

Performance Metrics

- To evaluate the performance of the machine Learning, metrics are used.
 - These metrics help quantify how well a model is performing, particularly in classification tasks.
1. **Confusion metrics:** It is a table that summarizes the performance of a classification model by comparing predicted labels with actual labels.
 - The confusion metrics have 4 components:
 - True Positives (TP)
 - False Positive (FP)
 - True Negative (TN)
 - False Negative (FN)
 - The confusion matrix allows for the calculation of various performance metrics such as accuracy, precision, recall, and F1 score.
 2. **Accuracy:** Is the ratio of correctly predicted instances to the total instances in the dataset.
 - Formula: $\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$
 - Accuracy is usually for balanced Datasets.
 3. **Precision:** measures the proportion of true positive predictions among all positive predictions made by the model.
 - Formula: $\text{Precision} = \frac{TP}{TP+FP}$.
 - High precision indicates that fewer false positives are present.
 - Precision is particularly important in scenarios where false positives carry significant costs.
 4. **Recall:** measures the proportion of actual positives that were correctly identified by the model.
 - Formula: $\text{Recall} = \frac{TP}{TP+FN}$
 - High recall indicates that most positive instances are captured by the model.
 5. **F1 Score:** score is the harmonic mean of precision and recall. It provides a single metric that balances both precision and recall.
 - **Formula:** $F1 = 2 \cdot \left(\frac{\text{Precision} \cdot \text{Recall}}{\text{Precision} + \text{Recall}} \right)$.
 - The F1 score ranges from 0 to 1, where 1 indicates perfect precision and recall.
 - It is particularly useful when you need to find an optimal balance between precision and recall.
 6. **Cross-Validation:** Cross-validation is a technique used to assess how well a model generalizes to an independent dataset.
 - Split data into smaller sets
 - Train model on one set, test on another

- Repeat with different sets to ensure model works well on unseen data.
- Provides a more reliable estimate of model performance than a single train-test split.
- Helps in mitigating overfitting by ensuring that every data point has been used for both training and validation.