1)Describe the decision tree classifier algorithm and how it works to make predictions.

Ans- A decision tree algorithm is a machine learning algorithm that uses a decision tree to make predictions. It follows a tree-like model of decisions and their possible consequences. The algorithm works by recursively splitting the data into subsets based on the most significant feature at each node of the tree.

2) Provide a step-by-step explanation of the mathematical intuition behind decision tree classification.

Ans- First, we calculate the percentage of records that fall into each class (p). Then we square those numbers and add them together. Finally, we subtract that number from one. Because decision trees split data into more than one group, our final step is to calculate the weighted average of the Gini Impurity in each group.

3) Explain how a decision tree classifier can be used to solve a binary classification problem.

Ans- A Binary Decision Tree is a structure based on a sequential decision process. Starting from the root, a feature is evaluated and one of the two branches is selected. This procedure is repeated until a final leaf is reached, which normally represents the classification target you're looking for.

4) Discuss the geometric intuition behind decision tree classification and how it can be used to make predictions.

Ans- Decision Trees are easy & Simple to implement & interpreted. Decision Tree is a diagram (flow) that is used to predict the course of action or a probability. Each branch of the decision tree represents an outcome or decision or a reaction. Decision Trees can be implemented in a variety of situations from personal to complex situations. The sequence of steps will give a better understanding easily.

In Programming, we regularly use If-else conditions, even the Decision Tree working process is similar to an If-else condition.

1. **Root Node:**Root Node is a top node with the base feature.
2. **Parent Node:**Nodes that get their origin from a root node or this can be represented as a decision node where the decision of Yes/No or True/False or prediction turn happens.
3. **Child Node:**these nodes get their origin from a parent node. If the decision made from a parent node is not satisfactory then these nodes will be created. Until we arrive at the final node where we have pure domination in a class (Yes/No) means that until we arrive at the leaf node.
4. **Leaf Node:**Can also be called a terminal Node or a final decision node where we will conclude.

5) Define the confusion matrix and describe how it can be used to evaluate the performance of a classification model.

Ans- A Confusion matrix is an N x N matrix used for evaluating the performance of a classification model, where N is the total number of target classes. The matrix compares the actual target values with those predicted by the machine learning model.

A confusion matrix is a table that allows you to visualize the performance of a classification model. You can also use the information in it to calculate measures that can help you determine the usefulness of the model. Rows represent predicted classifications, while columns represent the true classes from the data.

6) Provide an example of a confusion matrix and explain how precision, recall, and F1 score can be calculated from it.

Ans-

Accuracy = Correct Predictions / Total Cases \* 100%

Accuracy = (TP + TN) / (TP + TN + FP + FN +) \* 100% Where True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN).

Precision = TP / (TP + FP) \* 100%

Recall = TP / TP + FN.

F1 Score = 2 \* Precision \* Recall / Precision + Recall.

7) Discuss the importance of choosing an appropriate evaluation metric for a classification problem and explain how this can be done.

Ans- Evaluation metrics are used to measure the quality of the statistical or machine learning model. Evaluating machine learning models or algorithms is essential for any project. There are many different types of evaluation metrics available to test a model.

The key classification metrics: Accuracy, Recall, Precision, and F1- Score. The difference between Recall and Precision in specific cases. Decision Thresholds and Receiver Operating Characteristic (ROC) curve.

8) Provide an example of a classification problem where precision is the most important metric, and explain why.

Ans- Email Spam detection:This is one of the example where Precision is more important than Recall. Quick Recap: Precision: This tells when you predict something positive, how many times they were actually positive

9) Provide an example of a classification problem where recall is the most important metric, and explain

why. Another example would be hiring when there are a lot of similar candidates. Recall is more important than precision when the cost of acting is low, but the opportunity cost of passing up on a candidate is high.