

ASSIGNMENT

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Data 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

Euclidean Distance

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

$$= 4$$

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

$$= 5.1$$

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

$$= 3$$

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

$$= 4.24$$

$$P_5(A, F) = \sqrt{(2-5)^2 + (2-8)^2} = 6.7$$

$$P_6(A, G) = \sqrt{(2-6)^2 + (2-6)^2} = 5.65$$

$$P(A, H) = \sqrt{(2-7)^2 + (2-3)^2} = 4.5.1$$

$$P(A, I) = \sqrt{(2-8)^2 + (2-4)^2} = 6.3$$

$$P(A, J) = \sqrt{(2-10)^2 + (2-6)^2} = 8.9$$

$$P(A, K) = \sqrt{(2-12)^2 + (2-8)^2} = 11.66$$

$$P(B, C) = \sqrt{(2-3)^2 + (6-7)^2} = 1.4$$

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

$$P(B, E) = \sqrt{(2-5)^2 + (6-5)^2} = 3.16$$

$$P(B, F) = \sqrt{(2-5)^2 + (6-8)^2} = 3.6$$

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

$$P(B, H) = \sqrt{(2-7)^2 + (6-3)^2} = 5.8$$

$$P(B, I) = \sqrt{(2-8)^2 + (6-4)^2} = 6.3$$

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

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

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

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

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

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

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

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

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

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

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

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

$$P(D, G) = \frac{\sqrt{(5-6)^2 + (8-6)^2}}{4.1}$$

$$P(D, H) = \sqrt{(5-7)^2 + (5-3)^2} \\ = 2.23$$

$$P(D, I) = \sqrt{(5-8)^2 + (5-4)^2} \\ = 3.6$$

$$P(D, J) = \sqrt{(5-10)^2 + (5-6)^2} \\ = 6.4$$

$$P(D, K) = \sqrt{(5-12)^2 + (5-8)^2} \\ = 9.2$$

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

$$P(E, G) = \sqrt{(5-6)^2 + (5-6)^2} \\ = 1.41$$

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

$$P(E, I) = \sqrt{(5-8)^2 + (5-4)^2} \\ = 3.16$$

$$P(E, J) = \sqrt{(5-10)^2 + (5-6)^2} \\ = 5.09$$

$$P(E, K) = \sqrt{(5-12)^2 + (5-8)^2} \\ = 7.61$$

$$P(F, G) = \sqrt{(5-6)^2 + (8-6)^2} \\ = 2.23$$

$$P(F, H) = \sqrt{(5-7)^2 + (8-3)^2} \\ = 5.38$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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	2.2	6	2.23	0				
H	5.09	5.65	2.23	2.82	5.38	0			
I	6.3	5.8	3.6	2.92	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	2.82	0		
J	8.9	4.2	4.2	2.82	0	
K	11.66	6.32	6.32	5.65	2.82	0

Step-7:- Merging ~~BCEFG~~ & ~~HI~~

	A	BC DE FG	DHI	J	K
A	0				
BC DE FG	4	0			
DHI	5.09	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	(2.22)	0

Step - 10

	A	BCDEFGHIJK
A	0	3
BCDEFGHIJK	3	0

Hence, if we make 2 clusters,

Cluster	Parents
1	A
2	BCDEFGHIJK