


Technical Computing Camp 2018

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

Gareth Thomas





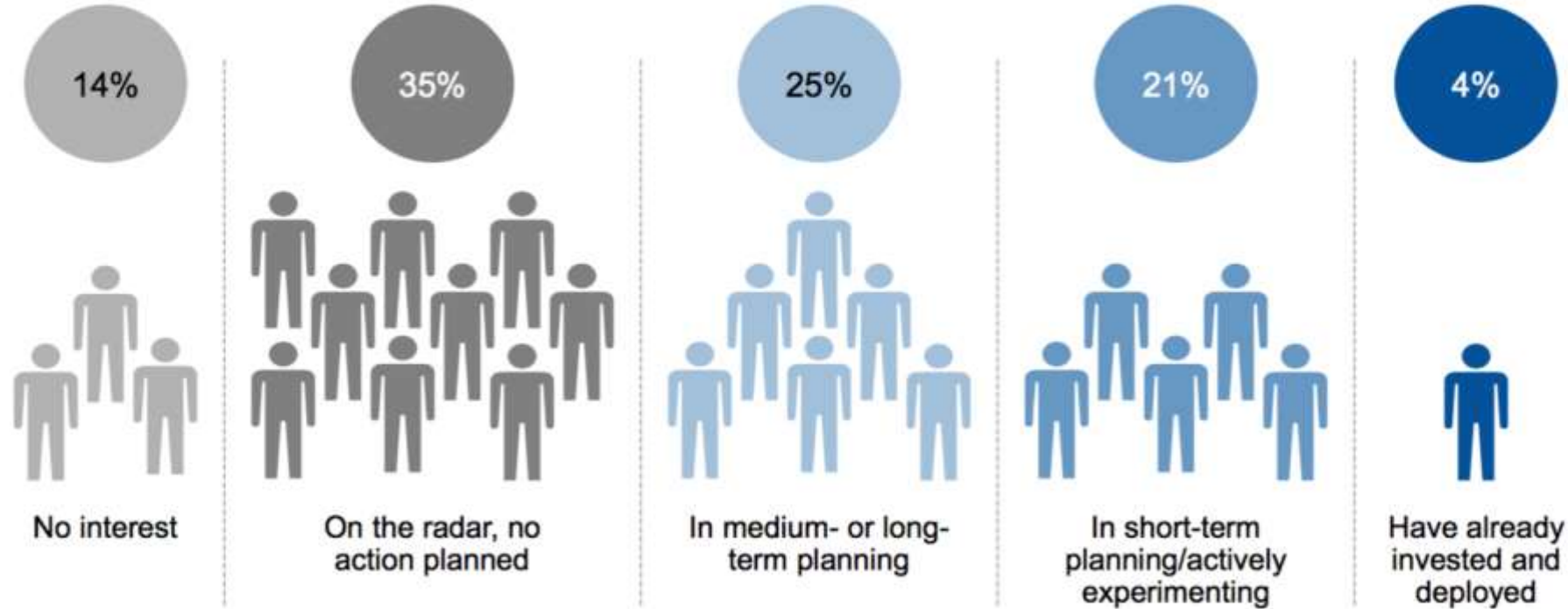
Alexa –
Write my TCC
keynote for me



Alexa –
Play soothing jazz

Artificial Intelligence Is in Early Adoption

Percentage of Respondents

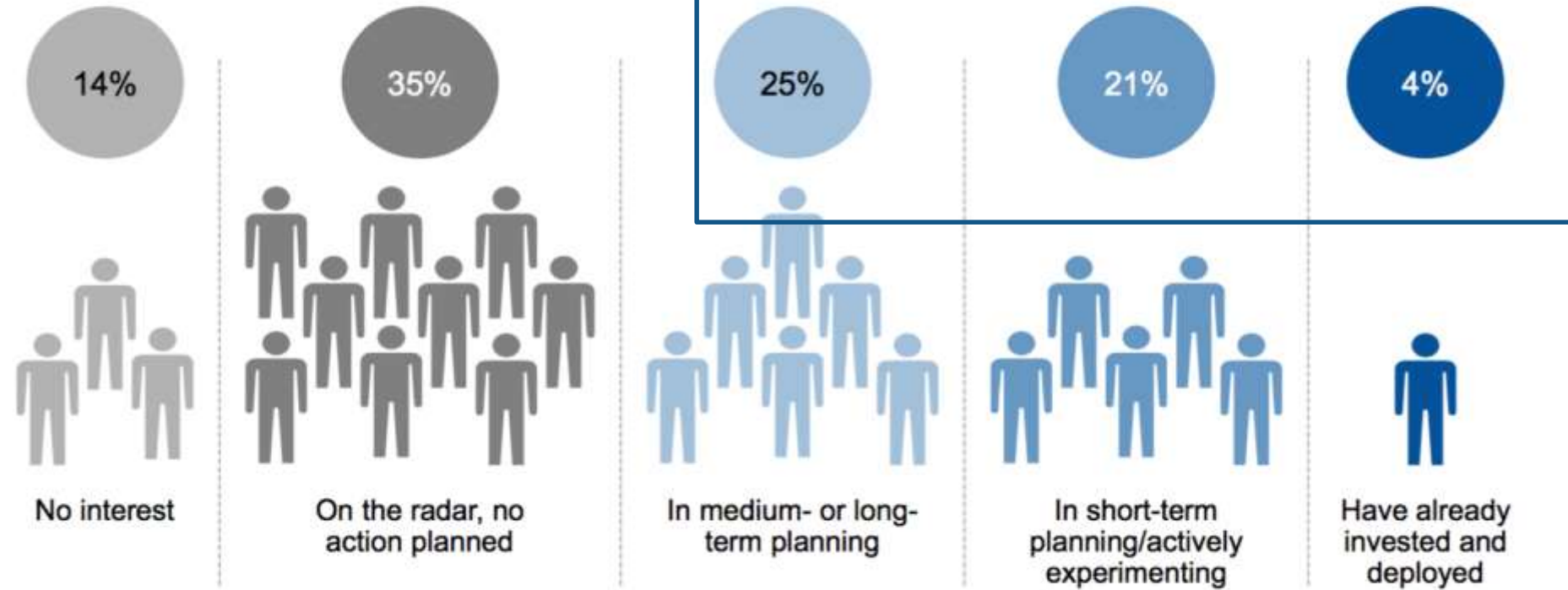


Q: What are your organization's plans in terms of artificial intelligence?
 Base: All Answering, n = 3,138
 Source: Gartner 2018 CIO Survey

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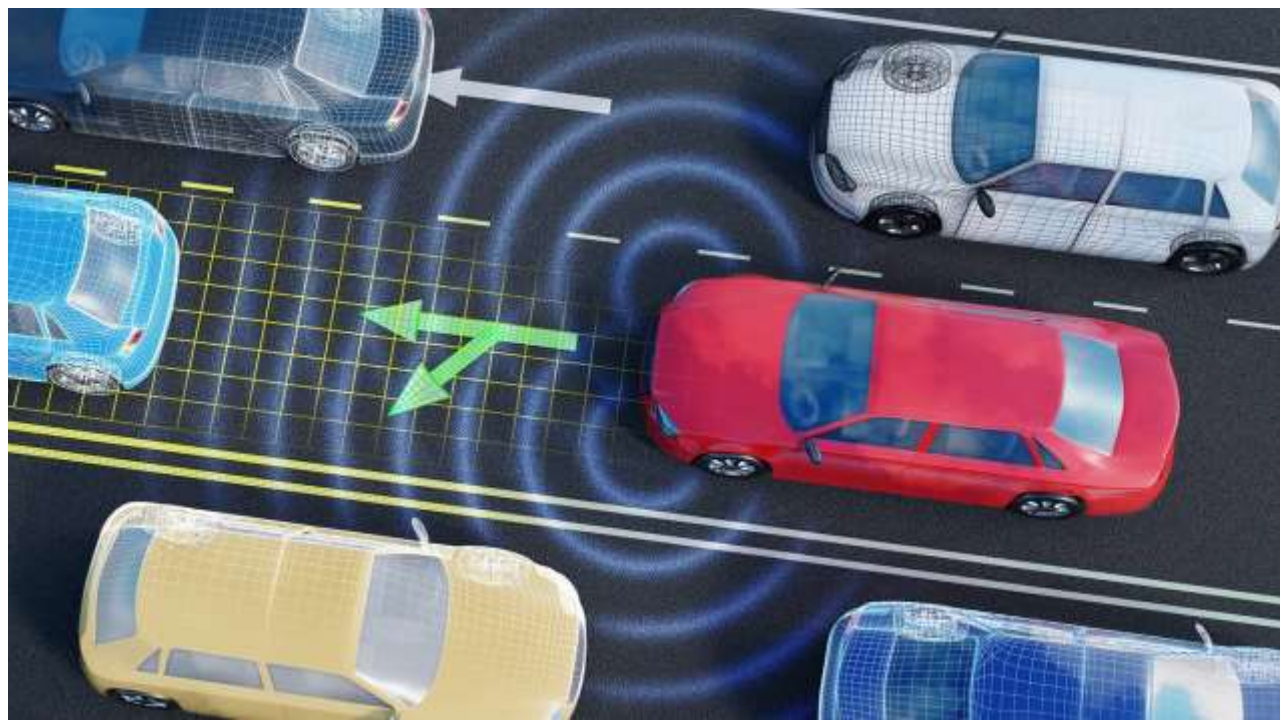
Artificial Intelligence Is in Early Adoption

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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*

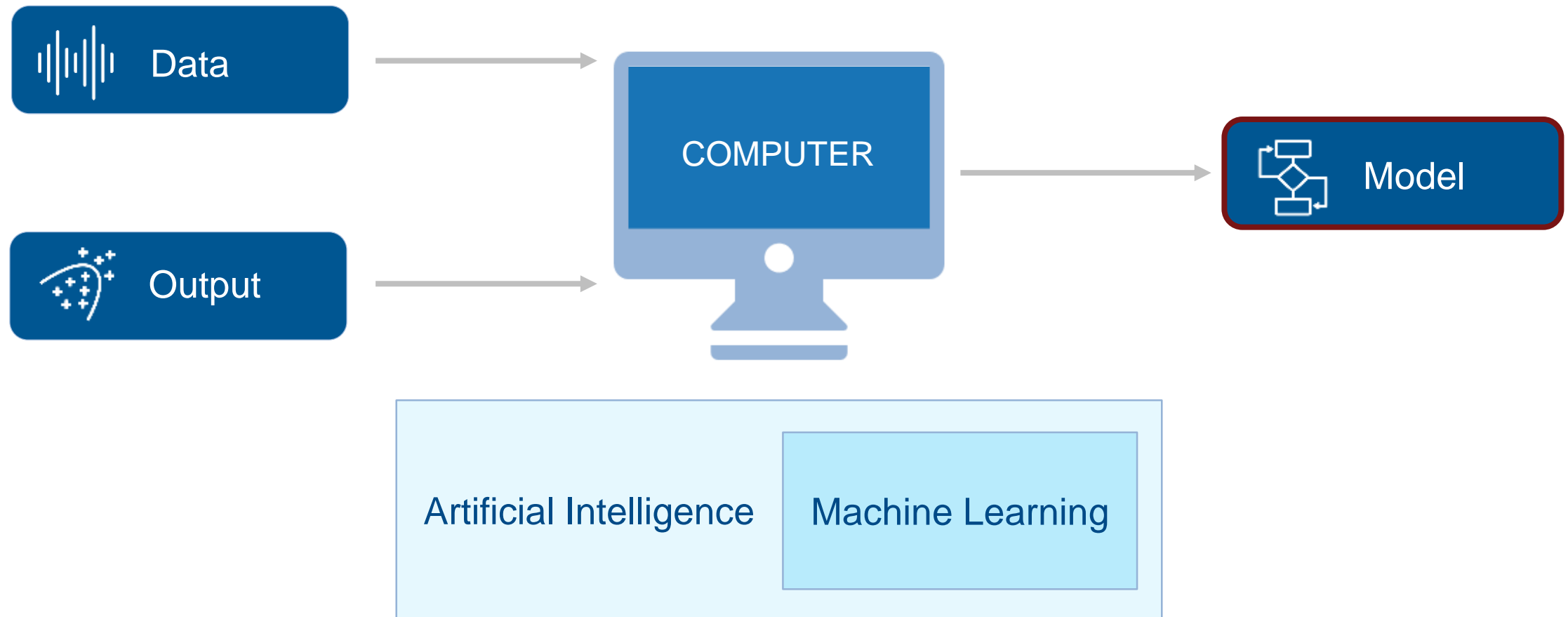
There are two ways to get a computer to do what you want



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



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



Are you ready for AI?



Data



Output



Model



Are you ready for AI?



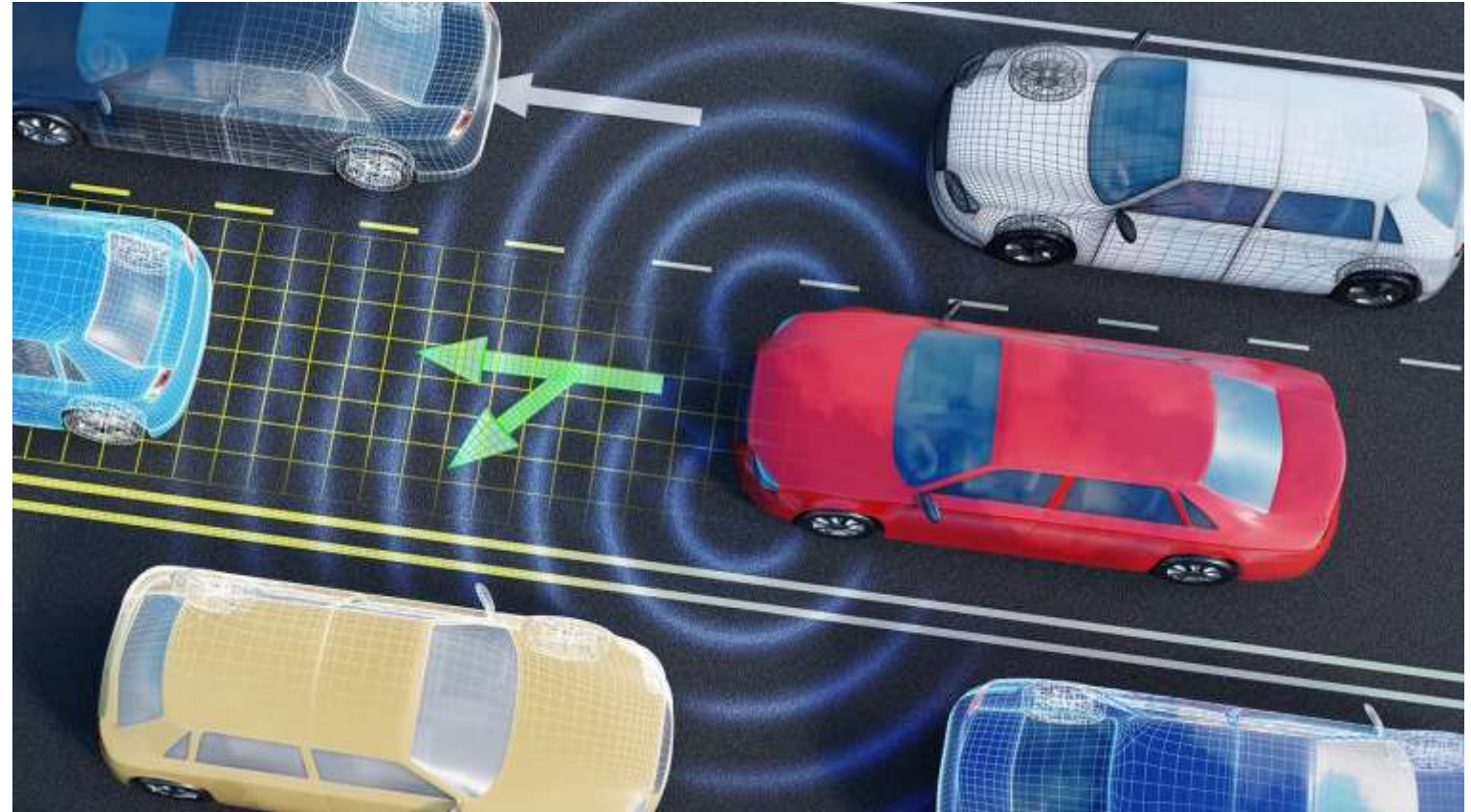
Data



Output



Model



Are you ready for AI?

Access Data

Analyze Data



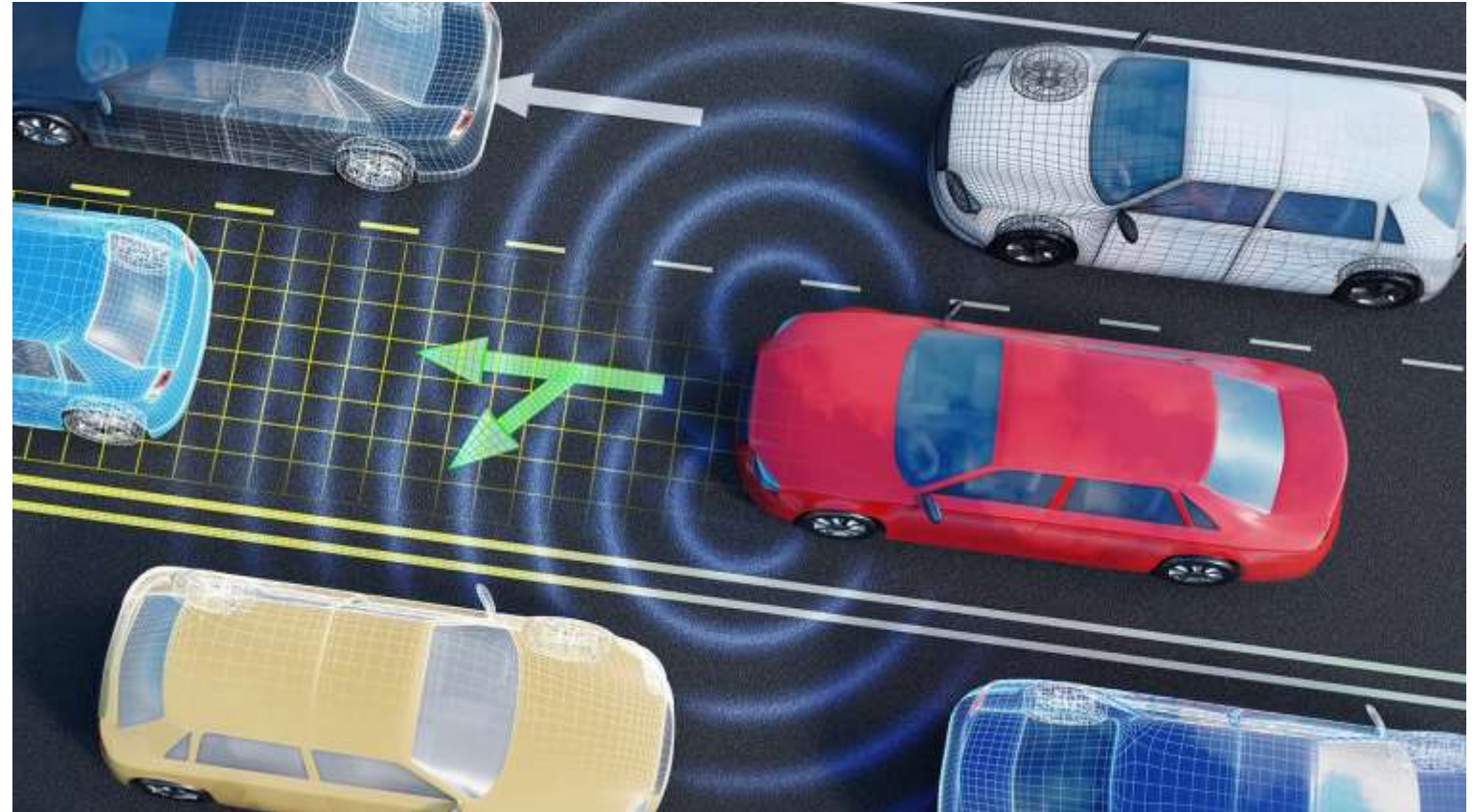
Data



Output



Model



Are you ready for AI?

Access Data

Analyze Data

Develop

Deploy



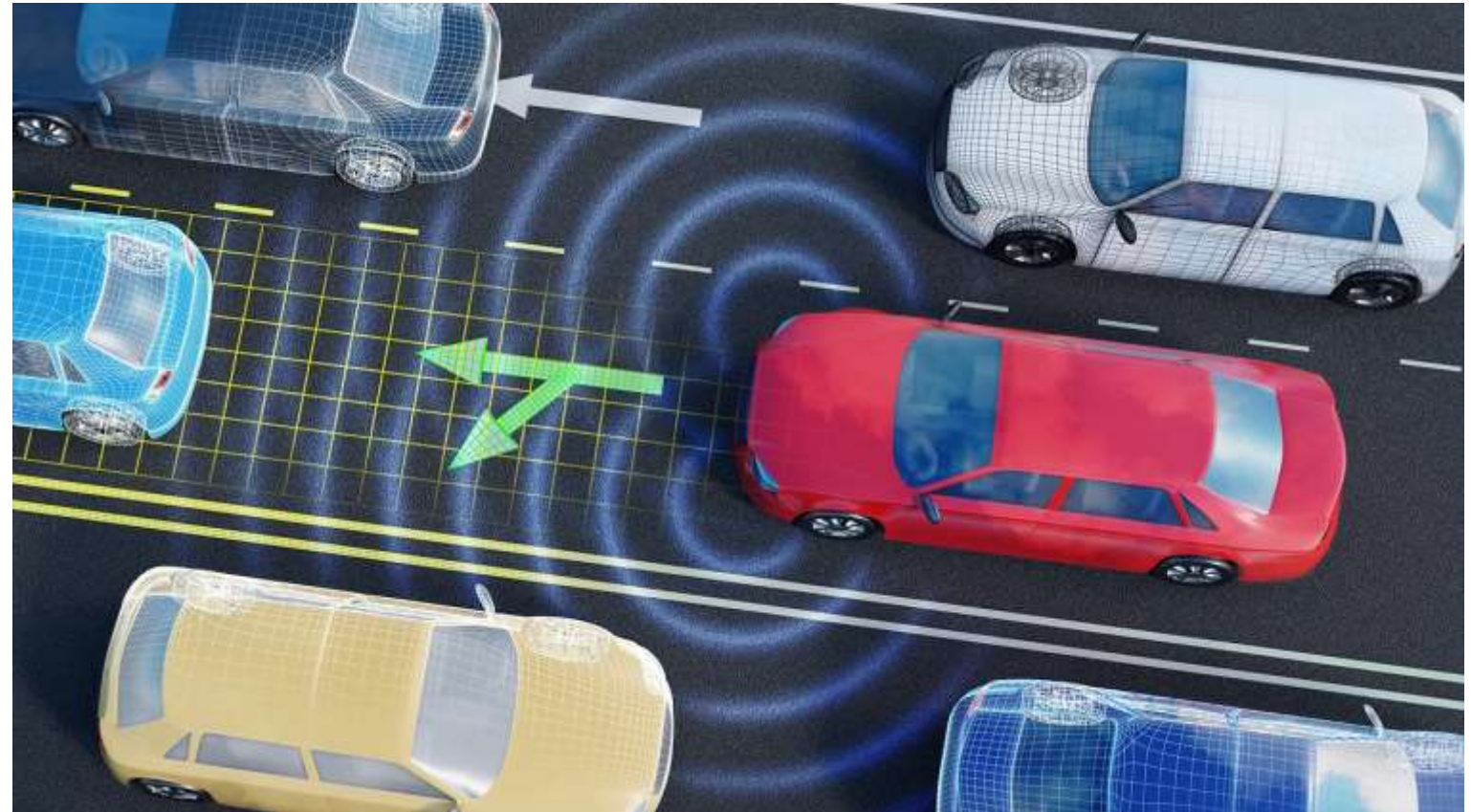
Data



Output



Model



Are you ready for AI?

Access Data
Analyze Data

Develop
Deploy

 Data

 Output

 Model

EVERYTHING

ELSE

Are you ready for AI?

Access Data

Analyze Data

Develop

Deploy



AI model

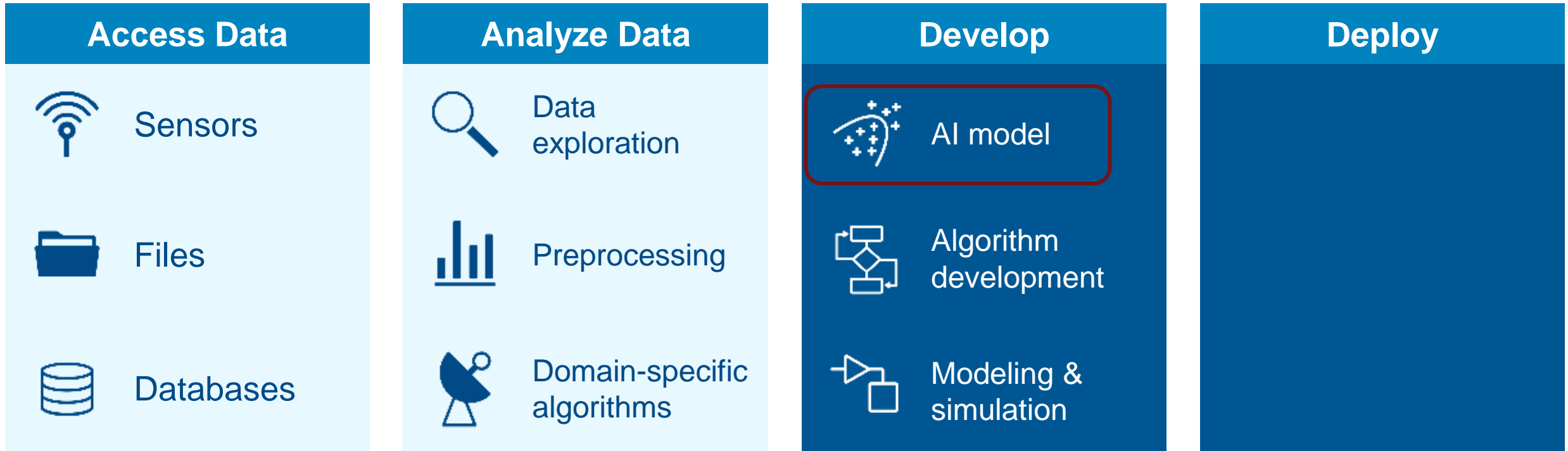


Algorithm
development

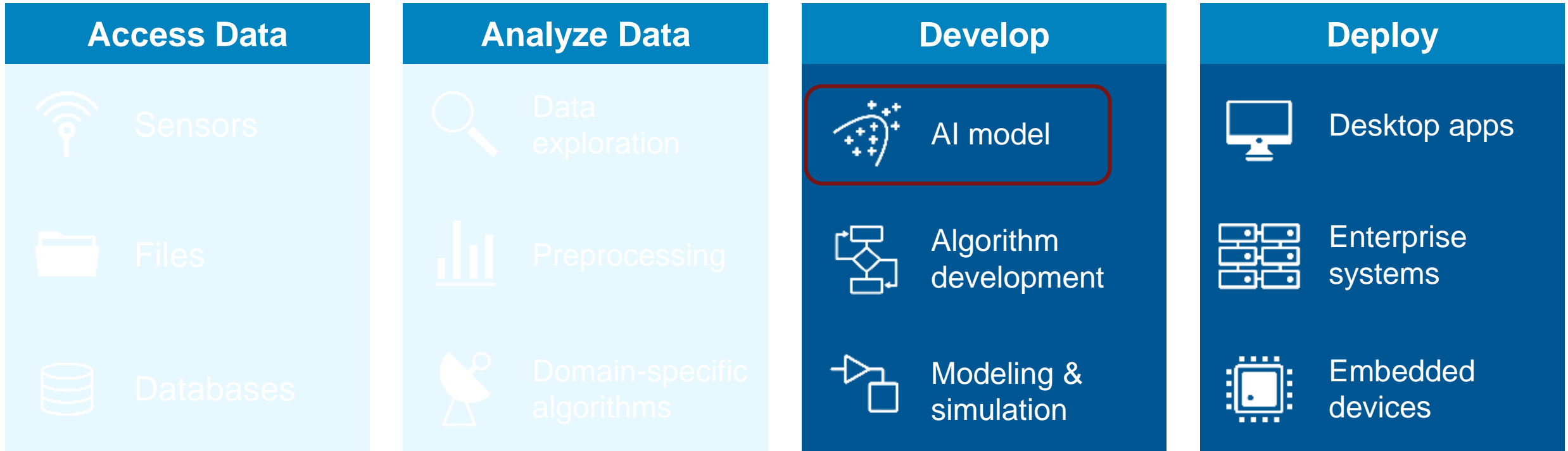


Modeling &
simulation

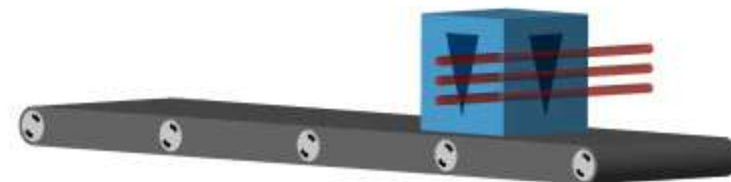
Are you ready for AI?



Are you ready for AI?



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 6.3 g
OF 12%
SAT FAT 3.1 g
OF 13%
SUGARS 1.6 g
OF 3%
SODIUM 245 mg
OF 11%

90g e NET
Flavoured snack



Twisties

Chicken

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

90g e NET
Flavoured snack

What is crispiness?



+



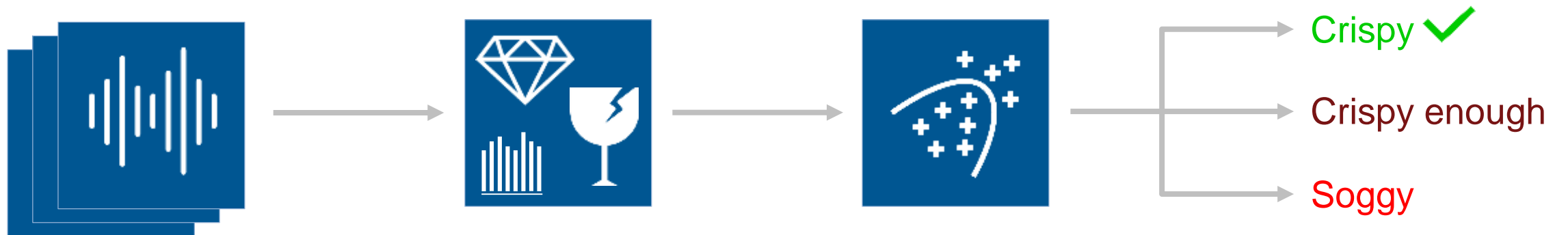
=



Replicating human perception with machine learning

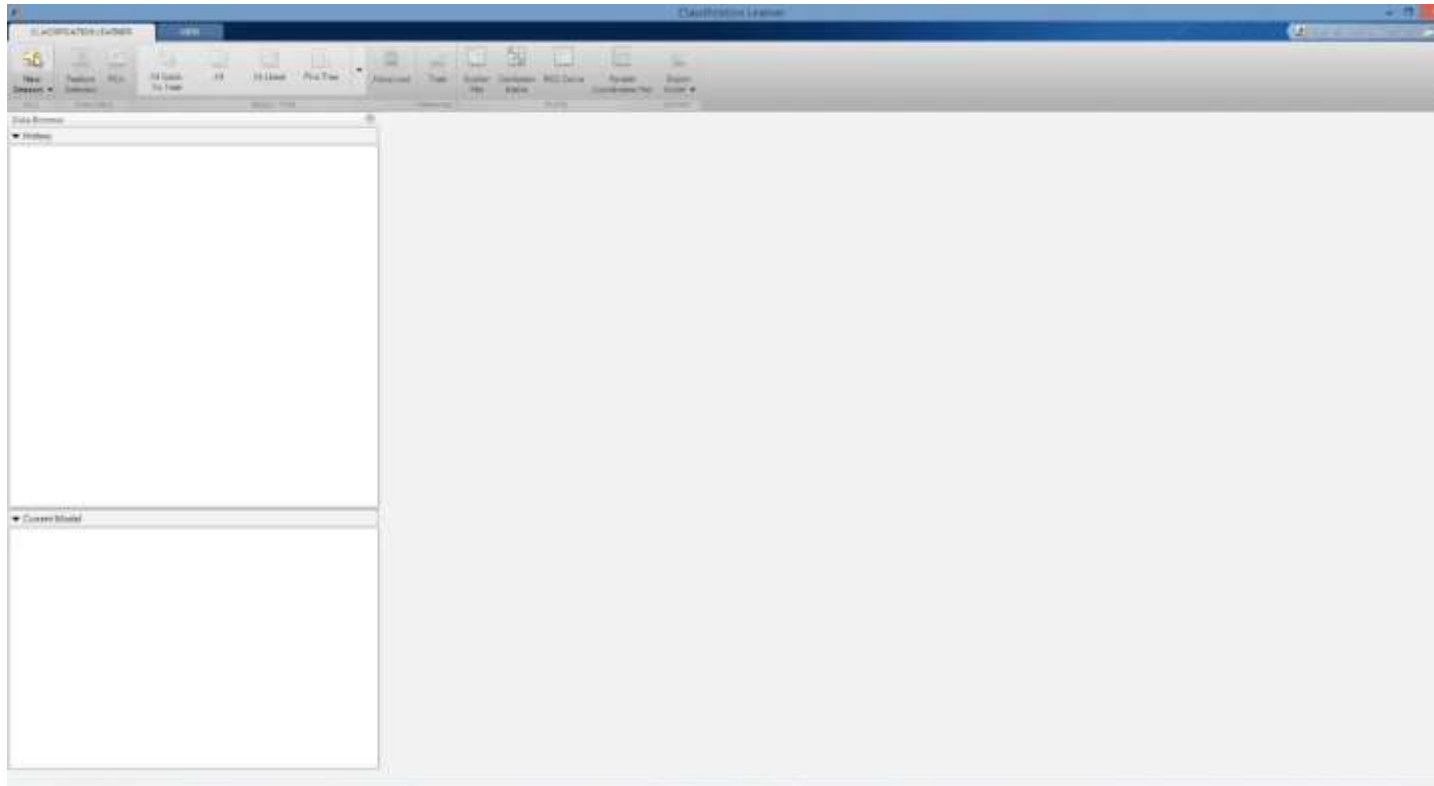
Technical University of Munich

Machine Learning Workflow



Replicating human perception with machine learning

Technical University of Munich



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

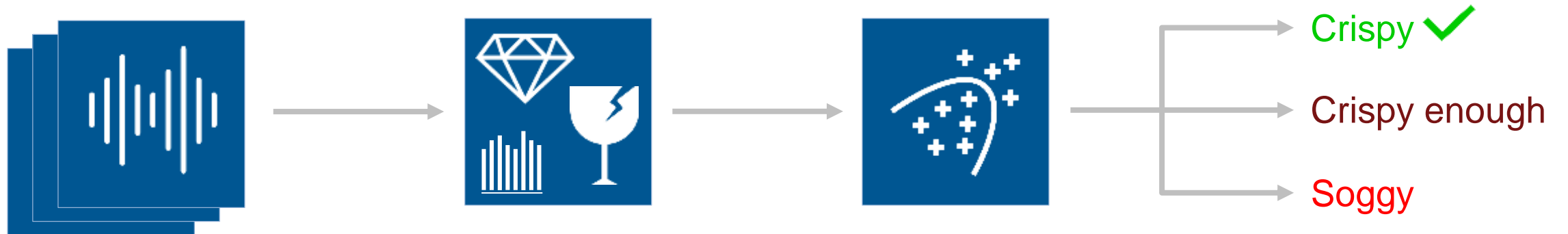
- No experience required
- Use apps to try out all possible models
- Use domain expertise and familiar tools to prepare data

Are you ready for AI if ...

You can't identify features in your data?

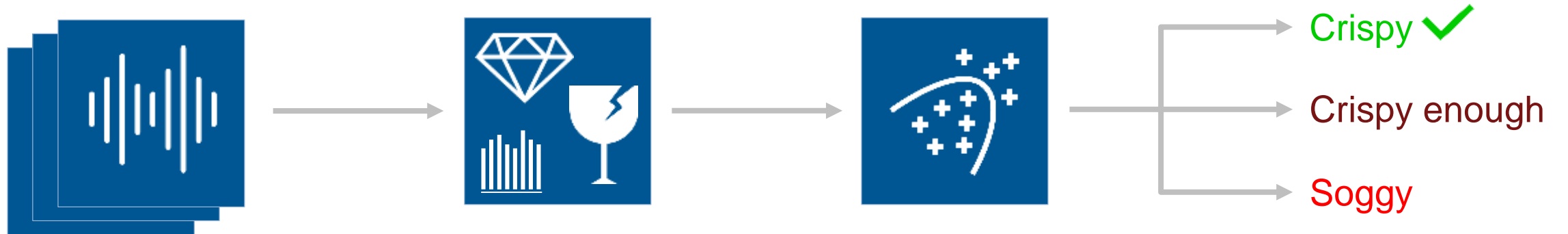
Use deep learning to identify features automatically

Machine Learning Workflow



Use deep learning to identify features automatically

Machine Learning Workflow



Deep Learning Workflow

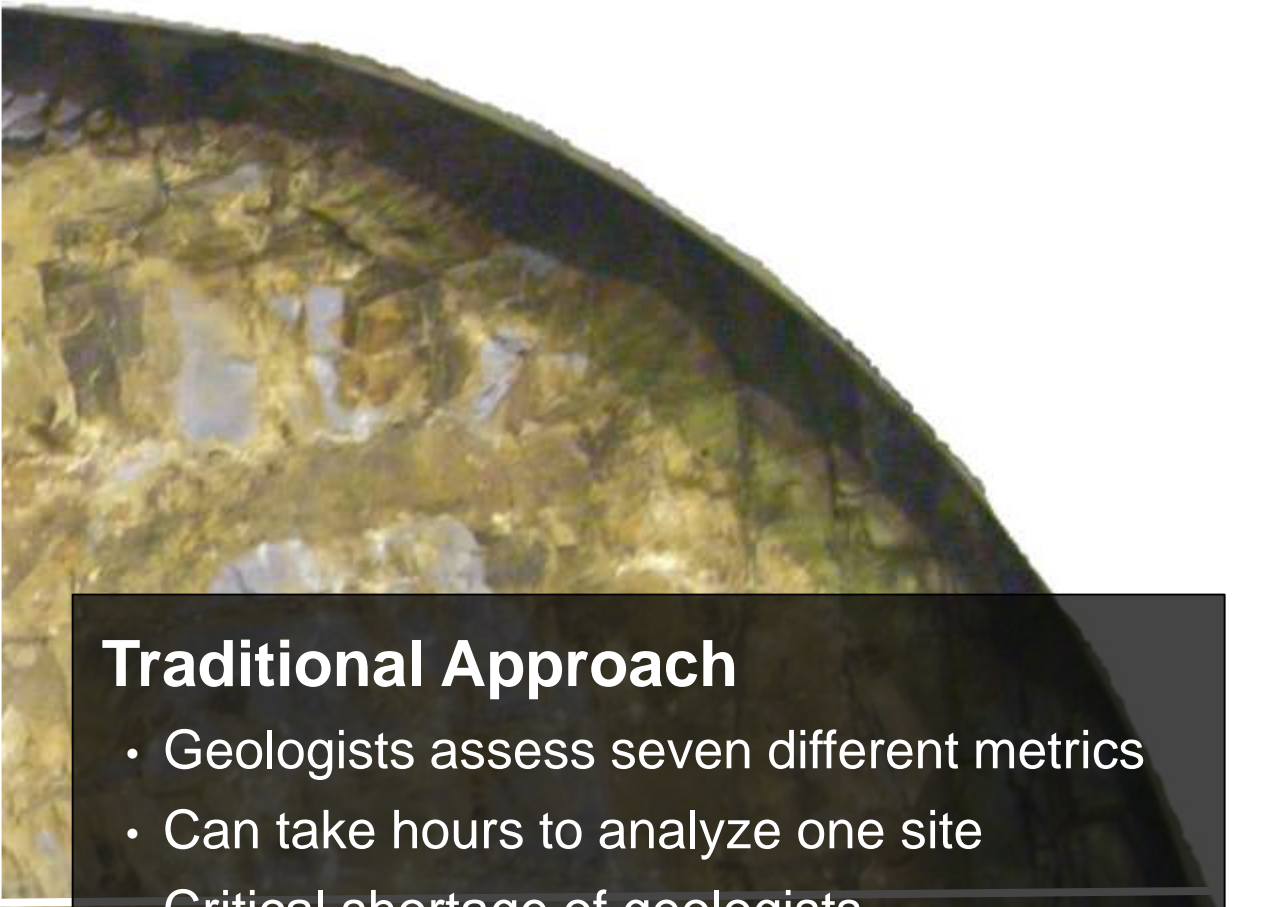




SPEED
LIMIT
45





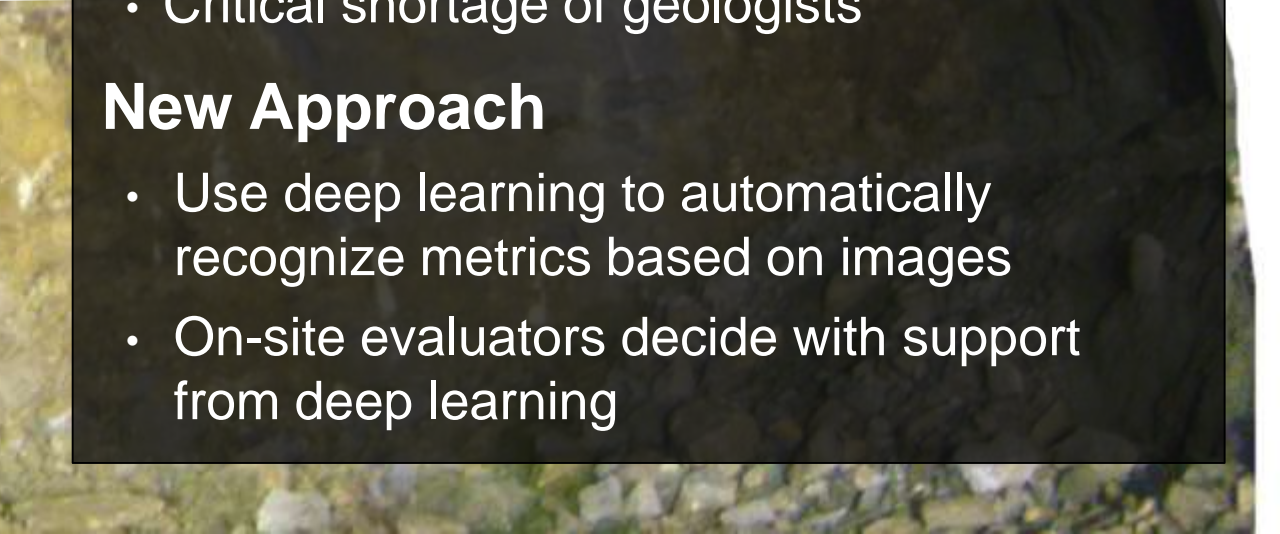


Traditional Approach

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

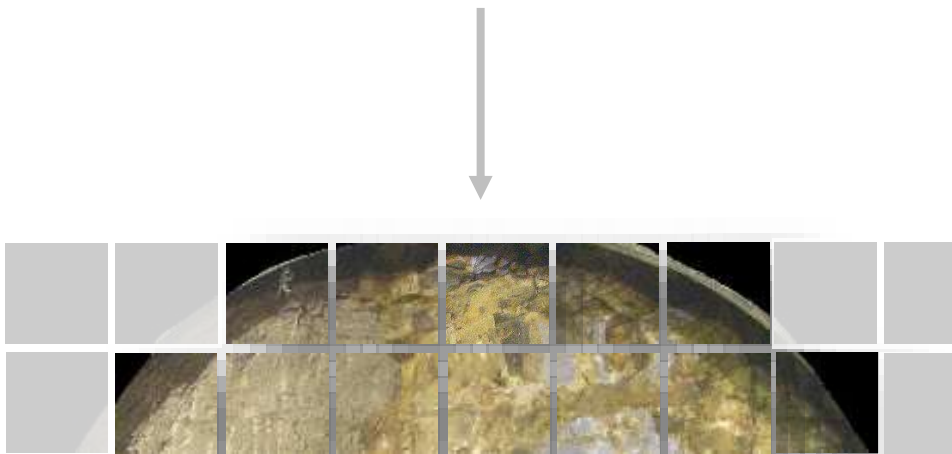
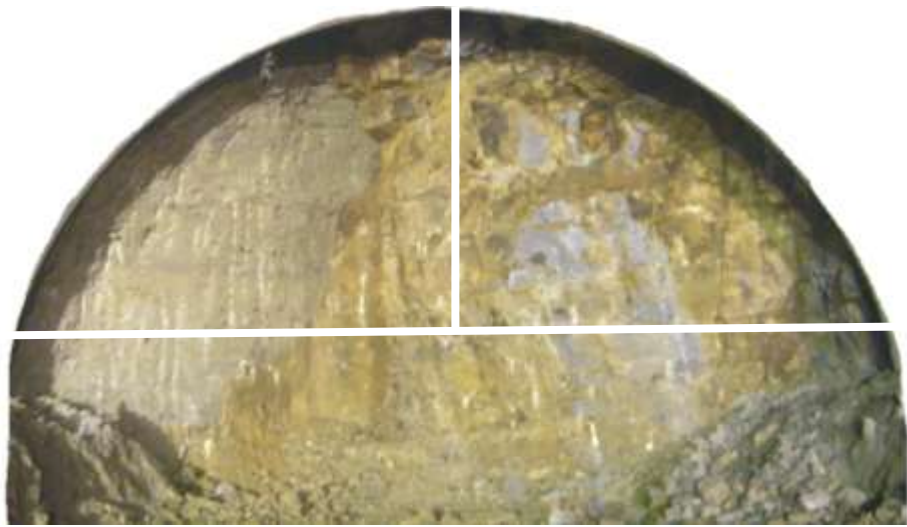
New Approach

- 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

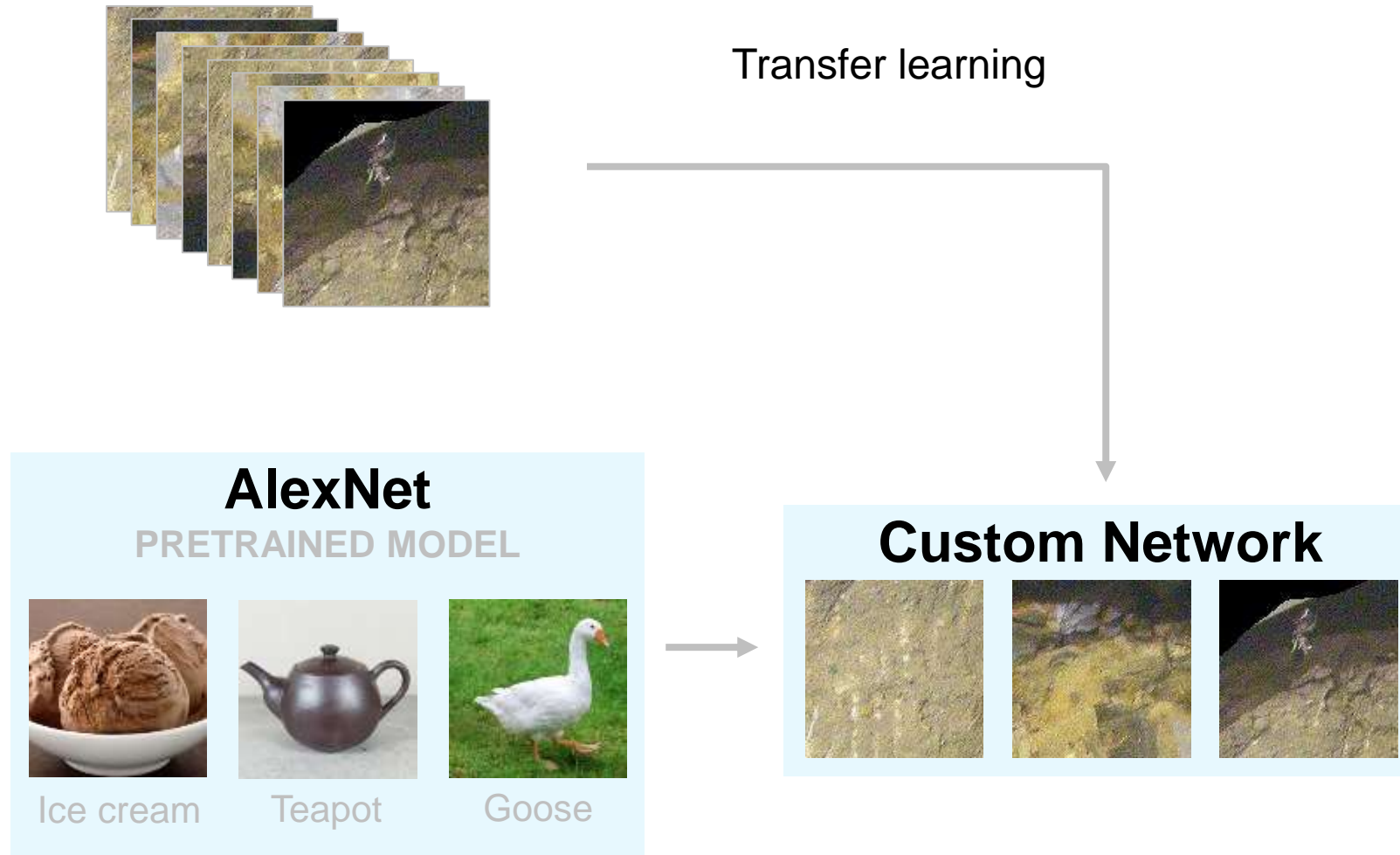
Obayashi Corporation



| 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 |
| | ⋮ | ⋮ | ⋮ |

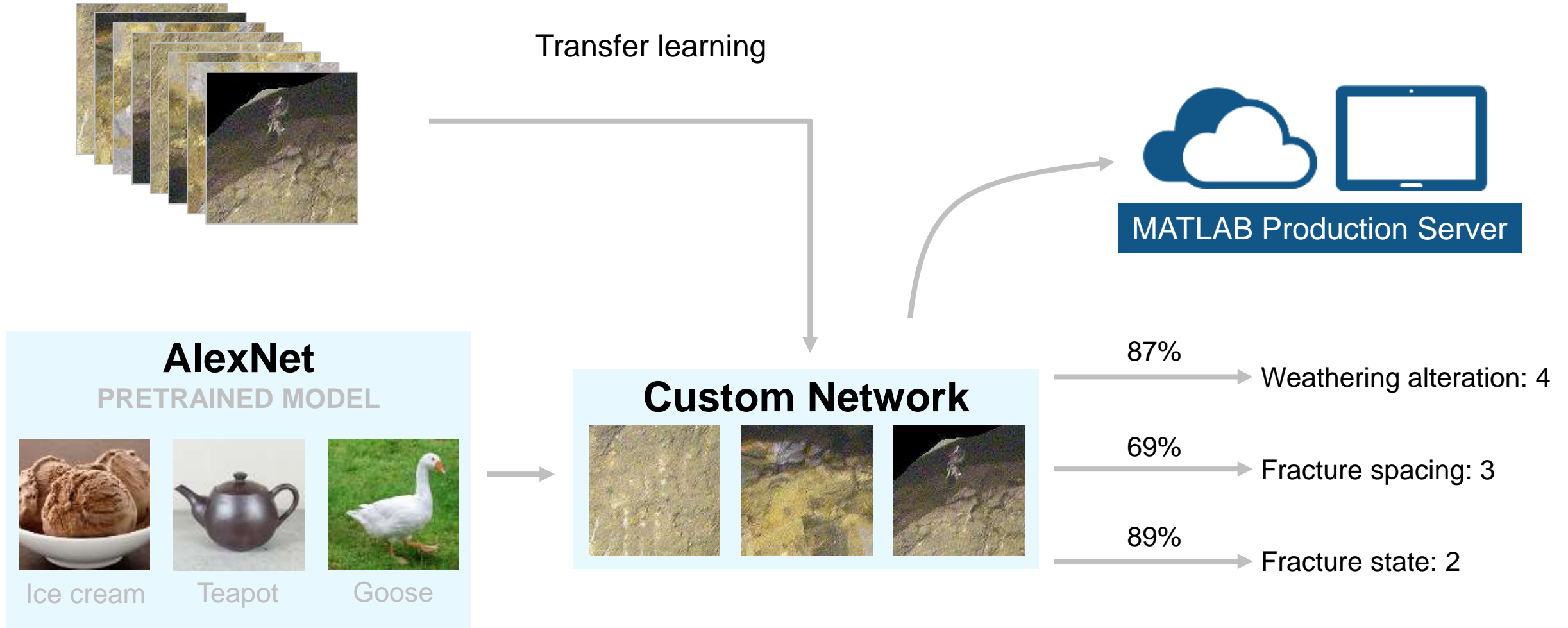
Efficient tunnel drilling with deep learning

Obayashi Corporation



Efficient tunnel drilling with deep learning

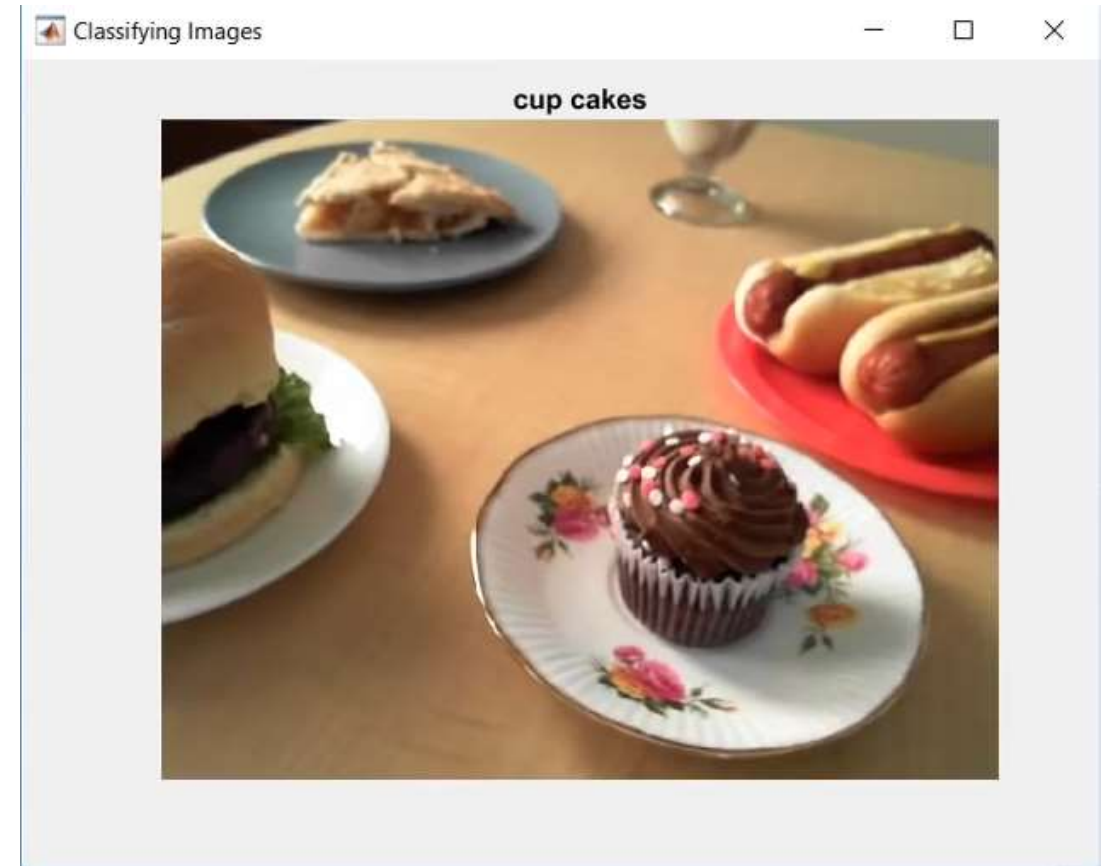
Obayashi Corporation



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)
```







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

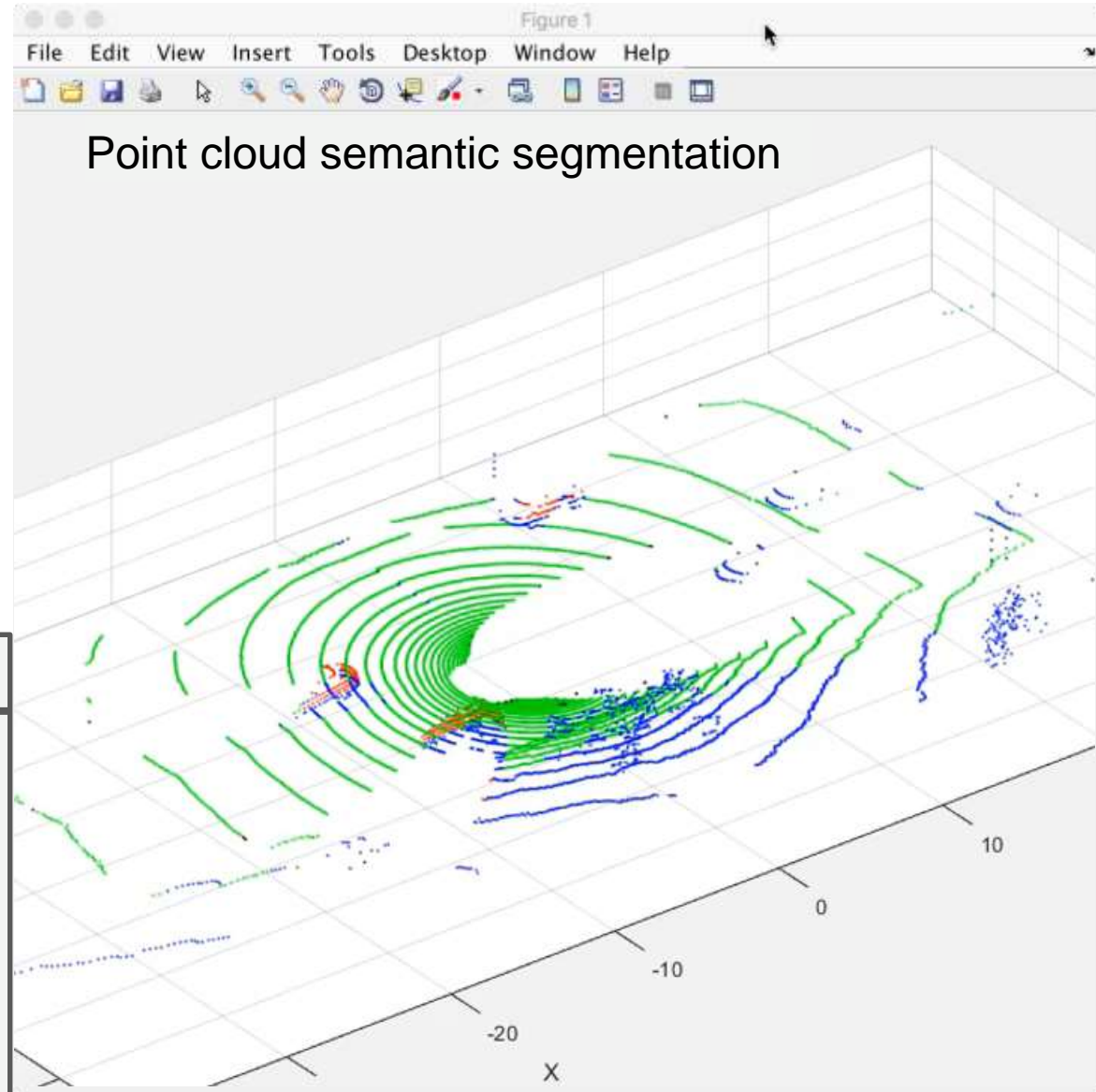
- Deep learning
- Transfer learning

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

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

The Autoliv logo is displayed in a large, bold, blue font. The word "Autoliv" is written in a sans-serif typeface, with a thick blue horizontal bar underneath the letters "iv".





| Classification | |
|----------------|---|
| Car |  |
| Truck |  |
| Background |  |
| Ground |  |

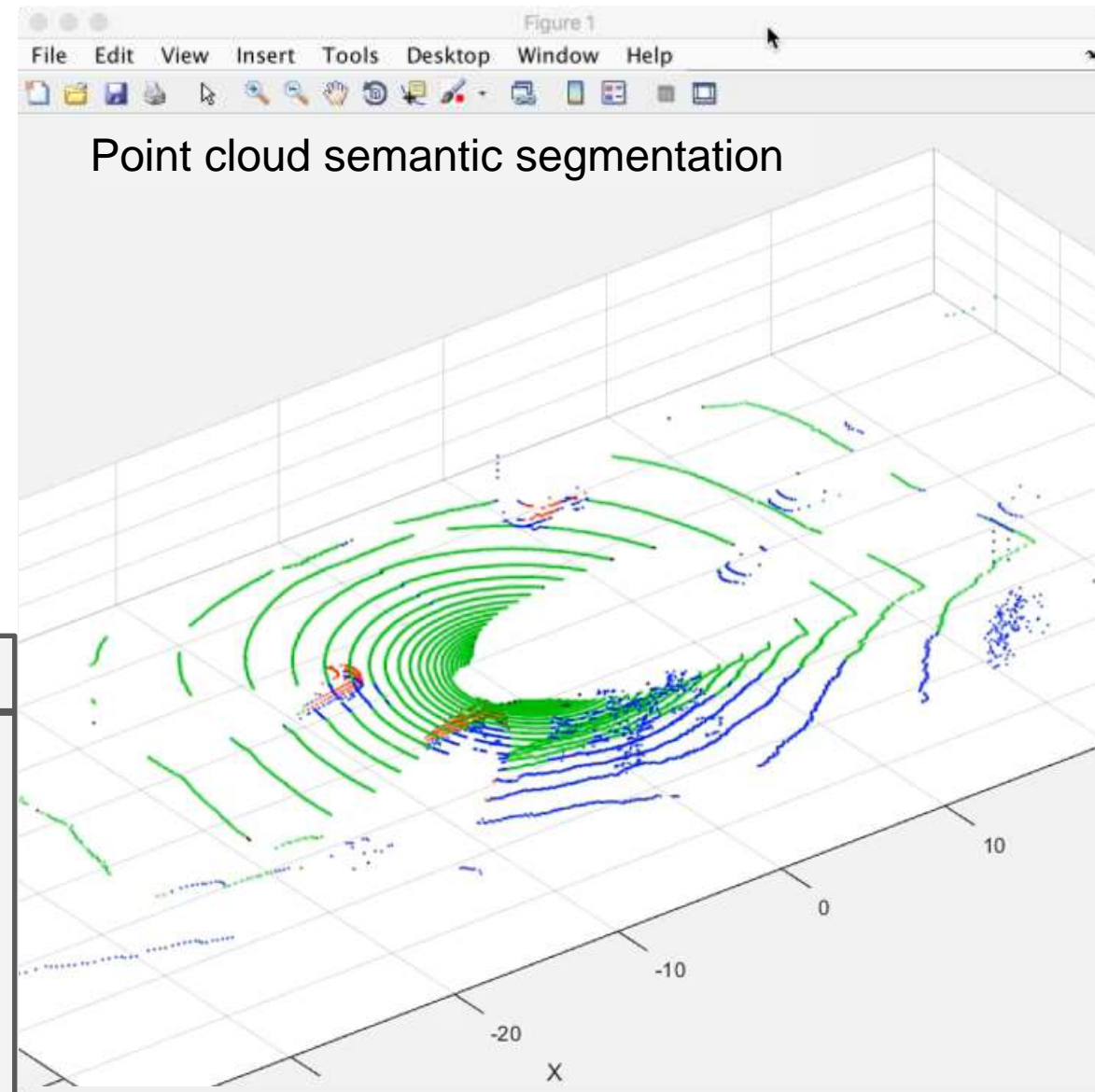


Are you ready for AI if you can't identify features in your data?

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

Autoliv

| Classification | |
|----------------|---|
| Car |  |
| Truck |  |
| Background |  |
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Are you ready for AI if ...

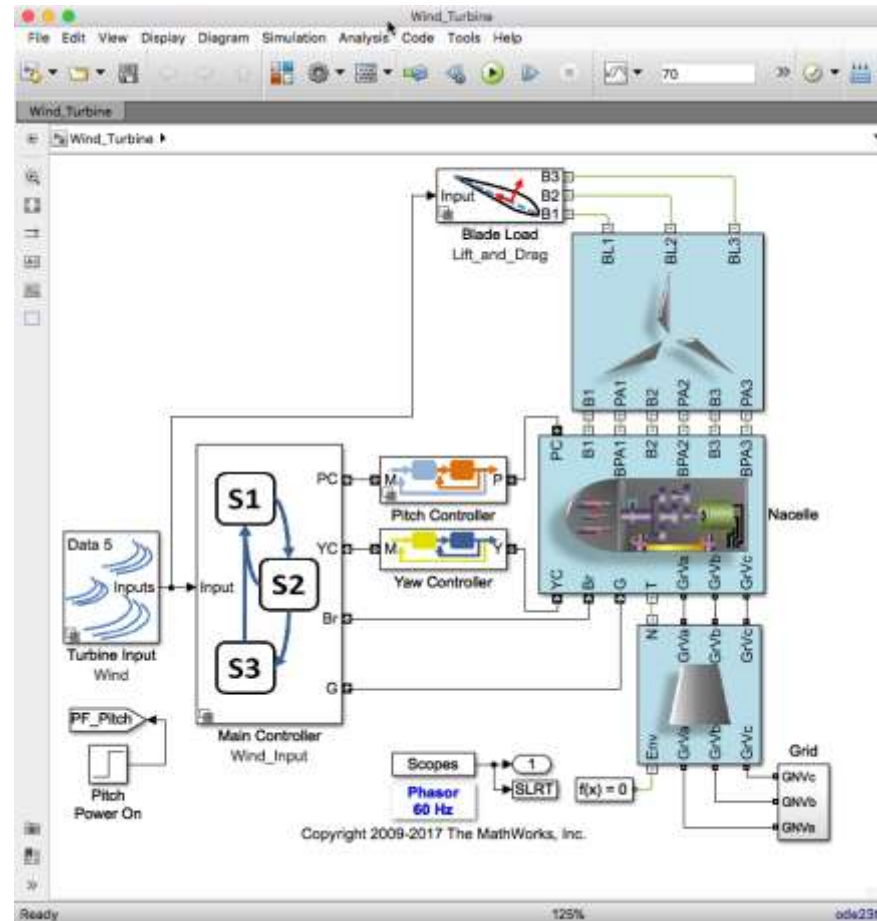
If you don't have the right data?



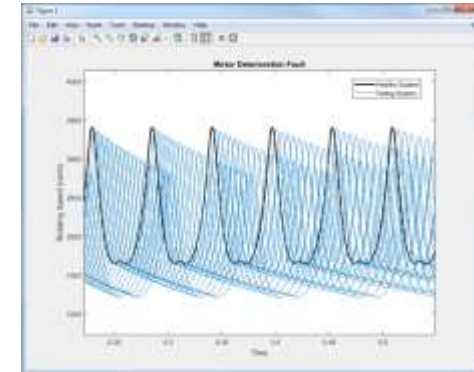
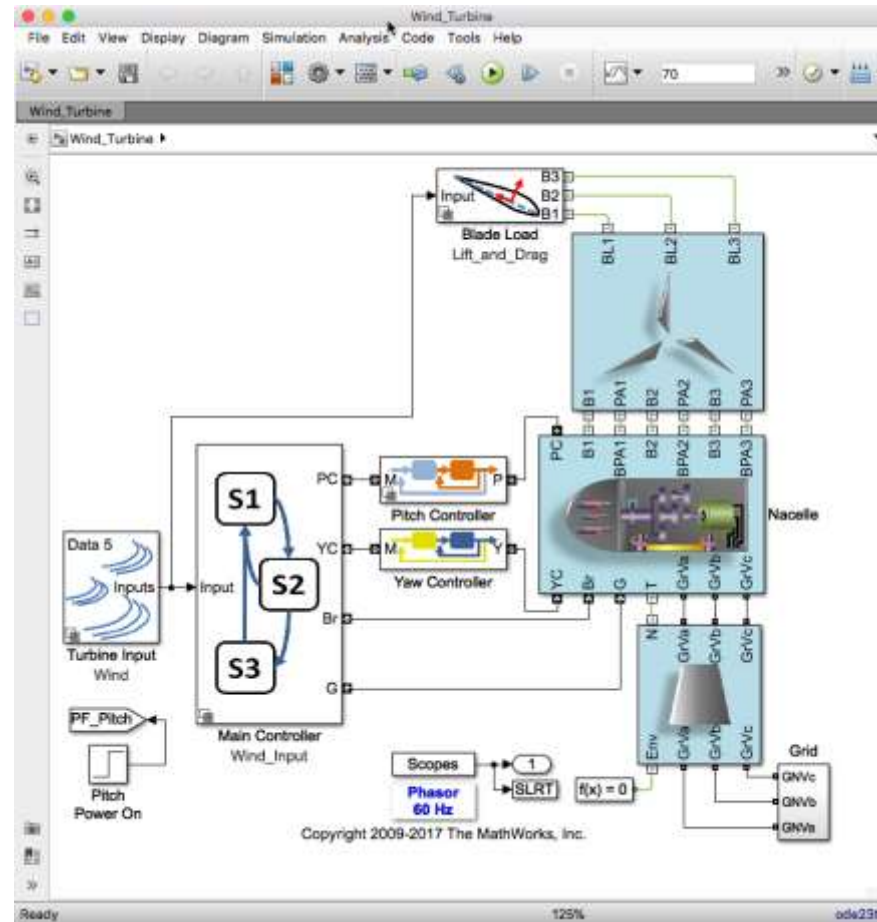
AI for Predictive Maintenance

- 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

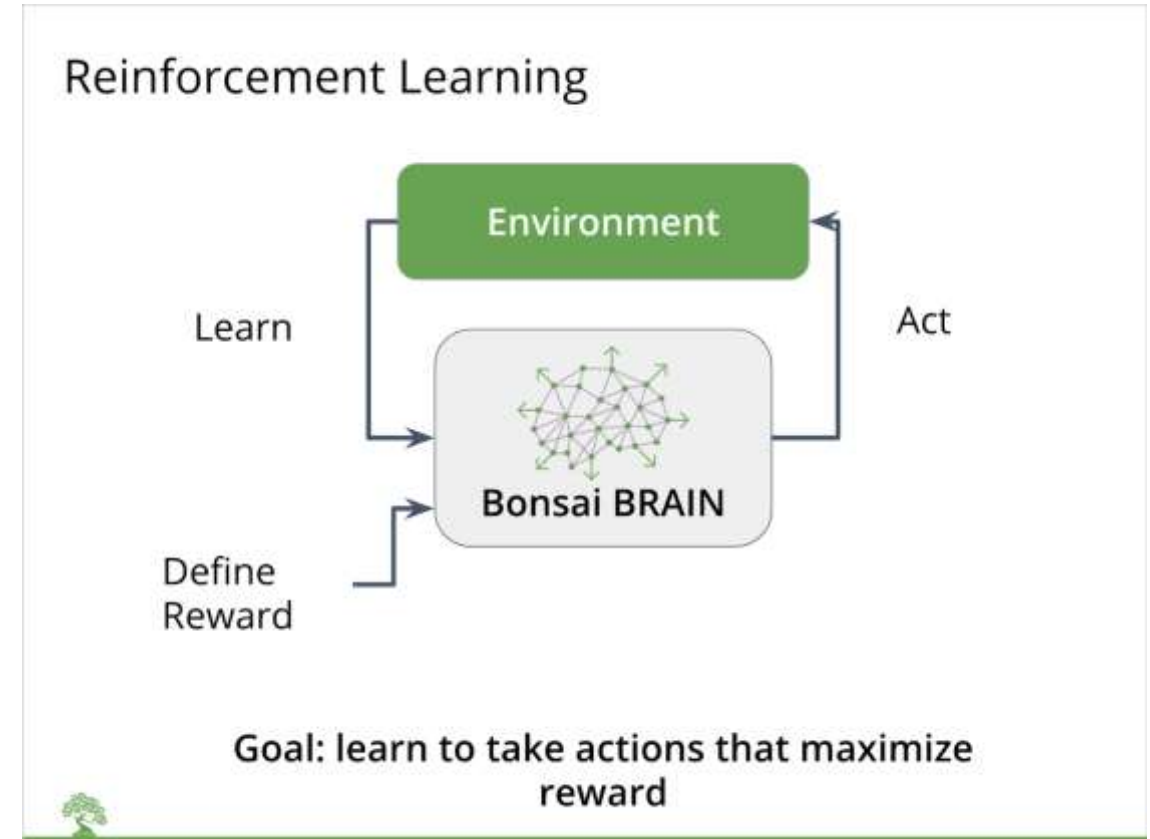


Predictive maintenance with synthetic failure data with MATLAB & Simulink



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

- Generate data with simulations
- Simulation environment for reinforcement learning



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

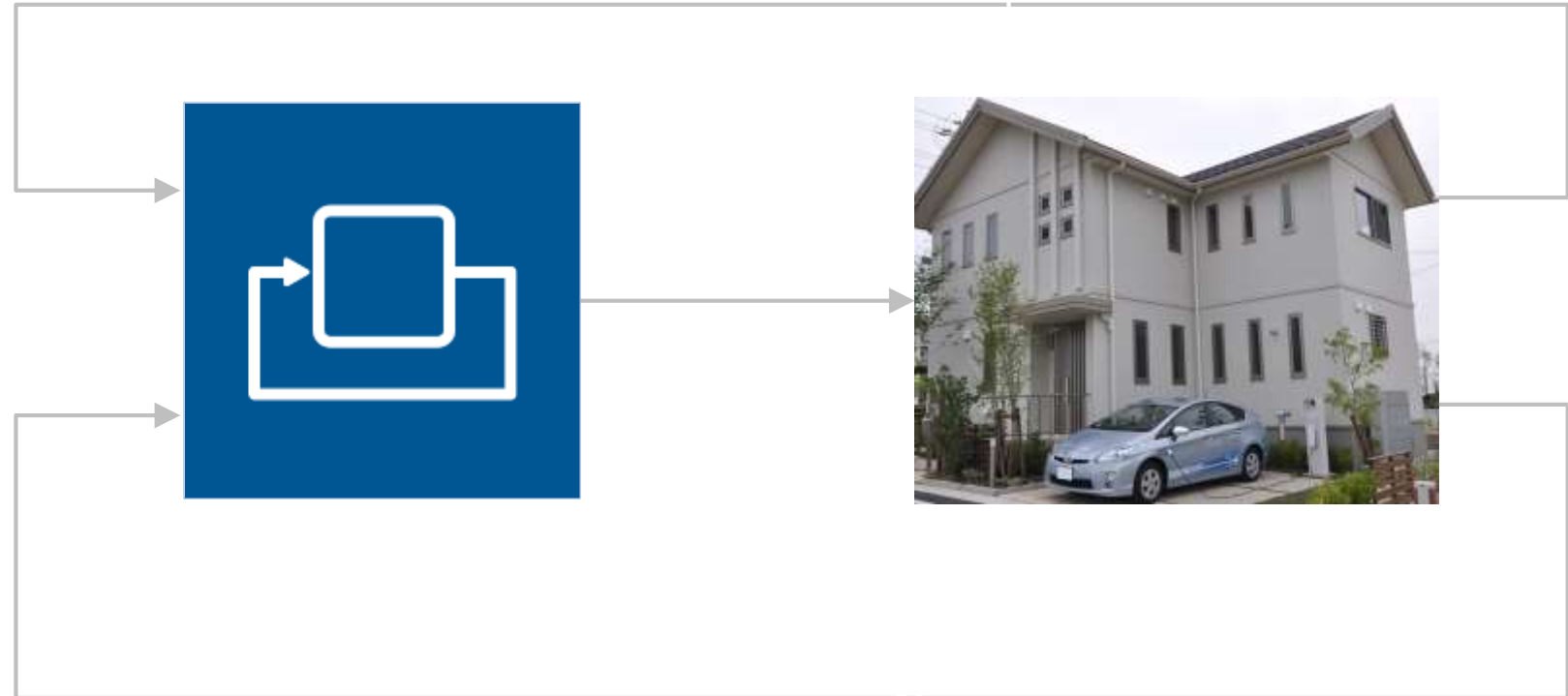
- Generate power with fuel cell and solar panels
- Store power in battery
- Buy power when needed; sell when extra
- Record data on environment and energy usage

Goals

- Minimize energy cost
- Use EV battery for additional storage

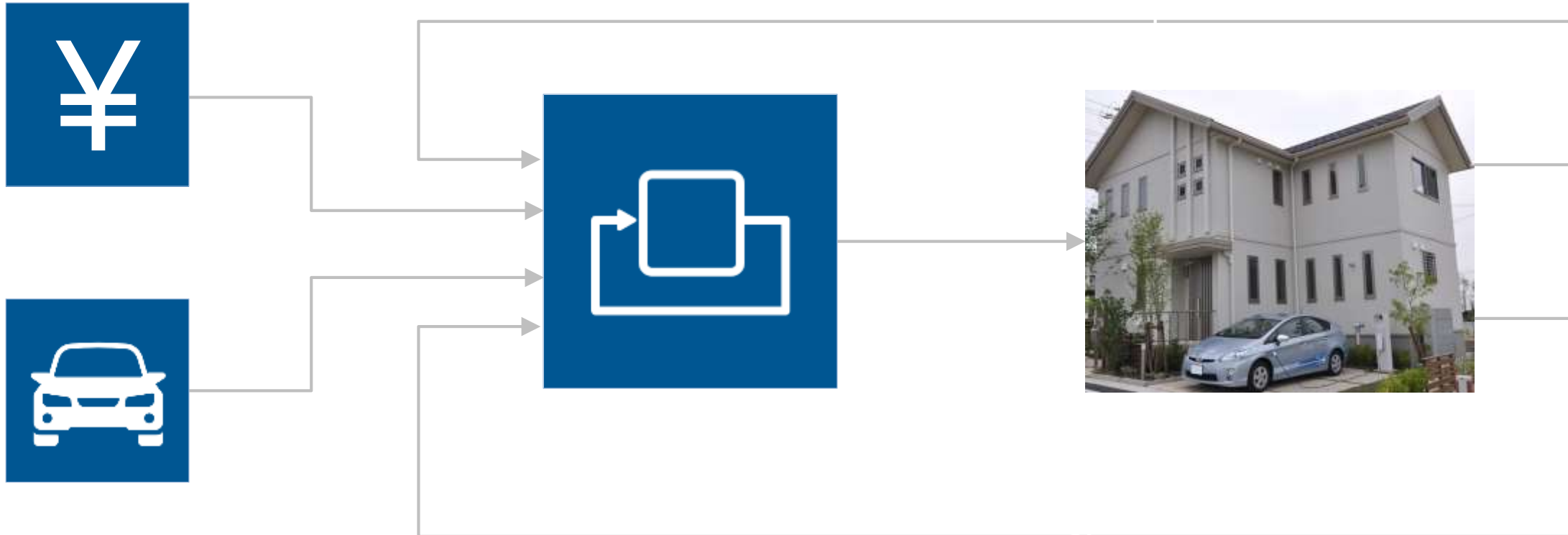
Optimizing home energy management system

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

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



Primary

Autonomous



EMG (Muscle) Control



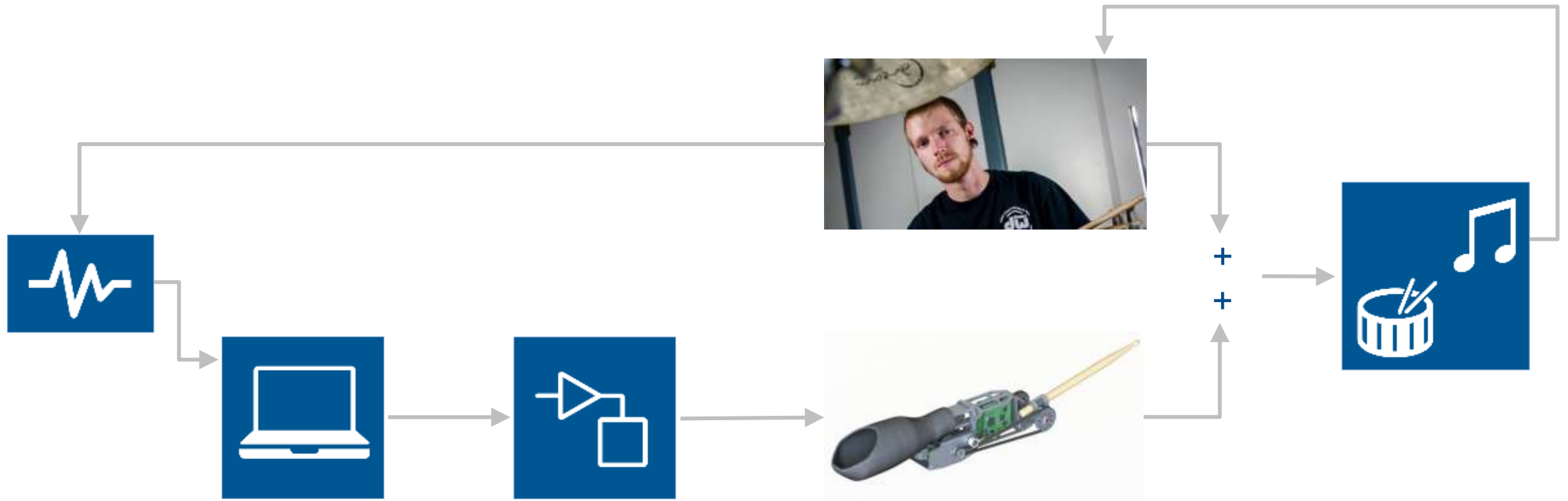
Autonomous

Primary

**An arm with
"a mind of its own"**

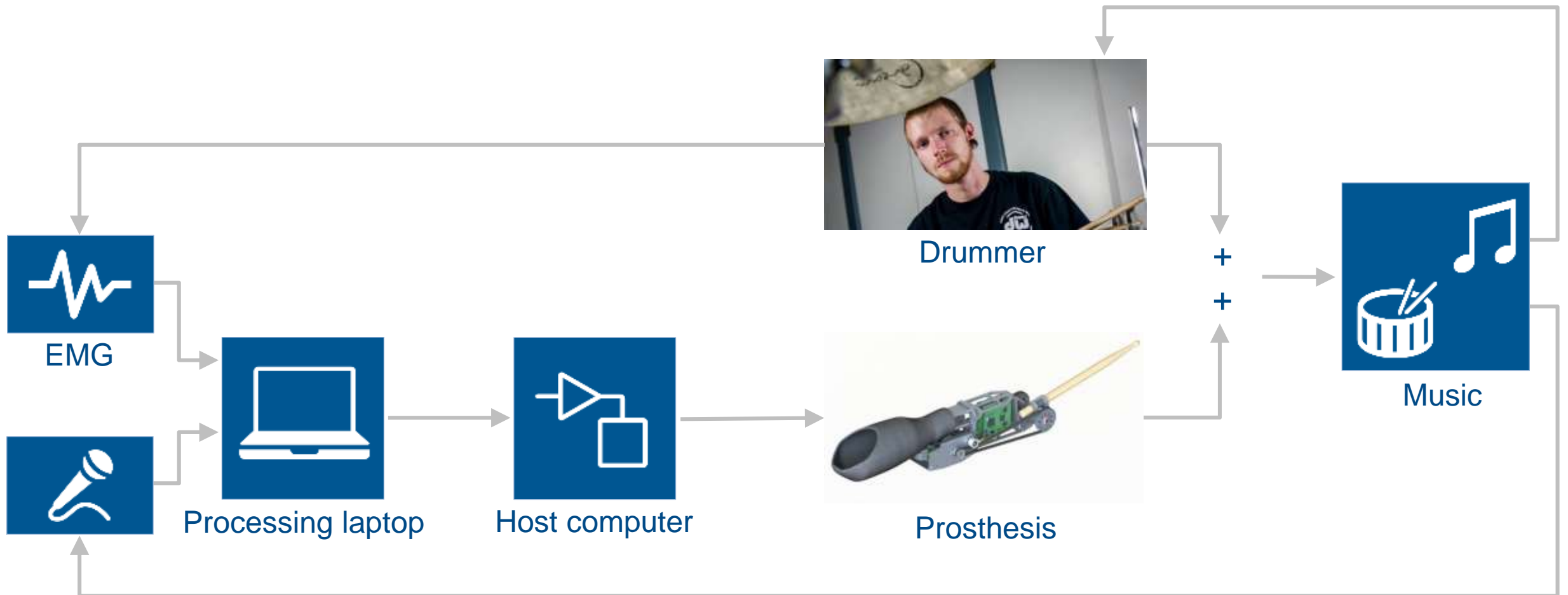
Exceeding human capabilities with a robotic drumming prosthesis

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 ...

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Easy programming

Apps

Domain expertise to prepare data

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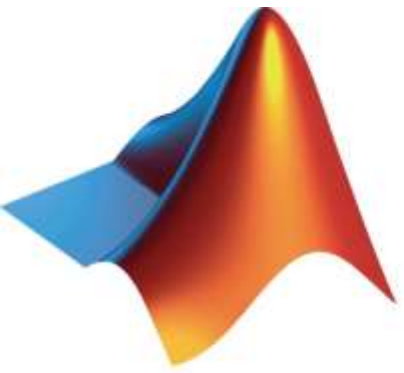
Use AI to label data

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!



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Accelerating the pace of engineering and science