Machine Learning:

## Welcome

-Grew out of work in AI

-New capability for computers

Examples:

-Database mining

Large datasets from growth of automation web.

E.g., Web click data, medical records, biology, engineering

-Applications can’t be programmed by hand.

E.g., Autonomous Helicopters, handwriting recognition, most of NLP, Computer Vision.

-Self-customizing programs

E.g., Amazon, Netflix product recommendations.

Understanding human learning (brain, real AI).

Machine Learning:

# What is Machine Learning

Two definitions of Machine Learning are offered.

Arthur Samuel (1959) Machine Learning: Field of study that gives computer program the ability to learn without being explicitly programmed.

Tom Mitchell (1998) Well-posed Learning Problem: A computer program is said to learn from experience E with respect to some task T and some performance measure P, if its performance on T, as measured by P, improves with experience E.

Machine Learning Algorithms:

-Supervised learning

-Unsupervised learning

Others: Reinforcement learning, recommender systems.

Also talk about: Practical advice for applying learning algorithms.

Introduction:

## Supervised Learning

“Right Answers” are given for experience.

REGRESSION: Predict continuous valued output. (A Continuous Function)

CLASSIFICATION: Discrete valued output. (Absolute Answers)

Supervised learning problems are categorized into "regression" and "classification" problems. In a regression problem, we are trying to predict results within a continuous output, meaning that we are trying to map input variables to some continuous function. In a classification problem, we are instead trying to predict results in a discrete output. In other words, we are trying to map input variables into discrete categories.

**Example 1:**

Given data about the size of houses on the real estate market, try to predict their price. Price as a function of size is a continuous output, so this is a regression problem.

We could turn this example into a classification problem by instead making our output about whether the house "sells for more or less than the asking price." Here we are classifying the houses based on price into two discrete categories.

**Example 2**:

(a) Regression - Given a picture of a person, we have to predict their age on the basis of the given picture

(b) Classification - Given a patient with a tumour, we have to predict whether the tumour is malignant or benign.

Introduction:

## Unsupervised Learning

We are provided with “unlabelled data”.

E.g. Clustering algorithms {(e.g., Google News Labels, DNA Grouping), Social Network Analysis, Market Segmentation, Astronomical data analysis}, Cocktail Party Algorithm,

Octave / MATLAB [Environment]

[W, s, v] = svd((repmat(sum(x.\*x,1), size(x,1),1). \*x) \*x’); (Cocktail Party Algorithm)

Unsupervised learning allows us to approach problems with little or no idea what our results should look like. We can derive structure from data where we don't necessarily know the effect of the variables.

We can derive this structure by clustering the data based on relationships among the variables in the data.

With unsupervised learning there is no feedback based on the prediction results.

**Example:**

Clustering: Take a collection of 1,000,000 different genes, and find a way to automatically group these genes into groups that are somehow similar or related by different variables, such as lifespan, location, roles, and so on.

Non-clustering: The "Cocktail Party Algorithm", allows you to find structure in a chaotic environment. (i.e. identifying individual voices and music from a mesh of sounds at a [cocktail party](https://en.wikipedia.org/wiki/Cocktail_party_effect)).