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

**Human Learning** is defined as a relatively permanent change in a person’s knowledge or behaviour as a result of experience, or it is a result of natural consequences where cognition, memory and intelligence can be an underlying mechanism so that people can perceive, process and apply information for natural adaption.

Examples may include:

i) Daily human chores.

ii) Abiding Safety protocols

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

There are several types of human learning, few of them include are:

i) Associative Learning

ii) Observational Learning

iii)Cognitive Learning

iv) Implicit Learning

v) Explicit Learning

vi) Experimental Learning

When it comes to machine learning, there are various techniques and approaches that parallel some aspects of human learning:

i) Supervised Learning: Similar to explicit learning, supervised learning involves training a machine learning model using labelled examples, where the desired outputs are provided.

ii) Unsupervised Learning: Unsupervised learning is akin to implicit learning, where the model learns from unlabeled data without specific guidance. It seeks to discover patterns, structures, or relationships in the data.

iii) Deep Learning: Deep learning models, such as neural networks, attempt to simulate aspects of human cognitive learning. They consist of multiple layers of interconnected artificial neurons and can learn hierarchical representations of data.

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

Machine Learning is a part of AI or a sub field of AI that involves the study of statistical techniques and computational models that allow systems to learn from data, identify patterns, and make accurate predictions or take actions based on that data.

A typical machine learning algorithm follows:

* Data Collection/ ingestion
* Data preprocessing
* Feature Extraction
* Model Selection
* Training
* Evaluation
* Deployment

The key responsibilities of ML include:

* Data related responsibility: It should collect the data from different and safe resources, where we can apply different data transformation techniques. It should also be responsible for safeguarding the privacy and security of sensitivity of data.
* Model related responsibility: The machine learning algorithms must ensure proper model selection and model training on the provided dataset. It also be available for proper evaluation of the data using different evaluation metrics.
* Ethical responsibility: Considering the ethical implications of the machine learning process and the potential impact on stakeholders. This involves evaluating the ethical consequences of decisions made by the model and taking steps to mitigate any harmful or unintended effects.

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

Reinforcement Learning is a process of gamifying the learning process. This type of learning process uses a reward and penalty system to train an AI system. If it makes the right move, it gets rewarded. If it makes a mistake, it receives a penalty

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

Learning can be conceptualized as a search process, where the learner explores a space of possible solutions or knowledge states to find an optimal or desirable outcome. This perspective views learning as a problem-solving task, where the learner aims to navigate through a space of possibilities to discover the best solution or acquire new knowledge.

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

The goals of machine learning are: 1) To make the computers smarter, more intelligent. The more direct objective in this aspect is to develop systems (programs) for specific practical learning tasks in application domains. 2) To develop computational models of human learning process and perform computer simulations.

There is a typical relationship between human learning and machine learning is the informed decision, Human learning theories and cognitive psychology provide insights into effective learning strategies, transfer of knowledge, and cognitive biases, which can guide the development of more efficient and robust machine learning algorithms. Secondly, Machine learning algorithms can provide feedback to human learners, aiding their learning process. Human learning and machine learning have complementary roles. While machine learning algorithms excel at processing large amounts of data, identifying complex patterns, and making accurate predictions, human learning incorporates higher-order thinking, creativity, abstract reasoning, and ethical decision-making, which are currently beyond the capabilities of machine learning systems.

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

Lets illustrate a real life illustration of credit card default prediction using machine learning as follows:

1) data collection: Data is collected from database where data is being recorded. Using proper logging we will retrieve the data from database.

2) data transformation: Once the data is collected it is then transformed as per model. The process of model transformation may include tasks like check for null values, check for cat and num columns, encoding the categorical values etc.

3)Feature engineering: This is also a process of data transformation where features get split into train and test data. And these are passed through encoding techniques, scaling etc.

4) Model Training: The data set is now ready for model training. Since it is a classification problem we will consider different classifier like logistic regression, random forest classifier etc. Model is trained on number of classifier to get best accuracy.

5) Evaluation: Once the model training is done, the same model is passed through prediction and test data is brought into to find the accuracy of the model. The best accuracy score model will be used for future prediction.

6) Deployment: Now this model is available for deployment to any cloud server.

8. Provide an example of the abstraction method.

One example of the abstraction method in machine learning is feature engineering. Feature engineering involves transforming or selecting the raw input data into a new representation that captures relevant information or patterns for a specific machine learning task. It is a form of abstraction where the focus is on extracting meaningful features that can improve the performance of the learning algorithm

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

The concept of generalization in machine learning refers to the ability of a trained model to accurately perform well on unseen or new data that was not part of the training set. Generalization is the ultimate goal of machine learning as it indicates that the model has learned underlying patterns and relationships from the training data and can apply that knowledge to make accurate predictions or decisions on previously unseen examples.

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

Classification refers to the type of class of data, where the target is defined into discrete data point, that may be binomial or multivariate distribution. When the target is set to be discrete we will consider it is a classification type problem. Where as regression problem will generate a target column of continuous values.

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

Regression models can provide insights into the relationship between input features and the predicted continuous output. Coefficients or weights associated with features can indicate the magnitude and direction of their influence on the predicted value.

An example of real life problem would be estimated time required for a delivery person to deliver food. It will provide the approximate time in minutes, which will be a continuous type.

12. Describe the clustering mechanism in detail.

Clustering is an unsupervised learning technique used to discover inherent patterns, structures, or groups in a dataset without prior knowledge of class labels or categories. It aims to partition the data into subsets or clusters, where instances within each cluster are more similar to each other than to instances in other clusters. Clustering helps in data exploration, understanding data distributions, identifying outliers, and generating insights.

The clustering mechanism varies depending on the specific clustering algorithm used, but here is a general overview of the clustering mechanism:

**Initialization**: The clustering mechanism begins by initializing the clusters. The number of clusters may be predefined or determined automatically by the algorithm. Initial cluster centroids or parameters are assigned based on a random selection, heuristics, or other initialization techniques.

**Assignment Step:**

**a. Distance Calculation:** Each data point is compared with the cluster centroids or neighboring data points to calculate its similarity or dissimilarity using a distance metric.

**b. Assignment:** The data point is assigned to the cluster that exhibits the closest similarity based on the chosen distance measure. This assignment is based on minimizing the distance or maximizing the similarity between the data point and the cluster.

**Update Step:**

**a. Cluster Centroid Recalculation:** After assigning the data points to clusters, the cluster centroids or parameters are updated to reflect the current assignment. This is typically done by calculating the mean, median, or other central tendency measures of the data points within each cluster.

**b. Iteration:** The assignment and update steps are repeated iteratively, with data points being reassigned to clusters and cluster centroids being updated until a convergence criterion is met. The convergence criterion can be a maximum number of iterations, a threshold for the change in cluster assignments or centroids, or other stopping conditions.

**Convergence and Final Clusters**: The clustering mechanism converges when the algorithm reaches a stable state, where further iterations do not significantly change the cluster assignments or cluster centroids. At this point, the final clusters are obtained, and each data point is assigned to a specific cluster.

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

i. Machine learning algorithms are used

ii. Studying under supervision: Supervised learning involves training a model using labeled data, where each data instance has corresponding input features and known target labels or outputs. The goal is to learn a mapping or relationship between the input features and the target labels, enabling the model to make predictions or classify new, unseen instances.

Key Characteristics of Supervised Learning:

**Labeled Training Data**: Supervised learning algorithms require a dataset with labeled examples, consisting of input features and their corresponding target labels.

**Prediction or Classification**: The focus is on predicting or classifying instances into predefined classes or categories or estimating a continuous target value.

**Training with Supervision**: During the training phase, the model learns from the labeled data by minimizing an objective function (e.g., loss or error function) that measures the discrepancy between predicted and actual labels.

**Evaluation with Test Data**: The trained model's performance is evaluated using a separate set of test data, measuring metrics like accuracy, precision, recall, or mean squared error, depending on the specific task.

Examples: Supervised learning tasks include image classification, sentiment analysis, spam detection, regression analysis, and speech recognition.

iii. Studying without supervision: Unsupervised learning deals with unlabeled data, where the training dataset consists only of input features without any corresponding target labels. The goal is to uncover underlying patterns, structures, or relationships in the data without prior knowledge of the output labels.

Key Characteristics of Unsupervised Learning:

**Unlabeled Data:** Unsupervised learning algorithms operate on unlabeled data, where only input features are available.

**Pattern Discovery or Data Exploration:** The focus is on discovering hidden structures, similarities, or clusters in the data, identifying outliers, or reducing the dimensionality of the dataset.

**Training without Supervision:** Without target labels, the model learns by finding inherent patterns or regularities in the input data using techniques like clustering, dimensionality reduction, or generative modeling.

**Evaluation Challenges:** Evaluation in unsupervised learning can be more subjective and challenging since there are no ground truth labels. Evaluation often involves visual inspection, comparison with domain knowledge, or using internal clustering or reconstruction metrics.

Examples: Unsupervised learning tasks include clustering customer segments, anomaly detection, topic modeling, recommender systems, and feature extraction.

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