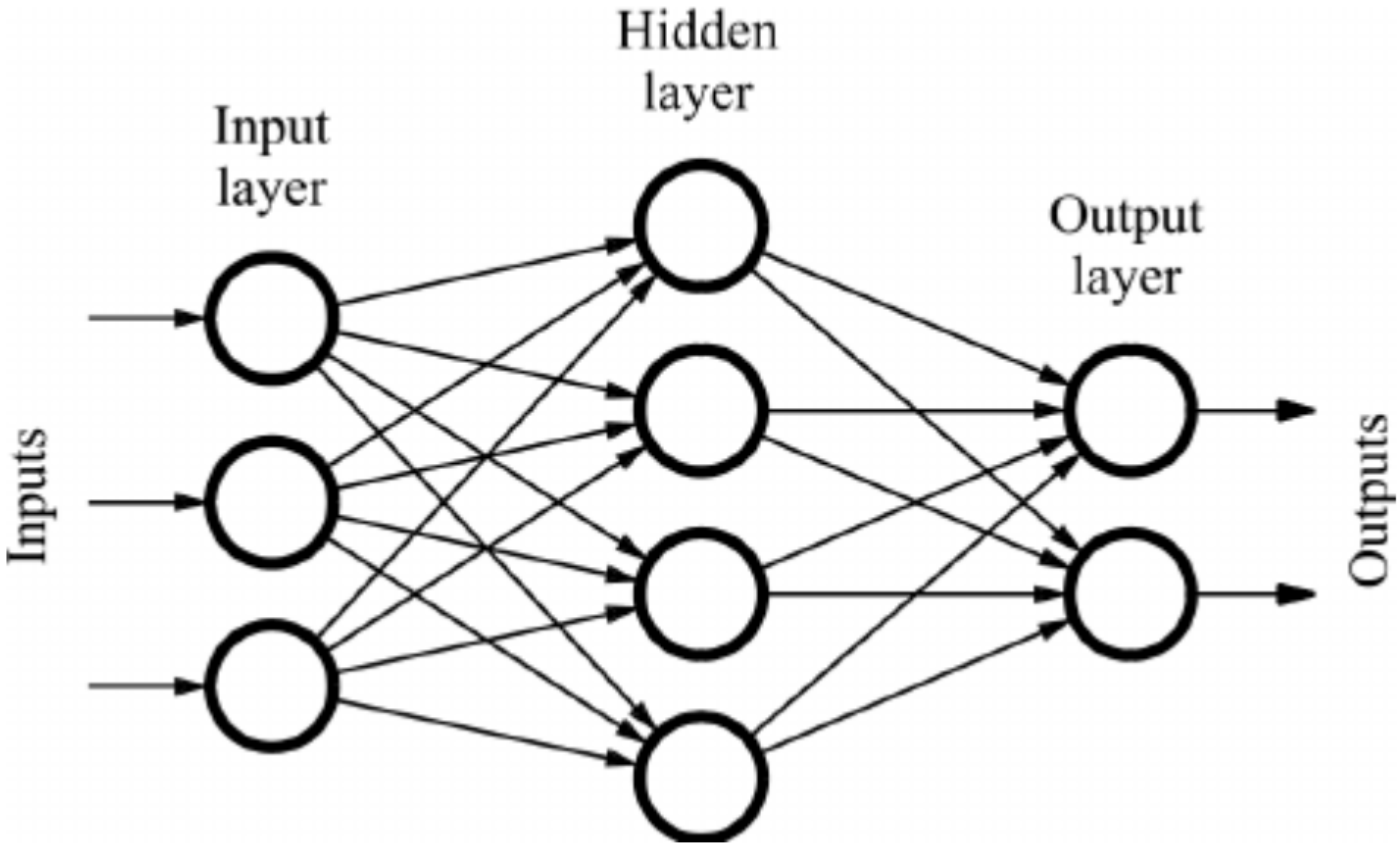
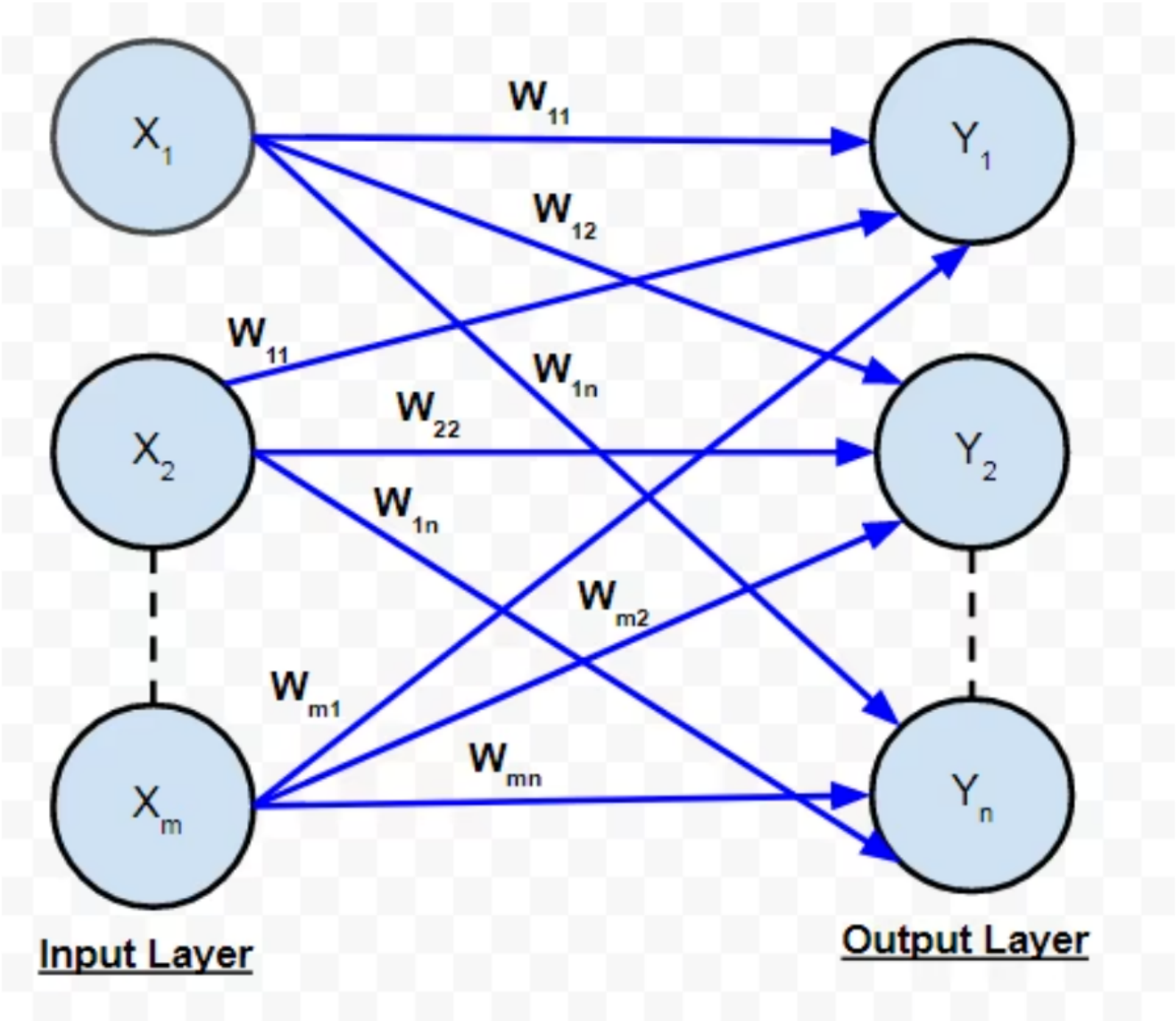
Types of Neural Networks

Feed Forward Neural Network

Signals travel in one way i.e. from input to output only in Feed forward Neural Network. There is no feedback or loops. The output of any layer does not affect that same layer in such networks. Feed forward neural networks are straight forward networks that associate inputs with outputs. They have fixed inputs and outputs. They are mostly used in pattern generation, pattern recognition and classification.


Hidden
layer
Input
layer
Output
layer
Inputs
Outputs

A. Single-layer Feed Forward Network:



It is the simplest and most basic architecture of ANN's. It consists of only two layers- the input layer and the output layer. **The input layer** consists of 'm' input neurons connected to each of the 'n' output neurons. The connections carry weights w_{11} and so on. The input layer of the neurons doesn't conduct any processing – they pass the i/p signals to the o/p neurons. The computations are performed in the output layer. So, though it has 2 layers of neurons, only one layer is performing the computation. This is the reason why **the network is known as SINGLE** layer.

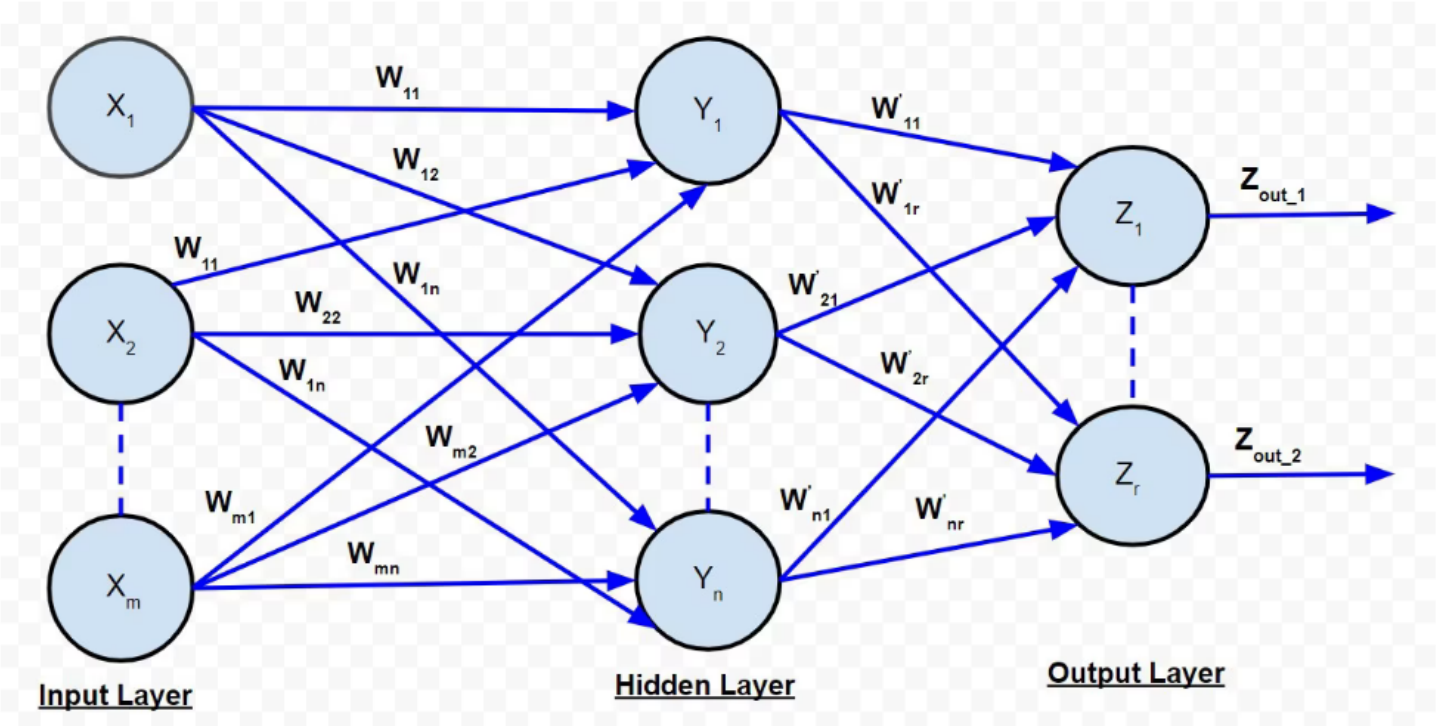
Also, the signals always flow from the input layer to the output layer. Hence, the **network is known as FEED FORWARD.**

The net signal input to the output neurons is given by:

$$y_{in_k} = x_1 w_{1k} + x_2 w_{2k} + \ldots + x_m w_{mk} = \sum_{i=1}^{m} x_i w_{ik}$$

The signal output from each output neuron will depend on the activation function used.

B. Multi-layer Feed Forward Network:

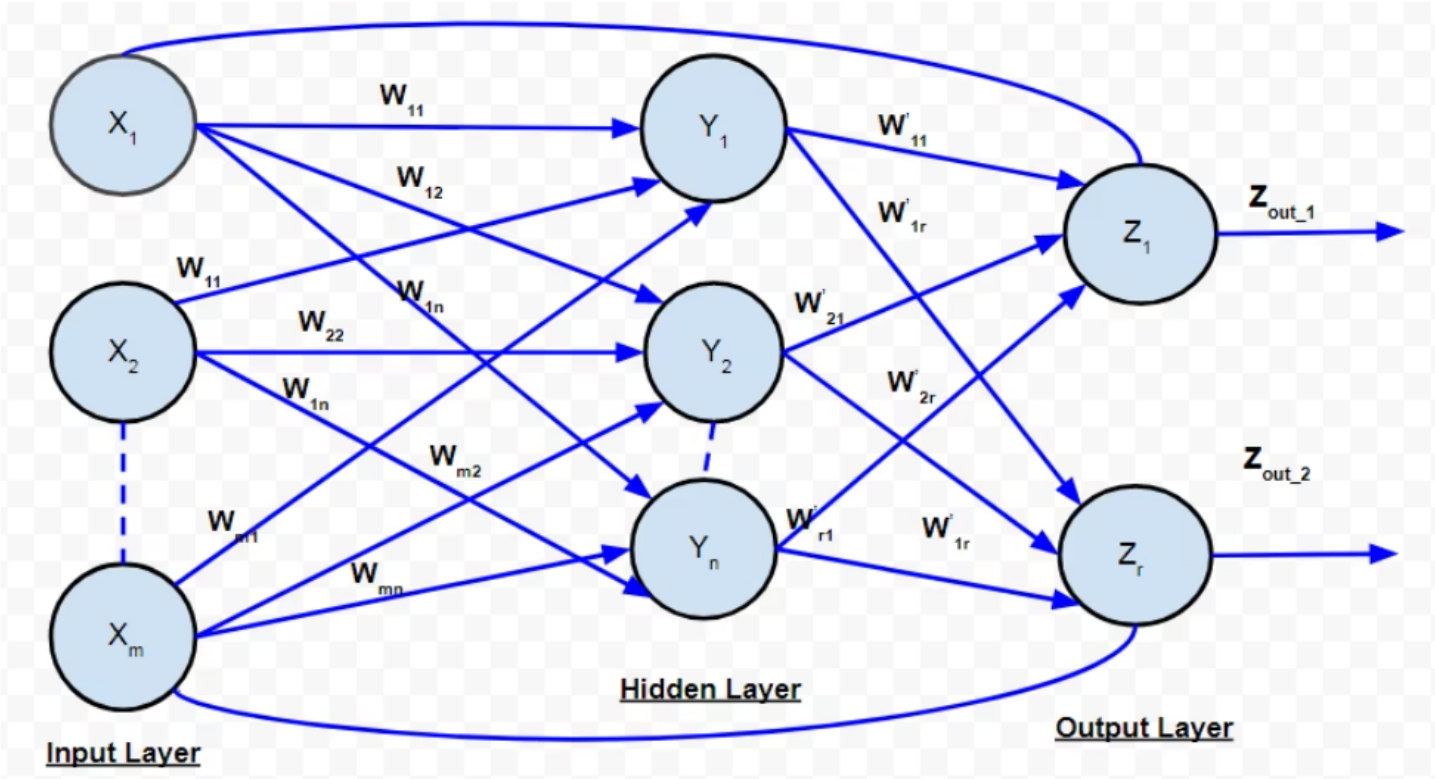


Multi-Layer Feed Forward Network

The multi-layer feed-forward network is quite similar to the single-layer feed-forward network, except for the fact that there are one or more intermediate layers of neurons between the input and output layer. Hence, the **network is termed as multi-layer.** Each of the layers may have a varying number of neurons. For example, the one shown in the above diagram has ‘m’ neurons in the input layer and ‘r’ neurons in the output layer and there is only one hidden layer with ‘n’ neurons.

$$y_{in_k} = x_1 w_{1k} + x_2 w_{2k} + \ldots + x_m w_{mk} = \sum_{i=1}^{m} x_i w_{ik}$$

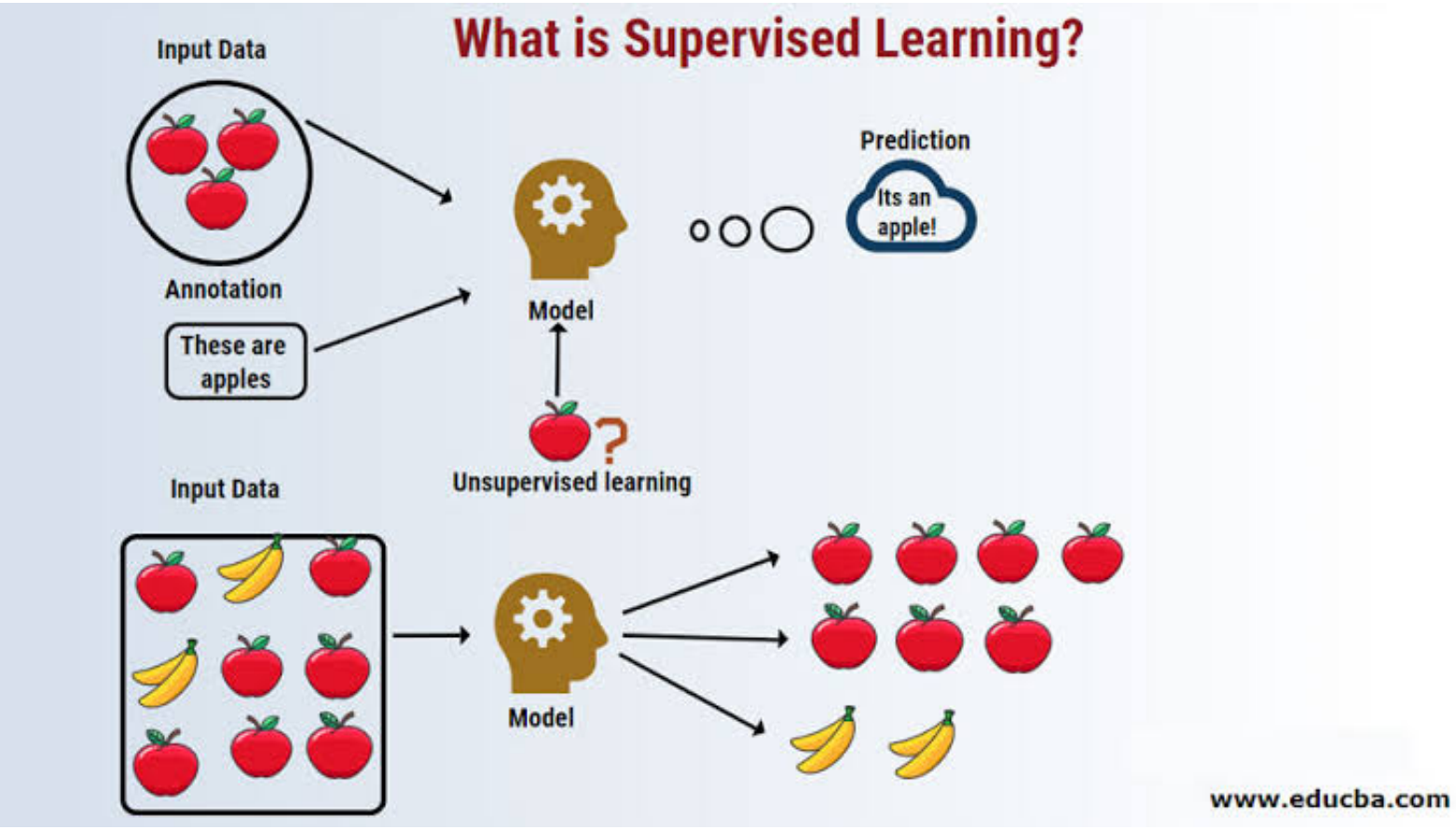
D. Recurrent Network:



Recurrent Network

In feed-forward networks, the signal always flows from the input layer towards the output layer (in one direction only). In the case of recurrent neural networks, there is **a feedback loop** (from the neurons in the output layer to the input layer neurons). There can be self-loops too.

Learning in ANN


What is Supervised Learning?
Input Data
Annotation
These are apples
Model
Prediction
Its an apple!
Unsupervised learning
Input Data
Model
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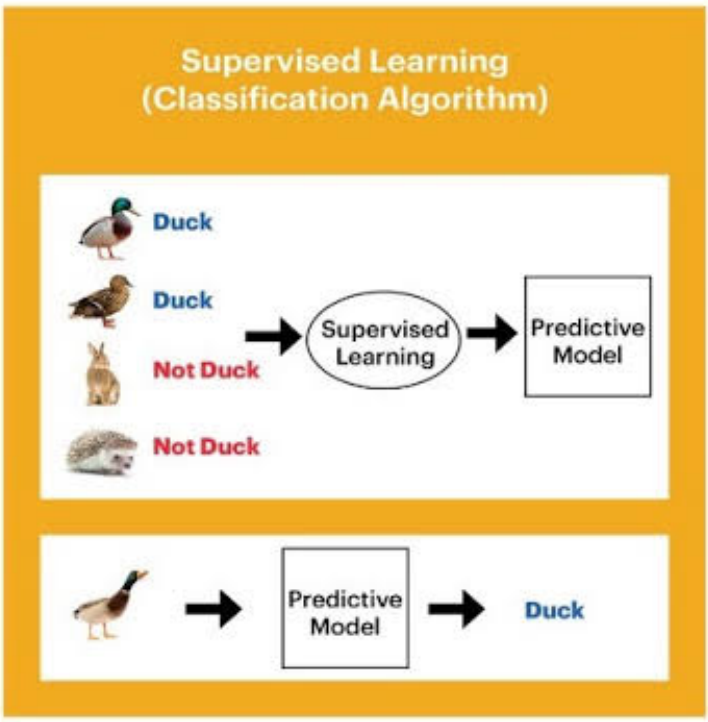

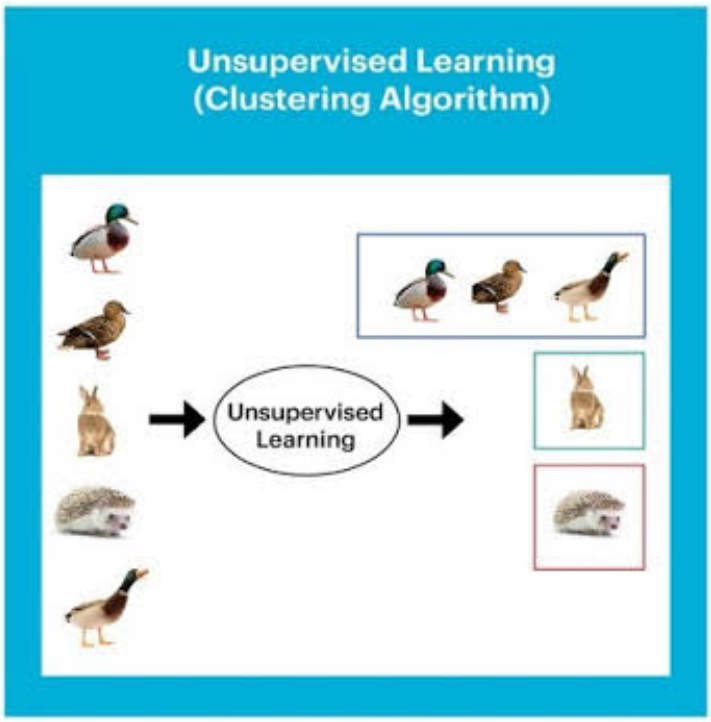

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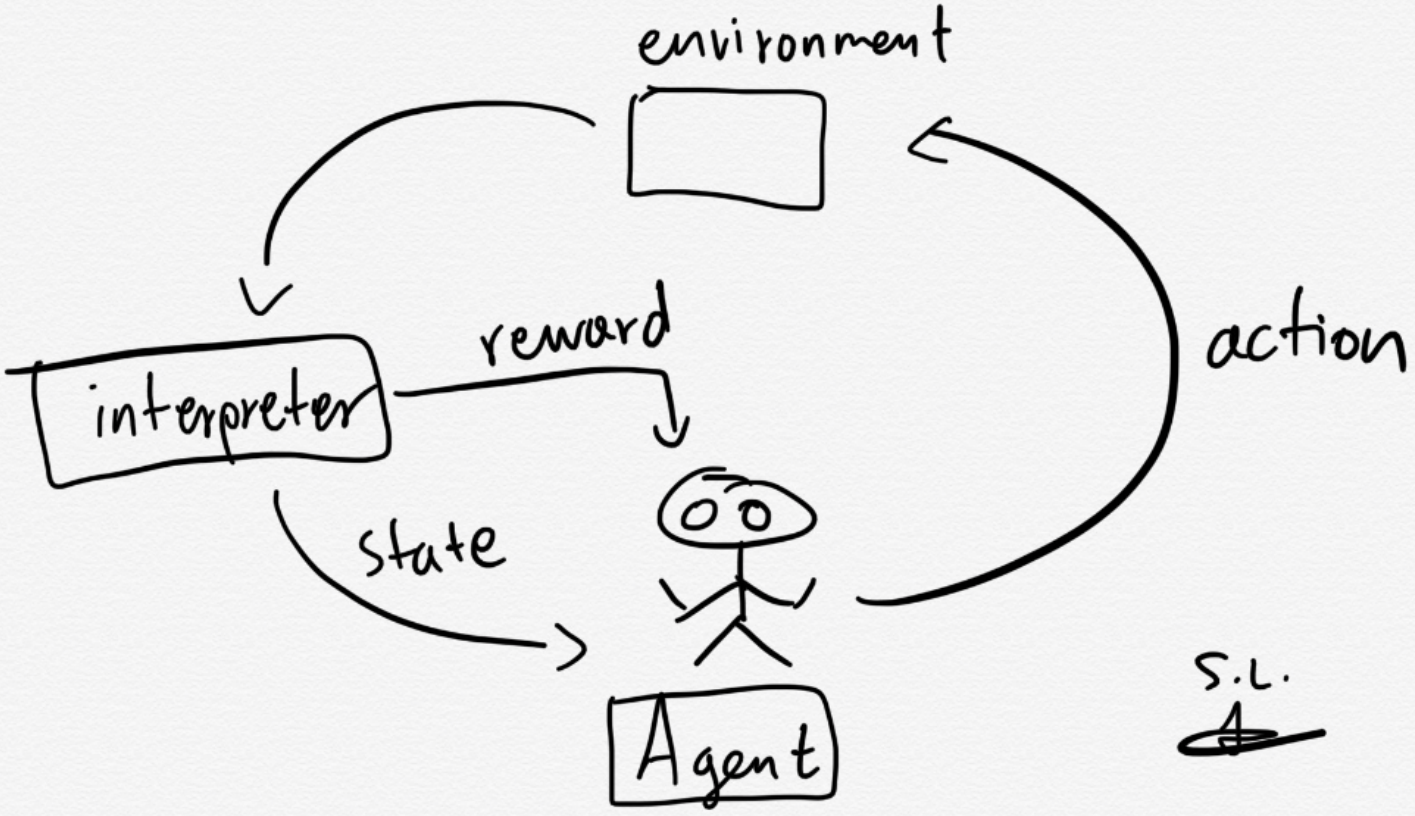
Reinforcement learning



Supervised learning uses a training set to teach models to yield the desired output. This training dataset includes inputs and correct outputs, which allow the model to learn over time. The algorithm measures its accuracy through the loss function, adjusting until the error has been sufficiently minimized.

In unsupervised learning, a deep learning model is handed a dataset without explicit instructions on what to do with it. The training dataset is a **collection of examples without a specific desired outcome** or correct answer. ... Unsupervised learning models automatically extract features and find patterns in the data.

What is the main difference between supervised and unsupervised learning?

The main difference between supervised and unsupervised learning: Labeled data. The main distinction between the two approaches is **the use of labeled datasets**. To put it simply, supervised learning uses labeled input and output data, while an unsupervised learning algorithm does not.

The goal of unsupervised learning is to **find the underlying structure of dataset, group that data according to similarities**, and represent that dataset in a compressed format. Example: Suppose the unsupervised learning algorithm is given an input dataset containing images of different types of cats and dogs.

Reinforcement Learning is a feedback-based Machine learning technique in which an agent learns to behave in an environment by performing the actions and seeing the results of actions. For each good action, the agent gets positive feedback, and for each bad action, the agent gets **negative feedback** or penalty.

Reward Function in Reinforcement Learning

The Reward Function is **an incentive mechanism that tells the agent what is correct and what is wrong using reward and punishment**. The goal of agents in RL is to maximize the total rewards.

1. RL is quite widely used in building AI for playing computer games. **AlphaGo Zero** is the first computer program to defeat a world champion in the ancient Chinese game of Go. Others include ATARI games, Backgammon ,etc

2. In robotics and industrial automation