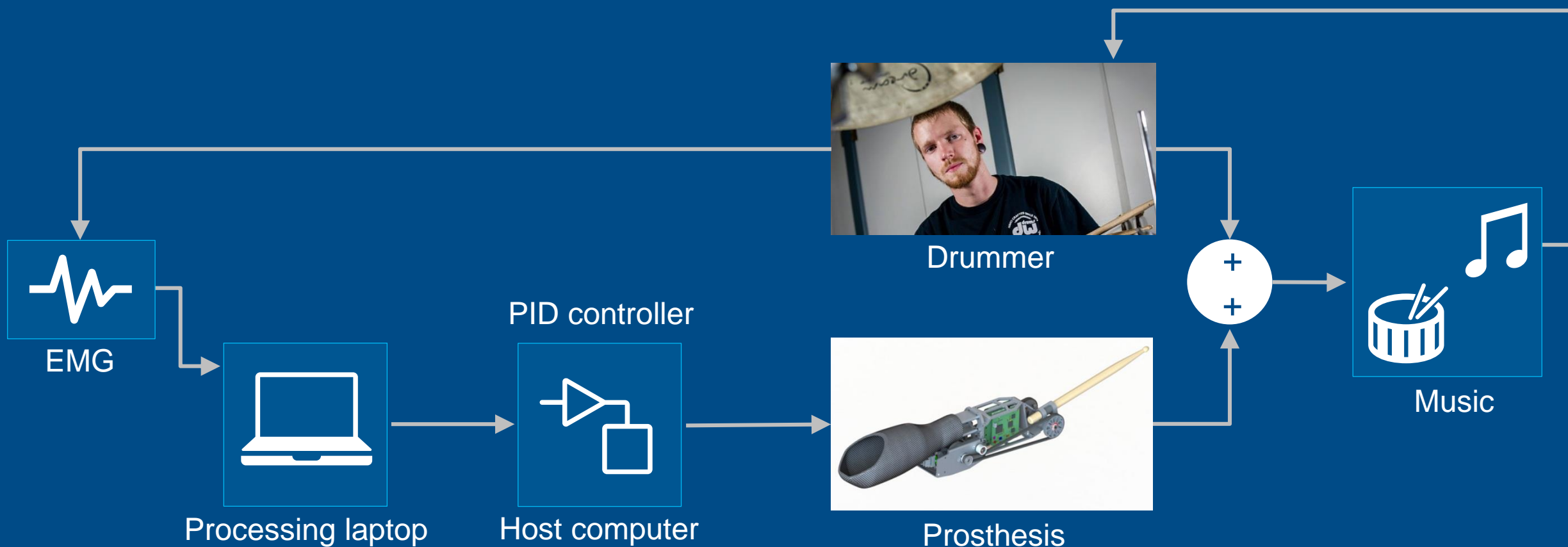
A close-up photograph of a custom-built robotic drumstick controller. Two wooden drumsticks are mounted on a metal frame. The frame includes a green printed circuit board (PCB) with various electronic components, a black gear, and a silver pneumatic cylinder. The entire assembly is positioned over a large, circular brass cymbal. Two black text boxes are overlaid on the image: one on the left stick labeled 'Autonomous' and one on the right stick labeled 'Primary'.

Autonomous

Primary

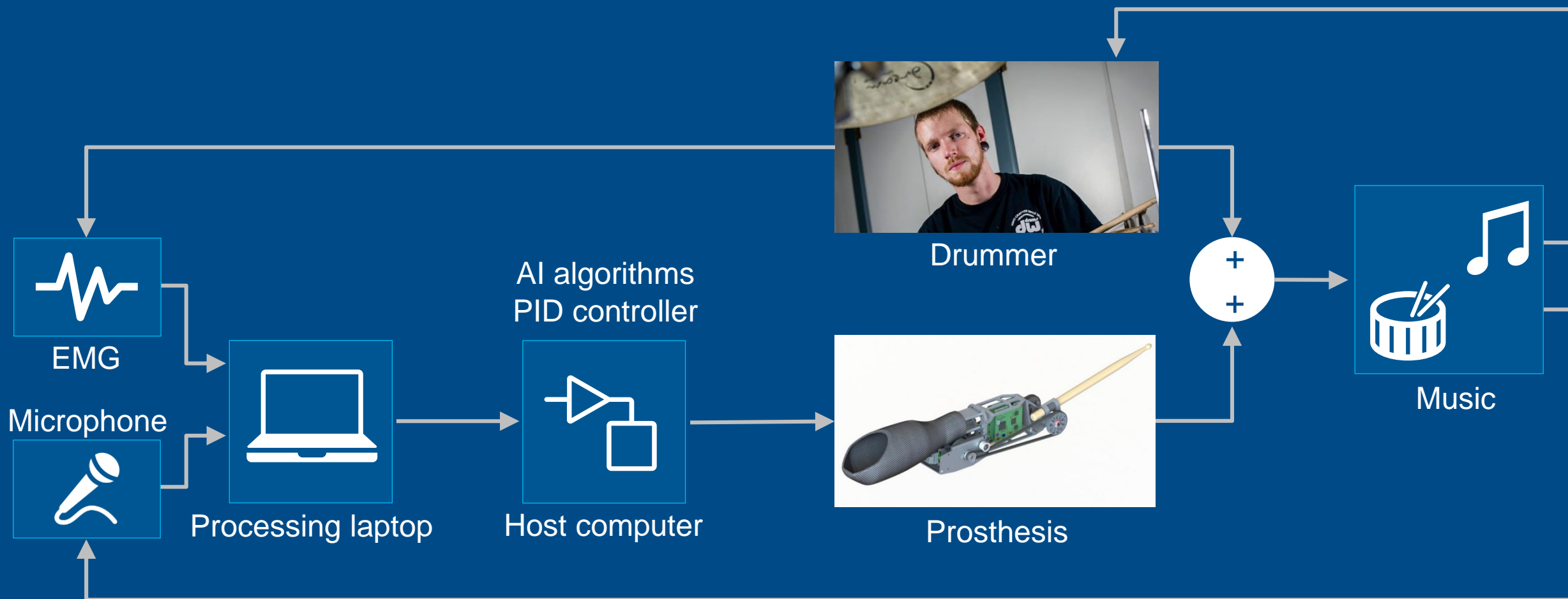
Exceeding human capabilities with a robotic drumming prosthesis

Georgia Tech Center for Music Technology



Exceeding human capabilities with a robotic drumming prosthesis

Georgia Tech Center for Music Technology







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

Is AI ready for you?

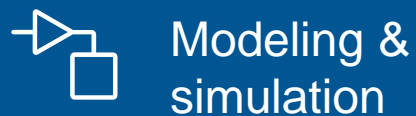
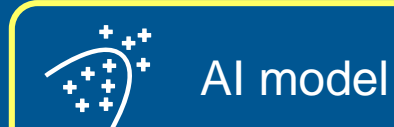
Access Data



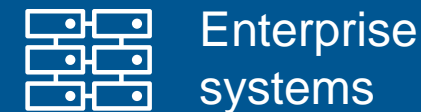
Analyze Data

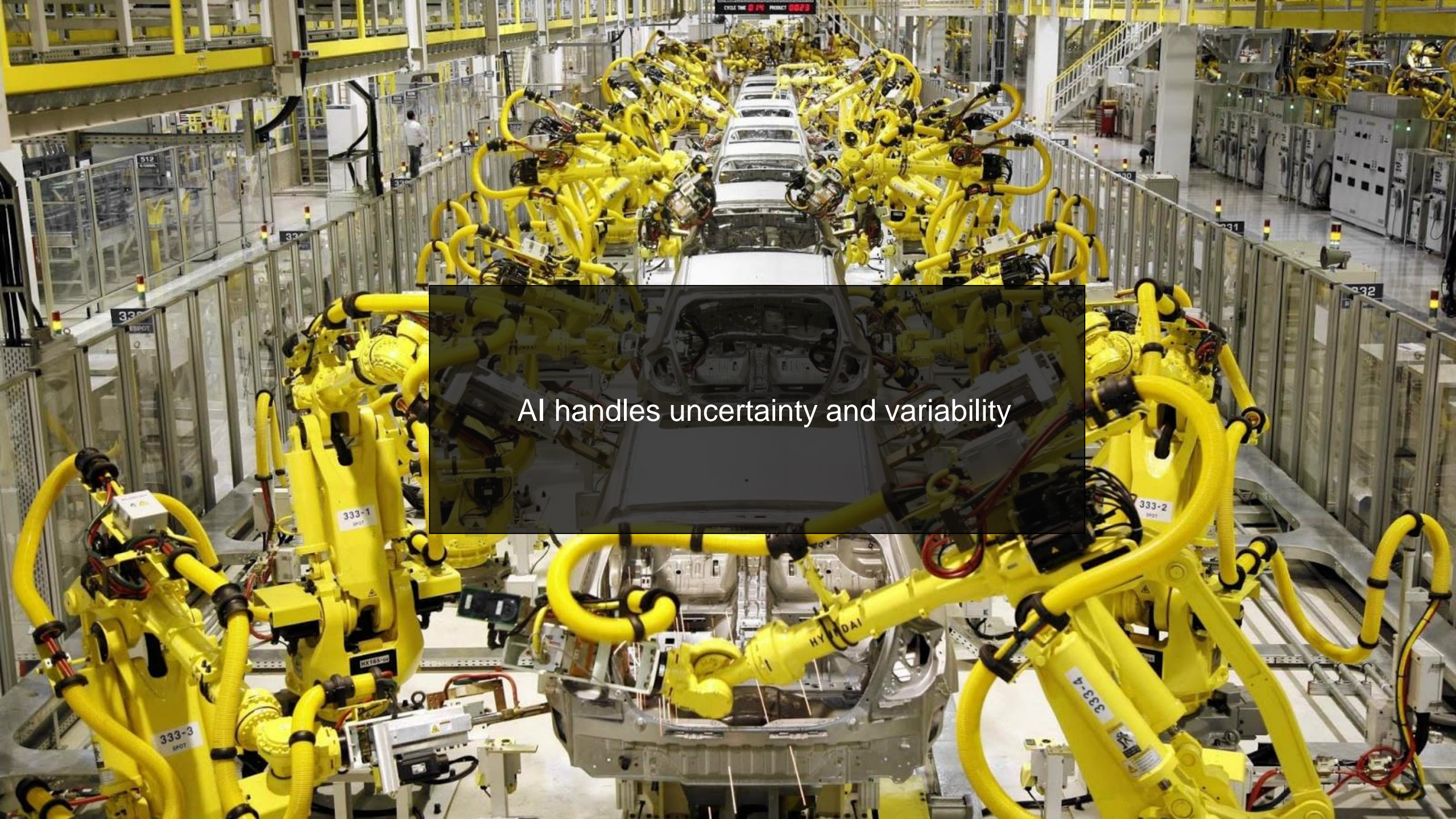


Develop



Deploy





AI handles uncertainty and variability

Are you ready for AI if ...

Are you ready for AI if ...

You've never used machine learning?

Domain expertise to identify features

Easy programming

Machine Learning apps

Are you ready for AI if ...

You've never used machine learning?

Domain expertise to identify features

Easy programming

Machine Learning apps

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?

Domain expertise to identify features
Easy programming
Machine Learning apps

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 using simulations
Use that data to train your AI

Are you ready for AI?

With MATLAB and Simulink, you ARE ready for AI!