**1. What is the concept of human learning? Please give two examples.**

Human Learning is the process acquiring the knowledge, skills through experience, study, or instructions.

Two examples of Human Learning

- Learning to ride a bike
- A children learns to walk

**2. What different forms of human learning are there? Are there any machine learning equivalents?**

There are several different forms of human learning

**1. Classical Conditioning** - It is a type of learning where we respond to a certain type of action. Example: Ringing a bell indicates a dog with the presentation of food.

**2. Observational learning** – In this type of learning we learn through observations.

**3. Cognitive Learning** – This type of learning involves in gaining the knowledge and understanding. Example: By reading books, attending lectures etc…

These are several forms of human learning's.

Yes, classical conditioning is related to reinforcement learning, which are used in some type RL algorithms. Observational learning can be related to supervised learning because supervised learning observes the labels and cognitive learning can be unsupervised, because gaining patterns, finding relationships.

**3. What is machine learning, and how does it work? What are the key responsibilities of machine learning?**

Machine learning is the field of computer science and artificial intelligence where that gives the machines to learn without explicitly being programmed.

It works by taking data in and using some statistical methods to identify the patterns, relationships within the data. The machine learning algorithms uses these patterns to make predictions or decisions about new data.

The key responsibilities of machine learning are

Data collection and preparation, Feature Engineering and feature selection, Model training, Deployment and maintenance.

**4. Define the terms "penalty" and "reward" in the context of reinforcement learning.**

In Reinforcement learning, the machine is referred as an agent.

If an agent does any mistake it gets penalty for doing mistake it is a sign of negative feedback and need to update its policies. If an agent does the work correctly it gets a reward for correct work, it is a sign of positive feedback.

**5. Explain the term "learning as a search"?**

It is the process of exploring and evaluating different possible solutions and strategies for find the best possible optimal solution.

**6. What are the various goals of machine learning? What is the relationship between these and human learning?**

The various goals of machine learning are

Prediction, clustering, anomaly detection, optimization, finding relationships

There goals of machine learning are similar to the goals of human learning. Humans also make predictions, classify, group similar items, detect anomalies based on information.

Many machine leaning algorithms are based on observational and cognitive learning approaches. But there is a difference between human learning and machine learning,

Machine learning is focuses on specific tasks or problems, and well known for speed and efficiency. Human learning is adaptable involves in wide range of questioning throughout learning process.

**7. Illustrate the various elements of machine learning using a real-life illustration.**

The various elements of machine learning using the example of a detecting malicious twitter bots.

**1. Data:** The first step in detecting malicious twitter bots is to collect and label the data. The data consists of number of tweets, age of account, likes, followers and other.

**2. Feature Engineering and selection**: Next, the collected data is to be cleaned and prepare for model building like handling missing values, treating outliers, formatting data and feature selection involves in selecting the necessary features that are required for detecting the malicious bots, the process involves is correlation matrix, Variance inflation factor. Etc…

**3. Algorithm selection:** There are many machine learning algorithms but we cannot use all them at a time. We need to make some assumptions on data and choose the algorithms accordingly.

**4. Model training:** Once the data is prepared, the algorithms are trained on the labelled data. The algorithm learns to recognize patterns in data that are associated with malicious bots and differentiate them for normal bots.

**5. Evaluation:** After training the algorithm, it is evaluated on the new test data to check its performance on detecting malicious bots.

**6. Deployment:** Finally, the model is integrated into twitter system to identify the malicious bots.

**8. Provide an example of the abstraction method.**

Abstraction in general is the process of eliminating or hiding the complex information.

So the same way works in machine learning. One example is the process reducing the irrelevant features using dimensionality reduction techniques like PCA, LDA, t-sne.

Means preserving only the relevant or important information in order to reduce the complexity.

**9. What is the concept of generalization? What function does it play in the machine learning process?**

Generalization is the ability of a machine learning model to accurately predict the outcome of new unseen data that is not encountered before. If a model is generalized then it can able to predict the outcomes accurately. To achieve a generalized model, the model must be able identify underlying patterns, relationships in training data this refers to the learning the essence of the data.

**10. What is classification, exactly? What are the main distinctions between classification and regression?**

Classification is a supervised machine learning task, we the target variable will in the discrete form.

The main difference in between classification and regression is, In regression the output feature is in continuous form whereas in classification the output feature is discrete form.

The performance of a regression problem is evaluated using r2 and adjusted r2 score and performance of a classification model is evaluated using accuracy ,recall, precision, f1-score ,ROC-AUC scores.

**11. What is regression, and how does it work? Give an example of a real-world problem that was solved using regression.**

Regression is a type of supervised learning algorithm, that is used to predict a continuous numerical values, such as weight, temperature, age based one or more input features.

Regression works by fitting a mathematical model to the training data that describes the best relationship between input features and output feature. The main goal is to reduce the difference between predicted and actual values.

Example: Predicting the stock prices based on historical data.

**12. Describe the clustering mechanism in detail.**

Clustering is a type of unsupervised learning in machine learning. Clustering means organizing the data into groups which shows the internal structure of data.

Example: Market segmentation, Underlying patterns, rules, Summarization etc…

Clustering is done based on two measurements or similarity measure

1. Similarity by correlation 2. Similarity by distance

Similarity measure shows the similarity or dissimilarity between any two data points and distance metrics include Euclidean distance, cosine similarity, jaccard similarity. Etc…

Majority of the clustering algorithms use similarity by distance.

There are various clustering algorithms are there including k-means clustering, hierarchical clustering, and DBSCAN.

**K-means** clustering is one of the most popular clustering algorithm. It works by selecting k random cluster centers and then assigns each data point to the nearest cluster based on similarity measure. After adding each data point to the cluster the cluster centroid is updated by computing the mean of all the data points in each cluster.

There is an updated version of k-means algorithm called K-means++. The only difference is in K-means we select the initial k-clusters randomly but in K-means++ algorithm it selects the clusters using an intelligent approach.

To select the optimal 'K' value we use different methods like **Elbow method**, **silhouette method**. Etc…

**Hierarchical clustering,** this algorithms works by recursively merging similar clusters together until all the data points belong to a single cluster. This can be done using either a bottom-up approach (**Agglomerative**) or a top-down approach (**Divisive**). To represent the hierarchical cluster we use **dendogram**.

**DBSCAN :** (**Density-Based Spatial Clustering of Applications with Noise**) the algorithm is based on density of the data points.

The algorithm works by identifying points that are in dense regions of the data and classifying them as core points and grouping together neighbouring and reachable non-core points. The algorithm has two parameters those are **MinPts** and **eplison (€)** that are required to form a dense region.
The algorithms has some key terms

**1. Core points**: Point that have at least MinPts points within a radius of epsilon (€).

**2. Border points:** Points that are within the radius of € of a core point but have less than the MinPts within that radius.

**3. Noise points:** Points that are neither core points nor border points.

**13. Make brief observations on two of the following topics:**

**i. Machine learning algorithms are used**

**ii. Studying under supervision**

**iii. Studying without supervision**

**iv. Reinforcement learning is a form of learning based on positive reinforcement.**

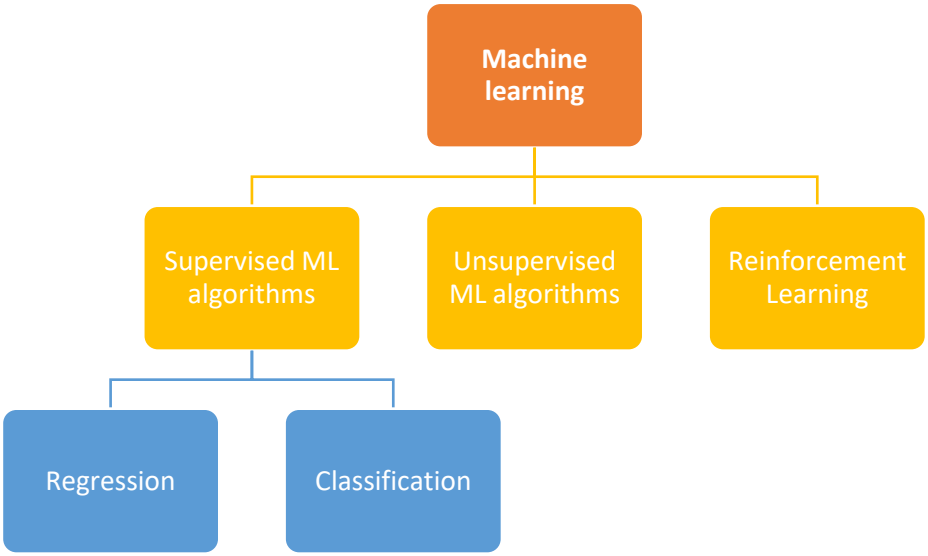
## i. Machine learning algorithms are used

Machine learning algorithms are classified into 3 types

1. Supervised Machine learning algorithms

2. Unsupervised Machine learning algorithms

3. Reinforcement Learning algorithms




**1. Supervised Machine learning algorithms**

In Supervised Machine learning algorithms there are input and output variables in other words we call it as labelled data. Based on the input features we need to predict the output or target feature.

There supervised ML algorithms are classified into 2 groups

1. Regression – Where the output variable is continuous

Regression algorithms include - Linear regression, Polynomial regression, Support vector regression, Decision tree regressor, Random Forest regression, AdaBoost regression, XGBoost regression, GradientBoosting Regression, K-nearest neighbours

2. Classification – Where the output variable is in discrete form.

Classification algorithms include – Logistic regression, Support Vector classifier, Decision Tree classifier, Random Forest classifier, AdaBoost classifier, XGBoost classifier, GradientBoosting classifier, K-nearest neighbours, Naïve Bayes

**2. Unsupervised Machine learning algorithms**

In unsupervised machine learning algorithms tries to organize the data into clusters based on internal data structure.

Unsupervised ML algorithms include

K-means, K-means++, hierarchical clustering, DBSCAN

**3. Reinforcement Learning**

Reinforcement learning is a type of machine learning that involves an agent interacting with an environment to learn optimal actions to take in different situations. The goal of reinforcement learning is to learn a policy that maximizes a reward signal over time.

Key components of Reinforcement learning are

Environment, agent, actions, Rewards

Main algorithms used in RL are

Q-learning, Policy Gradient. Etc…

**ii. Studying under supervision**

Studying under supervision typically refers to a learning situation in which a student is guided and supported by a teacher, tutor, or mentor. This type of learning can take many different forms, including one-on-one tutoring, group study sessions, online learning with a mentor, or apprenticeships. Supervisors may provide instruction, offer feedback on assignments or assessments, answer questions, or provide general guidance and support.

Studying under supervision is particularly effective for learners who benefit from structure, support, and feedback. It can help learners develop their skills and knowledge more quickly and effectively than they would on their own.