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In class programming.

Q1. Sol^n

Points	X-coordinate	Y-coordinate
P1	0.4005	0.5306
P2	0-2148	0.3854
P3	0.3457	0.3156
P4	0.2652	0.1875
P5	0.0789	0.4139
P6	0.4548	0.3022

Single Link

	P1	P2	P3	P4	P5	P6
P1	0.0					
P2	0.2357	0.0				
P3	0.2218	0.1483	0.0			
P4	0.3688	0.2042	0.1513	0.0		
P5	0.3421	0.1388	0.2843	0.2932	0.0	
P6	0.2347	0.2540	0.1100	0.2216	0.3921	0.0

Now, in the distance matrix, the min is:
Pair $[P_3, P_6] = 0.11$

Updating distance matrix MIN [dist (P3, P6), P1]

$\Rightarrow$ MIN (dist (P3, P1), (P6, P1))
$=$ min [(0.2218, 0.2347)]
$=$ 0.2218
$\Rightarrow$ MIN (dist (P3, P6), P2]
$=$ min (dist (P3, P2), dist (P6, P2))

$=$ min $(0.1483, 0.2540)$

$=$ 0.1483

$\Rightarrow$ MIN [dist (P3, P6), P4)]

$=$ min (dist (P3, P4), (P6, P4))

$=$ min (0.1513, 0.2216)

$=$ 0.1513

$\Rightarrow$ MIN [dist (P3, P6), P5]

$=$ min (dist (P5, P3), (P6, P5)

$=$ min (0.2843, 0.3921)

$=$ ~~0.3921~~ 0.2843.

Updated distance matrix for P3, P6.

	P1	P2	P3,P6	P4	P5
P1	0				
P2	0.2357	0			
P3,P6	0.2218	0.1483	0		
P4	0.3688	0.2042	0.1513	0	
P5	0.3421	0.1388	0.2843	0.2932	0

The min dist in distance matrix is:
    Pair [P2, P5] = 0.1388

$\Rightarrow$ MIN [dist (P2, P5), P1]

$=$ min (dist (P2, P1), (P5, P1))

$=$ min (0.2357, 0.3421)

$=$ 0.2357.

$\Rightarrow$ MIN [dist (P2, P5), (P3, P6)]

$=$ min (dist (P2(P3, P6), P5(P3, P6)].

$= \min(0.1483, 0.2843)$

$= 0.1483$

$\Rightarrow \text{MIN} [\text{dist} (P2, P5), P4]$

$\Rightarrow \min(\text{dist}(P2, P4), (P5, P4))$

$\Rightarrow \min(0.2042, 0.2932)$

$= 0.2042.$

Updated distance matrix is:

	P1	P2,P5	P3,P6	P4
P1	0			
P2,P5	0.2357	0		
P3,P6	~~0.2218~~	0.1483	0	
P4	0.3688	0.2042	0.1513	0

The min matrix pair is for cluster:

Pair $(P3, P6), (P2, P5) = 0.1483$

$\Rightarrow \text{MIN} [\text{dist}((P2, P5), (P3, P6)) P1)]$

$= \min(\text{dist}((P2, P5), P1), (P3, P6), P1)]$

$= \min(0.2357, 0.2218)$

$= 0.2218$

$\Rightarrow \text{MIN} [\text{dist}((P2, P5), (P3, P6)), (P4))]$

$= \min[\text{dist}((P2, P5), P4), (P3, P6), P4)]$

$= \min(0.2042, 0.1513)$

$= 0.1513$

Updated distance matrix is:

	P1	P2, P5, P3, P6	P4
P1	0		
P2,P5,P3,P6	0.2218	0	
P4	0.3688	0.1513	0

The min distance is for cluster:
Pair ((P2, P5, P3, P6), P4) = 0.1513

⇒ MIN [dist (P2, P5, P3, P6) , (P4, P1)]
= min [dist ((P2, P5, P3, P6), P1), (P2, P5, P3, P6), P4)
= min (0.2218)

⇒ MIN [dist (P2, P5, P3, P6) , P4)]
= min [dist ((P2, P5, P3, P6), P1) , (P2, P5, P3, P6) (P1, P4)
= min (0.2218, 0.3688)
= 0.2218.

∴ Final Distance matrix for cluster is:

	P1	P2, P5, P3, P6, P4
P1	0	
P2,P5,P3,P6,P4	0.2218	0

Dendogram

P3   P6   P2   P5   P4   P1
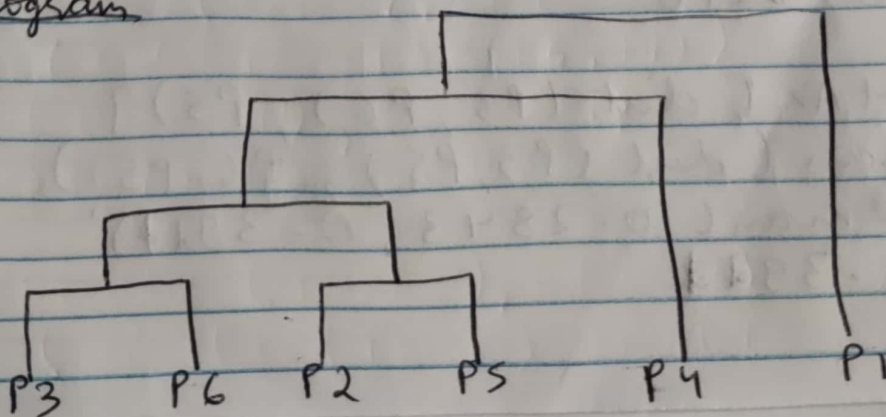
Complete Link

	P1	P2	P3	P4	P5	P6
P1	0					
P2	0.2357	0				
P3	0.2218	0.1483	0			
P4	0.3688	0.2042	0.1513	0		
P5	0.3421	0.1388	0.2843	0.2932	0	
P6	0.2347	0.2540	0.1100	0.2216	0.3924	0

The lowest is: Pair (P3, P6) = 0.1100

$$\Rightarrow MAX [dist (P3,P6), P1)]$$
$$= max [(P3, P1), (P6, P1)]$$
$$= max (0.2218, 0.2347)$$
$$= 0.2347$$

$$\Rightarrow MAX [dist (P3, P6), P2]$$
$$= max (dist (P3, P2), (P6, P2)]$$
$$= max (0.1483, 0.2540)$$
$$= 0.2540$$

$$\Rightarrow MAX [dist (P3, P6), P4]$$
$$= max (dist (P3, P4), (P6, P4)]$$
$$= max (0.1513, 0.2216)$$
$$= 0.2216$$

$$\Rightarrow MAX [dist (P3, P6), P5)]$$
$$= max (dist (P3, P5), (P6, P5))$$
$$= max (0.2843, 0.3924)$$
$$= 0.3924$$

	P1	P2	P3, P6	P4	P5
P1	0				
P2	0.2357	0			
P3, P6	0.2347	0.2540	0		
P4	0.3688	0.2042	0.2216	0	
P5	0.3421	0.1388	0.3921	0.2932	0

⇒ The lowest is: Pair (P2, P5) = 0.1388

⇒ MAX { dist (P2, P5), P1)
$=$ max (dist((P2, P1), (P5, P1))
$=$ max (0.2357, 0.3421)
$=$ 0.3421

⇒ MAX { dist (P2, P5), (P3, P6))
$=$ max (dist(P2, (P3, P6)), (P5, (P3, P6))]
$=$ max (0.2540, 3.921)
$=$ 0.3921.

⇒ MAX { dist (P2, P5), P4]
$=$ max (dist (P2, P4), (P5, P4))
$=$ max (0.2042, 0.2932).
$=$ 0.2932

	P1	P2 P5	P3 P6	P4
P1	0			
P2, P5	0.3421	0		
P3, P6	0.2347	0.3921	0	
P4	0.3688	0.2932	0.2216	0

∴ Min from cluster is:
Pair (P4, (P3, P6)) = ~~0.70~~ 0.2216

⇒ MAX [dist (P3, P4, P6), P1)]
= man (dist((P3, P6), (P1) ~~P4~~), (P1, P4)]
= man (0.3688, 0.2347)
= 0.3688

⇒ MAX [dist (P3, P4, P6), (P2, P5)]
= man (dist((P3, P6) P2, P5)), ((P4), P3, P5)]
= man (0.3922, 0.2932)
= 0.3922

	P1	P2 P5	P3 P6 P4
P1	0		
P2 P5	0.3421	0	
P3 P6 P4	0.3688	0.3922	0

Min from distance matrix is:
~~Pair [(P2)(P3, P6, P4)] = 0.3688 0.3921~~
Pair [(P1), (P2, P5)] = 0.3421

⇒ MAX [dist((P3, P6, P4), P1)
= man (dist((P3, P6, P4), P1), (P3, P6, P4), (P3, P5)
= man (0.3688, 0.3921)
= 0.3921

	P1 P2 P5	P3 P6 P4
P1 P2 P5	0	
P3 P6 P4	0.3922	0

∴, cluster Dendogram is:
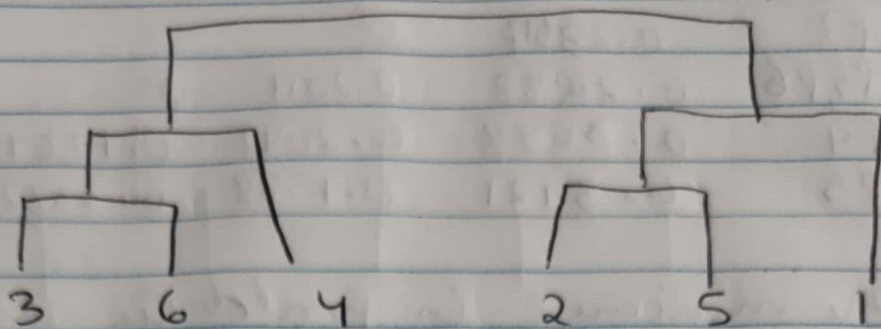
Average Link

Minimum distance matrix is for cluster
P am (P3, P6) = 0.11

⇒) Avg [(P3, P6), P1]
= Avg (0.2218, 0.2347)
= 0.2282

2) Avg [(P3, P6), P2]
= Avg (0.1483, 0.2540)
= 0.2011

⇒) Avg [(P3, P6), P4]
= Avg (0.1513, 0.2216)
= 0.1864.

⇒) Avg [(P3, P6), P5]
= Avg (0.2873, 0.3921)
= 0.3382.

	P1	P2	P3 P6	P4	P5
P1	0				
P2	0.2357	0			
P3,P6	0.2282	0.2011	0		
P4	0.3688	0.2042	0.1864	0	
P5	0.3421	0.1388	0.3382	0.2932	0

- The minimum in matterin distance is:
  Pair (P2, P5) = 0.1388.

=) Avg [dist (P2, P5), P1)]
⇒ Avg (dist (P2, P1), (P5, P1)]
= avg (0.2357, 0.3421)
= 0.2889.

2) Avg [dist (P2, P5), (P3, P6)]
= avg { dist [(P3, P6), P2), ((P3, P6), P5)}
= avg (0.2011, 0.3382)
= 0.2946.

2) Avg { dist (P2, P5), P4)]
= avg (dist (P2, P4), (P5, P4)]
= avg (0.2042, 0.2932)
= 0.2487.

	P1	P2 P5	P3 P6	P4
P1	0			
P2 P5	0.2889	0		
P3 P6	0.2282	0.2946	0	
P4	0.3688	0.2487	0.1864	0

The minimum dist matrix is for cluster:
Pair [(P3, P6), P4] = 0.1864.

$\Rightarrow$ Avg [dist (P3, P4, P6), (P1)]

$=$ avg { dist((P3, P6), P1), (P4 $\cancel{\text{P4}}$ P1)]

$=$ avg (0.2282, 0.3688)

$=$ 0.2985

$\Rightarrow$ Avg [dist (P3, P4, P6), (P2, P5)]

$=$ avg [dist((P3, P6), P2, P5), ((P4 $\cancel{0}$), P3, P5)]

$=$ avg (0.2946, 0.2487)

$=$ 0.2591.

	P1	P2 P5	P3 P4 P6
P1	0		
P2 P5	0.2889	0	
P3 P4 P6	0.2985	0.2591	0

∴ Min dist. matrix is for cluster:
Pair [(P5, P2), (P3, P4, P6)] = 0.2591

$\Rightarrow$ Avg[dist (P2, P3, P4, P5, P6), P1)]

$=$ avg (dist ((P5, P2), P1)), ((P3, P4, P6), P1)]

$=$ avg (0.2889, 0.2985)

$=$ 0.2937.

	P1	P2 P3 P4 P5 P6
P1	0	
P2 P3 P4 P5 P6	0.2937.	0

Dendogram

3 6 4 2 5 1