Machine Learning

Index

- Machine Learning
  - Introduction
  - Different definitions
- Machine Learning Algorithms
  - Supervised Learning
  - Unsupervised Learning
  - Semi-supervised Learning
  - Reinforcement Learning

Fascinating world of Machine Learning

- Natural Language Processing : Translation (google Translate GNMT)
  - (2006 Statistical Machine translation, 2016 Neural Machine translation)
- Speech Recognition
- Speech to Text Conversion
- Text to Speech Conversion
- Smart Assistants (Virtual Personal Assistant)
- Spam filters
- Computer Vision :
  - Hand writing recognition
  - Biometrics
  - Gesture
  - Emotions

Fascinating world of Machine Learning

- Data Analytics
- Traffic Alerts : Google Map
- Transportation : Uber, Ola
- Web Searching
- Chatbots
- Recommender Systems
- Self driving vehicles
  https://www.youtube.com/watch?v=VCdxqn0fcnE

Fascinating world of Machine Learning

- Intelligent Homes /smart Homes
- Health Care
  - Elderly Care
  - Drug Discovery
- Dynamic Pricing
  - Flights, Cabs
- Data base Mining
- Fraud detection (On line transactions)
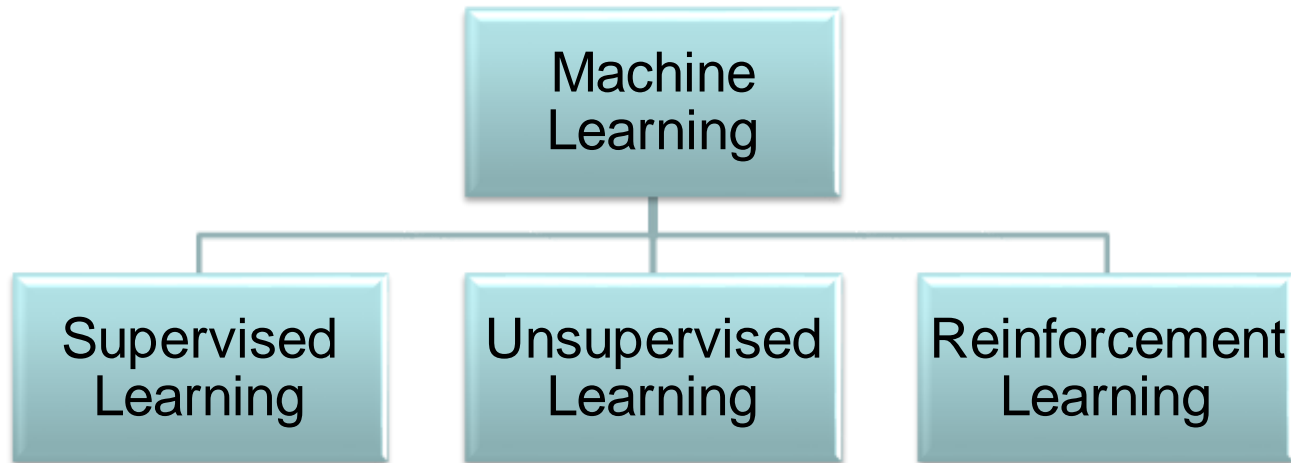
What is Machine Learning

- Older definition in late fifties offered by Arthur Saumel: He described it as: "The field of study that gives computers the ability to learn without being explicitly programmed." This is an older, informal definition.

- Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

- **Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.**

- Tom Mitchell provides a more modern definition: "A computer program is **said to** learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E."

- A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E."

- Example: Playing Tic Tac Toe/Chess

  E = the experience of playing many games of Tic tac toe

- T = the task of playing game of tic tac toe

- P = the probability that the program will win the next game.

- Any machine learning problem can be assigned to one of three broad categories

-

```
                    ┌──────────────┐
                    │   Machine    │
                    │   Learning   │
                    └──────────────┘
            ┌──────────────┼──────────────┐
    ┌──────────────┐ ┌──────────────┐ ┌──────────────┐
    │  Supervised  │ │ Unsupervised │ │Reinforcement │
    │   Learning   │ │   Learning   │ │   Learning   │
    └──────────────┘ └──────────────┘ └──────────────┘
```
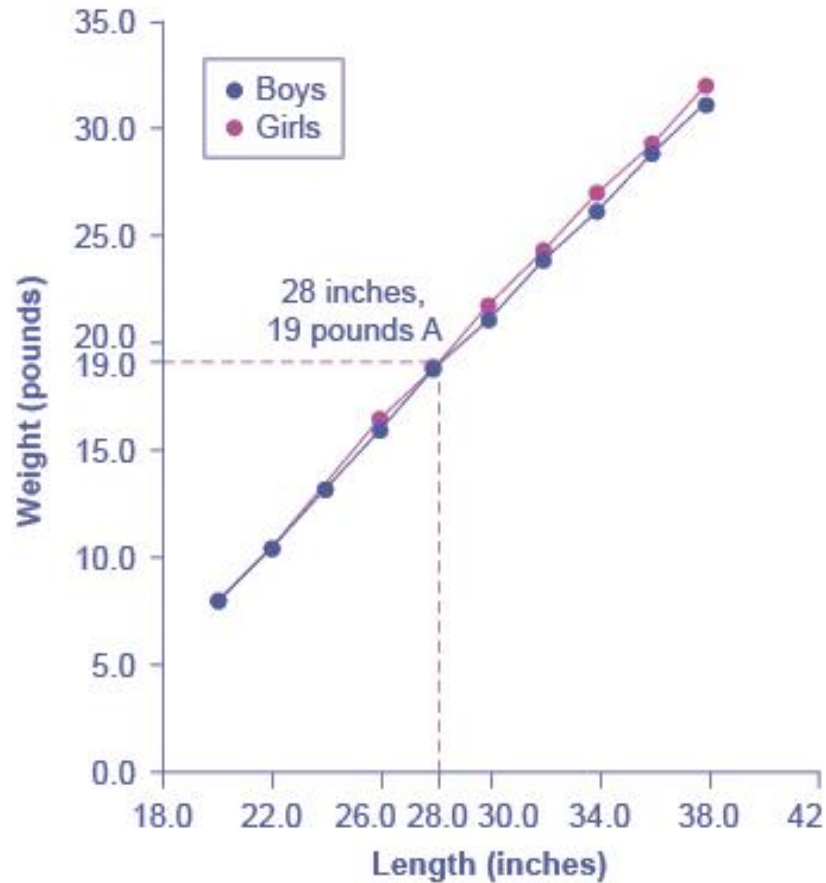
Supervised Learning

- Before formal definition let us few examples::
- Collect data of height and weight of your class mates and tabulate it
- Plot the points on graph paper ; pairs (h,w): height on horizontal axis and weight on vertical axis

Roll No	Height in inches	Weight in pounds
1	63	150
2	….	…
3	….	….

Regression
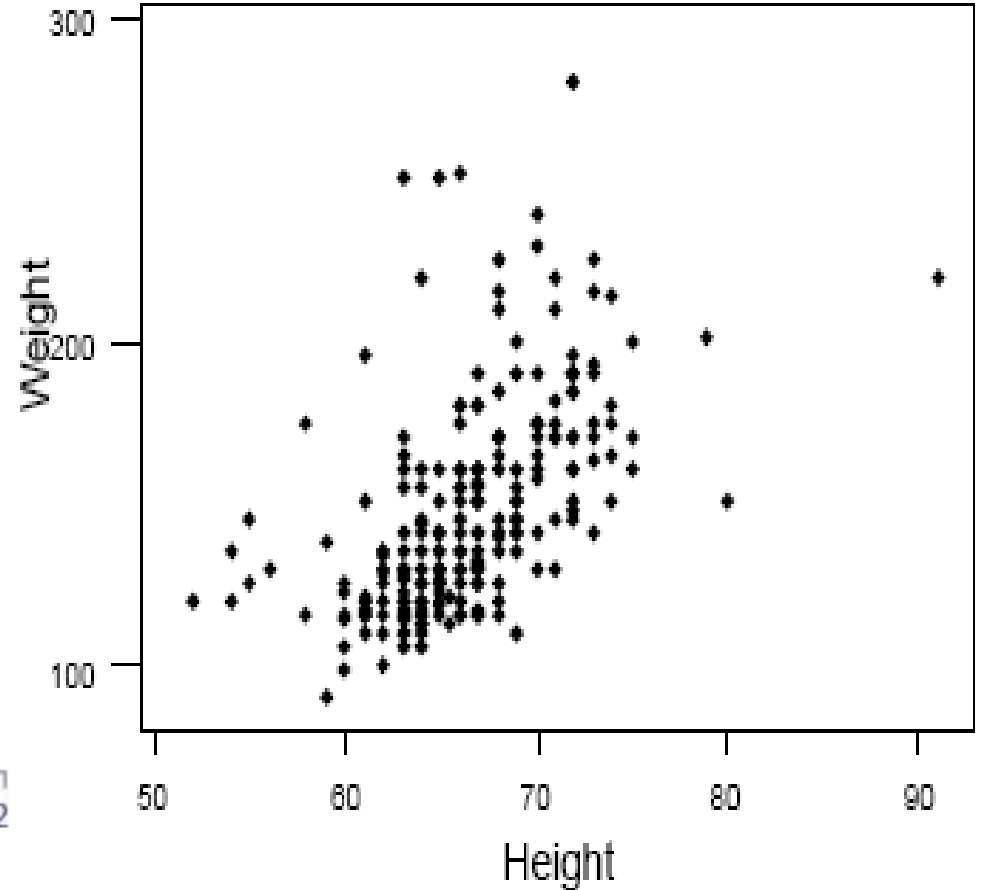
Classification

Binary outcome 0 or 1
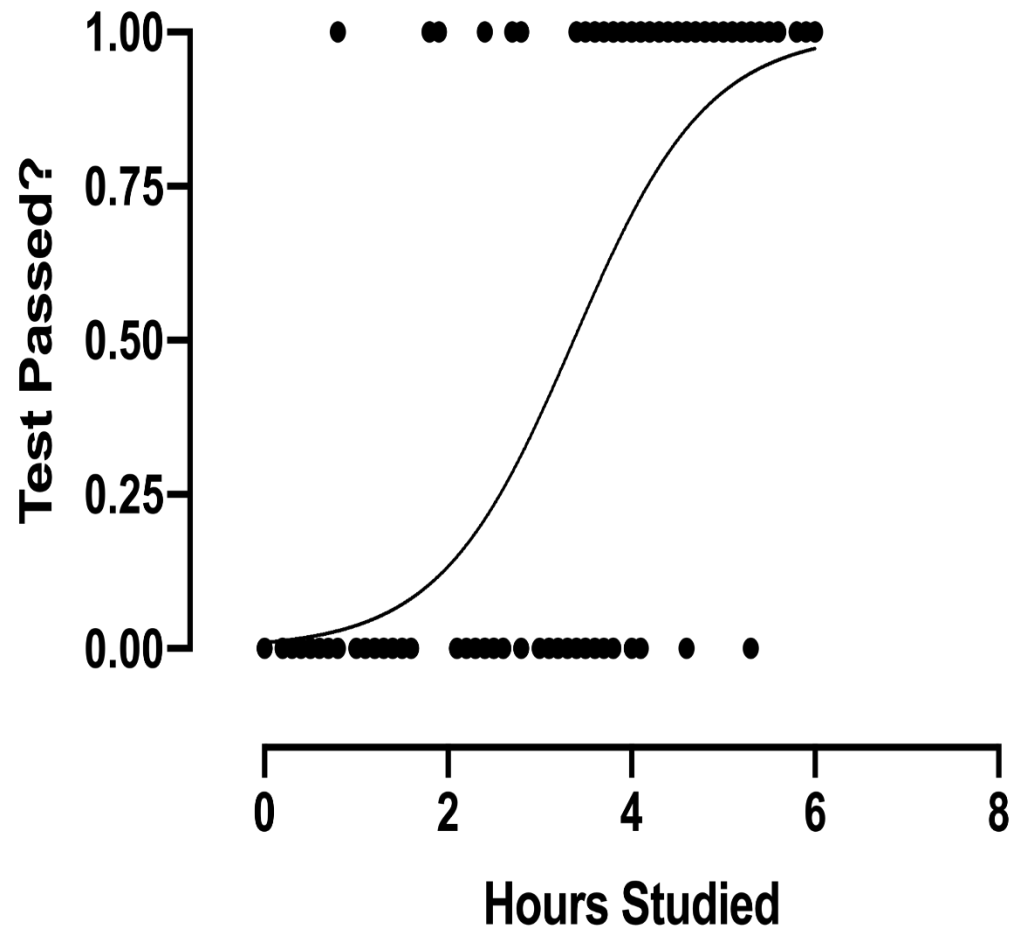
1 means passes the test

0 means fails the test

Outcome is a categorical variable : Here passes or not passes; coded as 1 and 0
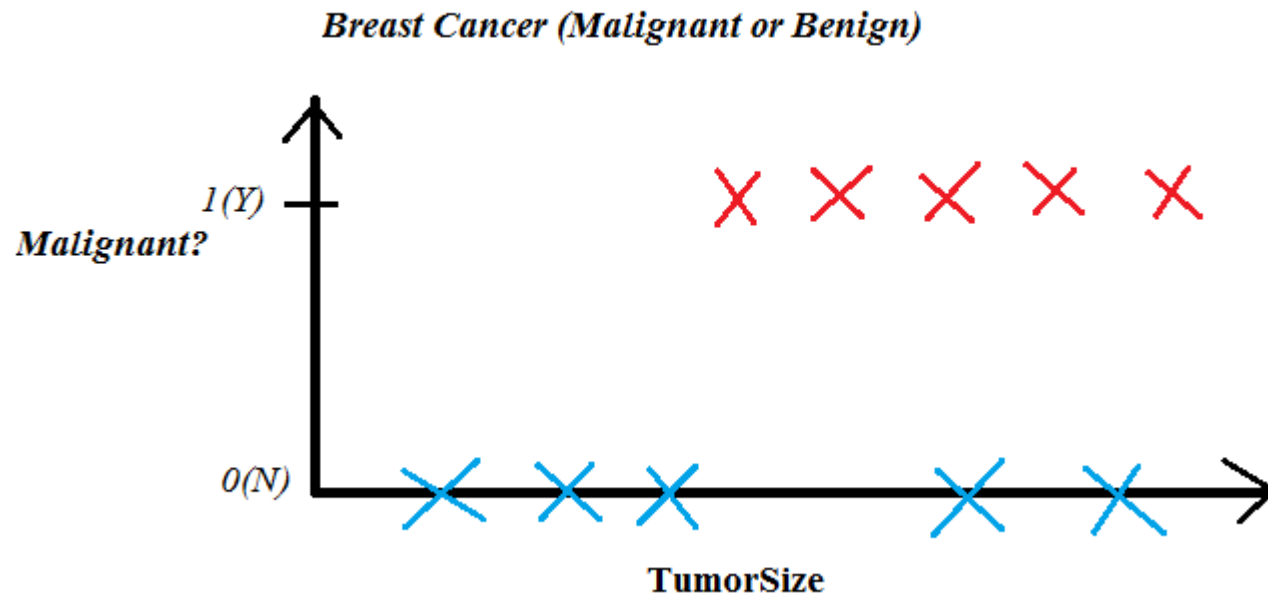
Discrete valued outcome

There can be more than two outcomes, like fails, passes, second class, first class… coded as discrete outcomes 0,1,2,3

Classification

- Wingshore.wordpress.com

Breast Cancer (Malignant or Benign)
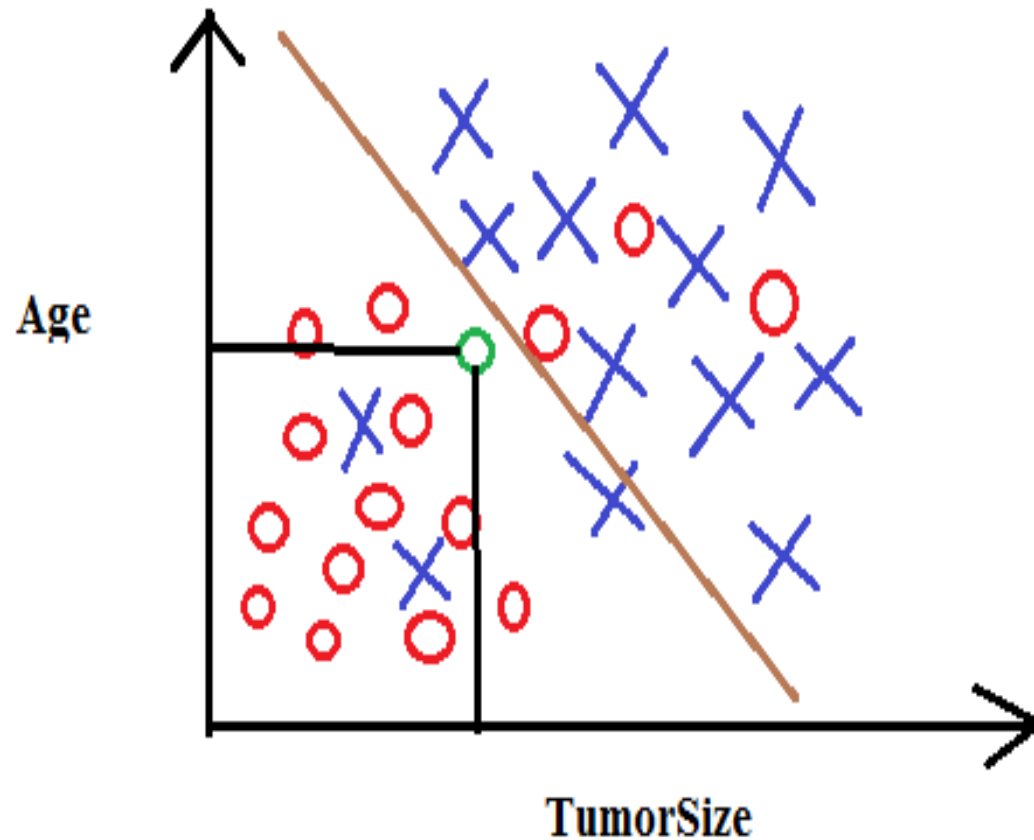

1(Y) — Malignant?

0(N)

TumorSize

Classification

- Age on y axis, Tumour size on x axis, Red circles represent benign tumours, blue crosses denote malignant tumours, what is the prediction for green circle?
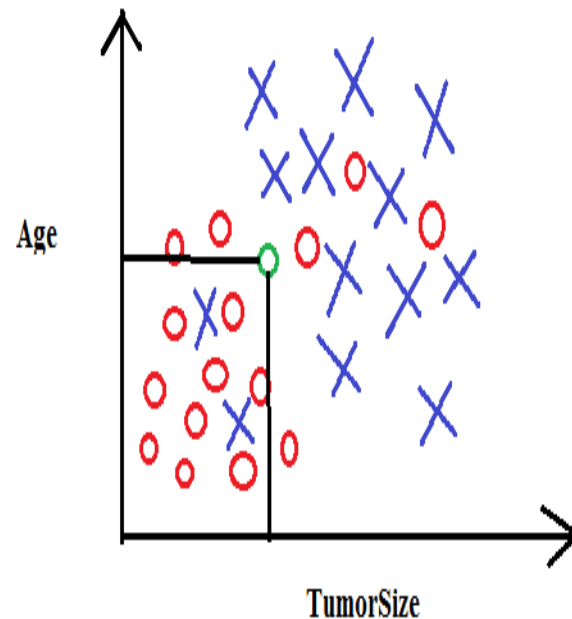
Classification…..

Supervised Learning

Supervised Learning is a concept of Machine Learning, wherein the preconceived data sets are labeled.

The data sets consists of a set of the training examples. So, it comprises of the input(data sets or vector) and the output(supervisory signal), which goes hand in hand.

Supervised Learning is the concept of Machine Learning, which is handled by predetermined set of training examples(features) to predict the future output values for the same patterned approach.

Supervised Learning

- A mathematical model based on sample data, known as **training data**, in order to make **predictions** without being explicitly programmed to do so.

- This training dataset should contain many examples of inputs and outputs from which learning will take place

- One has idea that relationship between input variable and output variable exists

Supervised Learning → Regression

Supervised Learning → Classification
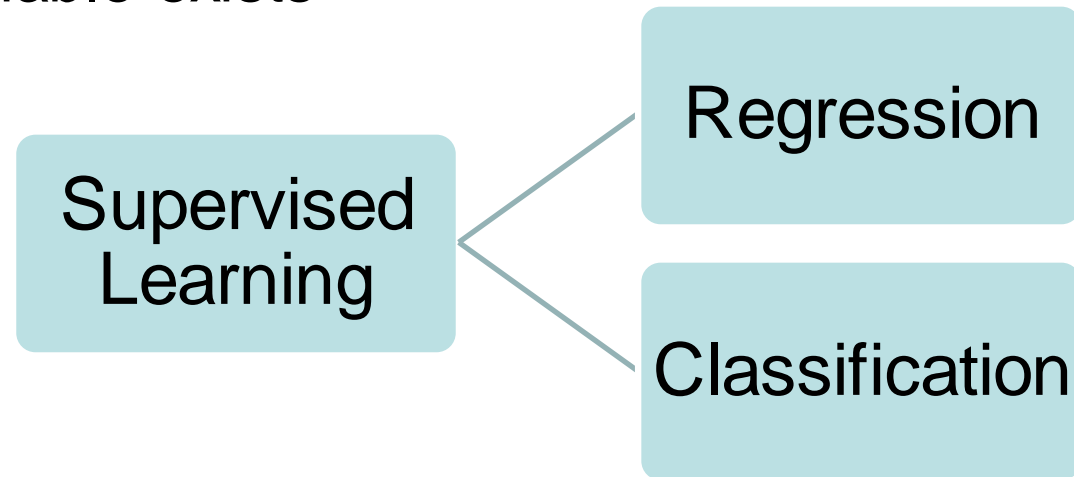
Regression

- **Output is a continuous function of input variable, output variable takes continuous values**

- **Input variable is being tried to map to continuous output**

- **Examples**:

- Given training set of height weight pairs, (h,w); to predict weight for a person given his height

- Input need not be continuous, given training set of picture and weight pairs of persons, (picture, weight), to predict weight given a particular person picture.

- Given the demand and sales data, to predict sales of next year

Quiz time:Check the learning

- Which of the following are regression tasks?

(Appropriate Labeled data available)

1. Predicting price of house given its size
2. Predicting whether house can be sold above 10 million Rs?
3. Predicting nationality of person
4. Predicting age of person from photograph
5. Predicting amount of rainfall tomorrow
6. Predicting whether it is going to rain heavily tomorrow?
7. Given a tumour size , weather it is benign or malignant?

Classification

- **Output is a discrete function of input variable, output variable takes discrete values**

- **Input variable is being tried to map to discrete output**

- **Examples**:

- Given 60 articles written by males and 60 articles authored by females, training set of article gender pairs, to predict gender of author for a particular article

- To categorize applications for education loan , in approved loans and not approved loans

- To use weather prediction algothirm to know weather I need to take umbrella before leaving for university from home

Quiz…

- **Which of the following is/are classification problem(s)?**
- Predicting the gender of a person by his/her handwriting style
- Predicting house price based on area of the house in a locality
- Predicting whether monsoon will be normal in this coming season
- Predict the number of movies which shall be downloaded next month on netflix
- Predicting weather client account is hacked or compromised

Terminologies and facts

- **Input Variables are called features**
- There can be more than one input variables, infact in real life there are plenty…
- To deal with large number of features , practically infinite : SVM is used
- Tumour size and age example : 2 features

Unsupervised Learning

wingshore.wordpress. com

Cocktail Party

- Two speakers speak simultaneously

- Overlapping voices can be separated in structured forms

- Individual voices will be separated

- Uses Singular Value Decomposition (Linear Algebra, matrices, eigen values) one line code

Cocktail party problem

Speaker #1

Microphone #1
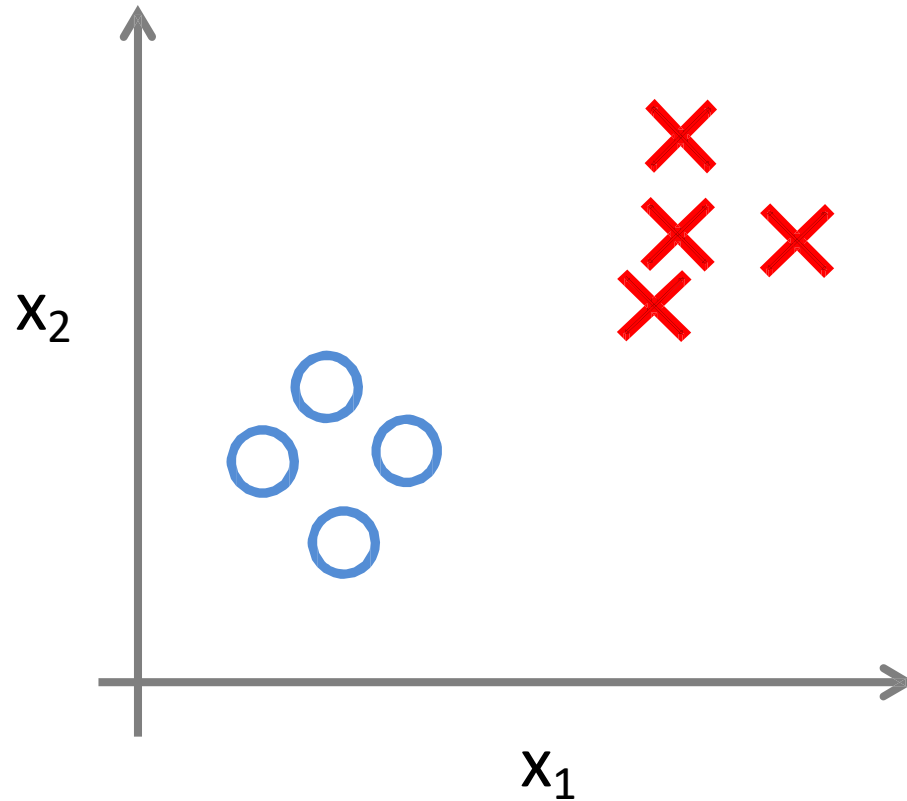
Speaker #2

Microphone #2
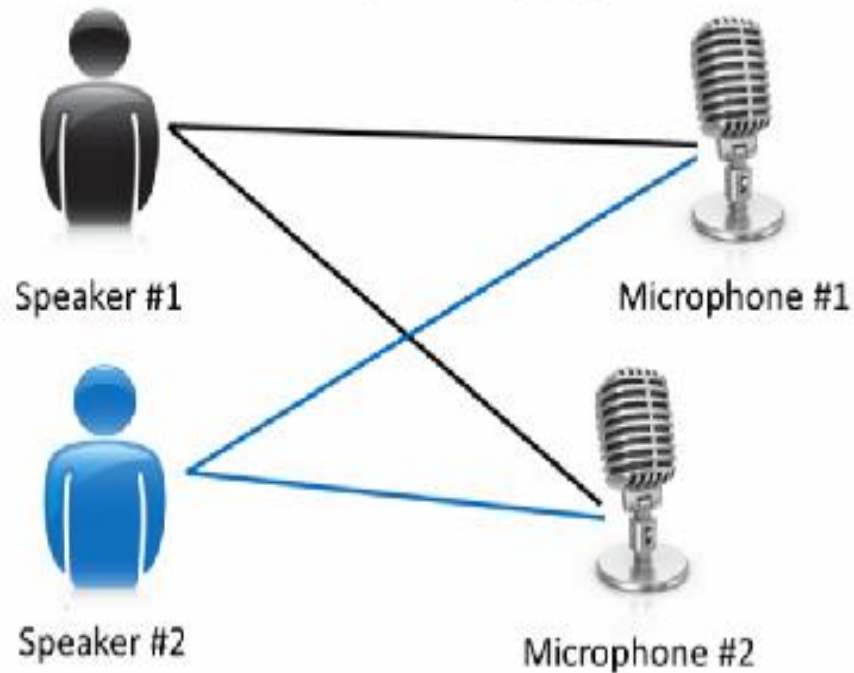
Unsupervised Learning

- Data set is not labelled or every data item has the same label

- we find a structure or pattern for the problem set without labeling the data set.

- we don't know what exactly the data is labeled for, we tend to find the pattern and not the right or wrong answer about the problem.
- There is no potential signal for error and correctness of the solution of the problem.
- We derive this structure by clustering the data based on relationships among the variables in the data.
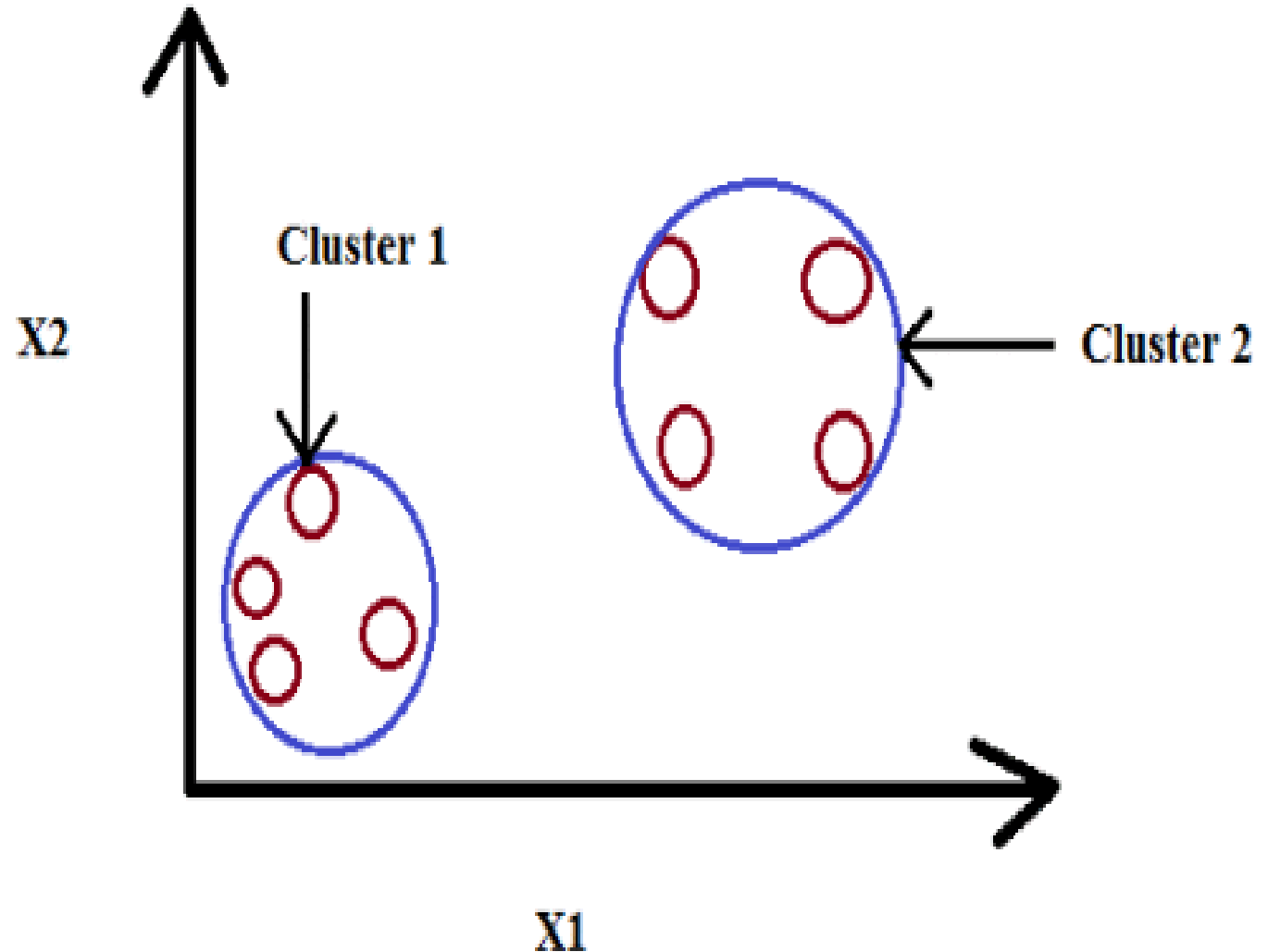
Unsupervised Learning Examples

- Grouping people in social networking
- Anamoly detection in patterns (Fraud detection in credit card transactions)
- Data mining (Frequent Data patterns , Association rule mining ….)
- Reducing the number of features in data set
- Auto pilot helicopter
- Galaxy formation

Supervised Learning

Unsupervised Learning

Regression