22011A0538

J.N.T.U.H UNIVERSITY COLLEGE OF ENGINEERING SCIENCE AND TECHNOLOGY HYDERABAD, KUKATPALLY, HYDERABAD – 500085

CERTIFICATE

This is to certify that **KOLLURU ANUDEEPIKA** of CSE(Regular) III year, II Semester bearing with Hall-Ticket number **22011A0538** has fulfilled her **MACHINE LEARNING LAB** record for the academic year 2024-2025.

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Signature of the HOD ***Signature of the Staff***

Date of Examination *:*

_____ _____

Internal Examiner ***External Examiner***

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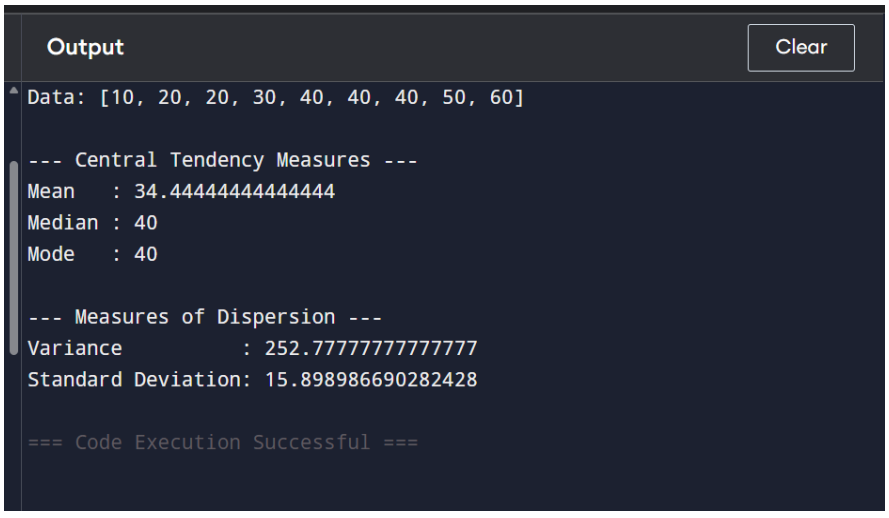
1. Write a python program to compute Central Tendency Measures: Mean, Median, Mode Measure of Dispersion: Variance, Standard Deviation

```
def calculate_mean(data):
    return sum(data) / len(data)

def calculate_median(data):
    sorted_data = sorted(data)
    n = len(sorted_data)
    mid = n // 2
    if n % 2 == 1:
        return sorted_data[mid]
    else:
        return (sorted_data[mid - 1] + sorted_data[mid]) / 2

def calculate_mode(data):
    frequency = {}
    for num in data:
        frequency[num] = frequency.get(num, 0) + 1

    max_freq = max(frequency.values())
    modes = [k for k, v in frequency.items() if v == max_freq]

    if len(modes) == 1:
        return modes[0]
    else:
        return "No unique mode"

def calculate_variance(data):
    mean = calculate_mean(data)
    n = len(data)
    return sum((x - mean) ** 2 for x in data) / (n - 1)  # Sample variance

def calculate_std_dev(data):
    variance = calculate_variance(data)
    return variance ** 0.5

def compute_statistics(data):
    if len(data) == 0:
        print("Data list is empty.")
        return
```

```
    mean = calculate_mean(data)
    median = calculate_median(data)
    mode = calculate_mode(data)
    variance = calculate_variance(data)
    std_dev = calculate_std_dev(data)

    print("Data:", data)
    print("\n--- Central Tendency Measures ---")
    print(f"Mean   : {mean}")
    print(f"Median : {median}")
    print(f"Mode   : {mode}")

    print("\n--- Measures of Dispersion ---")
    print(f"Variance        : {variance}")
    print(f"Standard Deviation: {std_dev}")

# Example usage
data = [10, 20, 20, 30, 40, 40, 40, 50, 60]
compute_statistics(data)
```

Output:

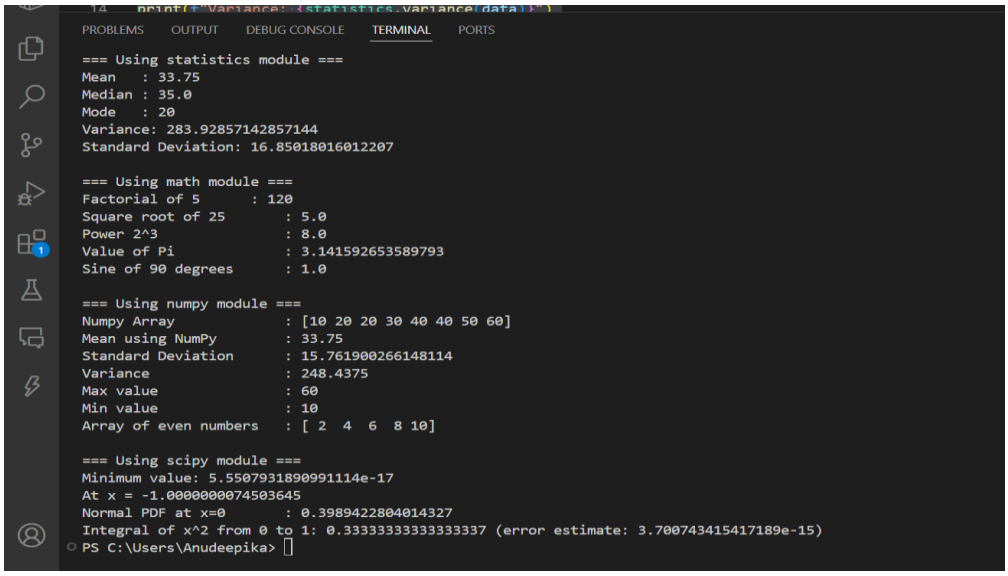


2. Study of Python Basic Libraries such as Statistics, Math, Numpy and Scipy

```
# Import libraries
import statistics
import math
import numpy as np
from scipy import stats, integrate,optimize

# Sample Data
data = [10, 20, 20, 30, 40, 40, 50, 60]

print("=== Using statistics module ===")
print(f"Mean   : {statistics.mean(data)}")
print(f"Median : {statistics.median(data)}")
print(f"Mode   : {statistics.mode(data)}")
print(f"Variance: {statistics.variance(data)}")
print(f"Standard Deviation: {statistics.stdev(data)}")

print("\n=== Using math module ===")
num = 5
print(f"Factorial of {num}     : {math.factorial(num)}")
print(f"Square root of 25      : {math.sqrt(25)}")
print(f"Power 2^3              : {math.pow(2, 3)}")
print(f"Value of Pi            : {math.pi}")
print(f"Sine of 90 degrees     : {math.sin(math.radians(90))}")

print("\n=== Using numpy module ===")
np_data = np.array(data)
print(f"Numpy Array            : {np_data}")
print(f"Mean using NumPy       : {np.mean(np_data)}")
print(f"Standard Deviation     : {np.std(np_data)}")
print(f"Variance               : {np.var(np_data)}")
print(f"Max value              : {np.max(np_data)}")
print(f"Min value              : {np.min(np_data)}")
print(f"Array of even numbers  : {np.arange(2, 11, 2)}")

print("\n=== Using scipy module ===")
```

```
# Function: f(x) = (x + 1)^2
f = lambda x: (x + 1)**2

# Minimize starting from x = 0
result = optimize.minimize(f, x0=0)

print(f"Minimum value: {result.fun}")
print(f"At x = {result.x[0]}")
# Normal distribution probability density at x = 0
print(f"Normal PDF at x=0       : {stats.norm.pdf(0, loc=0, scale=1)}")

# Integration example: ∫ x^2 dx from 0 to 1
result, error = integrate.quad(lambda x: x**2, 0, 1)
print(f"Integral of x^2 from 0 to 1: {result} (error estimate: {error})")
```

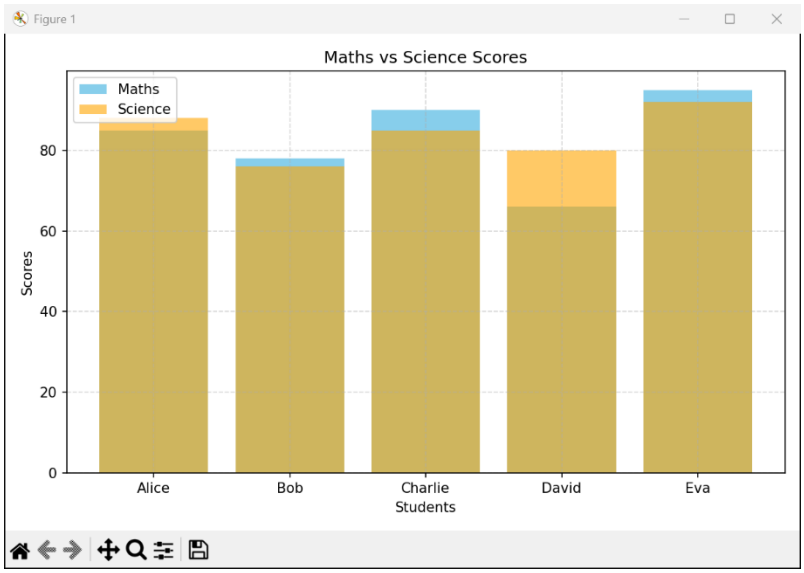
Output:



3. Study of Python Libraries for ML application such as Pandas and Matplotlib

```
import pandas as pd
import matplotlib.pyplot as plt

# Sample Data (Cleaned)
data = {
   'Name': ['Alice', 'Bob', 'Charlie', 'David', 'Eva'],
   'Age': [24, 27, 22, 32, 29],
   'Maths': [85, 78, 90, 66, 95],
   'Science': [88, 76, 85, 80, 92],
   'City': ['Delhi', 'Mumbai', 'Delhi', 'Chennai', 'Mumbai']
}

df = pd.DataFrame(data)

# Basic Data Checks
print("=== Head ===")
print(df.head())

print("\n=== Info ===")
df.info()

print("\n=== Describe ===")
print(df.describe())

print("\n=== Rows 1 to 3 ===")
print(df[1:4])

print("\n=== Sorted by Age ===")
print(df.sort_values(by='Age'))

# Bar Chart for Maths vs Science Scores
plt.figure(figsize=(8, 5))
plt.bar(df['Name'], df['Maths'], color='skyblue', label='Maths')
plt.bar(df['Name'], df['Science'], color='orange', alpha=0.6, label='Science')

plt.title("Maths vs Science Scores")
plt.xlabel("Students")
plt.ylabel("Scores")
plt.legend()
plt.grid(True, linestyle='--', alpha=0.5)
plt.tight_layout()
```

plt.show()



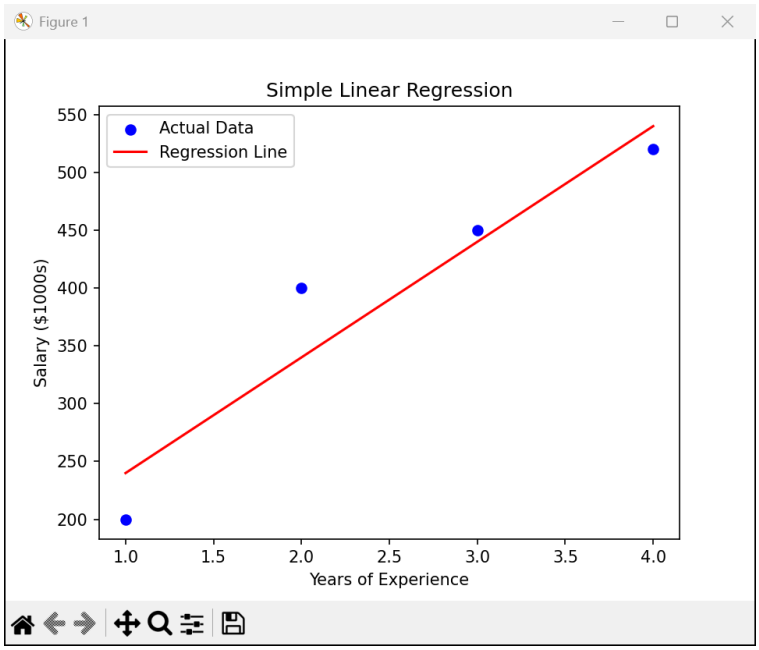

```
PS C:\Users\Anudeepika\OneDrive\Desktop\Coding\pract> python hi.py
=== Head ===
      Name  Age  Maths  Science     City
0    Alice   24     85       88    Delhi
1      Bob   27     78       76   Mumbai
2  Charlie   22     90       85    Delhi
3    David   32     66       80  Chennai
4      Eva   29     95       92   Mumbai

=== Info ===
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5 entries, 0 to 4
Data columns (total 5 columns):
 #   Column   Non-Null Count  Dtype
---  ------   --------------  -----
 0   Name     5 non-null      object
 1   Age      5 non-null      int64
 2   Maths    5 non-null      int64
 3   Science  5 non-null      int64
 4   City     5 non-null      object
dtypes: int64(3), object(2)
memory usage: 332.0+ bytes

=== Describe ===
             Age      Maths    Science
count   5.000000   5.000000   5.000000
mean   26.800000  82.800000  84.200000
std     3.962323  11.300442   6.340347
min    22.000000  66.000000  76.000000
25%    24.000000  78.000000  80.000000
50%    27.000000  85.000000  85.000000
75%    29.000000  90.000000  88.000000
max    32.000000  95.000000  92.000000

=== Rows 1 to 3 ===
      Name  Age  Maths  Science     City
1      Bob   27     78       76   Mumbai
2  Charlie   22     90       85    Delhi
3    David   32     66       80  Chennai

=== Sorted by Age ===
      Name  Age  Maths  Science     City
2  Charlie   22     90       85    Delhi
0    Alice   24     85       88    Delhi
1      Bob   27     78       76   Mumbai
4      Eva   29     95       92   Mumbai
3    David   32     66       80  Chennai
```

4. Write a Python program to implement Simple Linear Regression

```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
import numpy as np
import matplotlib.pyplot as plt

n = int(input("Enter the number of data points: "))
X = []
y = []

print("Enter years of experience and salary (in $1000s), space-separated:")

for _ in range(n):
    exp, sal = map(float, input().split())
    X.append([exp])
    y.append(sal)

X = np.array(X)
y = np.array(y)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=0)

model = LinearRegression()
model.fit(X_train, y_train)

y_pred = model.predict(X_test)

print("\nPredictions From test data:")
for i in range(len(X_test)):
    print(f"Experience: {X_test[i][0]} years -> Predicted Salary: ${y_pred[i]:.2f}")

# Predict for dynamic input
new_exp = float(input("\nEnter years of experience to predict salary: "))
pred_salary = model.predict([[new_exp]])
print(f"Predicted Salary for {new_exp} years experience: ${pred_salary[0]:.2f}")



plt.scatter(X, y, color='blue', label='Actual Data')

X_sorted = np.sort(X, axis=0)
plt.plot(X_sorted, model.predict(X_sorted), color='red', label='Regression Line')
plt.xlabel("Years of Experience")
```

```
plt.ylabel("Salary ($1000s)")
plt.title("Simple Linear Regression")
plt.legend()
plt.show()
```

Output:




```
PS C:\Users\Anudeepika\OneDrive\Desktop\Coding\pract> python hi.py
Enter the number of data points: 4
Enter years of experience and salary (in $1000s), space-separated:
1 200
2 400
3 450
4 520

Predictions From test data:
Experience: 3.0 years -> Predicted Salary: $440.00

Enter years of experience to predict salary: 6
Predicted Salary for 6.0 years experience: $740.00
```

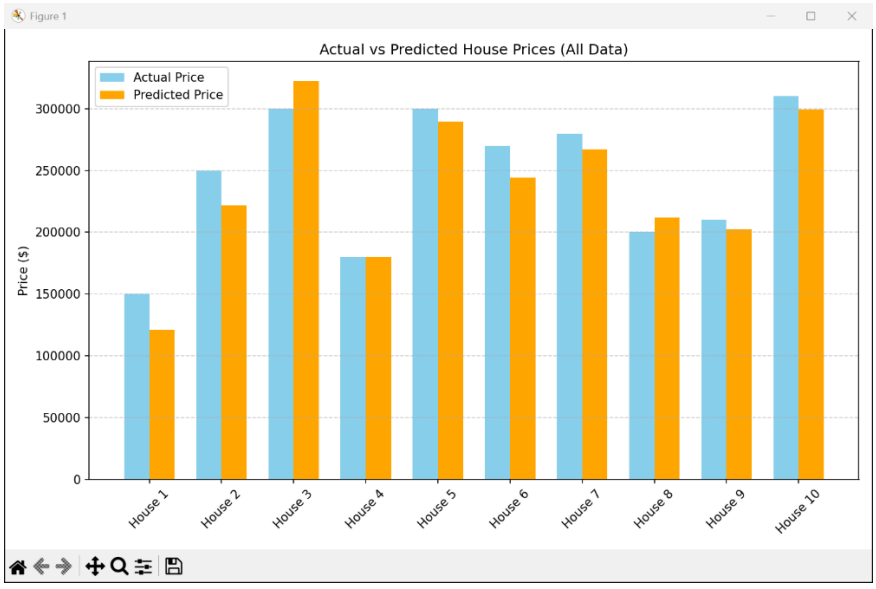
5. Implementation of Multiple Linear Regression for House Price Prediction using sklearn

```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error, r2_score
import numpy as np
import matplotlib.pyplot as plt
X = np.array([
   [1000, 2, 1],
   [1500, 3, 2],
   [2000, 4, 3],
   [1200, 2, 2],
   [1800, 3, 2],
   [1600, 3, 2],
   [1700, 3, 2],
   [1400, 2, 1],
   [1300, 2, 2],
   [1900, 4, 3]
])
y = np.array([150000, 250000, 300000, 180000, 300000, 270000, 280000, 200000, 210000,
310000])

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.4, random_state=42)

model = LinearRegression()
model.fit(X_train, y_train)

y_test_pred = model.predict(X_test)
mae = mean_absolute_error(y_test, y_test_pred)
r2 = r2_score(y_test, y_test_pred)

print(f"\nEvaluation on Test Data:")
print(f"Mean Absolute Error (MAE): ${mae:.2f}")
print(f"R² Score: {r2:.2f}")

y_all_pred = model.predict(X)

print("\nEnter new house details (Size_sqft Bedrooms Bathrooms):")
size, beds, baths = map(float, input().split())
new_house = np.array([[size, beds, baths]])
predicted_price = model.predict(new_house)
```

```
print(f"\nPredicted price for {int(size)} sqft, {int(beds)} bed, {int(baths)} bath house: ${predicted_price[0]:.2f}")

labels = [f"House {i+1}" for i in range(len(y))]
x = np.arange(len(labels))
bar_width = 0.35

plt.figure(figsize=(10, 6))
plt.bar(x - bar_width/2, y, width=bar_width, color='skyblue', label='Actual Price')
plt.bar(x + bar_width/2, y_all_pred, width=bar_width, color='orange', label='Predicted Price')

plt.xticks(x, labels, rotation=45)
plt.ylabel('Price ($)')
plt.title('Actual vs Predicted House Prices (All Data)')
plt.legend()
plt.grid(True, axis='y', linestyle='--', alpha=0.6)
plt.tight_layout()
plt.show()
```

Output:

```
Evaluation on Test Data:
Mean Absolute Error (MAE): $22500.00
R² Score: 0.72

Enter new house details (Size_sqft Bedrooms Bathrooms):
1000 4 2

Predicted price for 1000 sqft, 4 bed, 2 bath house: $82608.70
```

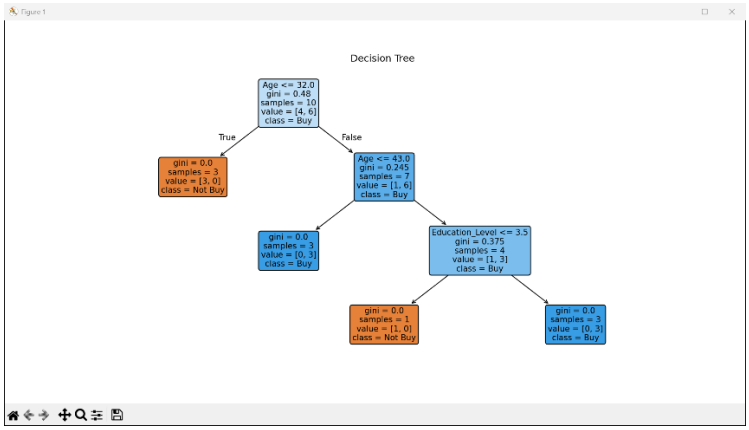


6.Implementation of Decision tree using sklearn and its parameter tuning.

```
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.metrics import accuracy_score, classification_report

data = {
   'Age':              [22, 25, 28, 30, 34, 36, 40, 42, 44, 48, 50, 52, 55, 58, 60],
   'Salary':           [20000, 25000, 27000, 30000, 35000, 40000, 45000, 50000, 55000, 60000,
70000, 75000, 80000, 85000, 90000],
   'Experience':       [1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 16, 18, 20],
   'Education_Level':   [1, 1, 2, 2, 2, 2, 3, 3, 3, 3, 4, 4, 4, 4, 4],  # 1=HS, 2=UG, 3=PG, 4=PhD
   'Buy':              [0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1]
}

df = pd.DataFrame(data)

# 2. Train/Test split
X = df[['Age', 'Salary', 'Experience', 'Education_Level']]
y = df['Buy']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=42)

# 3. Decision tree training
dt = DecisionTreeClassifier(random_state=42)
dt.fit(X_train, y_train)
y_pred = dt.predict(X_test)

params = {
   'criterion': ['gini', 'entropy'],
   'max_depth': [3, 4, 5, 6],
   'min_samples_split': [2, 3],
   'min_samples_leaf': [1, 2]
}

grid = GridSearchCV(DecisionTreeClassifier(random_state=42), params, cv=3)
grid.fit(X_train, y_train)
best_dt = grid.best_estimator_

y_pred_best = best_dt.predict(X_test)
print("\nBest Parameters:", grid.best_params_)
print("Accuracy (After Tuning):", accuracy_score(y_test, y_pred_best))
```

```
print("Classification Report (Tuned):\n", classification_report(y_test, y_pred_best))

# 5. Prediction point
test_point = pd.DataFrame({'Age': [35], 'Salary': [42000], 'Experience': [6], 'Education_Level': [2]})
prediction = best_dt.predict(test_point)
print(f"\nPrediction for point {test_point.values.tolist()[0]}: {'Buy' if prediction[0] == 1 else 'Not Buy'}")

# 6. Plot the decision tree
plt.figure(figsize=(14, 8))
plot_tree(
    best_dt,
    feature_names=['Age', 'Salary', 'Experience', 'Education_Level'],
    class_names=['Not Buy', 'Buy'],
    filled=True,
    rounded=True,
    fontsize=10
)
plt.title("Decision Tree ")
plt.show()
```

Output:




```
PS C:\Users\Anudeepika\OneDrive\Desktop\Coding\pract> python hi.py

Best Parameters: {'criterion': 'gini', 'max_depth': 3, 'min_samples_leaf': 1, 'min_samples_split': 2}
Accuracy (After Tuning): 0.6
Classification Report (Tuned):
              precision    recall  f1-score   support

           0       0.50      0.50      0.50         2
           1       0.67      0.67      0.67         3

    accuracy                           0.60         5
   macro avg       0.58      0.58      0.58         5
weighted avg       0.60      0.60      0.60         5


Prediction for point [35, 42000, 6, 2]: Buy
```

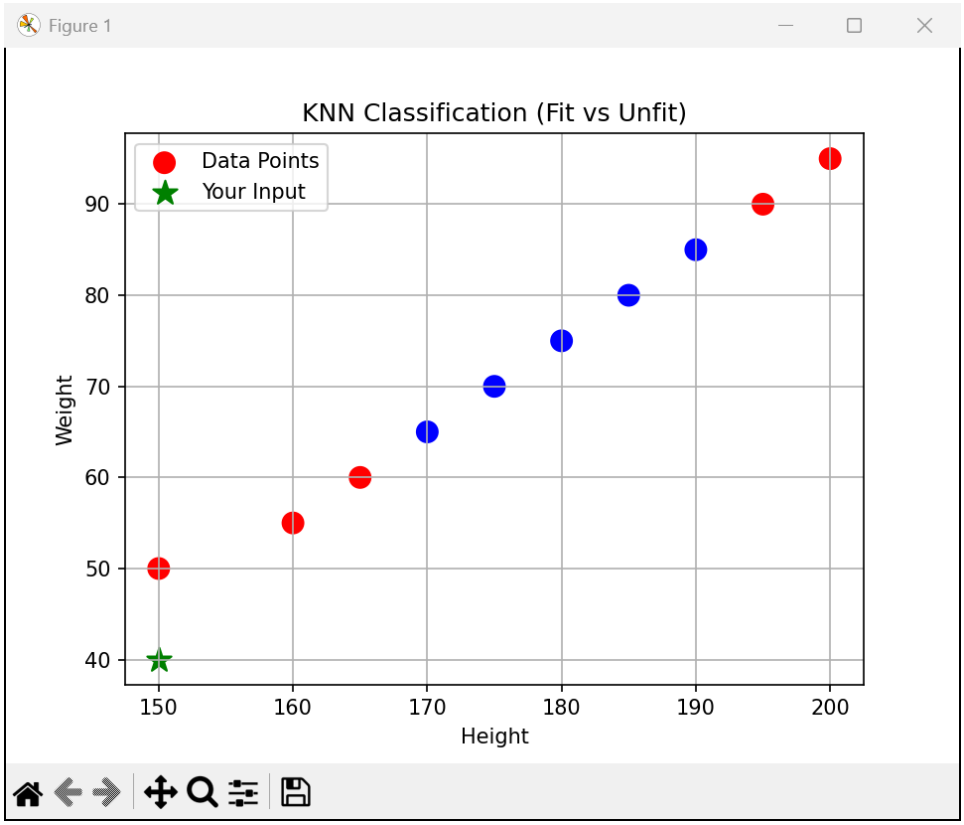
7.Implementation of KNN using sklearn

```
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import classification_report, confusion_matrix
import numpy as np

# Simple custom dataset: [Height, Weight]
X = np.array([
   [150, 50], [160, 55], [165, 60], [170, 65],
   [175, 70], [180, 75], [185, 80], [190, 85],
   [195, 90], [200, 95]
])
y = np.array([0, 0, 0, 1, 1, 1, 1, 1, 0, 0])  # 0 = Unfit, 1 = Fit

# Input K value
k = int(input("Enter value of k (neighbors): "))

# Train-test split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1)

# Train KNN model
model = KNeighborsClassifier(n_neighbors=k)
model.fit(X_train, y_train)

# Evaluate
y_pred = model.predict(X_test)
print("\nClassification Report:\n", classification_report(y_test, y_pred))

# Predict new point
print("\nEnter new data (Height Weight): ")
new_data = list(map(float, input().split()))
prediction = model.predict([new_data])[0]
print("Predicted class:", "Fit" if prediction == 1 else "Unfit")

# Plot data and prediction
colors = ['red' if label == 0 else 'blue' for label in y]
plt.scatter(X[:, 0], X[:, 1], c=colors, s=100, label='Data Points')
plt.scatter(new_data[0], new_data[1], c='green', s=150, marker='*', label='Your Input')
plt.xlabel("Height")
plt.ylabel("Weight")
plt.title("KNN Classification (Fit vs Unfit)")
```

```
plt.legend()
plt.grid(True)
plt.show()
```

Output:

```
PS C:\Users\Anudeepika\OneDrive\Desktop\Coding\pract> python hi.py
Enter value of k (neighbors): 2

Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         2
           1       1.00      1.00      1.00         1

    accuracy                           1.00         3
   macro avg       1.00      1.00      1.00         3
weighted avg       1.00      1.00      1.00         3


Enter new data (Height Weight):
150 40
Predicted class: Unfit
```



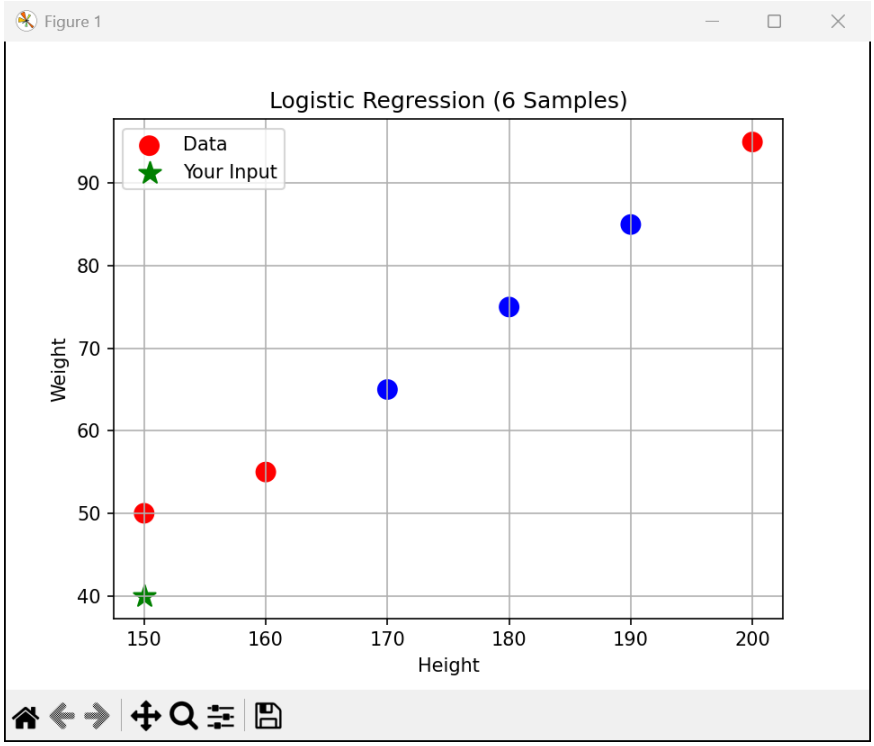
8.Implementation of Logistic Regression using sklearn

```
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
import numpy as np

# Custom dataset: Height vs Weight to classify Fitness (0 = Unfit, 1 = Fit)
X = np.array([
   [150, 50],
   [160, 55],
   [170, 65],
   [180, 75],
   [190, 85],
   [200, 95]
])
y = np.array([0, 0, 1, 1, 1, 0])

# Split into training and testing
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1)

# Train logistic regression model
model = LogisticRegression()
model.fit(X_train, y_train)

# Predict on test data
y_pred = model.predict(X_test)

print("\nClassification Report:\n", classification_report(y_test, y_pred, zero_division=0))

# Predict a new point
print("\nEnter Height and Weight to classify:")
new_point = list(map(float, input().split()))
pred = model.predict([new_point])[0]
print("Predicted class:", "Fit" if pred == 1 else "Unfit")

# Plot data and prediction point
colors = ['red' if label == 0 else 'blue' for label in y]
plt.scatter(X[:, 0], X[:, 1], c=colors, s=100, label='Data')
plt.scatter(new_point[0], new_point[1], c='green', s=150, marker='*', label='Your Input')
plt.xlabel("Height")
plt.ylabel("Weight")
```

```
plt.title("Logistic Regression (6 Samples)")
plt.legend()
plt.grid(True)
plt.show()
```

Output:

```
PS C:\Users\Anudeepika> cd C:\Users\Anudeepika\OneDrive\Desktop\Coding\pract
PS C:\Users\Anudeepika\OneDrive\Desktop\Coding\pract> python hi.py

Classification Report:
              precision    recall  f1-score   support

           0       0.00      0.00      0.00         1
           1       0.50      1.00      0.67         1

    accuracy                           0.50         2
   macro avg       0.25      0.50      0.33         2
weighted avg       0.25      0.50      0.33         2


Enter Height and Weight to classify:
150 40
Predicted class: Fit
```



9.Implementation of K-Means Clustering

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans

# Custom data: [Height (cm), Weight (kg)]
X = np.array([
   [150, 50],
   [160, 55],
   [165, 60],
   [175, 70],
   [185, 80],
   [195, 90]
])

# Apply KMeans clustering (3 clusters)
kmeans = KMeans(n_clusters=3, random_state=0)
kmeans.fit(X)

# Get cluster labels and centroids
labels = kmeans.labels_
centroids = kmeans.cluster_centers_

# Function to give meaning to clusters (manual logic)
def label_cluster(centroid):
   h, w = centroid
   if h < 165:
      return "Unfit"
   elif h < 180:
      return "Average"
   else:
      return "Fit"


# Take user input and predict
print("\nEnter Height and Weight to find your cluster:")
user_input = list(map(float, input().split()))
user_cluster = kmeans.predict([user_input])[0]
print(f"You belong to Cluster {user_cluster} → {label_cluster(centroids[user_cluster])}")

# Plotting
colors = ['red', 'green', 'blue']
```

```
plt.figure(figsize=(8, 6))
for i in range(len(X)):
    plt.scatter(X[i][0], X[i][1], color=colors[labels[i]], s=100)

# Plot centroids
for i, c in enumerate(centroids):
    plt.scatter(c[0], c[1], marker='X', color='black', s=200, label=f'Cluster {i}
({label_cluster(c)})')

# Plot user input
plt.scatter(user_input[0], user_input[1], color='purple', marker='*', s=200, label='Your Point')

plt.title("K-Means Clustering (Height vs Weight)")
plt.xlabel("Height (cm)")
plt.ylabel("Weight (kg)")
plt.legend()
plt.grid(True)
plt.show()
```

Output:

```
PS C:\Users\Anudeepika> python -u "c:\Users\Anudeepika\OneDrive\Deskt

Enter Height and Weight to find your cluster:
170 65
You belong to Cluster 0 → Average
```