Lab : 9a : KNN MODEL

Aim:
To implement a python program using a KNN Algorithm in a model.

Algorithm:

1. Import Necessary Libraries
● Import necessary libraries: pandas, numpy, train_test_split from sklearn.model_selection, StandardScaler from sklearn.preprocessing, KNeighborsClassifier from sklearn.neighbors, and classification_report and confusion_matrix from sklearn.metrics.

2. Load and Explore the Dataset
● Load the dataset using pandas.
● Display the first few rows of the dataset using df.head().
● Display the dimensions of the dataset using df.shape().
● Display the descriptive statistics of the dataset using df.describe().

3. Preprocess the Data
● Separate the features (X) and the target variable (y).
● Split the data into training and testing sets using train_test_split.
● Standardize the features using StandardScaler.

4. Train the KNN Model
● Create an instance of KNeighborsClassifier with a specified number of neighbors (k).
● For each data point, calculate the Euclidean distance to all other data points.
● Select the K nearest neighbors based on the calculated Euclidean distances.
● Among the K nearest neighbors, count the number of data points in each category
● Assign the new data point to the category for which the number of neighbors is maximum.

5. Make Predictions
● Use the trained model to make predictions on the test data.
● Evaluate the Model
● Generate the confusion matrix and classification report using the actual and predicted values.
● Print the confusion

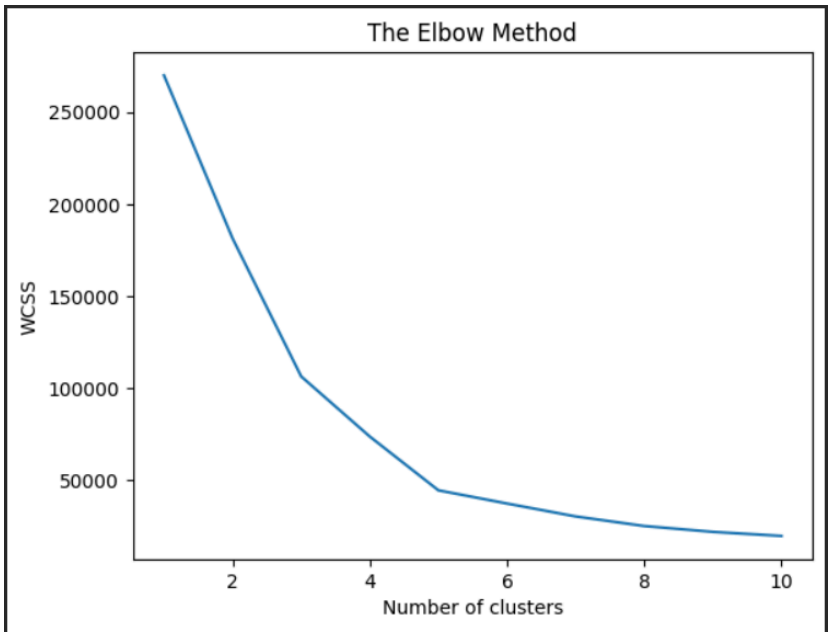
Program:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
dataset = pd.read_csv('/content/Mall_Customers.csv')
X = dataset.iloc[:,[3,4]].values
print(dataset)
```

```
     CustomerID   Genre  Age  Annual Income (k$)  Spending Score (1-100)
0             1    Male   19                  15                      39
1             2    Male   21                  15                      81
2             3  Female   20                  16                       6
3             4  Female   23                  16                      77
4             5  Female   31                  17                      40
..          ...     ...  ...                 ...                     ...
195         196  Female   35                 120                      79
196         197  Female   45                 126                      28
197         198    Male   32                 126                      74
198         199    Male   32                 137                      18
199         200    Male   30                 137                      83

[200 rows x 5 columns]
```

```
from sklearn.cluster import KMeans
wcss =[]
for i in range (1,11):
    kmeans = KMeans(n_clusters = i, init = 'k-means++', max_iter =300, n_init = 10, random_state = 0)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)
# Plot the graph to visualize the Elbow Method to find the optimal number of cluster
plt.plot(range(1,11),wcss)
plt.title('The Elbow Method')
plt.xlabel('Number of clusters')
plt.ylabel('WCSS')
plt.show()
```



kmeans=KMeans(n_clusters= 5, init = 'k-means++', max_iter = 300, n_init = 10, random_state = 0)
y_kmeans = kmeans.fit_predict(X)
Y_kmeans

```
array([3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4,
       3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 0,
       3, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 2, 1, 0, 1, 2, 1, 2, 1,
       0, 1, 2, 1, 2, 1, 2, 1, 2, 1, 0, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1,
       2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1,
       2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1,
       2, 1], dtype=int32)
```

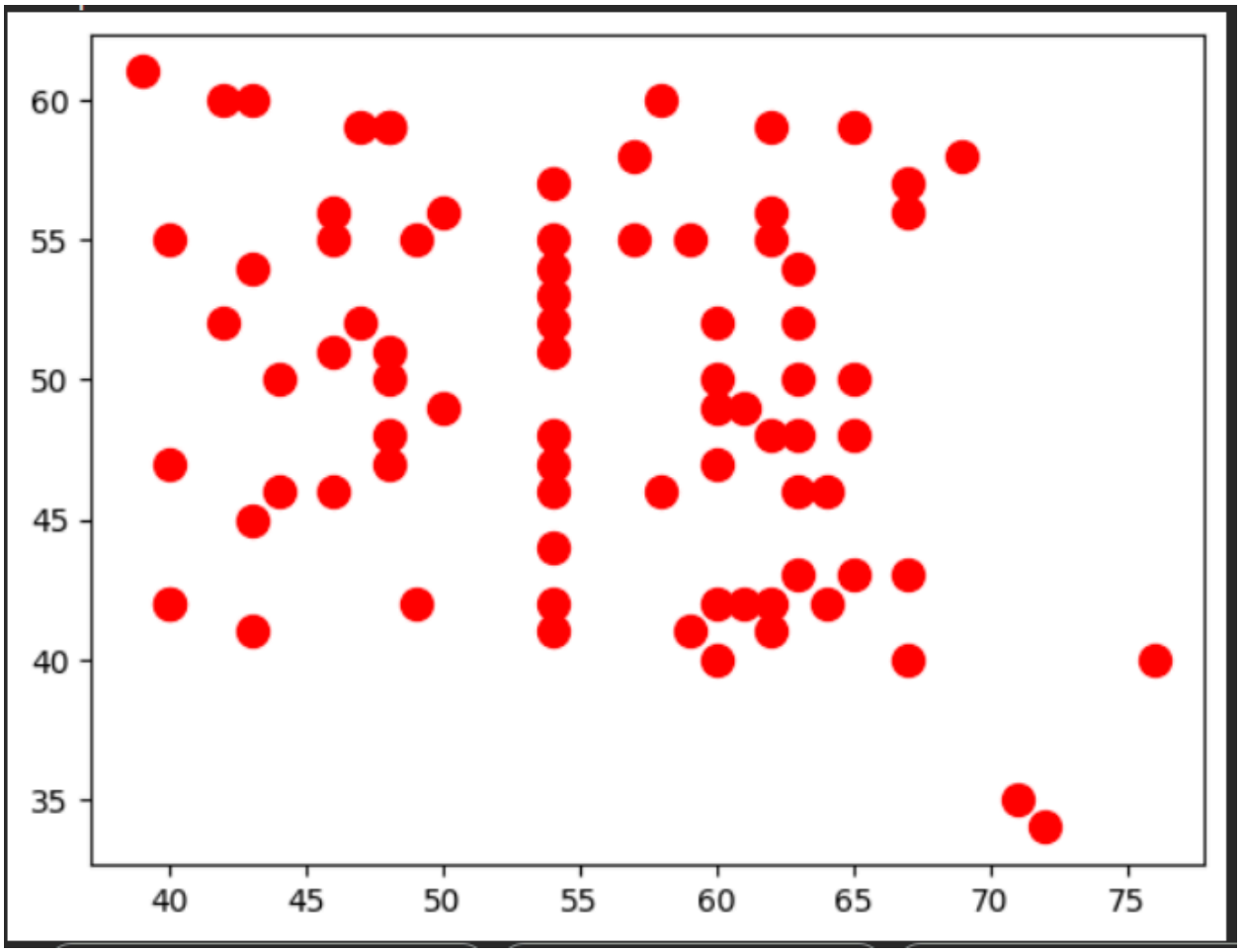
type(y_kmeans)

```
numpy.ndarray
```

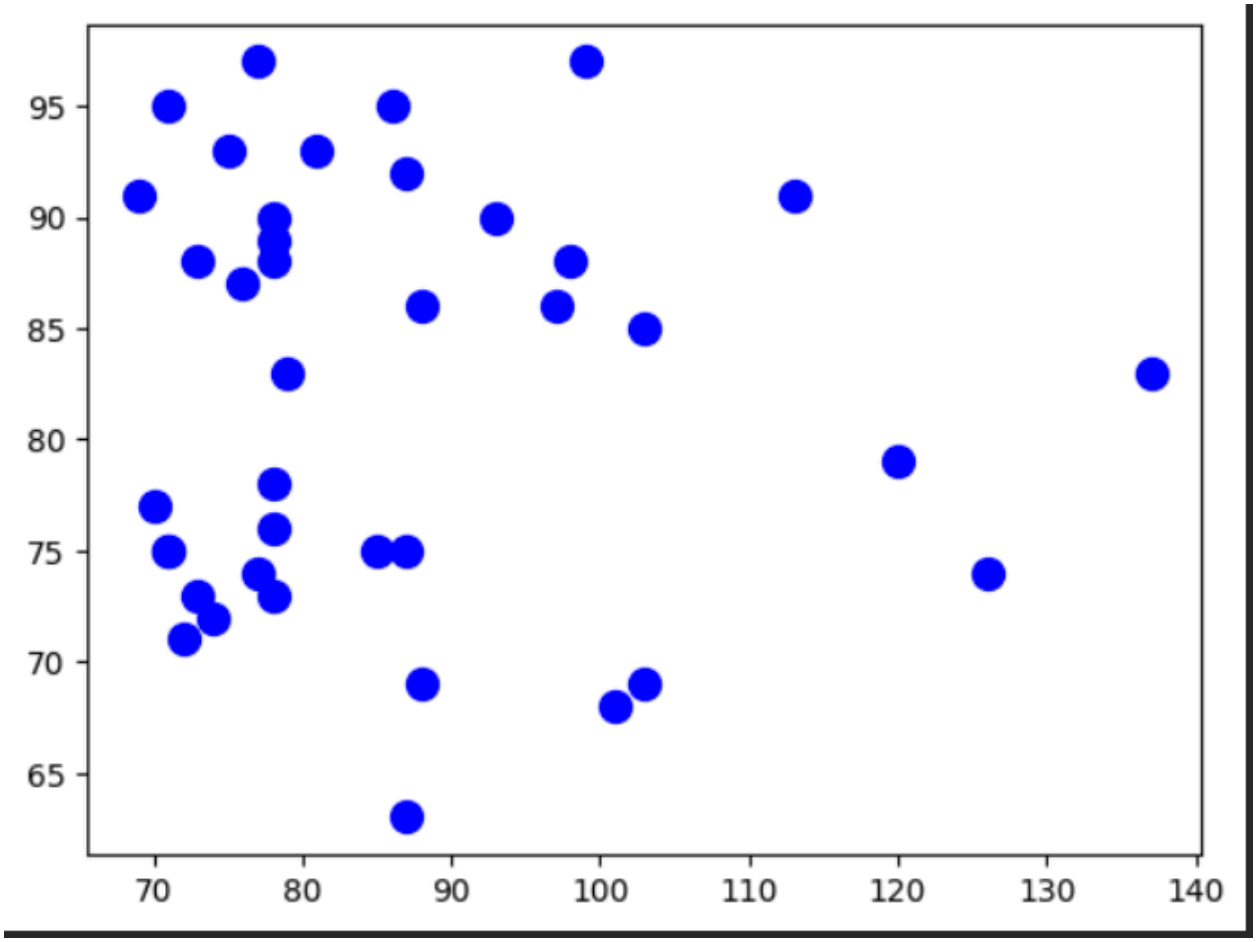
y_kmeans

```
array([3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4,
       3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 4, 3, 0,
       3, 4, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 2, 1, 0, 1, 2, 1, 2, 1,
       0, 1, 2, 1, 2, 1, 2, 1, 2, 1, 0, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1,
       2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1,
       2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1, 2, 1,
       2, 1], dtype=int32)
```

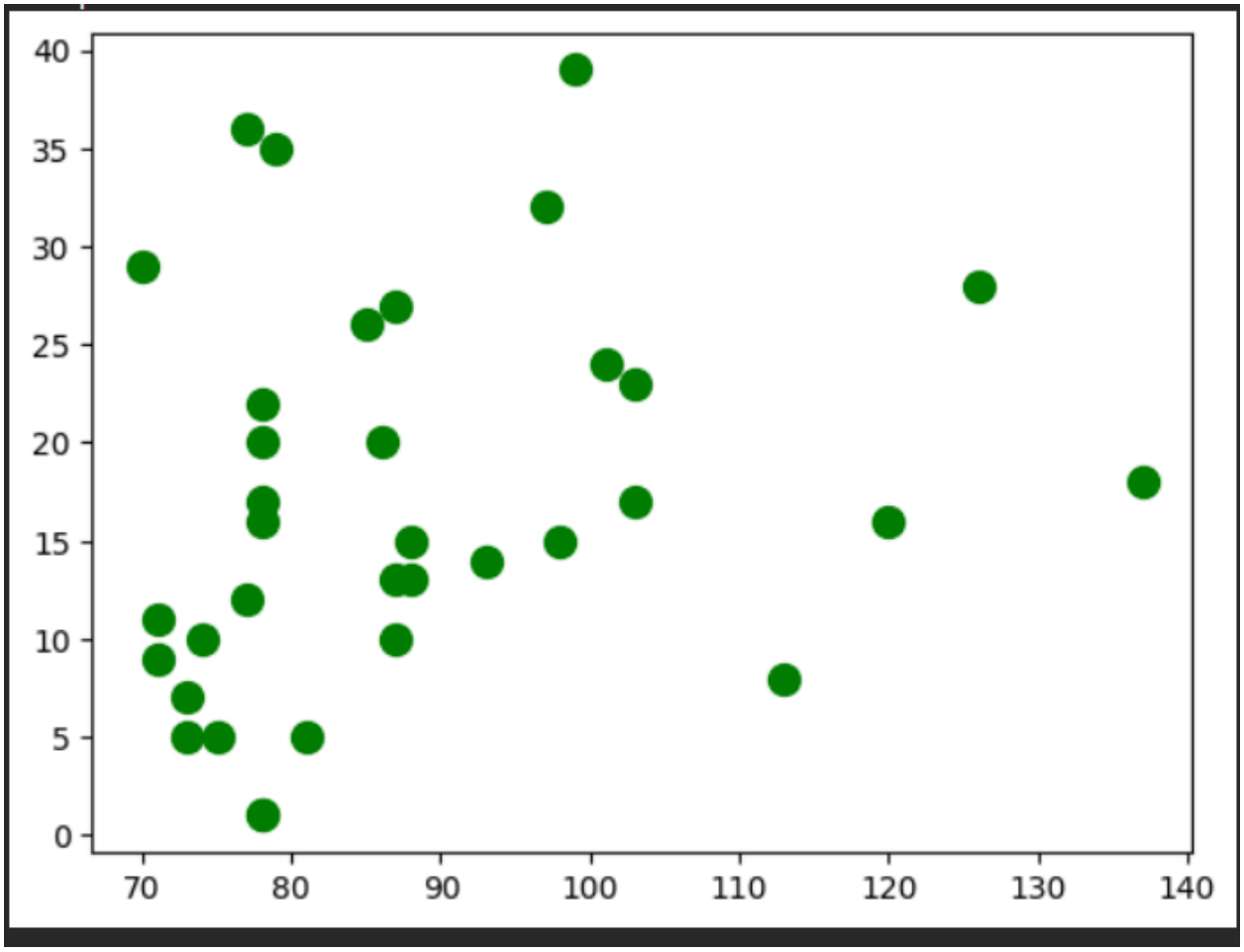
plt.scatter(X[y_kmeans == 0, 0], X[y_kmeans == 0, 1], s = 100, c = 'red', label = 'Cluster 1')



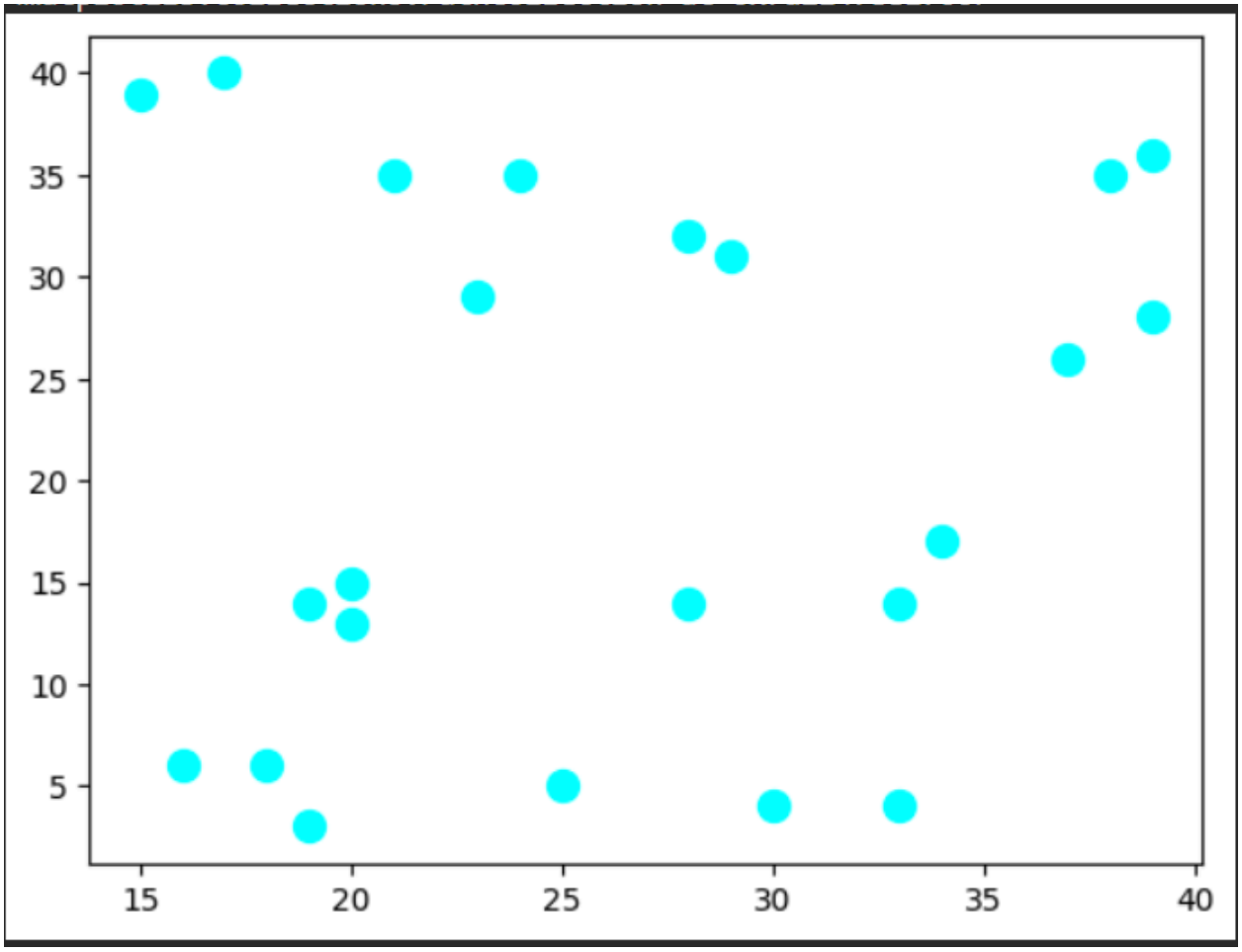
plt.scatter(X[y_kmeans == 1, 0], X[y_kmeans == 1, 1], s = 100, c = 'blue', label = 'Cluster 2')



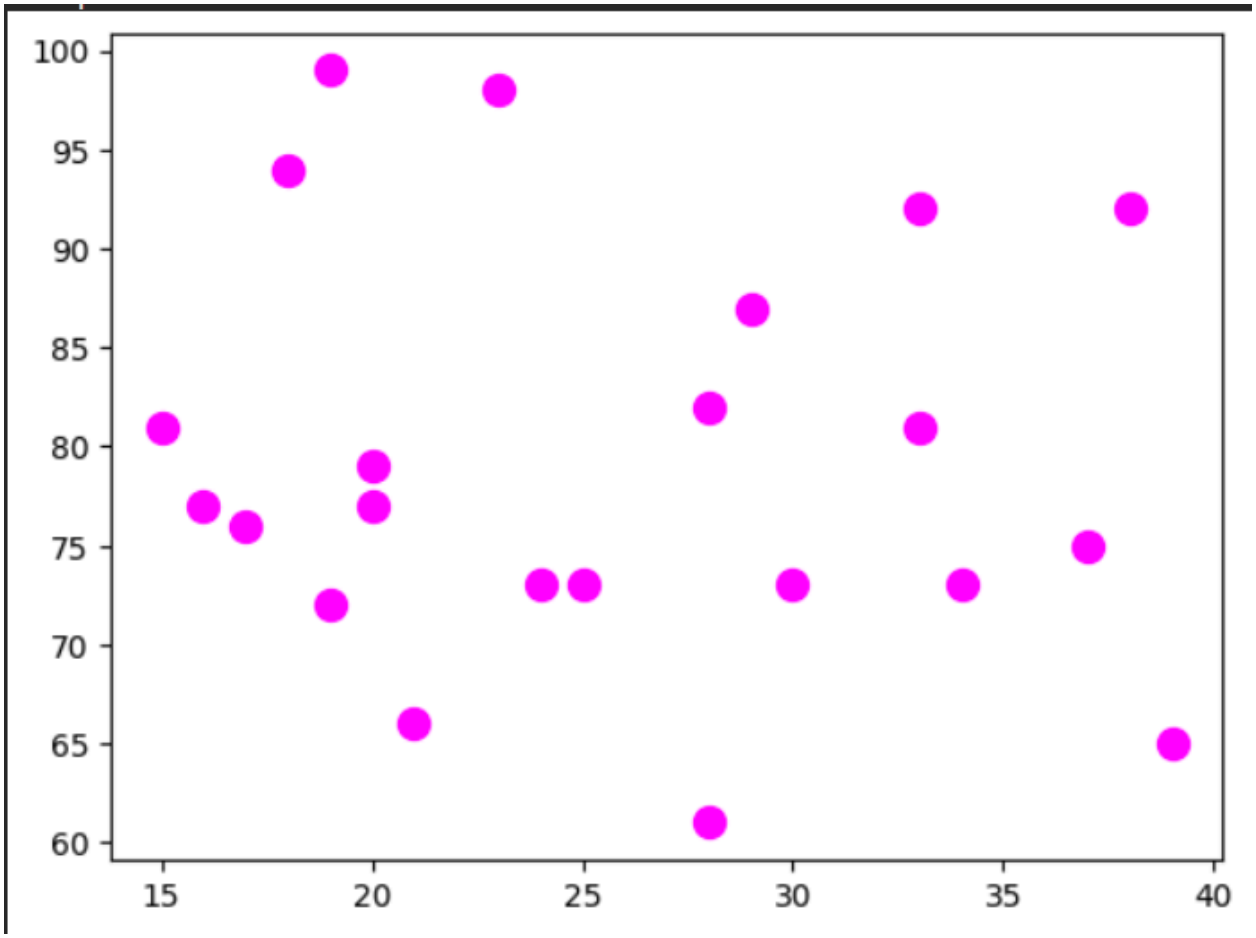
plt.scatter(X[y_kmeans == 2, 0], X[y_kmeans == 2, 1], s = 100, c = 'green', label = 'Cluster 3')



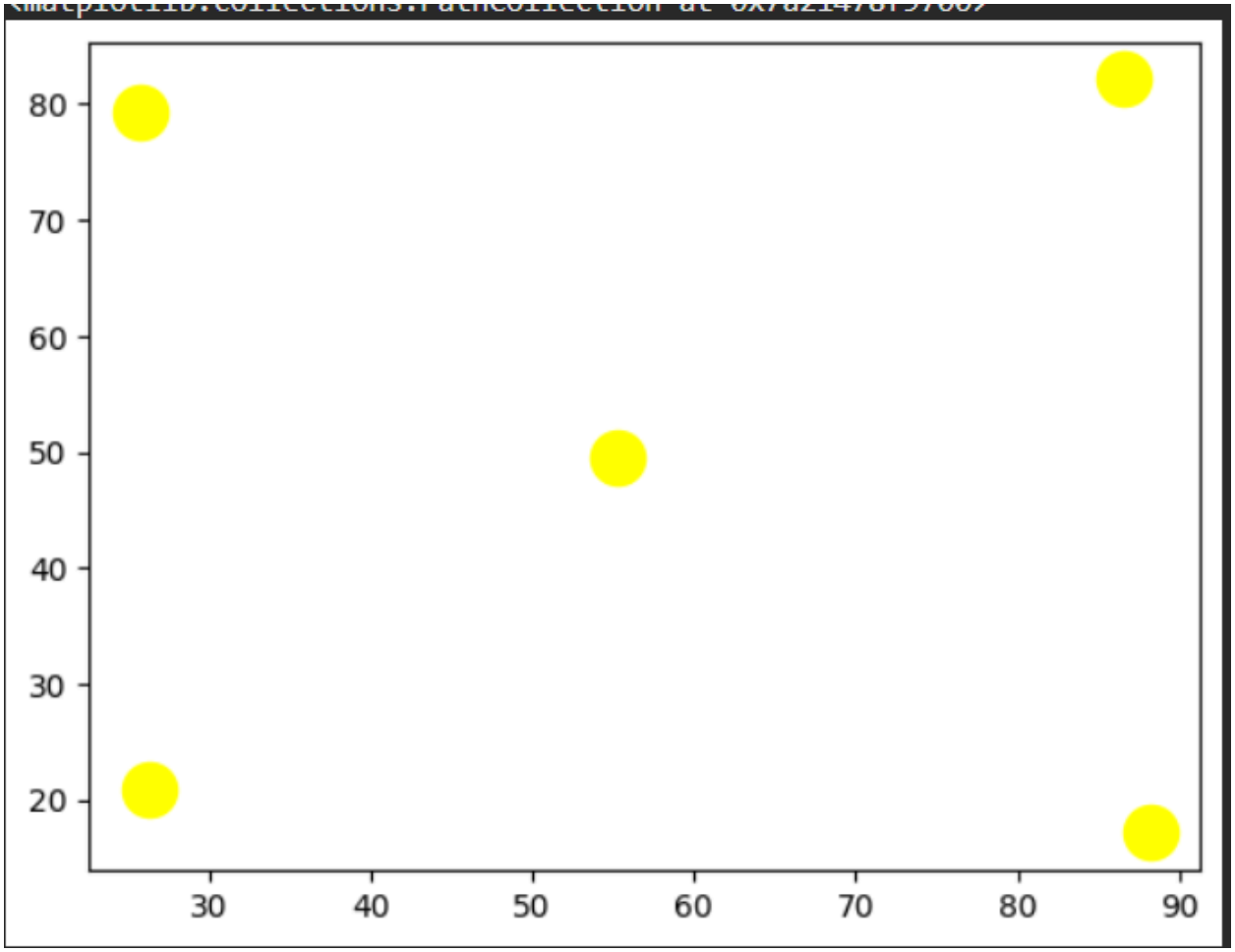
plt.scatter(X[y_kmeans == 3, 0], X[y_kmeans == 3, 1], s = 100, c = 'cyan', label = 'Cluster 4')



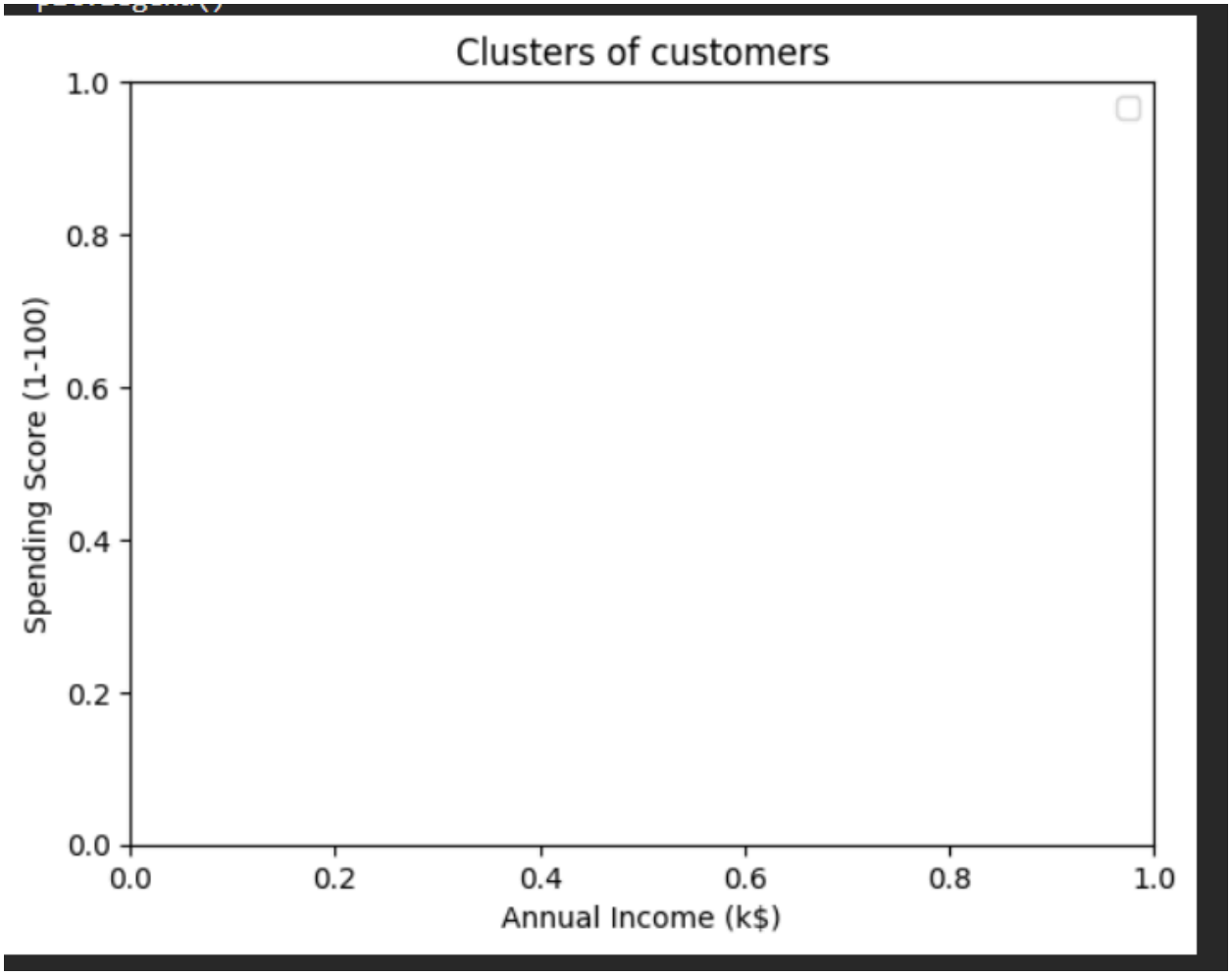
plt.scatter(X[y_kmeans == 4, 0], X[y_kmeans == 4, 1], s = 100, c = 'magenta', label ='Cluster 5')



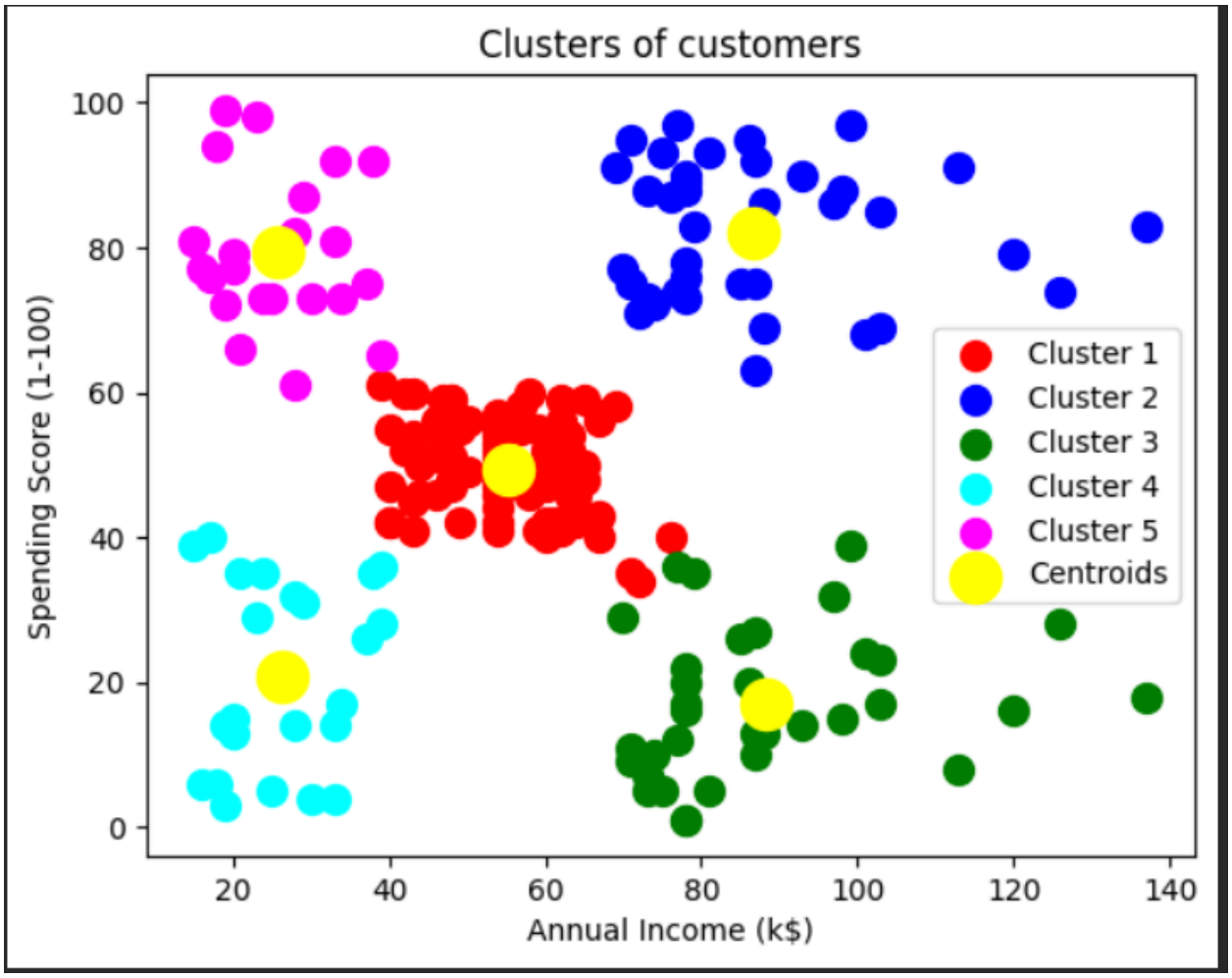
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s = 300, c = 'yellow',label = 'Centroids')




```
plt.title('Clusters of customers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```




```
plt.scatter(X[y_kmeans == 0, 0], X[y_kmeans == 0, 1], s = 100, c = 'red', label = 'Cluster 1')
plt.scatter(X[y_kmeans == 1, 0], X[y_kmeans == 1, 1], s = 100, c = 'blue', label = 'Cluster 2')
plt.scatter(X[y_kmeans == 2, 0], X[y_kmeans == 2, 1], s = 100, c = 'green', label = 'Cluster 3')
plt.scatter(X[y_kmeans == 3, 0], X[y_kmeans == 3, 1], s = 100, c = 'cyan', label = 'Cluster 4')
plt.scatter(X[y_kmeans == 4, 0], X[y_kmeans == 4, 1], s = 100, c = 'magenta', label =
'Cluster 5')
plt.scatter(kmeans.cluster_centers_[:, 0], kmeans.cluster_centers_[:, 1], s = 300, c = 'yellow',
label = 'Centroids')
plt.title('Clusters of customers')
plt.xlabel('Annual Income (k$)')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```



RESULT:-

Thus the python program to implement KNN model has been successfully implemented and the results have been verified and analyzed.

EXPERIMENT : 9(a)

A python program using a K-Means Algorithm in a model

AIM:

To implement a python program using a K-Means Algorithm in a model.

ALGORITHM:

1. Import Necessary Libraries:
Import required libraries like numpy, matplotlib.pyplot, and sklearn.cluster.

2. Load and Preprocess Data:
Load the dataset.
Preprocess the data if needed (e.g., scaling).

3. Initialize Cluster Centers:
Choose the number of clusters (K).
Initialize K cluster centers randomly.

4. Assign Data Points to Clusters:
For each data point, calculate the distance to each cluster center.
Assign the data point to the cluster with the nearest center.

5. Update Cluster Centers:
Calculate the mean of the data points in each cluster.
Update the cluster centers to the calculated means.

6. Repeat Steps 4 and 5:
Repeat the assignment of data points to clusters and updating of cluster centers until
convergence (i.e., when the cluster assignments do not change much between iterations).

7. Plot the Clusters:
Plot the data points and the cluster centers to visualize the clustering result.

CODE 1:

```
import numpy as np

import pandas as pd

import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split

from sklearn.preprocessing import StandardScaler

from sklearn.neighbors import KNeighborsClassifier

from sklearn.metrics import confusion_matrix,
classification_report

dataset = pd.read_csv("Mall_Customers.csv")


print("First 5 Rows of Dataset:")

print(dataset.head())
```

```
print("\nShape of Dataset:", dataset.shape)


print("\nDescriptive Statistics:")
print(dataset.describe())
```

OUTPUT 2:

First 5 Rows of Dataset:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

Shape of Dataset: (200, 5)

Descriptive Statistics:

	CustomerID	Age	Annual Income (k$)	Spending Score (1-100)
count	200.00000	200.000000	200.000000	200.000000
mean	100.50000	38.850000	60.560000	50.200000
std	57.87918	13.969007	26.264721	25.823522

min 1.00000 18.000000 15.000000 1.000000

max 200.00000 70.000000 137.000000 99.000000

CODE 3:

```
dataset['Gender'] = dataset['Gender'].map({'Male': 0, 'Female': 1})


X = dataset[['Gender', 'Age', 'Annual Income (k$)']].values
y = dataset['Spending Score (1-100)'].values


y = pd.cut(y, bins=[0, 40, 70, 100], labels=[0, 1, 2])  # Classification labels


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)


scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)


print("X_train shape:", X_train.shape)
print("X_test shape:", X_test.shape)
```

OUTPUT 3:

X_train shape: (160, 3)

X_test shape: (40, 3)

CODE 4:

```
k = 5
knn = KNeighborsClassifier(n_neighbors=k)
knn.fit(X_train, y_train)
y_pred = knn.predict(X_test)

print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
print("\nClassification Report:\n", classification_report(y_test, y_pred))
```

OUTPUT 4:

Confusion Matrix:

```
[[10  2  0]
 [ 3 11  1]
 [ 0  2 11]]
```

Classification Report:

	precision	recall	f1-score	support
0	0.77	0.83	0.80	12
1	0.73	0.73	0.73	15
2	0.92	0.85	0.88	13
accuracy			0.80	40

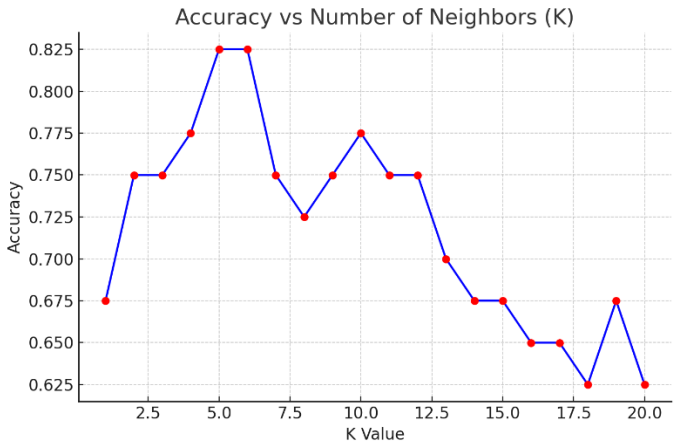
CODE 5:

```
# Test different K values
accuracy = []
k_values = range(1, 21)

for k in k_values:
    knn = KNeighborsClassifier(n_neighbors=k)
    knn.fit(X_train, y_train)
    accuracy.append(knn.score(X_test, y_test))

# Plot accuracy vs K
plt.figure(figsize=(8, 5))
plt.plot(k_values, accuracy, color='blue', marker='o',
markerfacecolor='red')
plt.title('Accuracy vs Number of Neighbors (K)')
plt.xlabel('K Value')
plt.ylabel('Accuracy')
plt.grid(True)
plt.show()
```

OUTPUT 5:



CODE 6:

```
# Use only 2 features for plotting

X_plot = dataset[['Age', 'Annual Income (k$)']].values

y_plot = pd.cut(dataset['Spending Score (1-100)'], bins=[0, 40, 70, 100], labels=[0, 1, 2])


scaler2 = StandardScaler()

X_plot = scaler2.fit_transform(X_plot)


knn2 = KNeighborsClassifier(n_neighbors=5)

knn2.fit(X_plot, y_plot)


# Plot points by category

plt.figure(figsize=(7, 6))

plt.scatter(X_plot[y_plot == 0][:, 0], X_plot[y_plot == 0][:, 1], c='red', label='Low Spenders')
```

plt.scatter(X_plot[y_plot == 1][:, 0], X_plot[y_plot == 1][:, 1], c='blue', label='Medium Spenders')

plt.scatter(X_plot[y_plot == 2][:, 0], X_plot[y_plot == 2][:, 1], c='green', label='High Spenders')

plt.title('KNN Visualization of Spending Categories')

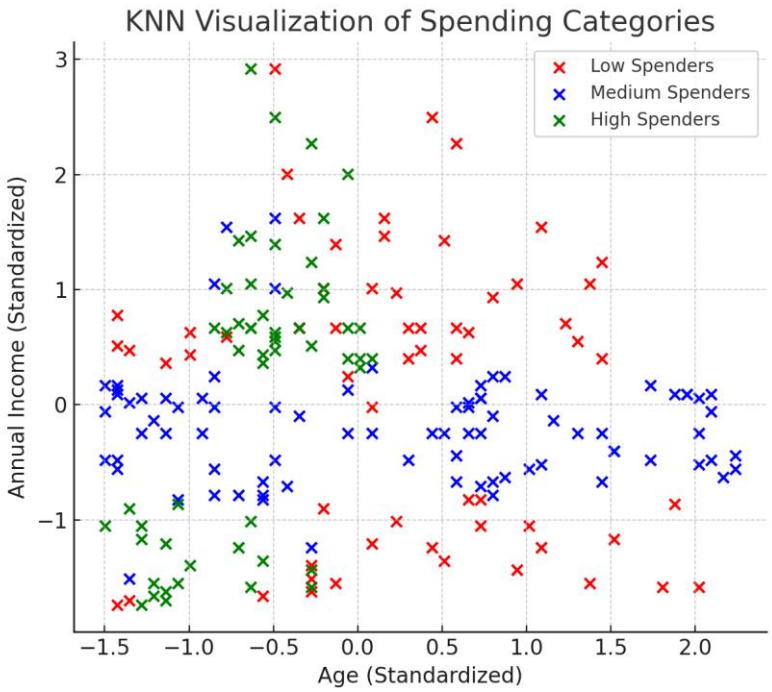
plt.xlabel('Age (Standardized)')

plt.ylabel('Annual Income (Standardized)')

plt.legend()

plt.show()

OUTPUT 6:



CODE 6:

print("Final Model Accuracy: {:.2f}%".format(knn.score(X_test, y_test) * 100))

OUTPUT 6:

Final Model Accuracy: 80.00%

RESULT:

Thus a python program using a K-Means Algorithm in a model is written and the output is verified.