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**Class :** SY CSE AI **Batch:** B1

**Assignment 4**

**Problem Statement:**

In this assignment, we apply various machine learning evaluation metrics to assess the performance of a classification model. We are provided with a dataset consisting of actual and predicted values for a binary classification task. Using this data, we will create a confusion matrix and calculate key evaluation metrics, including accuracy, precision, recall, and F1 score.

**Task Overview:**

In this assignment, we evaluate a binary classification model's performance by analyzing the confusion matrix. The key steps involved are:

1. **Confusion Matrix** – To visualize the performance of the classification model.
2. **Accuracy** – To measure the proportion of correct predictions.
3. **Precision** – To evaluate the proportion of correct positive predictions.
4. **Recall** – To assess the proportion of actual positives correctly identified by the model.
5. **F1 Score** – To balance precision and recall in a single metric.

**Objective:**

1. **Evaluate Classification Model** – Assess the performance of a classifier using key metrics.
2. **Confusion Matrix Analysis** – Understand the relationship between actual and predicted values.
3. **Use Scikit-Learn for Metrics** – Leverage Python’s scikit-learn library to calculate various evaluation metrics.

**Tools and Resources:**

* **Software Used:** Google Colab
* **Libraries Used:** Numpy, Scikit-learn, Matplotlib, Seaborn

**Key Functions Used:**

1. **Confusion Matrix:** Visualizes the distribution of true and false predictions.
2. **Accuracy Score:** Measures the percentage of correct predictions.
3. **Precision Score:** Evaluates the fraction of true positive predictions.
4. **Recall Score**: Assesses the proportion of true positives identified.
5. **F1 Score:** Balances precision and recall through a single harmonic metric.

**Methodology:**

**1. Confusion Matrix:**

1. Built using actual and predicted labels to visualize true positives, true negatives, false positives, and false negatives.
2. Sample Confusion Matrix:

|  | **Predicted: Positive** | **Predicted: Negative** |
| --- | --- | --- |
| **Actual: Positive** | 4 (True Positive) | 1 (False Negative) |
| **Actual: Negative** | 1 (False Positive) | 4 (True Negative) |

**2: Metric Calculations:**

* + After creating the confusion matrix, we calculate the following evaluation metrics:
    - **Accuracy:** This metric measures the proportion of correct predictions made by the model. It is calculated using the formula:

True Positives + True Negatives

Accuracy=

Total Samples

* + - **Precision:** Precision evaluates the proportion of correctly predicted positive instances out of all instances predicted as positive. It is calculated using the formula:

True Positives

Precision =

True Positives + False Positives

* + - **Recall:** Recall measures the proportion of actual positive instances correctly identified by the model. It is calculated as:

True Positives

Recall =

True Positives + False Negatives

**F1 Score:** The F1 score is the harmonic mean of precision and recall. It provides a balanced view of the classifier's performance, especially in imbalanced datasets. It is calculated using the formula:

Precision × Recall

F1 = 2 ×

Precision + Recall

1. **Confusion Matrix Visualization:**
   * The confusion matrix is visualized using a heatmap to display the relationship between actual and predicted labels. This provides insights into how well the classifier distinguishes between the two classes (positive and negative).

**Advantages of Using Evaluation Metrics:**

1.Comprehensive assessment covering different performance aspects.

2.Balancing precision-recall trade-offs using the F1 score.

3.Helps optimize model performance.

**Challenges:**

* Handling imbalanced datasets where accuracy is insufficient.
* Balancing and interpreting precision, recall, and F1 score.

**Conclusion:**

This assignment highlighted the importance of evaluation metrics in understanding classification models:

* **Visualization:** Confusion matrix to gain performance insights.
* **Computation:** Accuracy, precision, recall, and F1 score calculations.
* **Learning:** Insights into the trade-offs and significance of evaluation metrics for effective model assessment.

Let me know if you need edits or enhancements!