ML- Assignment 2

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

**Ans.** *Human learning is the process by which one acquire new knowledge, skills, through observations and interaction.*

*Two examples are learning a new language and riding a bicycle.*

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

**Ans.** *Different forms of human learning are:*

* *Classical Conditioning- a dog that learns to associate the sound of a bell with food and starts to salivate at the sound of the bell.*
* *Operant Conditioning- a child learns that if they clean their room, they will receive a reward.*
* *Observational Learning- a child learns to tie their shoes by watching their parent or caregiver do it.*
* *Insight Learning- a person struggling with a difficult math problem suddenly sees the solution.*

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

**Ans.** *Machine learning is a type of artificial intelligence that allows computer systems to automatically learn and improve from experience without being explicitly programmed.*

*The key responsibilities of machine learning are:*

* *Data Preparation*
* *Model Development*
* *Model Training*
* *Model Evaluation*
* *Model Deployment*
* *Monitoring and Maintenance*

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

**Ans.** *A "penalty" is negative feedback given to the agent when it performs an undesired action or fails to achieve a goal. Penalties are used to discourage the agent from taking similar actions in the future.*

*A "reward" is positive feedback given to the agent when it performs a desired action or achieves a goal. Rewards are used to encourage the agent to take similar actions in the future.*

**5. Explain the term “learning as a search”?**

**Ans***. "Learning as a search" is a concept in artificial intelligence and machine learning that refers to the idea of finding the best solution or strategy to solve a problem.*

*In a machine learning algorithm, the search might involve trying different models, parameter settings, or features to find the one that best fits the data and provides the most accurate predictions. Similarly, in a reinforcement learning algorithm, the search might involve trying different actions and strategies to maximize the reward signal.*

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

**Ans.** *Various goals of Machine Learning includes:*

* *Prediction*
* *Classification*
* *Clustering*
* *Recommendation*

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

**Ans.** *Various elements of machine learning includes:*

* *Data Collection*
* *Data Pre-processing*
* *Feature Extraction*
* *Model Selection*
* *Training*
* *Evaluation*
* *Deployment*

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

**Ans.** *An example of abstraction method in programming is object-oriented programming, where a programmer can create classes that represent real-world entities or concepts such as cars, animals, or employees. These classes can contain properties, methods, and behaviour that simulate the behaviour of the real-world entity they represent.*

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

**Ans.** *Generalization is a key concept in machine learning that refers to the ability of a trained model to perform well on new, previously unseen data, beyond the data that was used to train the model. In other words, a model that can generalize well is able to make accurate predictions on data it has never seen before.*

*The concept of generalization is important in machine learning because the ultimate goal of a machine learning model is to perform well on real-world data, not just on the data it was trained on. Overfitting is a common problem in machine learning where a model becomes too complex and fits the training data too closely, leading to poor generalization performance on new data.*

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

**Ans.** *Classification is a type of supervised machine learning task that involves predicting the category or class of a given input. In classification, the machine learning algorithm is trained on labelled data where the input is associated with a specific output class. The goal of classification is to train a model that can accurately predict the class of a new, unseen input based on its features.*

*The main distinctions between classification and regression:*

* *Output type*
* *Performance Evaluation*
* *Algorithm Selection*

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

**Ans.** *Regression is a type of supervised machine learning algorithm that is used to predict a continuous output variable based on one or more input features. In regression, the algorithm learns a function that maps the input features to the output variable by minimizing the difference between the predicted output and the true output.*

*Here is an example of a real-world problem, suppose a real estate agent wants to predict the selling price of a house based on its size and number of bedrooms. They can use a linear regression algorithm to learn a function that maps the house size and number of bedrooms to the selling price. The agent can train the algorithm on a dataset of houses that were recently sold, where each data point includes the house size, number of bedrooms, and selling price. Once the algorithm is trained, the agent can input the size and number of bedrooms for a new house and get a predicted selling price as the output.*

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

**Ans.** *The goal of clustering is to find patterns in the data and to identify groups that have similar properties or behaviours. Clustering is an unsupervised learning technique, meaning that it does not rely on labelled data to make predictions or classify data.*

*The clustering mechanism involves several steps:*

* *Selecting the Data*
* *Choosing the Distance*
* *Choosing the Clustering Algorithm*
* *Initialization*
* *Assignment*
* *Updating*
* *Iteration*
* *Evaluation*

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

**i. Machine learning algorithms are used**

**Ans.** *Here are brief descriptions of some popular Machine Learning algorithms:*

*Decision Trees: A tree-like model used for classification and regression tasks.*

*Random Forests: An ensemble of decision trees used for classification, regression, and feature selection.*

*Logistic Regression: A statistical model used for binary classification.*

*Support Vector Machines: A model that separates data into classes using a hyperplane in a high-dimensional space.*

*K-Nearest Neighbours: A model that classifies data points based on their similarity to neighbouring data points.*

*K-Means Clustering: A model that groups data points into clusters based on their similarity.*

*Neural Networks: A model inspired by the structure of the human brain, used for complex classification and regression tasks.*

**ii. Studying under supervision**

**iii. Studying without supervision**

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

**Ans.** *Reinforcement learning is a form of learning that is based on trial-and-error interactions with an environment, in which an agent learns to take actions that maximize a reward signal. The reward signal can be positive or negative, and the agent's goal is to learn a policy that maps states to actions in a way that maximizes the cumulative reward over time.*

*In reinforcement learning, the agent learns through a process of trial and error, where it takes an action in the environment, receives a reward or penalty, and updates its policy accordingly. The agent's goal is to learn a policy that maximizes the expected cumulative reward over time.*

*While reinforcement learning does use rewards, it is not solely based on positive reinforcement. The reward signal can be negative, and the agent learns to avoid actions that lead to negative rewards or penalties. This is known as negative reinforcement or punishment.*