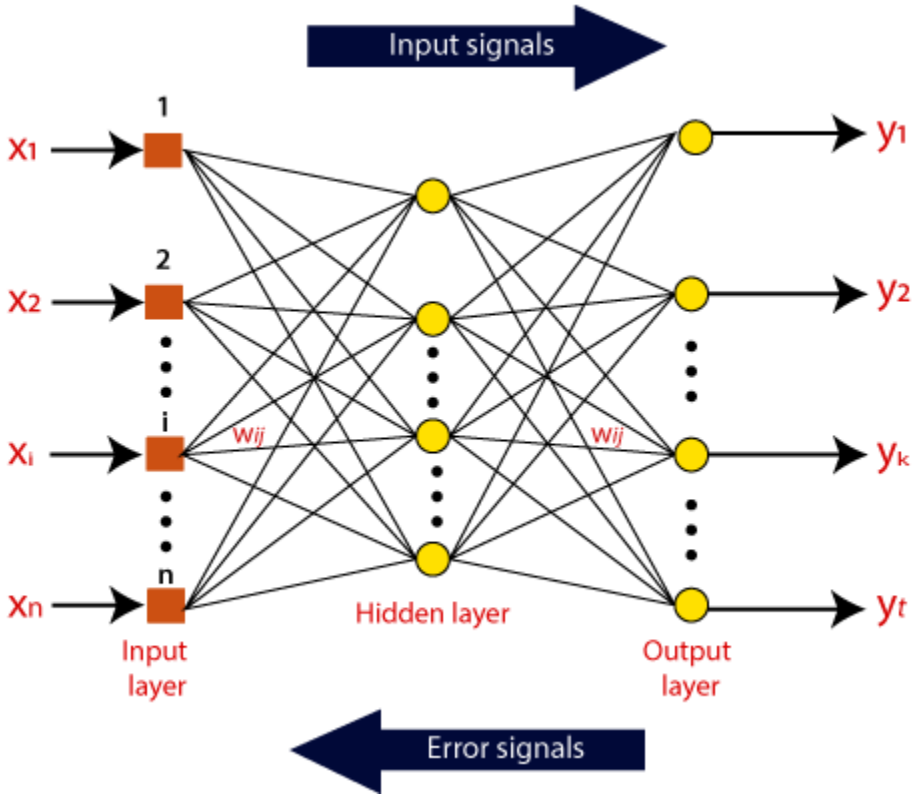
# UNIT-2

## Artificial neural Networks-1:

**Introduction:** The term "**Artificial Neural Network**" is derived from Biological neural networks that develop the structure of a human brain. Similar to the human brain that has neurons interconnected to one another, artificial neural networks also have neurons that are interconnected to one another in various layers of the networks. These neurons are known as nodes.

**Neural network representation:** Artificial Neural Network can be best represented as a weighted directed graph, where the artificial neurons form the nodes. The association between the neurons outputs and neuron inputs can be viewed as the directed edges with weights. The Artificial Neural Network receives the input signal from the external source in the form of a pattern and image in the form of a vector. These inputs are then mathematically assigned by the notations x(n) for every n number of inputs.




## Appropriate problems for neutral network learning:

Instances are represented by many attribute-value pairs.

• The target function output may be discrete-valued, real-valued, or a vector of several real-valued or discrete-valued attributes.

• The training examples may contain errors.

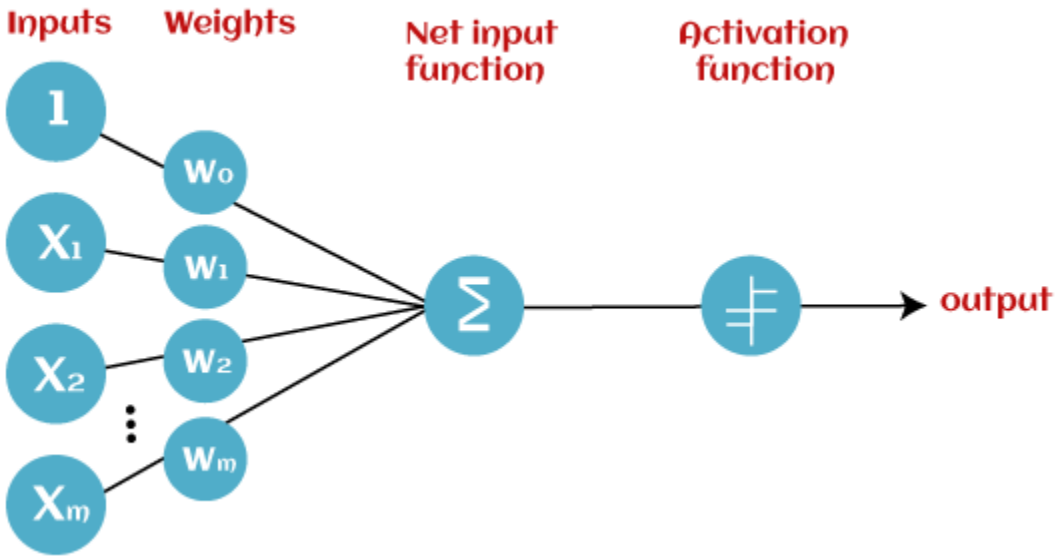
• Long training times are acceptable.

• Fast evaluation of the learned target function may be required.

• The ability of humans to understand the learned target function is not important.

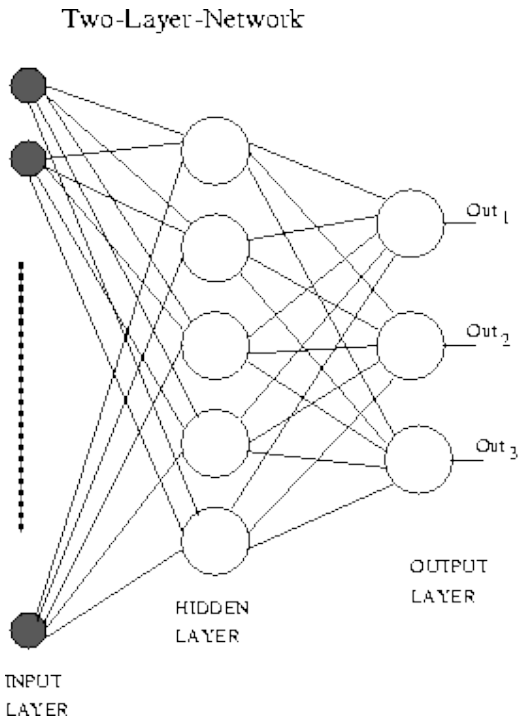
## Perceptions:

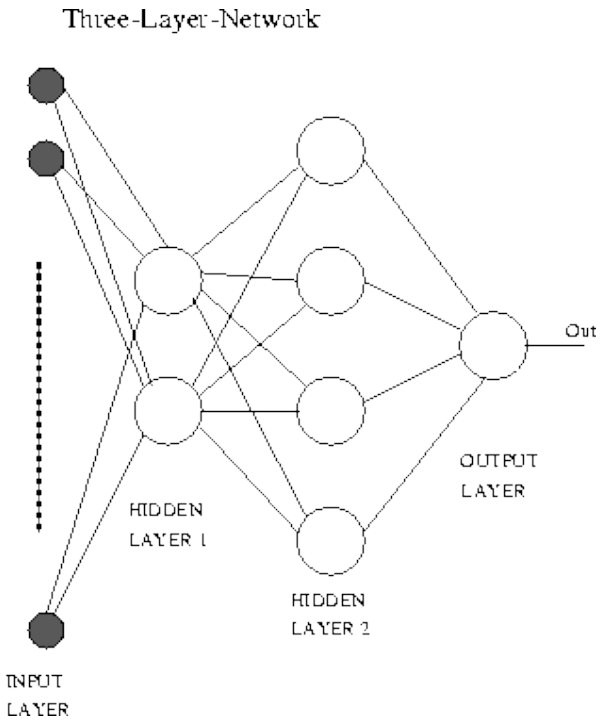
Perceptron is Machine Learning algorithm for supervised learning of various binary classification tasks. Further, *Perceptron is also understood as an Artificial Neuron or neural network unit that helps to detect certain input data computations in business intelligence.*




## Multilayer networks and the back-propagation algorithm:

Multilayer networks solve the classification problem for non linear sets by employing *hidden layers*, whose neurons are not directly connected to the output. The additional hidden layers can be interpreted geometrically as additional hyper-planes, which enhance the separation capacity of the network.

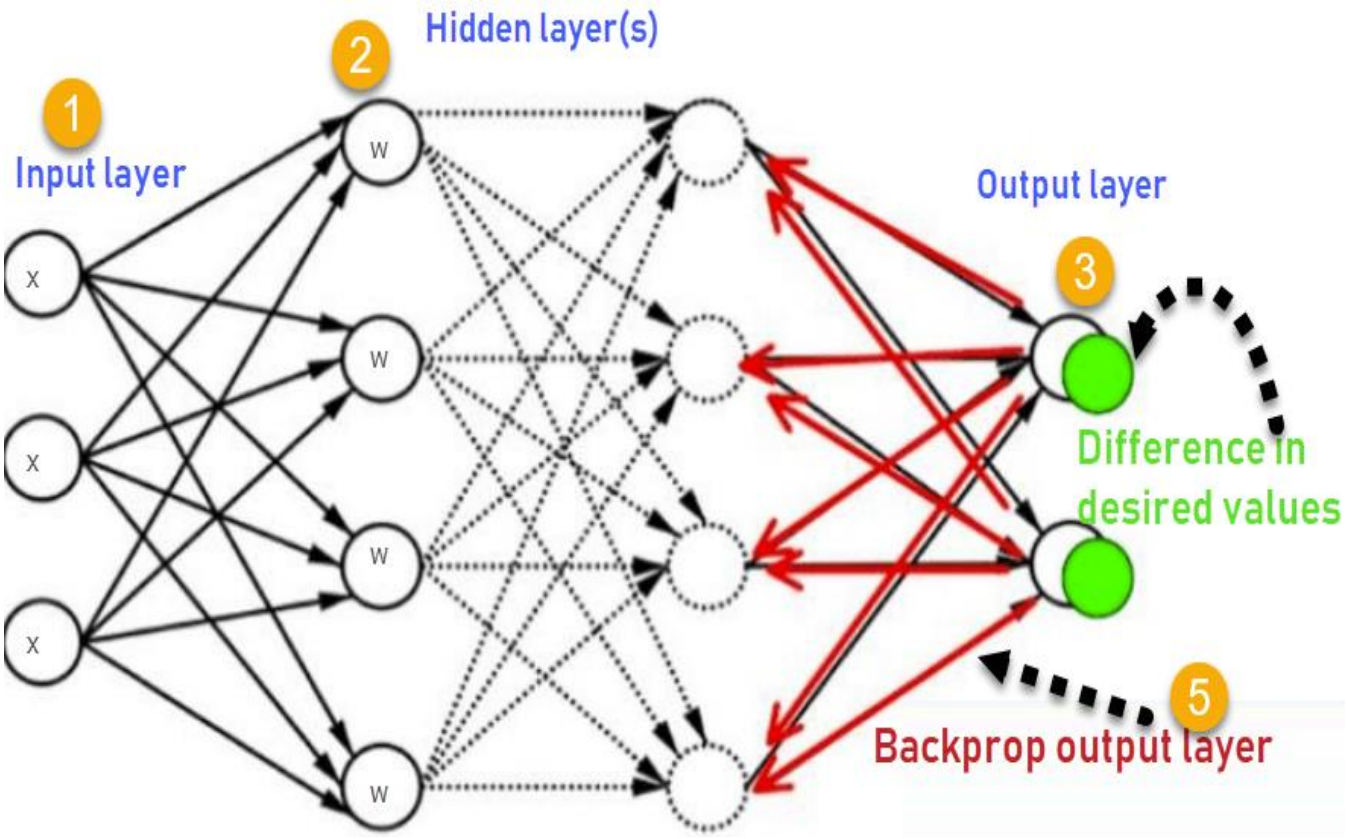



## Backpropagation algorithm:

Backpropagation (backward propagation) is an important mathematical tool for improving the accuracy of predictions in data mining and machine learning. Essentially, backpropagation is **an algorithm used to calculate derivatives quickly**.

1. Input layer
2. Hidden layer
3. Output layer




This image summarizes the functioning of the backpropagation approach.

1. Input layer receives x
2. Input is modeled using weights w
3. Each hidden layer calculates the output and data is ready at the output layer
4. Difference between actual output and desired output is known as the error
5. Go back to the hidden layers and adjust the weights so that this error is reduced in future runs

This process is repeated till we get the desired output. The training phase is done with supervision. Once the model is stable, it is used in production.

# Artificial Neural Networks-2

## Remarks on the Back-Propagation algorithm:

1.convergence and local minima
2.Representation power of feed forward networks
3.hypothesis space seach and inductive bias
4.hidden layer representation
5.Generalization ,overfitting,stopping criterian

## An illustrative example: face recognition, advanced topics in artificial neural networks:

Neural nets for face recognition

Training images : 20 different persons with 32 images per person. – (120x128 resolution → 30x32 pixel image) – After 260 training images, the network achieves an accuracy of 90% over a separate test set. – Algorithm parameters : $\eta$=0.3, $\alpha$=0.3

## Advanced topics in artificial neural networks:

An introduction to some advanced neural network topics such as snapshot ensembles, dropout, bias correction, and cyclical learning rates.

## Evaluation Hypotheses:

**Motivation:** Motivation is a condition that activates and sustains behavior toward a goal. It is critical to learning and achievement across the life span in both informal settings and formal learning environments.

- Estimating the accuracy with which it will classify future instances - also probable error of this accuracy estimate
- A space of possible instances . Different instances in may be encountered with different frequencies which is modeled by some unknown probability distribution . Notice says nothing about whether is a positive or negative example. The learning task is to learn the target concept, , by considering a space of possible hypothesis. Training examples of the target function are provided to the learner by a trainer who draws each instance independently, according to the distribution and who then forwards the instance along with the correct target value to the learner.
- Are instances ever really drawn independently?
- Sample error - the fraction of instances in some sample that it misclassifies , where is the number of samples in , and is 1 if , and 0 otherwise
- True error - probability it will misclassify a single randomly drawn instance from the distribution, where denotes that the probability is taken over the instance distribution.
- Really want but can only get.