📘 Laboratory Practice III – Practical 5

Name: Anuj Sachin Dhole
Roll No: B21042
Class: BE CE A
Subject: Laboratory Practice III (Machine Learning)

🧪 Practical 5

🎯 Problem Statement:

Implement the **K-Nearest Neighbors (KNN)** classification algorithm on the **Diabetes dataset** and evaluate its performance using classification metrics.

✅ Tasks to Perform:

1. **Load and pre-process the dataset.**
2. **Perform feature scaling using Min-Max Scaler.**
3. **Split the dataset into training and testing sets.**
4. **Apply the K-Nearest Neighbors (KNN) algorithm.**
5. **Generate predictions on the test set.**
6. **Compute and display the Confusion Matrix.**
7. **Evaluate the model using the following metrics:**
   - Accuracy
   - Error Rate
   - Precision
   - Recall
8. **Visualize the confusion matrix using `ConfusionMatrixDisplay`.**

📂 Dataset:

Source: Diabetes Dataset on Kaggle
File Used: `diabetes.csv`

Step 1: Import Libraries

In [2]:
```
pip install --upgrade scikit-learn --user
# You are using an old version of sklearn. I methods you can perform your task:
# Update Library using this command:
#for importing ConfusionMatrixDisplay
```

```
Requirement already up-to-date: scikit-learn in c:\users\mbal pc-17\appdata\roaming\python\python37\site-packages (1.0.2)
Requirement already satisfied, skipping upgrade: numpy>=1.14.6 in c:\programdata\anaconda3\lib\site-packages (from scikit-learn) (1.16.2)
Requirement already satisfied, skipping upgrade: joblib>=0.11 in c:\programdata\anaconda3\lib\site-packages (from scikit-learn) (1.3.2)
Requirement already satisfied, skipping upgrade: threadpoolctl>=2.0.0 in c:\programdata\anaconda3\lib\site-packages (from scikit-learn) (3.1.0)
Requirement already satisfied, skipping upgrade: scipy>=1.1.0 in c:\programdata\anaconda3\lib\site-packages (from scikit-learn) (1.2.1)
Note: you may need to restart the kernel to use updated packages.
```

In [3]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import (
    confusion_matrix,
    accuracy_score,
    precision_score,
    recall_score,
    classification_report,
    ConfusionMatrixDisplay
)
```

Step 2: Load Dataset

In [4]:
```
df = pd.read_csv('diabetes.csv')
print("Dataset Loaded Successfully")
print(df.head())
```

```
Dataset Loaded Successfully
   Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI  \
0            6      148             72             35        0  33.6
1            1       85             66             29        0  26.6
2            8      183             64              0        0  23.3
3            1       89             66             23       94  28.1
4            0      137             40             35      168  43.1

   Pedigree  Age  Outcome
0     0.627   50        1
1     0.351   31        0
2     0.672   32        1
3     0.167   21        0
4     2.288   33        1
```

Step 3: Split Features and Target

In [5]:
```
X = df.drop('Outcome', axis=1)   # Features
y = df['Outcome']                # Target variable (0 or 1)
```

Step 4: Feature Scaling using Min-Max

In [6]:
```
scaler = MinMaxScaler()
X_scaled = scaler.fit_transform(X)
```

Step 5: Train-Test Split (Cross Validation)

In [7]:
```
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42)
```

Step 6: Initialize and Train KNN

In [8]:
```
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(X_train, y_train)
```

Out[8]:
```
KNeighborsClassifier()
```

Step 7: Make Predictions

In [9]:
```
y_pred = knn.predict(X_test)
```

Step 8: Evaluate the Model

In [10]:
```
cm = confusion_matrix(y_test, y_pred)
accuracy = accuracy_score(y_test, y_pred)
error_rate = 1 - accuracy
precision = precision_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
```

Step 9: Display Evaluation Results

In [11]:
```
print("\n--- Evaluation Metrics ---")
print("\nConfusion Matrix:\n", cm)
print(f"\nAccuracy   : {accuracy:.4f}")
print(f"Error Rate : {error_rate:.4f}")
print(f"Precision  : {precision:.4f}")
print(f"Recall     : {recall:.4f}")
```

```
--- Evaluation Metrics ---

Confusion Matrix:
 [[78 21]
 [27 28]]

Accuracy   : 0.6883
Error Rate : 0.3117
Precision  : 0.5714
Recall     : 0.5091
```

Step 10: Classification Report

In [12]:
```
print("\n--- Classification Report ---")
print(classification_report(y_test, y_pred))
```

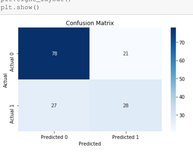
```
--- Classification Report ---
              precision    recall  f1-score   support

           0       0.74      0.79      0.76        99
           1       0.57      0.51      0.54        55

    accuracy                           0.69       154
   macro avg       0.66      0.65      0.65       154
weighted avg       0.68      0.69      0.68       154
```

Step 11: Confusion Matrix Heatmap

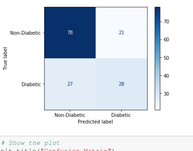
In [13]:
```
plt.figure(figsize=(6, 4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=['Predicted 0', 'Predicted 1'],
            yticklabels=['Actual 0', 'Actual 1'])
plt.title("Confusion Matrix")
plt.xlabel("Predicted")
plt.ylabel("Actual")
plt.tight_layout()
plt.show()
```



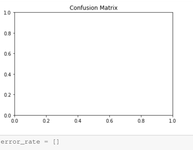
OR

In [15]:
```
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=['Non-Diabetic', 'Diabetic'])
disp.plot(cmap='Blues')
```

Out[15]:
```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x1ac4bb59828>
```



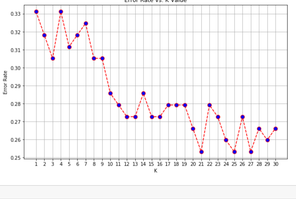
In [17]:
```
# Show the plot
plt.title("Confusion Matrix")
plt.show()
```



In [18]:
```
error_rate = []

# Try k values from 1 to 30
for k in range(1, 31):
    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(X_train, y_train)
    pred_k = knn.predict(X_test)
    error = 1 - accuracy_score(y_test, pred_k)
    error_rate.append(error)

# Plotting the error rate vs k value
plt.figure(figsize=(10, 6))
plt.plot(range(1, 31), error_rate, color='red', linestyle='dashed', marker='o',
         markerfacecolor='blue', markersize=8)
plt.title('Error Rate vs. K Value')
plt.xlabel('K')
plt.ylabel('Error Rate')
plt.grid(True)
plt.xticks(range(1, 31))
plt.show()
```



In [ ]:
```
```