CL1-04

July 24, 2025

```
[ ]: '''
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     ROLL NO.01
     COURSE: AI&DS
     CLASS: BE
     SUB:Computer Laboratory-I (Machine Learning)
     '''
```

```
[ ]: '''
     PRACTICAL NO-04:
         Implement K-Means clustering on Iris.csv dataset. Determine the number of␣
       ↪clusters
     using the elbow method.
     Dataset Link: https://www.kaggle.com/datasets/uciml/iris
     '''
```

```
[1]: # Import Required Libraries.
```

```
[75]: import os
      os.environ["OMP_NUM_THREADS"] = "1"
```

```
[77]: import pandas as pd
      import numpy as np
      import matplotlib.pyplot as plt
      from sklearn.cluster import KMeans
      import seaborn as sns
```

```
[79]: # Load the Iris Dataset.
```

```
[81]: df = pd.read_csv("Iris (1).csv")
```

```
[83]: df
```

```
[83]:       Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  \
      0      1            5.1           3.5            1.4           0.2
      1      2            4.9           3.0            1.4           0.2
      2      3            4.7           3.2            1.3           0.2
      3      4            4.6           3.1            1.5           0.2
```

```
4      5            5.0           3.6            1.4           0.2
..   …            …           …            …           …
145  146            6.7           3.0            5.2           2.3
146  147            6.3           2.5            5.0           1.9
147  148            6.5           3.0            5.2           2.0
148  149            6.2           3.4            5.4           2.3
149  150            5.9           3.0            5.1           1.8

            Species
0        Iris-setosa
1        Iris-setosa
2        Iris-setosa
3        Iris-setosa
4        Iris-setosa
..              …
145  Iris-virginica
146  Iris-virginica
147  Iris-virginica
148  Iris-virginica
149  Iris-virginica

[150 rows x 6 columns]
```

[85]:

```
df.head()
```

[85]:

```
   Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm      Species
0   1            5.1           3.5            1.4           0.2  Iris-setosa
1   2            4.9           3.0            1.4           0.2  Iris-setosa
2   3            4.7           3.2            1.3           0.2  Iris-setosa
3   4            4.6           3.1            1.5           0.2  Iris-setosa
4   5            5.0           3.6            1.4           0.2  Iris-setosa
```

[87]:

```
df.tail()
```

[87]:

```
      Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  \
145  146            6.7           3.0            5.2           2.3
146  147            6.3           2.5            5.0           1.9
147  148            6.5           3.0            5.2           2.0
148  149            6.2           3.4            5.4           2.3
149  150            5.9           3.0            5.1           1.8

            Species
145  Iris-virginica
146  Iris-virginica
147  Iris-virginica
148  Iris-virginica
149  Iris-virginica
```

[89]:

```
len(df)
```

[89]:

```
150
```

[91]:

```
df.shape
```

[91]:

```
(150, 6)
```

[93]:

```
df.columns
```

[93]:

```
Index(['Id', 'SepalLengthCm', 'SepalWidthCm', 'PetalLengthCm', 'PetalWidthCm',
       'Species'],
      dtype='object')
```

[95]:

```
for i, col in enumerate(df.columns):
    print(f'coloumn number {1+i} is {col}')
```

```
coloumn number 1 is Id
coloumn number 2 is SepalLengthCm
coloumn number 3 is SepalWidthCm
coloumn number 4 is PetalLengthCm
coloumn number 5 is PetalWidthCm
coloumn number 6 is Species
```

[97]:

```
df.dtypes
```

[97]:

```
Id                 int64
SepalLengthCm    float64
SepalWidthCm     float64
PetalLengthCm    float64
PetalWidthCm     float64
Species           object
dtype: object
```

[99]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             150 non-null    int64
 1   SepalLengthCm  150 non-null    float64
 2   SepalWidthCm   150 non-null    float64
 3   PetalLengthCm  150 non-null    float64
 4   PetalWidthCm   150 non-null    float64
 5   Species        150 non-null    object
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

```
[101]: df.describe()
```

```
[101]:                Id  SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm
       count  150.000000     150.000000    150.000000     150.000000    150.000000
       mean    75.500000       5.843333      3.054000       3.758667      1.198667
       std     43.445368       0.828066      0.433594       1.764420      0.763161
       min      1.000000       4.300000      2.000000       1.000000      0.100000
       25%     38.250000       5.100000      2.800000       1.600000      0.300000
       50%     75.500000       5.800000      3.000000       4.350000      1.300000
       75%    112.750000       6.400000      3.300000       5.100000      1.800000
       max    150.000000       7.900000      4.400000       6.900000      2.500000
```

```
[103]: # Checking the Missing Values.
```

```
[105]: df.isnull().sum()
```

```
[105]: Id                 0
       SepalLengthCm    0
       SepalWidthCm     0
       PetalLengthCm    0
       PetalWidthCm     0
       Species          0
       dtype: int64
```

```
[107]: df.drop('Id', axis = 1, inplace = True)
```

```
[109]: df.head()
```

```
[109]:    SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm      Species
       0            5.1           3.5            1.4           0.2  Iris-setosa
       1            4.9           3.0            1.4           0.2  Iris-setosa
       2            4.7           3.2            1.3           0.2  Iris-setosa
       3            4.6           3.1            1.5           0.2  Iris-setosa
       4            5.0           3.6            1.4           0.2  Iris-setosa
```

```
[111]: # K - Means Clustering.
```

```
[113]: df.isnull().sum()
```

```
[113]: SepalLengthCm    0
       SepalWidthCm     0
       PetalLengthCm    0
       PetalWidthCm     0
       Species          0
       dtype: int64
```

```
[115]: df['Species'].value_counts()
```

[115]:

```
Species
Iris-setosa        50
Iris-versicolor    50
Iris-virginica     50
Name: count, dtype: int64
```

[117]:

```
# Splitting into Training and Target Data
# Target Data
target_data = df.iloc[:, 4]
target_data.head()
```

[117]:

```
0    Iris-setosa
1    Iris-setosa
2    Iris-setosa
3    Iris-setosa
4    Iris-setosa
Name: Species, dtype: object
```

[119]:

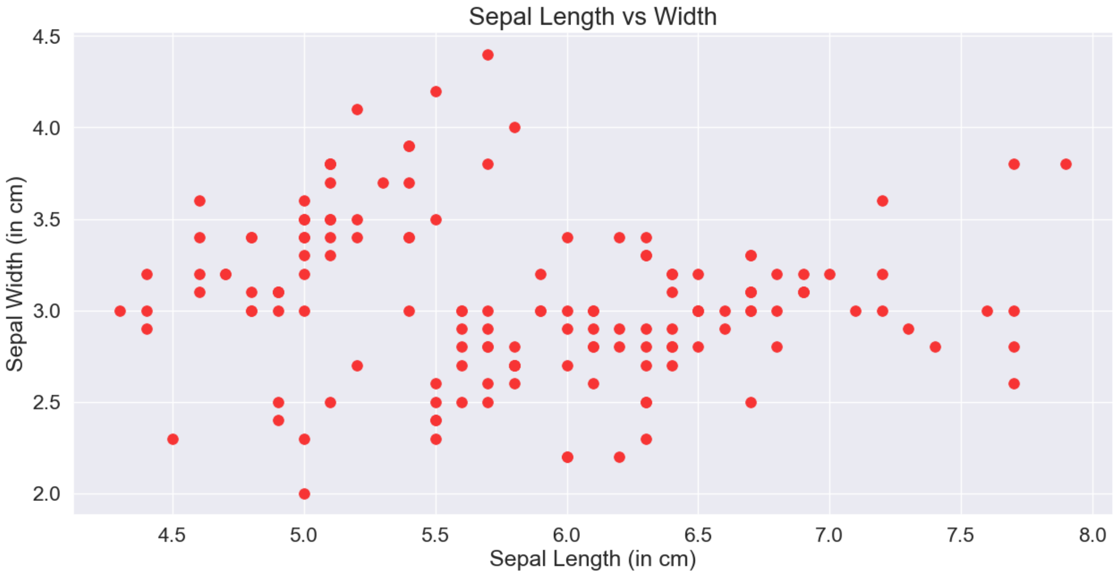
```
# Training Data
clustering_data = df.iloc[:,[0,1,2,3]]
clustering_data.head()
```

[119]:

```
   SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm
0            5.1           3.5            1.4           0.2
1            4.9           3.0            1.4           0.2
2            4.7           3.2            1.3           0.2
3            4.6           3.1            1.5           0.2
4            5.0           3.6            1.4           0.2
```

[121]:

```
fig, ax = plt.subplots(figsize=(15, 7))
sns.set(font_scale=1.5)
ax = sns.scatterplot(x=df['SepalLengthCm'], y=df['SepalWidthCm'], s=70,␣
 ↪color='#f73434', edgecolor='#f73434')
ax.set_ylabel('Sepal Width (in cm)')
ax.set_xlabel('Sepal Length (in cm)')
plt.title('Sepal Length vs Width', fontsize=20)
plt.show()
```



[123]:

```
# The Elbow Method.
```

[125]:

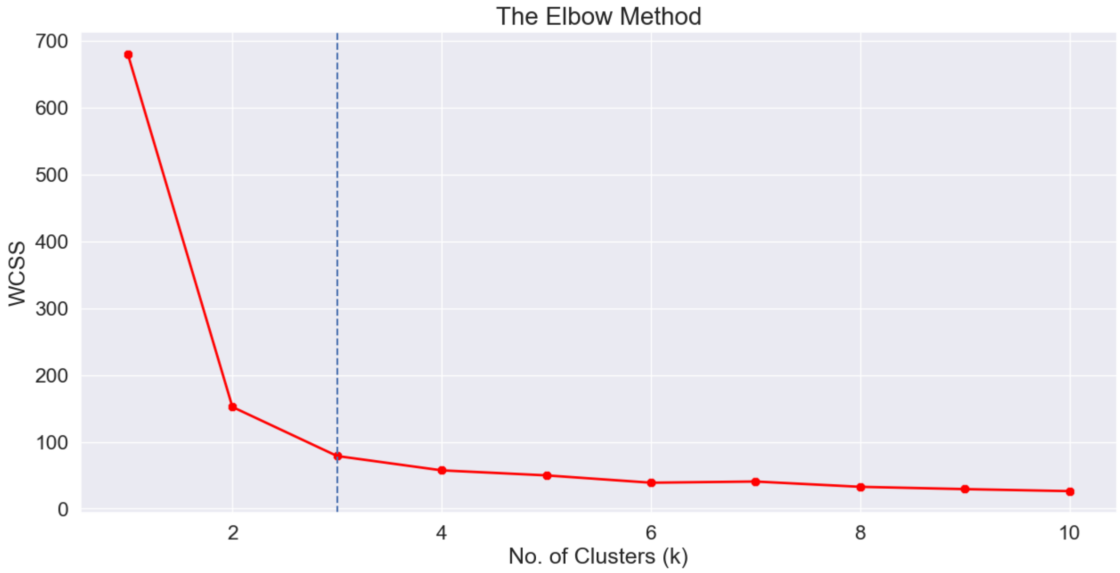
```
import warnings
warnings.simplefilter(action='ignore', category=FutureWarning)
from sklearn.cluster import KMeans
wcss = []
for i in range(1, 11):
   km = KMeans(i)
   km.fit(clustering_data)
   wcss.append(km.inertia_)
np.array(wcss)
```

```
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
```

```
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
```

```
[125]: array([680.8244    , 152.36870648,  78.94084143,  57.43531071,
               49.91714056,  38.93873974,  40.7202923 ,  32.79068756,
               29.33829297,  26.32961079])
```

```
[127]: fig, ax = plt.subplots(figsize = (15, 7))
       ax = plt.plot(range(1, 11), wcss, linewidth = 2, color = "red", marker = "8")
       plt.axvline(x = 3, ls = '--')
       plt.ylabel('WCSS')
       plt.xlabel('No. of Clusters (k)')
       plt.title('The Elbow Method', fontsize = 20)
       plt.show()
```



[129]:
```
# Clusters.
```

[131]:
```
kms = KMeans(n_clusters = 3, init = 'k-means++')
kms.fit(clustering_data)
KMeans(n_clusters = 3)
clusters = clustering_data.copy()
clusters['Cluster_Prediction'] = kms.fit_predict(clustering_data)
clusters.head()
```

```
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
D:\Anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1429: UserWarning:
KMeans is known to have a memory leak on Windows with MKL, when there are less
chunks than available threads. You can avoid it by setting the environment
variable OMP_NUM_THREADS=1.
  warnings.warn(
```

[131]:
```
   SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm  \
0            5.1           3.5            1.4           0.2
1            4.9           3.0            1.4           0.2
2            4.7           3.2            1.3           0.2
3            4.6           3.1            1.5           0.2
4            5.0           3.6            1.4           0.2

   Cluster_Prediction
```

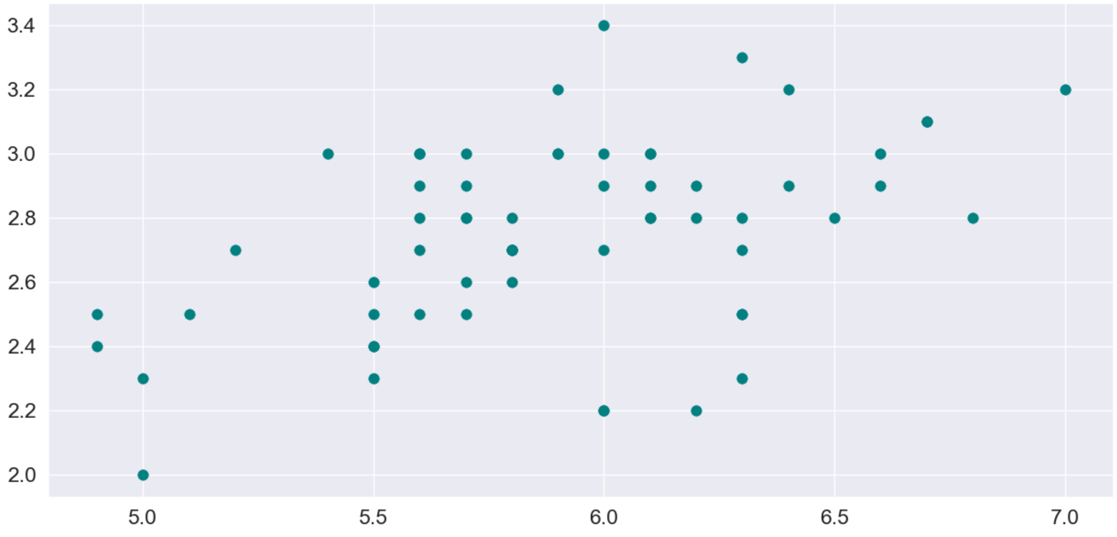
```
0                    1
1                    1
2                    1
3                    1
4                    1
```

[133]:
```
kms.cluster_centers_
```

[133]:
```
array([[5.9016129 , 2.7483871 , 4.39354839, 1.43387097],
       [5.006     , 3.418     , 1.464     , 0.244     ],
       [6.85      , 3.07368421, 5.74210526, 2.07105263]])
```

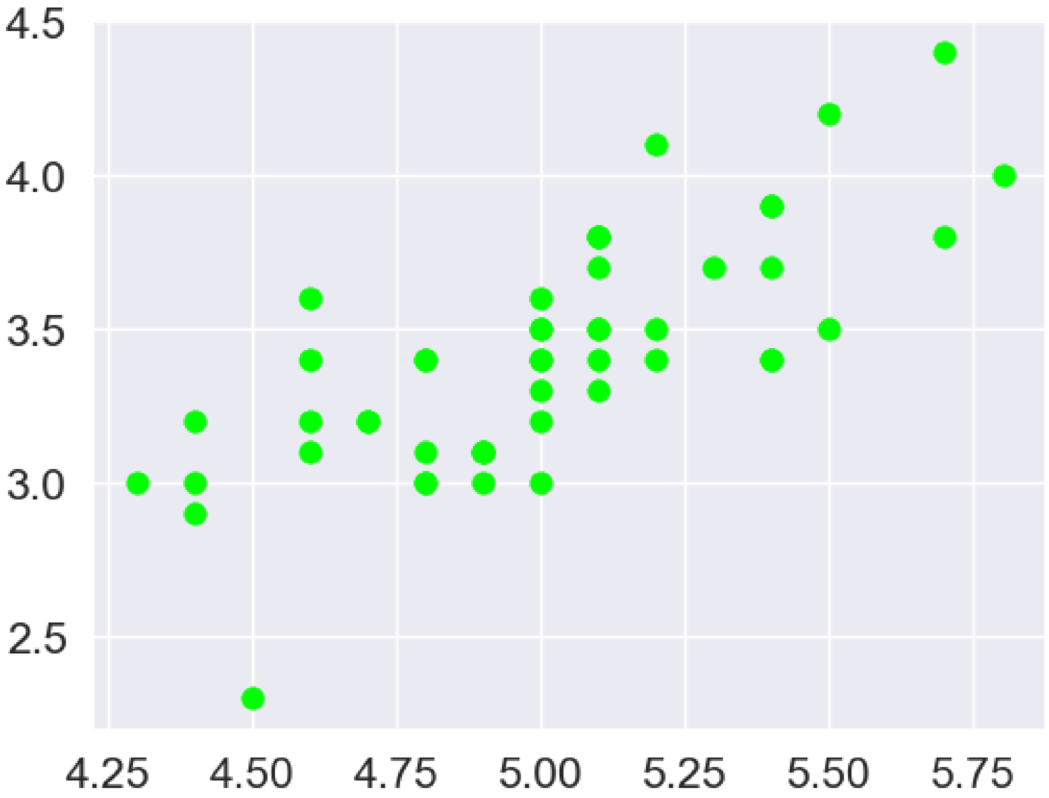
[135]:
```
fig, ax = plt.subplots(figsize = (15,7))
plt.scatter(x = clusters[clusters['Cluster_Prediction'] == 0]['SepalLengthCm'],
            y = clusters[clusters['Cluster_Prediction'] == 0]['SepalWidthCm'],
            s = 70, edgecolor = 'teal', linewidth = 0.3, c = 'teal', label =␣
 ↪'Iris-versicolor')
```

[135]:
```
<matplotlib.collections.PathCollection at 0x1603aeac920>
```



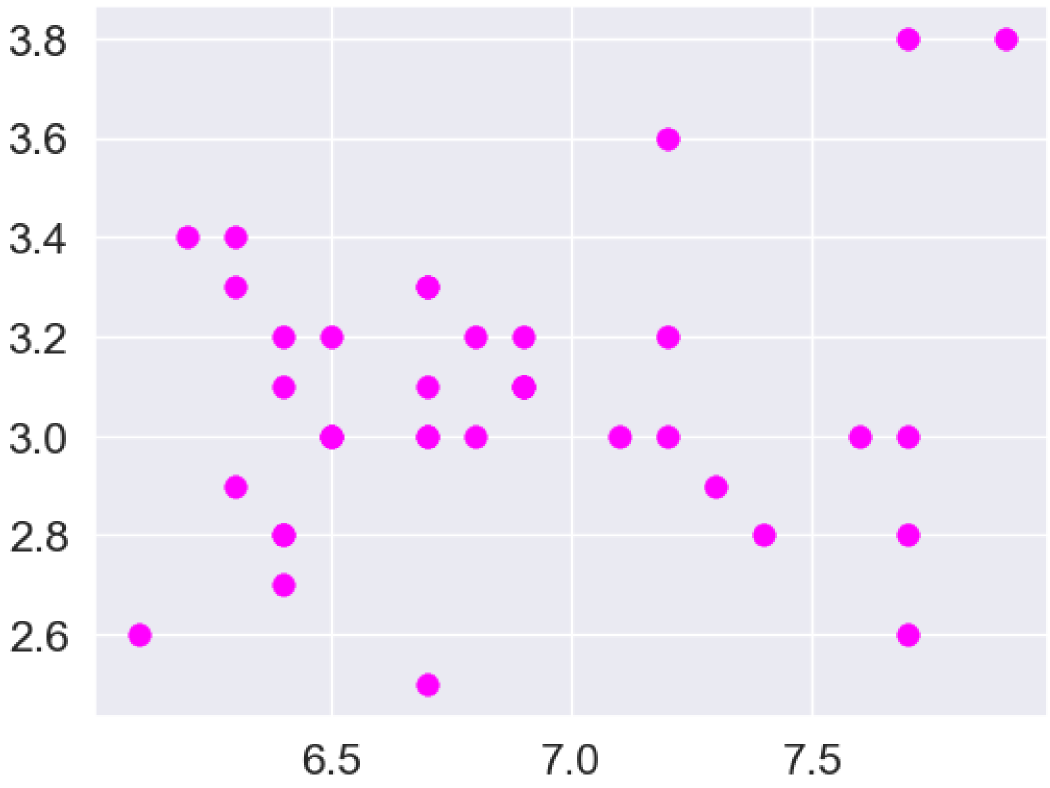
[137]:
```
plt.scatter(x = clusters[clusters['Cluster_Prediction'] == 1]['SepalLengthCm'],
            y = clusters[clusters['Cluster_Prediction'] == 1]['SepalWidthCm'],
            s = 70, edgecolor = 'lime', linewidth = 0.3, c = 'lime', label =␣
 ↪'Iris-setosa')
```

[137]:
```
<matplotlib.collections.PathCollection at 0x1603aec5dc0>
```



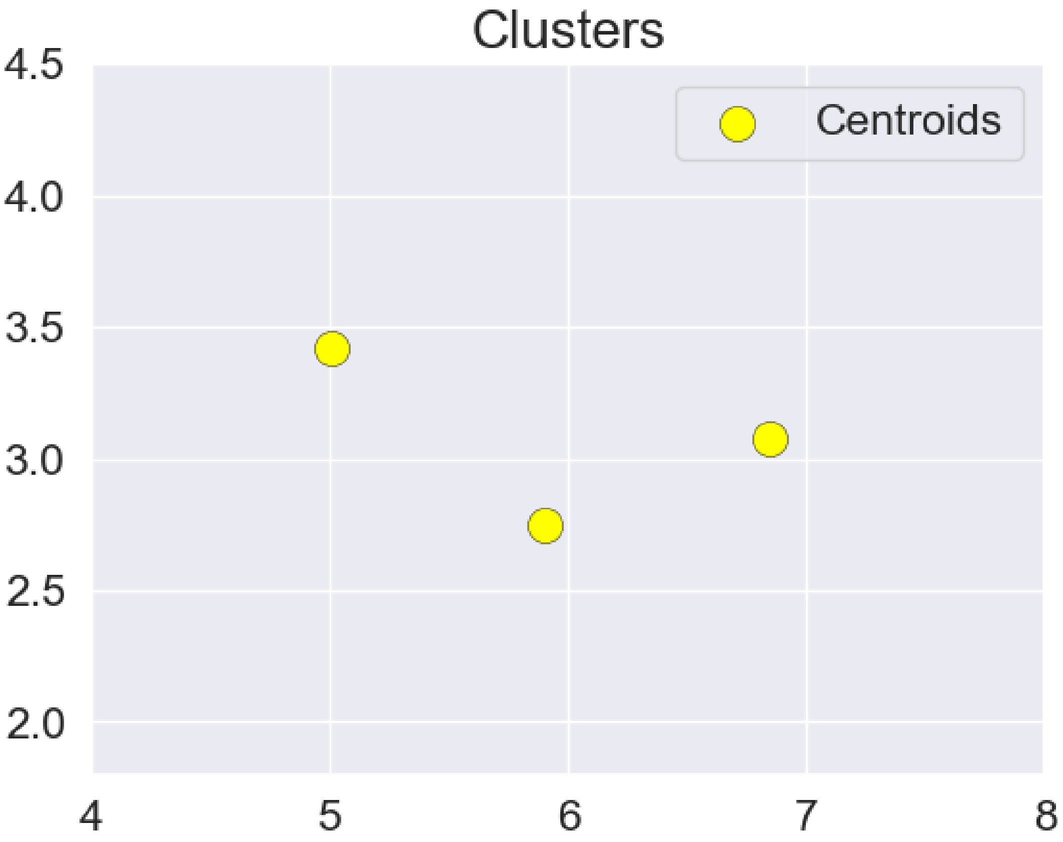
```
[139]: plt.scatter(x = clusters[clusters['Cluster_Prediction'] == 2]['SepalLengthCm'],
                   y = clusters[clusters['Cluster_Prediction'] == 2]['SepalWidthCm'],
                   s = 70, edgecolor = 'magenta', linewidth = 0.3, c = 'magenta',␣
        ↪label = 'Iris-virginica')
```

```
[139]: <matplotlib.collections.PathCollection at 0x1603af2ab70>
```



[141]:

```
plt.scatter(x = kms.cluster_centers_[:, 0], y = kms.cluster_centers_[:, 1], s =␣
 ↪170, c = 'yellow',
           label = 'Centroids', edgecolor = 'black', linewidth = 0.3)
plt.legend(loc = 'upper right')
plt.xlim(4, 8)
plt.ylim(1.8, 4.5)
ax.set_ylabel('Sepal Width (in cm)')
ax.set_xlabel('Sepal Length(in cm)')
plt.title('Clusters', fontsize = 20)
plt.show()
```


Clusters
Centroids
4.5
4.0
3.5
3.0
2.5
2.0
4
5
6
7
8

```
[ ]:
```