

MATLAB EXPO 2018

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

Albert Ramirez Perez



Alexa –
Write my Expo
keynote for me

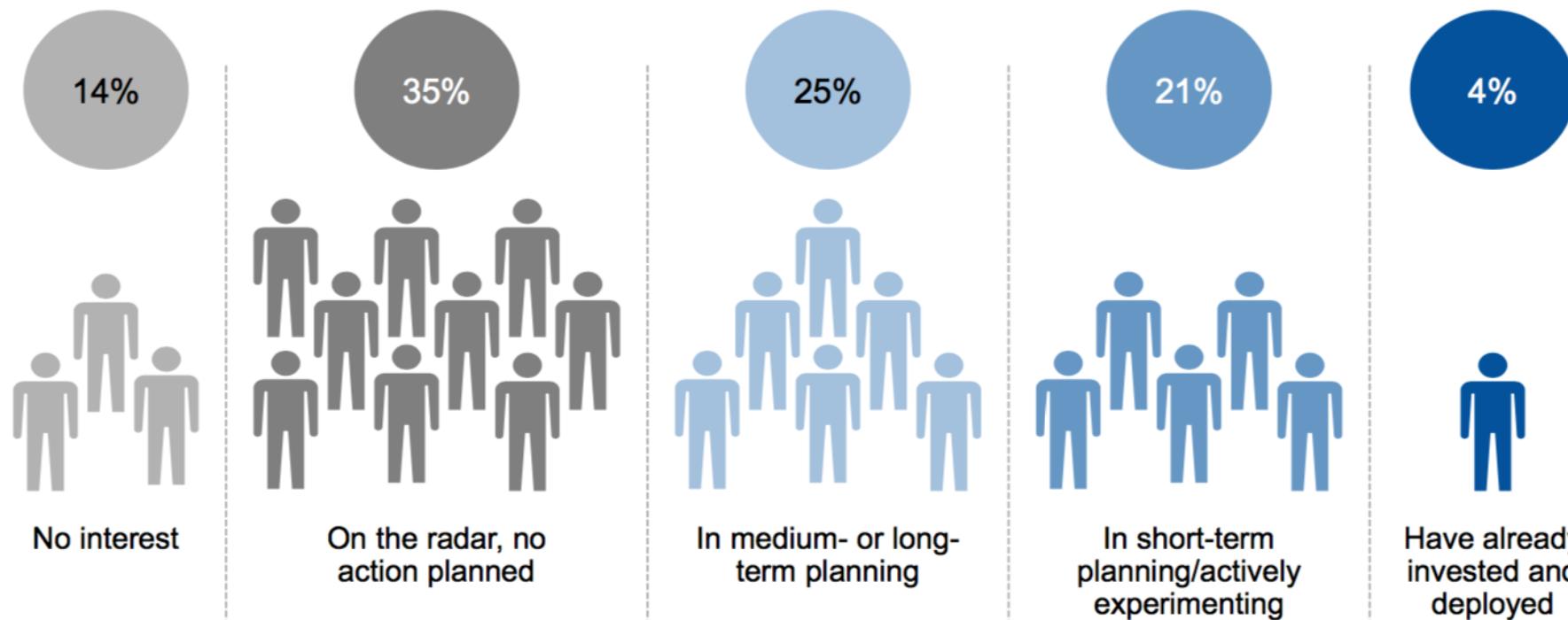


Alexa –
Play soothing jazz



Artificial Intelligence Is in Early Adoption

Percentage of Respondents



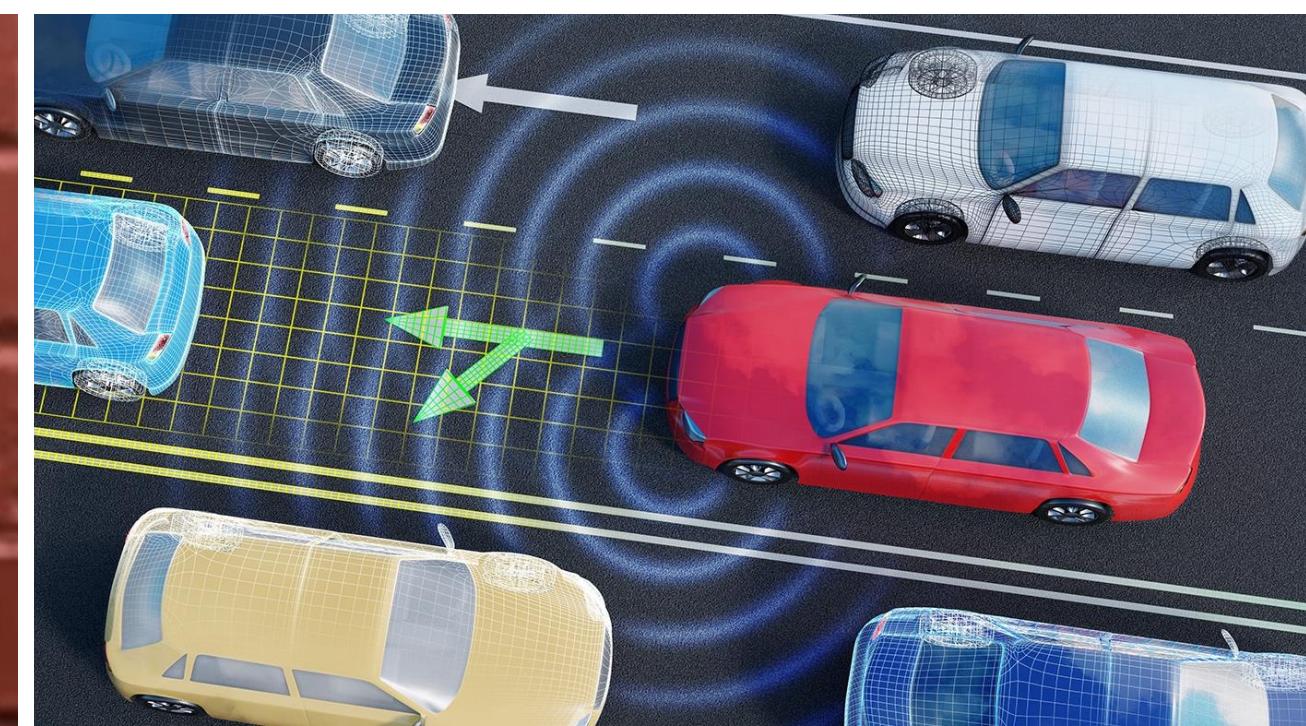
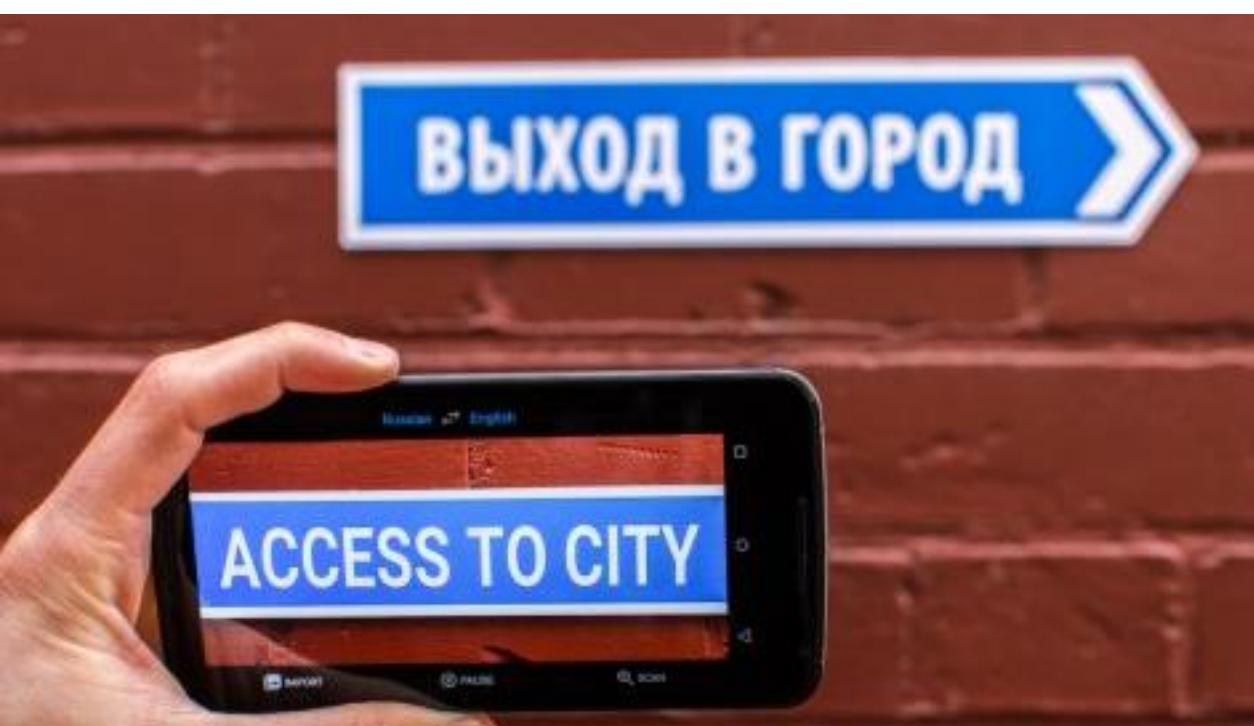
Q: What are your organization's plans in terms of artificial intelligence?

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



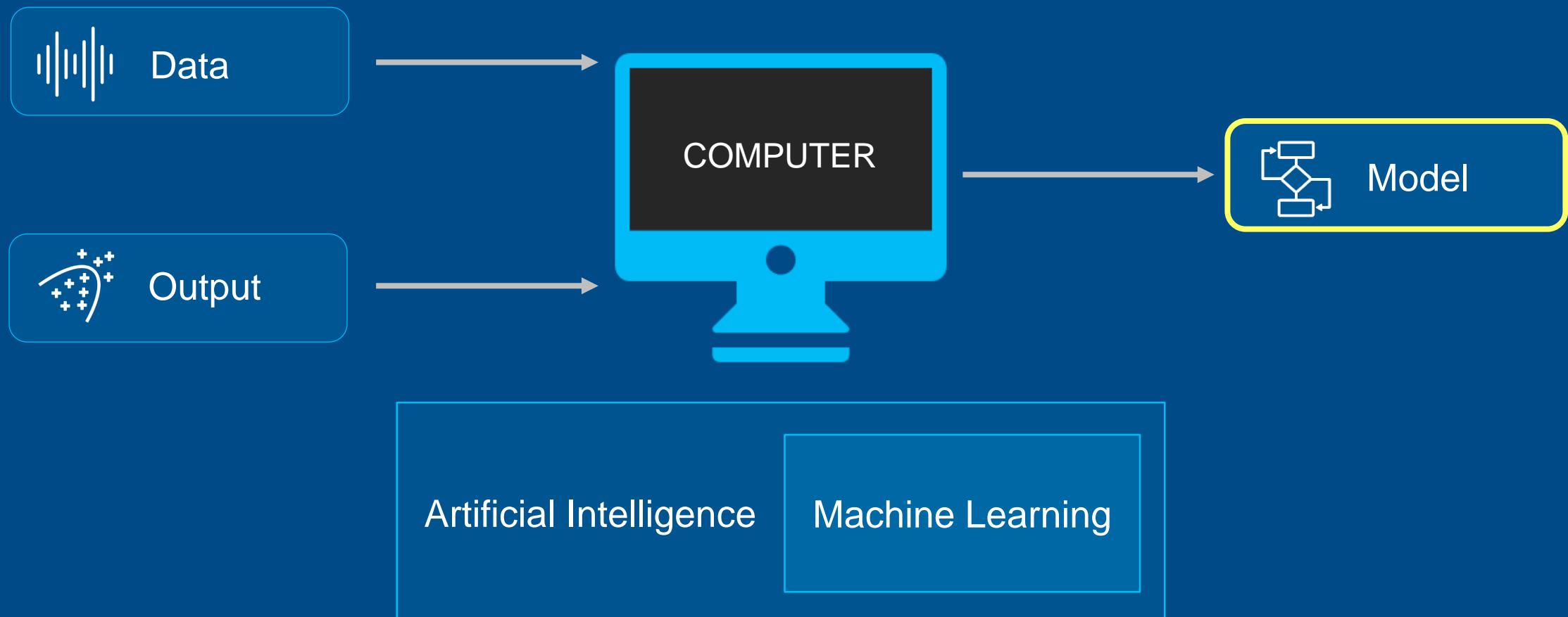
There are two ways to get a computer to do what you want

Machine Learning



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

Machine Learning



Are you ready for AI?



Are you ready for AI?



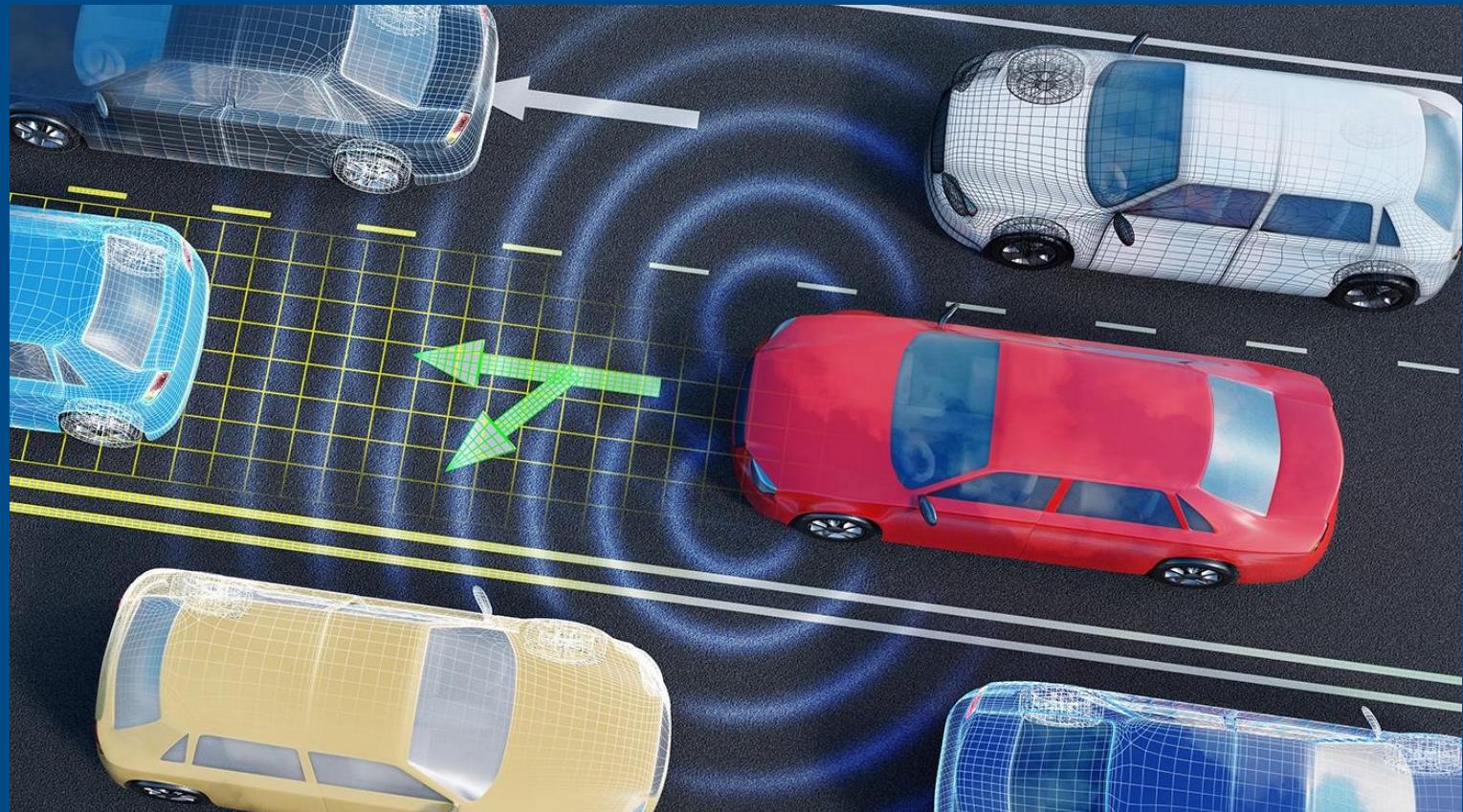
Data



Output



Model



Are you ready for AI?

Access Data

Analyze Data



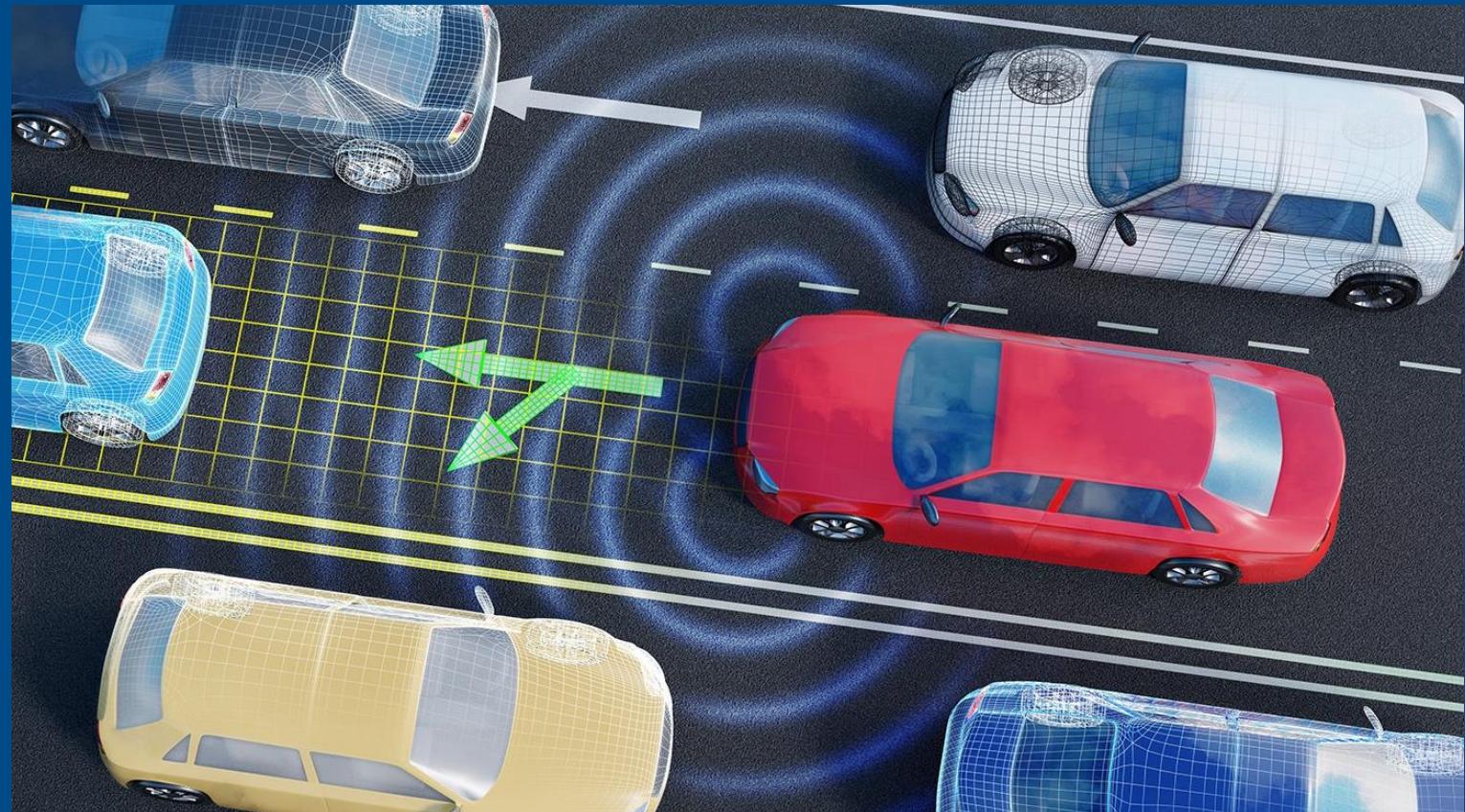
Data



Output



Model



Are you ready for AI?

Access Data

Develop

Analyze Data

Deploy



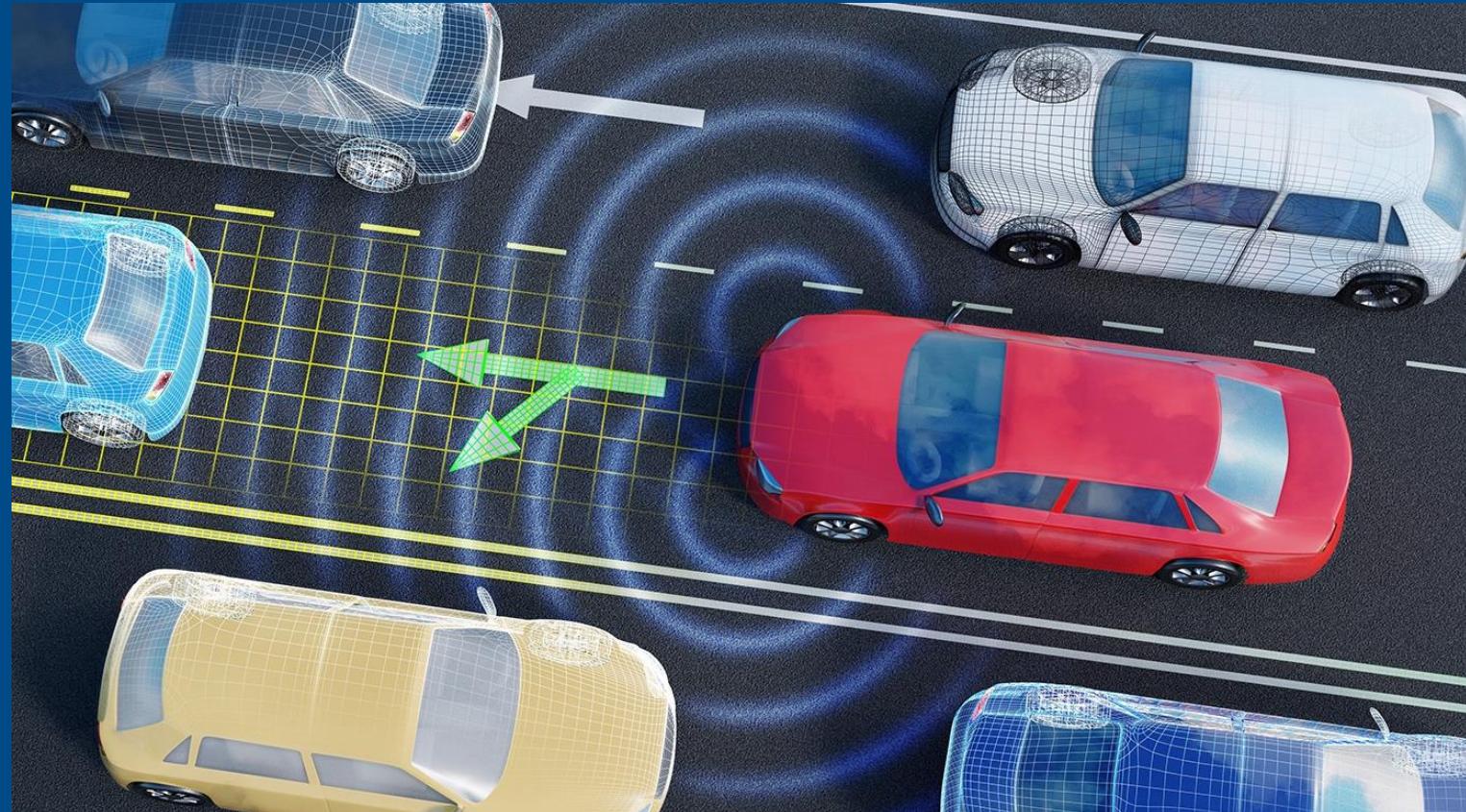
Data



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



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Develop



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Algorithm
development



Modeling &
simulation

Deploy



Desktop apps



Enterprise
systems



Embedded
devices

Are you ready for AI?

Caffe
TensorFlow

Access Data



Sensors



Files



Databases

Analyze Data



Data exploration



Preprocessing



Domain-specific
algorithms

Develop



AI model



Algorithm
development



Modeling &
simulation

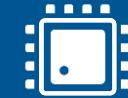
Deploy



Desktop apps



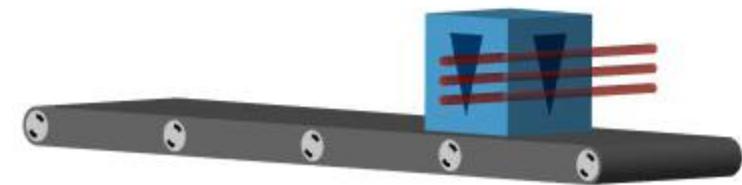
Enterprise
systems



Embedded
devices

Do you need AI?

X
Y
Z





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

90g e NET
flavoured snack

FAT 6.5 g
SAT FAT 3.9 g
SUGARS 1.6 g
SODIUM 245 mg



Twisties

chicken

90g e NET
flavoured sn

FAT 7.4 g
SAT FAT 3.6 g
SUGARS 0.7 g
SODIUM 213 mg

What is crispiness?



Crushing Sound



Crushing Force



Crispy



Crispy Enough

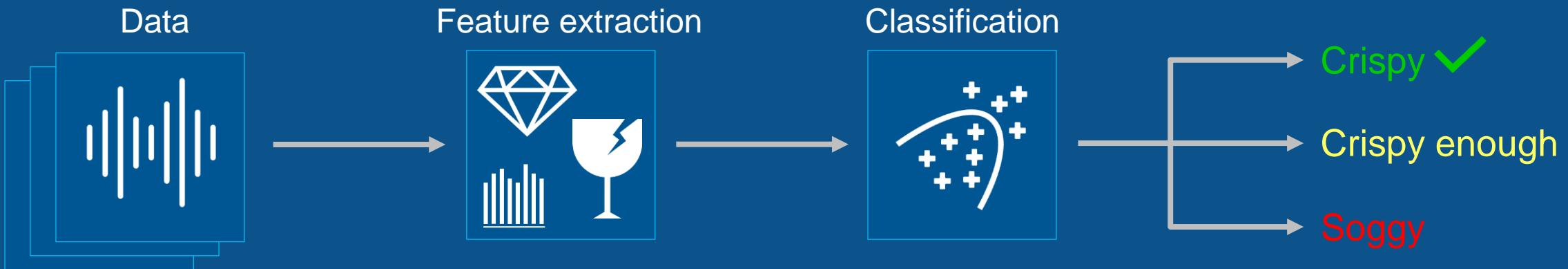


Soggy

Replicating human perception with machine learning

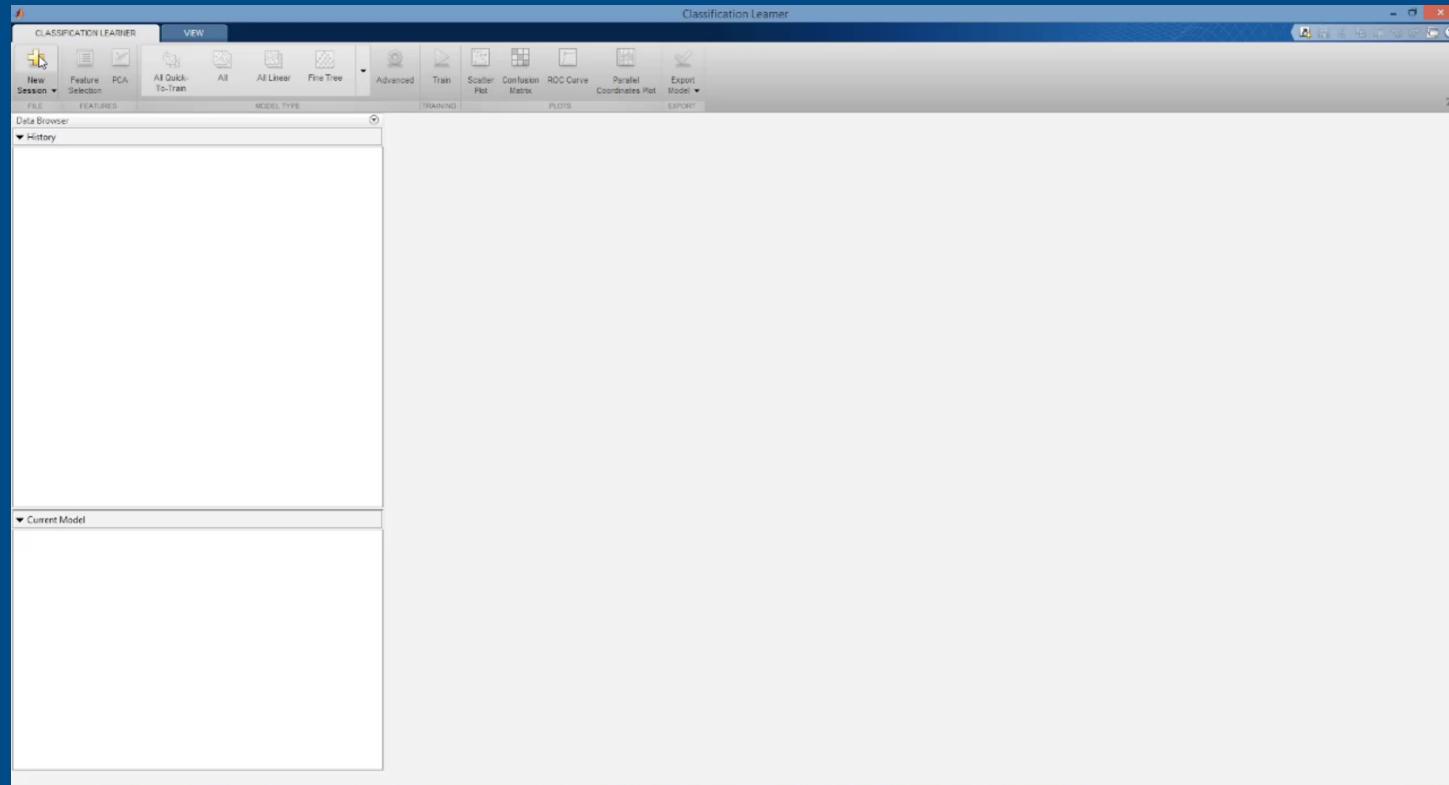
Technical University of Munich

Machine Learning Workflow

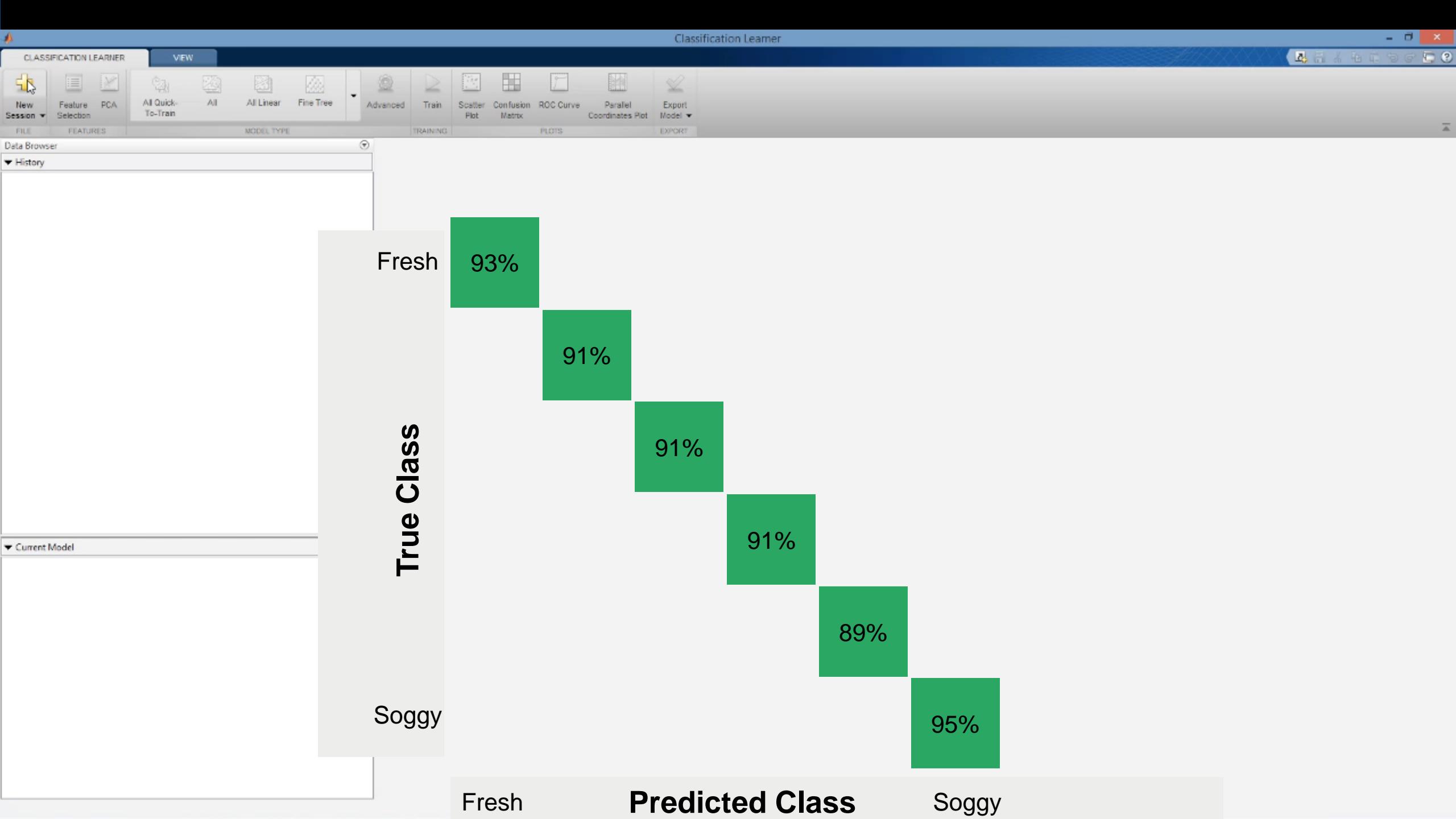


Replicating human perception with machine learning

Technical University of Munich



Classification Learner



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

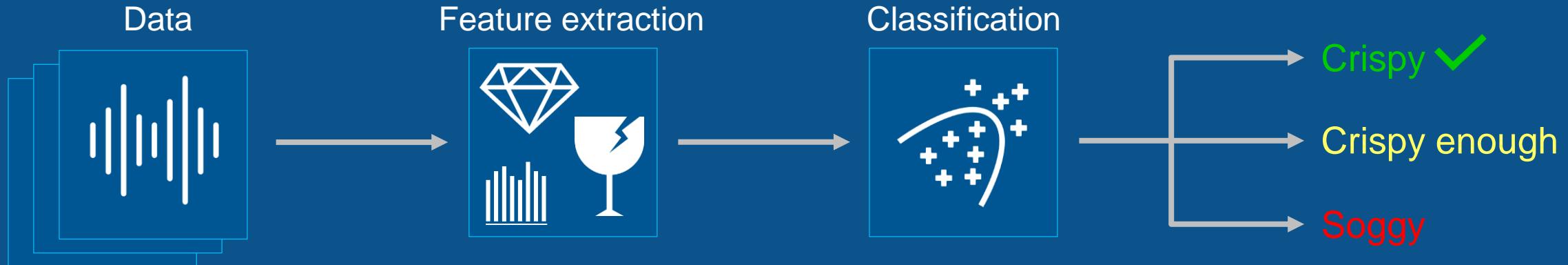
- No experience required
- Use apps to try out all possible models
- Use domain expertise and familiar tools to prepare data

Are you ready for AI if ...

You can't identify features in your data?

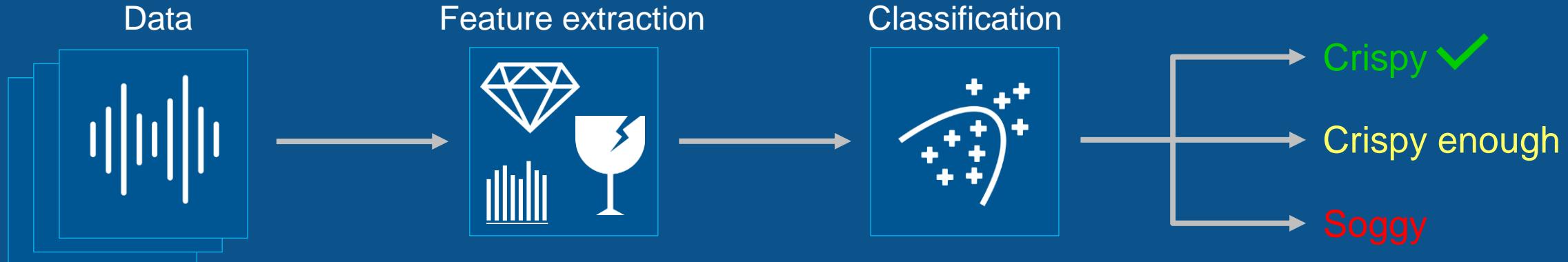
Use deep learning to identify features automatically

Machine Learning Workflow

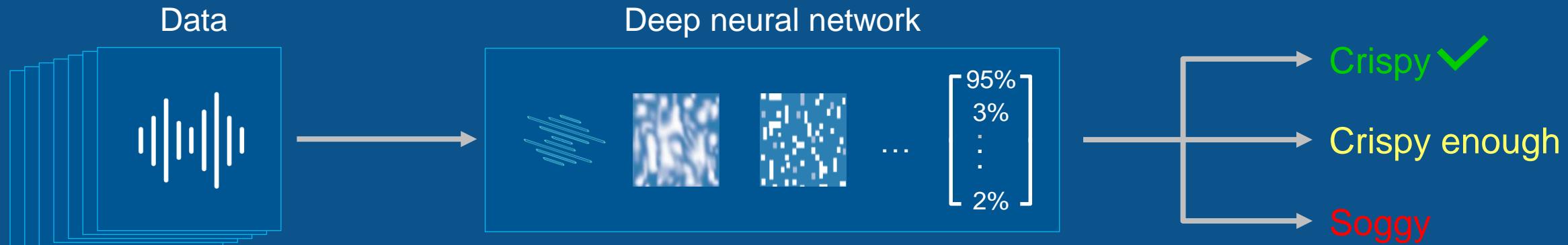


Use deep learning to identify features automatically

Machine Learning Workflow



Deep Learning Workflow





SPEED
LIMIT
45

Mikusa Tunnel
Japan

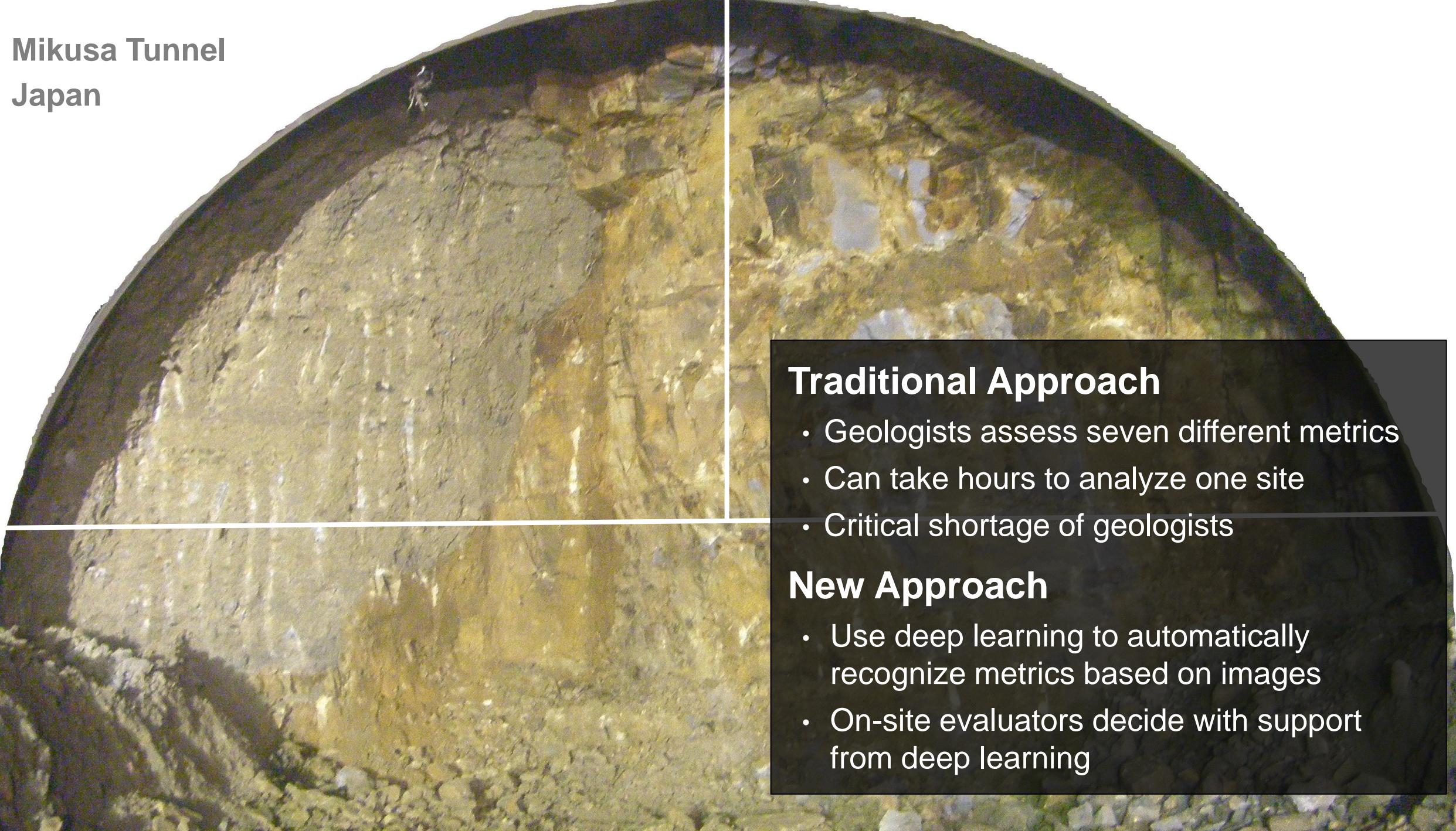


Traditional Approach

- Geologists assess seven different metrics



Mikusa Tunnel Japan



Traditional Approach

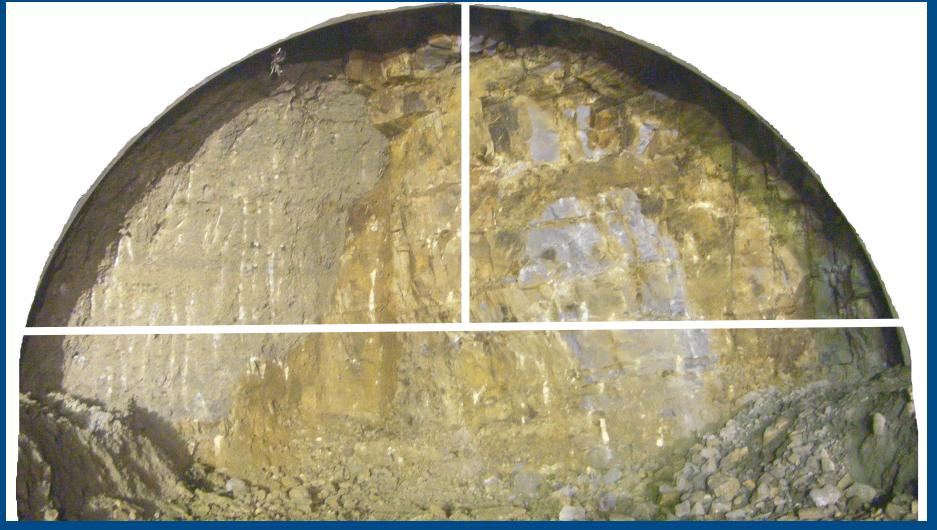
- Geologists assess seven different metrics
- Can take hours to analyze one site
- Critical shortage of geologists

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

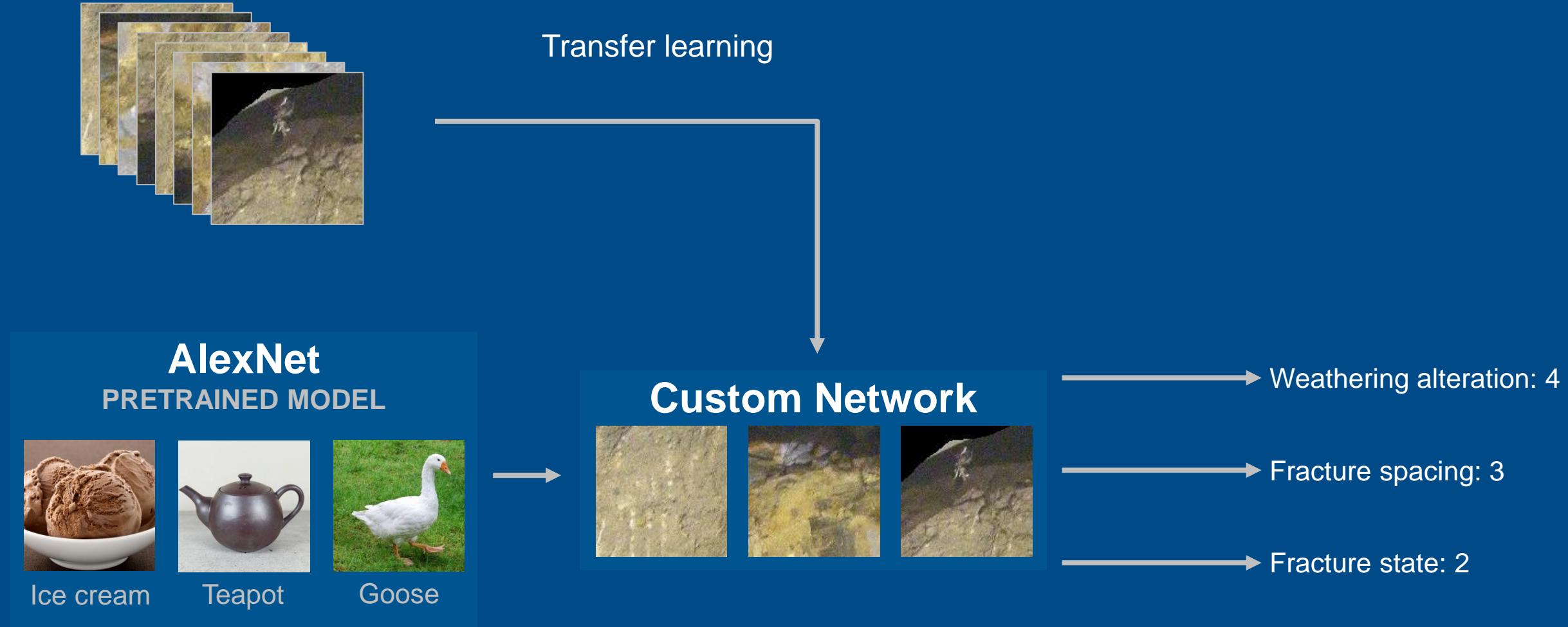


Label each
sub-image

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
:	:	:	:

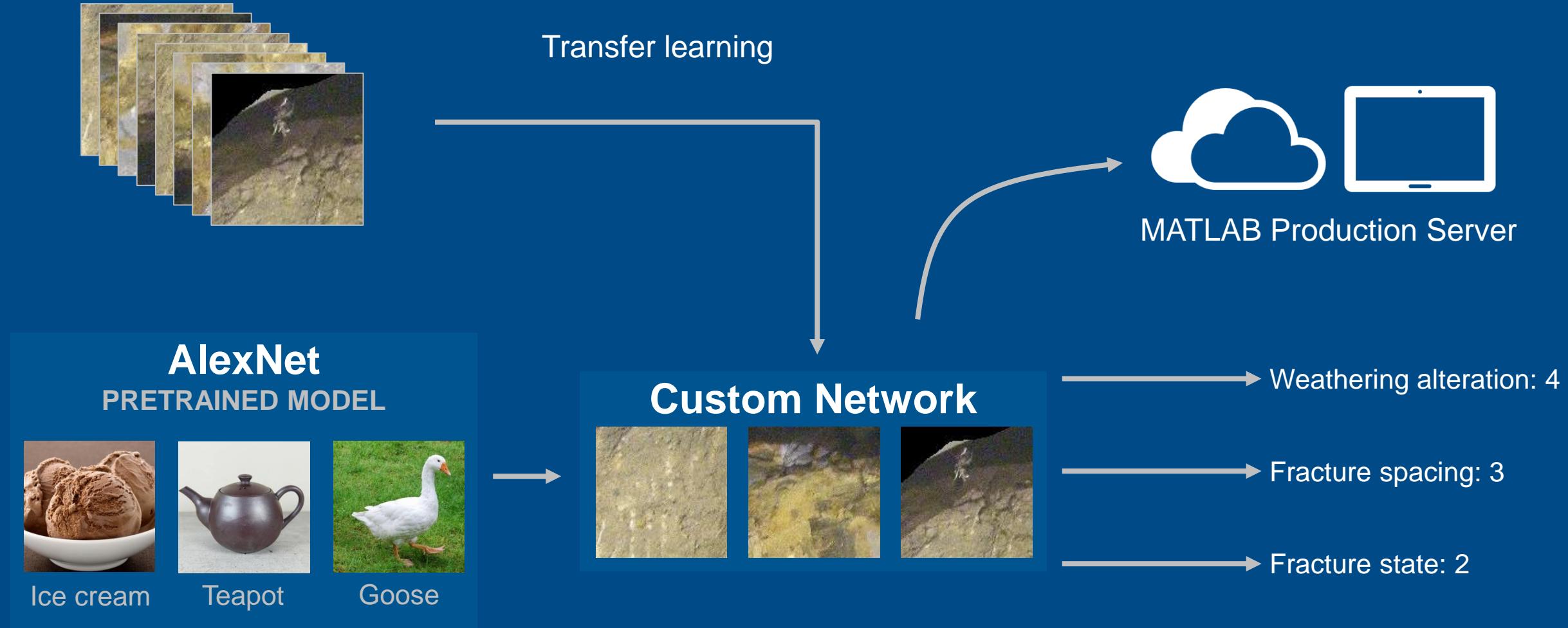
Efficient tunnel drilling with deep learning

Obayashi Corporation



Efficient tunnel drilling with deep learning

Obayashi Corporation



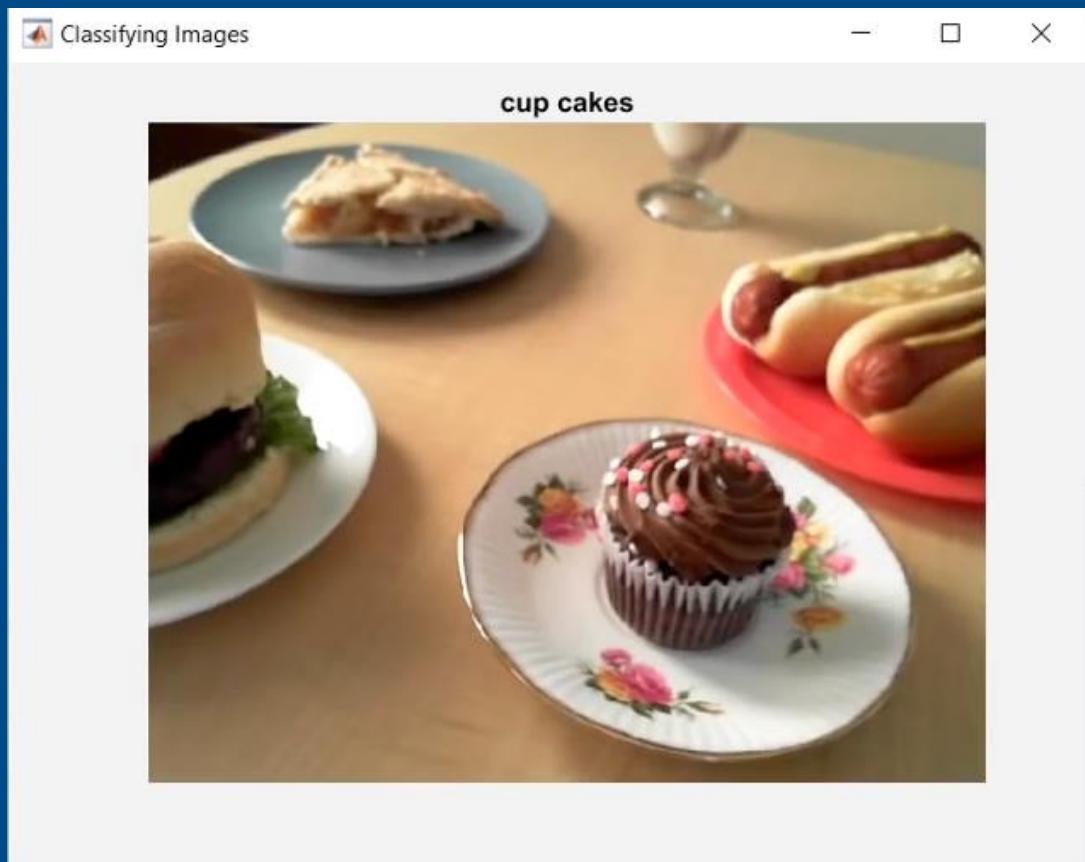
Are you ready for AI if you can't identify features in your data?

- Deep learning

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



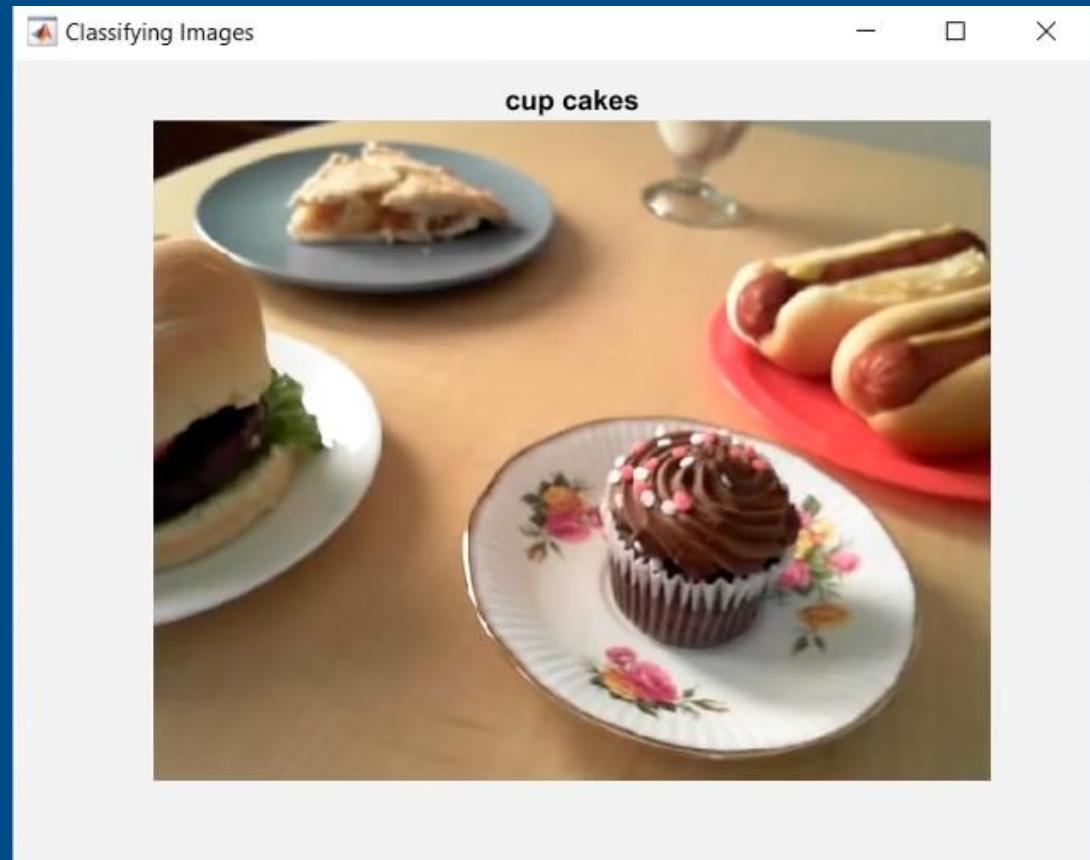
Deep learning in 5 lines of code



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

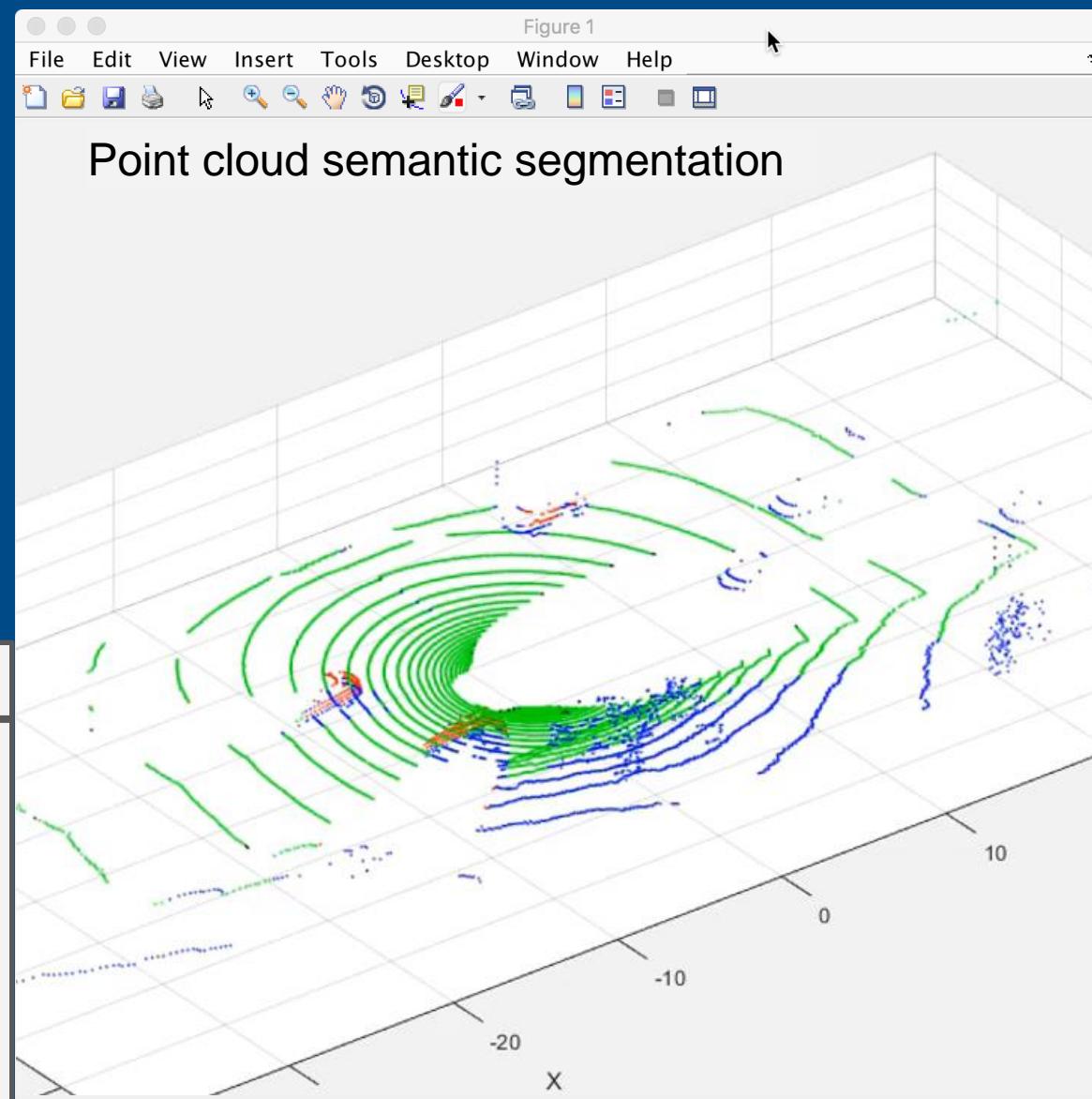


Are you ready for AI if you can't identify features in your data?

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



Classification	
Car	
Truck	
Background	
Ground	

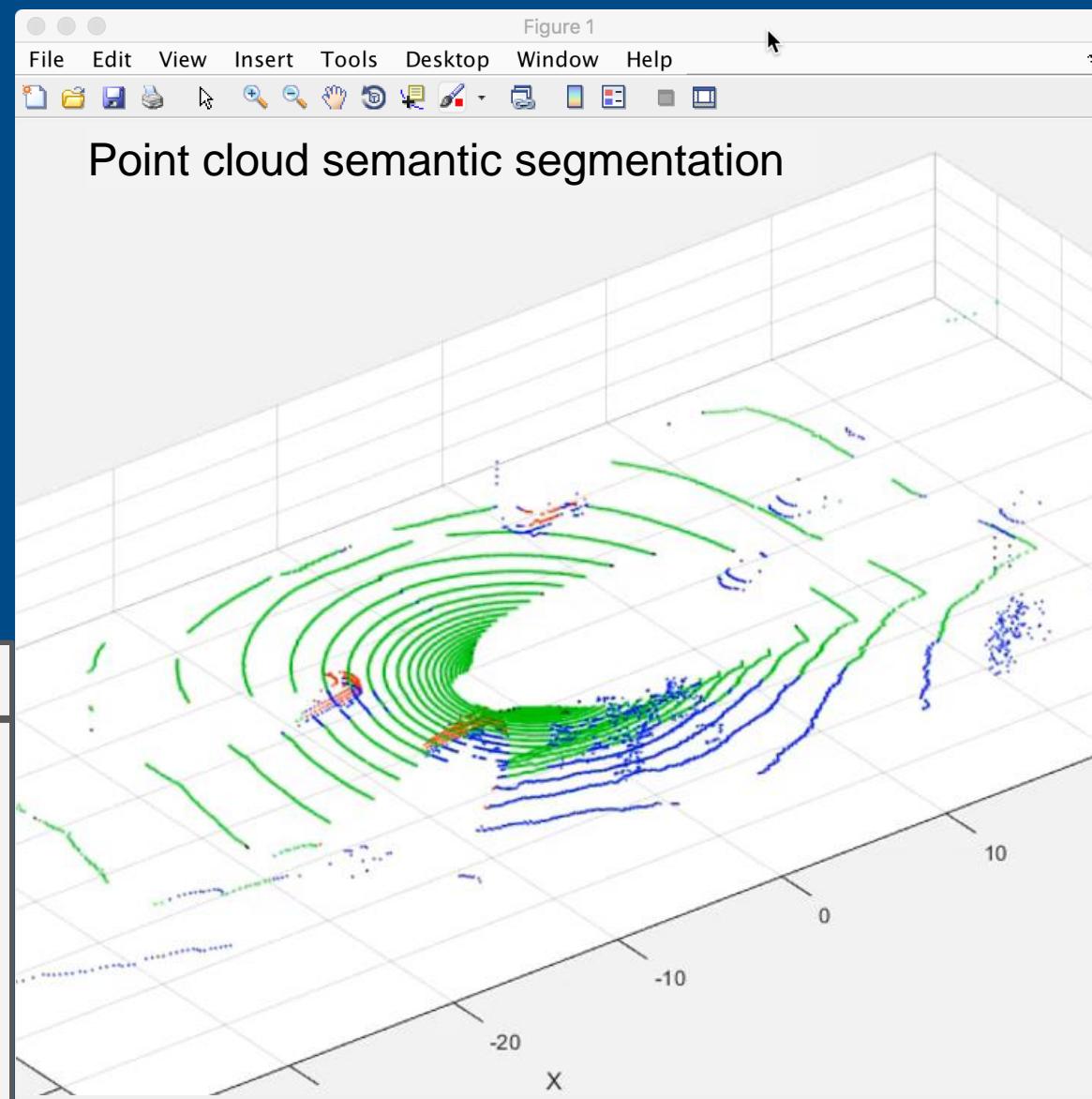


Are you ready for AI if you can't identify features in your data?

- Deep learning
- Transfer learning
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Classification	
Car	
Truck	
Background	
Ground	



Are you ready for AI if ...

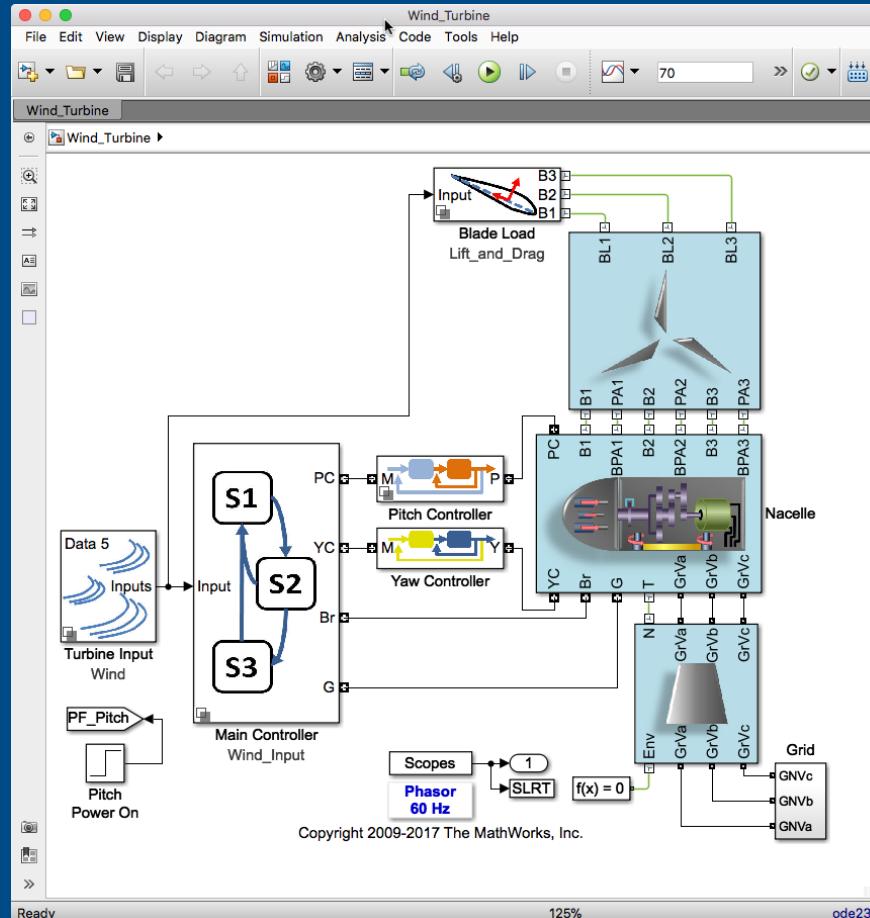
If you don't have the right data?

A white wind turbine is shown from a low angle, looking up. The tower is white, and the nacelle and two blades are visible. The bottom blade is severely damaged, with large sections missing and exposed internal components. The top blade is intact and white. The background is a clear, light blue sky.

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



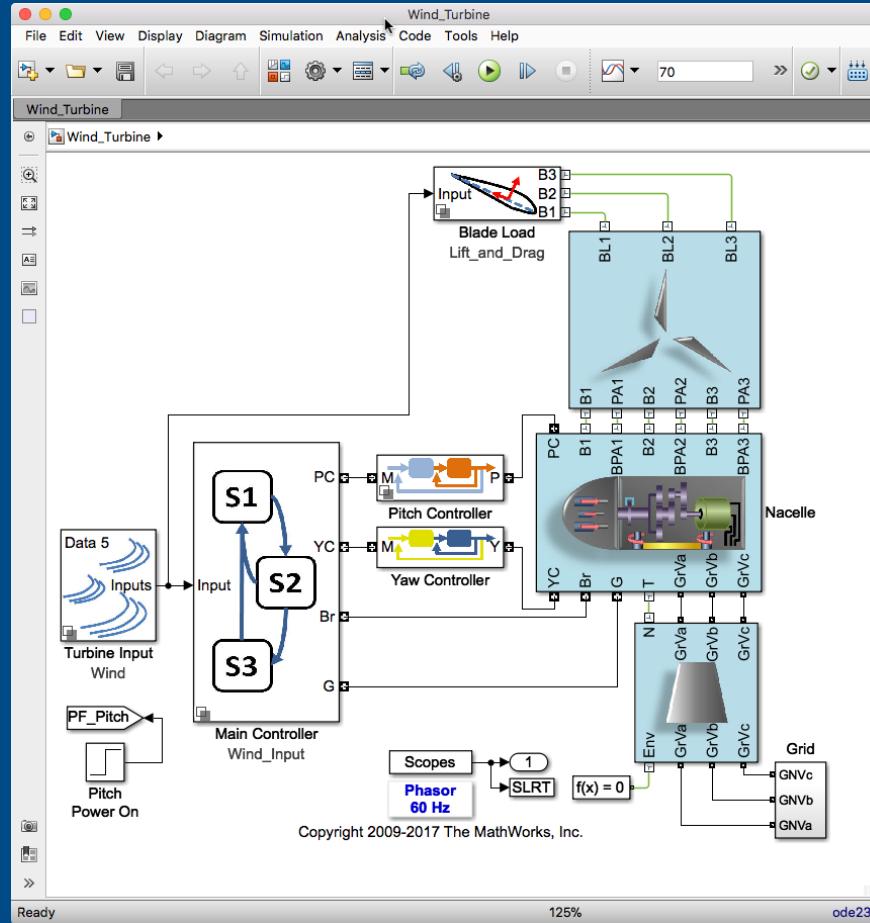
Simulink model

Predictive maintenance with synthetic failure data with MATLAB & Simulink



Measured data

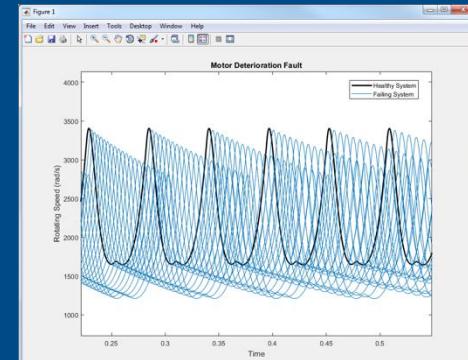
Refine model



Simulink model



Modify model



Failure signals

Failure characteristics

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

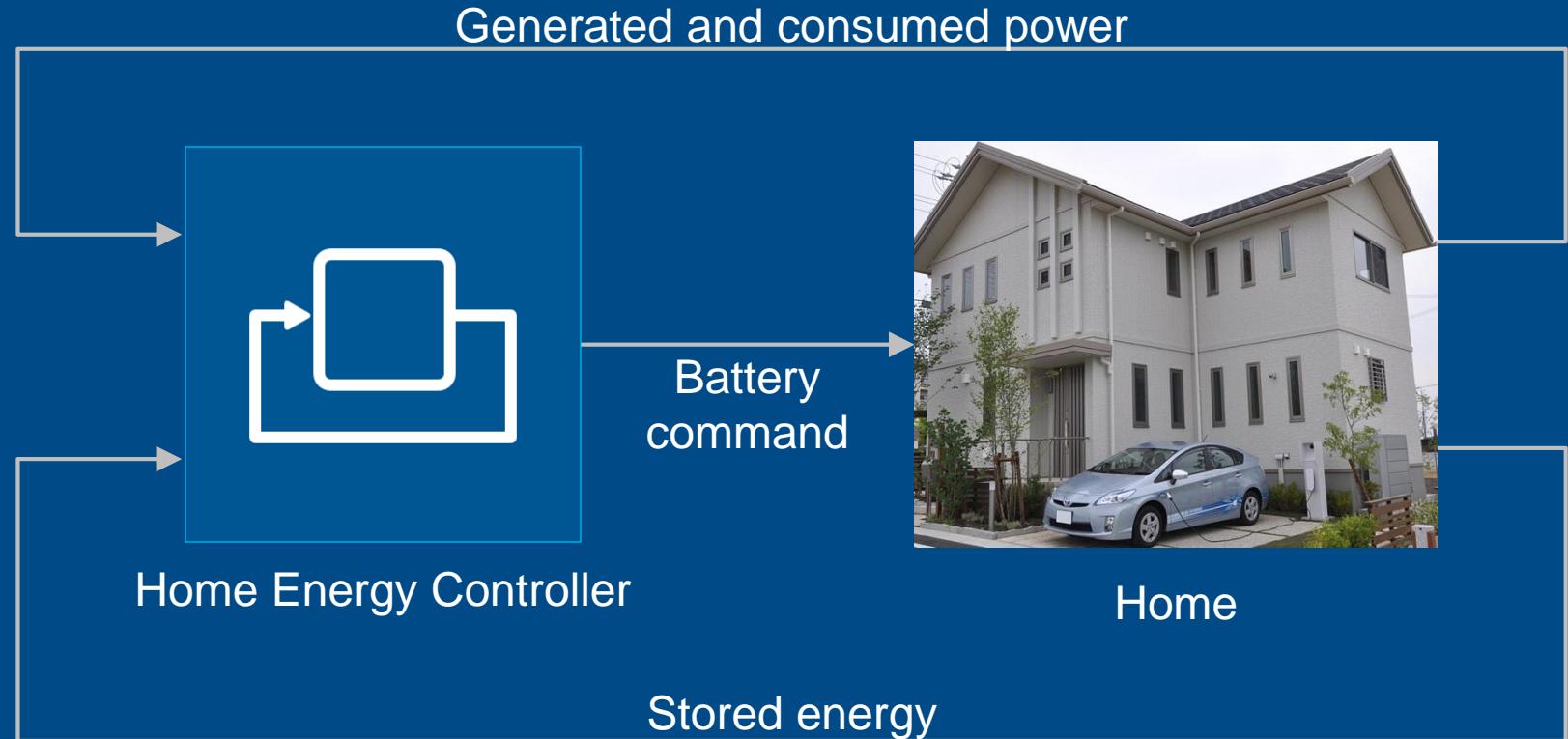
- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage

Goals

- Minimize energy cost
- Use EV battery for additional storage

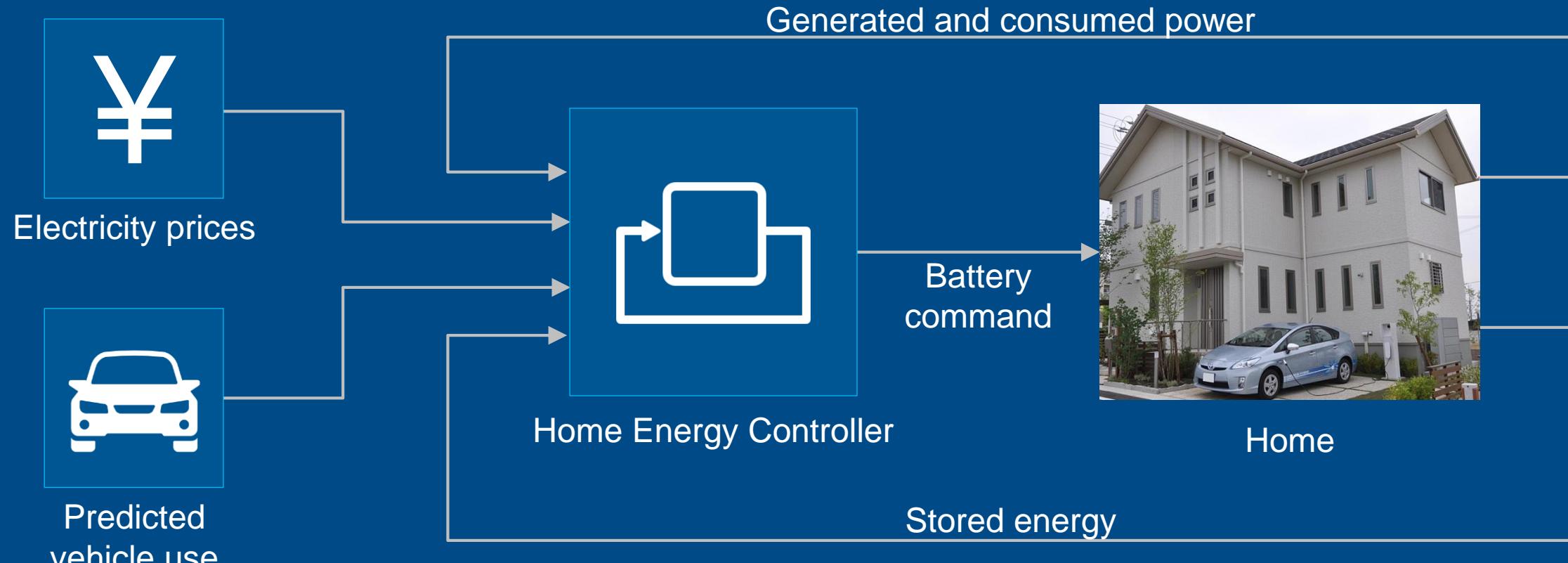
Optimizing home energy management system

Denso



Optimizing home energy management system

Denso



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



DENSO

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

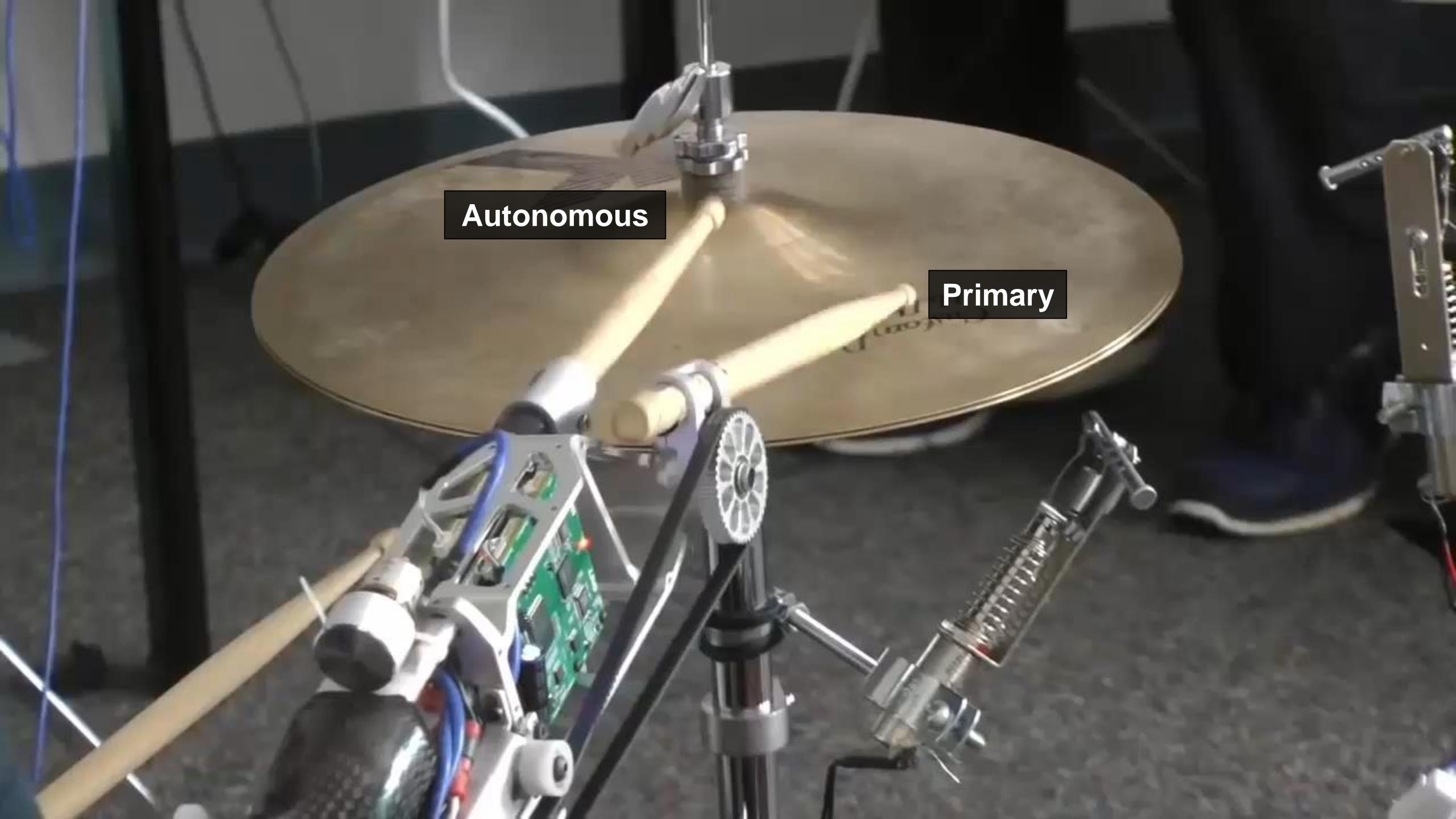
A medium shot of a young man with a reddish-brown beard and short hair, wearing a black t-shirt with a DW Drums logo. He is seated behind a drum set, holding drumsticks. A robotic arm with a drumstick is positioned next to his right hand. The background shows a wall with a circular logo and a window. Two text boxes are overlaid on the image: "Primary" in the upper right and "Autonomous" in the lower right.

Primary

Autonomous



EMG (Muscle) Control

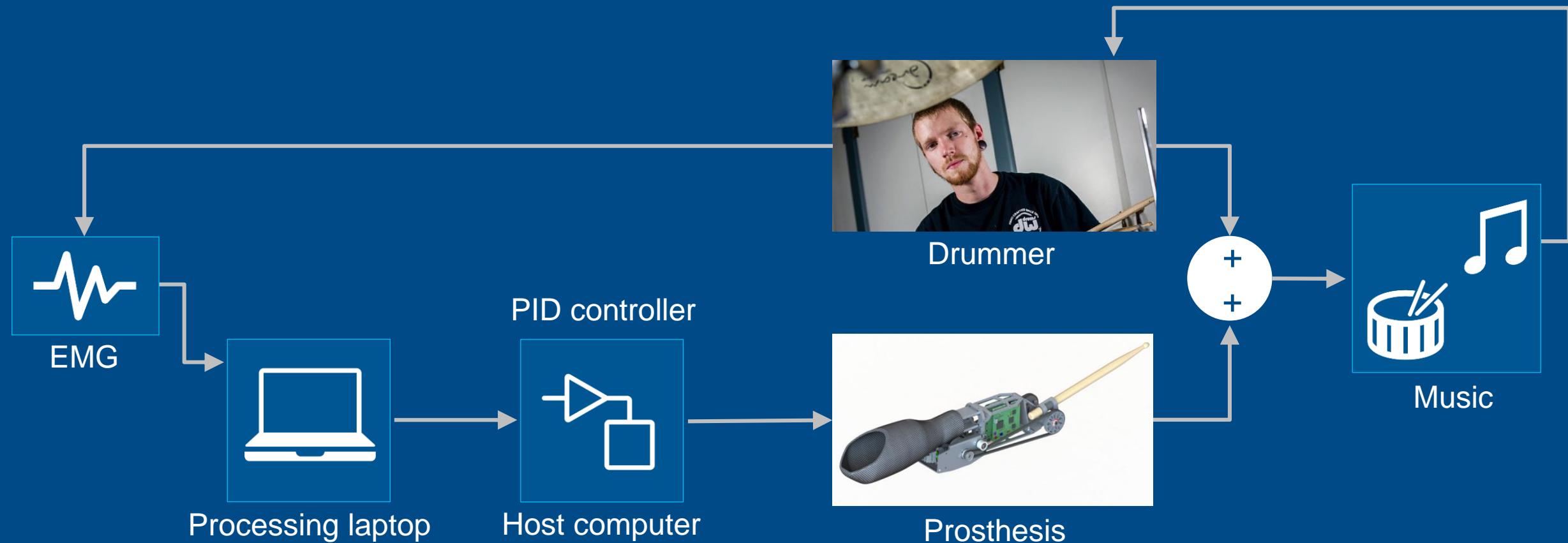
A close-up photograph of a robotic arm interacting with a cymbal. The arm, which has a metallic and blue-painted mechanical structure, is holding a light-colored wooden drumstick. It is positioned to strike the edge of a large, shiny brass cymbal. The background is dark and out of focus.

Autonomous

Primary

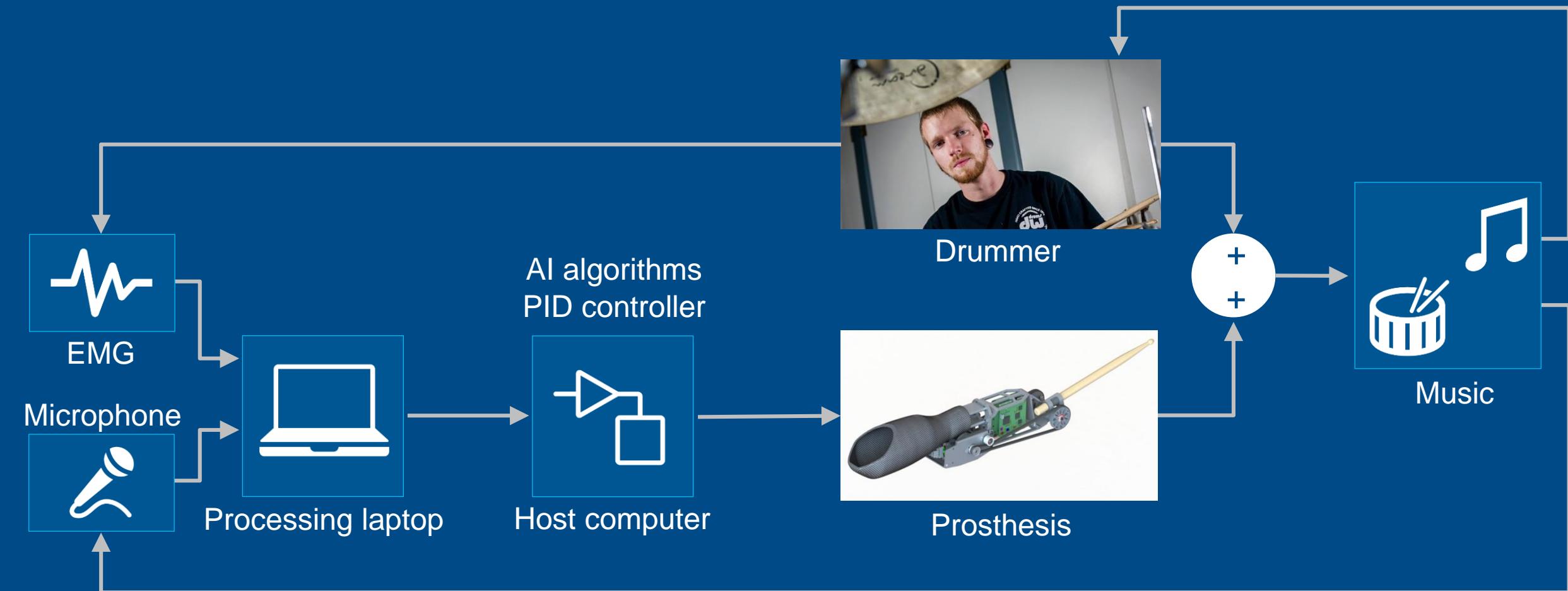
Exceeding human capabilities with a robotic drumming prosthesis

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



Sensors



Files



Databases

Analyze Data



Data exploration



Preprocessing



Domain-specific
algorithms

Develop



AI model



Algorithm
development

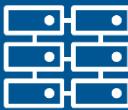


Modeling &
simulation

Deploy



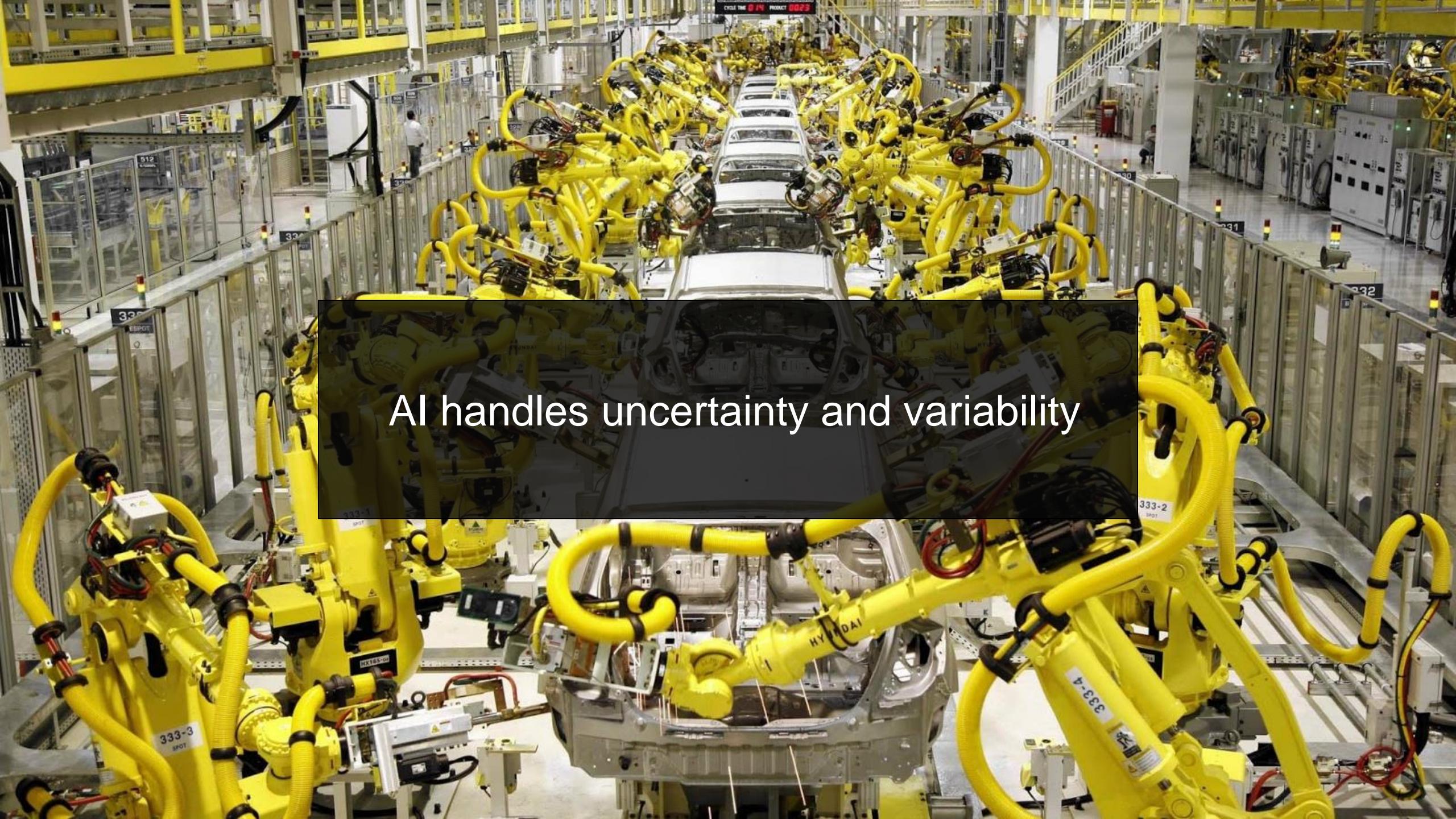
Desktop apps



Enterprise
systems



Embedded
devices



A large industrial assembly line, likely a car factory, featuring numerous yellow robotic arms working on the frames of white cars. The scene is filled with complex machinery, conveyor belts, and safety railings. In the center, a large black rectangular box contains the text "AI handles uncertainty and variability".

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!