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## **Assignment 4**

### **Problem Statement:**

Apply appropriate ML algorithm on a dataset. Create confusion matrix based on the data and find:

- a) Accuracy
- b) Precision
- c) Recall
- d) F-1 score

### **Objective:**

- To apply a supervised machine learning algorithm to predict customer response.
- To analyze the dataset and preprocess the data for better model performance.
- To evaluate model performance using a confusion matrix.
- To compute key classification metrics (Accuracy, Precision, Recall, F1-score).

### **Resources used:**

- Software used: Visual Studio Code
- Libraries used: Pandas, Matplotlib, Seaborn, SKLearn

### **Theory:**

Classification is a supervised learning technique where the model learns to map input features to predefined labels. The goal is to train a model that can accurately classify new data points into one of the given categories. In this assignment, we focus on binary classification (Customer will respond: Yes or No).

### **Confusion Matrix:**

A confusion matrix is a performance measurement tool for classification models. It consists of four components:

- True Positives (TP): Correctly predicted positive cases.
- True Negatives (TN): Correctly predicted negative cases.
- False Positives (FP): Incorrectly predicted positive cases (Type I Error).
- False Negatives (FN): Incorrectly predicted negative cases (Type II Error).

## Evaluation Metrics:

- Accuracy: Measures the overall correctness of the model.
- Precision: Measures how many predicted positive cases were actually positive.
- Recall: Measures how many actual positive cases were correctly predicted.
- F1-Score: Harmonic mean of precision and recall, balancing both metrics.

## Methodology:

### 1. Data Preprocessing:

- Load the dataset using Pandas.
- Handle missing values (imputation or removal).
- Encode categorical variables (e.g., gender) using one-hot encoding.
- Normalize numerical features using MinMaxScaler or StandardScaler.
- Split the dataset into training and testing sets (e.g., 75% training, 25% testing).

### 2. Choosing the ML Algorithm:

Since the problem is a binary classification task, suitable algorithms include:

- Logistic Regression
- Decision Tree Classifier
- Random Forest Classifier
- Support Vector Machine (SVM)
- K-Nearest Neighbors (KNN)
- Neural Networks (optional for advanced modeling)

### 3. Model Training & Prediction:

- Train the selected ML model on the training dataset.
- Predict customer responses on the test dataset.

### 4. Confusion Matrix & Performance Metrics Calculation:

- Compute the confusion matrix (True Positives, True Negatives, False Positives, False Negatives).
- Derive the following metrics from the confusion matrix:
  - a) Accuracy
  - b) Precision
  - c) Recall (Sensitivity)
  - d) F1-Score

**Conclusion:**

- The chosen ML model was able to predict responses with reasonable accuracy.
- Based on the evaluation metrics, the model's performance can be assessed for further improvements.
- Feature engineering and hyperparameter tuning could further enhance the model's effectiveness.