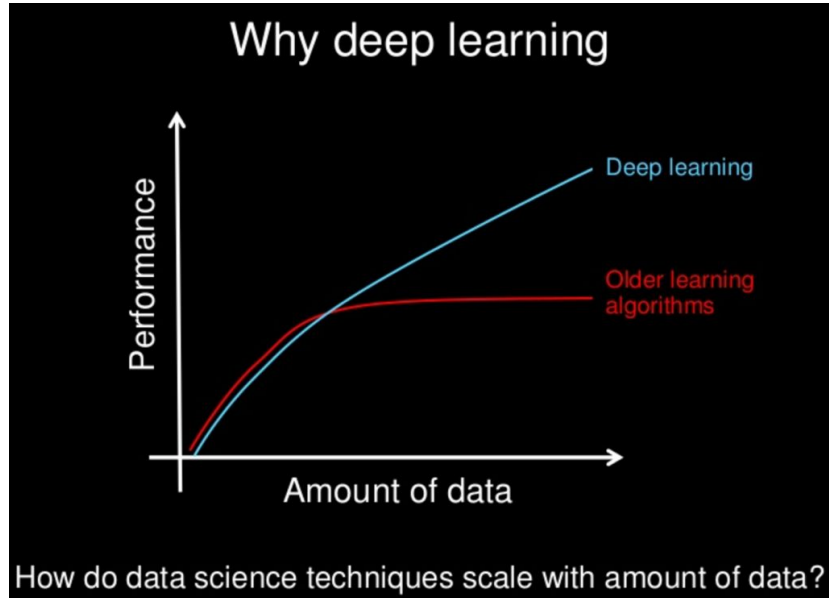# Deep Learning and Neural Networks

-An introduction to Neural Network Fundamentals
**-Dikscha Sapra**

Why Deep Learning?

- ❖ With increase in data, there is increase in the performance of the algorithm.
- ❖ The same is not true for other Machine learning algorithms, as they reach a plateau after a certain amount of data is provided
- ❖ Deep Learning is not a new technique, it has been around for decades, but it has only gained popularity in the last 15 years
- ❖ **Reason Being- Enormous increase in availability of data.**

Brain Neurons

In brain neurons, signal is transmitted from one neuron to another till it reaches the nerve endings.
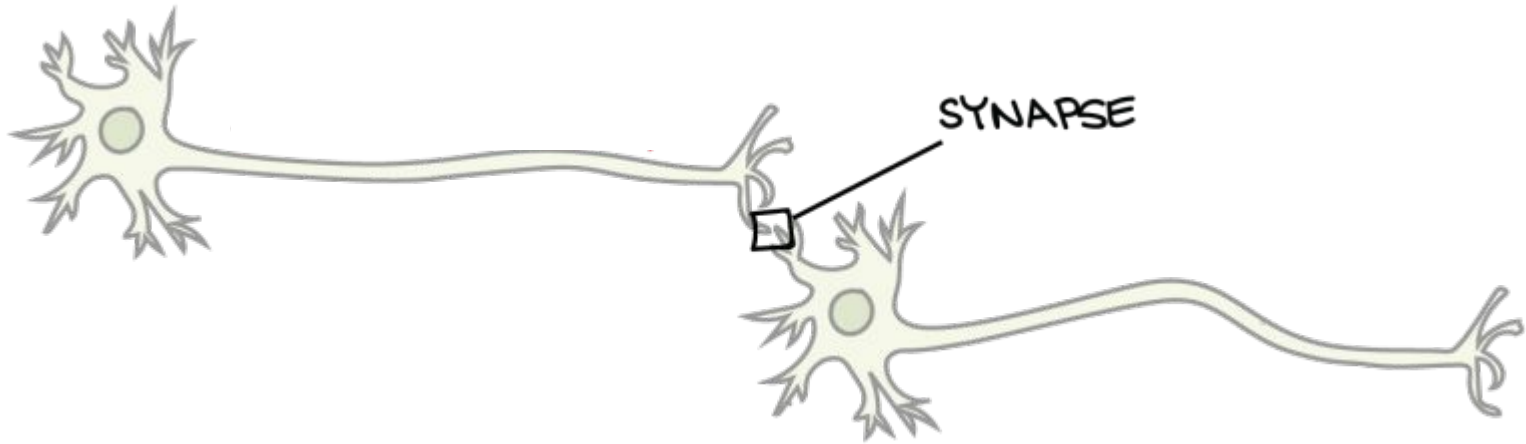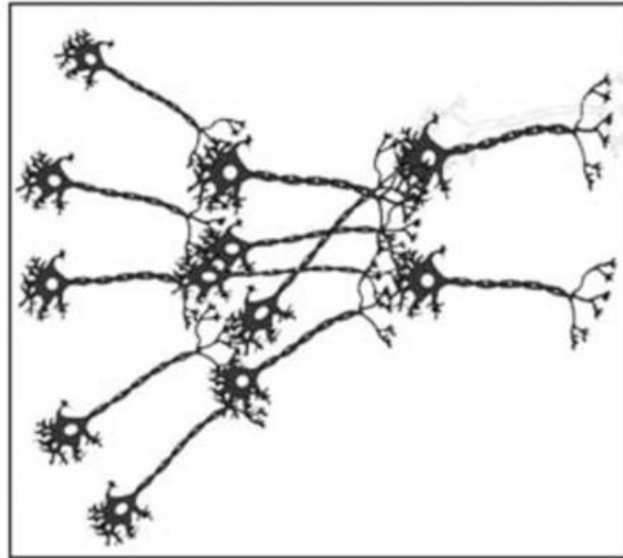

SYNAPSE

SYNAPSE: The transfer of electric signal between two neurons

Neural Networks

As the name suggests, Neural networks (also called as Artificial Neural Networks ANN) are inspired by the neurons in the human brain.
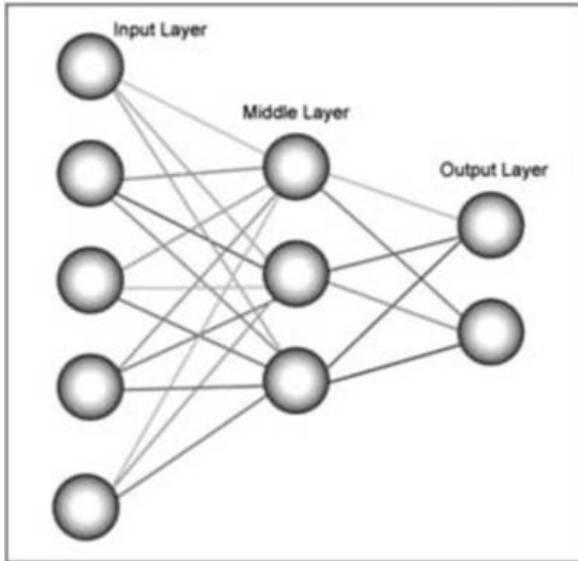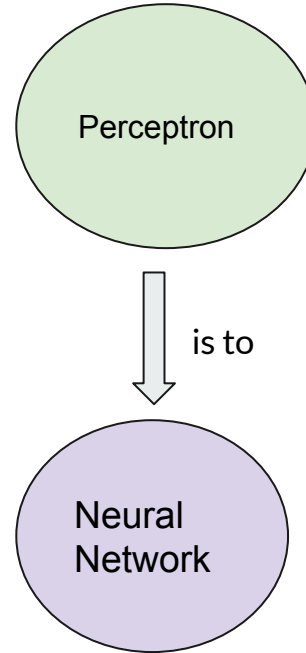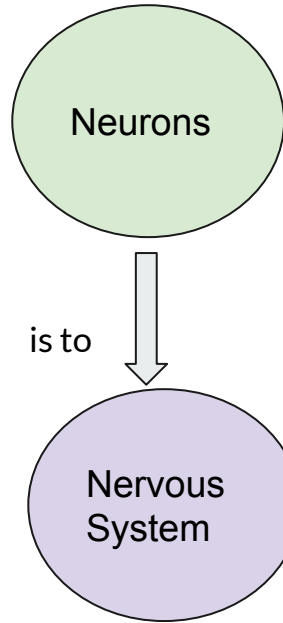

Neural Networks

Brain Nervous System

Neural Networks

Neurons → is to → Nervous System

Perceptron → is to → Neural Network

Perceptron- Single Layer Perceptron

❖ Before we begin talking about Perceptron, let us look at a general dataset
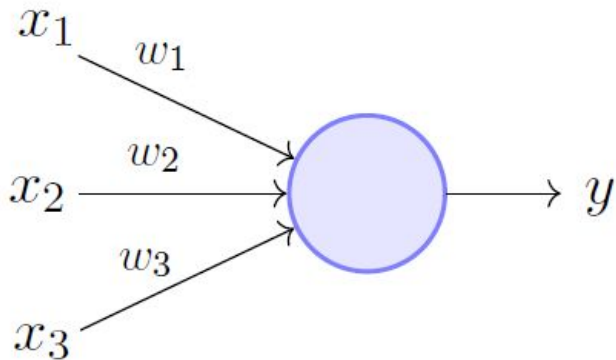
Independent variables

Dependent variable

	CodeNum	CTHick	CellSize	CellShape	MarAd	EpiCells	BareNuc	BLChr	NormNuc	Mito	CI
1	61634.00	5	4	3	1	2	4	2	3	1	2
2	63375.00	9	1	2	6	4	10	7	7	2	4
3	76389.00	10	4	7	2	2	8	6	1	1	4
4	95719.00	6	10	10	10	8	10	7	10	7	4
5	128059.0	1	1	1	1	2	5	5	1	1	2
6	142932.0	7	6	10	5	3	10	9	10	2	4

x_1 x_2 x_3 x_4 x_5 x_6 x_7 x_8 x_9 x_{10} Y

X

Perceptron-Single Layer Perceptron

Like a single unit in Neural Network is called Neuron, the single most basic unit in Artificial neural network is called Perceptron.

❖ The various features of our dataset (independent values) are given as input $x_1, x_2, x_3, ... x_n$.
❖ Each input feature is given a weight to determine how important it is.
❖ Perceptron makes a decision y (dependent variable) on the basis of an activation function.

Multi Layer Perceptron

When a perceptron that teams up with additional perceptrons, stacked in several layers, to solve complex problems.
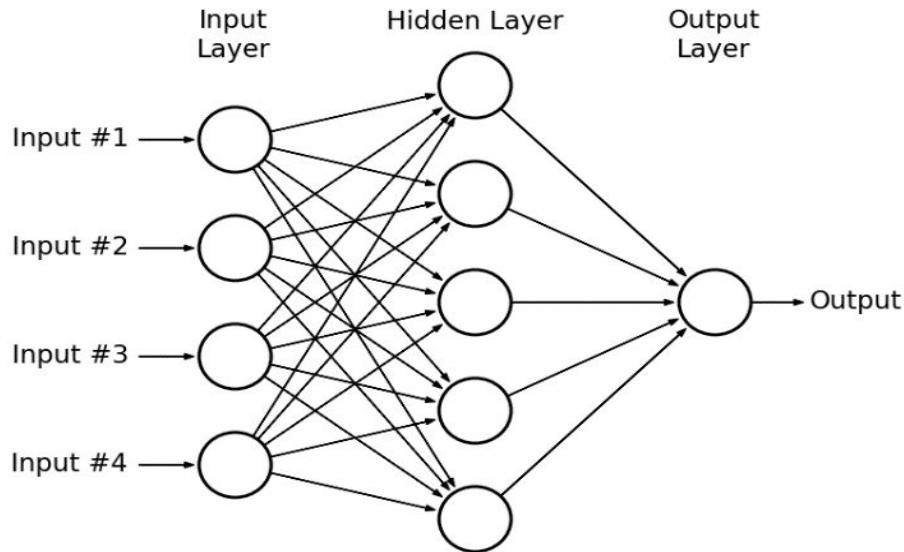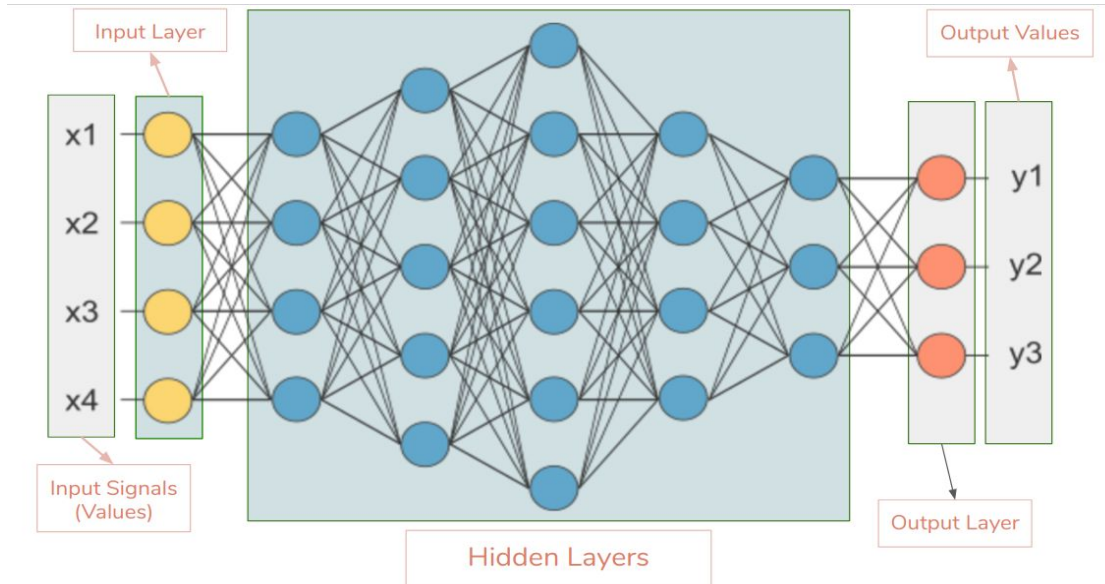

In this example, we have three layers-
- ❖ **Input layer**
- ❖ **Hidden Layer**
- ❖ **Output Layer**
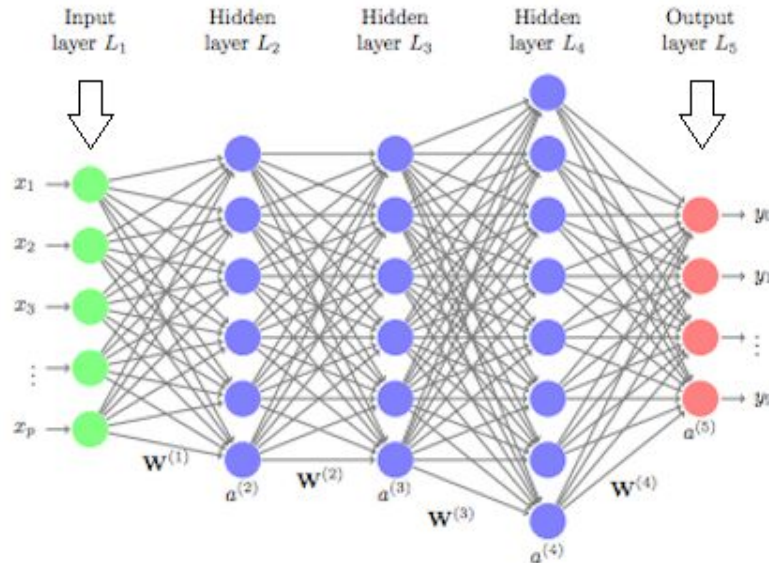
What are Hidden Layers?

Hidden layers constitute of all the layers in a Neural Network other than the input and the output layer - Hence the word hidden.

❖ Hidden layers act like a black box - the internal mechanism is hidden.

❖ Each layer contributes to the final output layer by applying some mathematical transformations

When is a Neural Network Called Deep?

Whenever there are more than 3 layers (Input, Hidden, Output) in a Neural Network, we call it a deep Neural network.
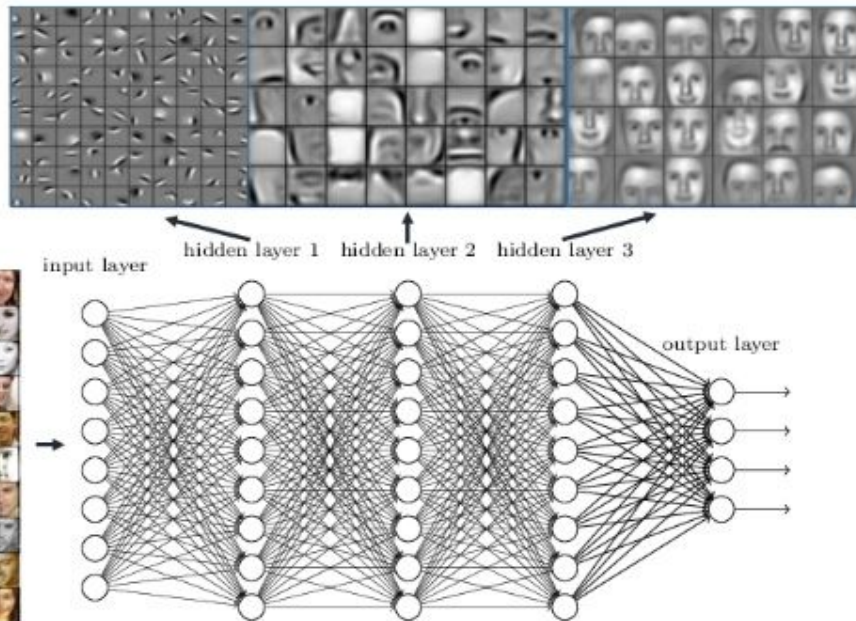

❖ Each hidden layer has a certain meaning for the final classification.
❖ Each layer helps in classifying, a certain aspect of the final output layer

What do hidden layers do?

Face recognition

Deep neural networks learn hierarchical feature representations
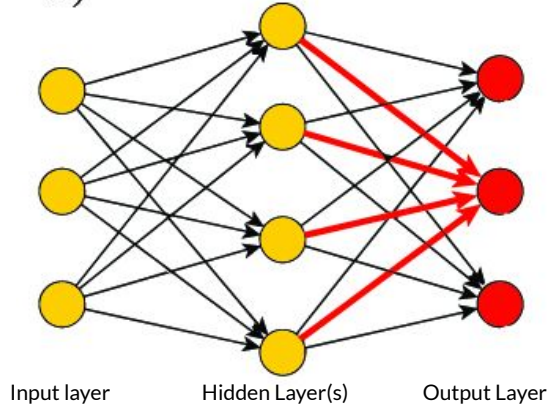
Let us consider a facial recognition Neural Network

- ❖ The initial layers start small - They identify edges
- ❖ The middle layer start to identify objects - like eyes, nose, ears etc.
- ❖ The final layers start to identify the final images and hence recognise the entire face.

Forward and Backward Propagation
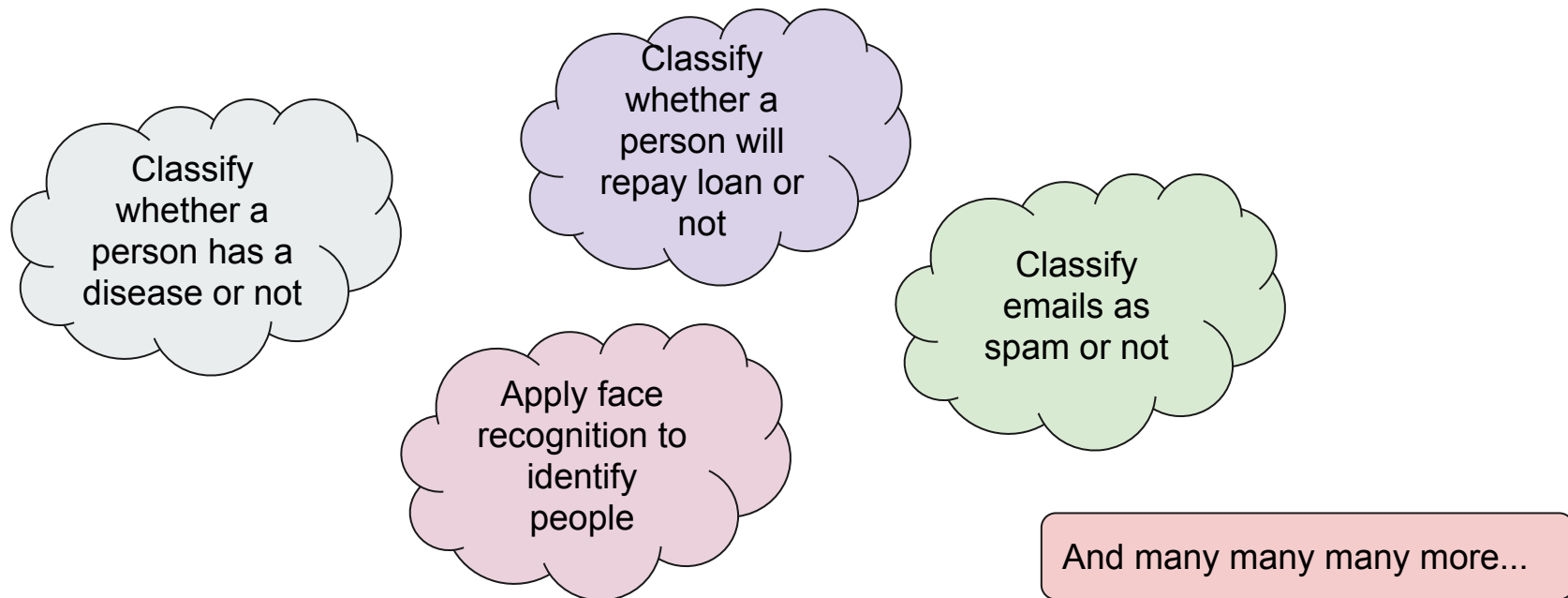

a) Forward Propagation

b) Backward Propagation

Input layer   Hidden Layer(s)   Output Layer
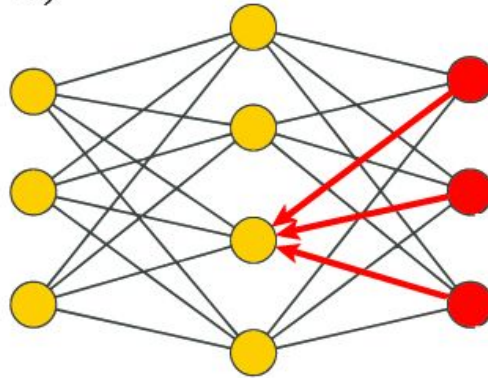
❖ **Forward Propagation:**
Signal goes from input layers towards output layers

❖ **Backward Propagation:**
Signal goes from output to input layers

Classification with Neural Networks

Classification: **Predicting what class/group certain element belongs to.**

Classify whether a person has a disease or not

Classify whether a person will repay loan or not

Apply face recognition to identify people

Classify emails as spam or not

And many many many more...

Neural Network Working: Handwriting recognition

Frameworks for DL in Python

Google's DL framework.
Can also work on ioS and Android
Architectural limitation: TensorFlow's architecture TPU only allows the execution of a model not to train it.

Operates with a dynamically updated graph. It allows you to make changes to the architecture in the process.
Not as easy for Deployment

It is built on top of TensorFlow. Designed to create neural networks with a complex architecture by DeepMind.
Mostly used to reproduce the research demonstrated in DeepMind's papers with greater ease than Keras, since DeepMind will be using Sonnet themselves.

Let's start working on deep learning techniques!

Downloadable links to the slides can be found here:
https://docs.google.com/presentation/d/1efnSyGxKXV8-eGXngk2MmN_QhBD0I5Onbt CSMHao08k/edit?usp=sharing