Topic :

Objective :

Outcomes :

Normalization in ML :-

Normalization is one of the most frequently used data preparation techniques, which helps us to change the values of numeric columns in the dataset to use a common scale.

Normalization is a scaling technique in ML learning applied during data preparation to change the values of numeric columns in the dataset to use a common scale. It is not necessary for all datasets in a model.

$$X_n = (X - X_{minimum}) / (X_{maximum} - X_{minimum})$$

- X_n = value of Normalization.
- $X_{maximum}$ = Maximum value of a feature
- $X_{minimum}$ = Minimum value of a feature.

Example :- lets assume we have a model dataset having maximum and minimum values of feature as mentioned above. To normalize the machine learning model, values are shifted and rescaled so their range can vary between 0 and 1. This technique is also known as Min-Max scaling. In this scaling technique we will change the feature values as follows.

Case 1:- If the value of x is minimum, the value of Numerator will be 0; hence Normalization will also be 0.

$$x_n = (x - x_{minimum}) / (x_{maximum} - x_{minimum})$$

Put $X = x_{minimum}$ in above formula we get;

$$x_n = x_{minimum} - x_{minimum} / (x_{minimum} - x_{minimum})$$

$$x_n = 0$$

Case 2:- If the value of x is maximum, then the value of the numerator is equal to the denominator; hence Normalization will be 1.

$$x_n = (x - x_{minimum}) / (x_{maximum} - x_{minimum})$$

Put $x = x_{maximum}$ in above formula, we get

$$x_n = x_{maximum} - x_{minimum} / (x_{maximum} - x_{minimum})$$

$$x_n = 1$$

Case 3:— On the other hand, if the value of X is neither maximum nor minimum, then value of normalization will also be between 0 and 1.

Hence, Normalization can be defined as a scaling method where values are shifted and rescaled to maintain their ranges between 0 and 1, or in other words; it can be referred to as Min-Max Scaling technique.

Normalization techniques in ML:—

- Min-Max Scaling:- This technique is also refered to as scaling. As we have already discussed above, the Min max scaling method helps the dataset to shift and rescale the values of their attributes, so they end up ranging b/w 0 and 1.
- Standardization Scaling:— Standardization scaling is also known as z-score normalization, in which values are centered around the mean with a unit standard deviation, which means the attribute becomes zero and the resultant distribution has a unit standard deviation.

Hence, standardization can be expressed as follows:

$$x' = \frac{x - \mu}{\sigma}$$

Here, μ represents the mean of feature value, and σ represents the standard deviation of feature values.

This technique is helpful for various ml c learning algorithm that use distance measure such as KNN, K-means clustering and Principal Component Analysis etc. further, it is also important that the model is build on assumptions & data is normally distributed.

Summary :

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Machine learning Models :- A machine learning model is defined as a mathematical representation of the output of the training process. ML learning is the study of different algorithm that can improve automatically through experience & old data and build the model.

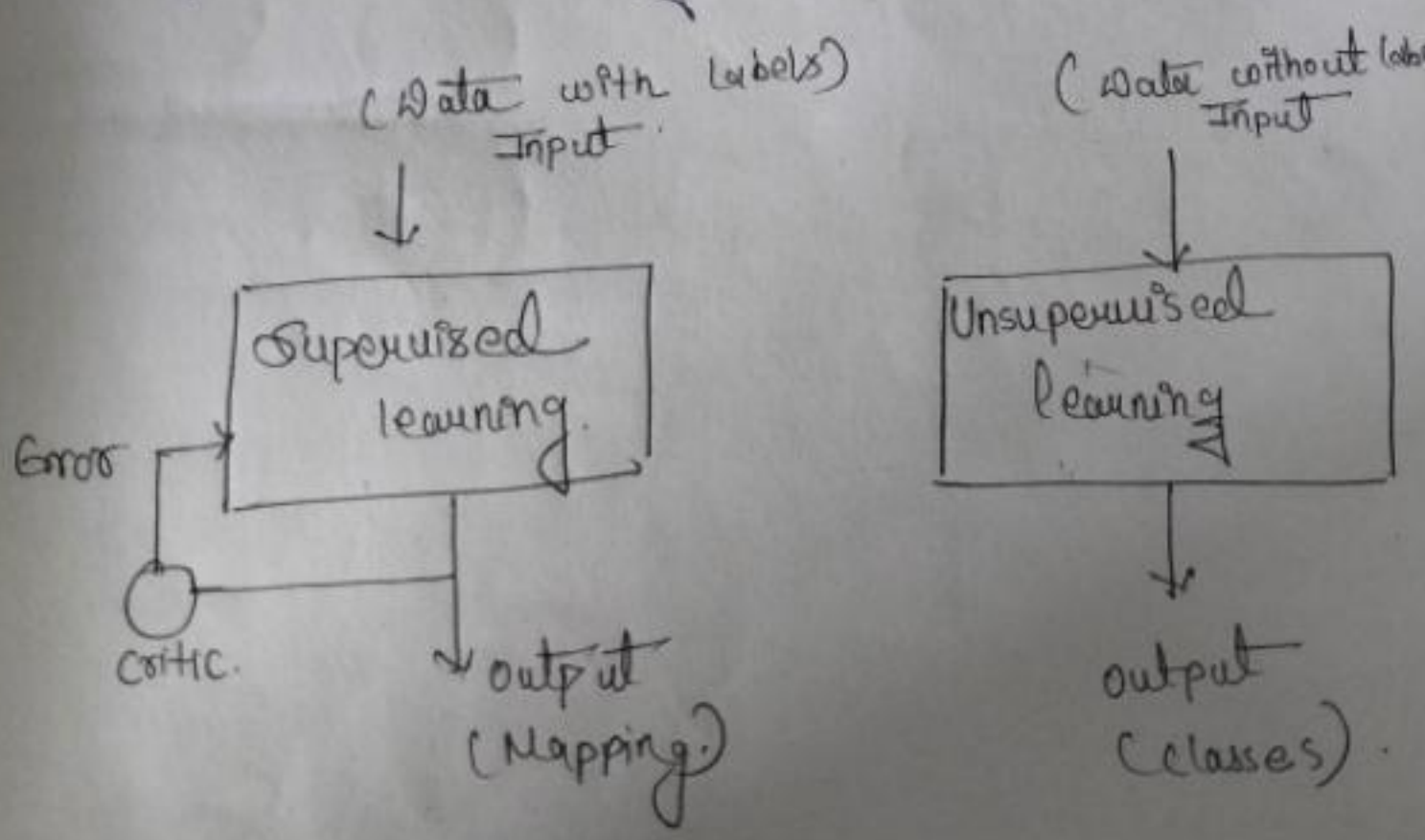
ML learning models can be understood as a program that has been trained to find patterns within new data and make predictions. These models are represented as a mathematical function that takes requests in the form of input data, makes predictions on input data, and then provides an output in response.

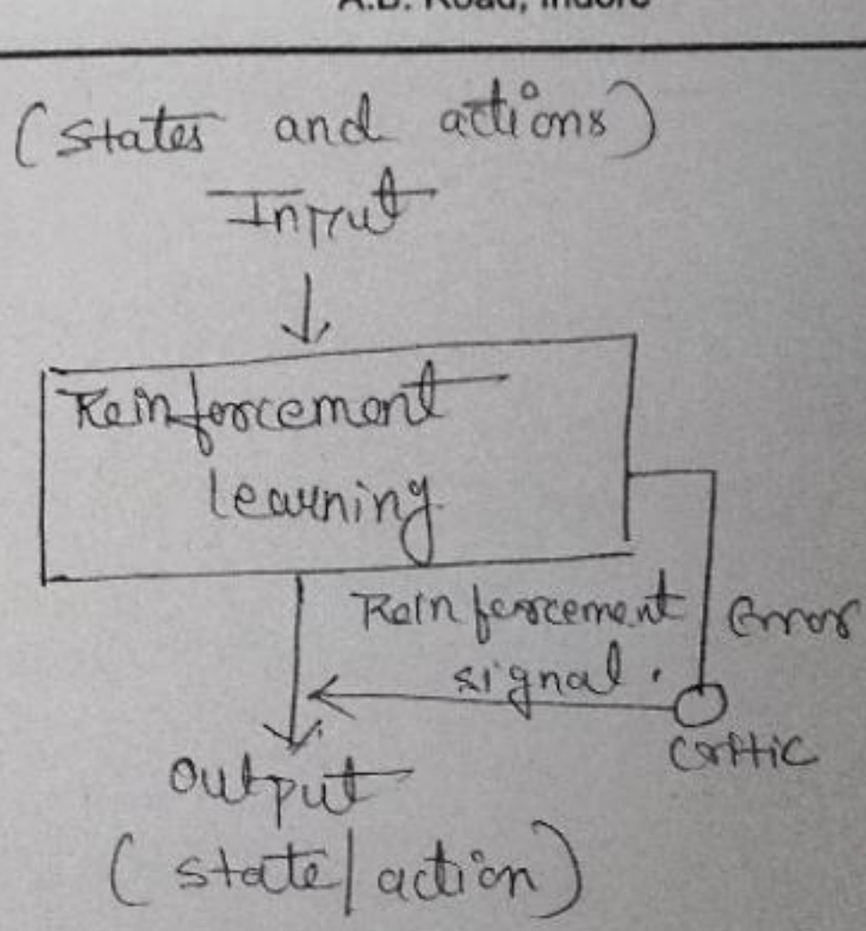
There are various types of ML learning models available based on different business goals and data sets.

Classification of Machine learning Models :—

Based on different business goals and data sets, there are three learning models for algorithms. Each machine learning algorithm settles into one of the three models:

- Supervised learning
- Unsupervised learning
- Reinforcement learning.





Supervised learning is further divided into two categories :-
- classification
- Regression.

Unsupervised learning is also divided into below Categories:
- Clustering
- Association Rule.
- Dimensionality Reduction.

Supervised Machine learning :-

Supervised learning is the types of machine learning in which machines are trained using well labelled training data, and on basis of that data, machines predict the output. The labelled data means some input data is already tagged with the correct output.

In supervised learning, the training data provided to the machines work as the supervisor that teaches the machines to predict the output correctly. It applies the same concept as a student learns in the supervision of the teacher.

Supervised learning is a process of providing input data as well as correct output data to the machine learning model. The aim of a supervised learning algorithm is to find a mapping function to map the input variable (x) with the output variable (y).

In the real-world, supervised learning can be used for Risk Assessment, Image classification fraud detection, spam filtering etc.

How supervised learning Works?

In supervised learning, models are trained using labelled dataset, where the model learns about each type of data. Once the training process is completed, the model is tested on the basis of test data (a subset of the training set) and then it predicts the output.

The working of supervised learning can be easily understood by the below example & diagram:

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Suppose we have a dataset of different types of shapes which includes Square, rectangle, triangle and Polygon. Now the first step is that we need to train the model for each shape

- If the given shape has four sides, and all the sides are equal, then it will be labelled as a square.
- If the given shape has three sides, then it will be labelled as a triangle
- If the given shape has six equal sides then it will be labelled as hexagon.

Now, after training, we test our model using the test set, and the task of the model is to identify the shape.

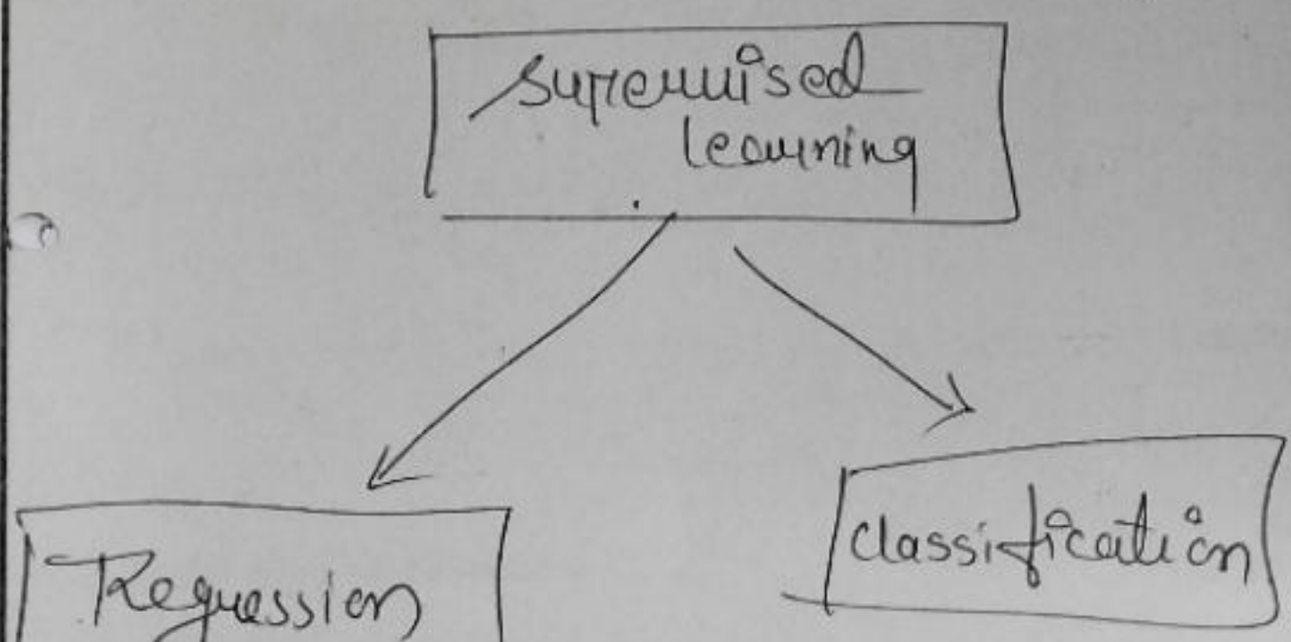
The m/c is already trained on all types of shapes and when it finds a new shape, it classifies the shape on the bases of a Number of sides, and predicts the output.

Q Steps Involved in Supervised learning :-

- first Determine the type of training dataset.
- Collect/Gather the labelled training data.
- Split the training dataset into training dataset, test dataset & Validation dataset.
- Determine the input features of the training dataset, which should have enough knowledge so that the model can accurately Predict the output.
- Determine the suitable algorithm for the model, such as support Vector machine decision tree etc.
- Execute the algorithm on the training dataset Sometimes we need Validation sets as the control Parameters which are the subset of training datasets.
- Evaluate the accuracy of the model by Providing the test set. If the model Predicts the correct output, which means our model is accurate.

Types of Supervised ML Algorithm.

Supervised learning can be further divided into two types of problems :—



1. Regression :— Regression algorithm are used if there is a relationship b/w the input variable and the output variable. It is used for the prediction of continuous variables, such as weather forecasting Market, Trends etc. Below are some popular Regression algorithm which come under supervised learning.

- Linear Regression
- Regression Tree
- Non-linear Regression
- Bayesian linear "
- Polynomial "

Classification :-

Classification algorithms are used when the output variable is categorial, which means there are two classes such as Yes-No, Male-female, True-false etc.

Spam filtering.

- Random forest
- Decision Trees
- Logistic Regression.
- Support Vector Machines.

Advantage of Supervised learning
- With the help of SL, the model can predict the o/p on the basis of prior experiences.
- In SL, we can have an exact idea about the classes of objects.
- SL model helps us to solve various real-world problems such as fraud detection, spam filtering etc.

Disadvantage of SL:-
- SL models are not suitable for handling the complex tasks.
- SL cannot predict the correct o/p if the test data is different from the training data set.
- Training required lots of computation times.
- In SL, we need enough knowledge about the classes of object.

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Reinforcement learning :-

1) Reinforcement learning is a feedback-based ML 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.

2) In ~~Rafi~~ Reinforcement learning, the agent learns automatically using feedbacks without any labeled data, unlike supervised learning.

3) Since there is no labeled data, so the agent is bound to learn by its experience only.

4) RL solves a specific type of problem where decision making is sequential, and the goal is long-term, such as

game playing, robotics etc.

Soy The agent interacts with the enviroment and explores it by itself. The primary goal of an agent in reinforcement learning is to improve the performance by getting the maximum positive rewards.

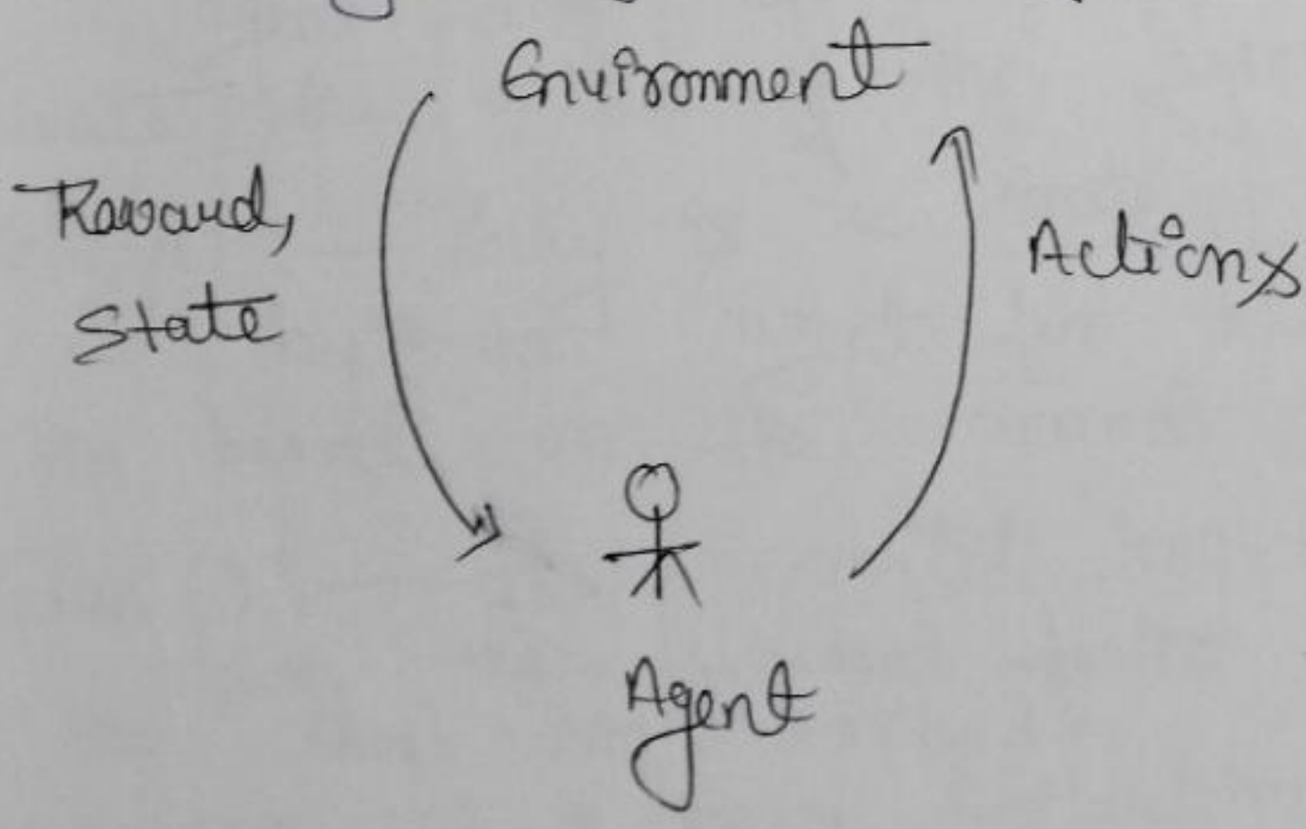
Sy The agent learns with the process of hit and trial, and based on the experience, it learns to perform the task in a better way.

Hence, we can say that "Reinforcement learning is a type of ML learning method where an intelligent agent interacts with the environment & learns to act within that". How a Robotic dog learns the movement of his arms is an example of Reinforcement learning.

game Example:— Suppose there is an AI agent present within a maze environment, and his goal is to find the diamond. The agent interacts with the environment by performing some actions and based on those actions, the state of the agent gets changed, and

It also receives a reward or penalty as feedback.

- The agent continues doing these three things (take action, change state / remain in the same state, and get feedback) and by doing these action, he learns and explores the environment.
- The agent learns that what actions lead to positive feedback or rewards and what actions lead to negative feedback penalty. As a positive reward, the agent gets a positive point and as a penalty it gets a negative point.



Terms used in Reinforcement learning.

- Agent() :— An entity that can receive/explore the environment and act upon it.
- Environment() :— A situation in which an agent is present or surrounded by. In RL, we assume the stochastic environment, which means it is random in nature.
- Action() :— Actions are the moves taken by an agent within the environment.
- State() :— State is a situation returned by the environment after each action taken by the agent.
- Reward() :— A feedback returned to the agent from the environment to evaluate the action of the agent.
- Policy() :— Policy is a strategy applied by the agent for the next action based on the current state.
- Value() :— It is expected long-term returned with the discount factor and opposite to the short-term reward.
- Q-Value() :— It is mostly similar to the Value, but it takes one additional Parameter as a current action (a).

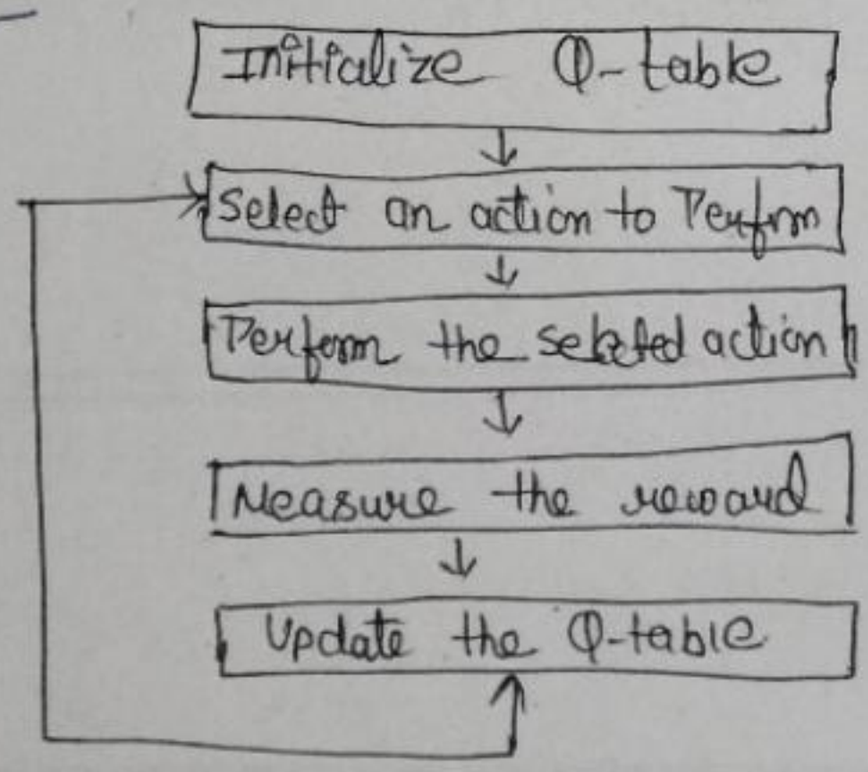
Reinforcement learning Algorithm's —

Reinforcement learning algorithms are mainly used in AI applications. The main used algorithms are :—

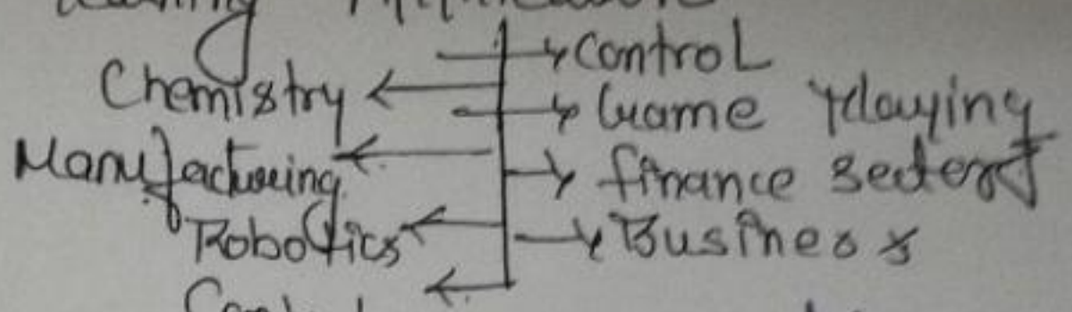
Q- learning :—

- Q-learning is an off policy RL algorithm, which is used for the temporal difference learning. The temporal difference learning methods are the way of comparing temporally successive predictions.
- It learns the value function Q(s,a) which means how good to take action "a" at a particular state "s".

? The below flowchart explain the working of Q-learning :—



Reinforcement learning Application



- Robotics :- RL is used in Robot Navigation, Robo-soccer, walking etc.
- Control :- RL can be used for adaptive control such as factory processes, admission control in telecommunication, Helicopter Pilot is an example of reinforcement learning.
- Game Playing :- RL can be used in Game Playing such as tic-tac-toe, chess etc.
- Chemistry :- RL can be used for optimizing the chemical reactions.
- Business :- RL is now used for business strategy planning.
- Manufacturing :- In various automobile manufacturing companies, the robots use deep reinforcement learning to pick goods and put them in some containers.
- finance sector :- The RL is currently used in the finance sector for evaluating trading strategies.

Summary :