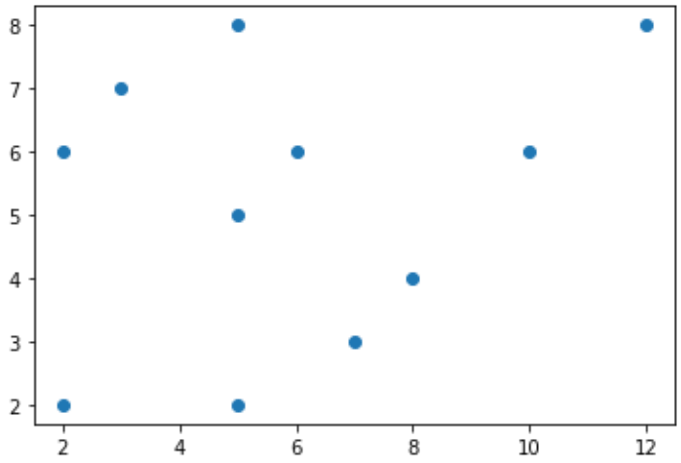
```
import numpy as np
import sklearn
import matplotlib.pyplot as plt
import scipy.cluster.hierarchy as sch
from sklearn.cluster import AgglomerativeClustering
```

```
X = np.array([[2,2],[2,6],[3,7],[5,2],[5,5],[5,8
    [6,6],[7,3],[8,4],[10,6],[12,8],])
```

Vishnu Vardhan Reddy Yeruva Resolve
7:32 PM Today
As per given data

```
plt.scatter(X[:,0],X[:,1])
```

```
<matplotlib.collections.PathCollection at
```




```
hcs = AgglomerativeClustering(linkage='single',n_clusters=2).fit(X)
hcs.labels_
```

```
array([1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0])
```

```
y_hcs = hcs.fit_predict(X)
```

```
plt.scatter(X[y_hcs ==0,0],X[y_hcs==0,1],s=100,c='green')
plt.scatter(X[y_hcs ==1,0],X[y_hcs==1,1],s=100,c='blue')
plt.scatter(X[y_hcs ==2,0],X[y_hcs==2,1],s=100,c='yellow')
plt.scatter(X[y_hcs ==3,0],X[y_hcs==3,1],s=100,c='red')
plt.scatter(X[y_hcs ==4,0],X[y_hcs==4,1],s=100,c='black')
plt.scatter(X[y_hcs ==5,0],X[y_hcs==5,1],s=100,c='gray')
```

```
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```

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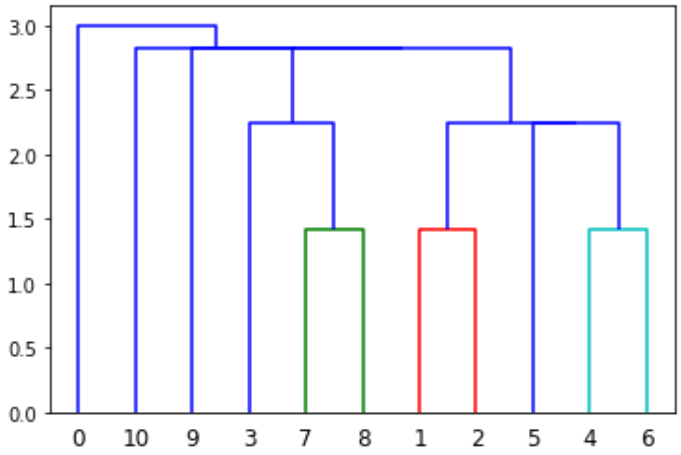
```
dendrogram = sch.dendrogram(sch.linkage(X,method='single'))
```




```
hcc = AgglomerativeClustering(linkage='complete',n_clusters=3).fit(X)
hcc.labels_
```

```
array([0, 2, 2, 0, 2, 2, 2, 0, 0, 1, 1])
```

```
y_hcc = hcc.fit_predict(X)
```

```
plt.scatter(X[y_hcc ==0,0],X[y_hcc==0,1],s=100,c='green')
plt.scatter(X[y_hcc ==1,0],X[y_hcc==1,1],s=100,c='blue')
plt.scatter(X[y_hcc ==2,0],X[y_hcc==2,1],s=100,c='yellow')
plt.scatter(X[y_hcc ==3,0],X[y_hcc==3,1],s=100,c='red')
plt.scatter(X[y_hcc ==4,0],X[y_hcc==4,1],s=100,c='black')
plt.scatter(X[y_hcc ==5,0],X[y_hcc==5,1],s=100,c='gray')
```

```
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```
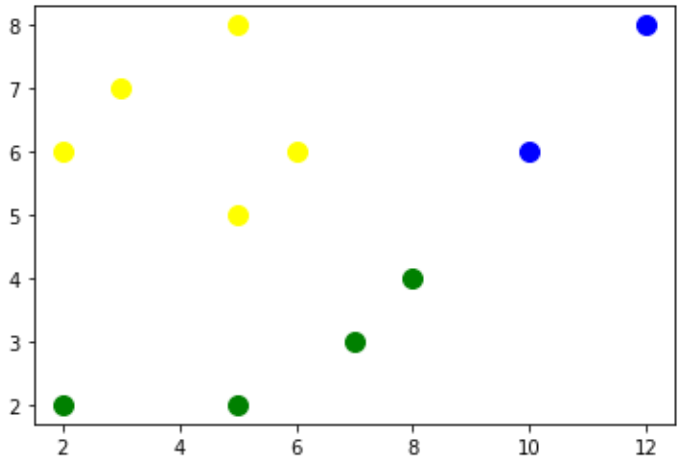
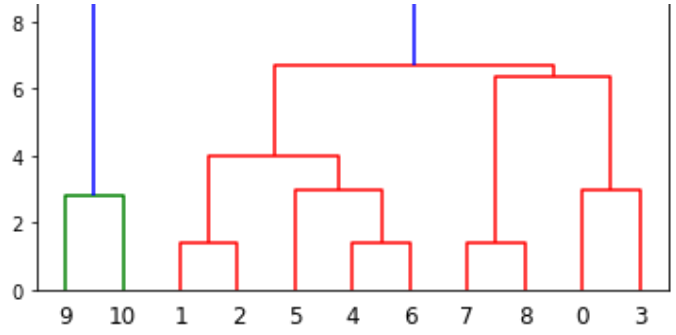





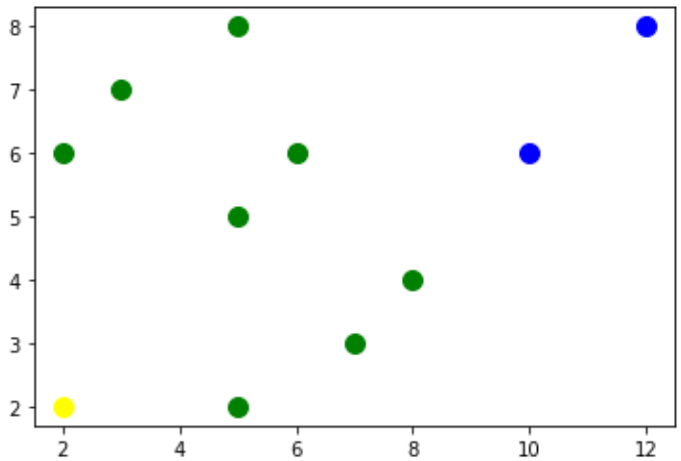

```
hca = AgglomerativeClustering(linkage='average',n_clusters=3).fit(X)
hca.labels_
```

```
array([2, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1])
```

```
y_hca = hca.fit_predict(X)
```

```
plt.scatter(X[y_hca ==0,0],X[y_hca==0,1],s=100,c='green')
plt.scatter(X[y_hca ==1,0],X[y_hca==1,1],s=100,c='blue')
plt.scatter(X[y_hca ==2,0],X[y_hca==2,1],s=100,c='yellow')
plt.scatter(X[y_hca ==3,0],X[y_hca==3,1],s=100,c='red')
plt.scatter(X[y_hca ==4,0],X[y_hca==4,1],s=100,c='black')
plt.scatter(X[y_hca ==5,0],X[y_hca==5,1],s=100,c='gray')
```

```
<matplotlib.collections.PathCollection at
```



CMPE 256

ASSIGNMENT

NAME: NEVIL SHAH
SJSU ID:- 015964975

Data Points

Points	X	Y
A	2	2
B	2	6
C	3	7
D	5	2
E	5	5
F	5	8
G	6	6
H	7	3
I	8	4
J	10	6
K	12	8

Euclidian Distance

$$P_1(A,B) = \sqrt{(2-2)^2+(2-6)^2} = 4$$

$$P_2(A,C) = \sqrt{(2-3)^2+(2-7)^2} = 5.1$$

$$P_3(A,D) = \sqrt{(2-5)^2+(2-2)^2} = 3$$

$$P_4(A,E) = \sqrt{(2-5)^2+(2-5)^2} = 4.24$$

$P_5(A,F) = \sqrt{(2-5)^2+(2-8)^2}$

$= 6.7$

$P_6(A,G) = \sqrt{(2-6)^2+(2-6)^2}$

$= 5.65$

$P(A,H) = \sqrt{(2-7)^2+(2-3)^2}$

$= 5.1$

$P(A,I) = \sqrt{(2-8)^2+(2-4)^2}$

$= 6.3$

$P(A,J) = \sqrt{(2-10)^2+(2-6)^2}$

$= 8.9$

$P(A,K) = \sqrt{(2-12)^2+(2-8)^2}$

$= 11.66$

$P(B,C) = \sqrt{(2-3)^2+(6-7)^2}$

$= 1.4$

$P(B,D) = \sqrt{(2-5)^2+(6-2)^2}$

$= 5$

$P(B,E) = \sqrt{(2-5)^2+(6-5)^2}$

$= 3.16$

$P(B,F) = \sqrt{(2-5)^2+(6-8)^2}$

3.6

$P(B,G) = \sqrt{(2-6)^2+(6-6)^2}$

$= 4$

$P(B,H) = \sqrt{(2-7)^2+(6-3)^2}$

$= 5.8$

$P(B,I) = \sqrt{(2-8)^2+(6-4)^2}$

$= 6.3$

$$P(B, J) = \sqrt{(2-10)^2 + (6-6)^2}$$
$$= 8$$

$$P(B, K) = \sqrt{(2-12)^2 + (6-8)^2}$$
$$= 10.2$$

$$P(C, D) = \sqrt{(3-5)^2 + (7-2)^2}$$
$$= 5.38$$

$$P(C, E) = \sqrt{(3-5)^2 + (7-5)^2}$$
$$= 2.82$$

$$P(C, F) = \sqrt{(3-5)^2 + (7-8)^2}$$
$$= 2.24$$

$$P(C, G) = \sqrt{(3-6)^2 + (7-6)^2}$$
$$= 3.16$$

$$P(C, H) = \sqrt{(3-7)^2 + (7-3)^2}$$
$$= 5.65$$

$$P(C, I) = \sqrt{(3-8)^2 + (7-4)^2}$$
$$= 5.83$$

$$P(C, J) = \sqrt{(3-10)^2 + (7-6)^2}$$
$$= 7.07$$

$$P(C, K) = \sqrt{(3-12)^2 + (7-8)^2}$$
$$= 9.1$$

$$P(D, E) = \sqrt{(5-5)^2 + (2-5)^2}$$
$$= 3$$

$$P(D, F) = \sqrt{(5-5)^2 + (2-8)^2}$$
$$= 6$$

$$P(D, G) = \sqrt{(5-6)^2 + (2-6)^2}$$
$$= 4.1$$

$P(D,H) = \sqrt{(5-7)^2 + (8-3)^2}$

$= 2.23$

$P(D,I) = \sqrt{(5-8)^2 + (8-4)^2}$

$= 3.6$

$P(D,J) = \sqrt{(5-10)^2 + (8-6)^2}$

$= 6.4$

$P(D,K) = \sqrt{(5-12)^2 + (8-8)^2}$

$= 9.2$

$P(E,F) = \sqrt{(5-5)^2 + (5-8)^2}$

$= 3$

$P(E,G) = \sqrt{(5-6)^2 + (5-6)^2}$

$= 1.41$

$P(E,H) = \sqrt{(5-7)^2 + (5-3)^2}$

$= 2.82$

$P(E,I) = \sqrt{(5-8)^2 + (5-4)^2}$

$= 3.16$

$P(E,J) = \sqrt{(5-10)^2 + (5-6)^2}$

$= 5.09$

$P(E,K) = \sqrt{(5-12)^2 + (5-8)^2}$

$= 7.61$

$P(F,G) = \sqrt{(5-6)^2 + (8-6)^2}$

$= 2.23$

$P(F,H) = \sqrt{(5-7)^2 + (8-3)^2}$

$= 5.38$

$P(F,I) = \sqrt{(5-8)^2 + (8-4)^2}$

$= 5$

$P(F,J) = \sqrt{(5-10)^2 + (8-6)^2}$
$= 5.38$

$P(F,K) = \sqrt{(5-12)^2 + (8-8)^2}$
$= 7$

$P(G,H) = \sqrt{(6-7)^2 + (6-3)^2}$
$= 3.16$

$P(G,I) = \sqrt{(6-8)^2 + (6-4)^2}$
$= 2.82$

$P(G,J) = \sqrt{(6-10)^2 + (6-6)^2}$
$= 4$

$P(G,K) = \sqrt{(6-12)^2 + (6-8)^2}$
$= 6.32$

$P(H,I) = \sqrt{(7-8)^2 + (3-4)^2}$
$= 1.41$

$P(H,J) = \sqrt{(7-10)^2 + (3-6)^2}$
$= 4.24$

$P(H,K) = \sqrt{(7-12)^2 + (3-8)^2}$
$= 7.07$

$P(I,J) = \sqrt{(8-10)^2 + (4-6)^2}$
$= 2.828$

$P(I,K) = \sqrt{(8-12)^2 + (4-8)^2}$
$= 5.66$

$P(J,K) = \sqrt{(10-12)^2 + (6-8)^2}$
$= 2.828$

Distance Matrix-

	A	B	C	D	E	F	G	H	I	J	K
A	0	4	5.09	3	4.24	6.7	5.65	5.09	6.32	8.9	11.66
B	4	0	1.4	5	3.16	3.6	4	5.8	6.3	8	10.19
C	5.1	(1.4)	0	5.3	2.8	2.2	3.16	5.65	5.8	7.07	9.05
D	3	5	5.4	0	3	6	4.1	2.2	3.6	6.4	9.21
E	4.24	3.1	2.8	3	0	3	1.4	2.8	3.1	5.09	7.61
F	6.7	3.6	2.2	6	3	0	2.2	5.4	5	5.38	7
G	5.65	4	3.1	4.1	1.4	2.2	0	3.2	2.8	4	6.32
H	5.09	5.83	5.6	2.2	2.8	5.3	3.16	0	1.4	4.26	7.07
I	6.3	6.32	5.8	3.6	3.16	5	2.8	1.4	0	2.82	5.65
J	8.9	8	7.1	6.4	5.1	5.38	4	4.2	2.8	0	2.82
K	11.66	10.19	9	9.2	7.6	7	6.324	7.07	5.6	2.82	0

Step -2:- Merging points B and C as they have minimum distance

	A	BC	D	E	F	G	H	I	J	K
A	0									
BC	4	0								
D	3	5	0							
E	4.24	2.8	3	0						
F	6.7	2.2	6	3	0					
G	5.65	3.16	4.1	(1.4)	2.2	0				
H	5.09	5.65	2.8	2.82	5.4	3.1	0			
I	6.3	5.8	3.6	3.16	5	2.8	1.4	0		
J	8.9	4.8	6.4	5.09	5.4	4	4.2	2.8	0	
K	11.66	9.05	9.2	7.6	7	6.3	7.1	5.65	2.82	0

Step-3:- Merging points D & E

	A	BC	D	EG	F	H	I	J	K
A	0								
BC	4	0							
D	3	5	0						
EG	4.24	2.82	3	0					
F	6.7	2.27	6	2.23	0				
H	5.09	5.65	2.23	2.82	5.38	0			
I	6.3	5.8	3.6	2.82	5	(1.41)	0		
J	8.9	4.8	6.4	4.2	5.36	4.29	2.82	0	
K	11.66	9.05	9.2	6.32	7	6.32	5.65	2.82	0

Step: 4 Merging Points H & I

	A	BC	D	EG	F	HI	J	K
A	0							
BC	4	0						
D	3	5	0					
EG	4.24	2.82	3	0				
F	6.7	2.23	6	2.23	0			
HI	5.09	5.65	2.23	2.82	5	0		
J	8.9	4.8	6.4	4.2	5.38	2.82	0	
K	11.66	9.05	9.2	6.32	7	5.65	2.82	0

Step-5:- Merging Points BC & F

	A	BCF	D	EG	HI	J	K
A	0						
BCF	4	0					
D	3	5	0				
EG	4.24	2.23	3	0			
HI	5.09	5	2.23	2.82	0		
J	8.9	4.8	6.4	4.2	2.82	0	
K	11.66	7	9.2	6.32	5.65	2.82	0

Step-6:- Merging BCF & EG.

	A	BCEFG	D	HI	J	K
A	0					
BCEFG	4	0				
D	3	3	0			
HI	5.09	2.82	2.23	0		
J	8.9	4.2	6.4	2.82	0	
K	11.66	6.32	5.92	5.65	2.82	0

D

Step-7:- Merging & DHI

	A	BCDEFG	DHI	J	K
A	0				
BCDEFG	4	0			
DHI	3	2.82	0		
J	8.9	4	2.82	0	
K	11.66	6.32	5.65	2.82	0

Step-8

	A	BCDEFGHI	J	K
A	0			
BCDEFGHI	3	0		
J	8.9	2.82	0	
K	11.66	5.65	2.82	0

Step -9

	A	BCDE FGHIJ	K
A	0		
BCDEFGHIJ	3	0	
K	11.66	2.82	0

Step -10

	A	BCDEFGHIJk
A	0	
BCDEFGHIJk	3	0