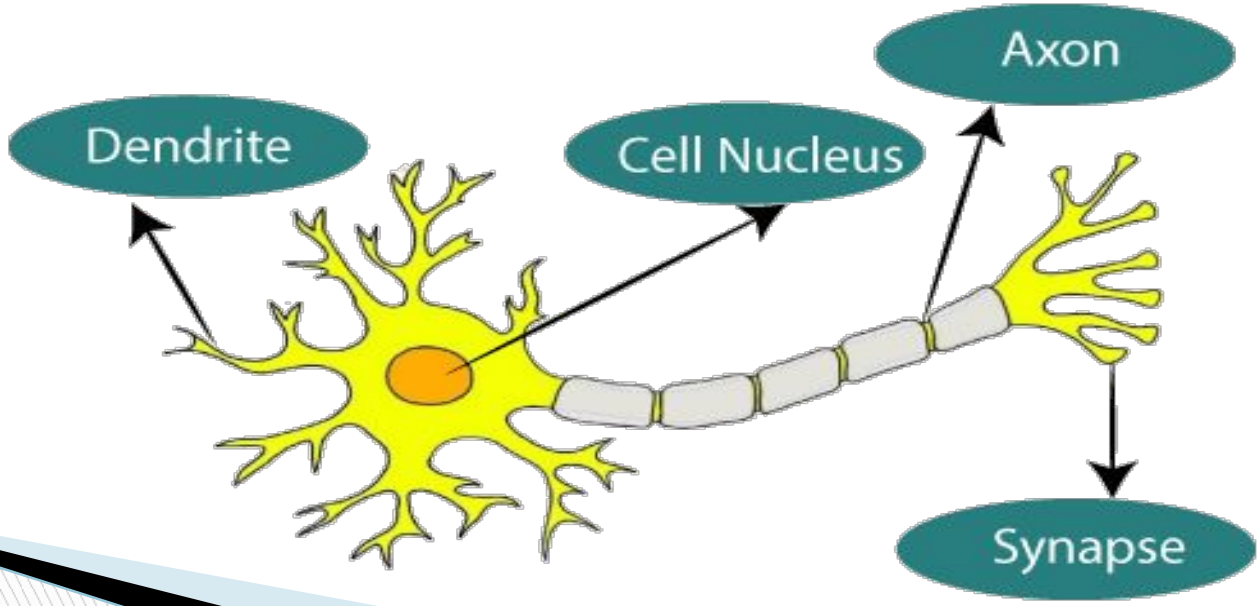
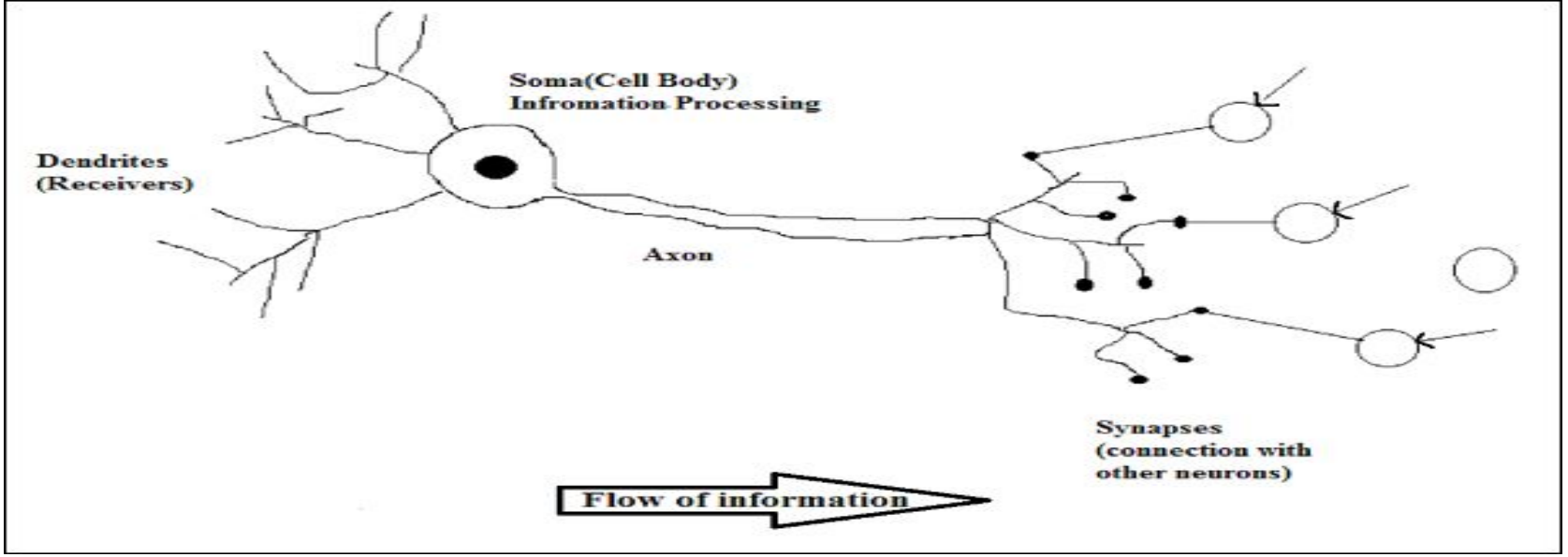
Artificial Neural Network (ANN)?

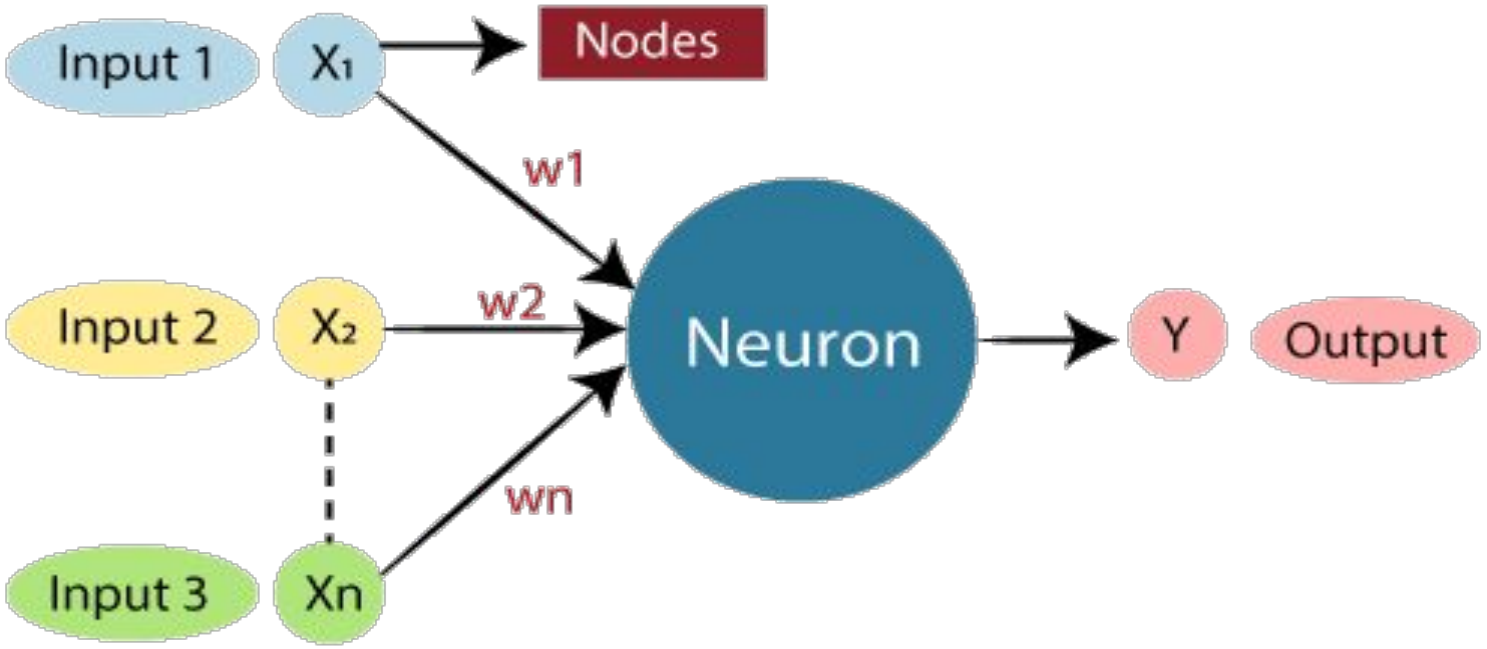
- ANN is information processing paradigm that is inspired by biological nervous system.
- Artificial neural networks are built like the human brain, with neuron nodes interconnected like a web.
- It is a computational network based on biological neural networks that construct the structure of the human brain.

- **Artificial Neural Network**" is derived from Biological neural networks that develop the structure of a human brain.
- The human brain has hundreds of billions of cells called neurons.
- Each neuron is made up of a cell body that is responsible for processing information by carrying information towards (inputs) and away (outputs) from the brain.





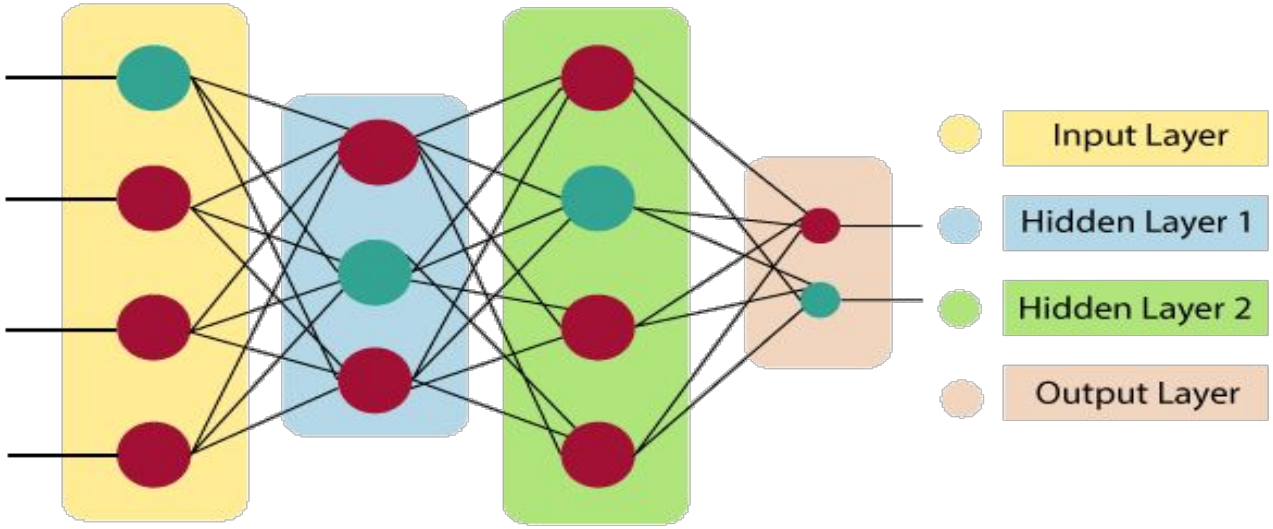
- **Dendrites** − They are tree-like branches, responsible for receiving the information from other neurons it is connected to. In other sense, we can say that they are like the ears of neuron.
- **Soma** − It is the cell body of the neuron and is responsible for processing of information, they have received from dendrites.
- **Axon** − It is just like a cable through which neurons send the information.
- **Synapses** − It is the connection between the axon and other neuron dendrites.



Dendrites from Biological Neural Network represent **inputs** in Artificial Neural Networks, cell nucleus represents **Nodes**, synapse represents **Weights,** and Axon represents **Output.**

Architecture of an artificial neural network:

- Artificial Neural Network primarily consists of three layers:



Input Layer:

- it accepts inputs in several different formats provided by the programmer.

Hidden Layer:

- The hidden layer presents in-between input and output layers. It performs all the calculations to find hidden features and patterns.

Output Layer:

- The input goes through a series of transformations using the hidden layer, which finally results in output that is conveyed using this layer.
- The artificial neural network takes input and computes the weighted sum of the inputs and includes a bias. This computation is represented in the form of a transfer function.

$$\sum_{i=1}^{n} Wi * Xi + b$$

It determines weighted total is passed as an input to an activation function to produce the output. Activation functions choose whether a node should fire or not. Only those who are fired make it to the output layer..

- Neural Network or **artificial neural network** (ANN) are modeled the same as the human brain. The human brain has a mind to think and analyze any task in a particular situation.
- But how can a machine think like that? For the purpose, an artificial brain was designed is known as a neural network.
- The neural network is made up many **perceptions**.

Backpropagation:

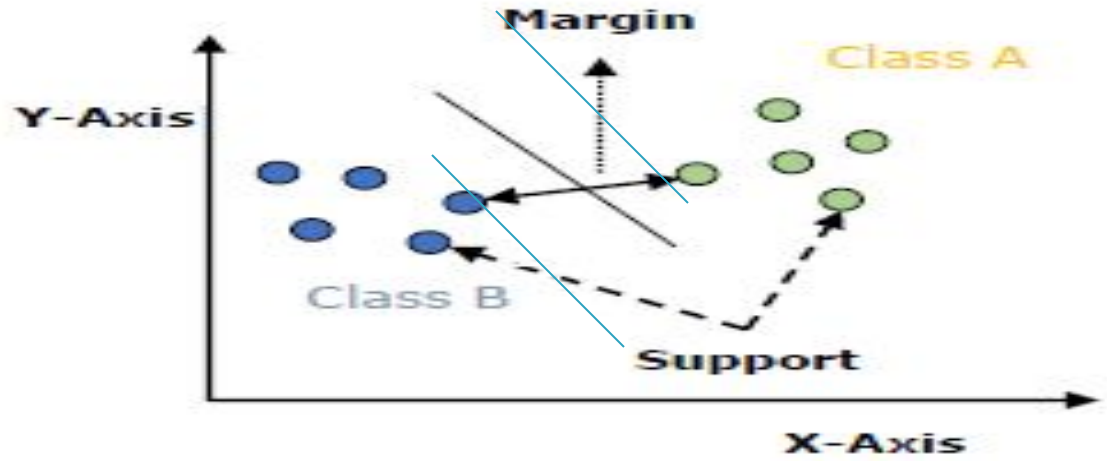
- Backpropagation is a supervised learning algorithm, for training Multi-layer Perceptrons (Artificial Neural Networks).
- The Backpropagation algorithm looks for the minimum value of the error function in weight space using a technique called the delta rule or gradient descent.
- The weights that minimize the error function is then considered to be a solution to the learning problem.

Support Vector Machine

- Support vector machines (SVMs) are powerful supervised machine learning algorithms which are used both for classification and regression. But generally, they are used in classification problems.
- Support Vectors are simply the co-ordinates of individual observation.

Working of SVM

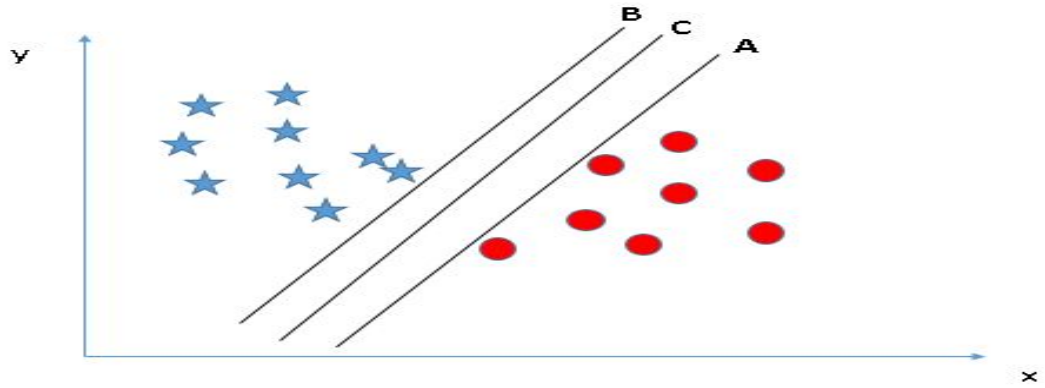
- An SVM model is basically a representation of different classes in a hyper-plane in multidimensional space.
- The hyper-plane will be generated in an iterative manner by SVM so that the error can be minimized.
- The goal of SVM is to divide the datasets into classes to find a maximum marginal hyper-plane (MMH).



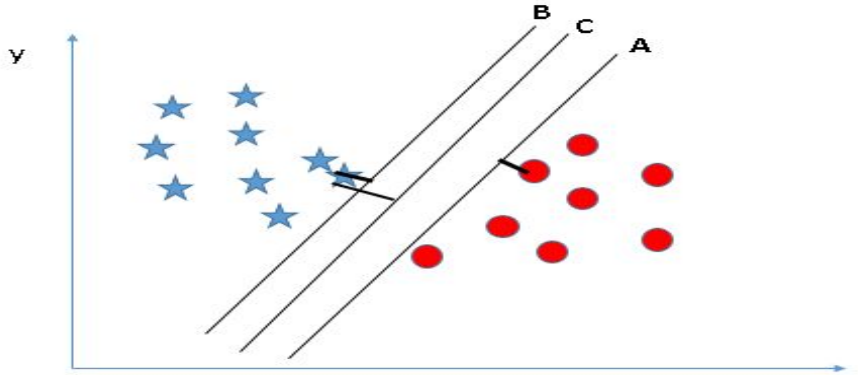
- The followings are important concepts in SVM −
- **Support Vectors** − Data points that are closest to the hyper-plane is called support vectors. Separating line will be defined with the help of these data points.
- **Hyper-plane** − It is a decision plane or space which is divided between a set of objects having different classes.
- **Margin** − It is the gap between two lines on the closet data points of different classes. It can be calculated as the perpendicular distance from the line to the support vectors.
- Large margin is considered as a good margin and small margin is considered as a bad margin.
- If we select a hyper-plane having low margin then there is high chance of miss-classification.

Identify the right hyper-plane

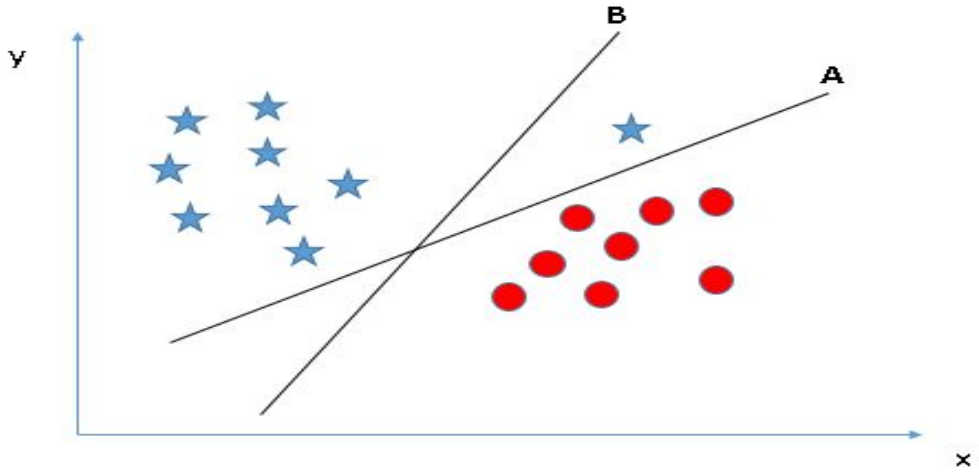
Here, we have three hyper-planes (A, B and C) and all are separating the classes well. Now, How can we identify the right hyper-plane?



In below diagram Here, maximizing the distances between nearest data point (either class) and hyper-plane will help us to decide the right hyper-plane. This distance is called as **Margin**.



Above, we can see that the margin for hyper-plane C is high as compared to both A and B. Hence, we name the right hyper-plane as C



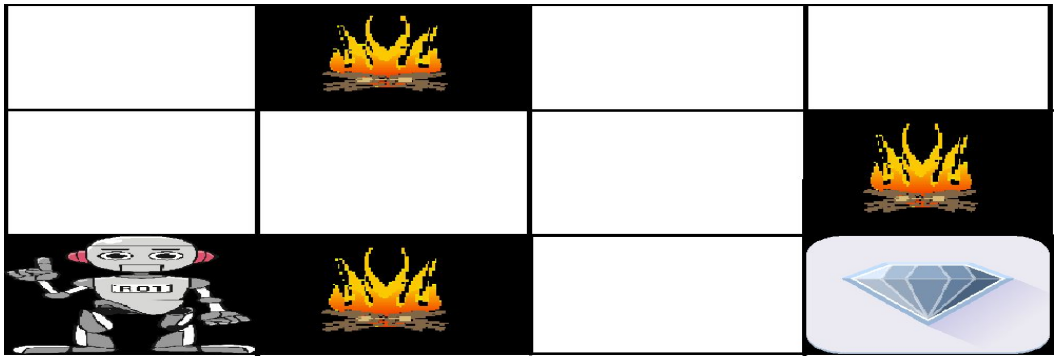
- In the above example hyper-plane **B** as it has higher margin compared to **A.** Here, hyper-plane B has a classification error and A has classified all correctly. Therefore, the right hyper-plane is **A.**

- The main goal of SVM is to divide the datasets into classes to find a maximum marginal hyper-plane (MMH) and it can be done in the following two steps −
- First, SVM will generate hyper-planes iteratively that isolate the classes in best way.
- Then, it will choose the hyper-plane that separates the classes correctly.
- **Pros of SVM classifiers**
- SVM classifiers offers great accuracy and work well with high dimensional space. SVM classifiers basically use a subset of training points hence in result uses very less memory.
- **Cons of SVM classifiers**
- They have high training time hence in practice not suitable for large datasets. Another disadvantage is that SVM classifiers do not work well with overlapping classes.

Reinforcement learning

- It is a feedback-based learning method. in which a learning agent gets a reward for each right action and gets a penalty for each wrong action
- is about taking suitable action to maximize reward in a particular situation.
- It is employed by various software and machines to find the best possible behavior or path it should take in a specific situation.
- Reinforcement learning differs from the supervised learning in a way that in supervised learning the training data has the answer key with it so the model is trained with the correct answer itself whereas in reinforcement learning, there is no answer but the reinforcement agent decides what to do to perform the given task. In the absence of training dataset, it is bound to learn from its experience.

- We have an agent and a reward, with many hurdles in between. The agent is supposed to find the best possible path to reach the reward. The following problem explains the problem more easily.



The above image shows robot, diamond and fire. The goal of the robot is to get the reward that is the diamond and avoid the trouble that is fire. The robot learns by trying all the possible paths and then choosing the path which gives him the reward with the least hurdles. Each right step will give the robot a reward and each wrong step will subtract the reward of the robot. The total reward will be calculated when it reaches the final reward that is the diamond.

- **Main points in Reinforcement learning –**

Input: The input should be an initial state from which the model will start

Output: There are many possible output as there are variety of solution to a particular problem

Training: The training is based upon the input, The model will return a state and the user will decide to reward or punish the model based on its output.

The model keeps continues to learn.

- The best solution is decided based on the maximum reward.

Applications of Reinforcement Learning –

- RL can be used in robotics for industrial automation.
- RL can be used in machine learning and data processing
- RL can be used to create training systems that provide custom instruction and materials according to the requirement of students.

Adaptive real-time machine learning

- The fourth generation of machine intelligence is adaptive learning, creates the first truly integrated human and machine learning environment.
- For text analytics, this has given us the most accurate analytics to date, allowing us to get actionable information in many areas for the first time.
- For examples we will share here, we show that adaptive learning is 95% accurate in predicting people's intention to purchase a car.
- Adaptive learning correlates with actual sales, unlike any previous approach to Machine Intelligence.