Importing Libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.axes as ax
import seaborn as sns

sns.set()
```

Loading Data

In [2]:
```
data = pd.read_csv(r'C:\Users\vamsi\Desktop\ML\13.Agglomerative Clustering\study_
data
```

Out[2]:

	repetition_time	study_time	knowledge_level
0	0.00	0.00	Low
1	0.24	0.90	High
2	0.25	0.33	Low
3	0.65	0.30	High
4	0.98	0.24	Low
...	...	...	...
253	0.92	0.58	High
254	0.19	0.60	High
255	0.29	0.77	High
256	0.61	0.26	High
257	0.87	0.74	High

258 rows × 3 columns

In [3]:
```
#data = data[:50]
data = data.drop(columns='knowledge_level',axis=1)
```

In [4]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 258 entries, 0 to 257
Data columns (total 2 columns):
 #   Column           Non-Null Count  Dtype  
---  ------           --------------  -----  
 0   repetition_time  258 non-null    float64
 1   study_time       258 non-null    float64
dtypes: float64(2)
memory usage: 4.2 KB
```

In [5]:
```
data.describe()
```

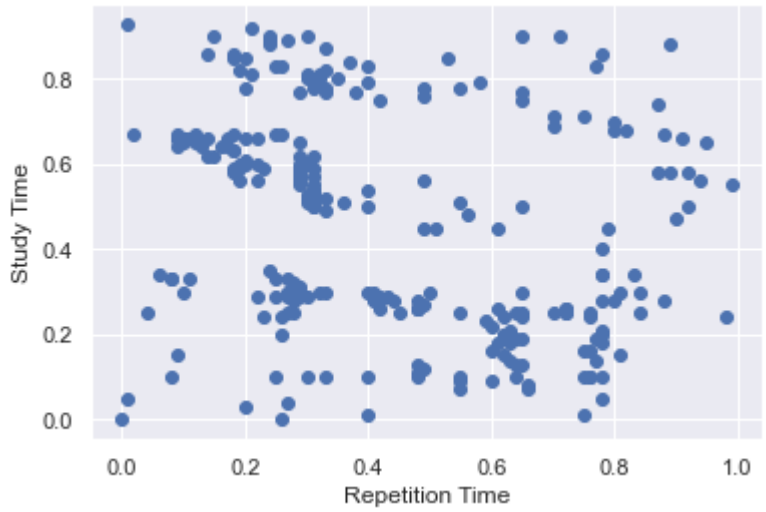
Out[5]:

	repetition_time	study_time
count	258.000000	258.000000
mean	0.432713	0.458539
std	0.248108	0.255211
min	0.000000	0.000000
25%	0.250000	0.250000
50%	0.330000	0.500000
75%	0.647500	0.660000
max	0.990000	0.930000

Plotting data

In [6]:
```
plt.scatter(data['repetition_time'],data['study_time'])
plt.xlabel('Repetition Time')
plt.ylabel('Study Time')
```

Out[6]:
```
Text(0, 0.5, 'Study Time')
```



Preparing Input data

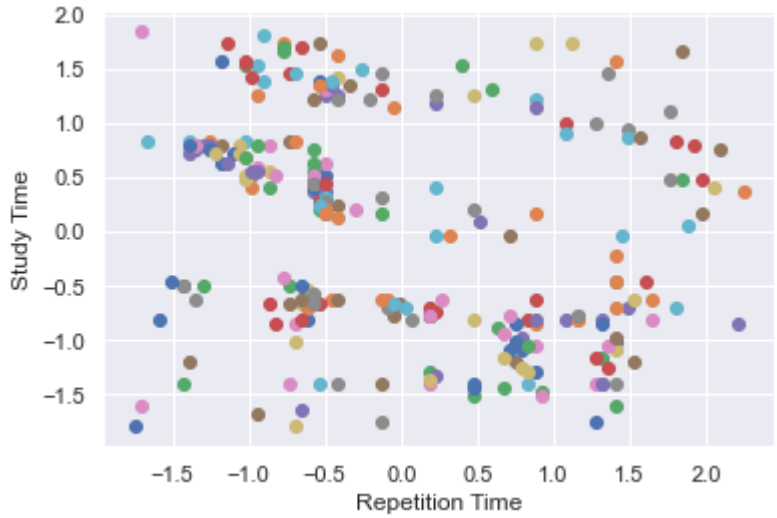
In [7]:
```
from sklearn import preprocessing

data_scaled = data.copy()
data_scaled = preprocessing.scale(data)
data_scaled[:5]
```

Out[7]:
```
array([[-1.74744134, -1.80019743],
       [-0.77824063,  1.73315205],
       [-0.73785726, -0.50463595],
       [ 0.87747726, -0.62241427],
       [ 2.21012825, -0.8579709 ]])
```

In [8]:
```
for i in range(data_scaled.size//2):
    plt.scatter(data_scaled[i][0],data_scaled[i][1])
plt.xlabel('Repetition Time')
plt.ylabel('Study Time')
```

Out[8]:
```
Text(0, 0.5, 'Study Time')
```



Elbow Method

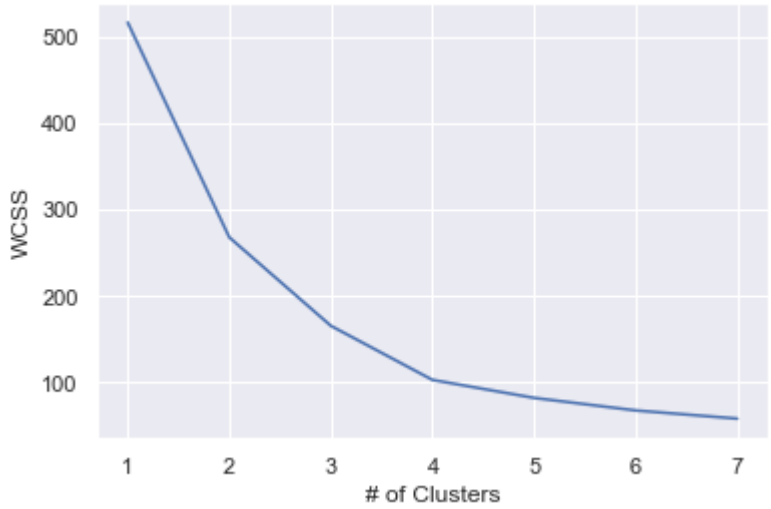
In [9]:
```
from sklearn.cluster import KMeans
```

In [10]:
```
#Within cluster sum of squares
wcss = []
for i in range(1,8):
    kmeans = KMeans(n_clusters=i,random_state=0)
    kmeans.fit(data_scaled)
    wcss.append(kmeans.inertia_)
wcss
```

Out[10]:
```
[516.0000000000005,
 267.8668182480292,
 165.6928343152814,
 103.24699730418467,
 82.47097800189657,
 67.98237690657507,
 58.53043828711949]
```

In [11]:
```
plt.plot(range(1,len(wcss)+1),wcss)
plt.xlabel('# of Clusters')
plt.ylabel('WCSS')
```

Out[11]:
```
Text(0, 0.5, 'WCSS')
```

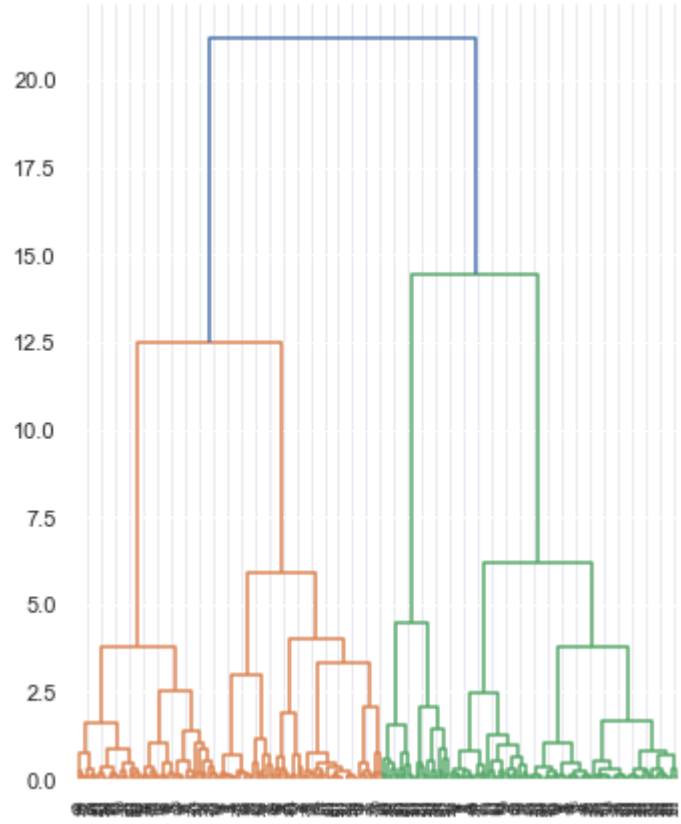


Dendogram

In [12]:
```
from scipy.cluster.hierarchy import dendrogram, linkage
```

In [13]:
```
z = linkage(data_scaled,method="ward")
```

In [14]:
```
fig,ax = plt.subplots(figsize=(5,6))
ax = dendrogram(z)
plt.tight_layout()
plt.show()
```



Agglomerative Clustering

In [15]:
```
from sklearn.cluster import AgglomerativeClustering
ag = AgglomerativeClustering(n_clusters=4,affinity="euclidean",linkage="ward")
ag.fit(data_scaled)
```

Out[15]:
```
AgglomerativeClustering(n_clusters=4)
```

In [16]:
```
cluster_data = data.copy()
cluster_data['cluster_pred'] = ag.fit_predict(data_scaled)
cluster_data
```

Out[16]:

	repetition_time	study_time	cluster_pred
0	0.00	0.00	1
1	0.24	0.90	0
2	0.25	0.33	1
3	0.65	0.30	3
4	0.98	0.24	3
...	...	...	...
253	0.92	0.58	2
254	0.19	0.60	0
255	0.29	0.77	0
256	0.61	0.26	3
257	0.87	0.74	2

258 rows × 3 columns

Clustering Labels

In [17]:
```
ag.labels_
```

Out[17]:
```
array([1, 0, 1, 3, 3, 0, 0, 1, 3, 0, 0, 1, 3, 0, 0, 0, 1, 1, 1, 1, 3, 0,
       0, 1, 3, 0, 1, 1, 2, 0, 0, 3, 3, 0, 0, 1, 3, 1, 1, 1, 3, 0, 0, 3,
       1, 0, 0, 0, 2, 0, 1, 1, 3, 0, 0, 1, 3, 0, 0, 3, 3, 0, 0, 1, 3, 1,
       1, 1, 1, 0, 0, 0, 3, 0, 0, 1, 3, 1, 1, 1, 3, 0, 0, 1, 3, 1, 0, 1,
       3, 0, 0, 3, 3, 1, 0, 3, 3, 0, 0, 1, 1, 0, 0, 1, 3, 0, 0, 1, 3, 0,
       1, 1, 2, 0, 0, 1, 3, 2, 0, 0, 3, 3, 1, 0, 2, 2, 0, 1, 3, 3, 1, 0,
       3, 2, 0, 0, 1, 3, 0, 1, 3, 3, 0, 1, 1, 2, 1, 1, 3, 2, 0, 1, 1, 3,
       0, 0, 0, 2, 0, 0, 3, 3, 0, 0, 1, 0, 0, 2, 3, 0, 1, 0, 2, 3, 0, 1,
       3, 2, 0, 0, 3, 2, 0, 1, 3, 3, 0, 0, 3, 2, 0, 0, 1, 2, 0, 1, 1, 3,
       0, 1, 3, 1, 1, 1, 2, 3, 0, 0, 1, 2, 0, 0, 2, 3, 0, 1, 1, 2, 0, 1,
       3, 3, 0, 0, 3, 2, 0, 1, 2, 2, 0, 1, 3, 2, 0, 1, 3, 0, 0, 0, 3, 2,
       0, 1, 3, 2, 0, 1, 2, 3, 0, 0, 3, 2, 0, 0, 3, 2], dtype=int64)
```

Visualization

In [18]:
```
plt.scatter(data['repetition_time'],data['study_time'],c=cluster_data['cluster_pr
plt.xlabel('Repetetion Time')
plt.ylabel('Study Time')
```

Out[18]: Text(0, 0.5, 'Study Time')