```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

```
data = pd.read_csv('/content/drive/MyDrive/Datasets/Wholesale customers data.csv')
data.head()
```

	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicassen
0	2	3	12669	9656	7561	214	2674	1338
1	2	3	7057	9810	9568	1762	3293	1776
2	2	3	6353	8808	7684	2405	3516	7844
3	1	3	13265	1196	4221	6404	507	1788
4	2	3	22615	5410	7198	3915	1777	5185

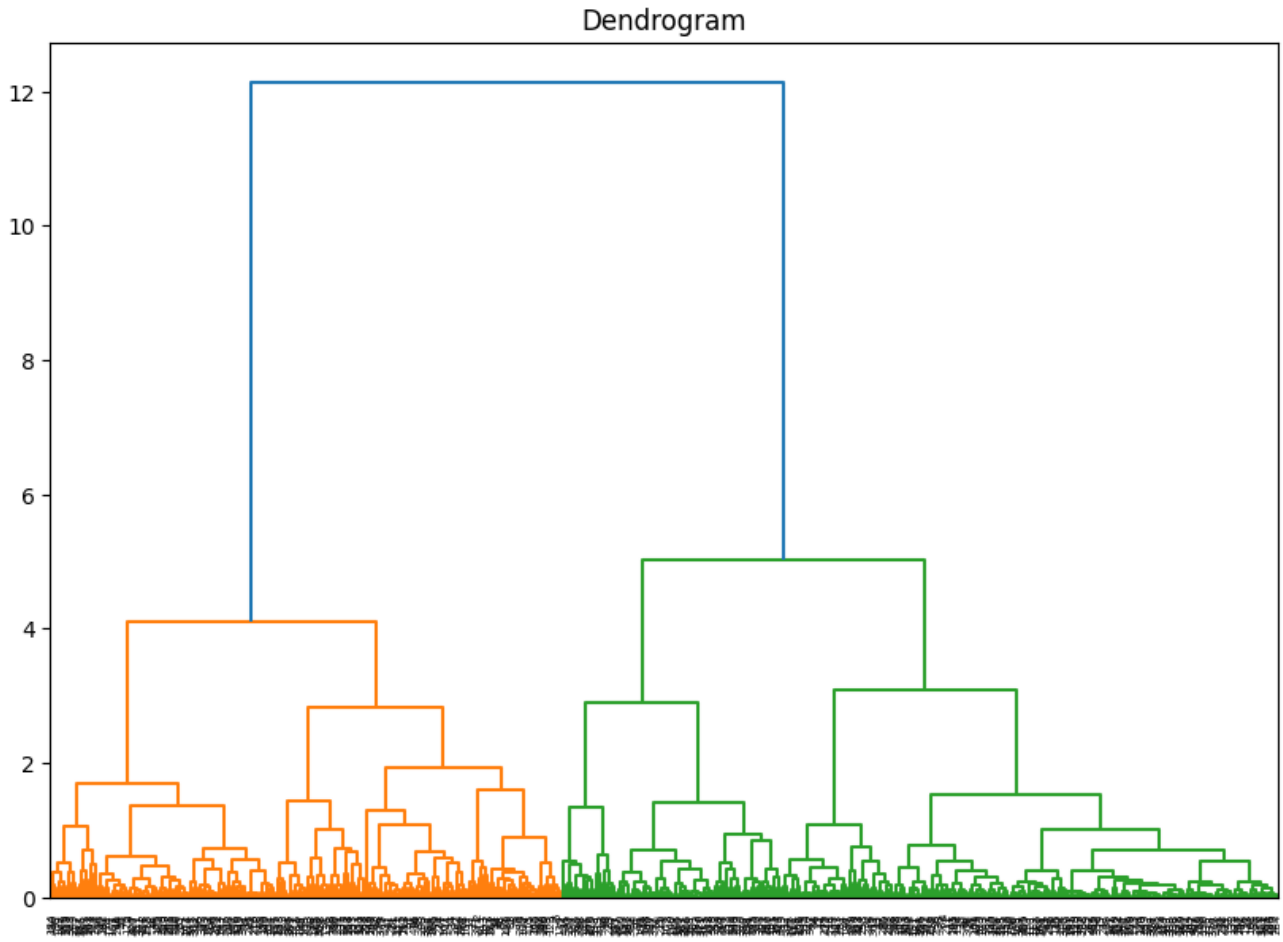
```
from sklearn.preprocessing import normalize
data_scaled = normalize(data)
data_scaled = pd.DataFrame(data_scaled, columns=data.columns)
data_scaled.head()
```

	Channel	Region	Fresh	Milk	Grocery	Frozen	Detergents_Paper	Delicas
0	0.000112	0.000168	0.708333	0.539874	0.422741	0.011965	0.149505	0.074
1	0.000125	0.000188	0.442198	0.614704	0.599540	0.110409	0.206342	0.111
2	0.000125	0.000187	0.396552	0.549792	0.479632	0.150119	0.219467	0.489
3	0.000065	0.000194	0.856837	0.077254	0.272650	0.413659	0.032749	0.115
4	0.000079	0.000119	0.895416	0.214203	0.284997	0.155010	0.070358	0.205

```
data_scaled.shape
```

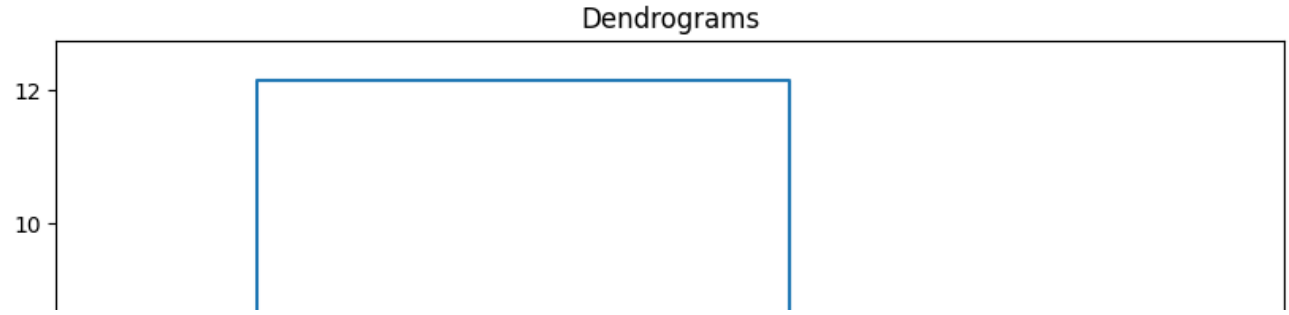
```
(440, 8)
```

```
import scipy.cluster.hierarchy as shc
plt.figure(figsize=(10, 7))
plt.title("Dendrogram")
dend = shc.dendrogram(shc.linkage(data_scaled, method='ward'))
```




```
plt.figure(figsize=(10, 7))
plt.title("Dendrograms")
dend = shc.dendrogram(shc.linkage(data_scaled, method='ward'))
plt.axhline(y=6, color='r', linestyle='--')
```

```
<matplotlib.lines.Line2D at 0x79311fbf01f0>
```

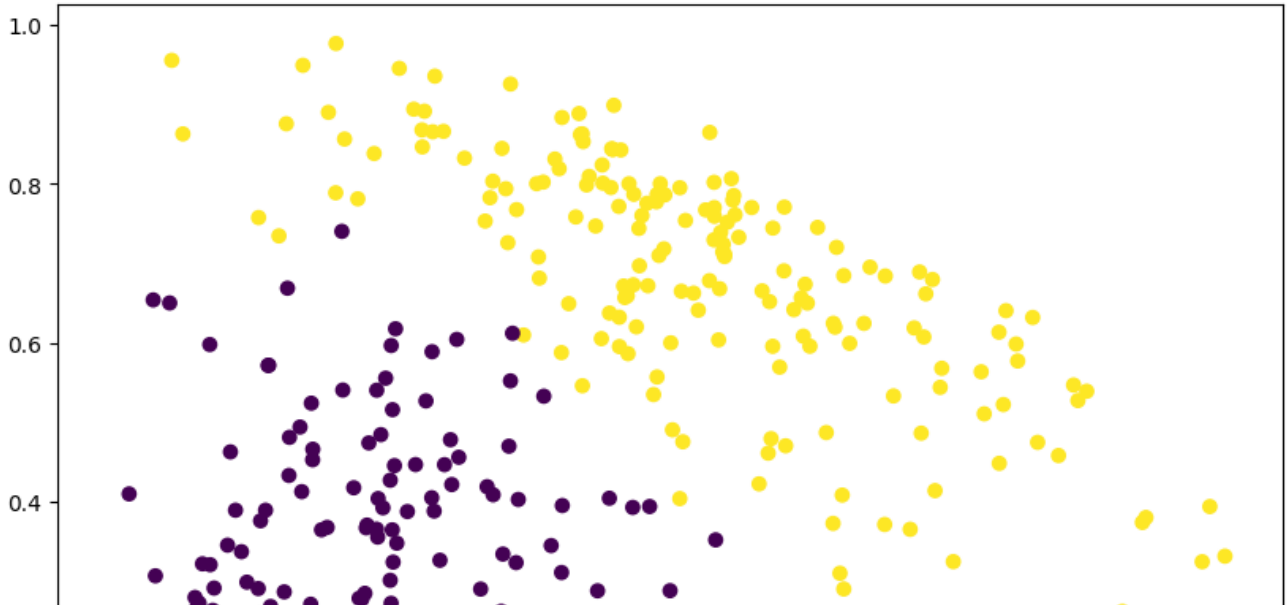



```
from sklearn.cluster import AgglomerativeClustering
cluster = AgglomerativeClustering(n_clusters=2, affinity='euclidean', linkage='ward')
cluster.fit_predict(data_scaled)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_agglomerative.py:983: Future
  warnings.warn(
array([1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0,
       0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1,
       1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0,
       0, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1,
       0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0,
       0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1,
       0, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1,
       0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
       0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0,
       0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1,
       1, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0,
       0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1,
       1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0,
       0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0,
       1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1,
       1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1])
```

```
plt.figure(figsize=(10, 7))
plt.scatter(data_scaled['Milk'], data_scaled['Grocery'], c=cluster.labels_)
```

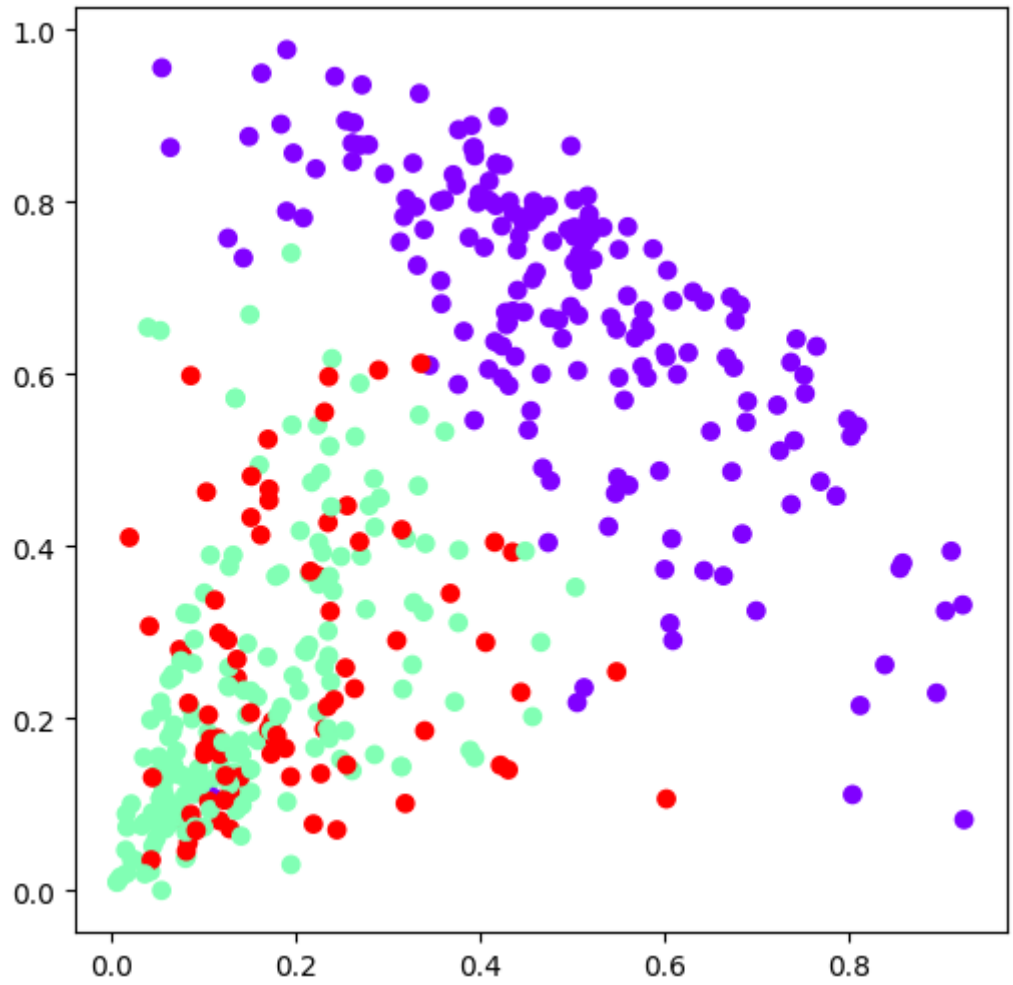
```
<matplotlib.collections.PathCollection at 0x79311f129ff0>
```




```
ac3 = AgglomerativeClustering(n_clusters = 3, affinity='euclidean', linkage='ward')

plt.figure(figsize =(6, 6))
plt.scatter(data_scaled['Milk'], data_scaled['Grocery'],
            c = ac3.fit_predict(data_scaled), cmap ='rainbow')
plt.show()
```

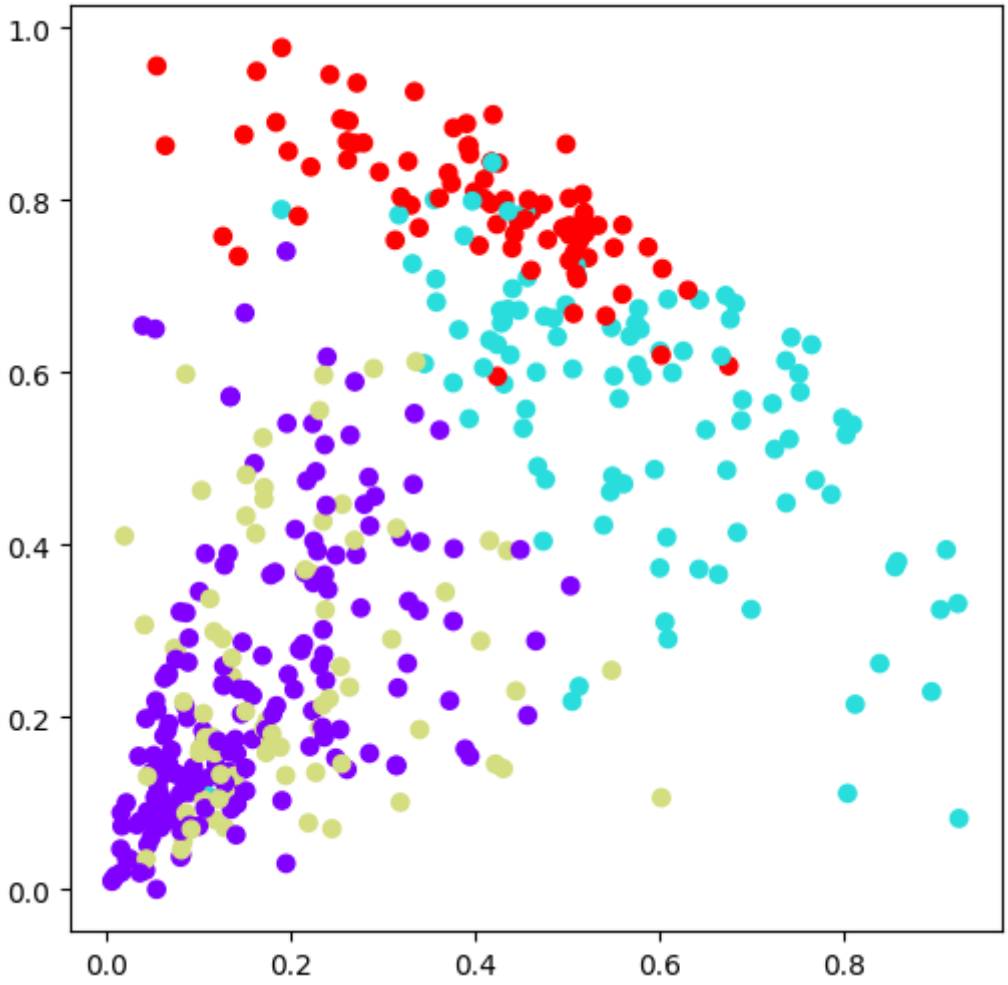
```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_agglomerative.py:983: Future
  warnings.warn(
```



```
ac2 = AgglomerativeClustering(n_clusters = 4, affinity='euclidean', linkage='ward')

plt.figure(figsize =(6, 6))
plt.scatter(data_scaled['Milk'], data_scaled['Grocery'], c = ac2.fit_predict(data_scaled)
plt.show()
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_agglomerative.py:983: Future
  warnings.warn(
```




```
from sklearn.metrics import silhouette_score

silhouette_scores = []
silhouette_scores.append(
        silhouette_score(data_scaled, cluster.fit_predict(data_scaled)))
silhouette_scores.append(
        silhouette_score(data_scaled, ac3.fit_predict(data_scaled)))
silhouette_scores.append(
        silhouette_score(data_scaled, ac2.fit_predict(data_scaled)))
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_agglomerative.py:983: Future
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_agglomerative.py:983: Future
  warnings.warn(
/usr/local/lib/python3.10/dist-packages/sklearn/cluster/_agglomerative.py:983: Future
  warnings.warn(
```

```
plt.bar([2,3,4], silhouette_scores)
plt.xlabel('Number of clusters', fontsize = 20)
plt.ylabel('S(i)', fontsize = 20)
plt.show()
```