Data Mining (Δ02): Exercise Set 2: 2.2 - 7Clusters Dataset

Name: Nefeli Eleftheria Sextou

Student ID: 503

E-mail: pcs00503@uoi.gr, nsekstou@cs.uoi.gr

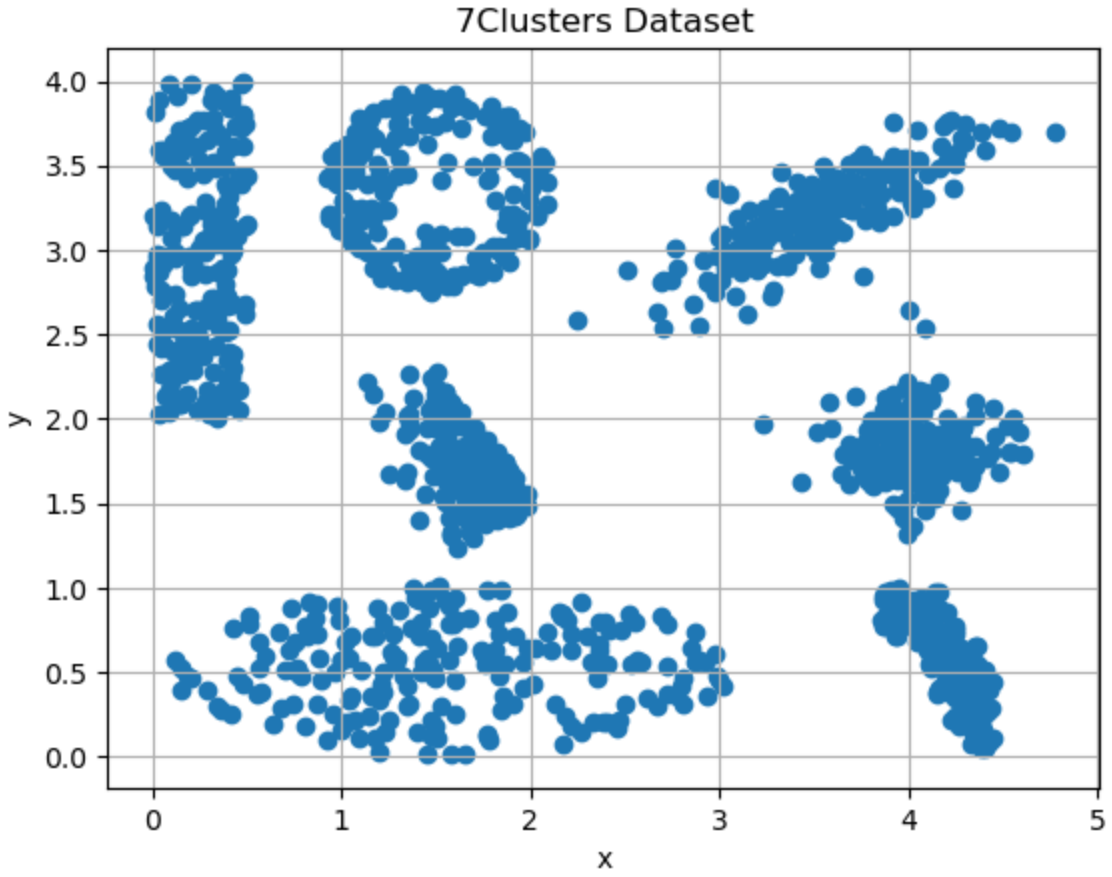
In [1]:
```
#general
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

#data preprocessing


#classifiers
from sklearn.cluster import KMeans
from sklearn.cluster import AgglomerativeClustering
from sklearn.cluster import SpectralClustering

#to ignore warnings
import warnings
warnings.filterwarnings('ignore')
```

Load Data

In [2]:
```
data = []
# read the file line by line
with open(r'C:\Users\Nefeli\Desktop\dm_msc\DM_Homework2_2024\clustering\7clusters.txt',
    for line in file:
        # Strip whitespace, split (by space)
        clean_line = line.strip().split()
        data.append((float(clean_line[0]), float(clean_line[1])))

# Create DataFrame from the list
main_df = pd.DataFrame(data, columns=['x', 'y'])
#rings3
```

Plot data

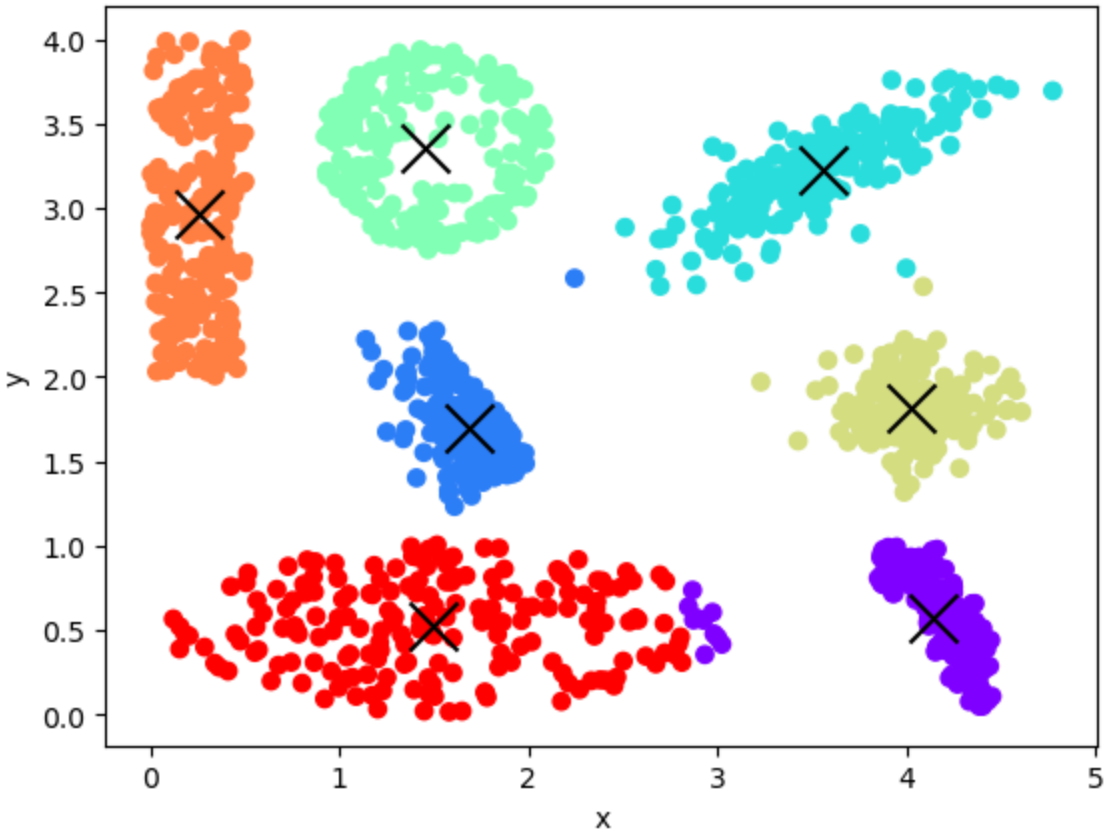
In [3]:
```
plt.scatter(main_df['x'], main_df['y'])
plt.xlabel('x')
plt.ylabel('y')
plt.title('7Clusters Dataset')
plt.grid(True)
plt.show()
```



Expected number of clusters: 7

k-means

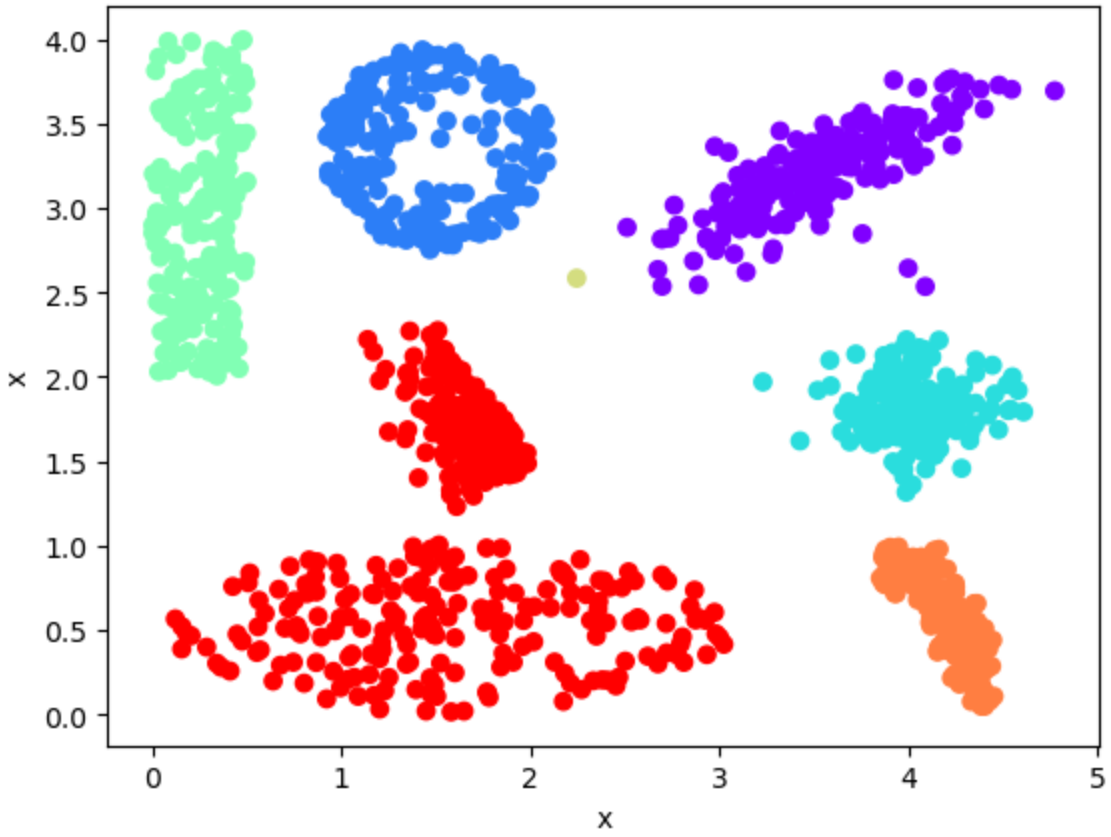
In [4]:
```
#init and fit
kmeans = KMeans(n_clusters=7)
kmeans.fit(main_df)

# get centroids and labels
centroids = kmeans.cluster_centers_
labels = kmeans.labels_

plt.scatter(main_df['x'], main_df['y'], c=labels, cmap='rainbow')
plt.scatter(centroids[:, 0], centroids[:, 1], s=300, c='black', marker='x')
plt.xlabel('x')
plt.ylabel('y')
plt.show()
```



Agglomerative Clustering : single link

In [5]:

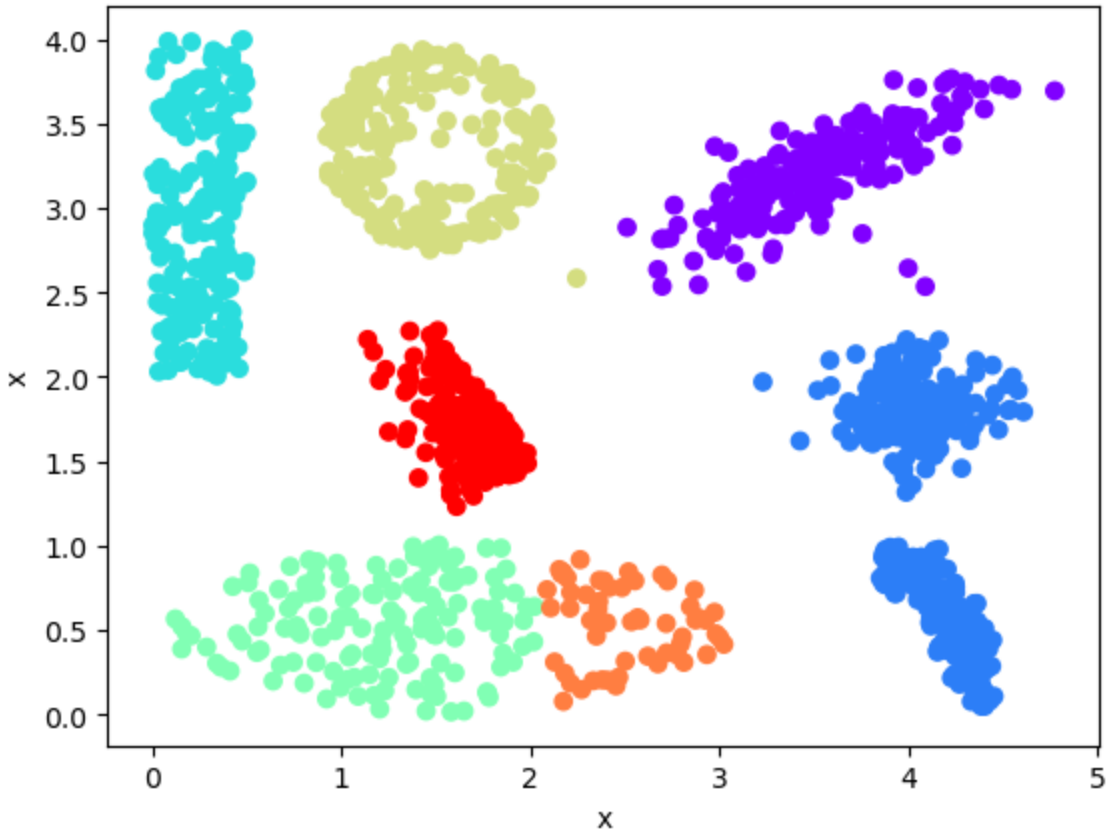
```
#init and fit
agg_cluster = AgglomerativeClustering(n_clusters=7, linkage='single')

#get labels
labels = agg_cluster.fit_predict(main_df)

plt.scatter(main_df['x'], main_df['y'], c=labels, cmap='rainbow')
plt.xlabel('x')
plt.ylabel('x')
plt.show()
```



Agglomerative Clustering : average link

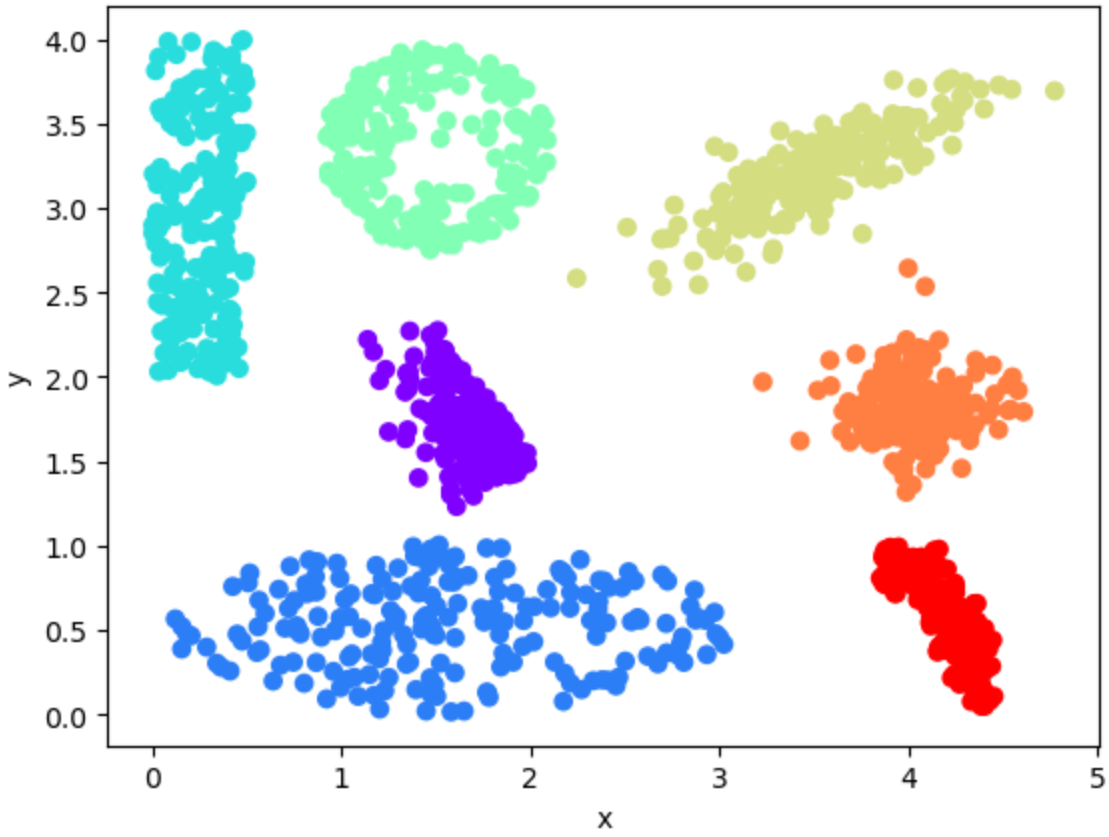
In [6]:

```
#init and fit
agg_cluster = AgglomerativeClustering(n_clusters=7, linkage='average')

#get labels
labels = agg_cluster.fit_predict(main_df)

plt.scatter(main_df['x'], main_df['y'], c=labels, cmap='rainbow')
plt.xlabel('x')
plt.ylabel('x')
plt.show()
```



Spectral Clustering

In [7]:
```
# perform spectral clustering
sigma = 0.1 # tried 0.1, 0.5, 1
spectral_cluster = SpectralClustering(n_clusters=7, affinity='rbf', gamma = (1/(sigma**2
labels = spectral_cluster.fit_predict(main_df)

plt.scatter(main_df['x'], main_df['y'], c=labels, cmap='rainbow')
plt.xlabel('x')
plt.ylabel('y')
plt.show()
```



Remarks

Spectral Clustering for *sigma=0.1* succeeds in achieving the expected clustering while the other methods fail.

The data is mostly well separated but each cluster is of different shape, size and density. This makes classification quite difficult for most of the applied classifiers. Only Spectral Clustering is able to model the dataset's structure effectively. Spectral Clustering is a good choice for handling non-convex clusters and varying densities due to its ability to use eigenvalues of the similarity matrix to reduce dimensions and as a consequence also simplify the structure into a form that is easier to manage.

In [ ]: