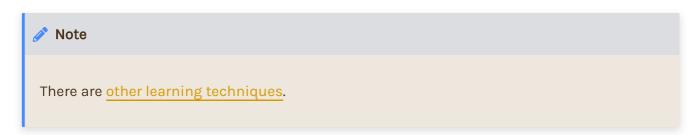
Introduction Contents of the course

```
#Supervised-learning [1]
#Unsupervised-learning [2]
#Reinforcement-learning [3]
```



Machine Learning

What is machine learning?

Machine learning is the study of computer #algorithms that improve automatically through experience. It is seen as a part of artificial intelligence.

55 Quote

Machine learning is the science of getting computers to act without being explicitly programmed.

A. Samuel

55 Quote

Machine learning is concerned with the automatic discovery of regularities in data through the use of computer #algorithms and with the use of these regularities to take actions.

Christopher M. Bishop

55 Quote

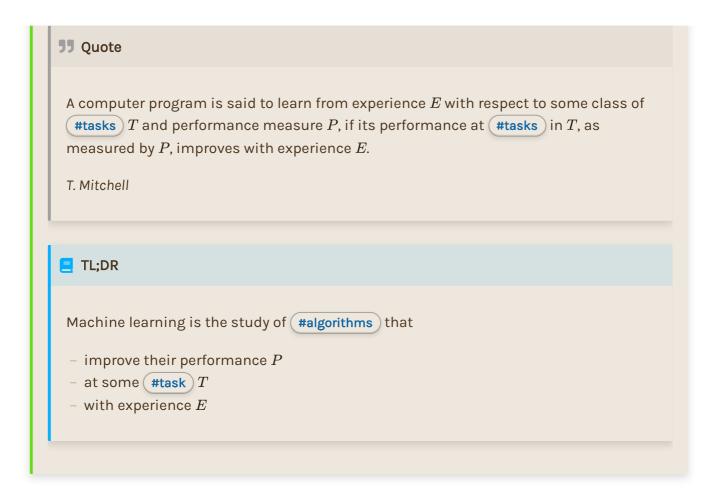
The goal of machine learning is to develop methods that can automatically detect patterns in data, and then to use the uncovered patterns to predict future data or other outcomes of interest.

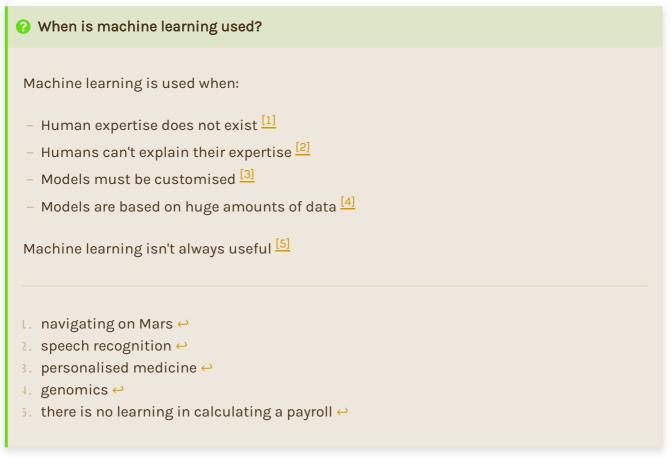
Kevin P. Murphy

55 Quote

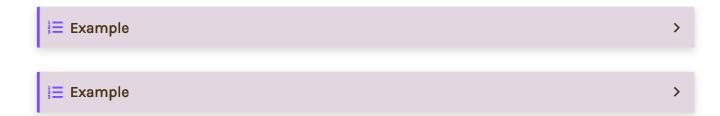
Machine learning is about predicting the future based on the past.

Hal Daume III

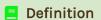




A well-defined learning $\mbox{\tt \#task}$ is given by a triplet < T, P, E >.



Artificial Intelligence



Programs with the ability to learn and reason like humans

55 Quote

Our ultimate objective is to make programs that learn from their experience as effectively as humans do.

John McCarthy

Deep Learning

Definition

Subset of machine learning in which artificial neural networks adapt and learn from vast amounts of data

99 Quote

Deep learning allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction

Nature [1]

1. www.nature.com/articles/nature14539 ↔

Deep learning means using a neural network with several layers of nodes between input and output. The series of layers between input and output compute relevant features automatically in a series of stages, just as our brains seem to.

Deep Learning Revolution - Why Now?

- Flood of available data
- Increased computational power
- Growing number of machine learning (#algorithms) and theory developed by researchers
- Increased support from the industry

The Learning Process

- Measuring devices
 - Sensors
 - Cameras
 - Databases
- #Preprocessing
 - Noise filtering
 - #Feature-extraction
 - #Normalisation
- #Dimensionality-reduction
 - (#Feature-selection
 - (#Feature-projection
- Model learning
 - #Classification
 - #Regression
 - #Clustering
 - Description
- Model testing loop
 - #Cross-validation
 - #Bootstrapping
- Analysis results

Data, features, and models

Every item in the dataset is turned into a vector in some way. We then choose the **#features** of these items which are also represented with vectors and could be thought of as the questions we can ask about the different items in the dataset.

Example

We could represent an apple with the features [red, round, leaf, 85g] and a banana with the features [yellow, curved, no leaf, 120g]. We would then choose which of these features should hold the most weight in our model.

Training and test data, generalisation

i Idea

Training data and test set should belong to the same "data distribution"

More technically, using a probabilistic model of learning, there is some probability distribution over example/label pairs called the "data generating distribution". Both the training data and the test set are generated based on this distribution

Example

If a large amount of our training set contains red apples, then a proportionally large amount of our test set [1] should contain red apples.

- L. depending on the size of the training and test sets ←
- 1. Lazy vs. Eager Learning ←
- 2. Unsupervised Learning ←
- 3. Reinforcement Learning ↔