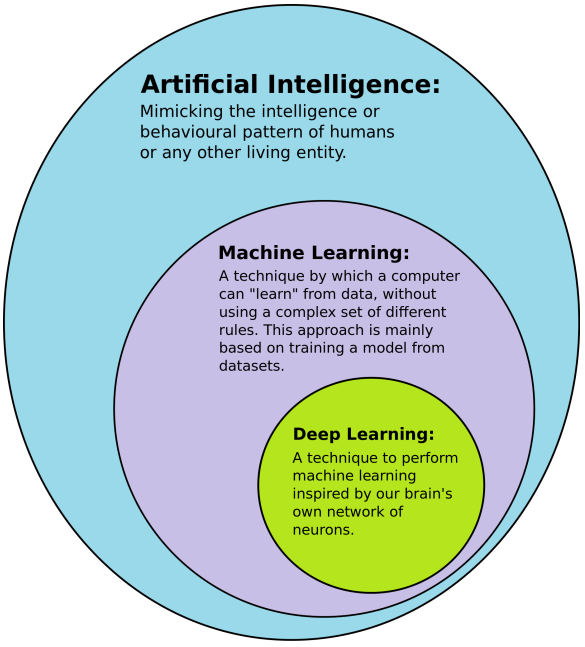
Session1_03112023

Agenda:

Introduction to ML and getting familiar with different learning methods and understanding the fundamentals of Signal Processing

Machine Learning

Artificial Intelligence, Machine Learning and Deep Learning are interrelated with each other.Some real world examples where machine learning is used were discussed.



Difference between Machine learning and general programming:

In conventional programming, a program is available and for the given inputs the program gives an output. In machine learning, inputs and outputs are given, the model should devise the program (or a relation) for the given data so that for any similar input it'll give an output based on the pattern/relation it observed in the data.

Classification of algorithms

In a broad perspective, machine learning algorithms can be classified into

1. Supervised learning
    a. The dataset is labelled i.e each entry in the dataset has a label or output associated with it
2. Unsupervised learning
    a. Data is not labelled; need to identify the pattern in the data cluster them
3. Reinforcement learning
    a. Reward based learning algorithm

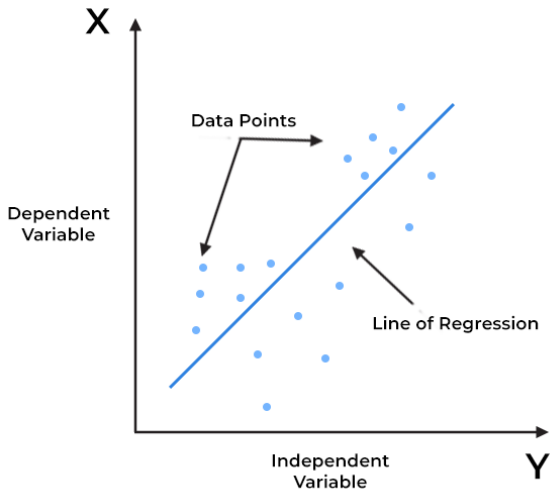
Supervised learning:

There are various supervised learning algorithms of which ‘Linear Regression’ and ‘Logistic Regression’ were seen (a general overview of what these algorithms are and how they work).

1.Linear Regression

Linear regression is a method that finds a linear equation that best describes the correlation of the explanatory variables with the dependent variable. This is achieved by fitting a line to the data using least squares.

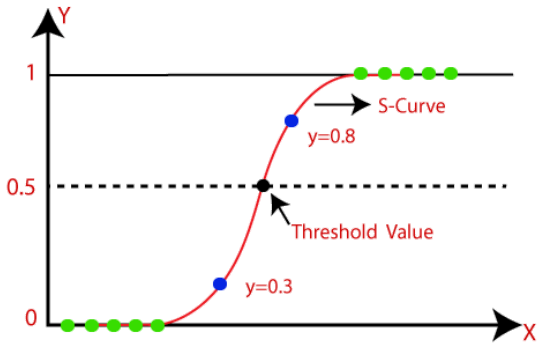
The well known example of ‘House Price Prediction’ was discussed.



After finding a better fitting line (line of regression), the model can now predict the output for any given input using it.

2.Logistic Regression

Logistic Regression is used to predict a binary outcome such as yes or no based on the observation from the dataset. It uses a Sigmoid curve to make the predictions.



A threshold point is set (0.5) and any value above it will be classified as 1 (or class 1) and any value below it will be classified as 0 (or class 2).

Training and testing split:

For any machine learning problem, the dataset will be split into train data, validation data and test data to check on the performance of the model. Majority of the data will be given for training and once the model learns from the data it'll be validated using the validation data and tested using test data (unknown data to the model). Based on the performance on validation data, a model can be fine tuned to provide better results during testing.

Signal Processing

Anything that carries information can be called as a signal. They can be images, audio, video etc.

Relation between signal processing and machine learning:

Signal processing deals with the analysis and manipulation of signals, which can be in various forms, such as audio signals, images, or time-series data. They can be

used to extract meaningful features from raw data. These features can then be fed into machine learning algorithms for classification, regression, or other tasks.

Data plays an important role in machine learning. Appropriate signal processing techniques can help us get a suitable data ready.

Single tone and Composite tone signal:
Signal with one frequency component is known as single tone signal and signal with multiple frequency components is known as composite tone signal.

Nyquist rate:

The theorem states that the sampling frequency must be at least greater than or equal to twice the maximum frequency of the signal i.e **fsamp ≥ 2fmax.** This makes sure that there are enough number of samples to represent a signal.

MATLAB Hands on session

Topics covered:

1. Generating single tone and composite tone signals
2. Plotting of signals
3. Introduction to Fourier Transform