Machine Learning- Class 2

1. What are Overfitting and Underfitting?

Overfitting and underfitting describe how well a machine learning model learns from training data.

- **Overfitting** occurs when a model learns the training data too well, including noise and minor fluctuations. Such a model performs very well on training data but poorly on unseen or new data.

- **Underfitting** occurs when a model is too simple to capture the underlying pattern in the data. It performs poorly on both training and testing data.

2. What is the difference between Supervised and Unsupervised Learning?

These learning types differ based on the availability of labeled data.

- **Supervised Learning:**
  Uses labeled data, where both input features and target outputs are known. The model learns by comparing its predictions with the correct answers.

- **Unsupervised Learning:**
  Works with unlabeled data and identifies hidden patterns, structures, or groupings without predefined outcomes.

Key Difference:
Supervised learning predicts known outcomes, while unsupervised learning discovers unknown patterns.

3. What is a training dataset and a testing dataset? Why is data splitting important?

- **Training Dataset:**
  The portion of data used to train the machine learning model and learn patterns.
- **Testing Dataset:**
  The portion of data used to evaluate the model's performance on unseen data.

Importance of Data Splitting:

- Prevents model bias
- Evaluates generalization ability
- Detects overfitting or underfitting

Splitting data ensures that the model can perform reliably on new, real-world data.

4. What is feature scaling and why is it needed in some algorithms?

Feature scaling is the process of standardizing or normalizing input features so that they have similar ranges or distributions.

Why Feature Scaling Is Needed:

- Prevents features with larger values from dominating the model
- Improves convergence speed in optimization algorithms
- Enhances performance of distance-based algorithms

Feature scaling is especially important for algorithms such as linear regression, support vector machines, and k-nearest neighbors.

5. How does a Linear Regression model work?

Linear Regression is a supervised machine learning algorithm used to model the relationship between one or more input variables (features) and a continuous output variable (target). The main objective of linear regression is to predict the target value by finding the best-fitting straight line through the data points.

The model assumes that there is a linear relationship between the input features and the target variable. This relationship is represented using a linear equation, where each input feature is multiplied by a coefficient that indicates its influence on the output.

During training, the model compares its predicted values with the actual values present in the dataset. The difference between these values is called the error. The goal of the model is to minimize this error across all data points. To achieve this, linear regression uses an optimization process to adjust the coefficients so that the overall error is as small as possible. Commonly, this is done by minimizing the sum of squared errors, which penalizes larger mistakes more strongly.

Once the optimal coefficients are learned, the model can be used to make predictions on new, unseen data by applying the learned relationship between inputs and output.

Key Characteristics of Linear Regression:

- Predicts continuous numerical values
- Easy to interpret and explain
- Works best when the relationship between variables is linear
- Sensitive to outliers and feature scaling