In [1]:

```
import pandas as pd
import numpy as np
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
from sklearn.preprocessing import StandardScaler, normalize
```

In [2]:

```
df=pd.read_csv('Downloads/Telegram Desktop/dataset.csv',sep=',',header=None)
```

In [3]:

```
df
```

Out[3]:

	0	1
0	76.954460	10.881760
1	76.962920	10.859130
2	76.968980	10.865150
3	76.974120	10.867120
4	76.973840	10.869670
...	...	...
2908	79.131900	12.921410
2909	79.129570	12.921030
2910	76.721080	8.082150
2911	80.320300	13.214610
2912	0.071984	0.102649

2913 rows × 2 columns

In [4]:

```
from scipy.cluster.hierarchy import single, cophenet
from scipy.spatial.distance import pdist, squareform
```

In [5]:

```
df = normalize(df)
c1,coph=cophenet(linkage(df, 'single'),pdist(df))
c2,coph=cophenet(linkage(df, 'complete'),pdist(df))
c3,coph=cophenet(linkage(df, 'average'),pdist(df))
c4,coph=cophenet(linkage(df, 'weighted'),pdist(df))
c5,coph=cophenet(linkage(df, 'centroid'),pdist(df))
linkage=pd.DataFrame({"Linkage":['Single','Complete','Average','Weighted','Centroid'],
                      "Cophenet Coeff":[c1,c2,c3,c4,c5]})
linkage
```

Out[5]:

	Linkage	Cophenet Coeff
0	Single	0.902287
1	Complete	0.899687
2	Average	0.954197
3	Weighted	0.944419
4	Centroid	0.954197

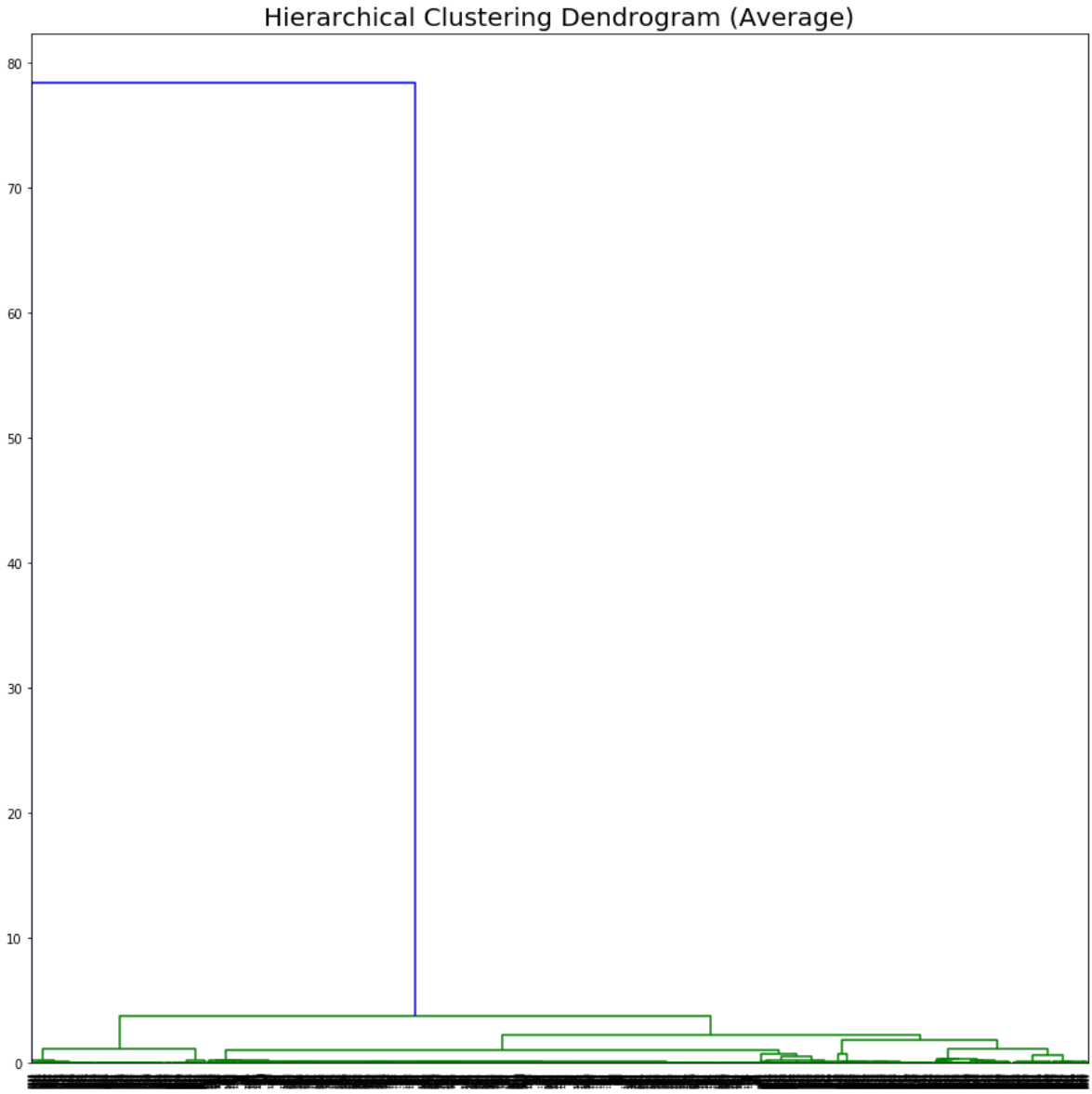
In [30]:

```
df=pd.read_csv('Downloads/Telegram Desktop/dataset.csv',sep=',',header=None)
from sklearn.cluster import AgglomerativeClustering
from sklearn.metrics import silhouette_score
db_index=[]
for i in range(2,8):
    db_index.append(silhouette_score(df, AgglomerativeClustering(n_clusters=i,linkage='aver
db_index = pd.DataFrame({'K Values':['2','3','4','5','6','7'],
                         'Silhouette index':db_index})
print(db_index)
print('K value 2 is giving the optimum')
```

```
  K Values  Silhouette index
0        2          0.975861
1        3          0.717708
2        4          0.761593
3        5          0.809102
4        6          0.817452
5        7          0.814944
K value 2 is giving the optimum
```

In [8]:

```
linked = linkage(df, 'average')
plt.figure(figsize=(15, 15))
dendrogram(linked)
plt.title('Hierarchical Clustering Dendrogram (Average)', fontsize=20)
plt.show()
```

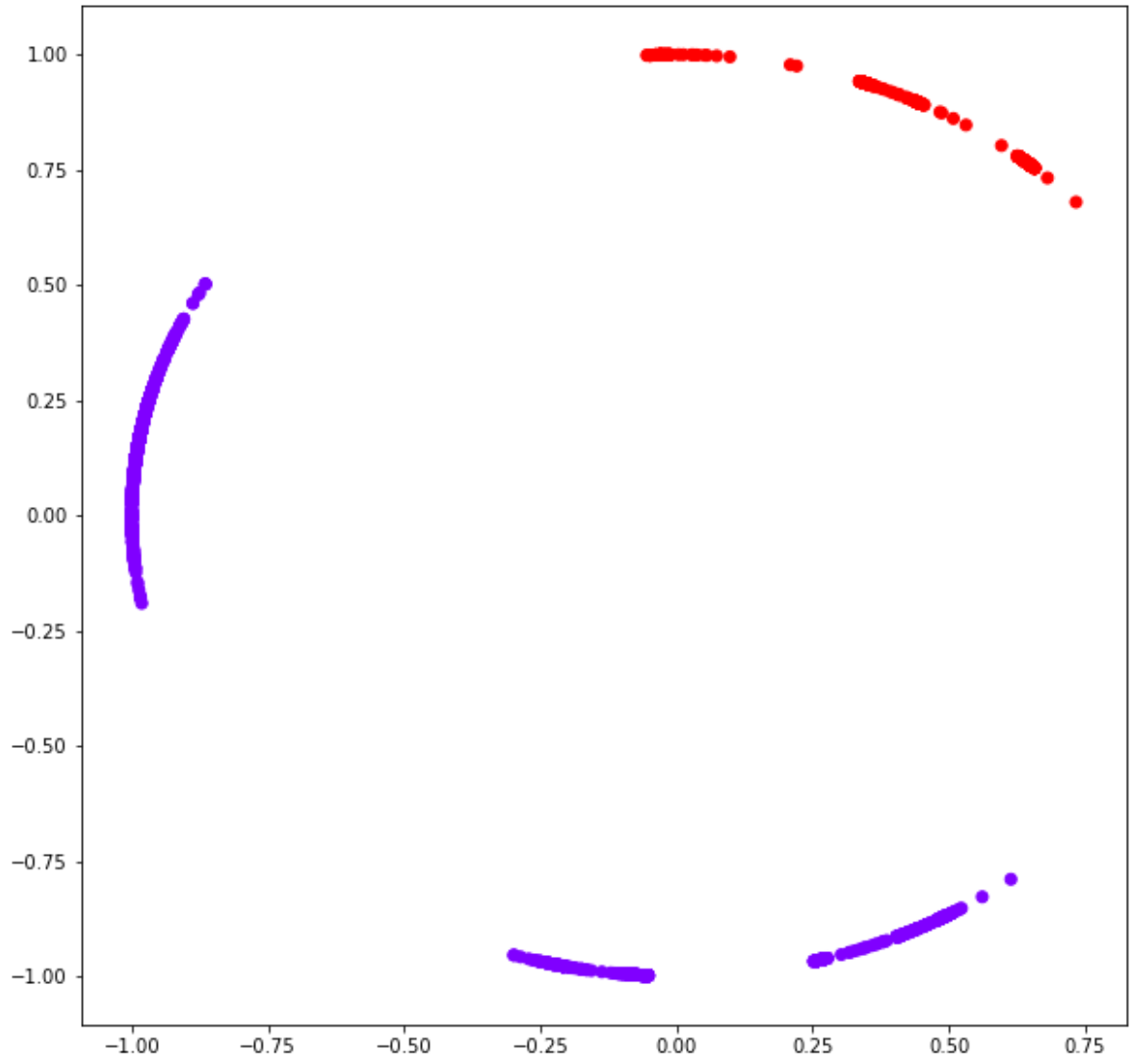


In [31]:

```
df=pd.read_csv('Downloads/Telegram Desktop/dataset.csv',sep=',',header=None)
scaler = StandardScaler()
X_scaled = scaler.fit_transform(df)
X_normalized = normalize(X_scaled)
X_normalized = pd.DataFrame(X_normalized)
ac2 = AgglomerativeClustering(n_clusters=2,linkage='average',affinity='euclidean')
plt.figure(figsize =(10, 10))
plt.scatter(X_normalized[0], X_normalized[1],
           c = ac2.fit_predict(X_normalized), cmap ='rainbow')
```

Out[31]:

```
<matplotlib.collections.PathCollection at 0x2821e90d080>
```



In [ ]: