

# MATLAB EXPO 2018

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


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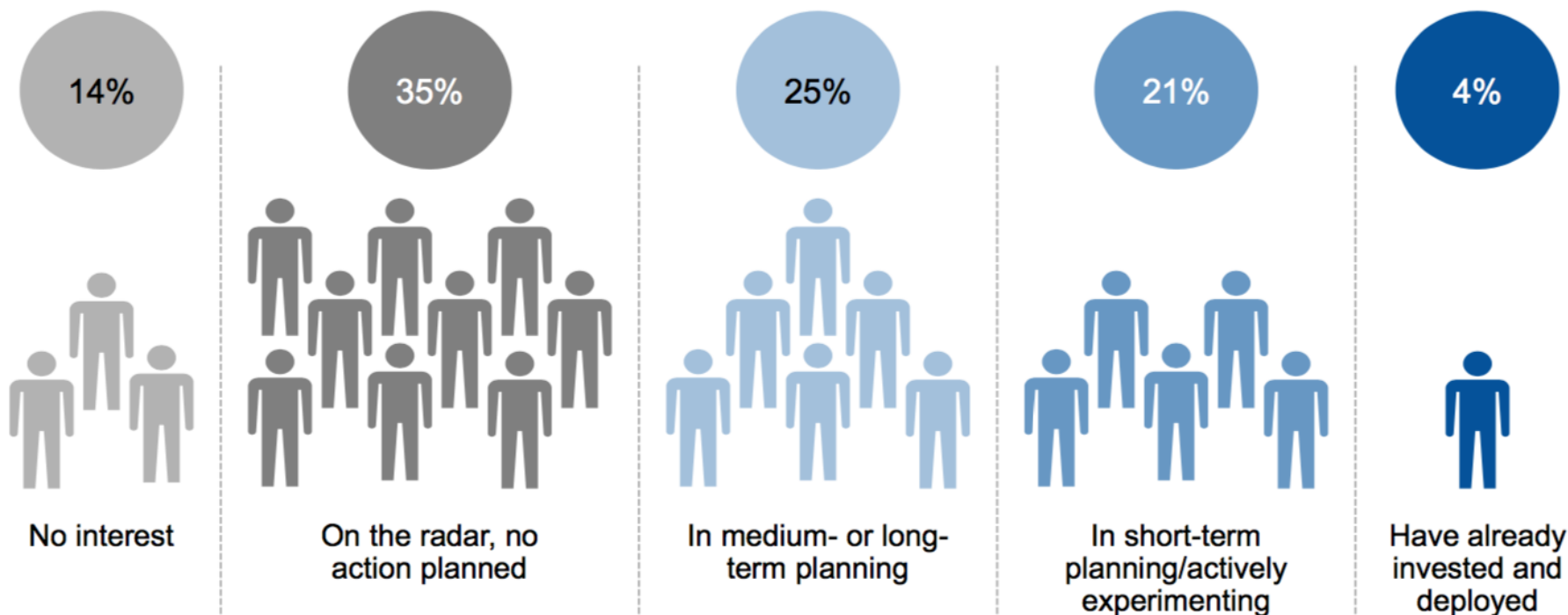
Alexa –  
Write my Expo  
keynote for me



Alexa –  
Play soothing jazz

# Artificial Intelligence Is in Early Adoption

Percentage of Respondents



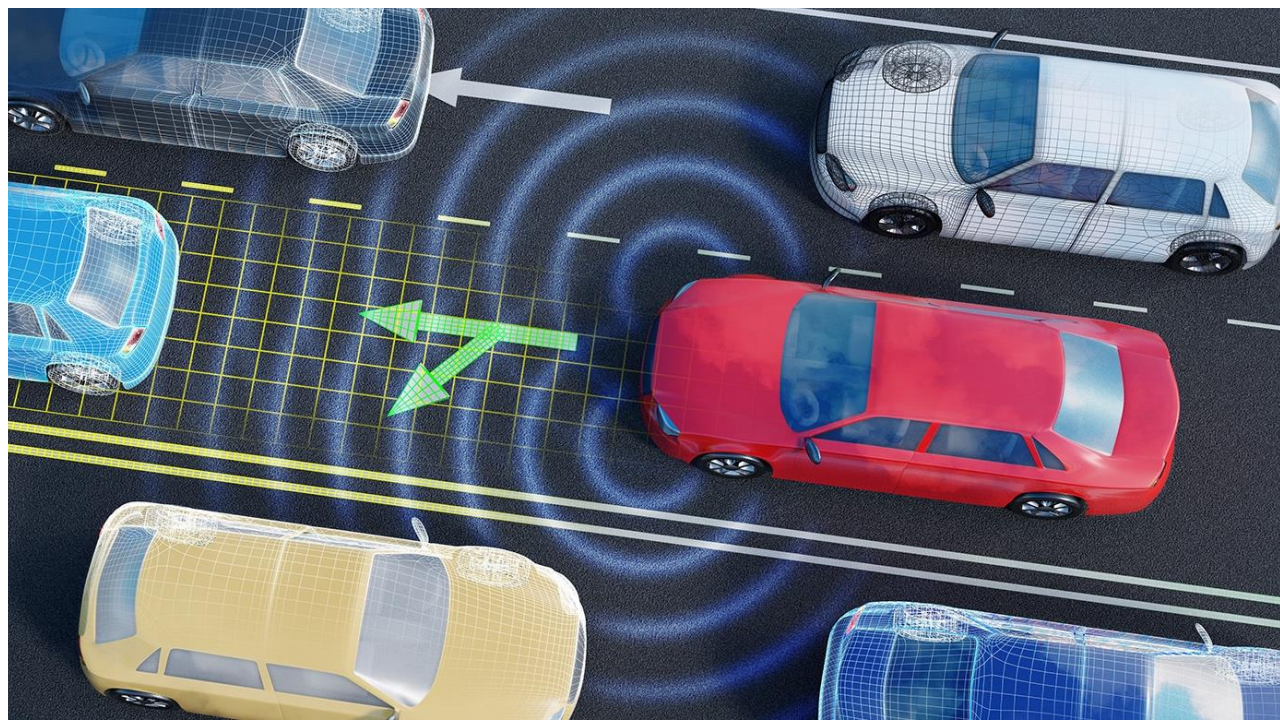
Q: What are your organization's plans in terms of artificial intelligence?

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?



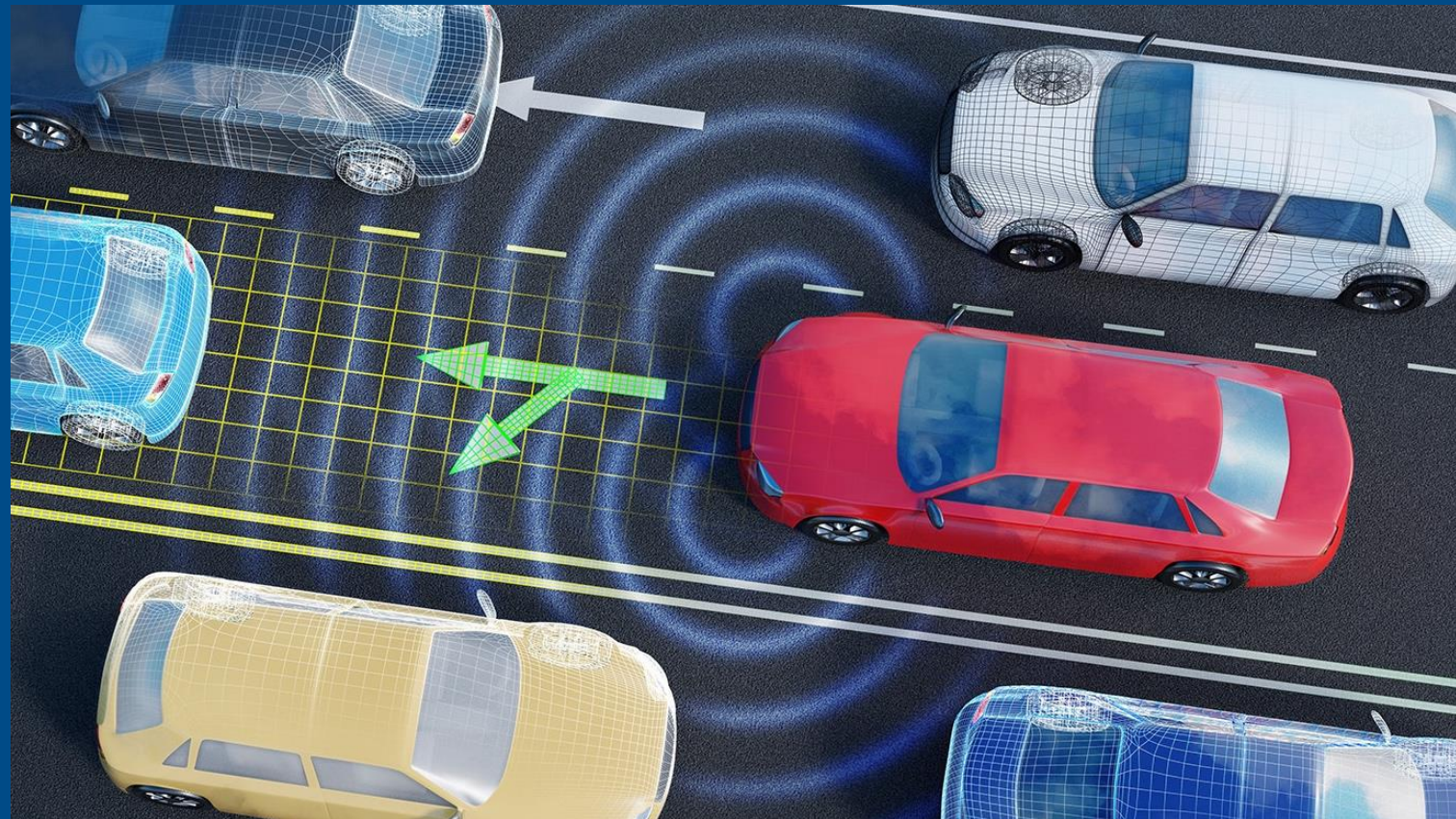
Data



Output



Model



# Are you ready for AI?

Access Data

Analyze Data



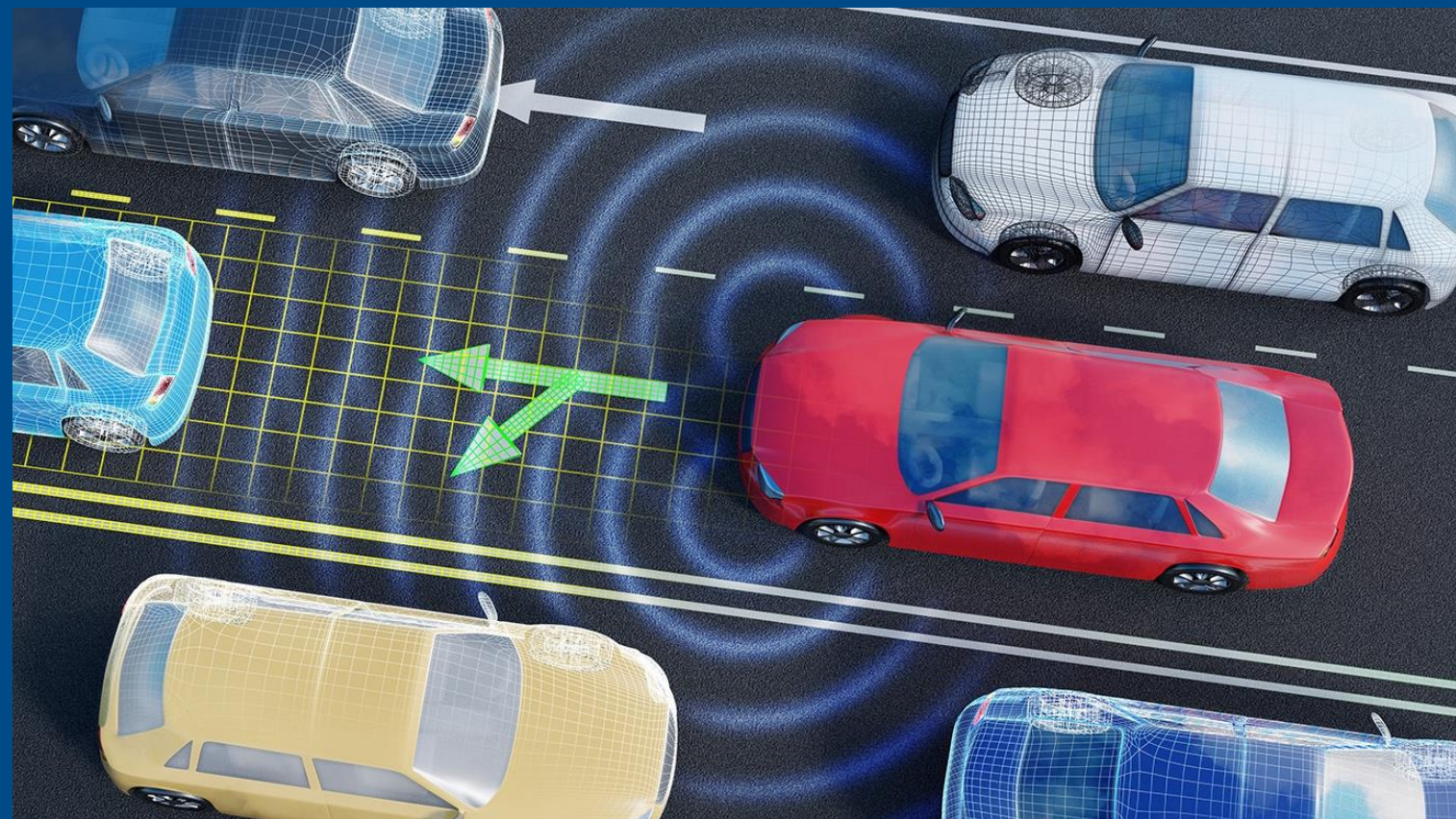
Data



Output



Model



# Are you ready for AI?

Access Data

Analyze Data

Develop

Deploy



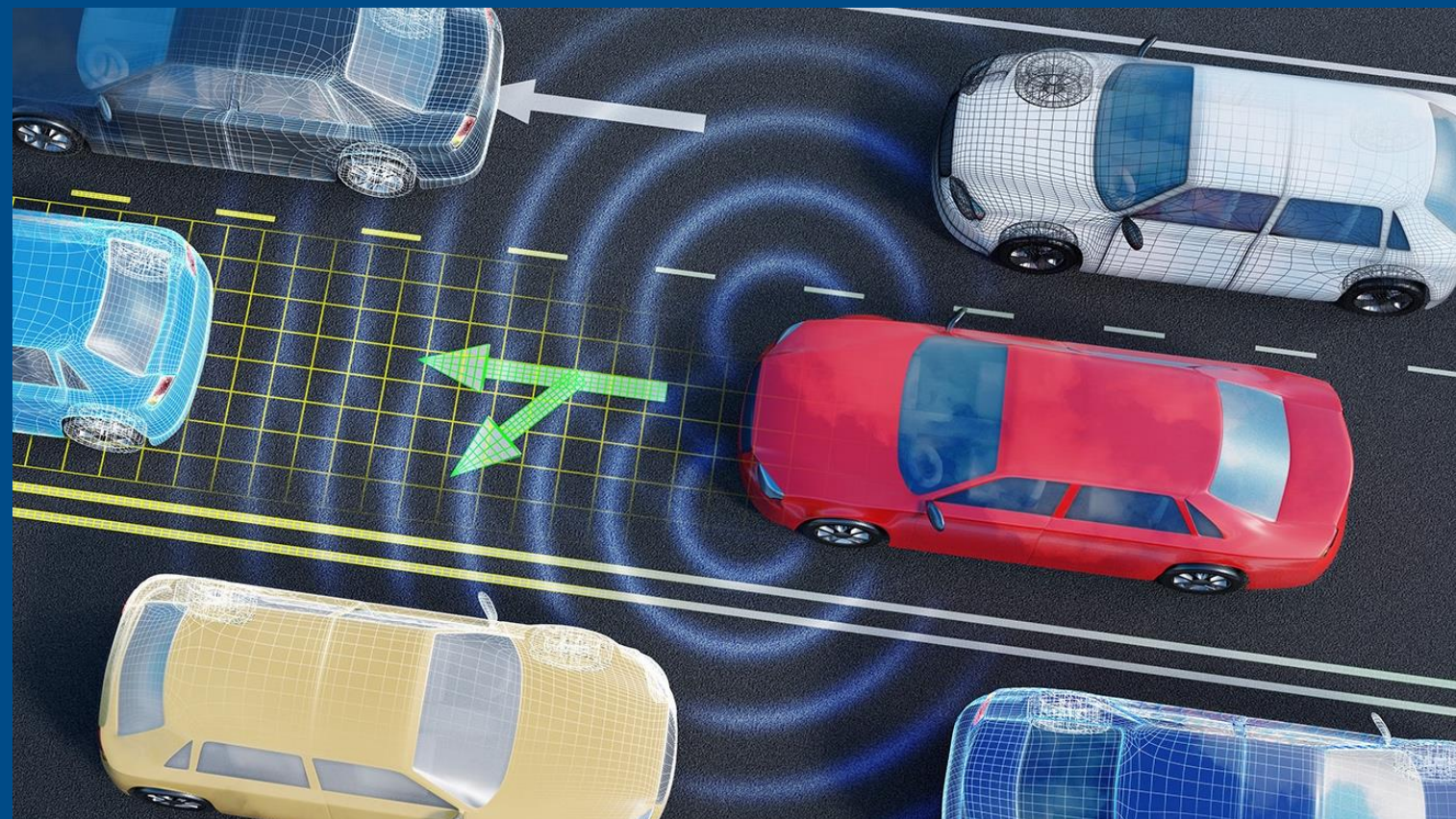
Data



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?

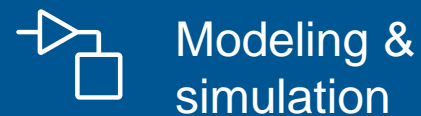
## Access Data



## Analyze Data



## Develop



## Deploy

# Are you ready for AI?

## Access Data



Sensors



Files



Databases

## Analyze Data



Data exploration



Preprocessing



Domain-specific algorithms

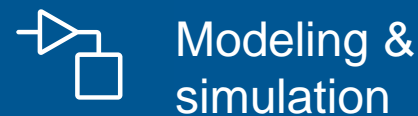
## Develop



AI model



Algorithm development

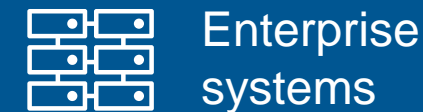


Modeling & simulation

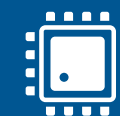
## Deploy



Desktop apps



Enterprise systems



Embedded devices

# Are you ready for AI?



## Access Data



Sensors



Files



Databases

## Analyze Data



Data exploration



Preprocessing



Domain-specific algorithms

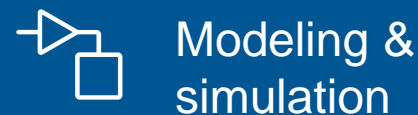
## Develop



AI model



Algorithm development



Modeling & simulation

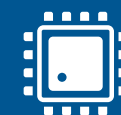
## Deploy



Desktop apps

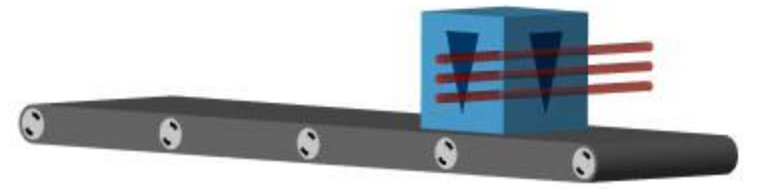


Enterprise systems



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

**FAT** 16.5g  
Df 13%

**SAT FAT** 3.1g  
Df 6%

**SUGARS** 1.6g  
Df 3%

**SODIUM** 245mg  
Df 11%

90g e NET  
Flavoured snack



# Twisties

Chicken

**FAT** 7.4g  
Df 11%

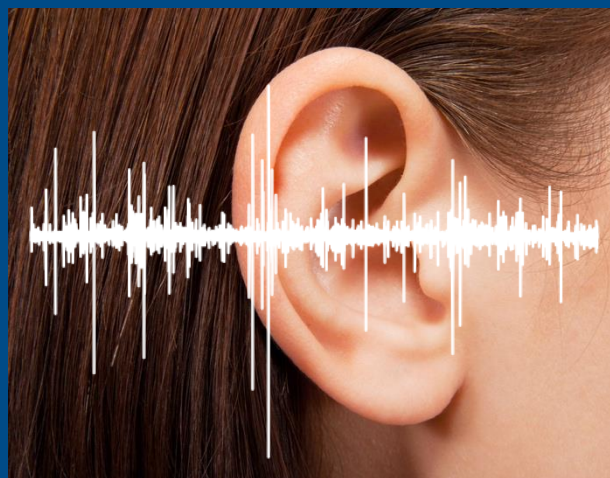
**SAT FAT** 3.6g  
Df 15%

**SUGARS** 0.7g  
Df 1%

**SODIUM** 213mg  
Df 9%

90g e NET  
Flavoured snack

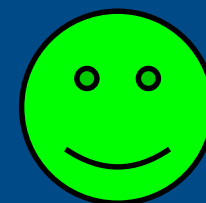
# What is crispiness?



Crushing Sound



Crushing Force



Crispy



Crispy Enough

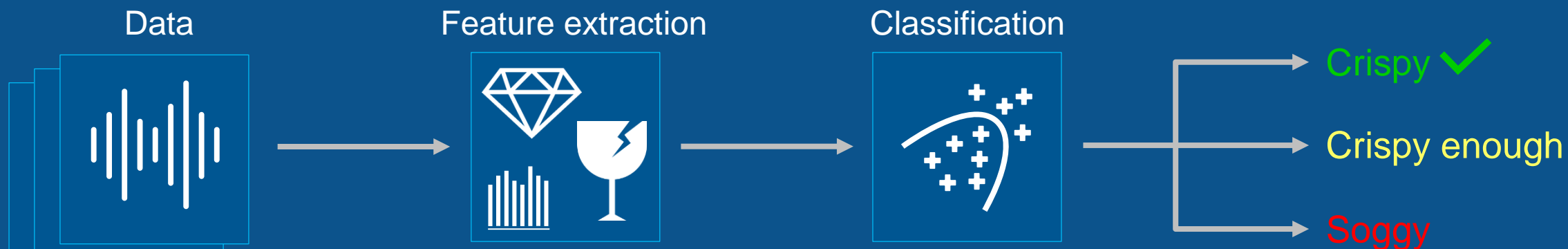


Soggy

# Replicating human perception with machine learning

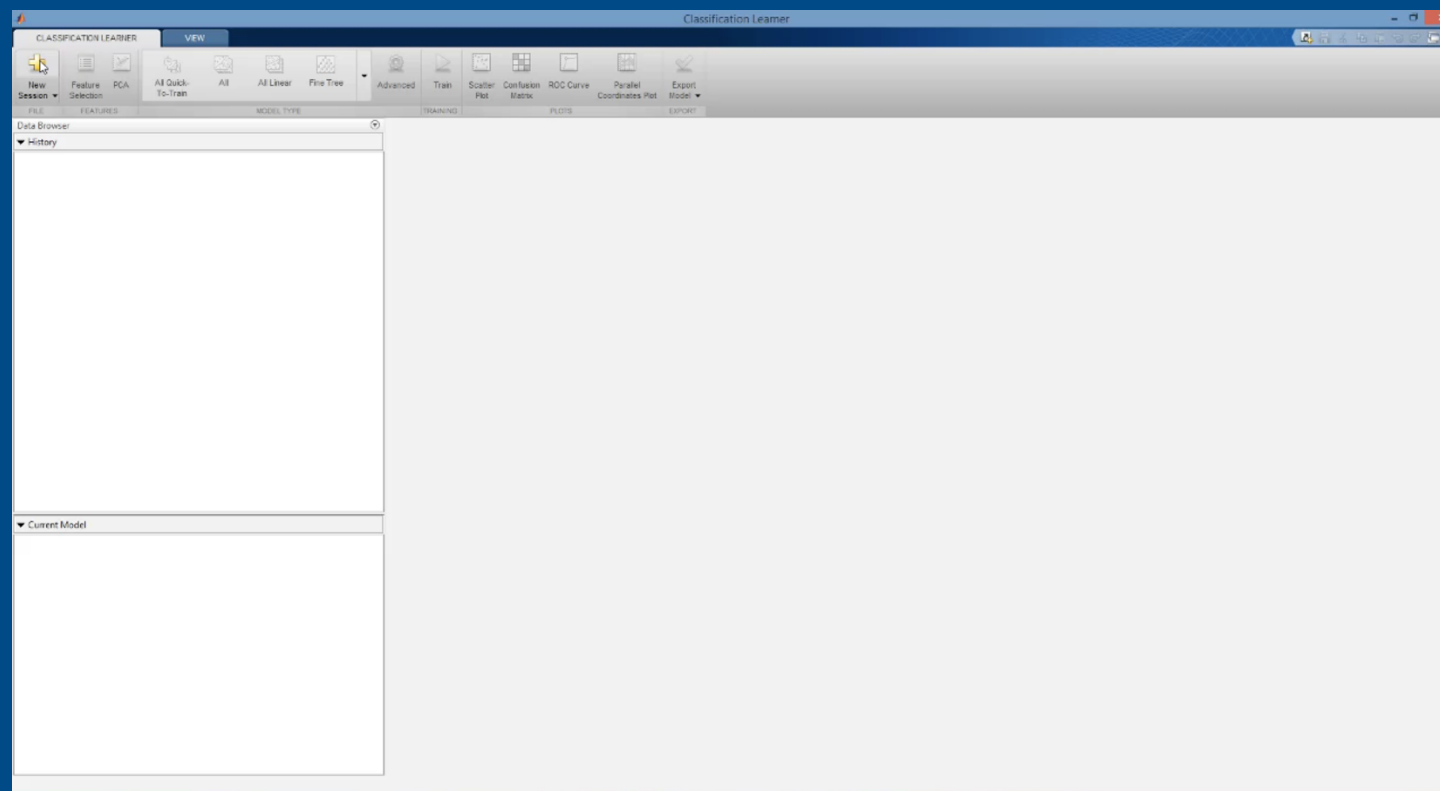
## Technical University of Munich

### Machine Learning Workflow

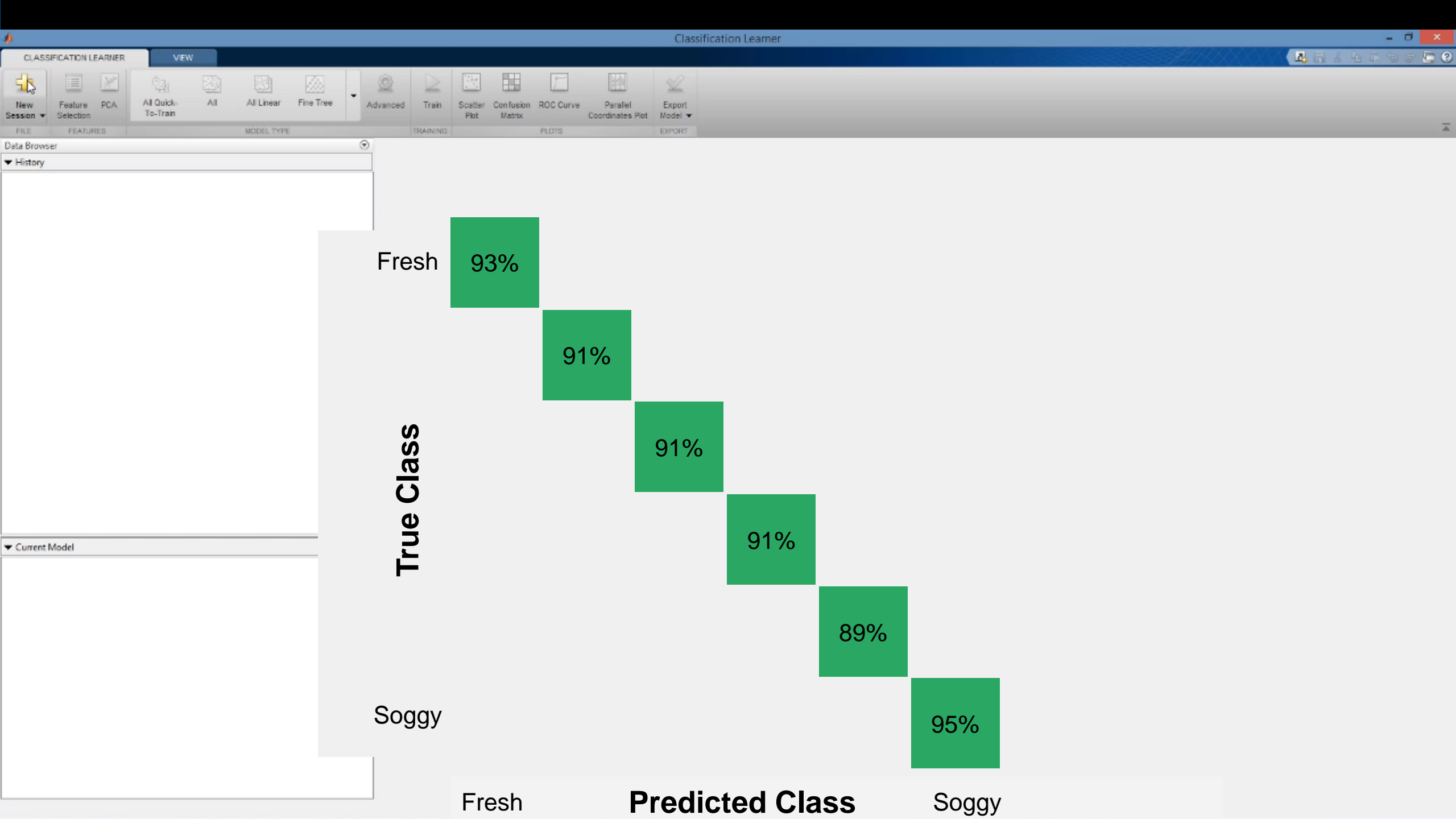


# Replicating human perception with machine learning

## Technical University of Munich



Classification Learner

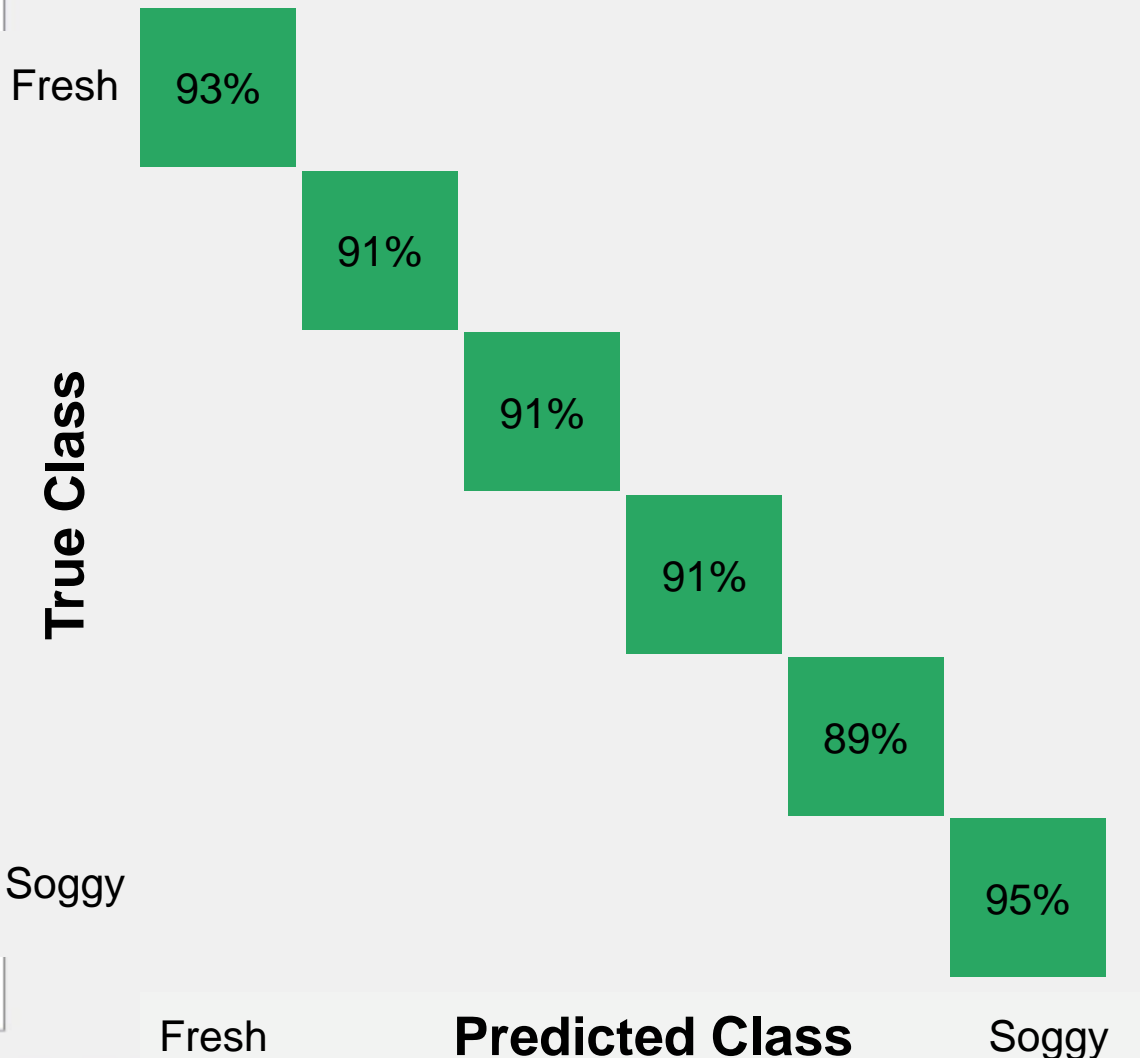


Navigation and toolbars including: New Session, Feature Selection, PCA, All Quick-To-Train, All, All Linear, Fine Tree, Advanced, Train, Scatter Plot, Confusion Matrix, ROC Curve, Parallel Coordinates Plot, Export Model.

Data Browser

History

Current Model



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

- 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



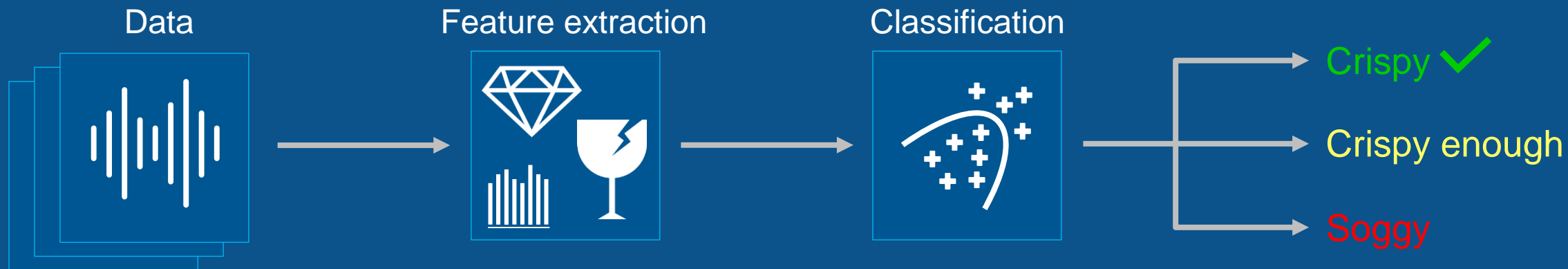
Crispy ✓

Crispy enough

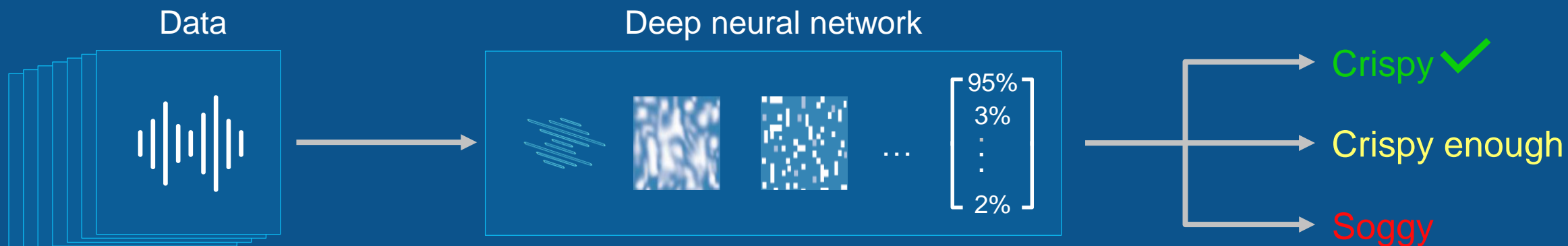
Soggy

# Use deep learning to identify features automatically

## Machine Learning Workflow



## 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



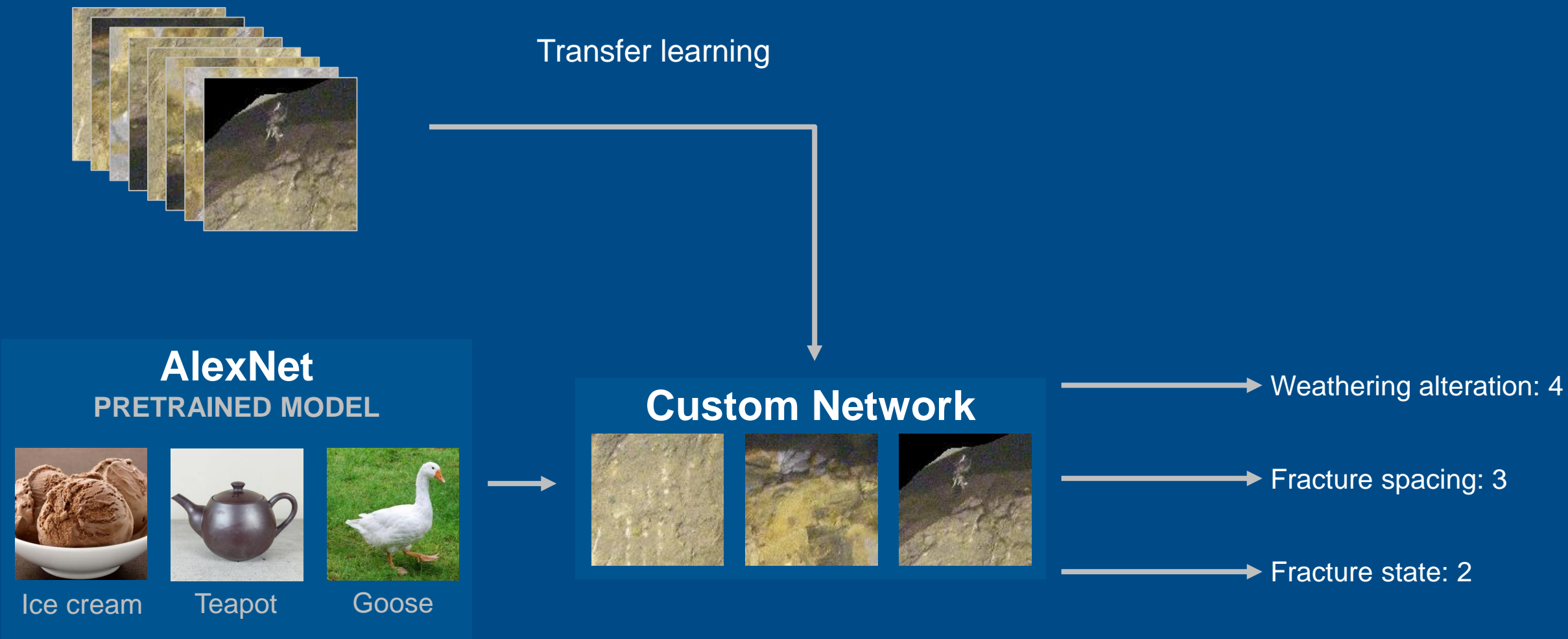
Label each  
sub-image



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
⋮	⋮	⋮	⋮

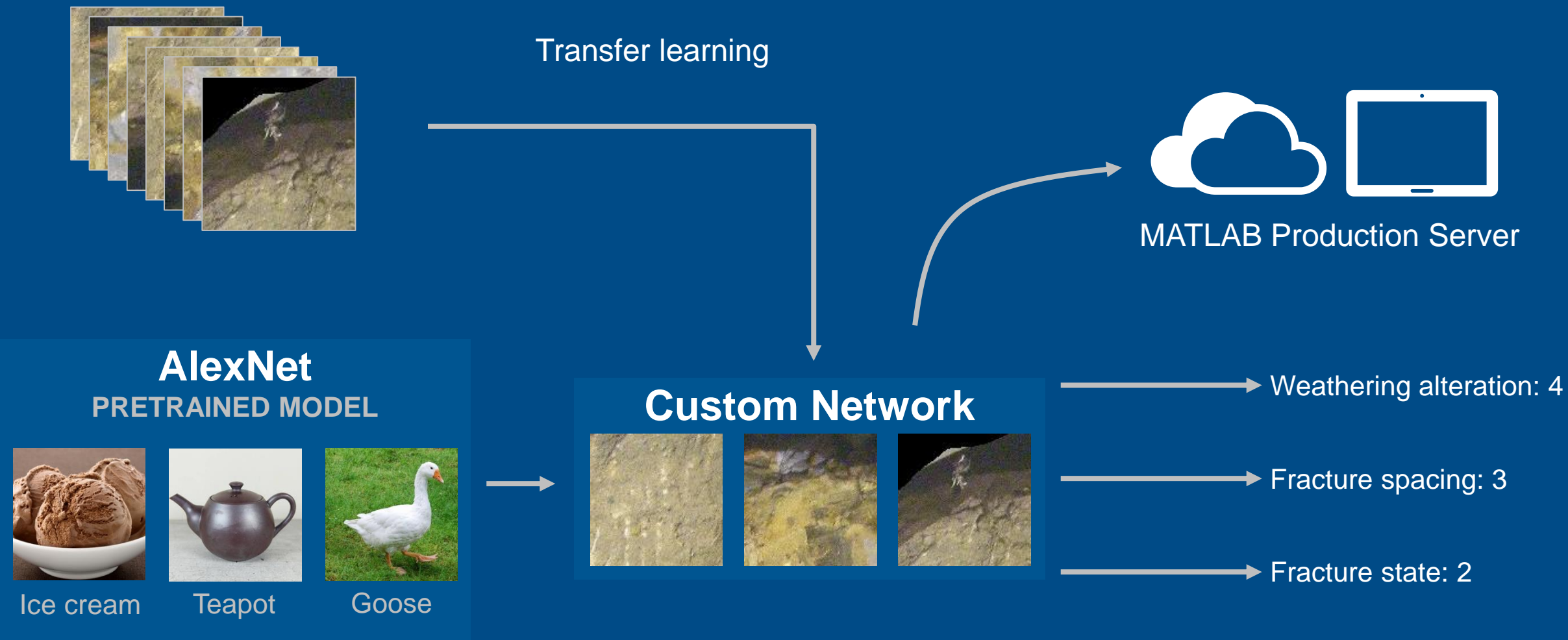
# Efficient tunnel drilling with deep learning

## Obayashi Corporation



# Efficient tunnel drilling with deep learning

## Obayashi Corporation





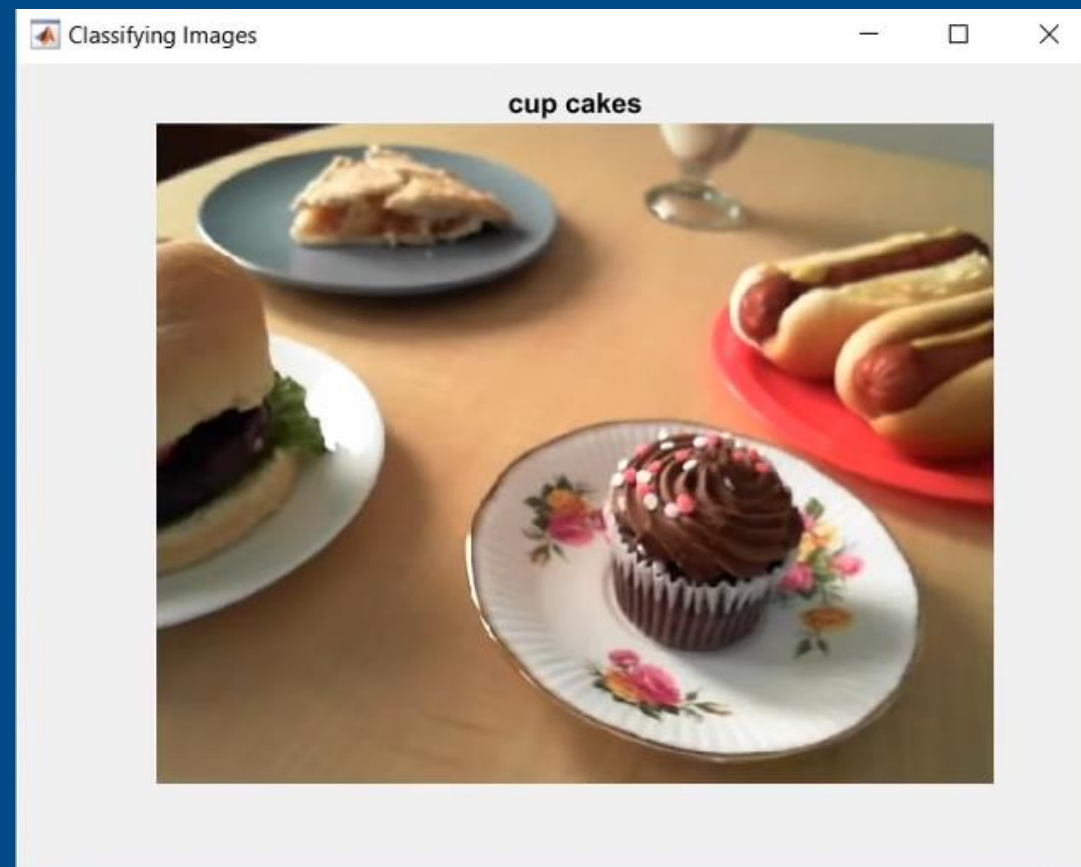
# Are you ready for AI if you can't identify features in your data?

- Deep learning

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



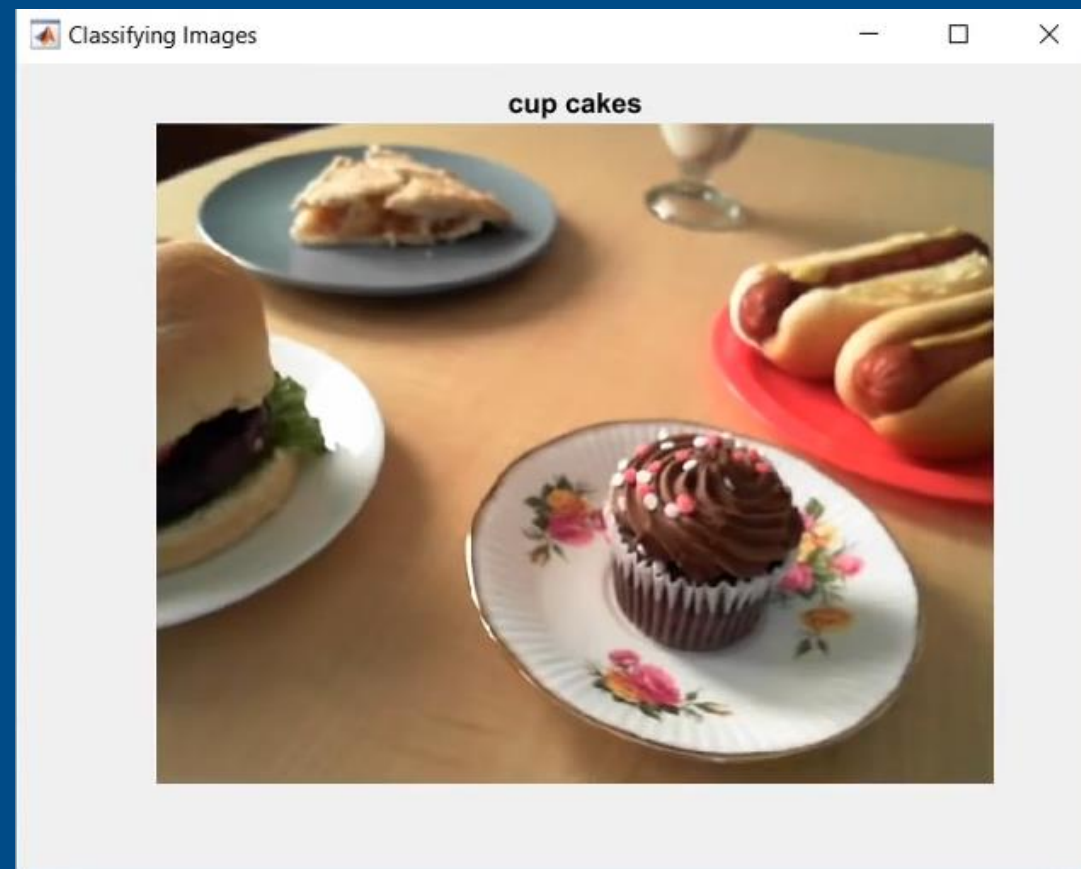
Deep learning in 5 lines of code



# 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

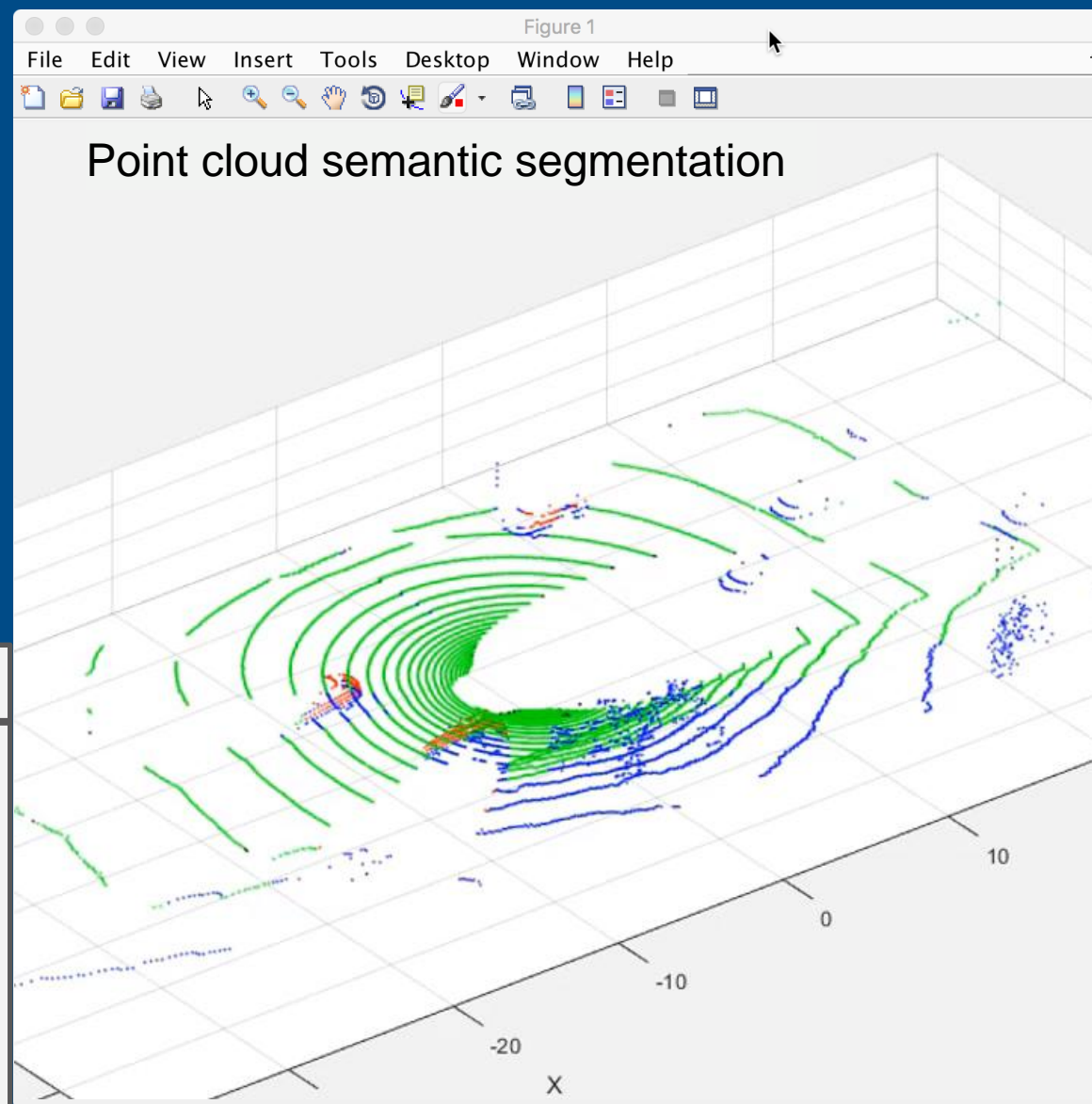


# Are you ready for AI if you can't identify features in your data?

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



Classification	
Car	
Truck	
Background	
Ground	



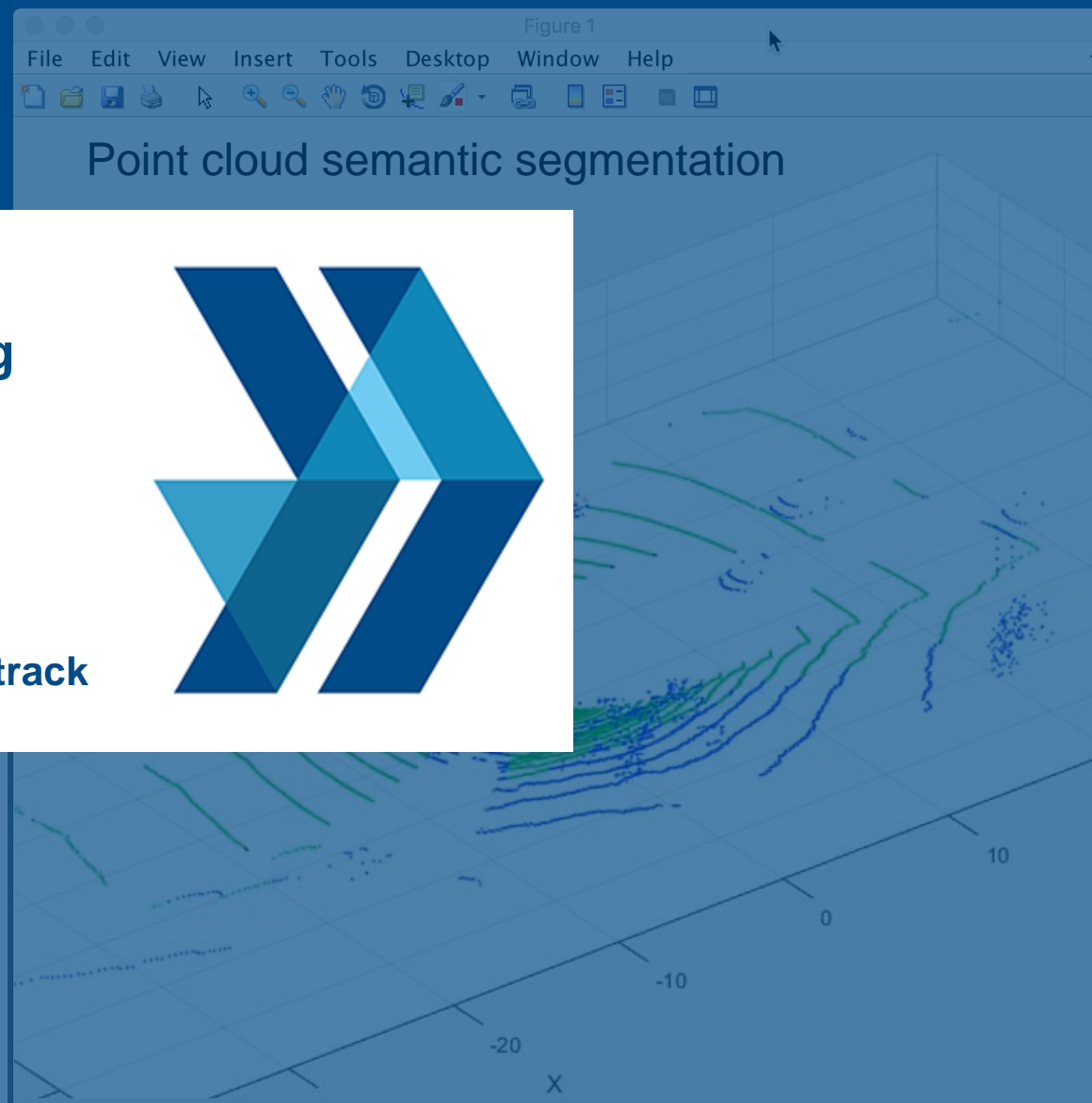
# Are you ready for AI if you can't identify features in your data?

- Deep learning
- Transfer learning
- Automation and

**Find out more:**  
**Demystifying Deep Learning**

**2:30 pm**

**Dr. Amod Anandkumar**  
**Robotics & Autonomous Systems track**



# Autoliv

**Are you ready for AI if ...**

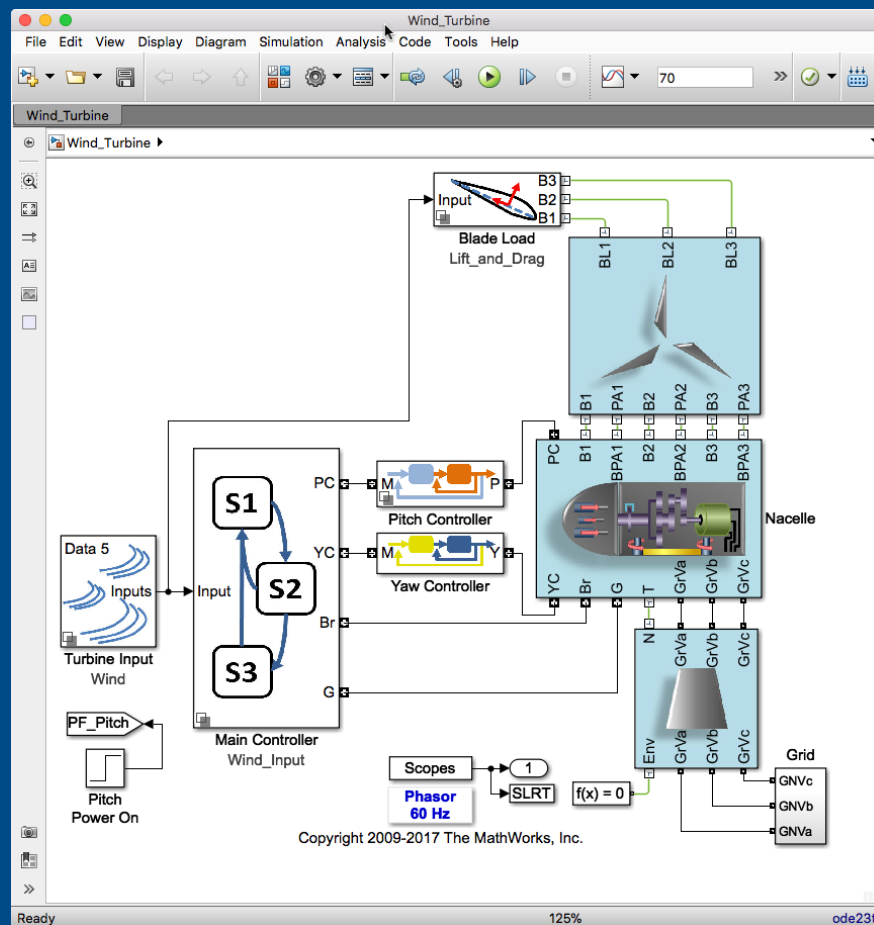
**If you don't have the right data?**



## 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



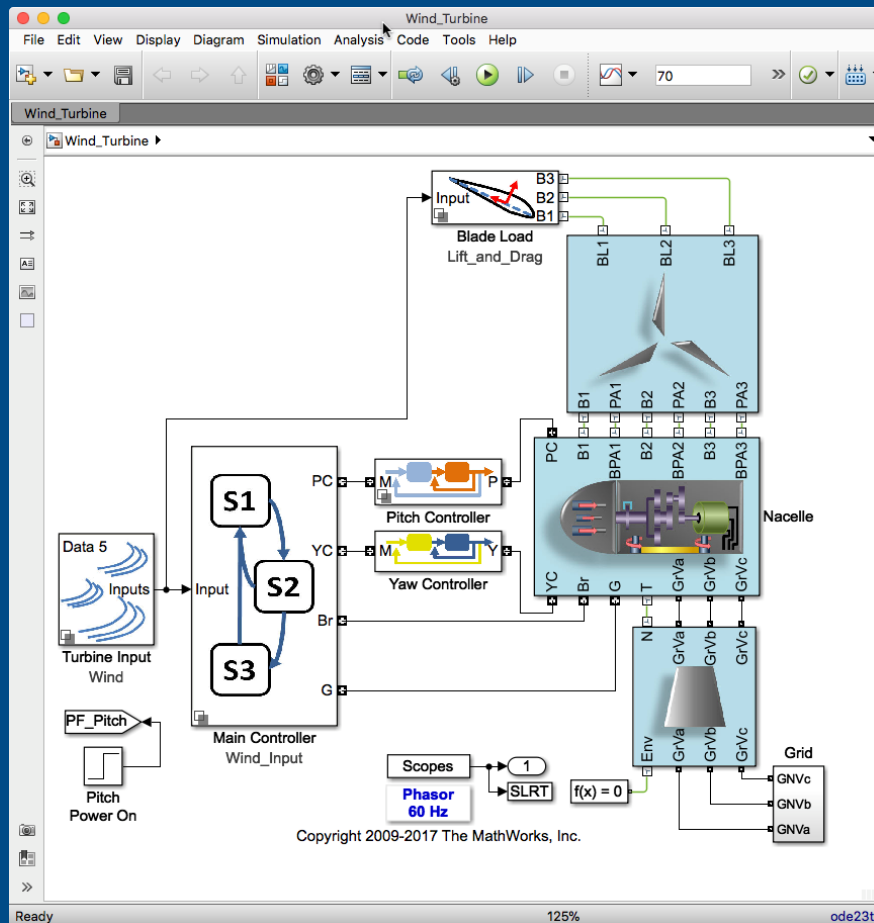
Measured data

Refine model

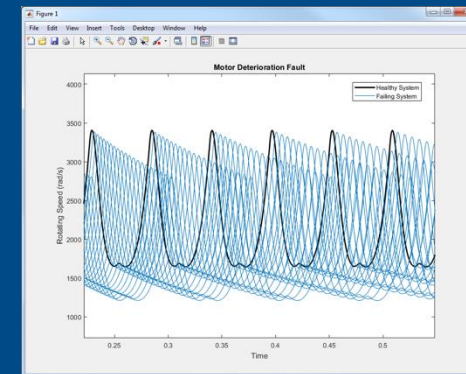


Failure conditions

Inject failures



Simulink model



Failure data



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

- Generate data with simulations
- Simulation env reinforcement

**Find out more:**  
**Predictive Maintenance using**  
**MATLAB & Simulink**

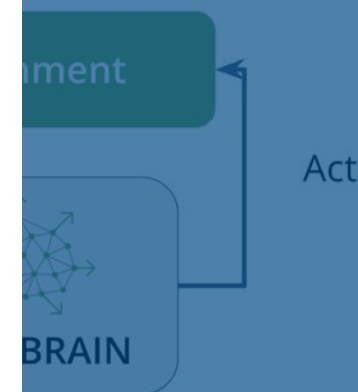
**11:45**

**Amit Doshi**

**Data Analytics Applications Track**



Reinforcement Learning



Goal: learn to take actions that maximize reward



**bonsai**



## 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**

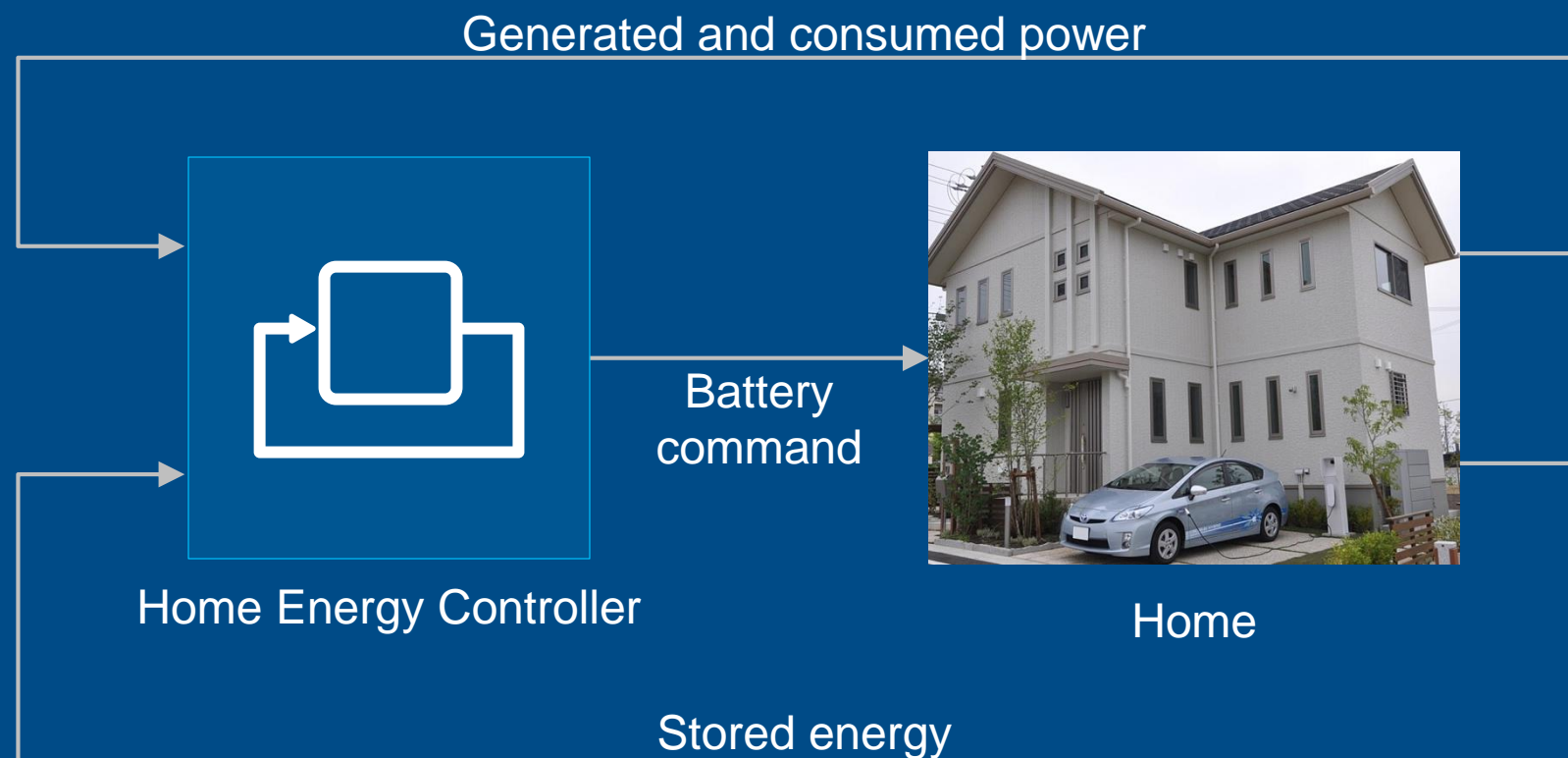
- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage

## **Goals**

- Minimize energy cost
- Use EV battery for additional storage

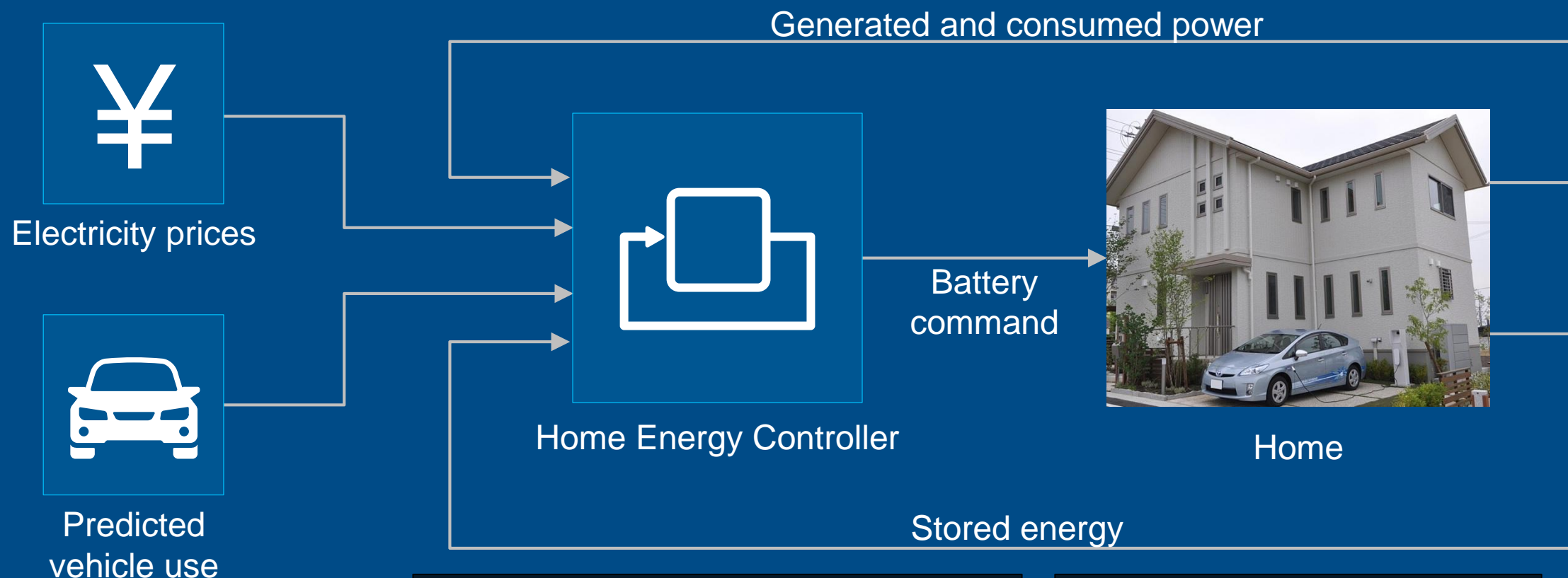
# Optimizing home energy management system

## 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

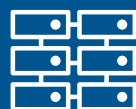


1000 CSV Files

### Analyze Data



Preprocessing



Parallel  
computing

### Develop



Classification  
Learner

### Deploy

# Optimizing home energy management system

## Denso

### Access Data

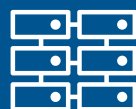


1000 CSV Files

### Analyze Data



Preprocessing



Parallel  
computing

### Develop



Classification  
Learner



Simulink



Simscape Power  
Systems

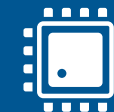


Control  
algorithms



Optimization

### Deploy



Embedded  
devices

# Optimizing home energy management system

## Denso

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

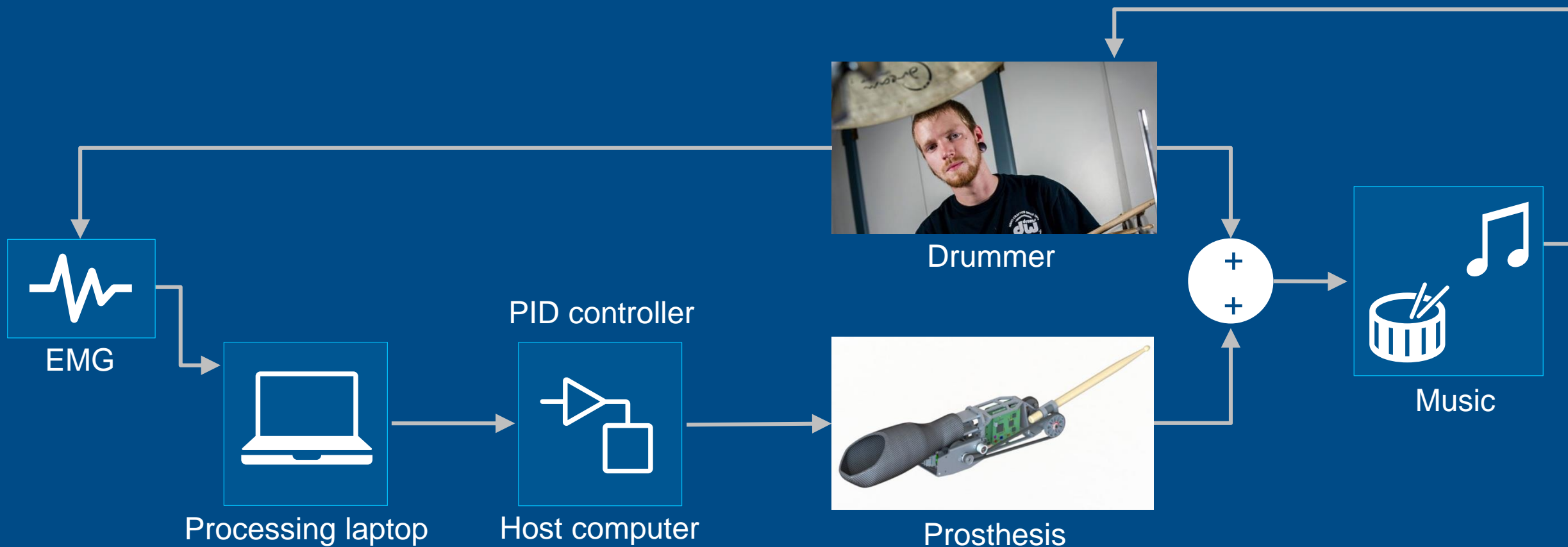


**Autonomous**

**Primary**

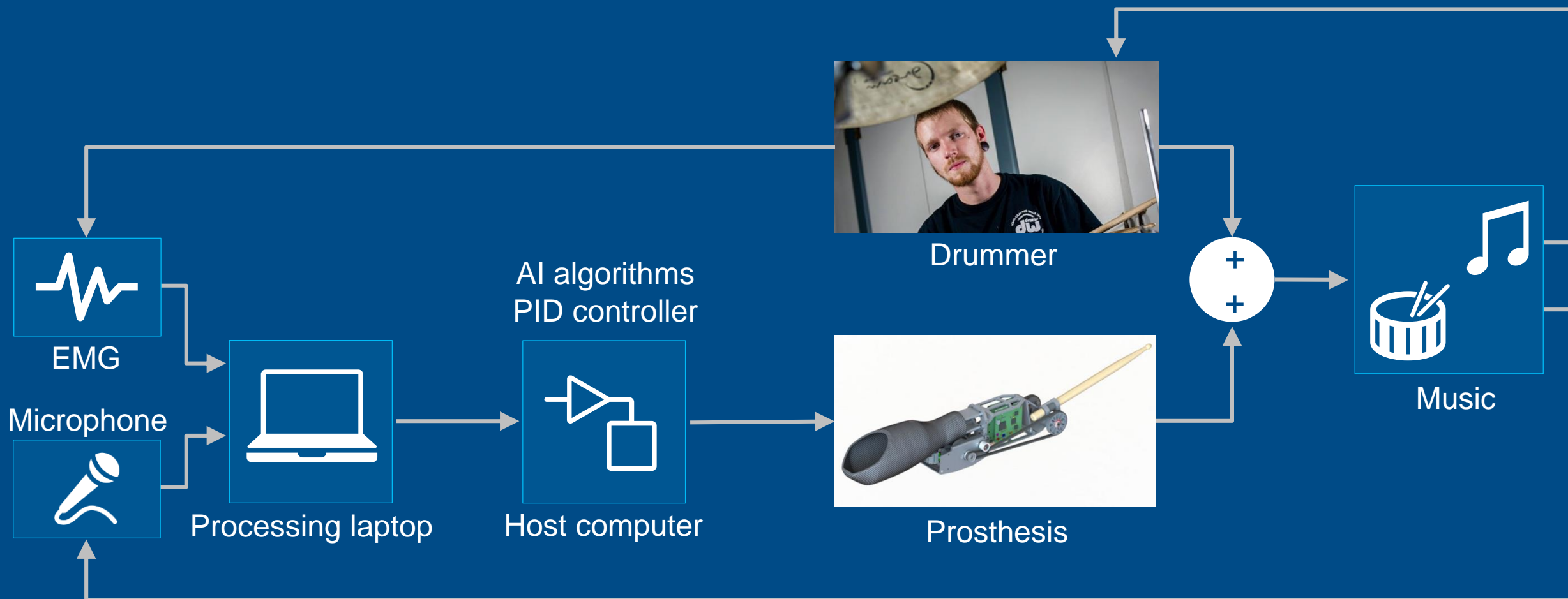
# Exceeding human capabilities with a robotic drumming prosthesis

## 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 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 failure data with simulations

Simulate environment for reinforcement learning

**With MATLAB and Simulink, you ARE ready for AI!**