# Dataset 2 spectral cluster

January 15, 2023

[ ]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.utils import resample
from sklearn.preprocessing  import  scale
from sklearn.decomposition  import PCA
from sklearn import metrics

from sklearn.metrics import ConfusionMatrixDisplay
from sklearn.model_selection import validation_curve
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import GridSearchCV
import matplotlib.pyplot as plt
import matplotlib.colors as colors
import os
from sklearn.metrics import silhouette_score, homogeneity_score
```

## 1 Data Preperation

[ ]:
```
csv0= pd.read_csv("0.csv")
csv1= pd.read_csv("1.csv")
csv2= pd.read_csv("2.csv")
csv3= pd.read_csv("3.csv")
allFiles=['0.csv', '1.csv', '2.csv','3.csv']
list = []
for file in allFiles:
    read = pd.read_csv(file, header = None)
    list.append(read)
data = pd.concat(list)
```

[ ]:
```
y = data[64]
X= data.drop(columns=64)
```

[ ]:
```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
```

```
X_scaled= scaler.fit_transform(X)
```

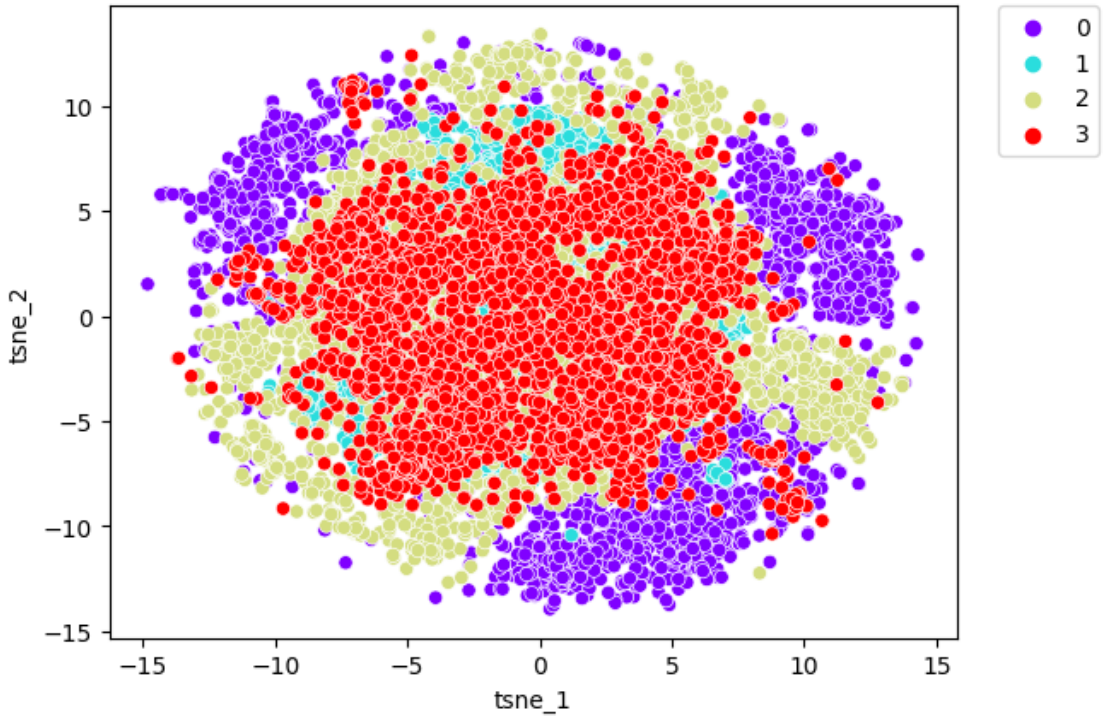
## 2 T-SNE

[ ]:
```
from sklearn.manifold import TSNE
n_components = 2
tsne = TSNE(n_components=2,perplexity=100)
x_tsne = tsne.fit_transform(X_scaled)
```

### 2.1 Plot for t-SNE

[ ]:
```
import seaborn as sns
X_isomap_df = pd.DataFrame({'tsne_1': x_tsne[:,0], 'tsne_2': x_tsne[:,1],␣
 ↪'label': y})
fig, ax = plt.subplots(1)
sns.scatterplot(x='tsne_1', y='tsne_2', hue='label',palette='rainbow',␣
 ↪data=x_tsne_df, ax=ax)
ax.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.0)
```

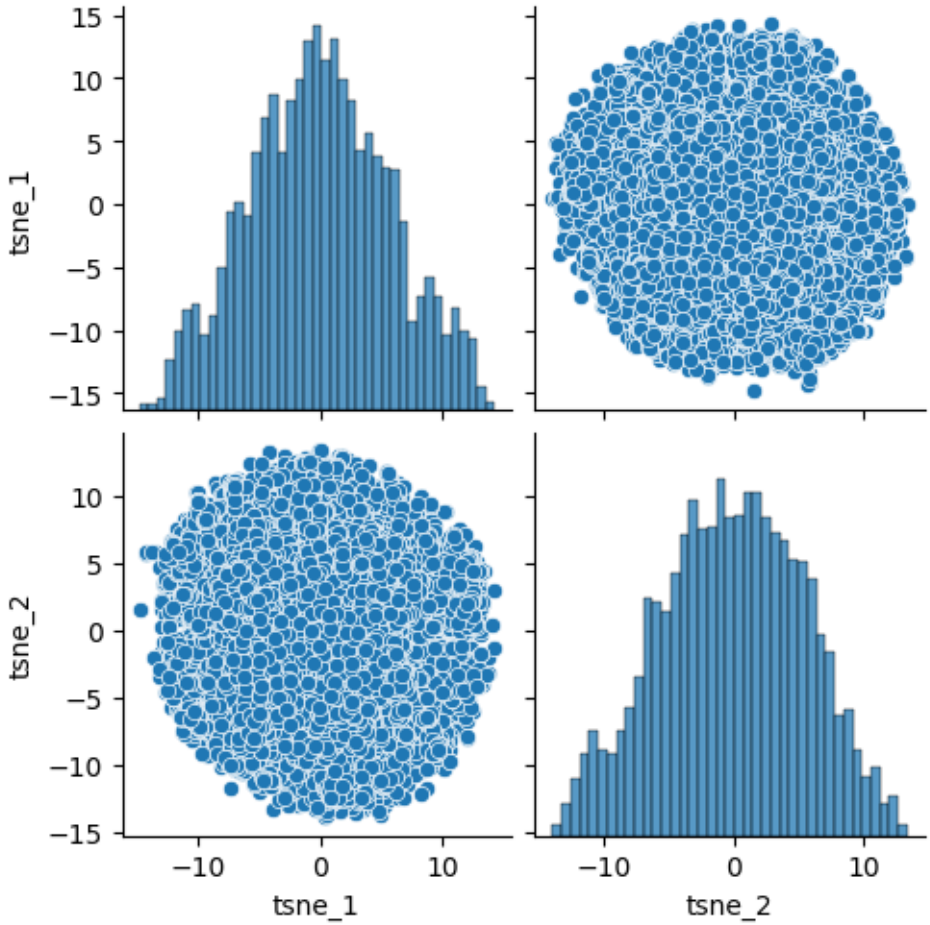
[ ]:
```
<matplotlib.legend.Legend at 0x1d49d7bce10>
```



### 2.2 Pairplot for t-SNE

[ ]:
```
x_tsne_df = pd.DataFrame({'tsne_1': x_tsne[:,0], 'tsne_2': x_tsne[:,1]})
sns.pairplot(x_tsne_df)
```

[ ]:
```
<seaborn.axisgrid.PairGrid at 0x1d4a01f6a50>
```



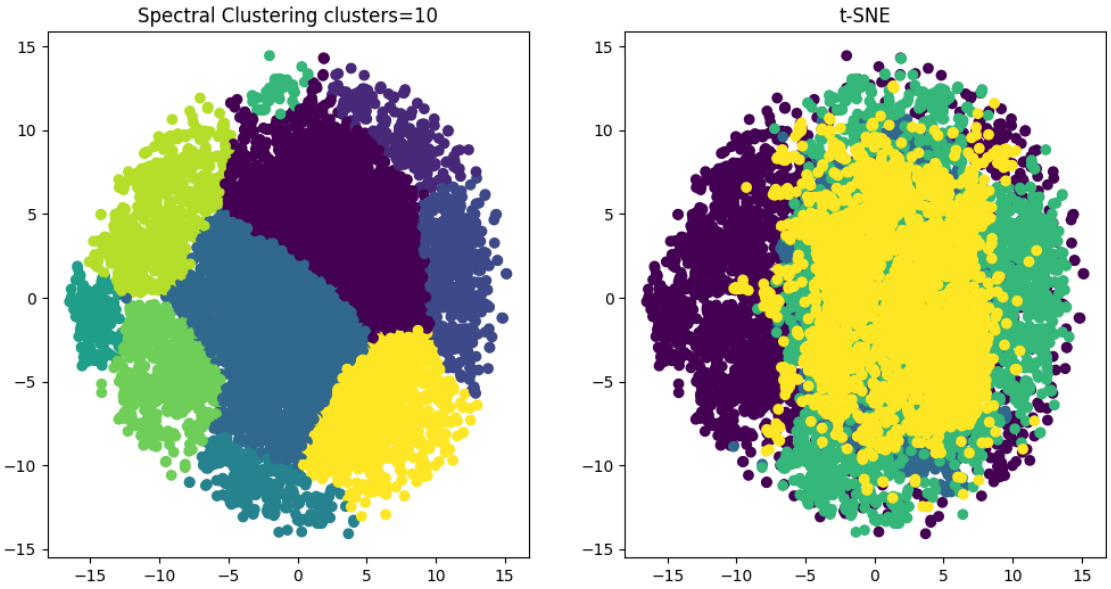

## 3 Spectral Clustering with RBF

### 3.1 Comparison between Spectral Clustering n_clusters and t-SNE

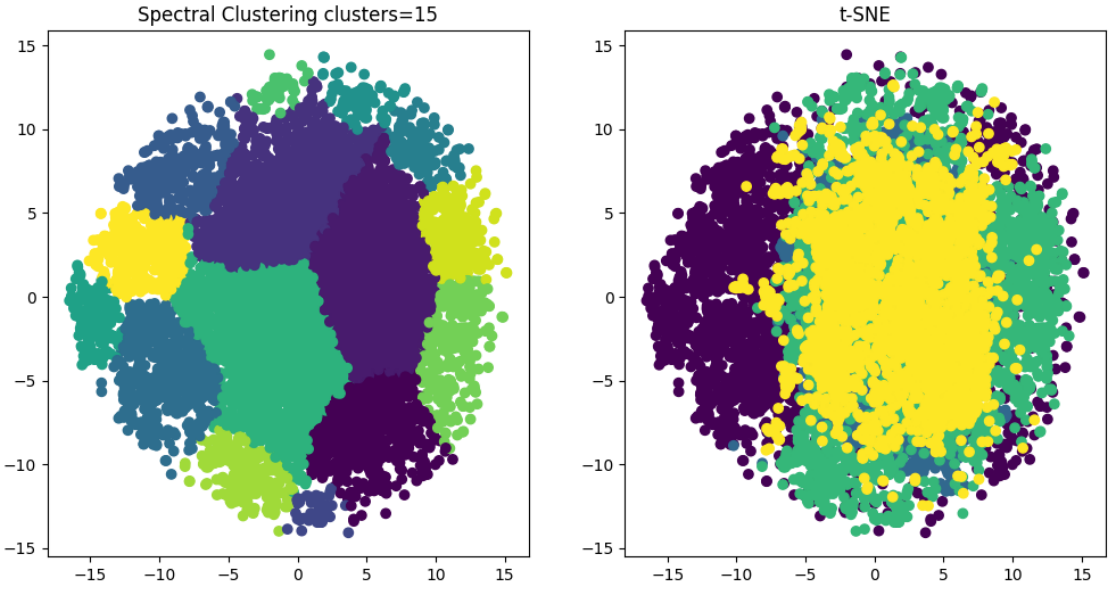
[ ]:
```
from sklearn.cluster import SpectralClustering
for i in range(10,25,5):
    sc = SpectralClustering(n_clusters=i,affinity='rbf',assign_labels='kmeans')
    labels_rbf = sc.fit_predict(x_tsne)
    silhouette = silhouette_score(x_tsne, labels_rbf)
    homogeneity = homogeneity_score(y, labels_rbf)
```

```
    print("rbf: {} \n Silhouette score: {:.3f} \n Homogeneity score: {:.3f}".
↪format(i, silhouette, homogeneity))
    fig, ax = plt.subplots(1, 2, figsize=(12, 6))

    # Create a scatter plot of the clustered data in the first subplot
    ax[0].scatter(x_tsne[:, 0],x_tsne[:, 1], c=labels_rbf)
    ax[0].set_title("Spectral Clustering clusters={}".format(i))

    # Create a scatter plot of the t-SNE reduced data in the second subplot
    ax[1].scatter(x_tsne[:, 0], x_tsne[:, 1],c=y)
    ax[1].set_title("t-SNE")

    plt.show()
```

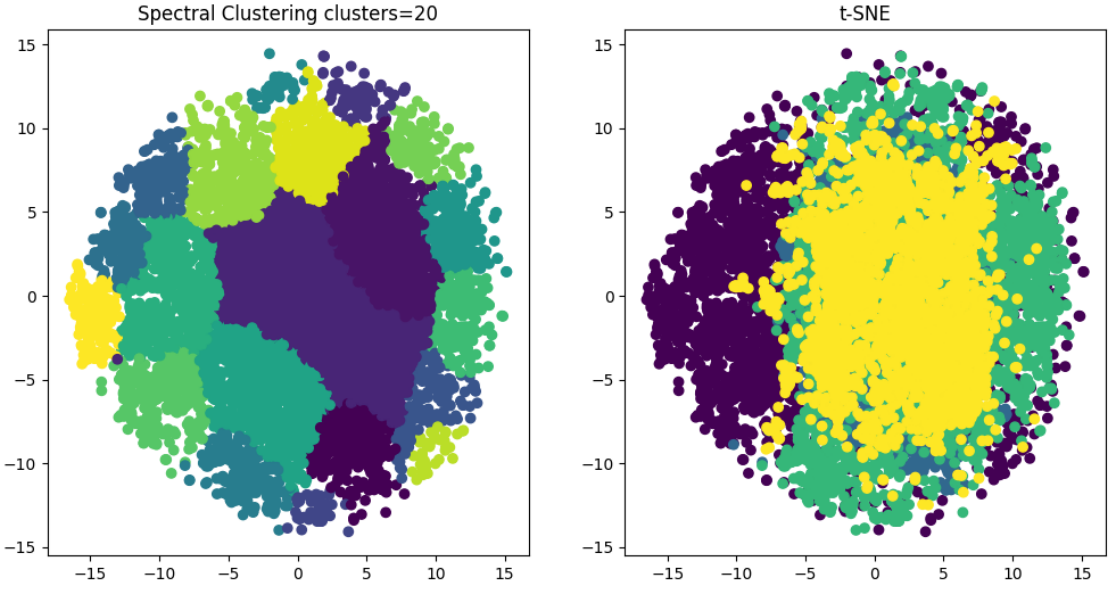
```
rbf: 10
 Silhouette score: 0.208
 Homogeneity score: 0.240
```




```
rbf: 15
 Silhouette score: 0.227
 Homogeneity score: 0.243
```




```
rbf: 20
 Silhouette score: 0.182
 Homogeneity score: 0.260
```



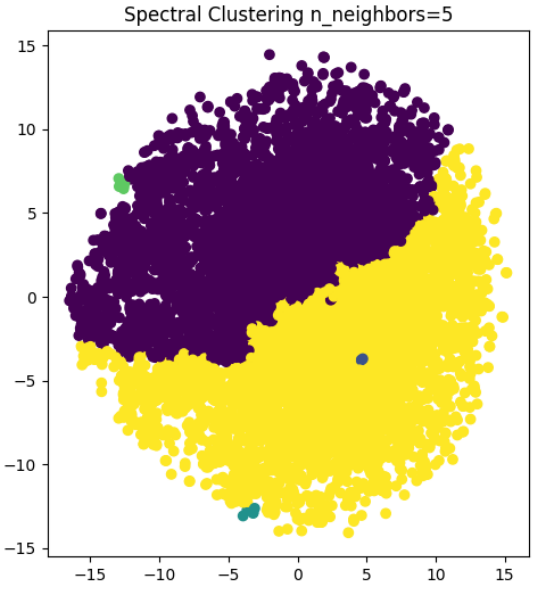
# 4 Specral Clustering with nearest neighbors

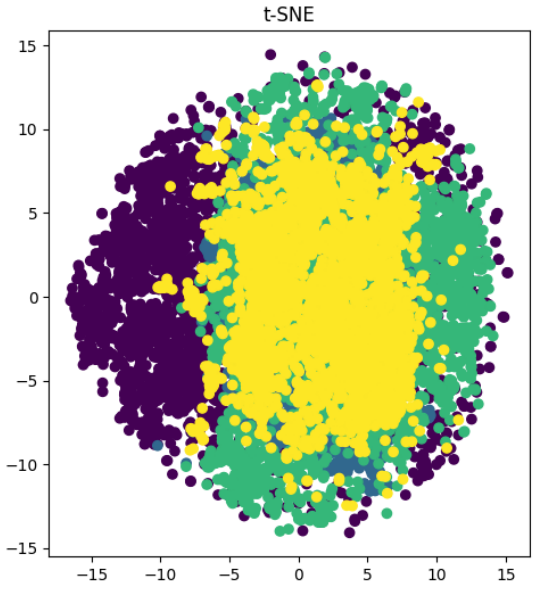
## 4.1 Comparison between Spectral Clustering n_neighbors and t-SNE

[ ]:
```
for i in range(5,40,5):
    sc =␣
 ↪SpectralClustering(n_clusters=i,affinity='nearest_neighbors',assign_labels='kmeans',n_neigh
    labels_nn = sc.fit_predict(x_tsne)
    silhouette = silhouette_score(x_tsne, labels_nn)
    homogeneity = homogeneity_score(y, labels_nn)
    print("n_neighbors: {} \n Silhouette score: {:.3f} \n Homogeneity score: {:.
 ↪3f}".format(i, silhouette, homogeneity))

    fig, ax = plt.subplots(1, 2, figsize=(12, 6))

    # Create a scatter plot of the clustered data in the first subplot
    ax[0].scatter(x_tsne[:, 0],x_tsne[:, 1], c=labels_nn)
    ax[0].set_title("Spectral Clustering n_neighbors={}".format(i))

    # Create a scatter plot of the t-SNE reduced data in the second subplot
    ax[1].scatter(x_tsne[:, 0], x_tsne[:, 1],c=y)
    ax[1].set_title("t-SNE")

    plt.show()
```

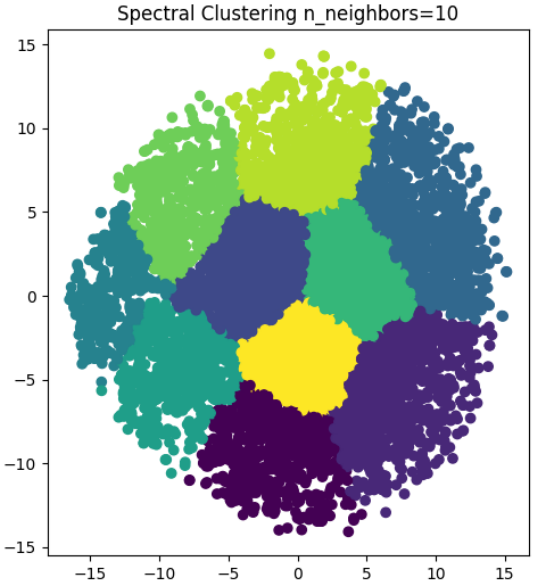
```
C:\Users\vaasimak\AppData\Roaming\Python\Python311\site-
packages\sklearn\manifold\_spectral_embedding.py:274: UserWarning: Graph is not
fully connected, spectral embedding may not work as expected.
  warnings.warn(
```

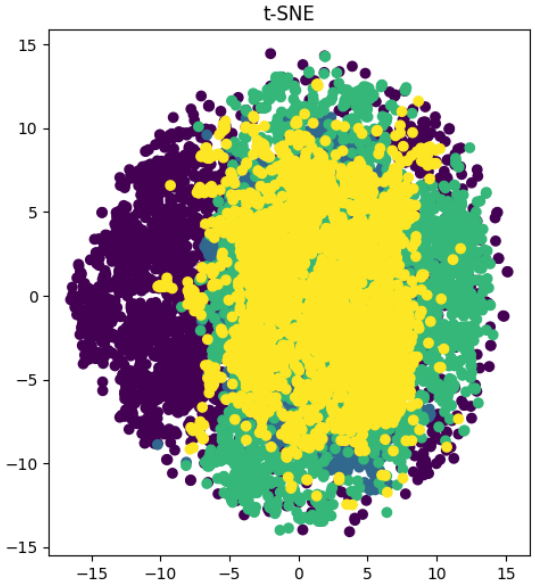
```
n_neighbors: 5
 Silhouette score: -0.191
 Homogeneity score: 0.013
```



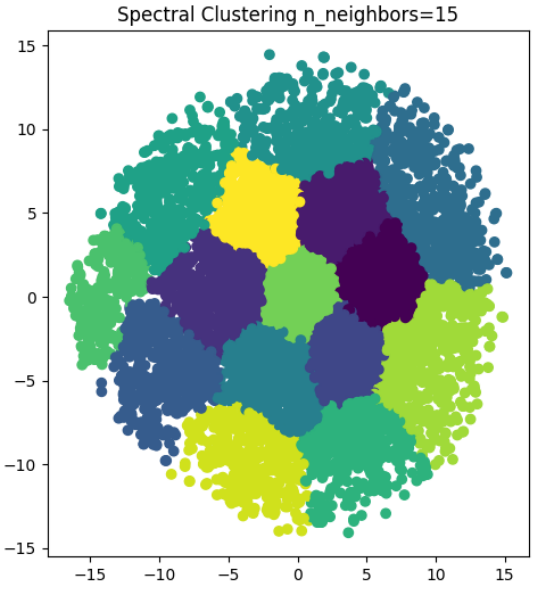



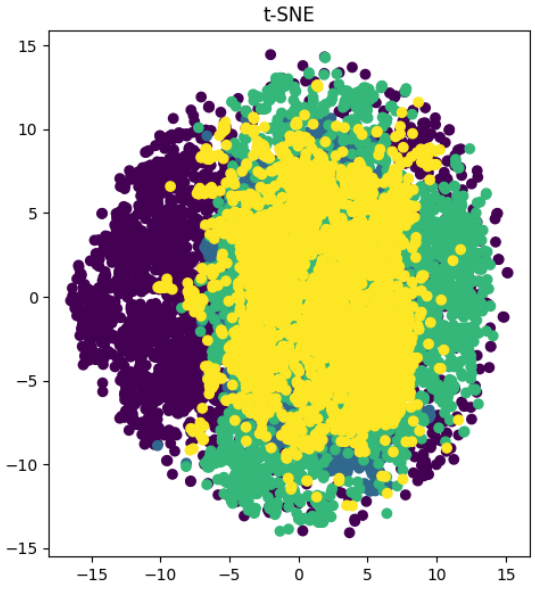

```
n_neighbors: 10
 Silhouette score: 0.319
 Homogeneity score: 0.179
```



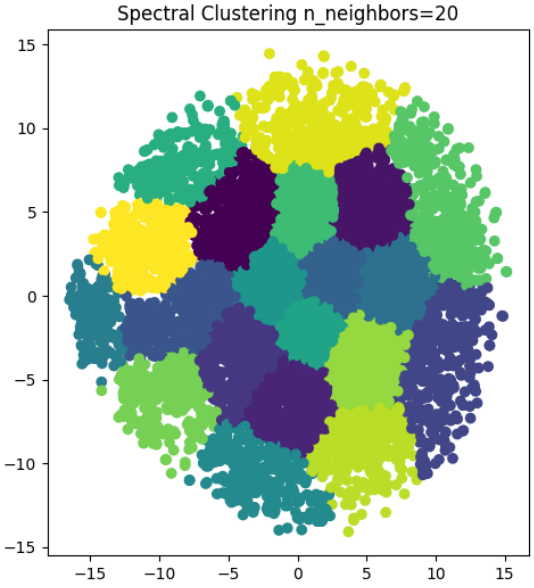



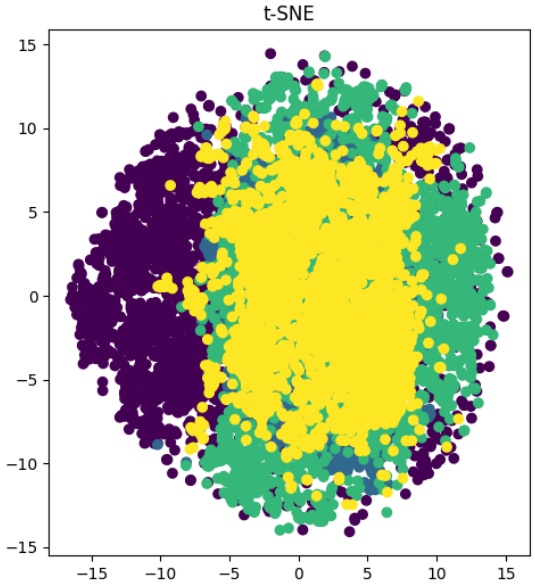

```
n_neighbors: 15
 Silhouette score: 0.328
 Homogeneity score: 0.227
```



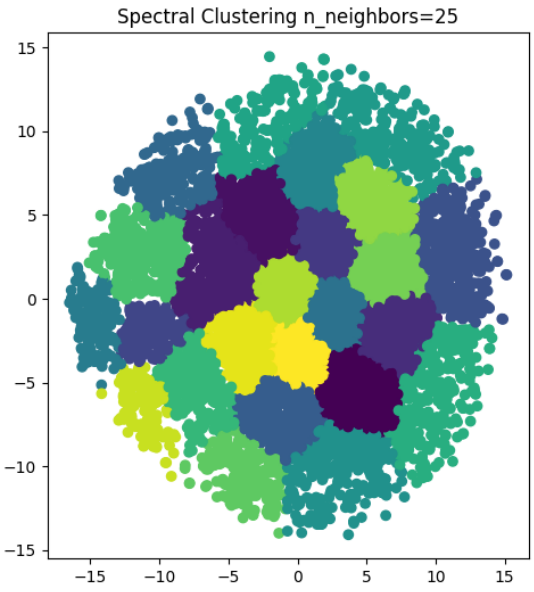



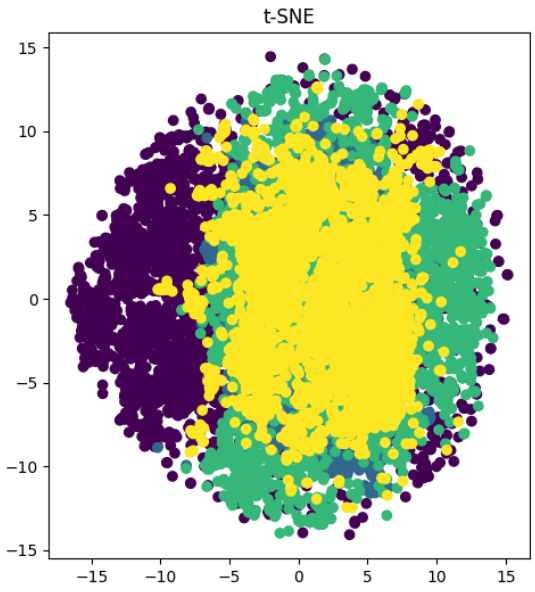

```
n_neighbors: 20
 Silhouette score: 0.321
 Homogeneity score: 0.266
```



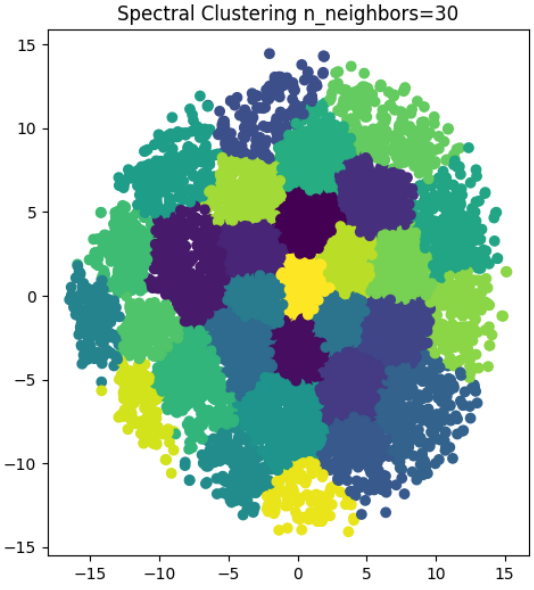



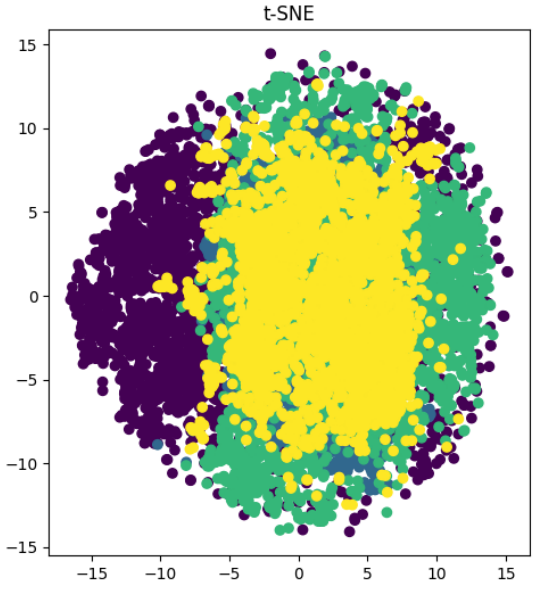

```
n_neighbors: 25
 Silhouette score: 0.336
 Homogeneity score: 0.290
```



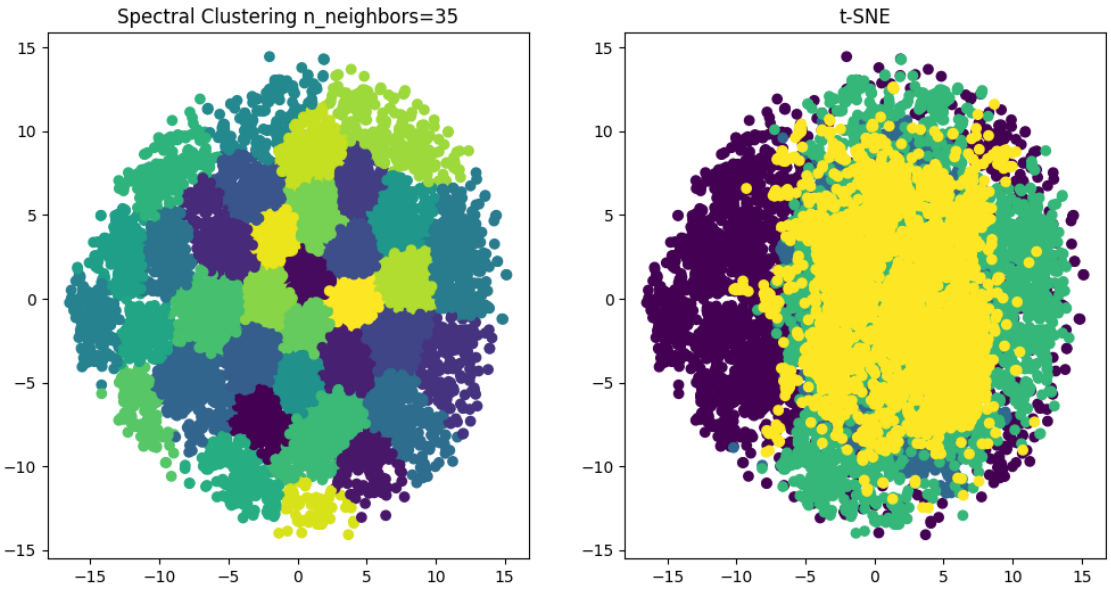




```
n_neighbors: 30
 Silhouette score: 0.337
 Homogeneity score: 0.303
```



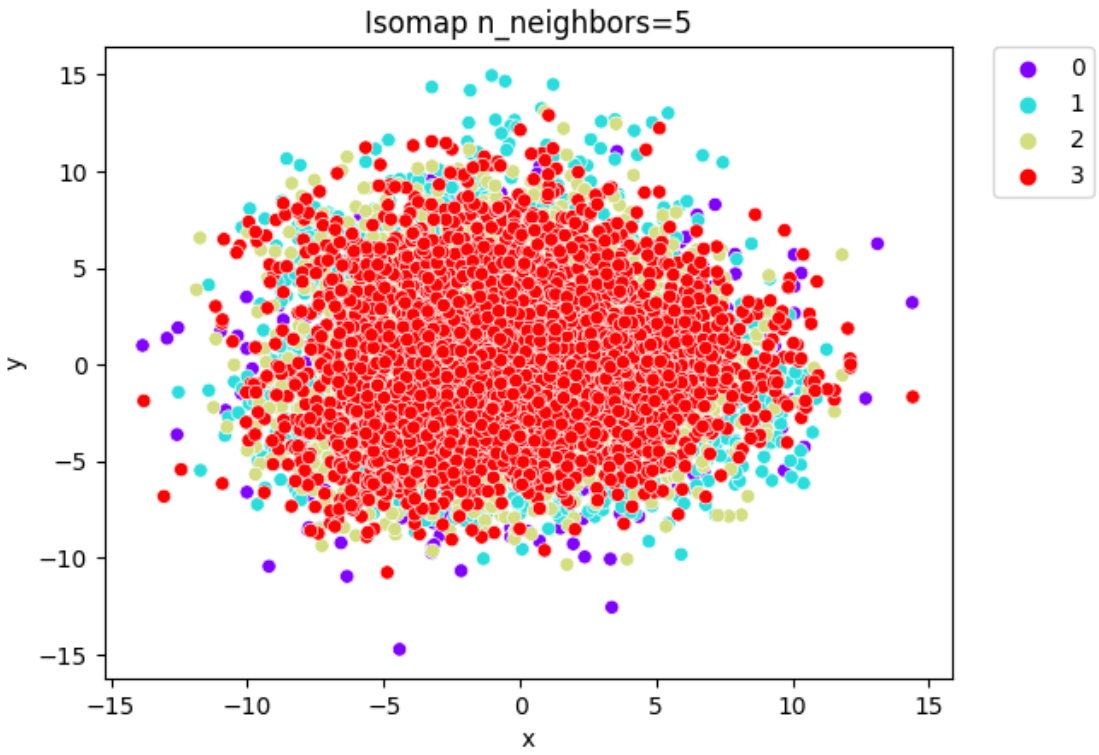

```
n_neighbors: 35
 Silhouette score: 0.333
 Homogeneity score: 0.306
```

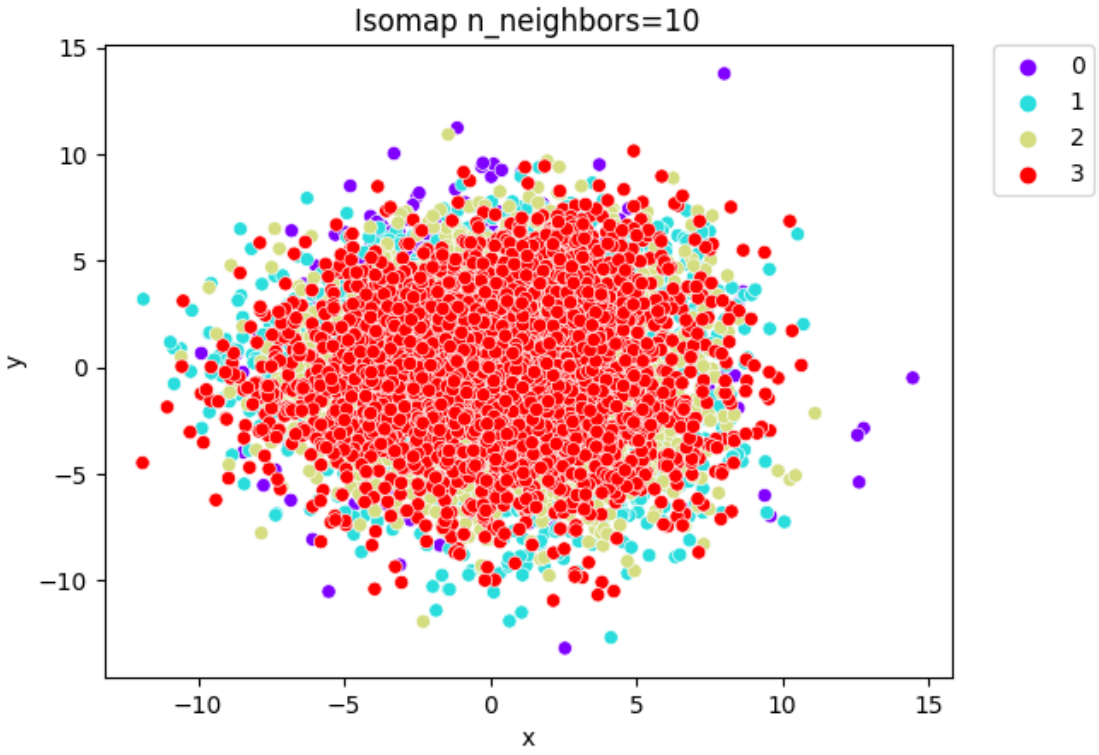


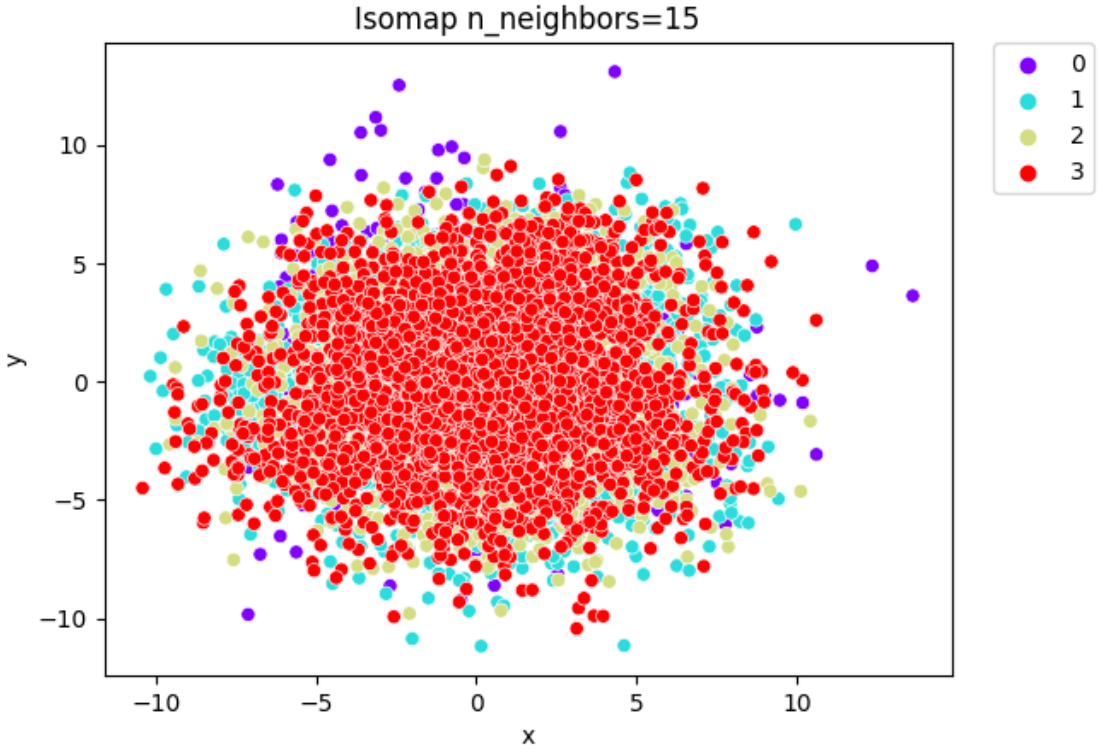

# 5 Isomap

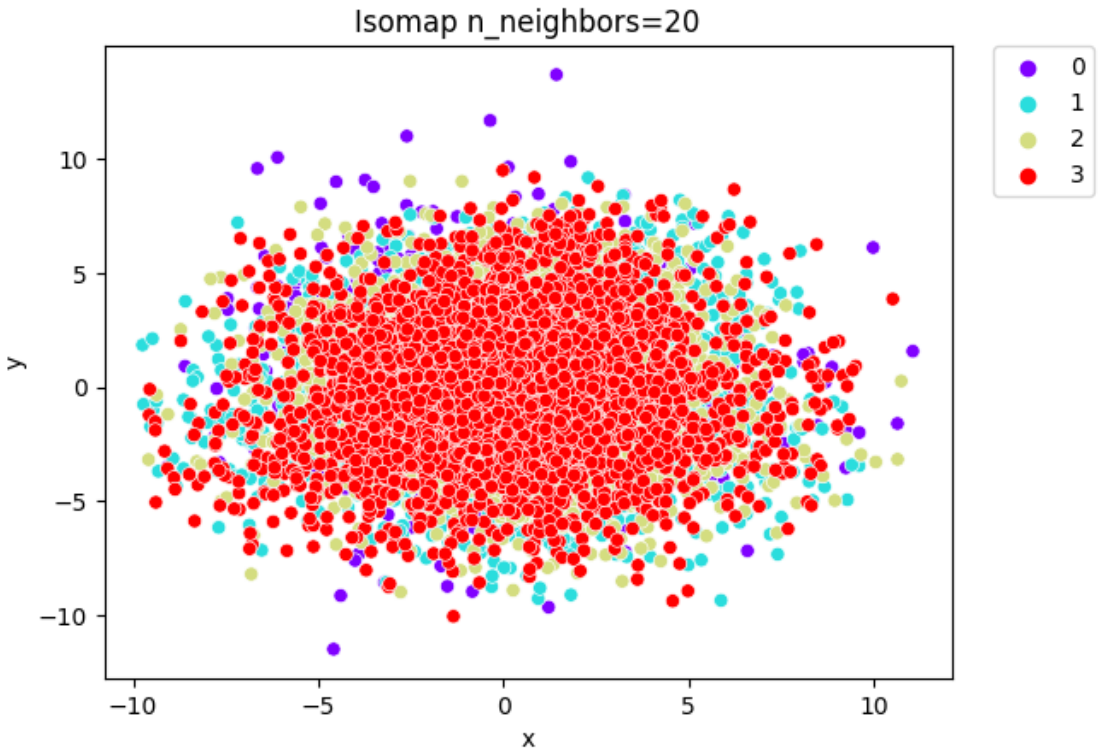
## 5.1 Plots for different values of Isomap n_neigbors

[ ]:
```
from sklearn.manifold import Isomap
for i in range(5,25,5):
    isomap = Isomap(n_components=2, n_neighbors=i,n_jobs=-1)
    X_isomap = isomap.fit_transform(X_scaled)
    x_isomap_df = pd.DataFrame({'x': X_isomap[:,0], 'y': X_isomap[:,1], 'label':
 ↪ y})
    fig, ax = plt.subplots(1)
    sns.scatterplot(x='x', y='y', hue='label',palette='rainbow',␣
 ↪data=x_isomap_df, ax=ax)
    ax.legend(bbox_to_anchor=(1.05, 1), loc=2, borderaxespad=0.)
    ax.set_title("Isomap n_neighbors={}".format(i))
    plt.show()
```


Isomap n_neighbors=5
0
1
2
3
15
10
5
0
−5
−10
−15
y
−15
−10
−5
0
5
10
15
x

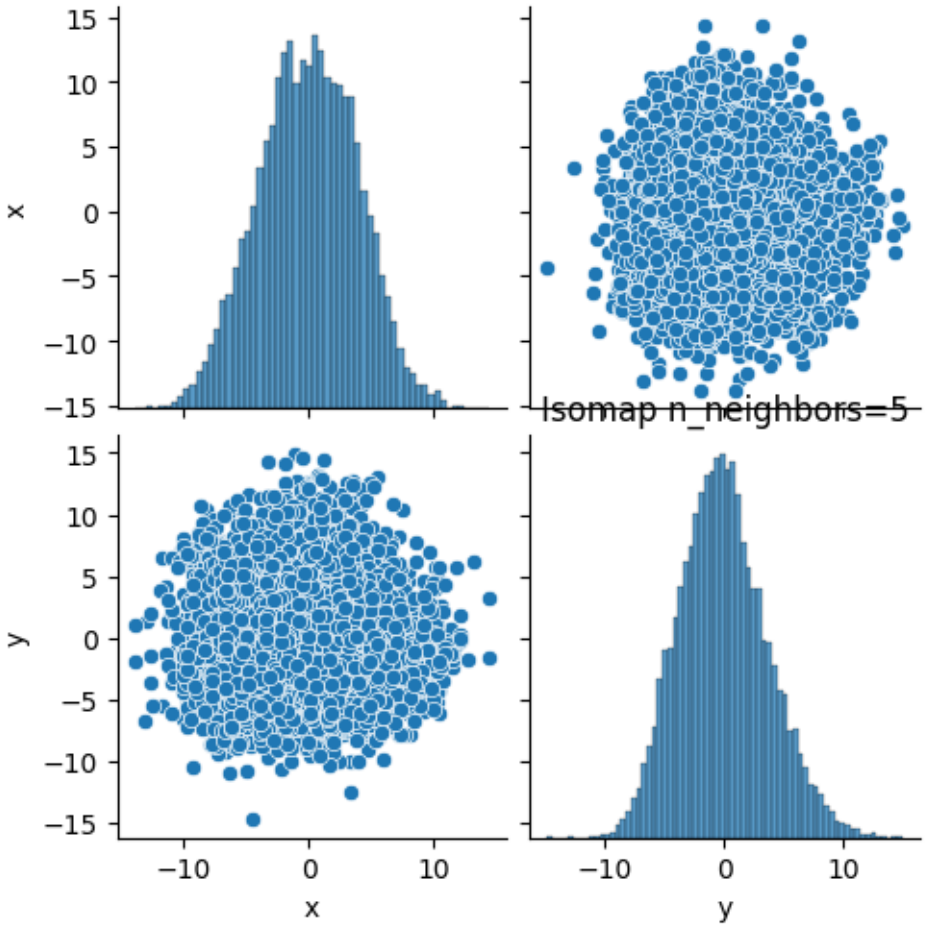

Isomap n_neighbors=10
0
1
2
3
15
10
5
0
−5
−10
y
−10
−5
0
5
10
15
x

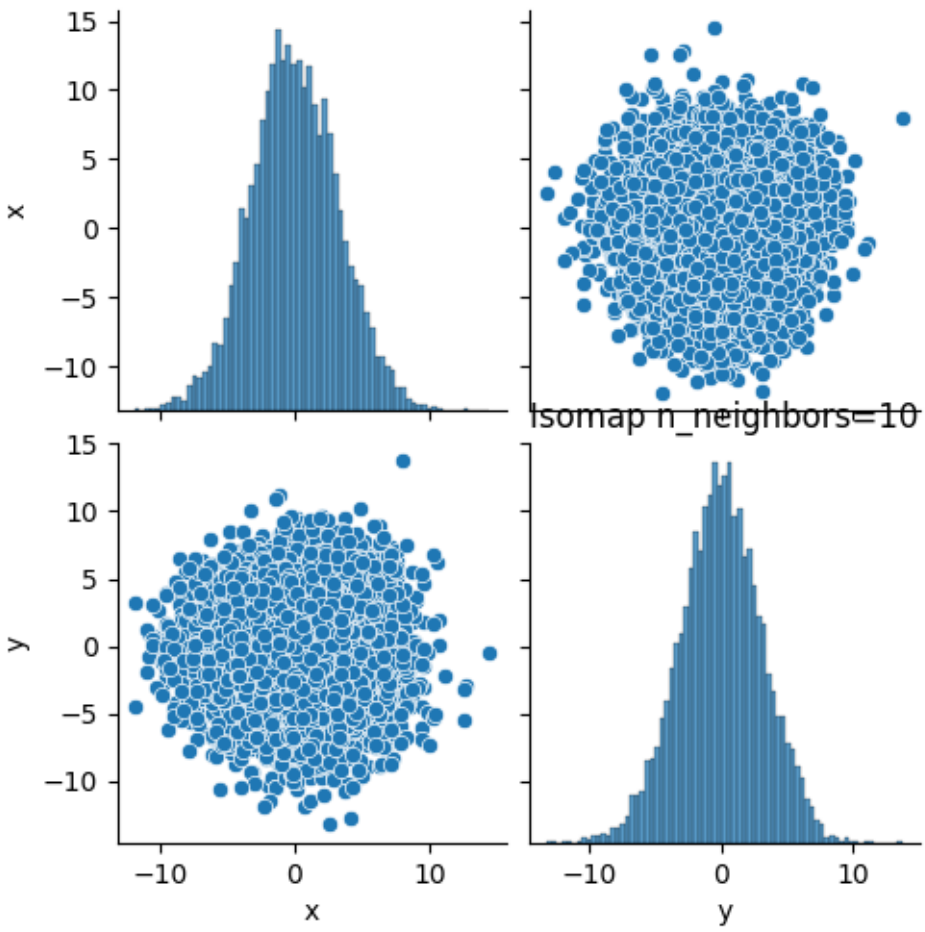

Isomap n_neighbors=15
0
1
2
3
10
5
0
−5
−10
y
−10
−5
0
5
10
x

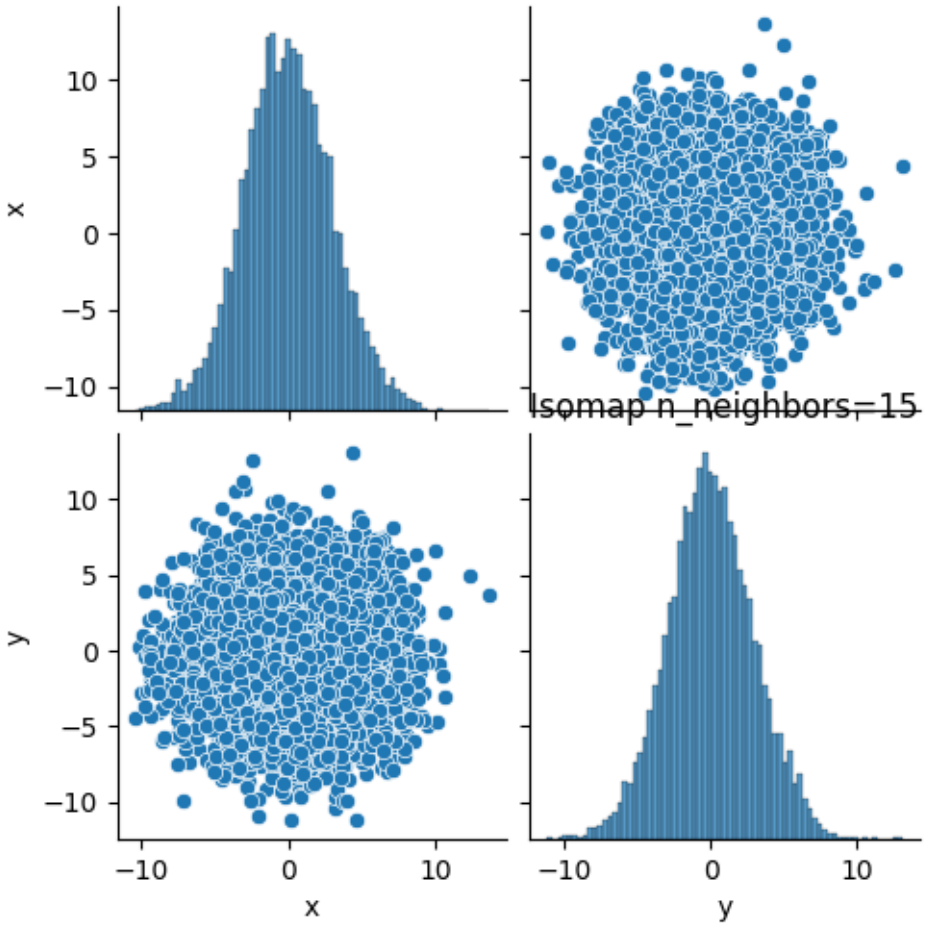

Isomap n_neighbors=20
0
1
2
3
10
5
0
−5
−10
y
−10
−5
0
5
10
x

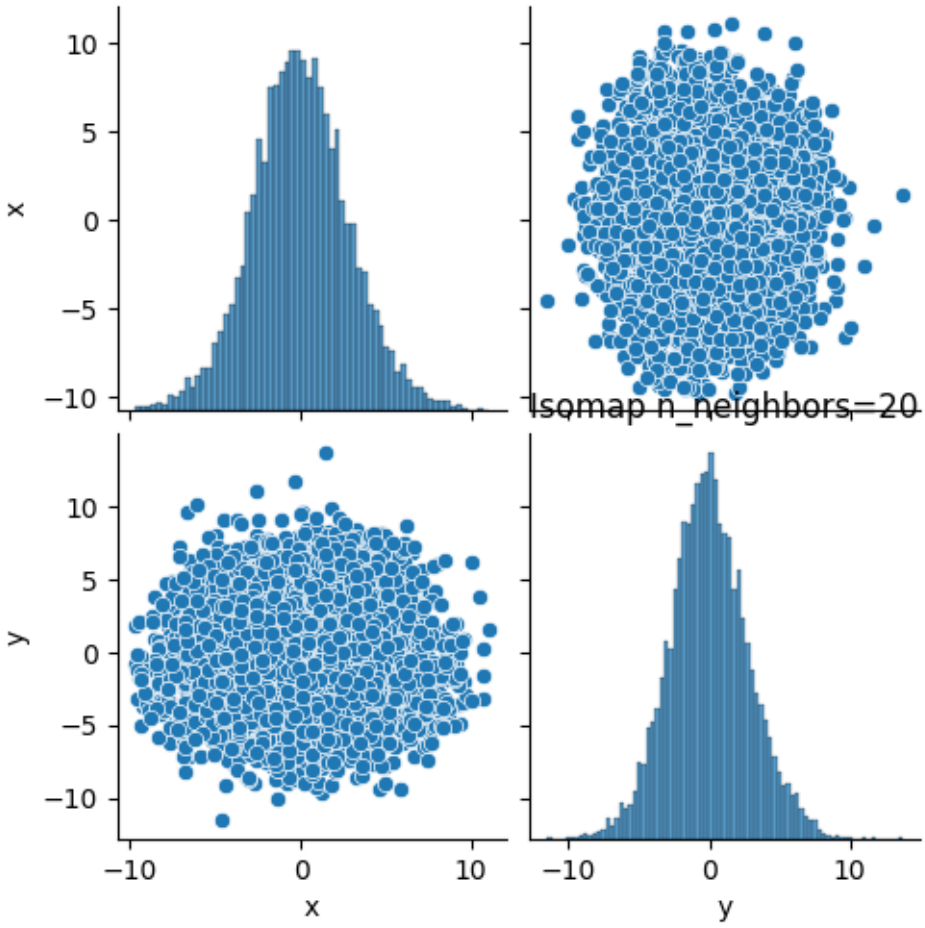
### 5.2 Pairplot for Isomaps different n_neighbors

[ ]:
```
from sklearn.manifold import Isomap
for i in range(5,25,5):
    isomap = Isomap(n_components=2, n_neighbors=i,n_jobs=-1)
    X_isomap = isomap.fit_transform(X_scaled)
    x_isomap_df = pd.DataFrame({'x': X_isomap[:,0], 'y': X_isomap[:,1], 'label':
 ↪ y})
    sns.pairplot(x_isomap_df.drop(columns = 'label'))
    plt.title("Isomap n_neighbors={}".format(i))
    plt.show()
```




Isomap n_neighbors=10
x
y
15
10
5
0
−5
−10
−10
0
10


Isomap n_neighbors=15
x
y
10
5
0
−5
−10
−10
0
10




[ ]:
```
from sklearn.manifold import Isomap
isomap = Isomap(n_components=2, n_neighbors=5,n_jobs=-1)
X_isomap = isomap.fit_transform(X_scaled)
```

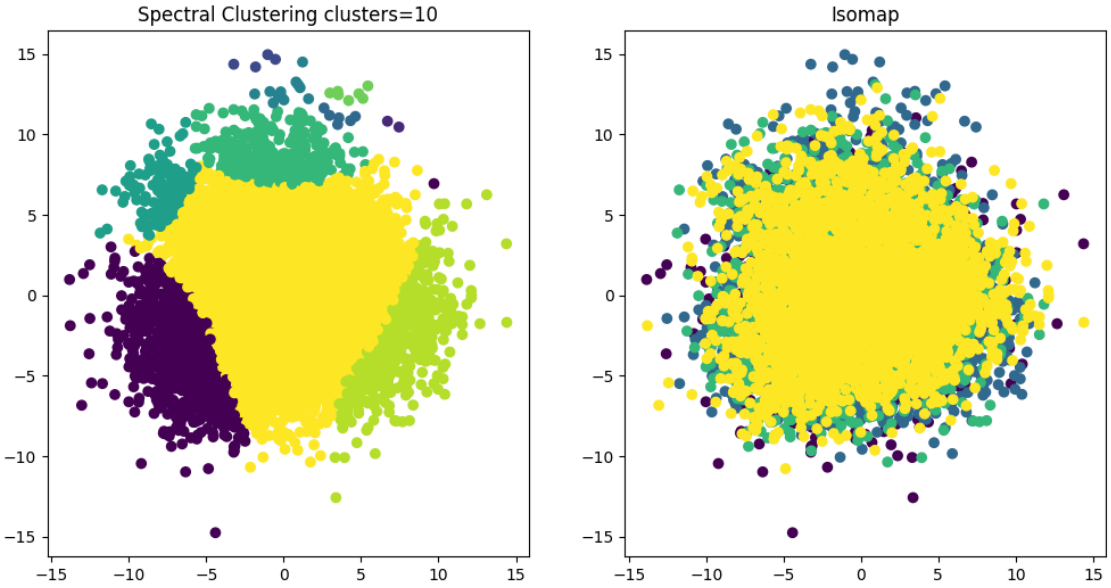
# 6 Spectral Clustering with RBF

## 6.1 Comparison between Spectral Clustering n_clusters and t-SNE

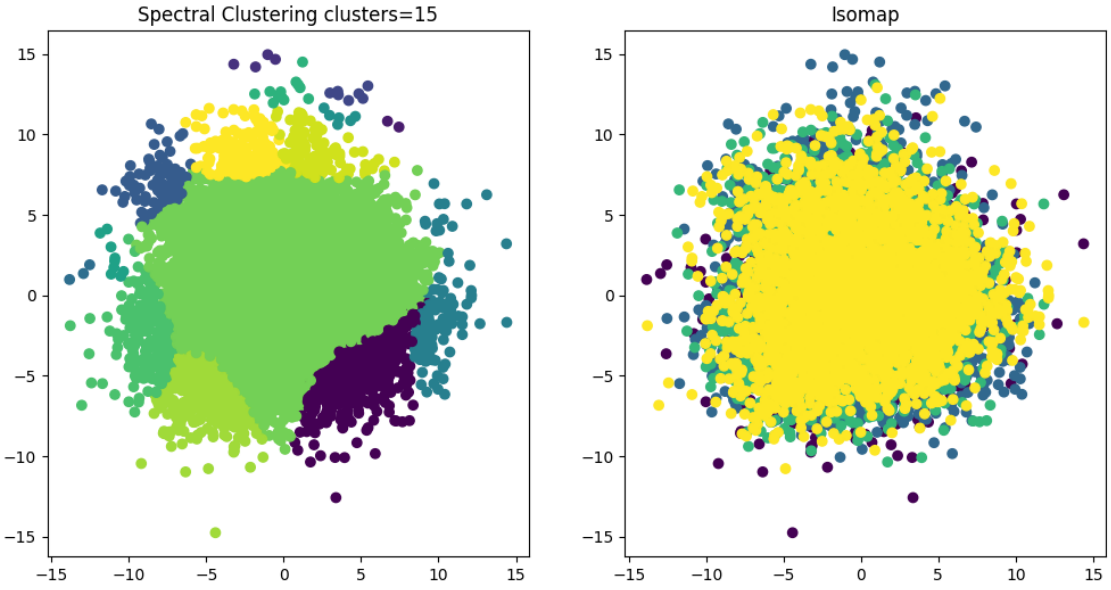
[ ]:
```
from sklearn.cluster import SpectralClustering
for i in range(10,25,5):
    sc = SpectralClustering(n_clusters=i,affinity='rbf',assign_labels='kmeans')
    labels_rbf = sc.fit_predict(X_isomap)
    silhouette = silhouette_score(X_isomap, labels_rbf)
    homogeneity = homogeneity_score(y, labels_rbf)
    print("rbf: {} \n Silhouette score: {:.3f} \n Homogeneity score: {:.3f}".
 ↪format(i, silhouette, homogeneity))
    fig, ax = plt.subplots(1, 2, figsize=(12, 6))
```

```
    # Create a scatter plot of the clustered data in the first subplot
    ax[0].scatter(X_isomap[:, 0],X_isomap[:, 1], c=labels_rbf)
    ax[0].set_title("Spectral Clustering clusters={}".format(i))

    # Create a scatter plot of the t-SNE reduced data in the second subplot
    ax[1].scatter(X_isomap[:, 0], X_isomap[:, 1],c=y)
    ax[1].set_title("Isomap")

    plt.show()
```

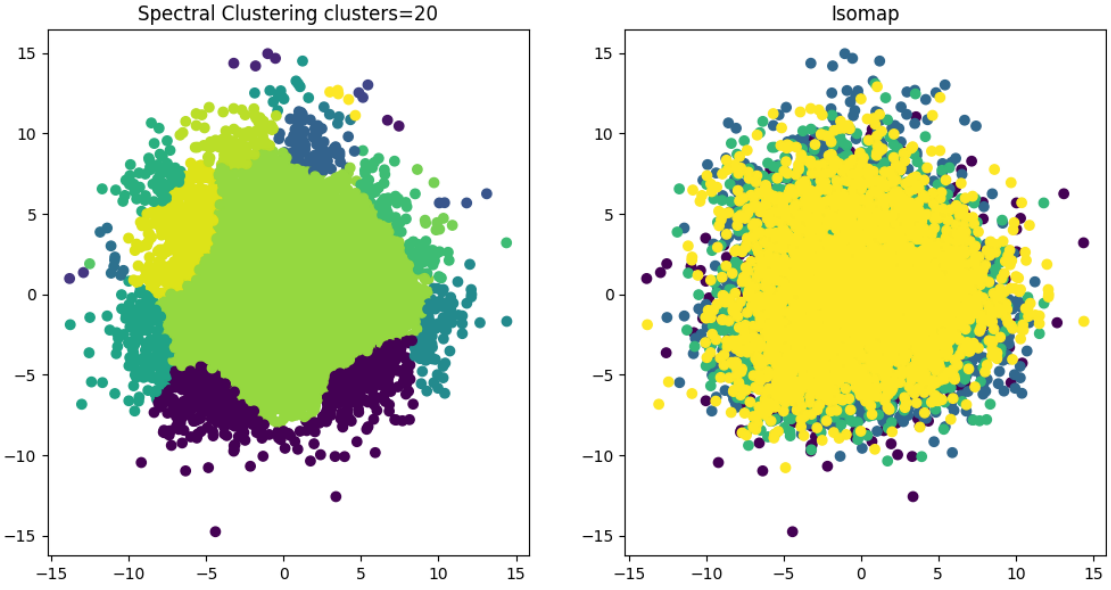
```
rbf: 10
 Silhouette score: 0.103
 Homogeneity score: 0.012
```




```
rbf: 15
 Silhouette score: 0.004
 Homogeneity score: 0.012
```




```
rbf: 20
 Silhouette score: 0.013
 Homogeneity score: 0.012
```



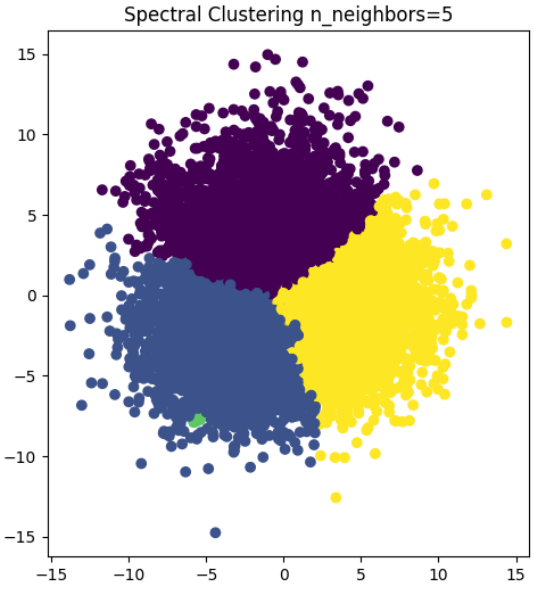
# 7 Spectral Clustering with nearest neighbors

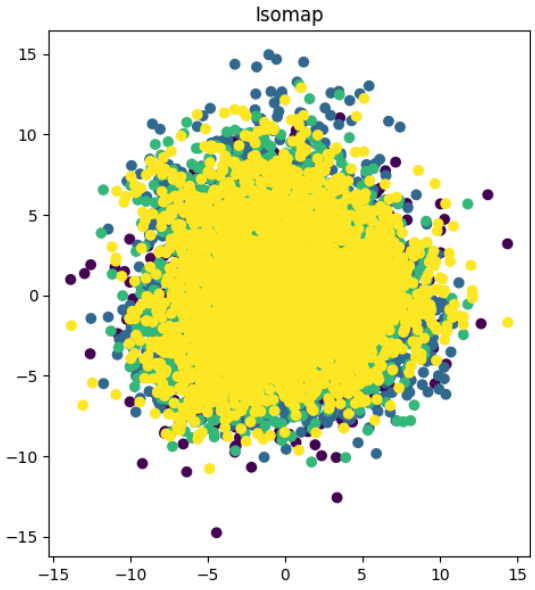
## 7.1 Comparison between Spectral Clustering n_neighbors and t-SNE

[ ]:
```
for i in range(5,40,5):
    sc =␣
 ↪SpectralClustering(n_clusters=i,affinity='nearest_neighbors',assign_labels='kmeans',n_neigh
    labels_nn = sc.fit_predict(X_isomap)
    silhouette = silhouette_score(X_isomap, labels_nn)
    homogeneity = homogeneity_score(y, labels_nn)
    print("n_neighbors: {} \n Silhouette score: {:.3f} \n Homogeneity score: {:.
 ↪3f}".format(i, silhouette, homogeneity))

    fig, ax = plt.subplots(1, 2, figsize=(12, 6))

    # Create a scatter plot of the clustered data in the first subplot
    ax[0].scatter(X_isomap[:, 0],X_isomap[:, 1], c=labels_nn)
    ax[0].set_title("Spectral Clustering n_neighbors={}".format(i))

    # Create a scatter plot of the t-SNE reduced data in the second subplot
    ax[1].scatter(X_isomap[:, 0], X_isomap[:, 1],c=y)
    ax[1].set_title("Isomap")

    plt.show()
```

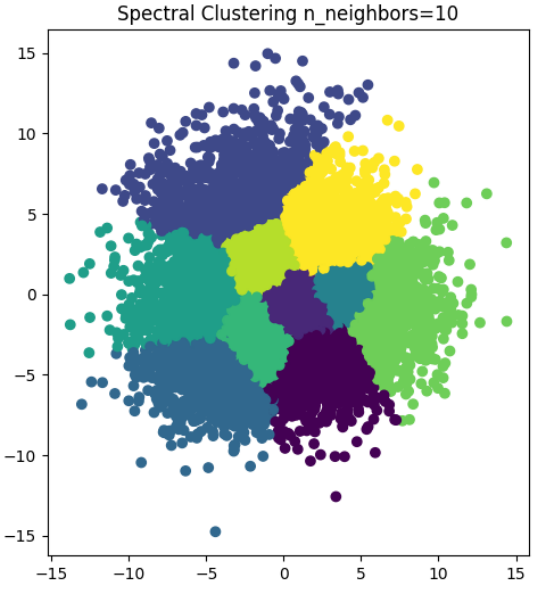
```
C:\Users\vaasimak\AppData\Roaming\Python\Python311\site-
packages\sklearn\manifold\_spectral_embedding.py:274: UserWarning: Graph is not
fully connected, spectral embedding may not work as expected.
  warnings.warn(
```

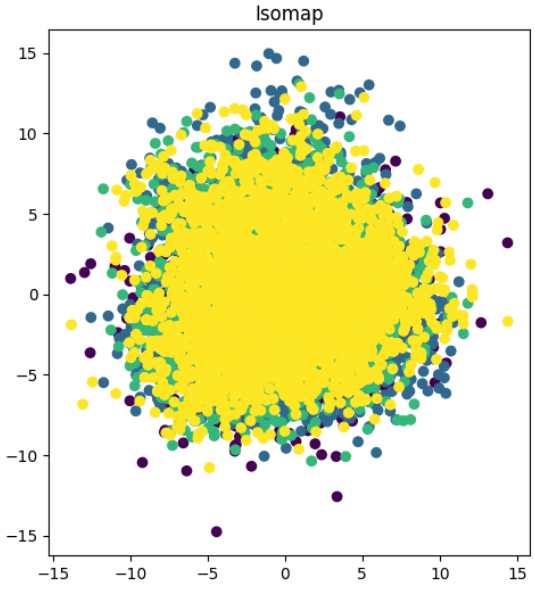
```
n_neighbors: 5
 Silhouette score: -0.036
 Homogeneity score: 0.003
```



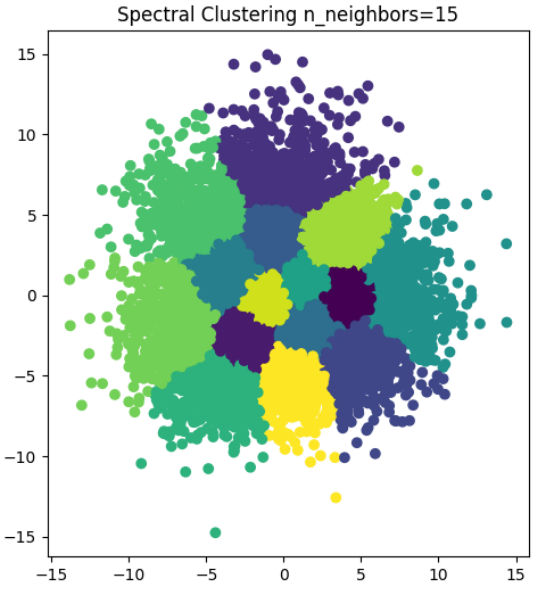



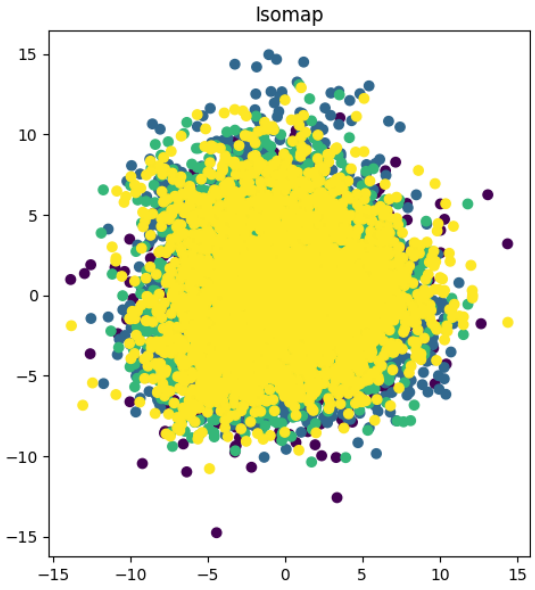

```
n_neighbors: 10
 Silhouette score: 0.277
 Homogeneity score: 0.016
```



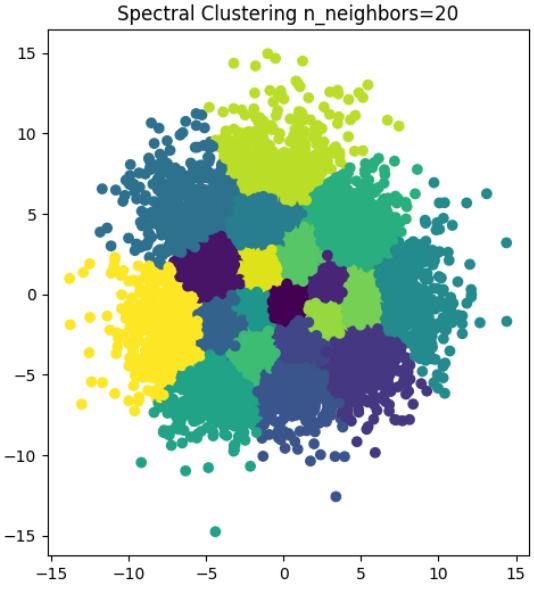



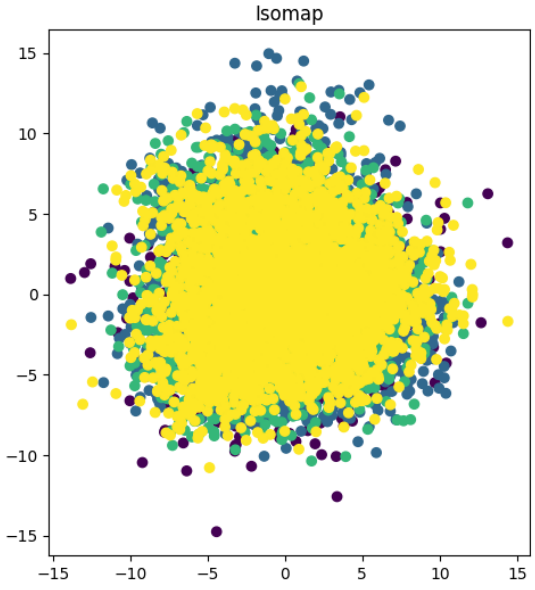

```
n_neighbors: 15
 Silhouette score: 0.301
 Homogeneity score: 0.020
```



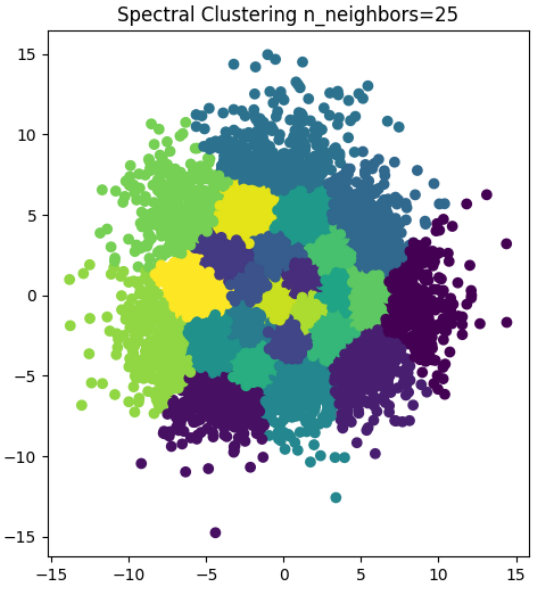



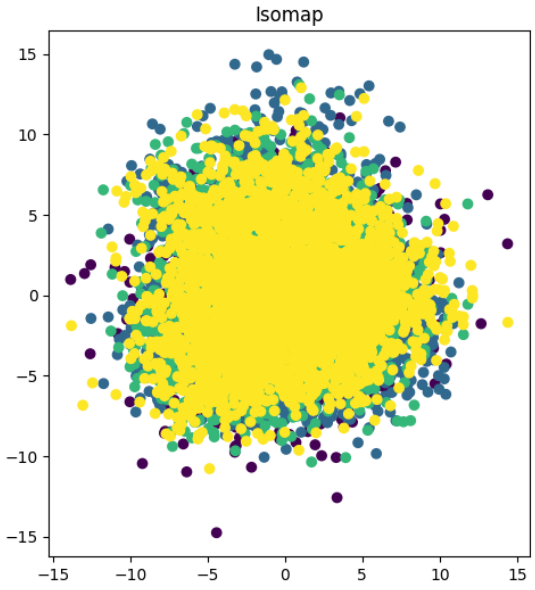

```
n_neighbors: 20
 Silhouette score: 0.282
 Homogeneity score: 0.022
```



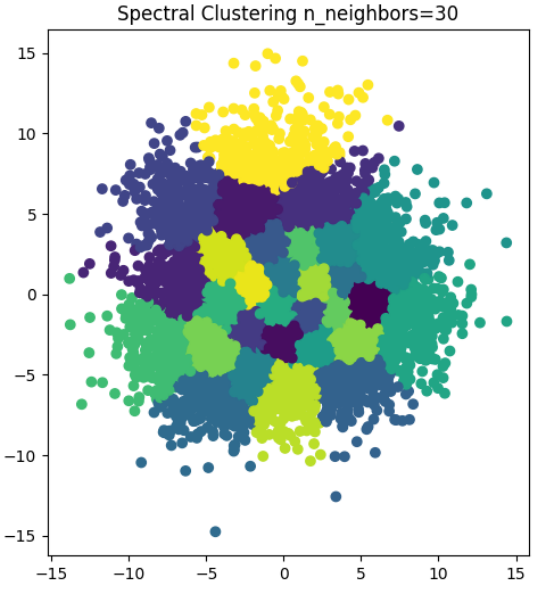



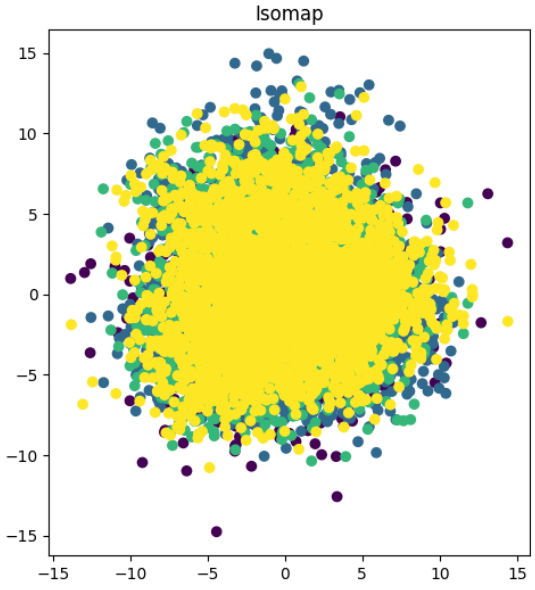

```
n_neighbors: 25
 Silhouette score: 0.288
 Homogeneity score: 0.024
```



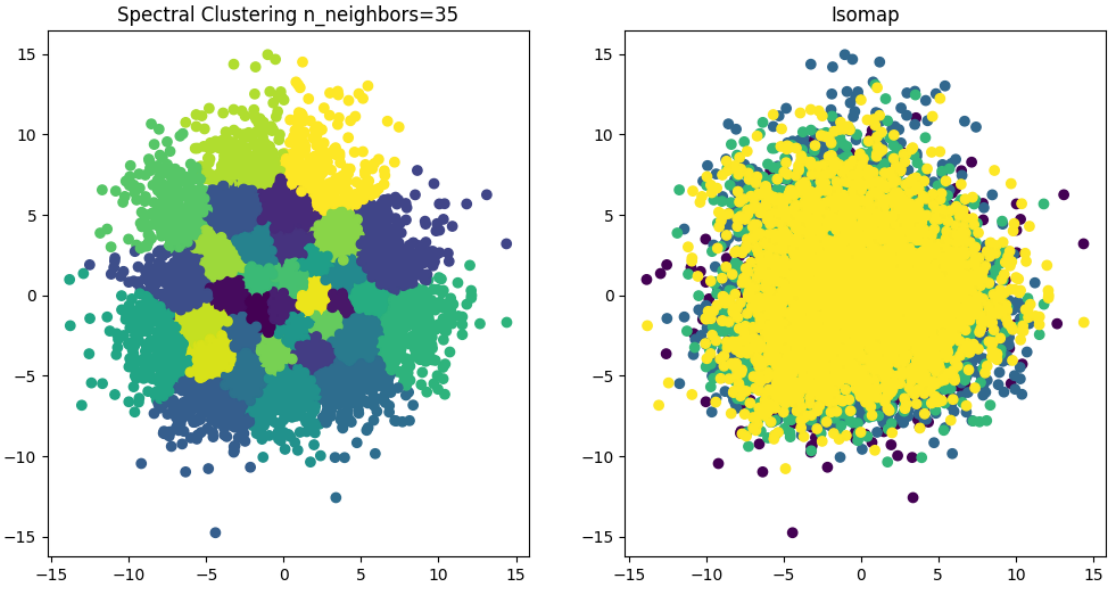




```
n_neighbors: 30
 Silhouette score: 0.289
 Homogeneity score: 0.025
```




```
n_neighbors: 35
 Silhouette score: 0.288
 Homogeneity score: 0.026
```


Spectral Clustering n_neighbors=35
Isomap
15
10
5
0
−5
−10
−15
−15
−10
−5
0
5
10
15