**IT-511 (ASSIGNMENT)**

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**Machine Learning (ML):**

Machine learning is a subset of artificial intelligence that enables computers to learn and improve their performance on a specific task through experience, without being explicitly programmed. It involves the use of algorithms and statistical models that allow systems to recognize patterns in data and make predictions or decisions based on that data.

**Types of Machine Learning:**

There are three main types of machine learning: supervised learning, unsupervised learning, and reinforcement learning.

**Supervised Learning:**

**Definition:** In supervised learning, the algorithm is trained on labeled data, where the input data and the corresponding output are provided. The algorithm learns to map the input data to the correct output during training and can then make predictions on new, unseen data.

**Example:** Email spam classification is a common example of supervised learning. The algorithm is trained on a dataset of emails labeled as spam or non-spam, and it learns to classify new emails into these categories based on their content.

**Unsupervised Learning:**

**Definition:** Unsupervised learning involves training algorithms on unlabeled data. The system tries to learn the patterns and the structure from the data without any explicit supervision.

**Example:** Clustering is a typical unsupervised learning task. For instance, clustering can be used to group similar customer purchase behavior in a retail dataset without knowing specific categories in advance.

**Semi-supervised learning:**

**Definition:**Semi-supervised learning is a type of machine learning that falls between supervised learning (where all the data is labeled) and unsupervised learning (where none of the data is labeled). In semi-supervised learning, the algorithm is trained on a dataset that contains both labeled and unlabeled data. This learning paradigm is common in scenarios where obtaining labeled data is expensive or time-consuming, but unlabeled data is abundant.

**Example:Image Recognition: Consider a scenario where you have a vast collection of images, but only a fraction of them are labeled. Semi-supervised learning can be used to train a model on the limited labeled data and the extensive unlabeled data. The model can learn to recognize patterns and features from the unlabeled images, which can enhance its accuracy when classifying new, unseen images.**

**Reinforcement Learning:**

**Definition:** Reinforcement learning involves an agent that interacts with an environment and learns to make decisions by receiving rewards or penalties. The agent learns to achieve a goal in an uncertain, potentially complex environment.

**Example:** Game playing, such as training a computer program to play chess or Go, is often used as an example of reinforcement learning. The program learns which moves are good or bad based on the outcomes of the game.

**Differentiation Between Types of Machine Learning:**

**Supervised vs. Unsupervised Learning:**

Supervised learning uses labeled data, while unsupervised learning uses unlabeled data.

Supervised learning predicts output based on input-output pairs, whereas unsupervised learning finds hidden patterns or intrinsic structures in input data.

**Supervised vs. Reinforcement Learning:**

In supervised learning, the algorithm is provided with labeled data and learns to predict output based on input features. In reinforcement learning, the algorithm learns to make sequences of decisions to maximize a reward signal.

**Unsupervised vs. Reinforcement Learning:**

Unsupervised learning finds patterns and structures in unlabeled data without any explicit reward signal. Reinforcement learning, on the other hand, learns to make decisions to maximize rewards obtained from interacting with an environment.