MATLAB EXPO 2018

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

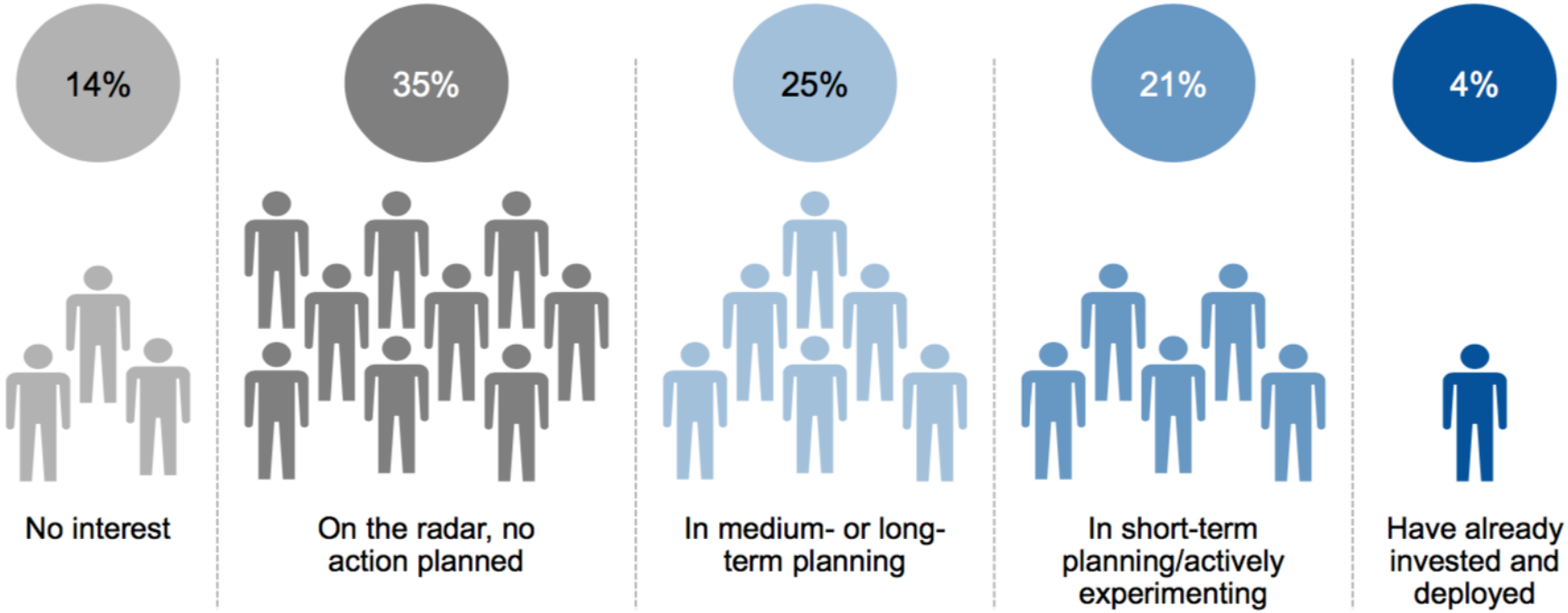
Loren Dean

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

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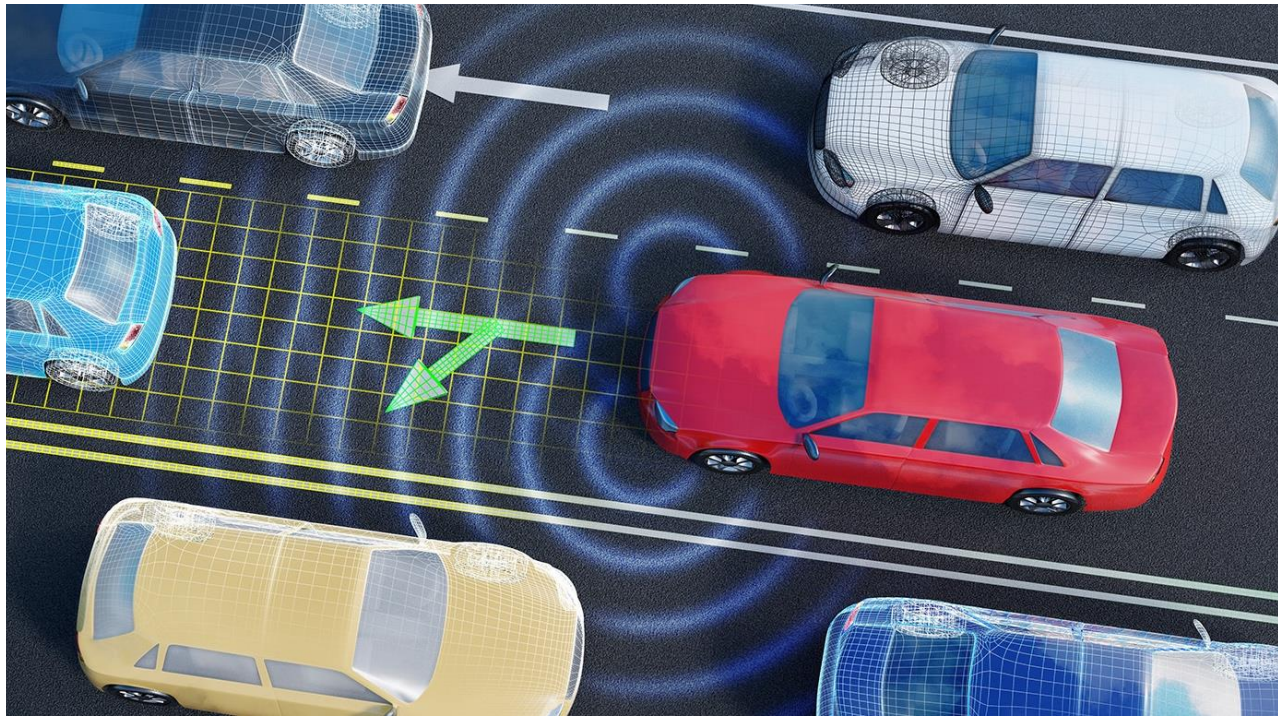
amazon

Luke Skywalker
94.5%

ВЫХОД В ГОРОД
ACCESS TO CITY



Artificial Intelligence

The capability of a machine to imitate intelligent human behavior

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Artificial Intelligence

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

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Artificial Intelligence Today

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

by training a machine to learn the desired behavior

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

Traditional Programming

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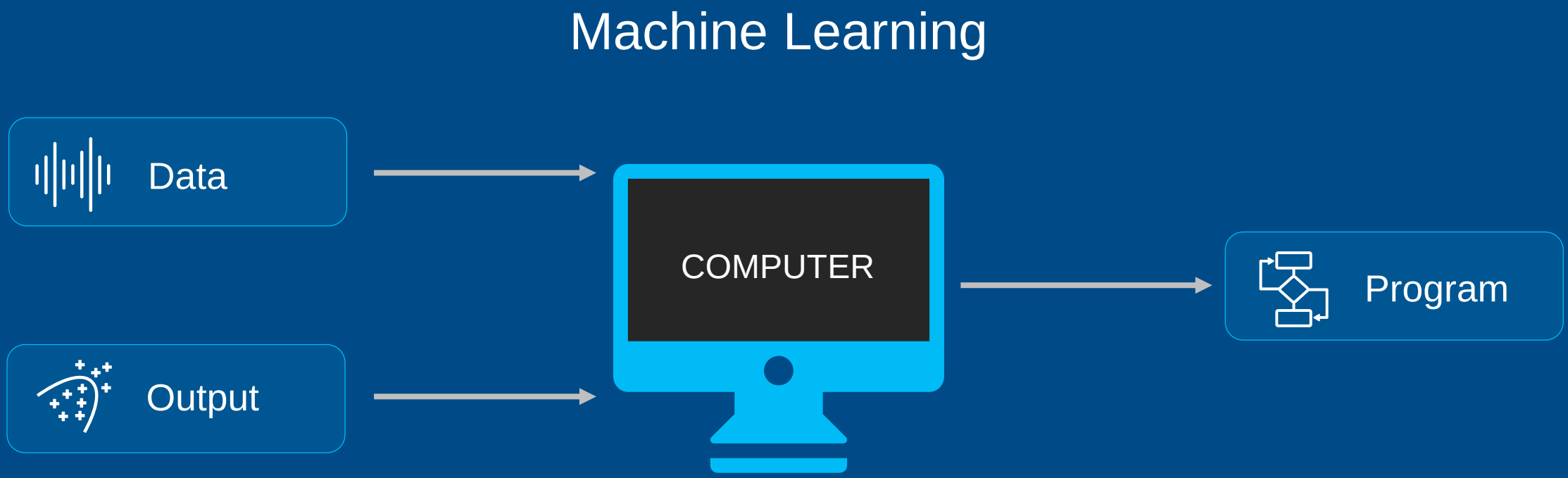
There are two ways to get a computer to do what you want



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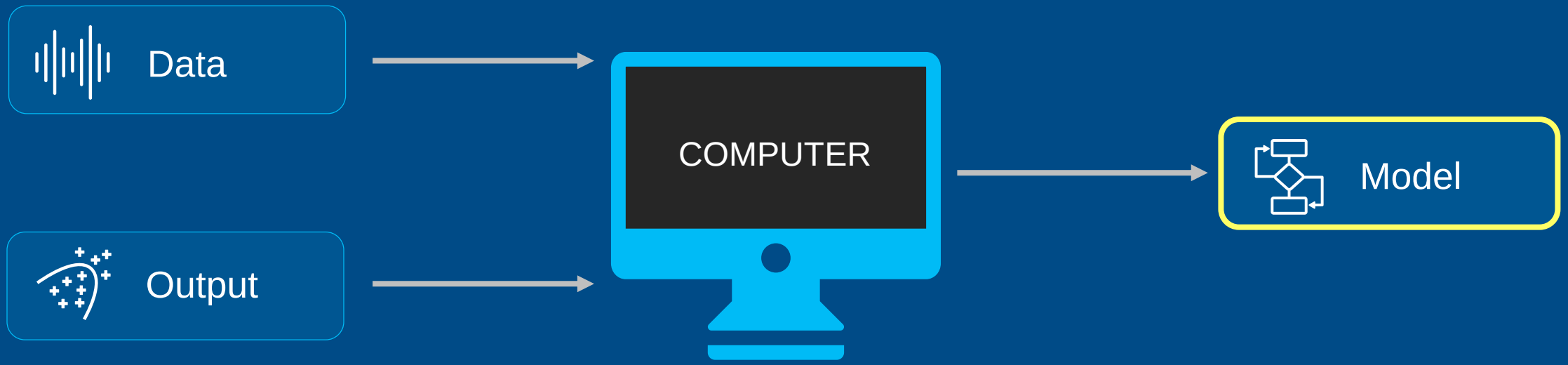
There are two ways to get a computer to do what you want

Machine Learning



Artificial Intelligence

Machine Learning

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Are you ready for AI?

Data

Output

Model

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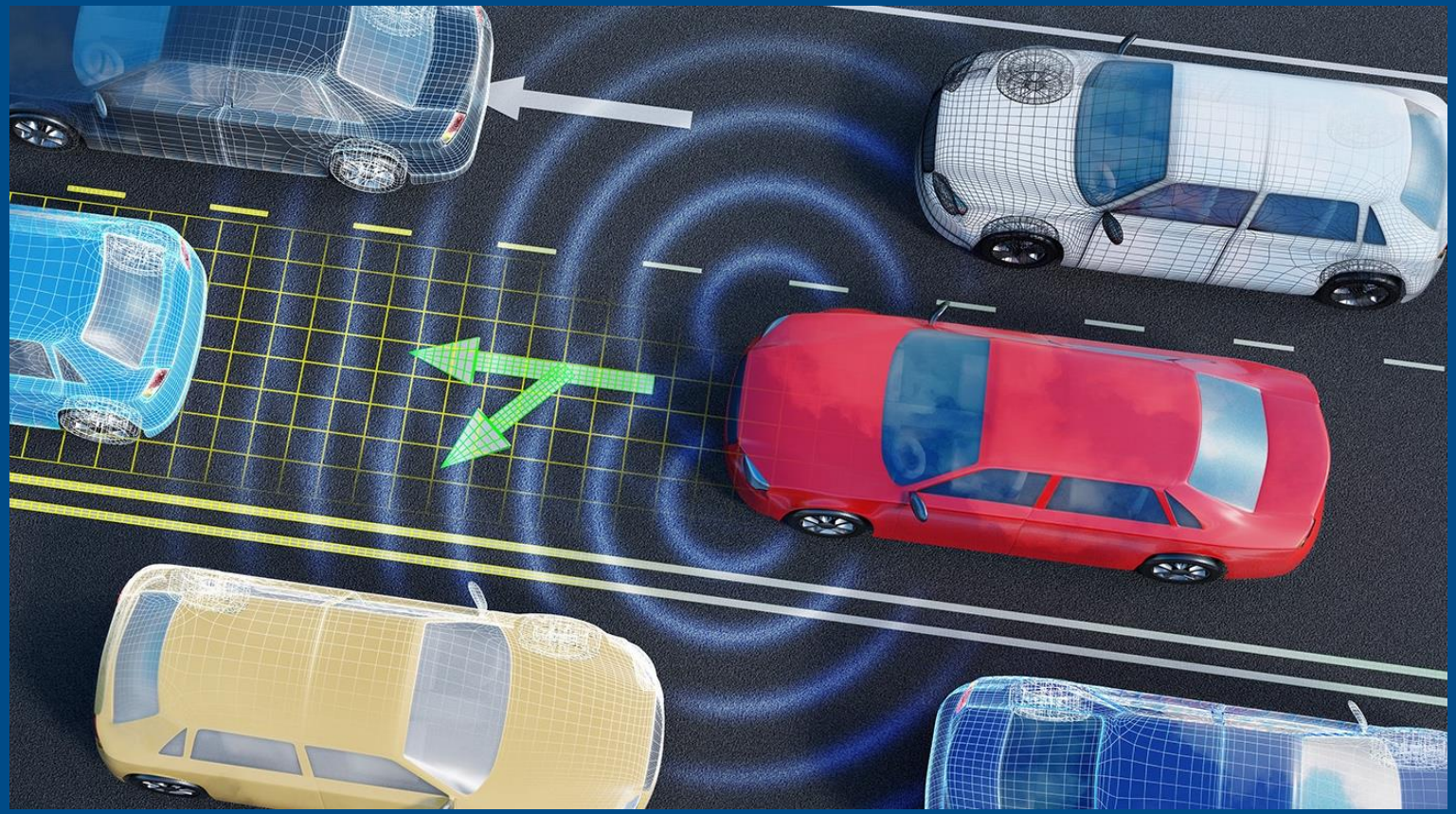
Are you ready for AI?

- Data
- Output
- Model



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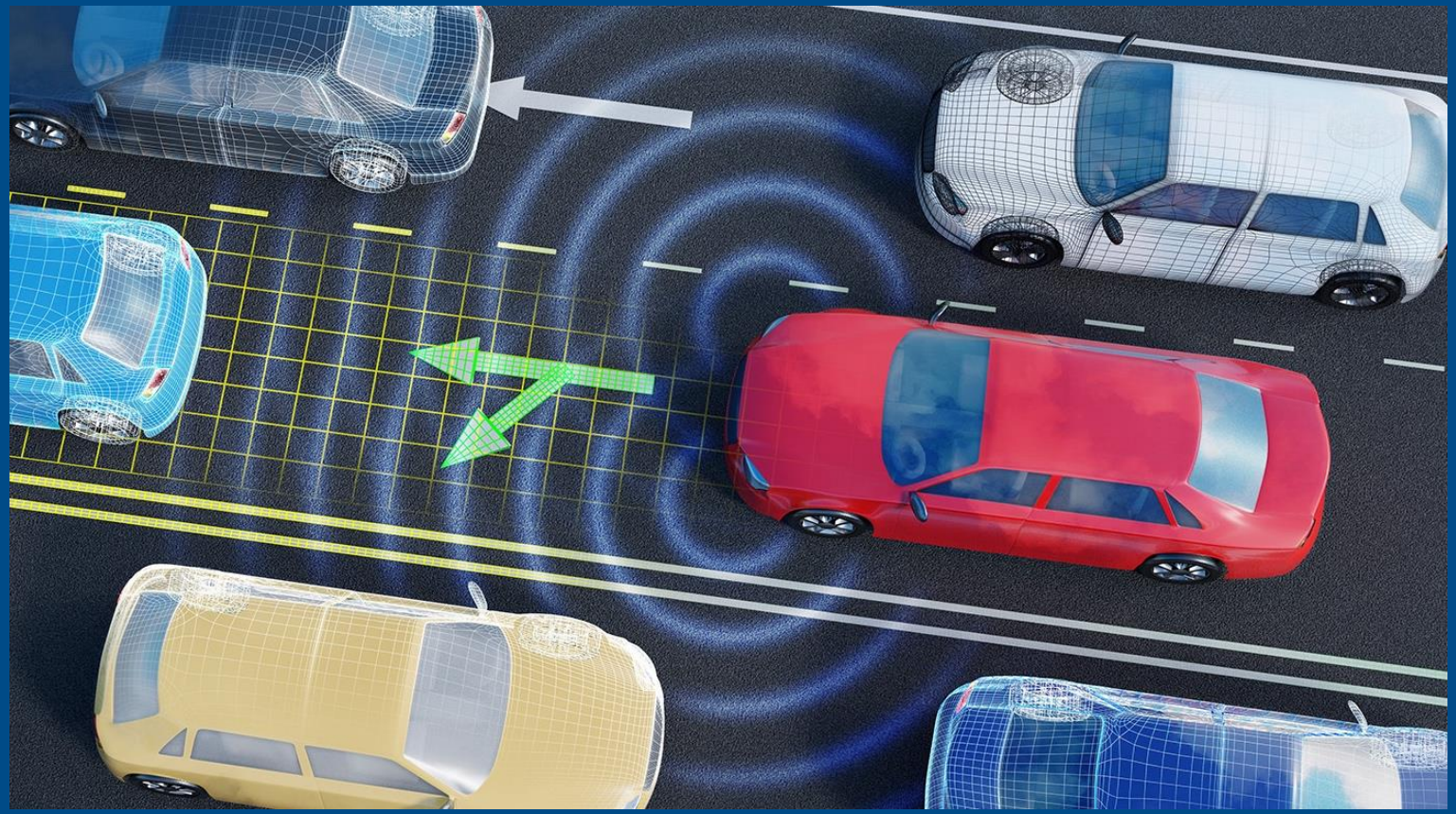
Are you ready for AI?

Access Data

Analyze Data

- Data
- Output
- Model



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Are you ready for AI?

Access Data

Develop

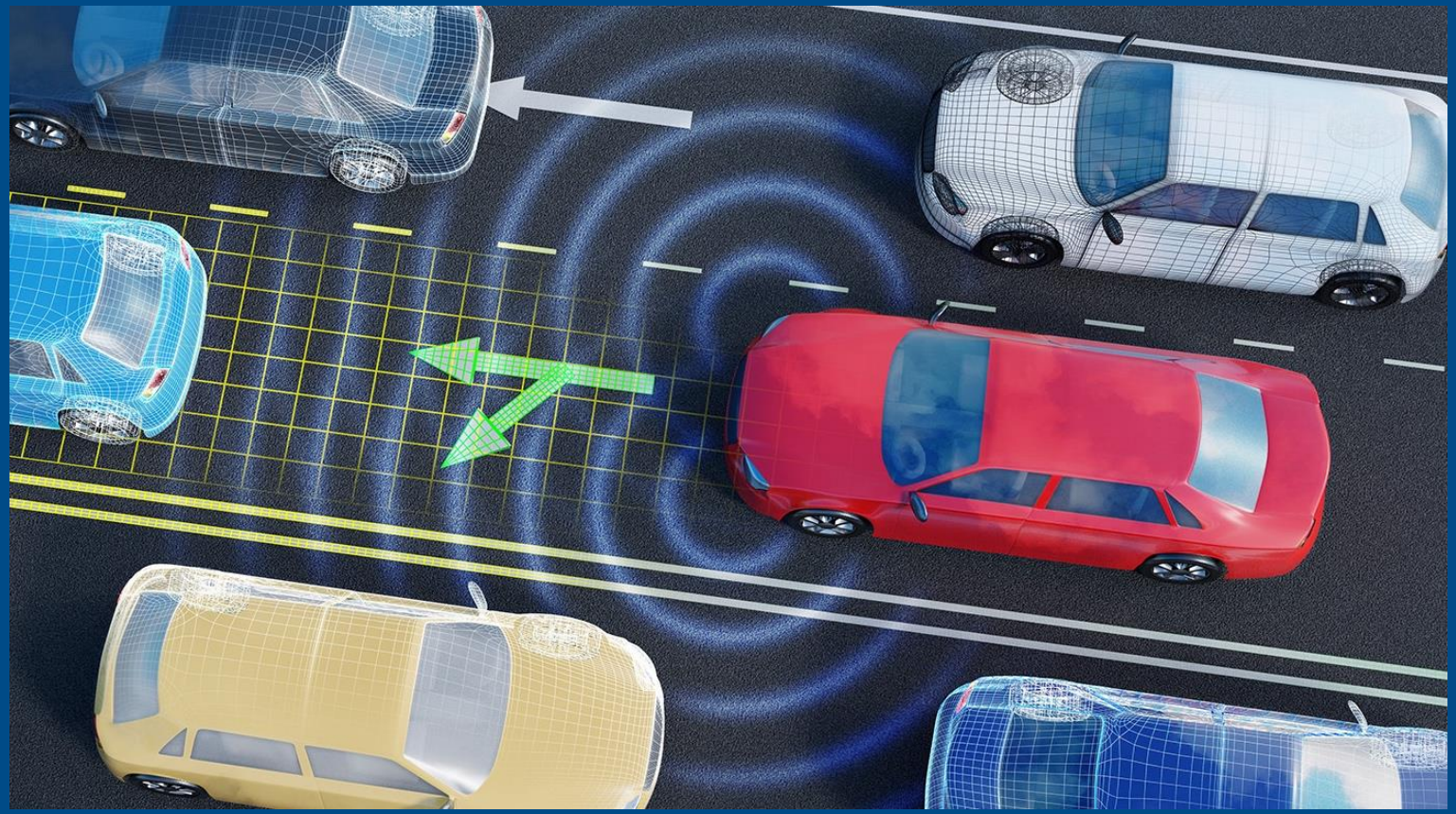
Analyze Data

Deploy

Data

Output

Model



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Are you ready for AI?

Access Data

Develop

Analyze Data

Deploy

Data

Output

Model

EVERYTHING ELSE

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Are you ready for AI?

Access Data	Analyze Data	Develop	Deploy
		AI model	
		Algorithm development	
		Modeling & simulation	

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Are you ready for AI?

Access Data	Analyze Data	Develop	Deploy
Sensors	Data exploration	AI model	
Files	Preprocessing	Algorithm development	
Databases	Domain-specific algorithms	Modeling & simulation	

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Are you ready for AI?

Access Data	Analyze Data	Develop	Deploy
Sensors	Data exploration	AI model	Desktop apps
Files	Preprocessing	Algorithm development	Enterprise systems
Databases	Domain-specific algorithms	Modeling & simulation	Embedded devices

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Are you ready for AI?

Caffe

TensorFlow

Access Data	Analyze Data	Develop	Deploy
Sensors	Data exploration	AI model	Desktop apps
Files	Preprocessing	Algorithm development	Enterprise systems
Databases	Domain-specific algorithms	Modeling & simulation	Embedded devices

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Do you need AI?

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KUKA
KUKA
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?

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Twisties
Cheese
FAT 8.3 g
SAT FAT 3.1 g
SUGARS 1.6 g
SODIUM 245 mg
90g e NET
Flavoured snack
Twisties
Chicken
FAT 7.4 g
SAT FAT 3.6 g
SUGARS 0.7 g
SODIUM 213 mg
90g e NET

What is crispiness?

Crushing Sound

+

Crushing Force

=

Crispy

Crispy Enough

Soggy

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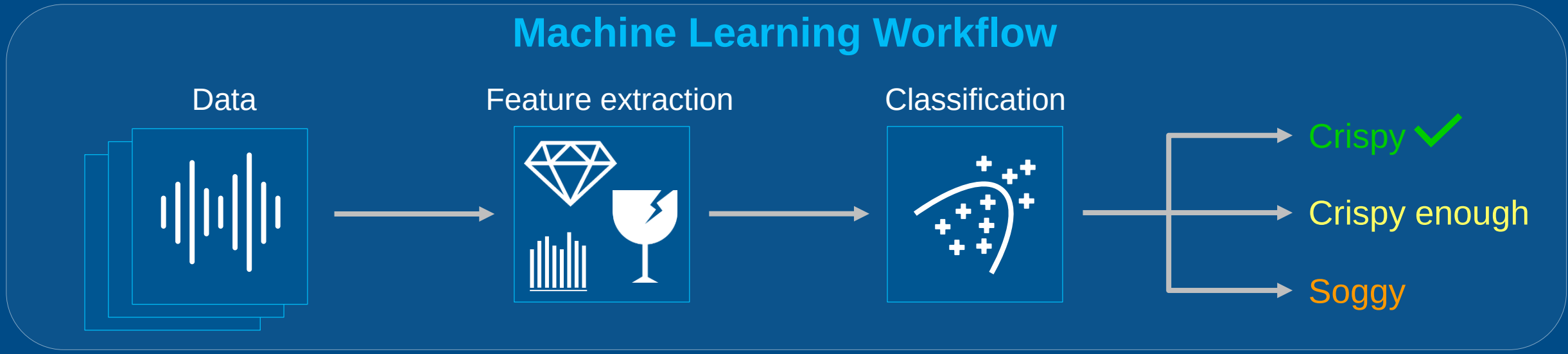
Replicating human perception with machine learning
Technical University of Munich



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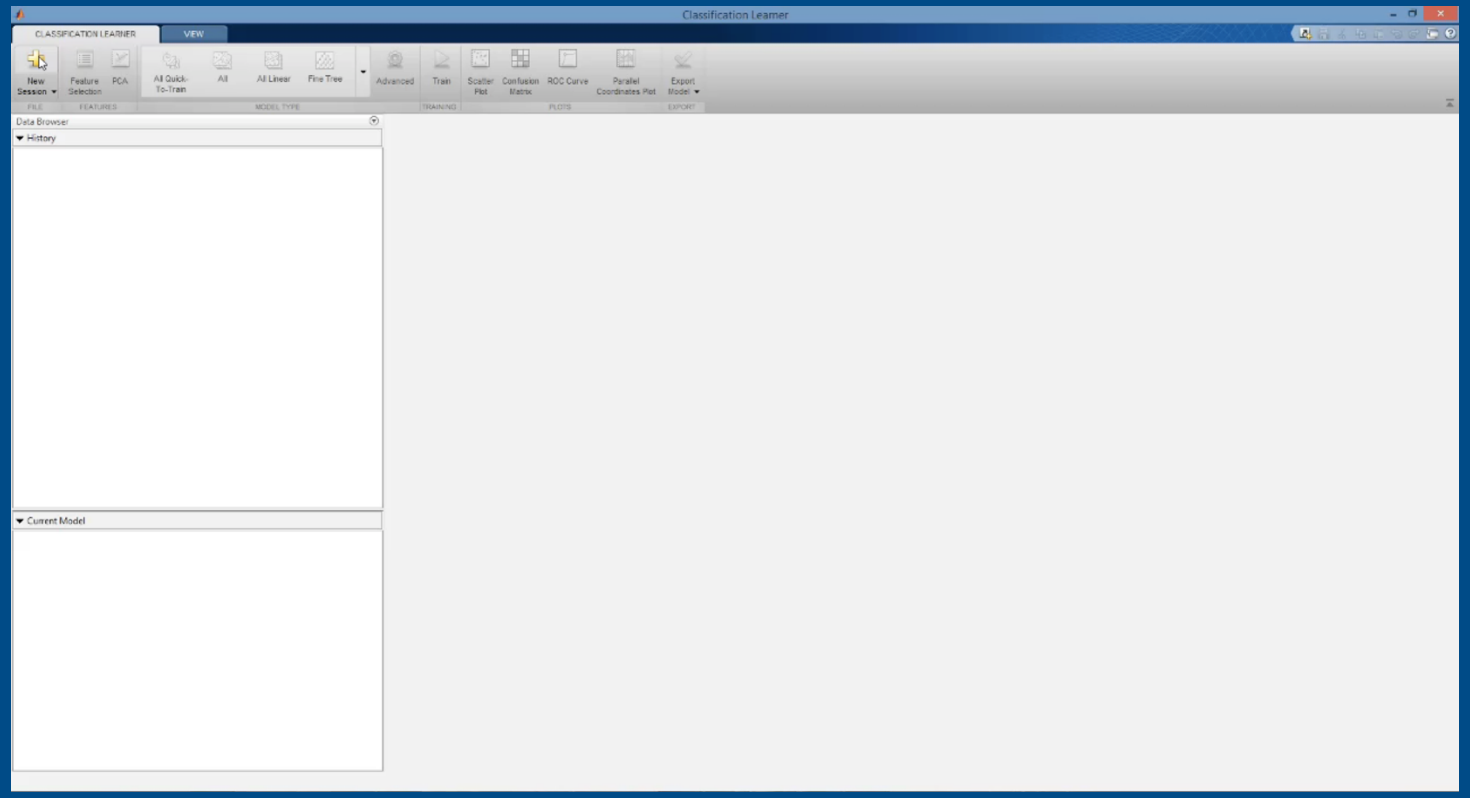
Replicating human perception with machine learning
Technical University of Munich



Classification Learner

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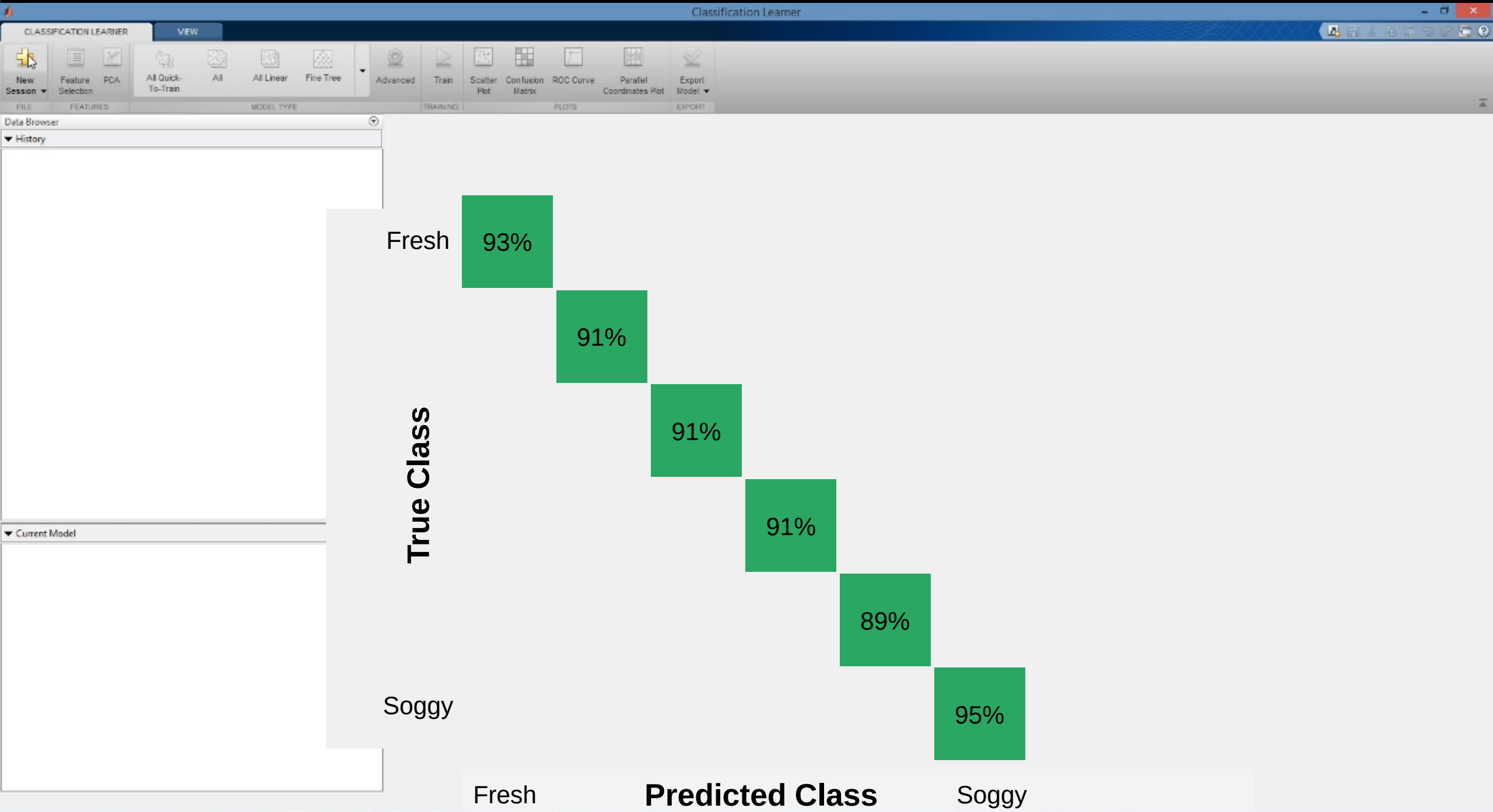
Classification Learner
CLASSIFICATION LEARNER
VIEW
New Session
Feature Selection
PCA
All Quick-To-Train
All
All Linear
Fine Tree
Advanced
Train
Scatter Plot
Confusion Matrix
ROC Curve
Parallel Coordinates Plot
Export Model
FILE
FEATURES
MODEL TYPE
TRAINING
PLOTS
EXPORT
Data Browser
History
Current Model
Fresh
93%
91%
91%
91%
89%
95%
Soggy
True Class
Fresh
Predicted Class
Soggy

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

- Minimal experience required
- Use apps to try out all possible models
- Use domain expertise and familiar tools to prepare data

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Are you ready for AI if …

You can’t identify features in your data?

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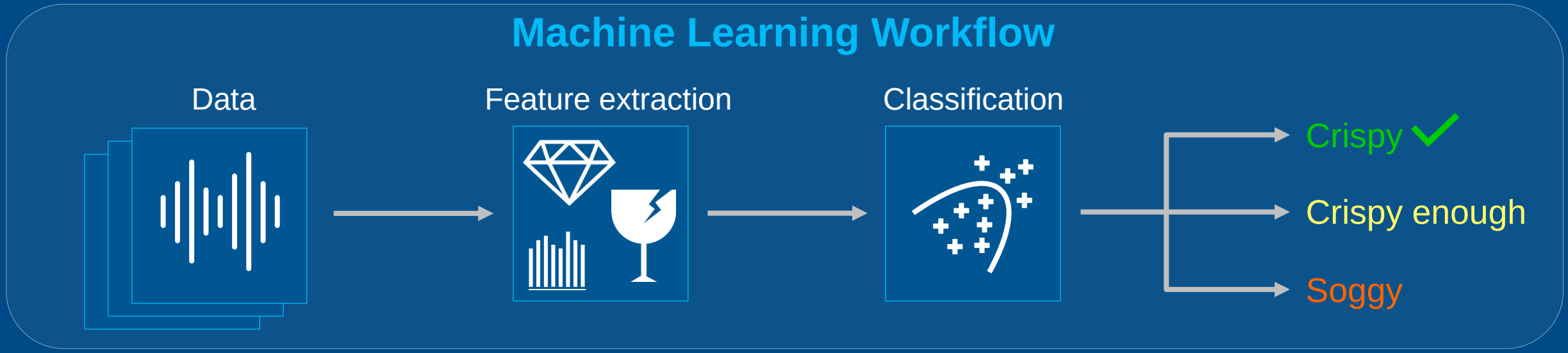
Use deep learning to identify features automatically



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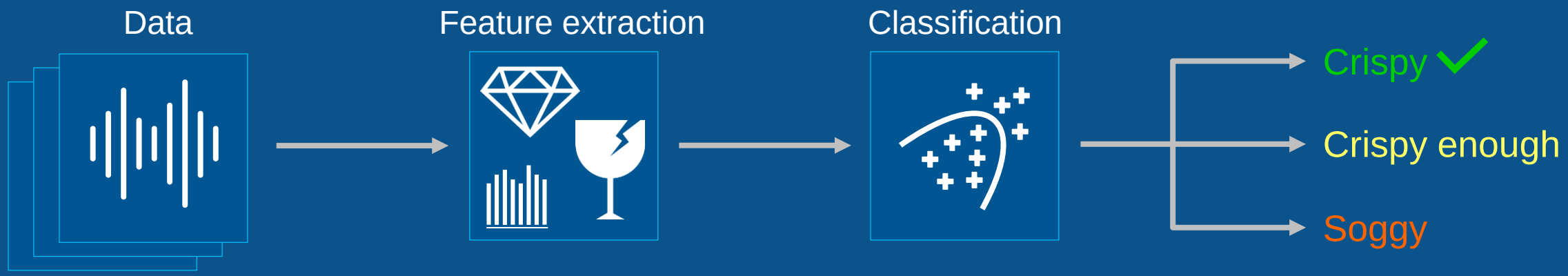
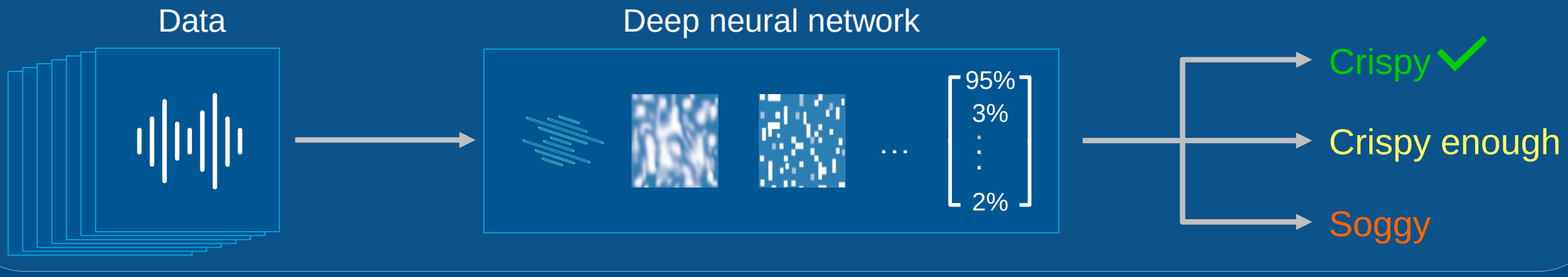
Use deep learning to identify features automatically

Machine Learning Workflow



Deep Learning Workflow



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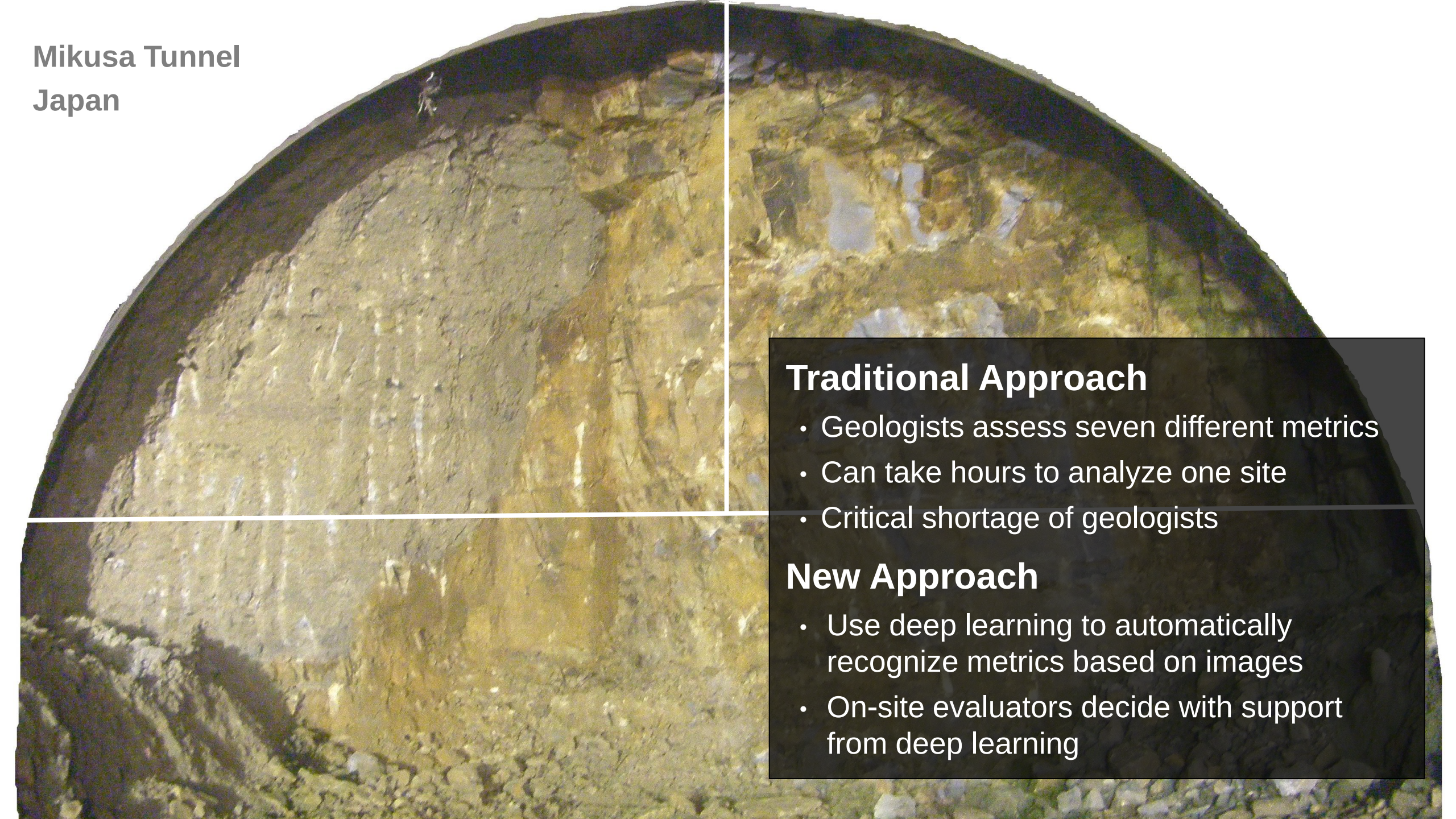
SPEED LIMIT 45

Mikusa Tunnel
Japan



Traditional Approach

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

New Approach

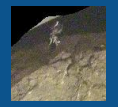
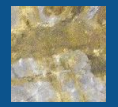
- Use deep learning to automatically recognize metrics based on images
- On-site evaluators decide with support from deep learning

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
⋮	⋮	⋮	⋮

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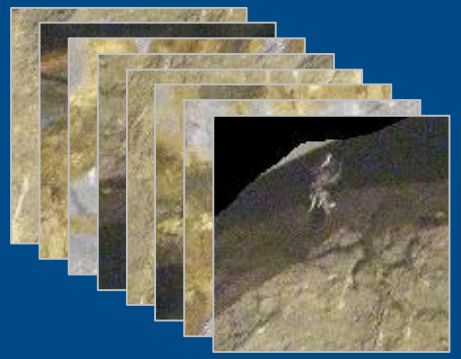
Efficient tunnel drilling with deep learning

Obayashi Corporation



Transfer learning

AlexNet

PRETRAINED MODEL

Ice cream

Teapot

Goose

Custom Network

Weathering alteration: 4

Fracture spacing: 3

Fracture state: 2

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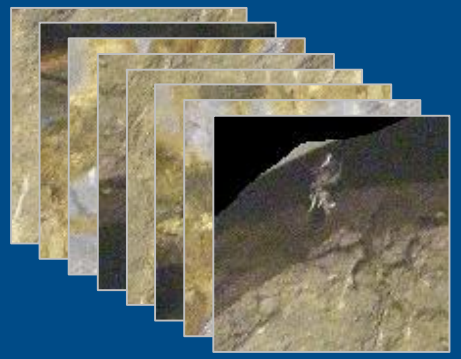
Efficient tunnel drilling with deep learning

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

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

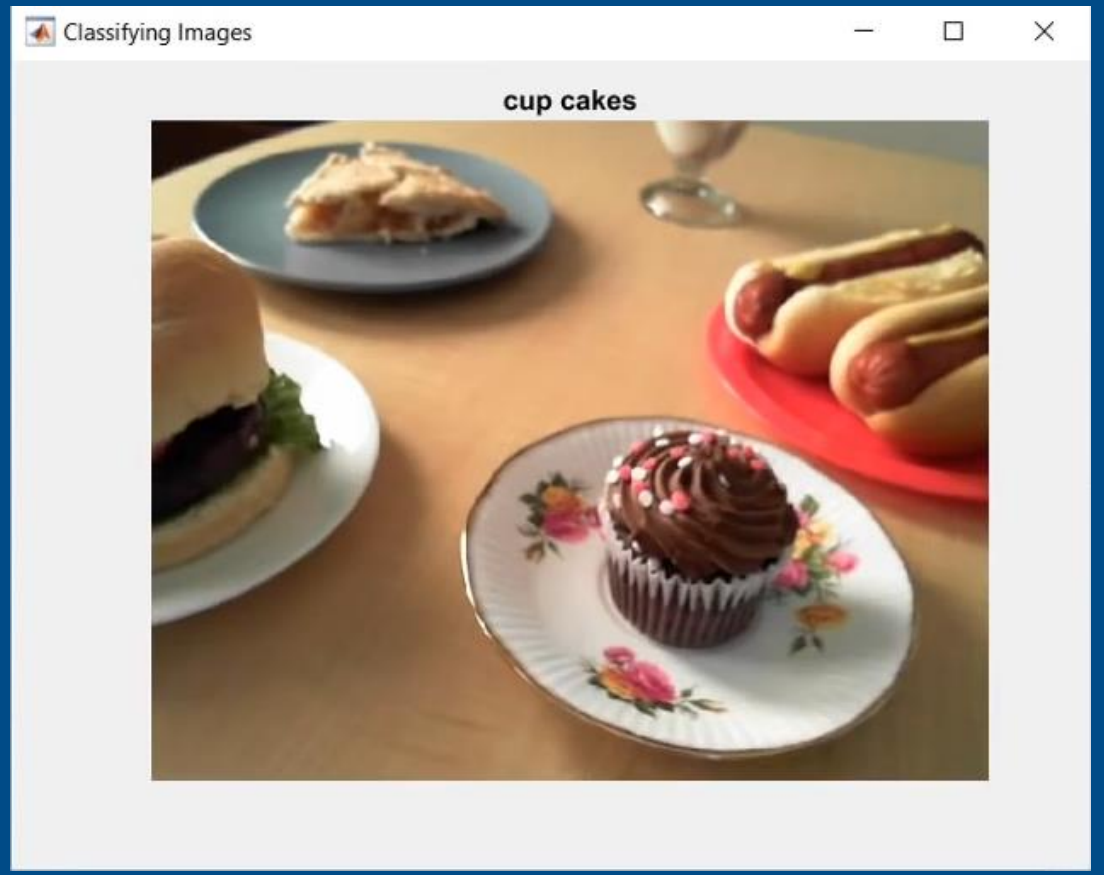
- Deep learning

```
nnet = alexnet;

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

label = classify(nnet, picture)
```

Deep learning in 5 lines of code



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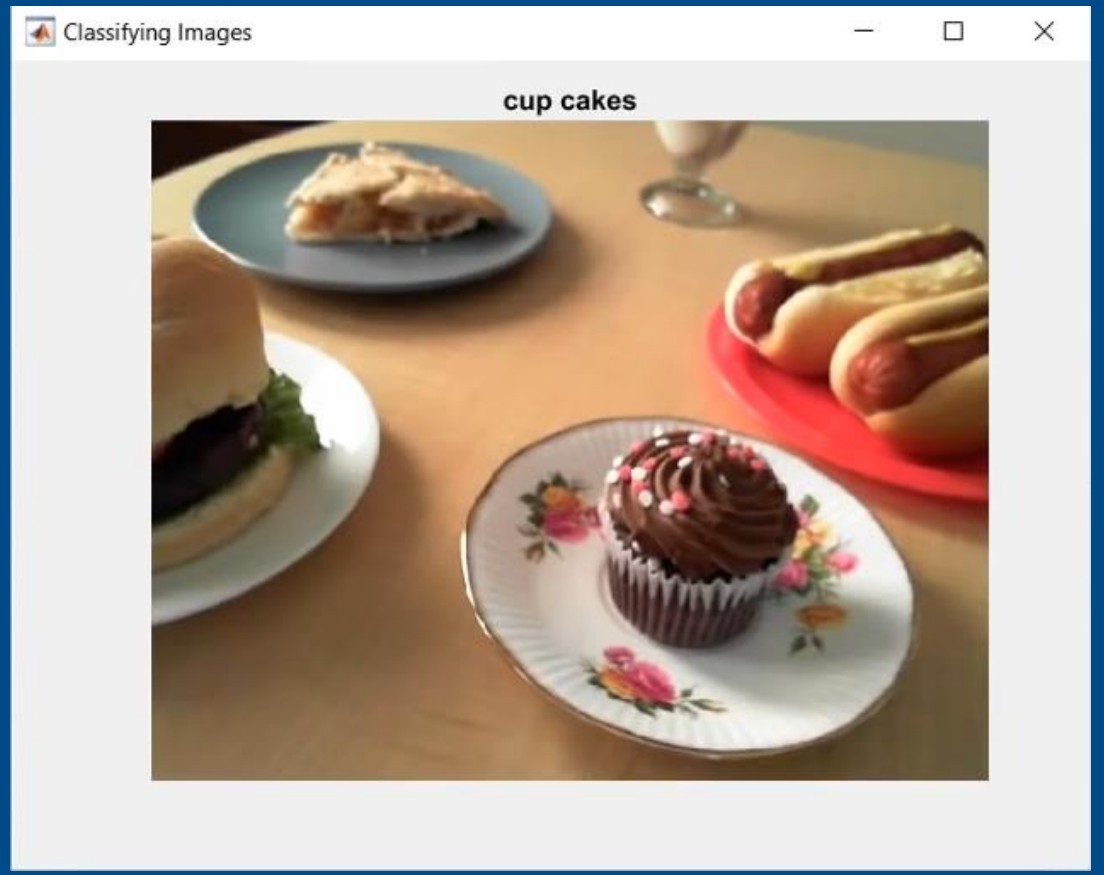
Are you ready for AI if you can’t identify features in your data?

- Deep learning
- Transfer learning

Deep learning in 5 lines of code



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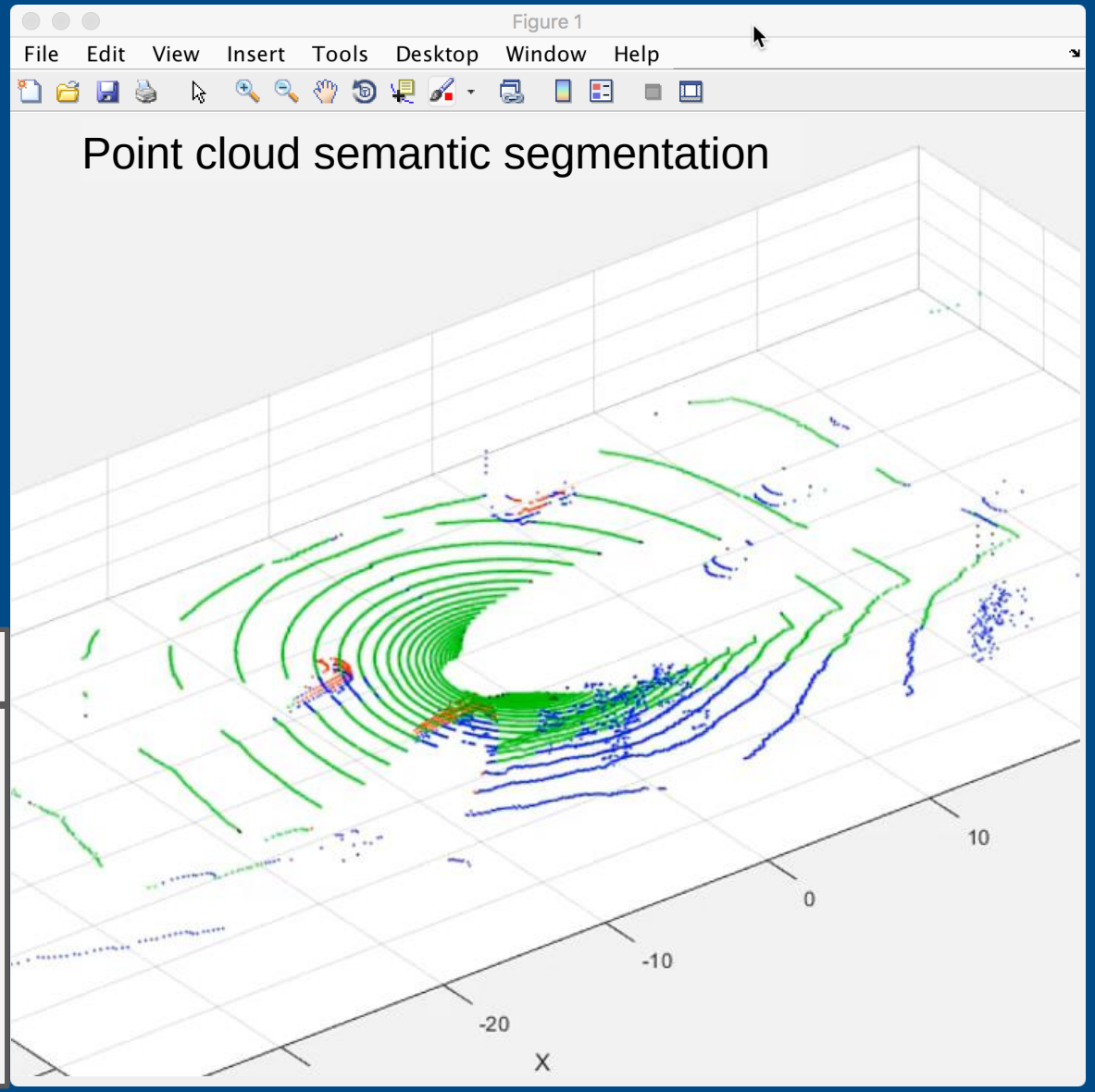
Are you ready for AI if you can't identify features in your data?

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

Autoliv



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

- Deep learning
- Transfer learning
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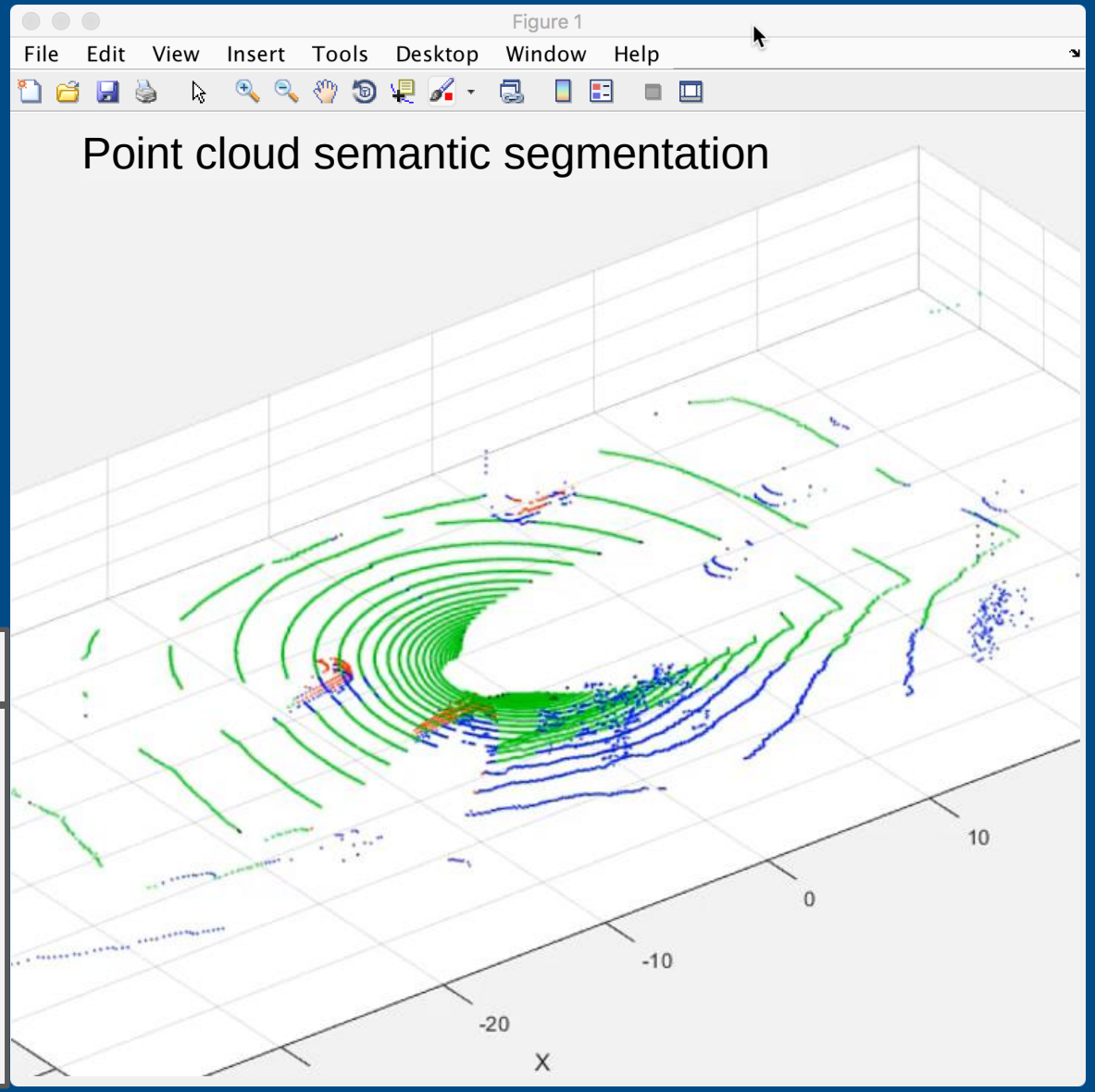
Autoliv



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Are you ready for AI if …

If you don’t have the right data?

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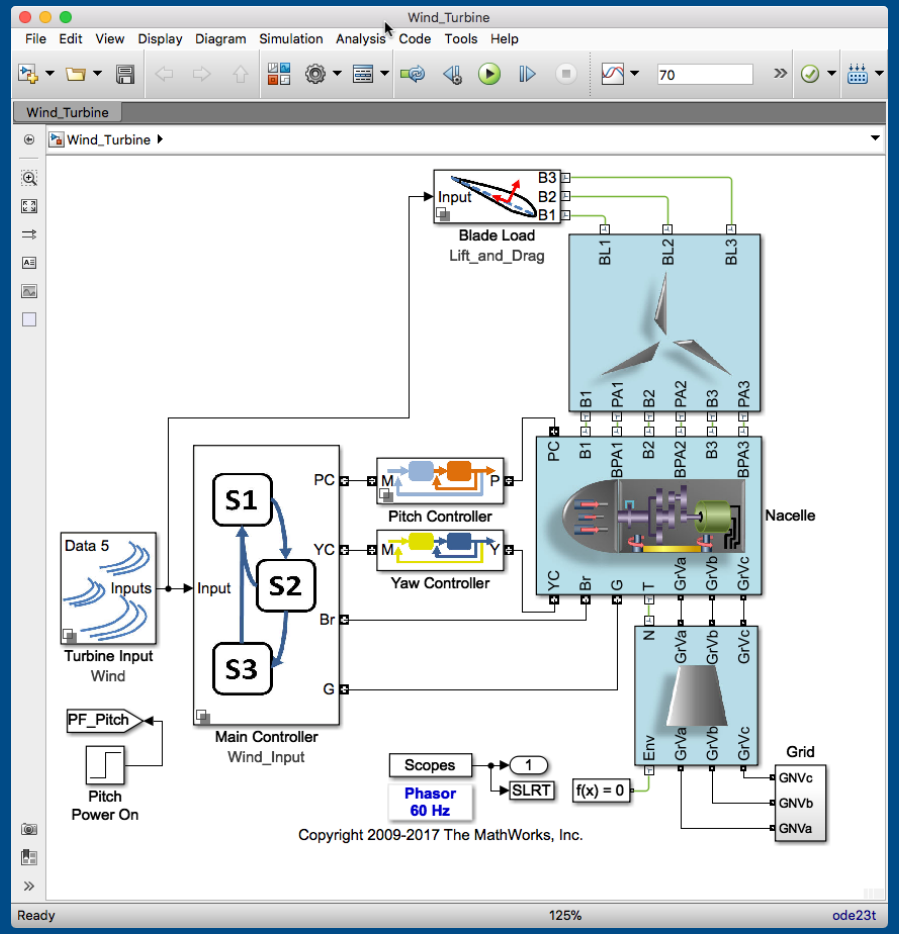
AI for Predictive Maintenance

- 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

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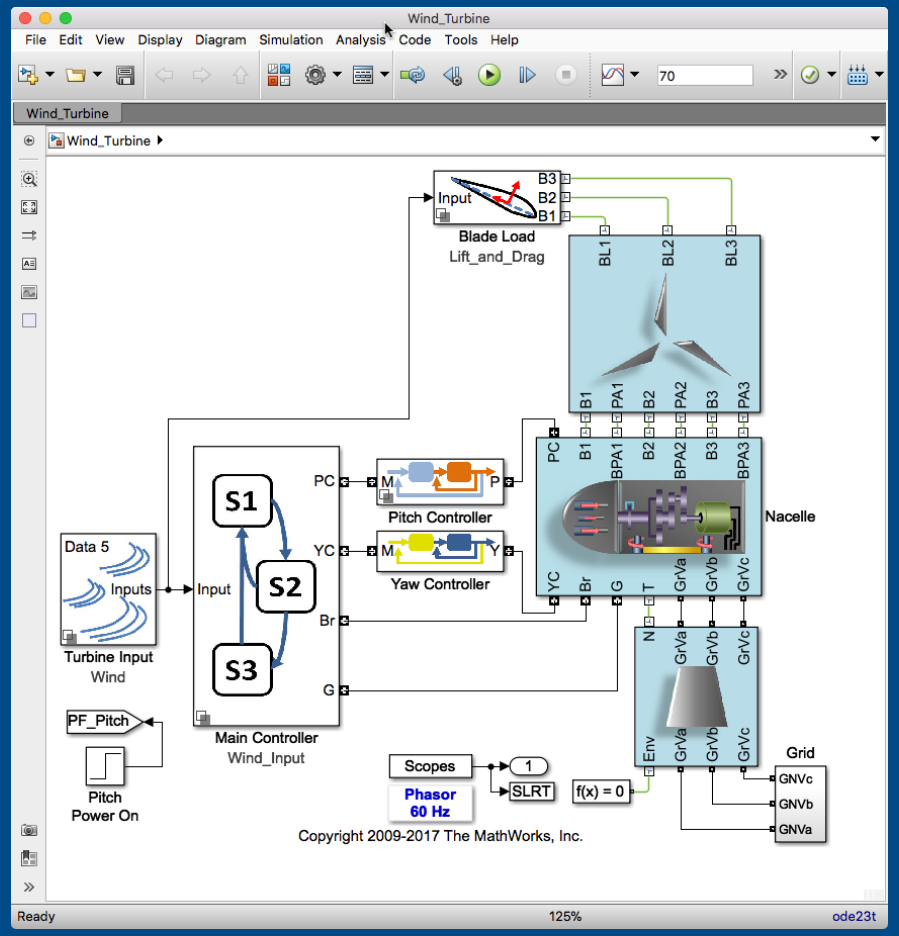
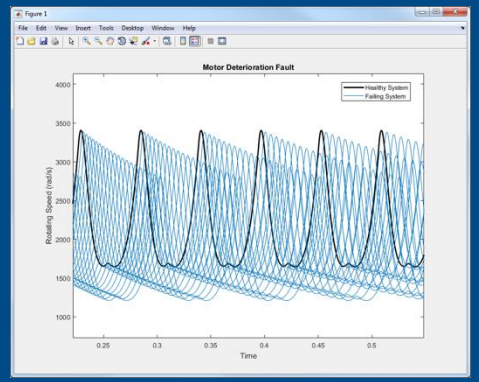
Predictive maintenance with synthetic failure data with MATLAB & Simulink

Measured data

Refine model



Simulink model



Failure data

Failure conditions

Inject failures

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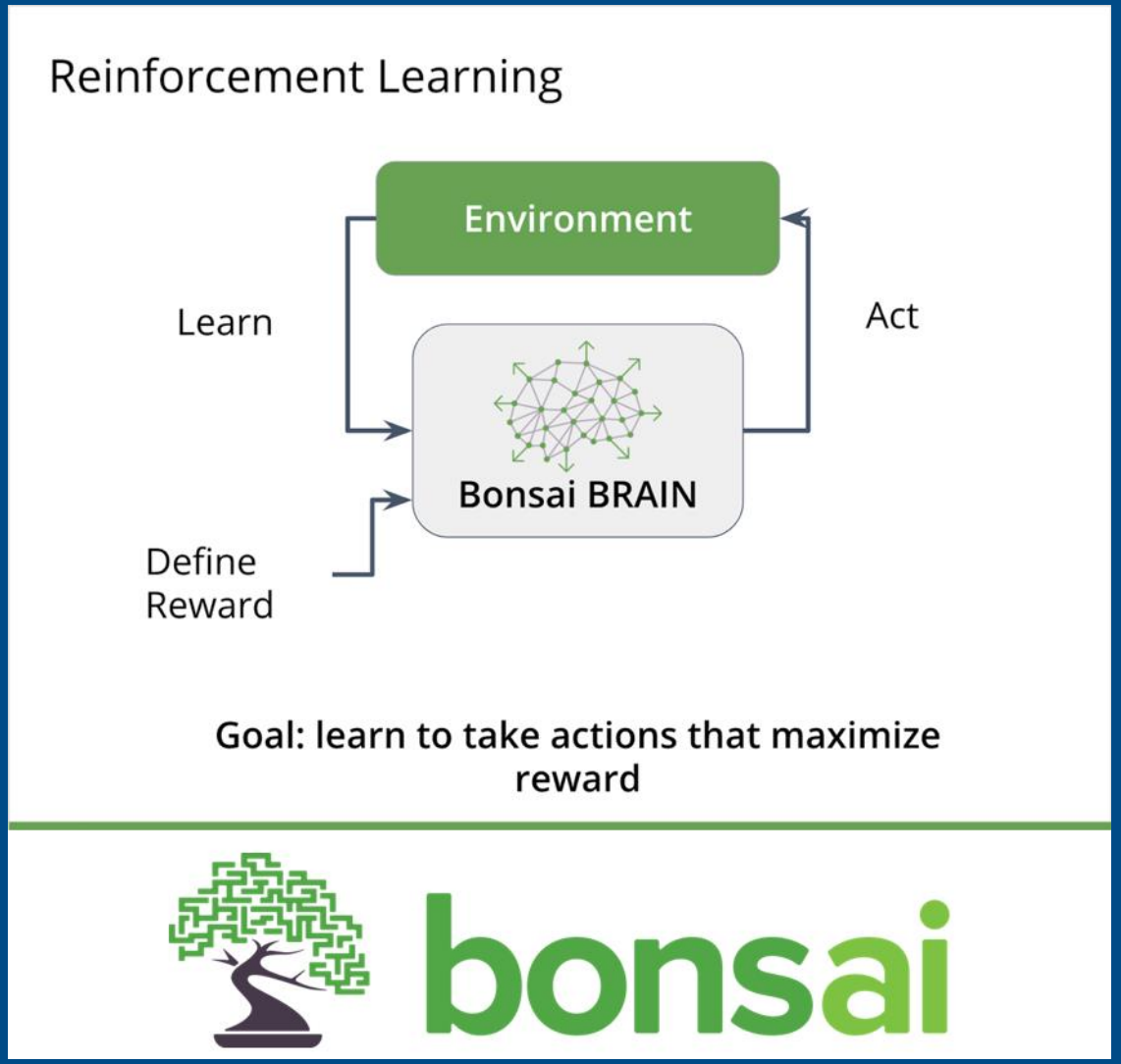
Are you ready for AI if you don’t have the right data?

- Generate data with simulations
- Simulation environment for reinforcement learning



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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

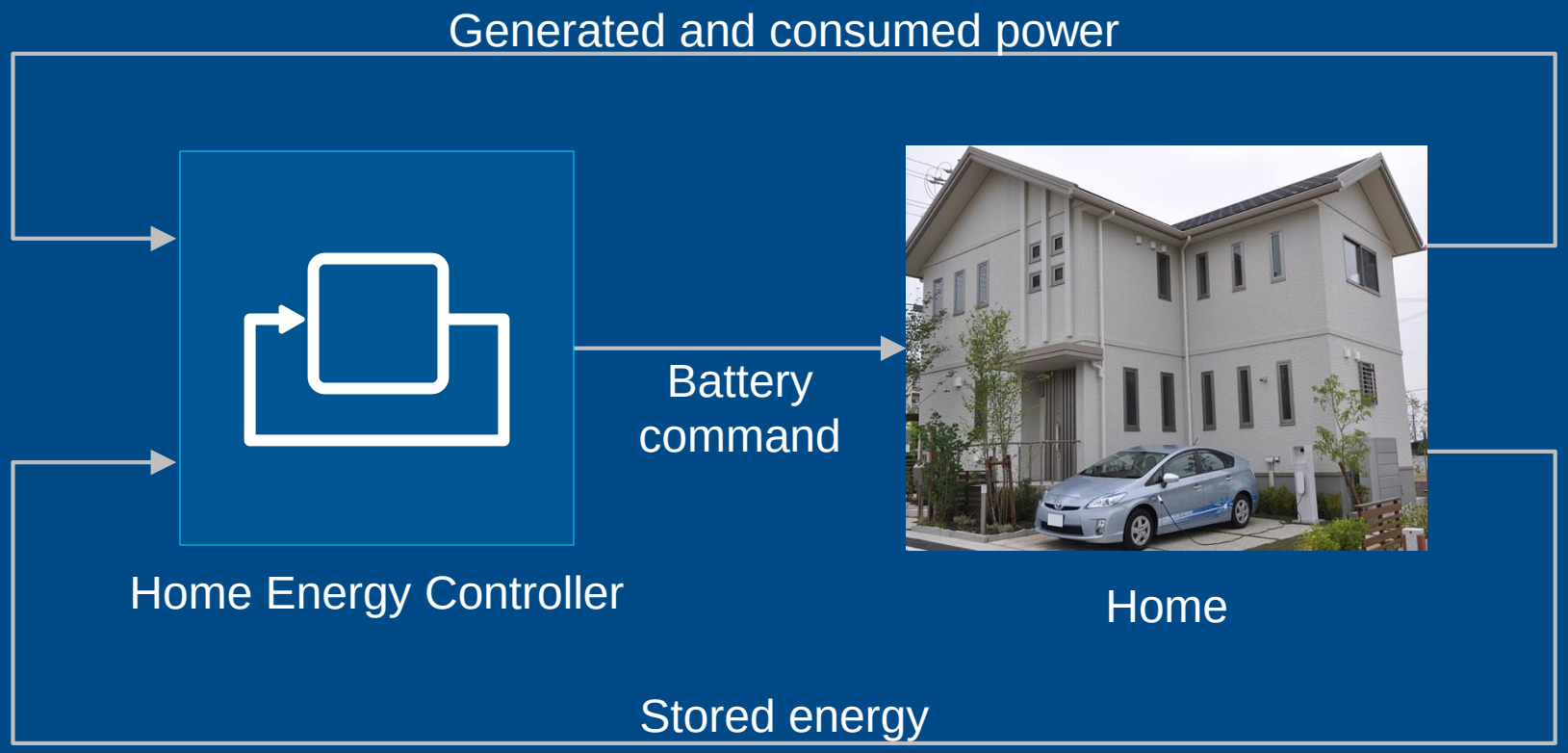
- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage

Goals

- Minimize energy cost
- Use EV battery for additional storage

Optimizing home energy management system

Denso



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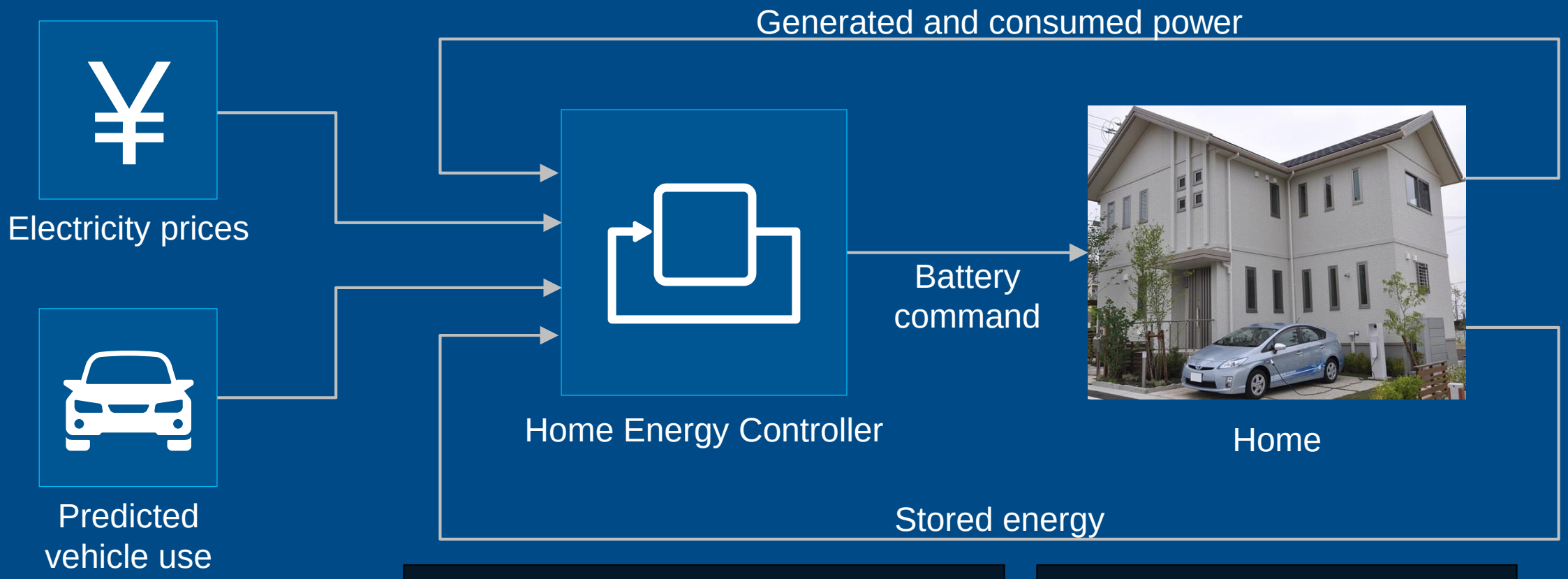
Optimizing home energy management system

Denso



Model predictive control

Mixed integer linear programming

Simscape Power Systems

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Optimizing home energy management system
Denso

Access Data	Analyze Data	Develop	Deploy
1000 CSV Files	Preprocessing Parallel computing	Classification Learner	

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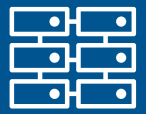
Optimizing home energy management system
Denso

Access Data

1000 CSV Files

Analyze Data

Preprocessing



Parallel computing

Develop

Classification Learner

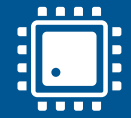
Simulink

Simscape Power Systems

Control algorithms

Optimization

Deploy



Embedded devices

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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."

algorithms

Optimization

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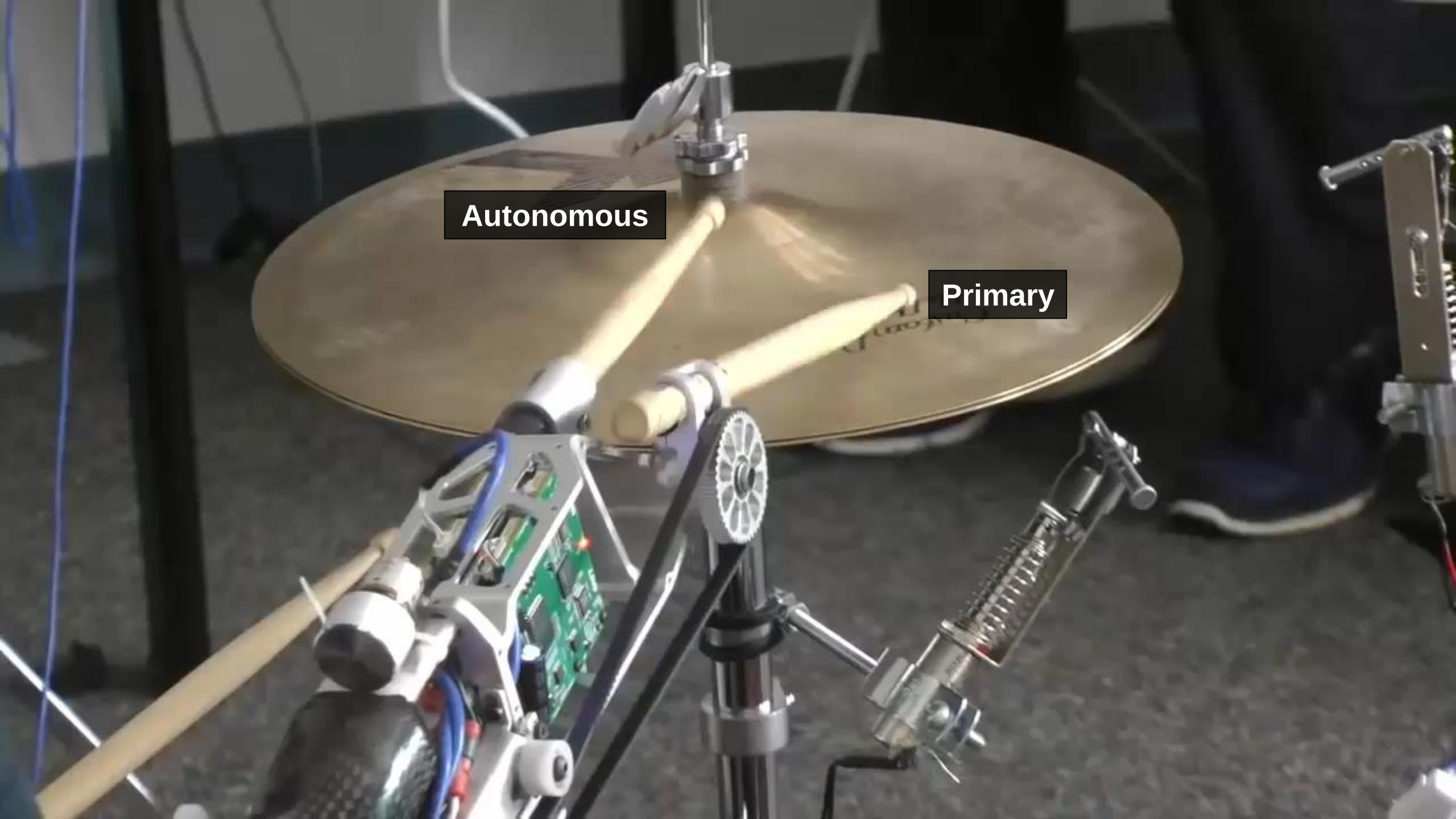
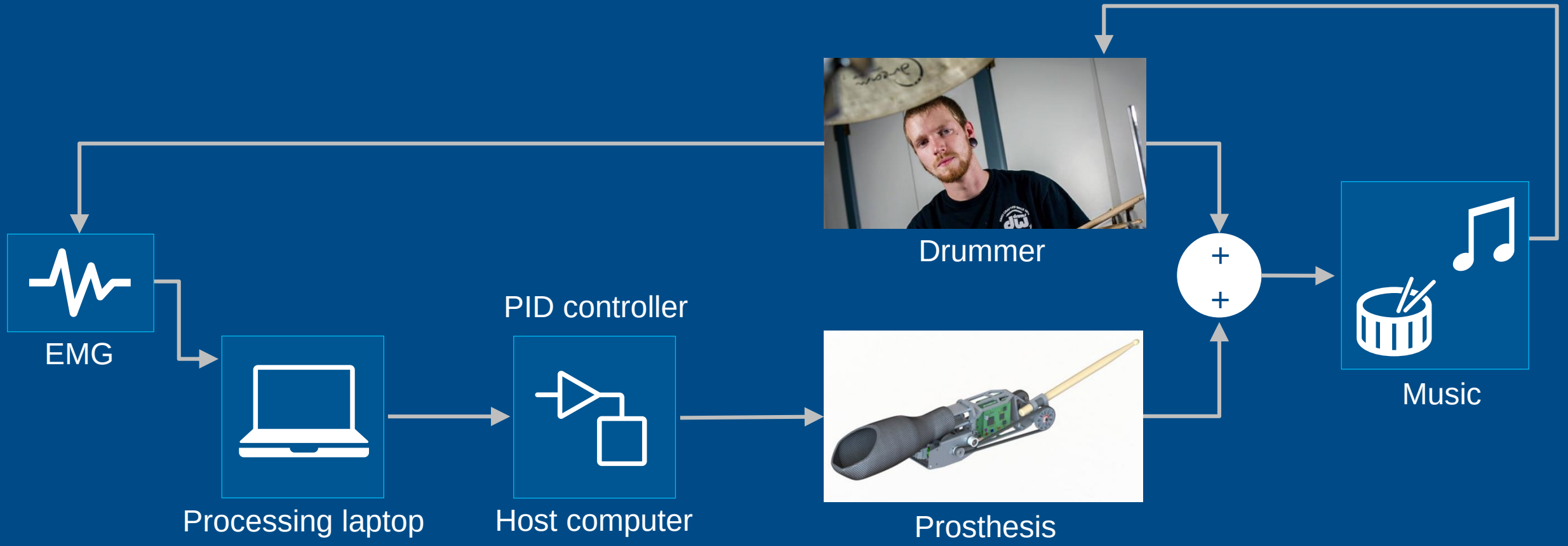
Primary
Autonomous

EMG (Muscle) Control


Autonomous
Primary

Exceeding human capabilities with a robotic drumming prosthesis

Georgia Tech Center for Music Technology



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Exceeding human capabilities with a robotic drumming prosthesis

Georgia Tech Center for Music Technology

Drummer

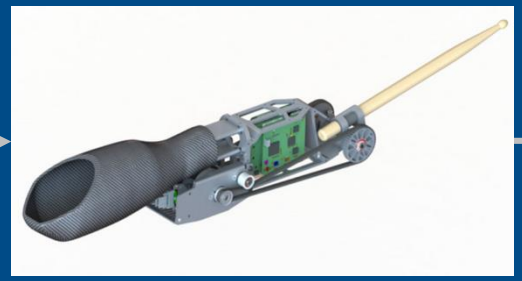
AI algorithms
PID controller

EMG

Microphone

Processing laptop

Host computer



Prosthesis

Music

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Are you ready for AI if …

You've never used machine learning?

Easy programming

Apps

Domain expertise to prepare data

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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

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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 failure data with simulations
- Simulate environment for reinforcement learning

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With MATLAB and Simulink, you ARE ready for AI!

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