1. Accuracy

Definition: Accuracy is the proportion of correct predictions (both true positives and true negatives) among the total number of cases examined.

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

Explanation: Accuracy measures the overall effectiveness of a model by indicating how often it correctly predicts both the positive and negative classes. However, it may not be reliable in cases where the class distribution is imbalanced (i.e., when one class is much more frequent than the other).

2. Precision

Definition: Precision is the proportion of true positive predictions among all positive predictions made.

Formula:

$$\text{Precision} = \frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}}$$

Explanation: Precision is a measure of a classifier's exactness. It tells us how many of the positive predictions made by the model are actually correct. High precision means that the model has a low false positive rate.

3. Recall (Sensitivity)

Definition: Recall (or sensitivity) is the proportion of true positive predictions among all actual positive cases.

Formula:

Explanation: Recall is a measure of a classifier's completeness. It tells us how many of the actual positive cases were correctly identified by the model. High recall means that the model has a low false negative rate.

4. F1 Score

Definition: The F1 score is the harmonic mean of precision and recall, which balances the two metrics.

Formula:

$$\text{F1 score} = 2 * \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$$

Explanation: The F1 score provides a single metric that balances the trade-off between precision and recall, especially useful in scenarios where you need to account for both false positives and false negatives. It is particularly valuable when you have an imbalanced dataset.

5. Confusion Matrix

Definition: A confusion matrix is a table that shows the number of true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN).

Structure:

		Predicted	
		Negative **(N)** **-**	Positive **(P)** **+**
Actual	Negative **-**	True Negative **(TN)**	**False Positive (FP) Type I Error**
	Positive **+**	**False Negative (FN) Type II Error**	True Positive **(TP)**

Explanation: The confusion matrix provides detailed insights into the performance of the classification model by showing the actual versus predicted classifications. Each cell in the matrix represents a specific type of prediction:

- **True Positive (TP):** The model correctly predicts the positive class.
- **True Negative (TN):** The model correctly predicts the negative class.
- **False Positive (FP):** The model incorrectly predicts the positive class (Type I error).
- **False Negative (FN):** The model incorrectly predicts the negative class (Type II error).

Using the confusion matrix, you can derive other important metrics such as accuracy, precision, recall, and the F1 score.