Import Library

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

Load Dataset from Local Directory

```
from google.colab import files
uploaded = files.upload()
```

Choose Files Mall_Customers.csv

- Mall_Customers.csv(text/csv) - 3981 bytes, last modified: 4/12/2023 - 100% done

Saving Mall_Customers.csv to Mall_Customers.csv

Load Dataset

```
dataset = pd.read_csv('Mall_Customers.csv')
```

Summarize Dataset

```
print(dataset.shape)
print(dataset.describe())
print(dataset.head(5))
```

```
(200, 5)
       CustomerID         Age  Annual Income (k$)  Spending Score (1-100)
count  200.000000  200.000000          200.000000              200.000000
mean   100.500000   38.850000           60.560000               50.200000
std     57.879185   13.969007           26.264721               25.823522
min      1.000000   18.000000           15.000000                1.000000
25%     50.750000   28.750000           41.500000               34.750000
50%    100.500000   36.000000           61.500000               50.000000
75%    150.250000   49.000000           78.000000               73.000000
max    200.000000   70.000000          137.000000               99.000000
   CustomerID  Gender  Age  Annual Income (k$)  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
```

Label Encoding

```
from sklearn import preprocessing
label_encoder = preprocessing.LabelEncoder()
dataset['Gender'] = label_encoder.fit_transform(dataset['Gender'])
dataset.head()
```

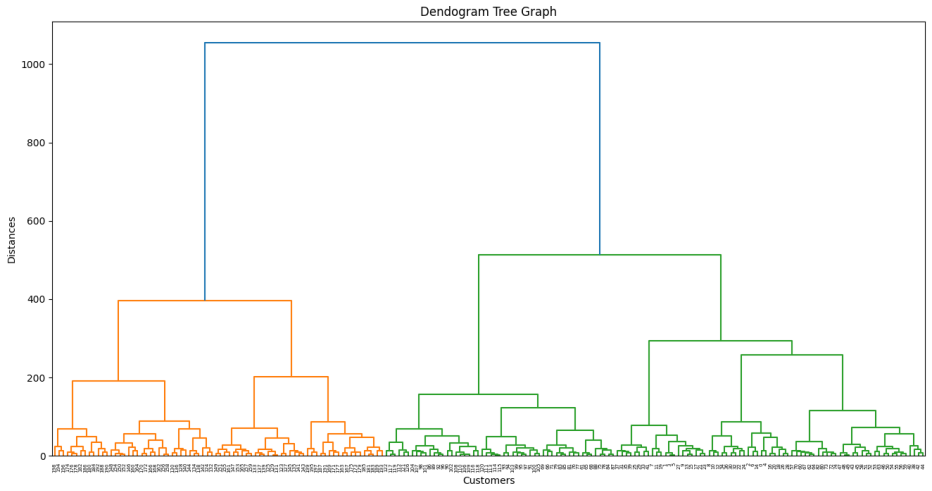
	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	1	19	15	39
1	2	1	21	15	81
2	3	0	20	16	6
3	4	0	23	16	77
4	5	0	31	17	40

Dendrogram Data Visualization

```
import scipy.cluster.hierarchy as clus

plt.figure(1, figsize = (16, 8))
dendrogram = clus.dendrogram(clus.linkage(dataset, method="ward"))

plt.title('Dendogram Tree Graph')
plt.xlabel('Customers')
plt.ylabel('Distances')
plt.show()
```



Finding the Hierarchial clustering to the dataset with n=5

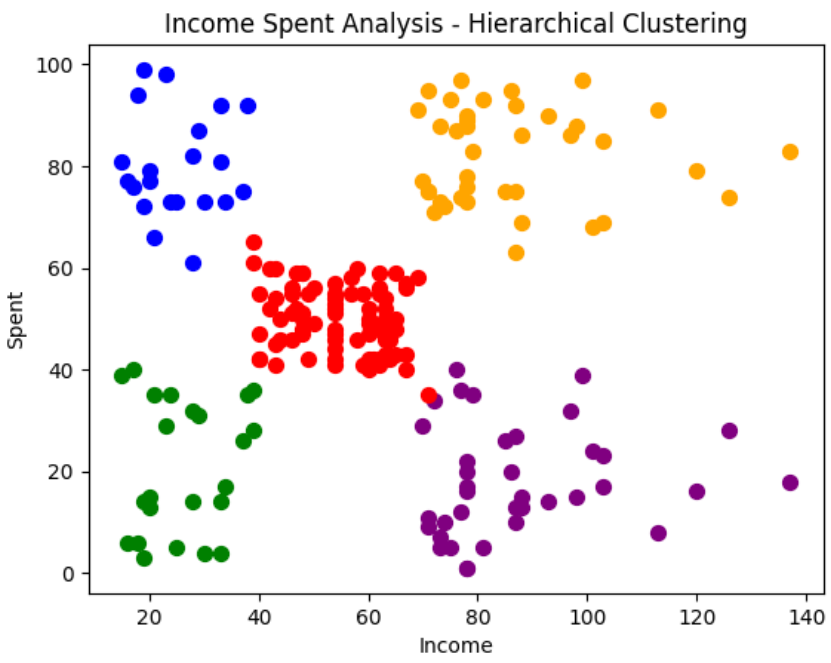
```
from sklearn.cluster import AgglomerativeClustering
model = AgglomerativeClustering(n_clusters=5, metric='euclidean', linkage='average')
y_means = model.fit_predict(dataset)
y_means
```

```
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, 2,
       3, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 1, 0, 1, 2, 1, 0, 1, 0, 1,
       0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1,
       0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1,
       0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1,
       0, 1])
```

Visualizing the number of clusters n=5

Cluster 1: Customers with Medium Income and Medium Spending
Cluster 2: Customers with High Income and High Spending
Cluster 3: Customers with Low Income and Low Spending
Cluster 4: Customers with High Income and Low Spending
Cluster 5: Customers with Low Income and High Spending

```
X = dataset.iloc[:, [3,4]].values
plt.scatter(X[y_means==0, 0], X[y_means==0, 1], s=50, c='purple', label='Cluster 1')
plt.scatter(X[y_means==1, 0], X[y_means==1, 1], s=50, c='orange', label='Cluster 2')
plt.scatter(X[y_means==2, 0], X[y_means==2, 1], s=50, c='red', label='Cluster 3')
plt.scatter(X[y_means==3, 0], X[y_means==3, 1], s=50, c='green', label='Cluster 4')
plt.scatter(X[y_means==4, 0], X[y_means==4, 1], s=50, c='blue', label='Cluster 5')
plt.title('Income Spent Analysis - Hierarchical Clustering')
plt.xlabel('Income')
plt.ylabel('Spent')
plt.show()
```



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