Applications of Deep Learning

The most common (and not so common) examples

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Agenda

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- Introduction
- Applications and use cases
- MathWorks' support

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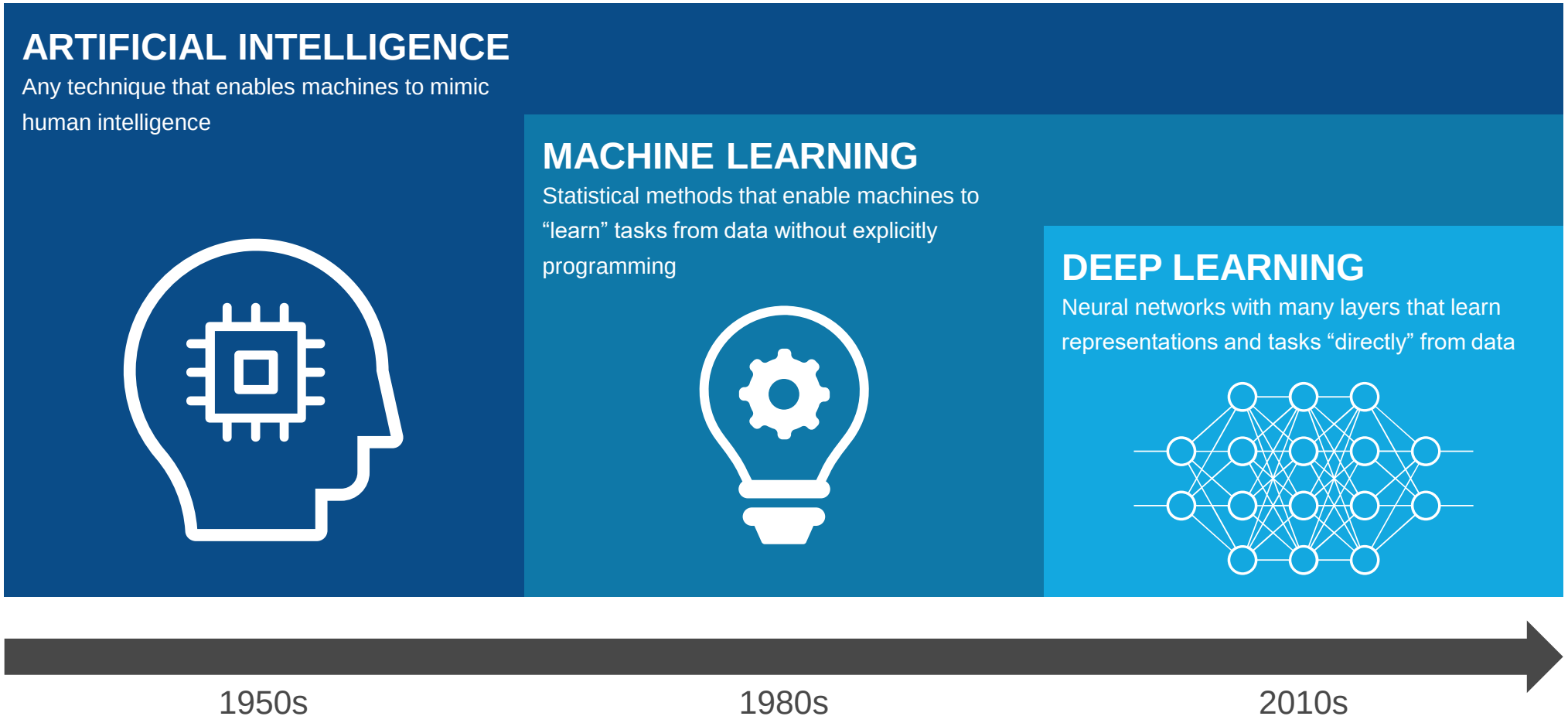
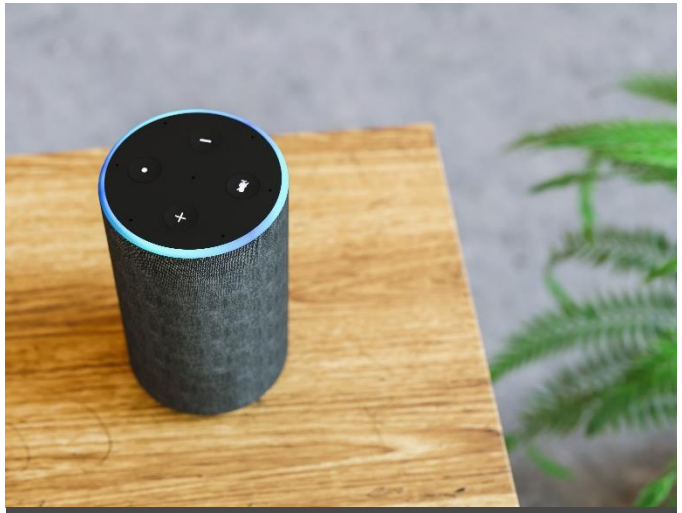
Deep learning is a key technology driving the AI megatrend

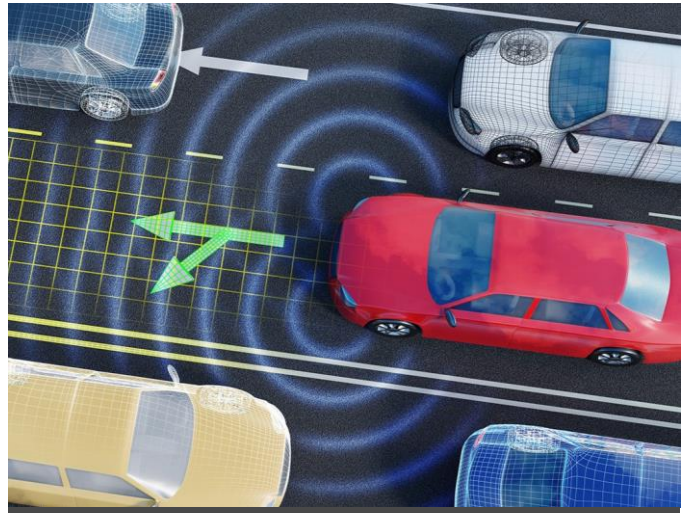


Deep learning is part of our everyday lives



Speech Recognition

Face Detection

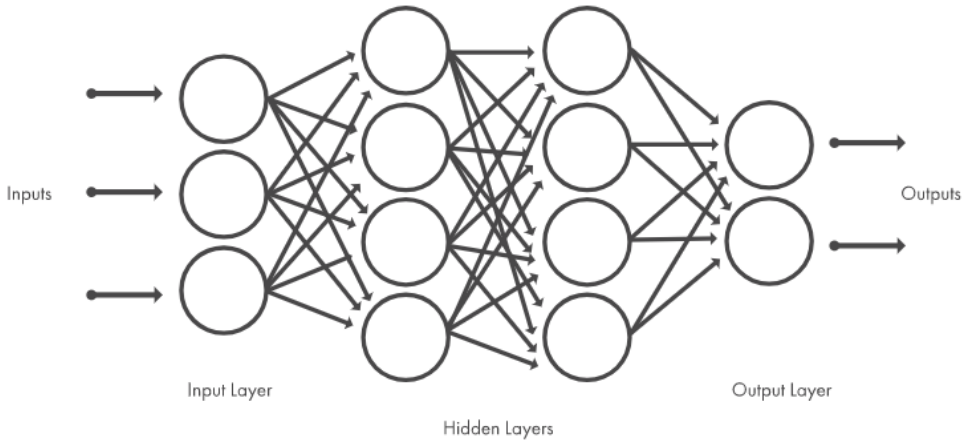


Automated Driving

DL uses neural networks and works similar to the human brain

DL neural networks consist of

- Neurons arranged in layers
- Layer combinations
- Learnable parameters (weights and biases)
- Hyperparameters (e.g. learning rate, number of epochs, mini batch size, etc.)

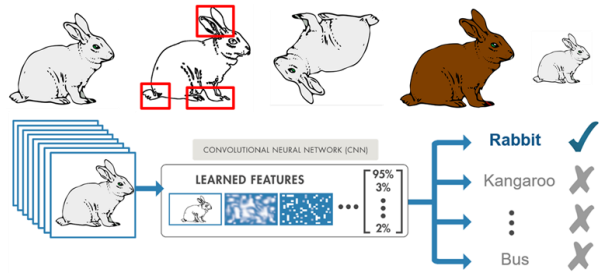


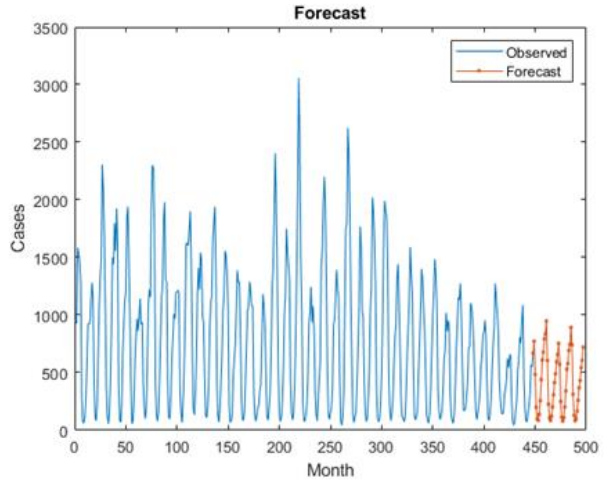
Applications of Deep Learning are very versatile

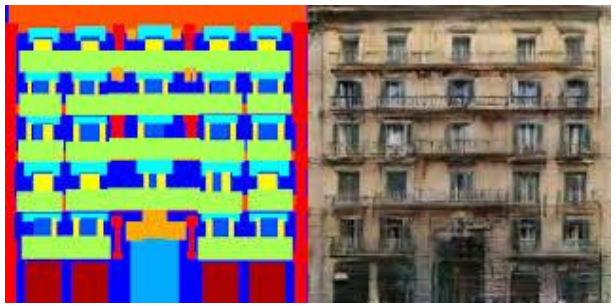
Most commonly, DL is used for:

- Classification: Output is categorical (or discrete)
- Regression: Output is numerical (or continuous)

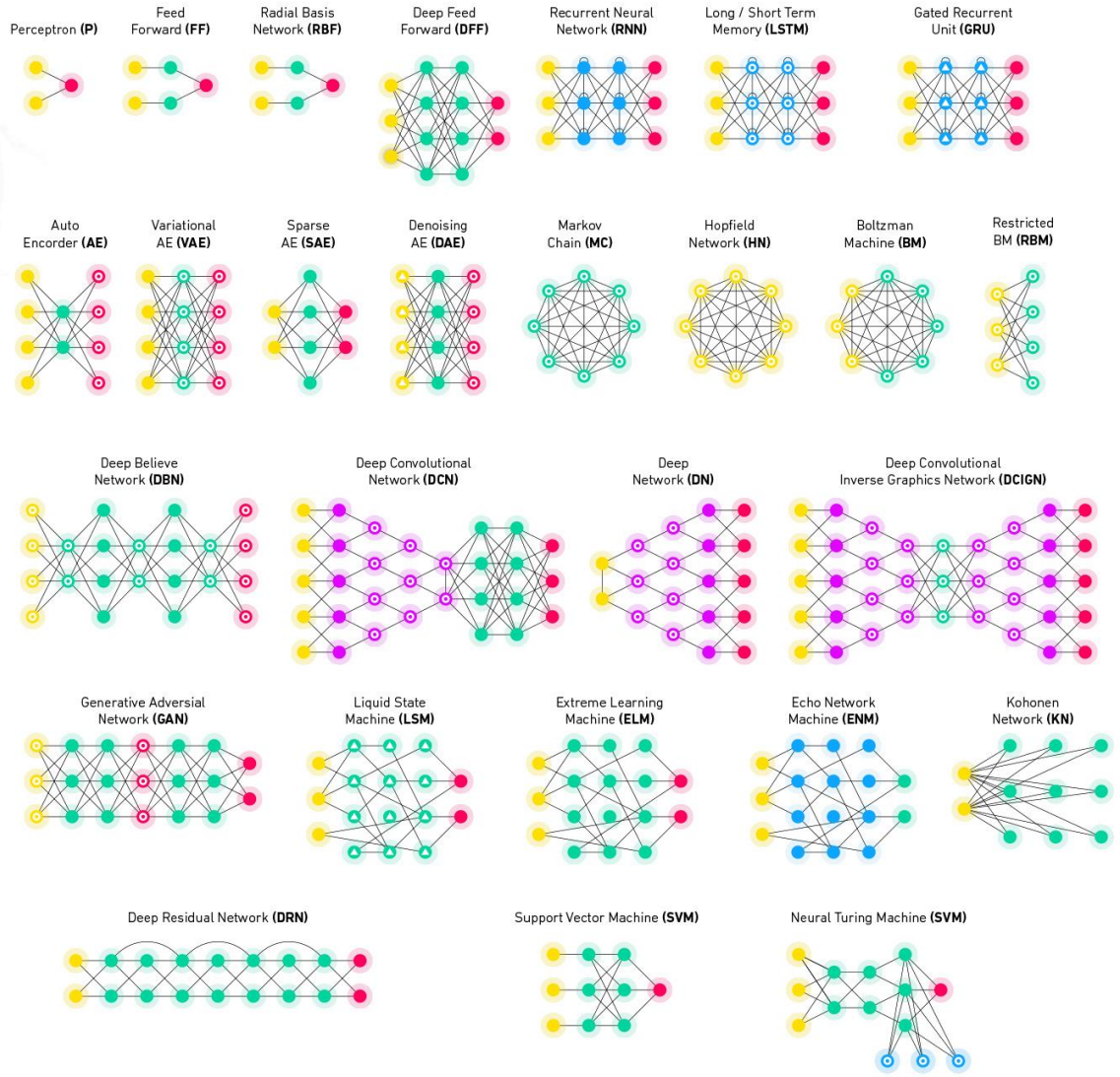
Some advanced networks are used to generate an output







Deep Learning is a fast evolving field



Deep Learning Workflow

Access and Explore Data

Files

Databases

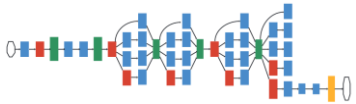
Sensors

Label and Preprocess Data

Data Augmentation/ Transformation

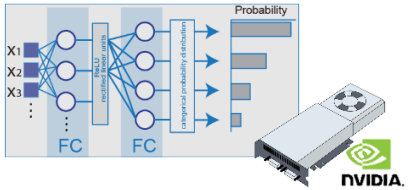
Labeling Automation

Import Reference Models



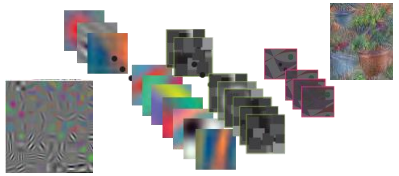
Develop Predictive Models

Hardware-Accelerated Training



Hyperparameter Tuning

Network Visualization

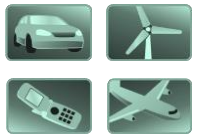


Integrate Models with Systems

Desktop Apps

Enterprise Scale Systems

Embedded Devices and Hardware



MathWorks

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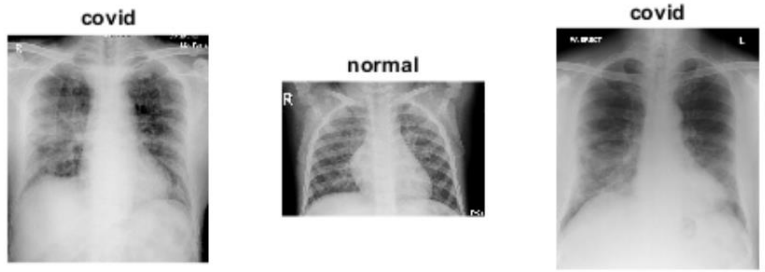
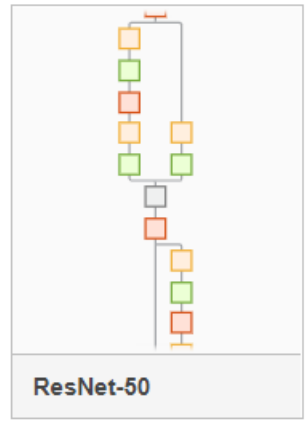
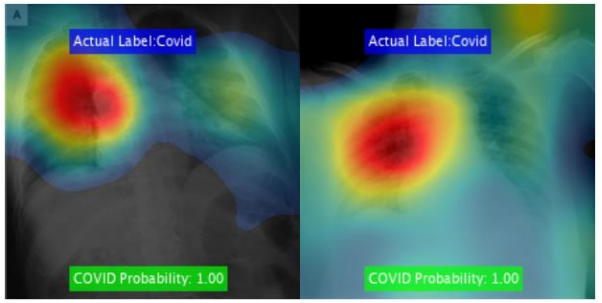
Applications and case studies
COVID-19 detection

Classification of x-ray images to detect COVID-19

- Used chest radiograph data
- Used ResNet-50, applied transfer learning technique
- Used k-fold validation
- Used Class Activation Mapping (CAM) to visualise the decision of the network



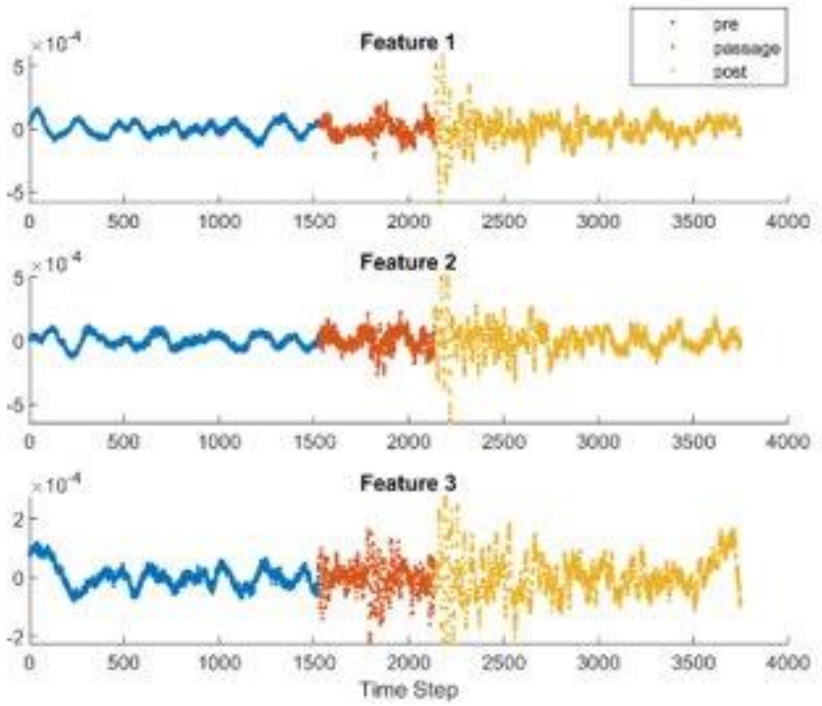




Applications and case studies
Seismic event detection

Predict seismic events

- Used data from geophones
- Used an LSTM with a relatively small data set
- Achieved accuracy of 97-99%
- Network generalises well on global data

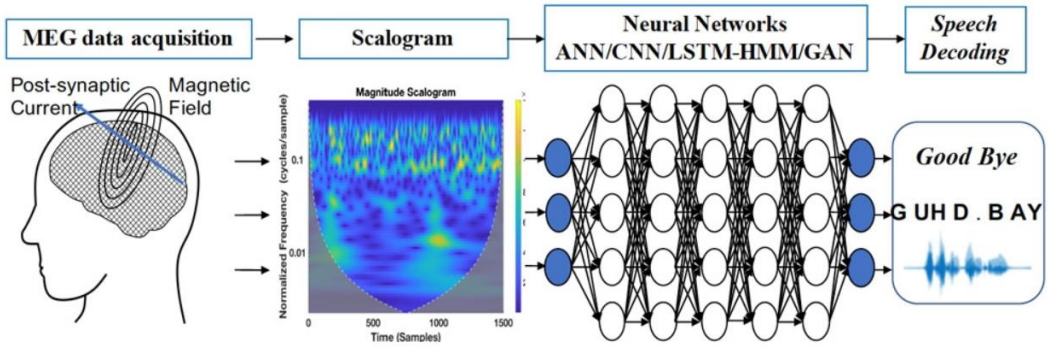


Applications and case studies

Converting brain signals to words

Classify brain signals to imagined words

- Used wavelet scalograms to extract features from MEG signals
- Used different pre-trained models
- Conducted training on seven-GPU parallel computing server



Applications and case studies

Designing a prosthetic that plays drums

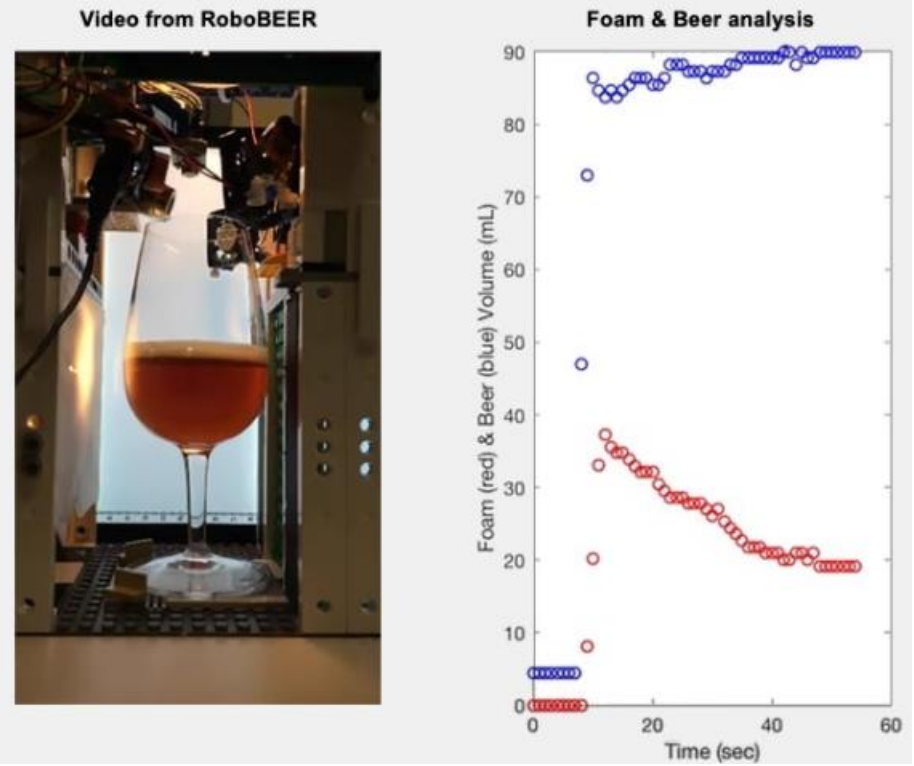
Playing a complementary drum beat

- Used machine learning and deep learning techniques
- The deep learning algorithms compose music

Applications and case studies
Classify beer gases

E-nose used to classify gases released from beers

- Used computer vision and machine learning
- Used consumer reactions to increase accuracy
- Achieved high accuracy (97%)
- Can be used for quality control



Applications and case studies

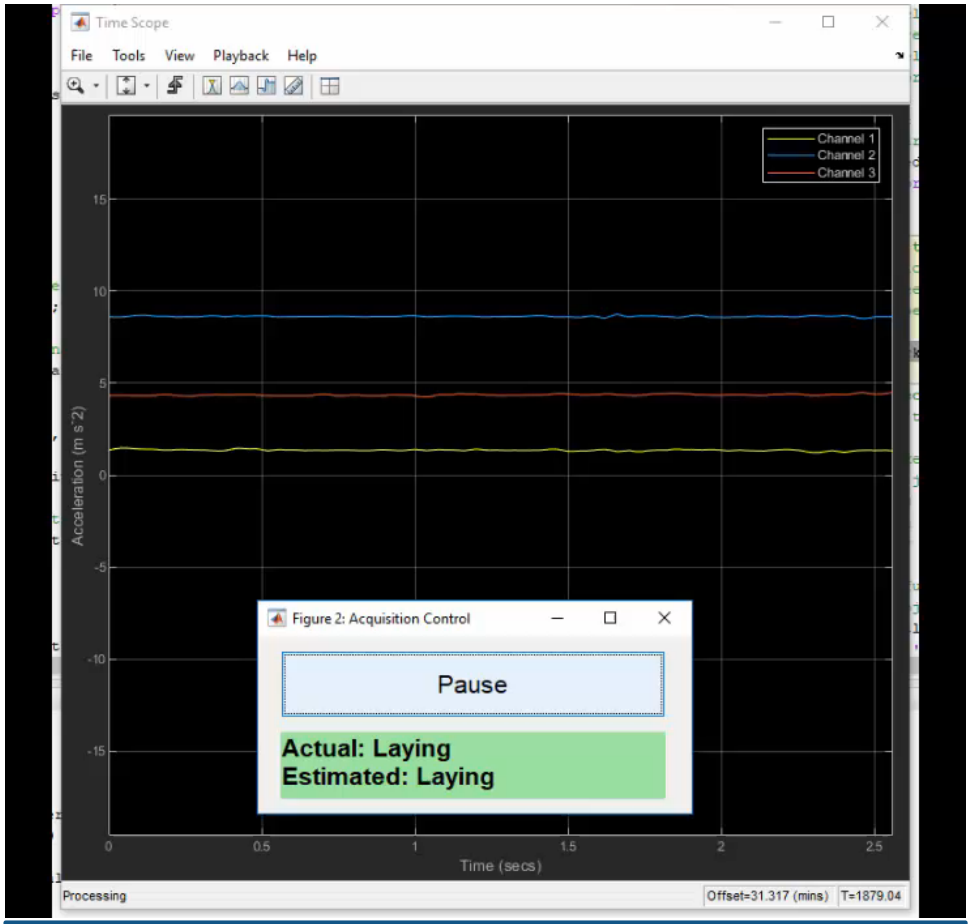
Object recognition and semantic segmentation

YOLO v2 (You Only Look Once)

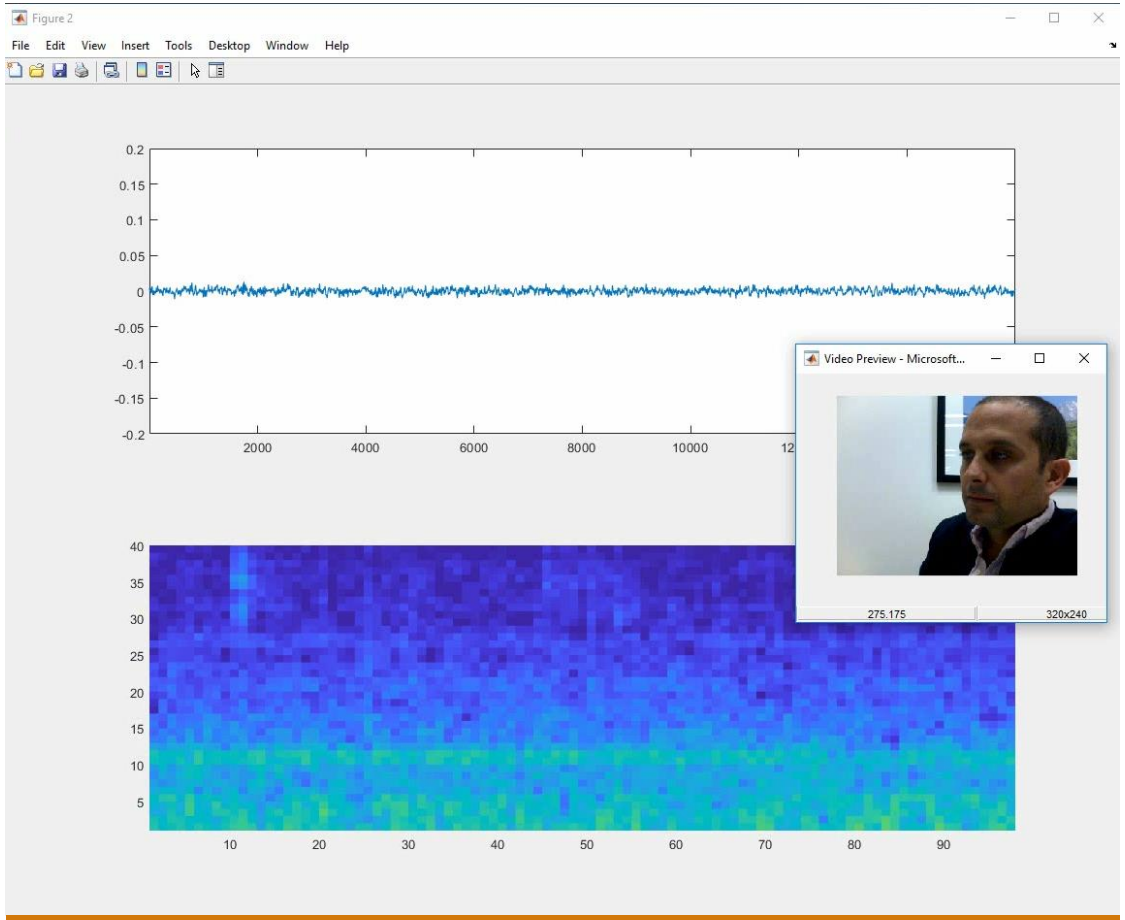
Semantic Segmentation using SegNet

Applications and case studies

Signal classification



Signal Classification using LSTMs



Speech Recognition using CNNs

Applications and case studies

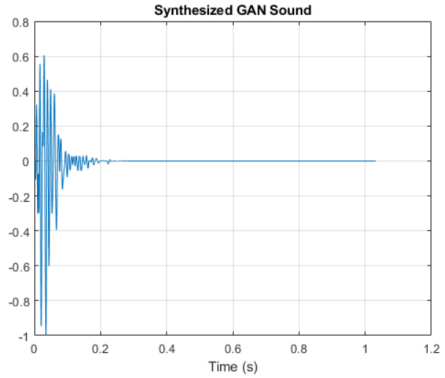
Creating/generating objects, text, signals, and art

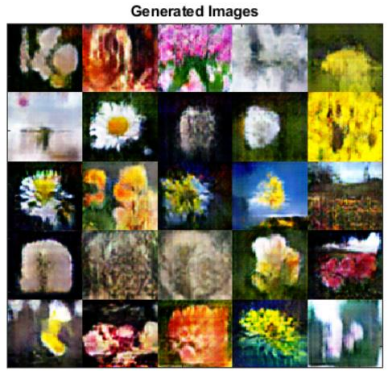
Generative Adversarial Networks (GANs) can be used to generate

- Signals (e.g. for music)
- Images (see “This X does not exist”)
- Text

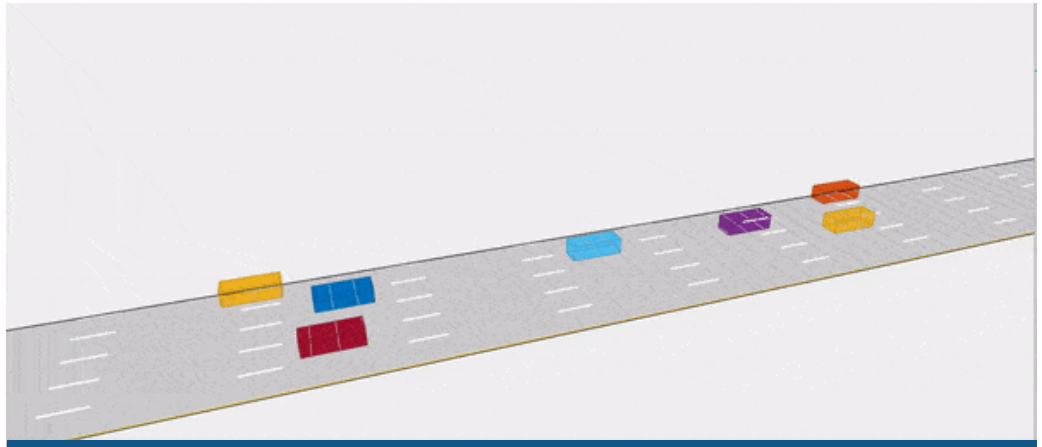
Convolution Neural Networks can be used to create

- Art

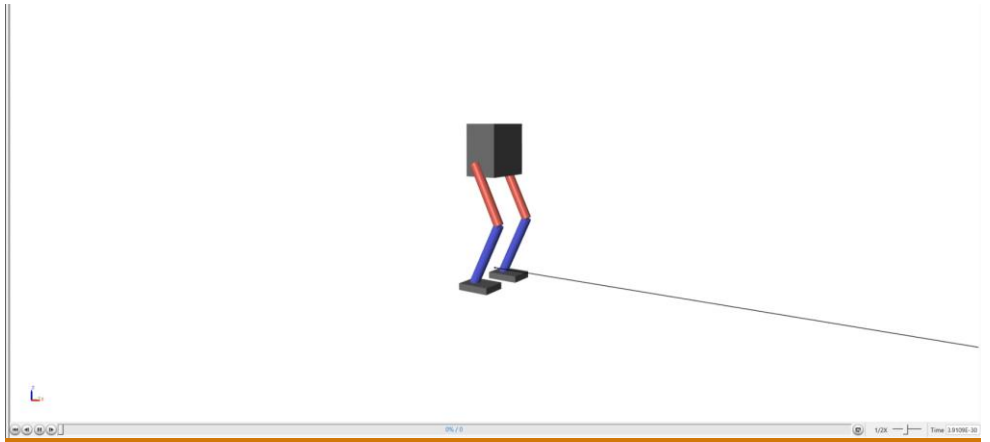




Applications of reinforcement learning



Teach a car to navigate traffic



Train a robot to walk

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MathWorks Engineering Support

Training

Consulting

Onsite Workshops and Seminars

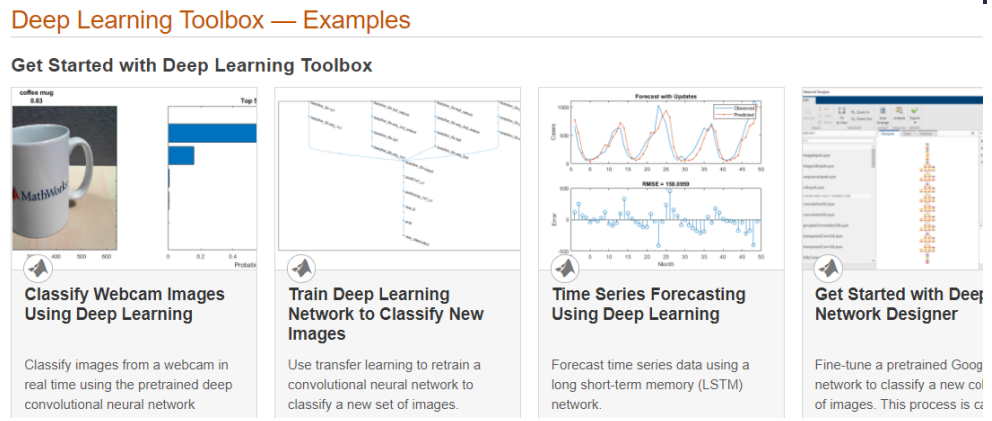
Guided Evaluations

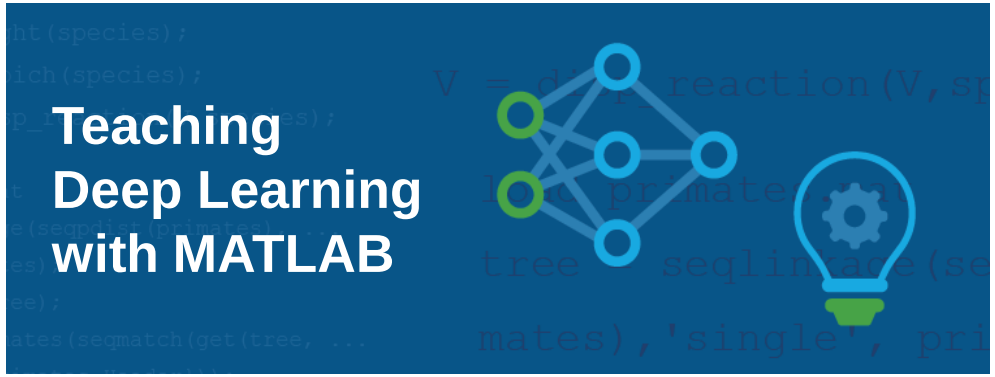
Technical Support

MathWorks

Further Learning and Teaching

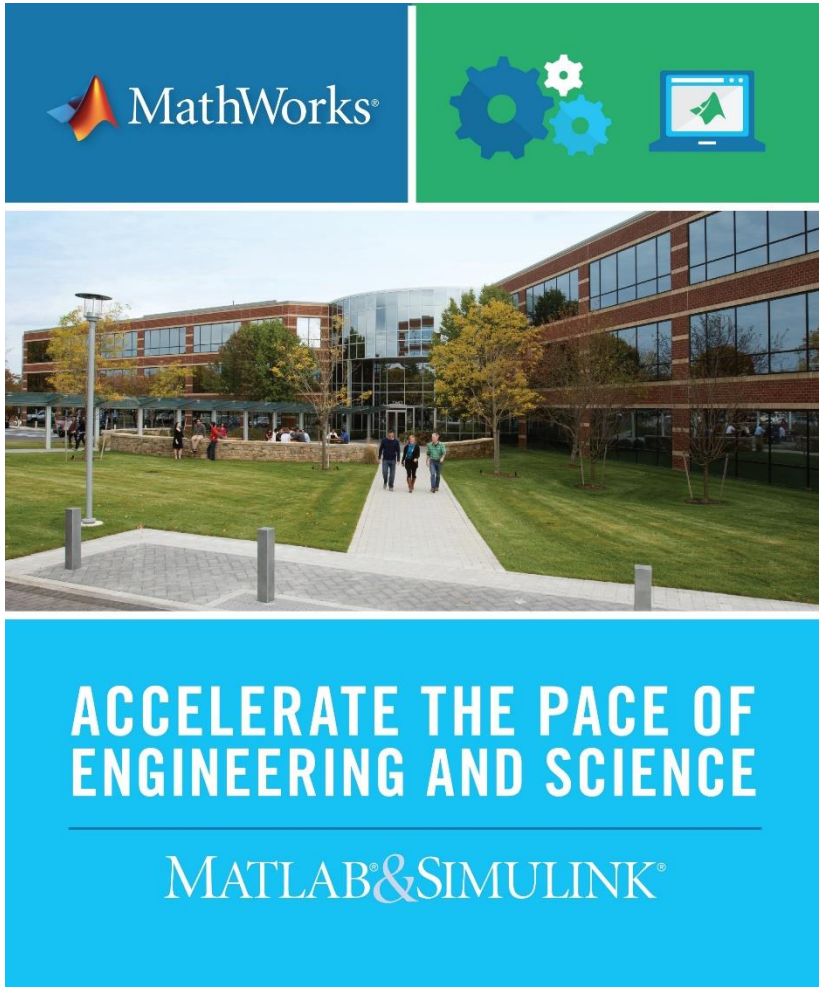
- Deep Learning Onramp
  - 2 hrs online tutorial
- Deep Learning Examples
  - Over 150 examples for different applications
- Teaching Deep Learning with MATLAB
  - Curriculum support





MathWorks

We are hiring



Around 300 open opportunities world wide:

- graduate program (EDG)
- product development
- application engineering & consulting
- training

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BOSTON TOP 10 EMPLOYER BRAND 2019 HIRED

Forbes: America's Best Employers for Women 2018

Forbes: America's Best Midsize Employers 2017

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https://www.mathworks.com/company/jobs/opportunities.html?s_tid=hp_ff_a_careers

THANK YOU

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