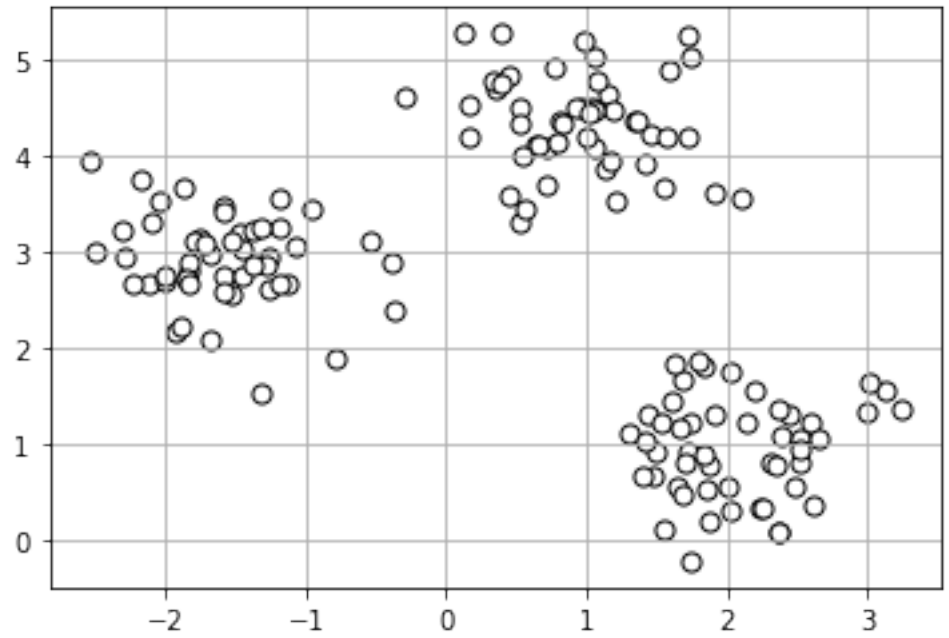
Chapter_11_Working_with_Unlabeled_Data _Clustering_Analysis

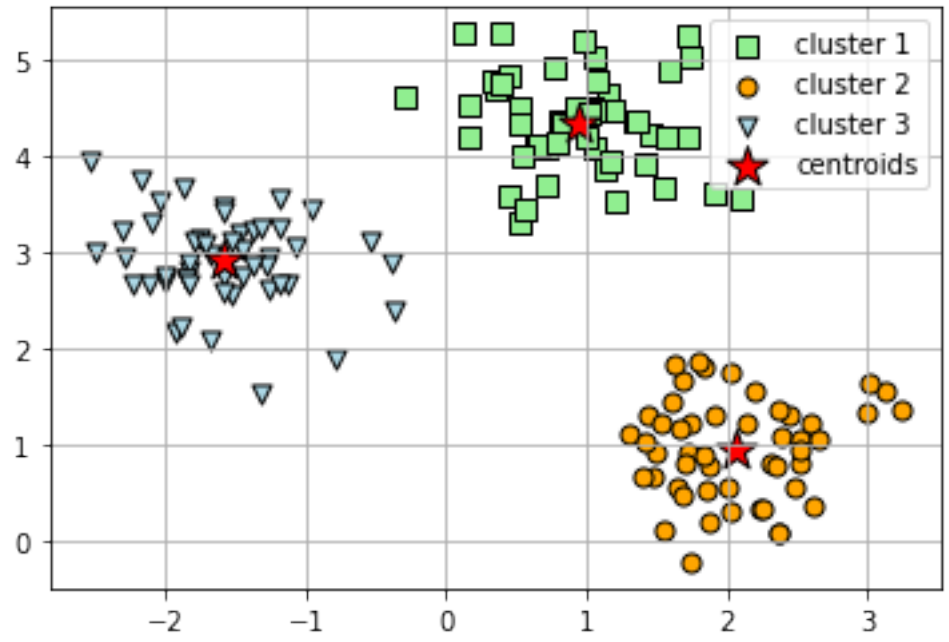
March 20, 2024

[1]:
```
from sklearn.datasets import make_blobs
X, y = make_blobs(n_samples=150,n_features=2,centers=3,cluster_std=0.
 ↪5,shuffle=True,random_state=0)
import matplotlib.pyplot as plt
plt.scatter(X[:,0],X[:,1],c='white',marker='o',edgecolor='black',s=50)
plt.grid()
plt.show()
```



[2]:
```
from sklearn.cluster import KMeans
km =␣
 ↪KMeans(n_clusters=3,init='random',n_init=10,max_iter=300,tol=1e-04,random_state=0)
y_km = km.fit_predict(X)
```

[3]:
```
plt.scatter(X[y_km == 0, 0],X[y_km == 0, 1],s=50, c='lightgreen',marker='s',␣
 ↪edgecolor='black',label='cluster 1')
plt.scatter(X[y_km == 1, 0],X[y_km == 1, 1],s=50, c='orange',marker='o',␣
 ↪edgecolor='black',label='cluster 2')
plt.scatter(X[y_km == 2, 0],X[y_km == 2, 1],s=50, c='lightblue',marker='v',␣
 ↪edgecolor='black',label='cluster 3')
plt.scatter(km.cluster_centers_[:, 0],km.cluster_centers_[:, 1],s=250,␣
 ↪marker='*',c='red', edgecolor='black',label='centroids')
plt.legend(scatterpoints=1)
plt.grid()
plt.show()
```



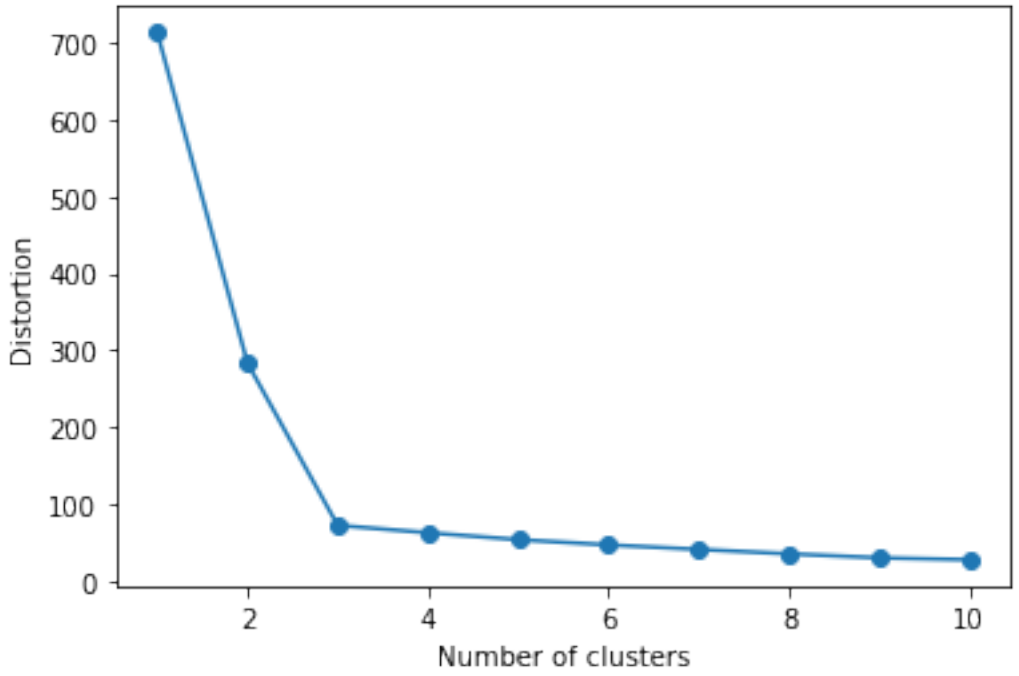
0.1 Elbow Method

[4]:
```
print('Distortion: %.2f' % km.inertia_)
```

```
Distortion: 72.48
```

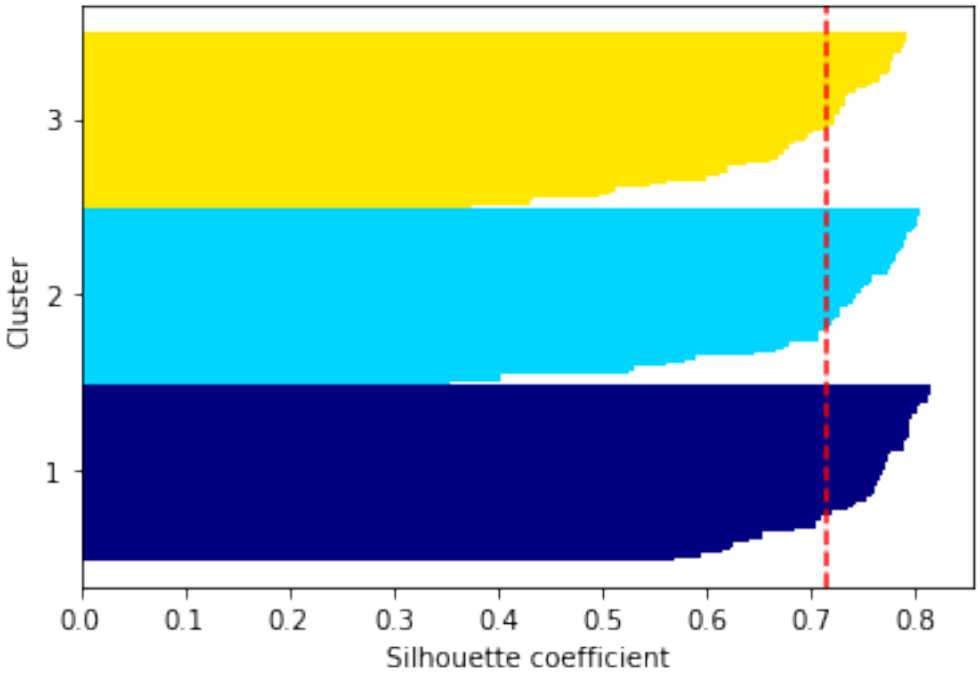
[7]:
```
distortions = []
for i in range(1, 11):
    km =␣
 ↪KMeans(n_clusters=i,init='k-means++',n_init=10,max_iter=300,random_state=0)
    km.fit(X)
    distortions.append(km.inertia_)
```

[8]:
```
plt.plot(range(1,11), distortions, marker='o')
plt.xlabel('Number of clusters')
plt.ylabel('Distortion')
plt.show()
```

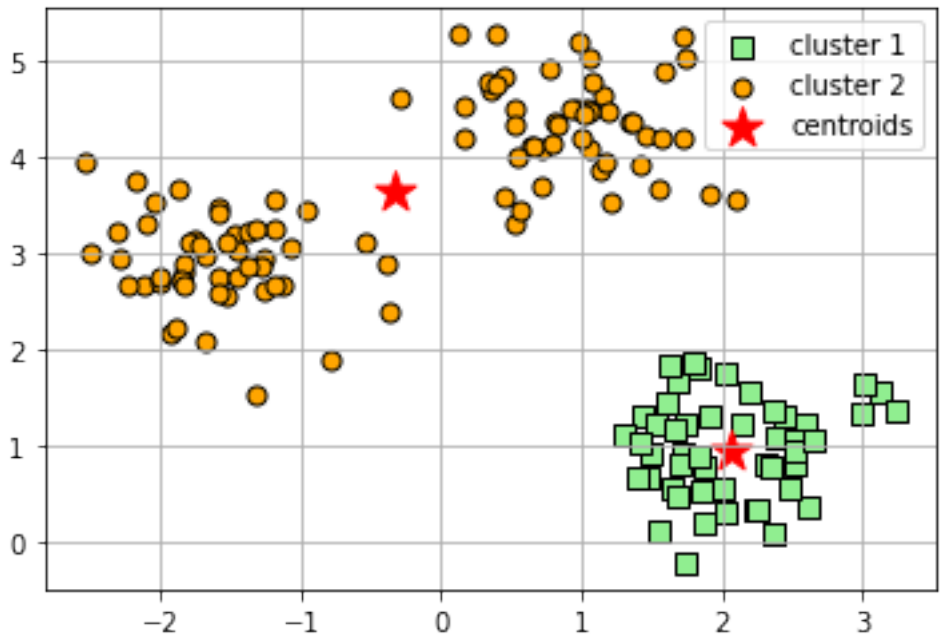


[9]:
```
km = ␣
 ↪KMeans(n_clusters=3,init='k-means++',n_init=10,max_iter=300,tol=1e-04,random_state=0)
y_km = km.fit_predict(X)
import numpy as np
from matplotlib import cm
from sklearn.metrics import silhouette_samples
cluster_labels = np.unique(y_km)
n_clusters = cluster_labels.shape[0]
silhouette_vals = silhouette_samples(X,y_km,metric='euclidean')
y_ax_lower, y_ax_upper = 0, 0
yticks = []
for i, c in enumerate(cluster_labels):
    c_silhouette_vals = silhouette_vals[y_km == c]
    c_silhouette_vals.sort()
    y_ax_upper += len(c_silhouette_vals)
    color = cm.jet(float(i) / n_clusters)
    plt.barh(range(y_ax_lower, y_ax_upper),c_silhouette_vals,height=1.
 ↪0,edgecolor='none',color=color)
    yticks.append((y_ax_lower + y_ax_upper) / 2.)
```

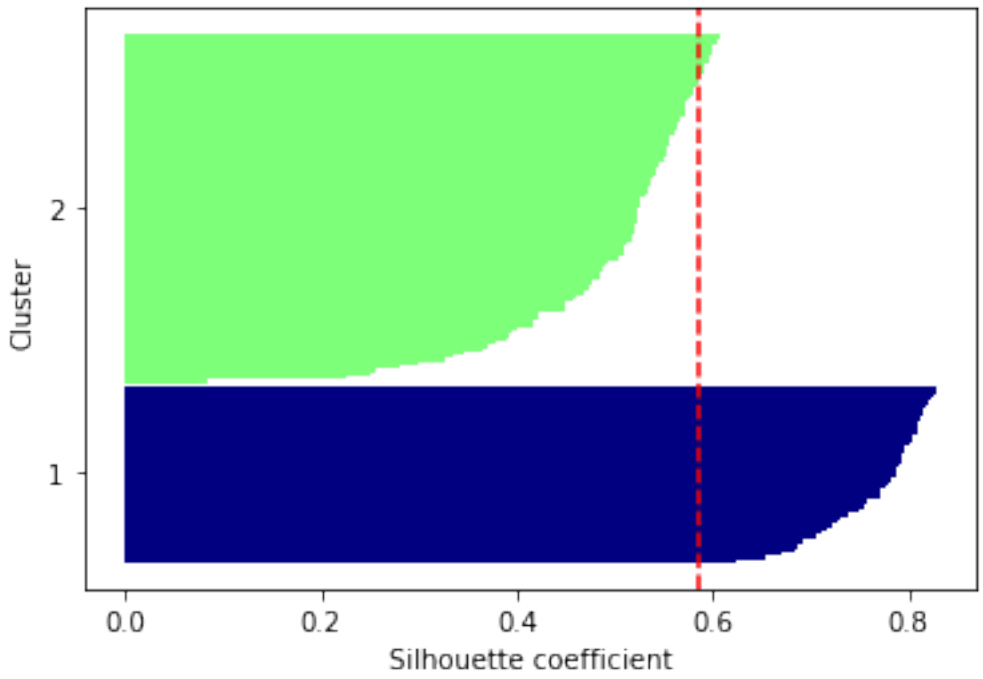
```
    y_ax_lower += len(c_silhouette_vals)
silhouette_avg = np.mean(silhouette_vals)
plt.axvline(silhouette_avg,color="red",linestyle="--")
plt.yticks(yticks, cluster_labels + 1)
plt.ylabel('Cluster')
plt.xlabel('Silhouette coefficient')
plt.show()
```



[10]:
```
km =␣
 ↪KMeans(n_clusters=2,init='k-means++',n_init=10,max_iter=300,tol=1e-04,random_state=0)
y_km = km.fit_predict(X)
plt.scatter(X[y_km==0,0],X[y_km==0,1],s=50,␣
 ↪c='lightgreen',edgecolor='black',marker='s',label='cluster 1')
plt.
 ↪scatter(X[y_km==1,0],X[y_km==1,1],s=50,c='orange',edgecolor='black',marker='o',label='clust
 ↪2')
plt.scatter(km.cluster_centers_[:,0],km.cluster_centers_[:
 ↪,1],s=250,marker='*',c='red',label='centroids')
plt.legend()
plt.grid()
plt.show()
```



[11]:
```
cluster_labels = np.unique(y_km)
n_clusters = cluster_labels.shape[0]
silhouette_vals = silhouette_samples(X,y_km,metric='euclidean')
y_ax_lower, y_ax_upper = 0, 0
yticks = []
for i, c in enumerate(cluster_labels):
    c_silhouette_vals = silhouette_vals[y_km == c]
    c_silhouette_vals.sort()
    y_ax_upper += len(c_silhouette_vals)
    color = cm.jet(i / n_clusters)
    plt.barh(range(y_ax_lower, y_ax_upper),c_silhouette_vals,height=1.
 ↪0,edgecolor='none',color=color)
    yticks.append((y_ax_lower + y_ax_upper) / 2)
    y_ax_lower += len(c_silhouette_vals)
silhouette_avg = np.mean(silhouette_vals)
plt.axvline(silhouette_avg, color="red", linestyle="--")
plt.yticks(yticks, cluster_labels + 1)
plt.ylabel('Cluster')
plt.xlabel('Silhouette coefficient')
plt.show()
```



[12]:
```
import pandas as pd
import numpy as np
np.random.seed(123)
variables = ['X', 'Y', 'Z']
labels = ['ID_0','ID_1','ID_2','ID_3','ID_4']
X = np.random.random_sample([5,3])*10
df = pd.DataFrame(X, columns=variables, index=labels)
df
```

[12]:

	X	Y	Z
ID_0	6.964692	2.861393	2.268515
ID_1	5.513148	7.194690	4.231065
ID_2	9.807642	6.848297	4.809319
ID_3	3.921175	3.431780	7.290497
ID_4	4.385722	0.596779	3.980443

[13]:
```
from scipy.spatial.distance import pdist, squareform
row_dist = pd.DataFrame(squareform(pdist(df,␣
 ↪metric='euclidean')),columns=labels, index=labels)
row_dist
```

[13]:

	ID_0	ID_1	ID_2	ID_3	ID_4
ID_0	0.000000	4.973534	5.516653	5.899885	3.835396
ID_1	4.973534	0.000000	4.347073	5.104311	6.698233
ID_2	5.516653	4.347073	0.000000	7.244262	8.316594

```
ID_3  5.899885  5.104311  7.244262  0.000000  4.382864
ID_4  3.835396  6.698233  8.316594  4.382864  0.000000
```

[15]:
```
from scipy.cluster.hierarchy import linkage
row_clusters = linkage(pdist(df, metric='euclidean'),method='complete')
```

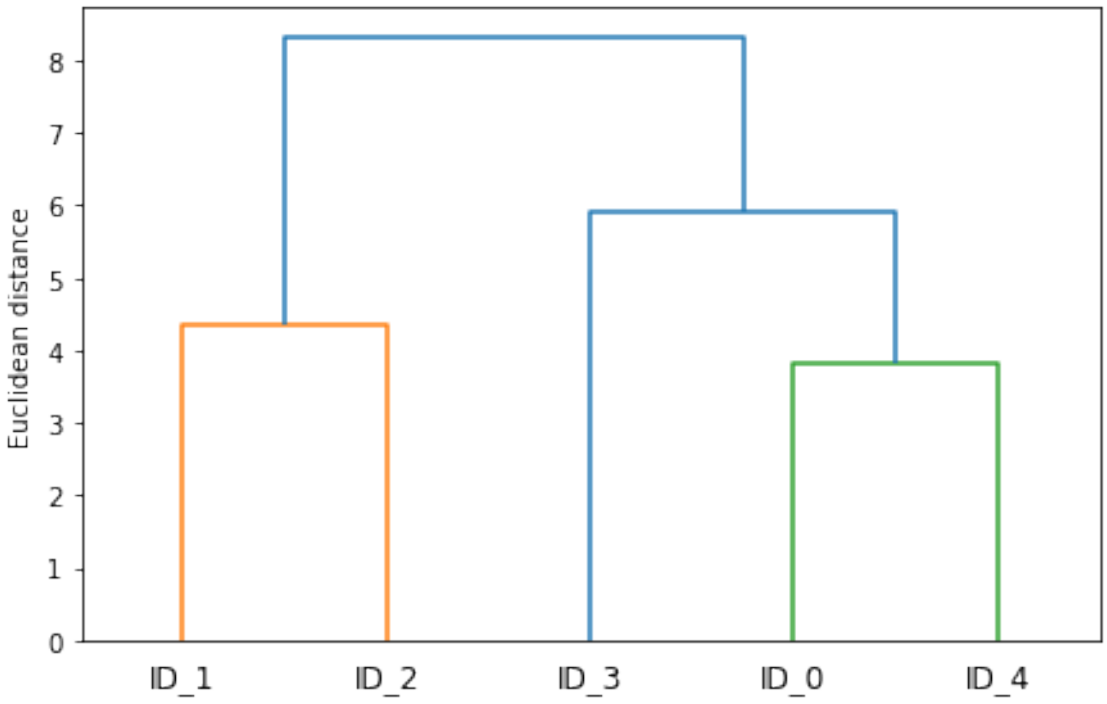
[16]:
```
row_clusters = linkage(df.values,method='complete', metric='euclidean')
```

[17]:
```
pd.DataFrame(row_clusters,columns=['row label 1','row label 2','distance','no. of items in clust.'],index=['cluster %d' %(i+1) for i in range(row_clusters.shape[0])])
```

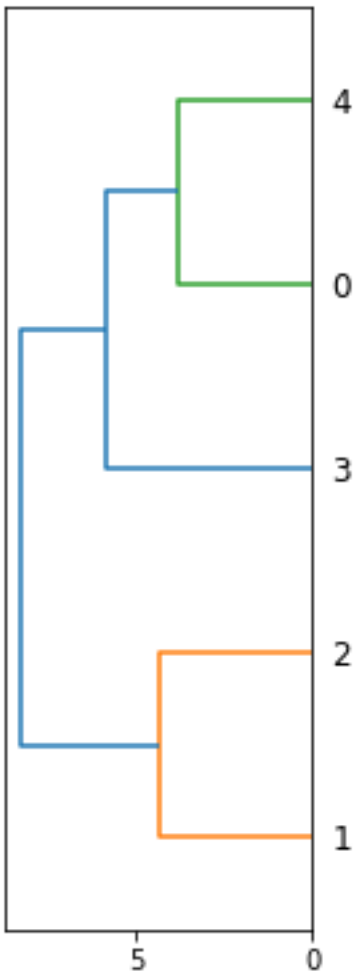
[17]:

	row label 1	row label 2	distance	no. of items in clust.
cluster 1	0.0	4.0	3.835396	2.0
cluster 2	1.0	2.0	4.347073	2.0
cluster 3	3.0	5.0	5.899885	3.0
cluster 4	6.0	7.0	8.316594	5.0

[18]:
```
from scipy.cluster.hierarchy import dendrogram
# make dendrogram black (part 1/2)
# from scipy.cluster.hierarchy import set_link_color_palette
# set_link_color_palette(['black'])
row_dendr = dendrogram(row_clusters,labels=labels)
plt.tight_layout()
plt.ylabel('Euclidean distance')
plt.show()
```



[19]:
```
fig = plt.figure(figsize=(8,8), facecolor='white')
axd = fig.add_axes([0.09,0.1,0.2,0.6])
row_dendr = dendrogram(row_clusters, orientation='left')
# note: for matplotlib < v1.5.1, please use orientation='right'
```



[20]:
```
df_rowclust = df.iloc[row_dendr['leaves'][::-1]]
```

[21]:
```
axm = fig.add_axes([0.23,0.1,0.6,0.6])
cax = axm.matshow(df_rowclust,interpolation='nearest', cmap='hot_r')
```

[23]:
```
axd.set_xticks([])
axd.set_yticks([])
for i in axd.spines.values():
```

```
    i.set_visible(False)
fig.colorbar(cax)
axm.set_xticklabels([''] + list(df_rowclust.columns))
axm.set_yticklabels([''] + list(df_rowclust.index))
plt.show()
```

```
C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Desktop\Sel
f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\ipykernel_launcher.py:6: UserWarning: FixedFormatter should only be
used together with FixedLocator

C:\Users\ankit19.gupta\OneDrive - Reliance Corporate IT Park Limited\Desktop\Sel
f_Projects\Python_Machine_Learning_Sebastian_Raschka\myenv\lib\site-
packages\ipykernel_launcher.py:7: UserWarning: FixedFormatter should only be
used together with FixedLocator
  import sys
```

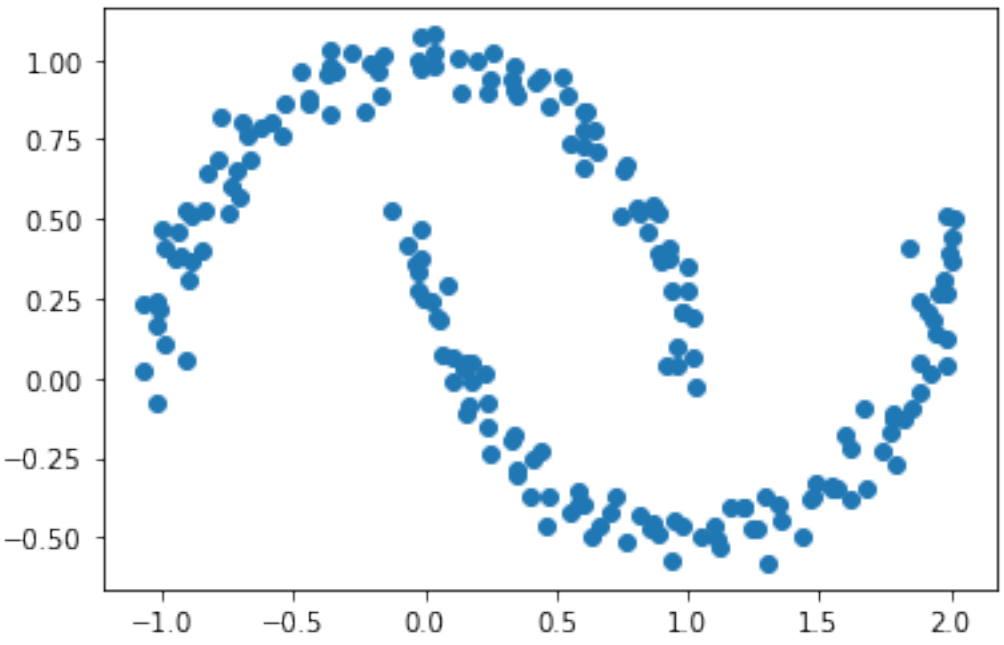
[24]:
```
from sklearn.cluster import AgglomerativeClustering
ac =␣
 ↪AgglomerativeClustering(n_clusters=3,affinity='euclidean',linkage='complete')
labels = ac.fit_predict(X)
print('Cluster labels: %s' % labels)
```

```
Cluster labels: [1 0 0 2 1]
```

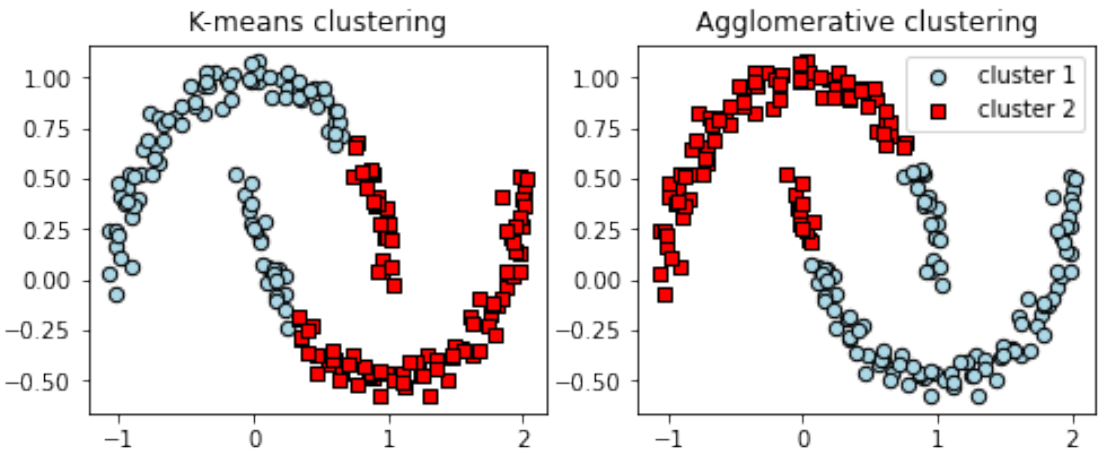
[25]:
```
ac =␣
 ↪AgglomerativeClustering(n_clusters=2,affinity='euclidean',linkage='complete')
labels = ac.fit_predict(X)
print('Cluster labels: %s' % labels)
```

```
Cluster labels: [0 1 1 0 0]
```

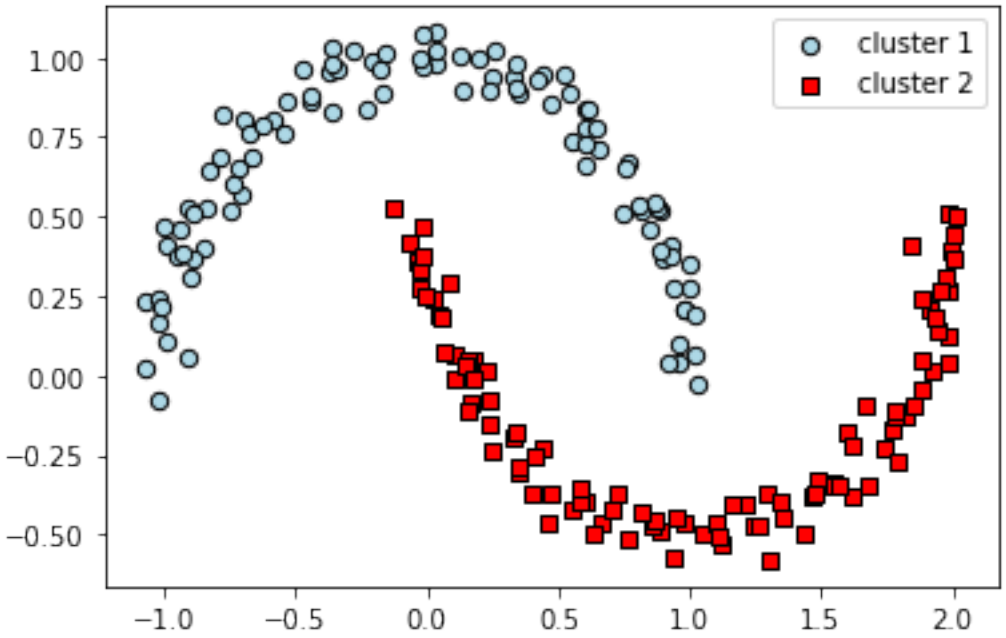
[26]:
```
from sklearn.datasets import make_moons
X, y = make_moons(n_samples=200,noise=0.05,random_state=0)
plt.scatter(X[:,0], X[:,1])
plt.show()
```



[27]:
```
f, (ax1, ax2) = plt.subplots(1, 2, figsize=(8, 3))
km = KMeans(n_clusters=2,random_state=0)
y_km = km.fit_predict(X)
ax1.
 ↪scatter(X[y_km==0,0],X[y_km==0,1],c='lightblue',edgecolor='black',marker='o',s=40,label='cl
 ↪1')
ax1.
 ↪scatter(X[y_km==1,0],X[y_km==1,1],c='red',edgecolor='black',marker='s',s=40,label='cluster␣
 ↪2')
ax1.set_title('K-means clustering')
ac =␣
 ↪AgglomerativeClustering(n_clusters=2,affinity='euclidean',linkage='complete')
y_ac = ac.fit_predict(X)
ax2.
 ↪scatter(X[y_ac==0,0],X[y_ac==0,1],c='lightblue',edgecolor='black',marker='o',s=40,label='cl
 ↪1')
ax2.
 ↪scatter(X[y_ac==1,0],X[y_ac==1,1],c='red',edgecolor='black',marker='s',s=40,label='cluster␣
 ↪2')
ax2.set_title('Agglomerative clustering')
plt.legend()
plt.show()
```



[28]:
```
from sklearn.cluster import DBSCAN
db = DBSCAN(eps=0.2,min_samples=5,metric='euclidean')
y_db = db.fit_predict(X)
plt.
  ↪scatter(X[y_db==0,0],X[y_db==0,1],c='lightblue',edgecolor='black',marker='o',s=40,label='cl
  ↪1')
plt.
  ↪scatter(X[y_db==1,0],X[y_db==1,1],c='red',edgecolor='black',marker='s',s=40,label='cluster␣
  ↪2')
plt.legend()
plt.show()
```



[ ]: