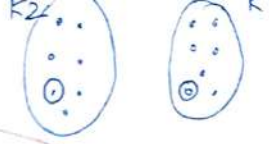
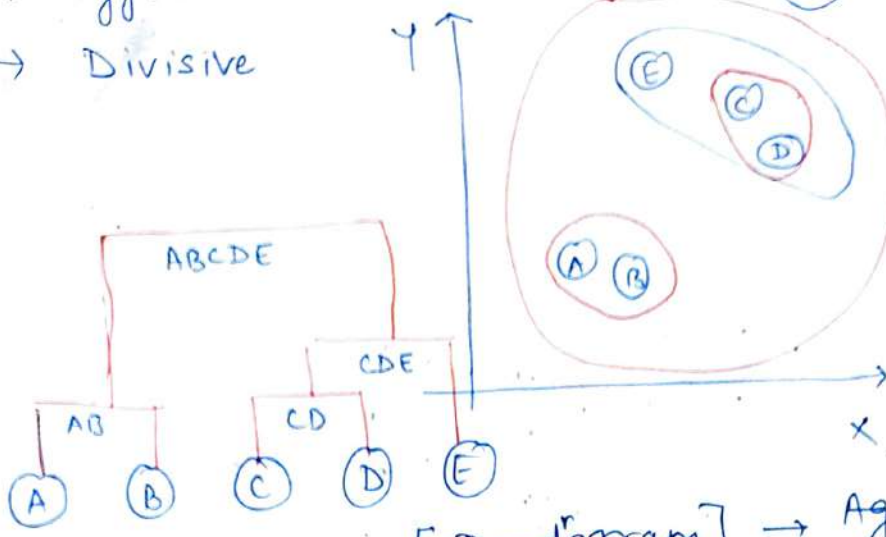
* Hierarchial clustering :-

→ ~~Agglomerative~~

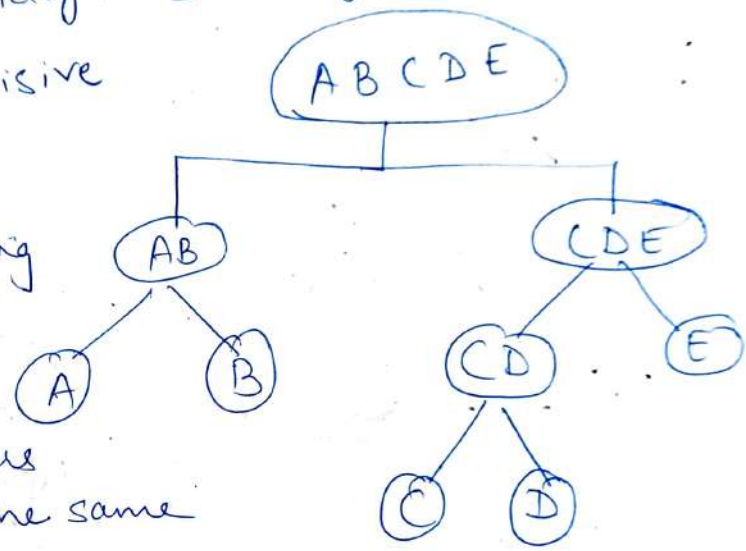
→ Divisive





Bottom-Up → [Dendrogram] → Agglomerative

Top-Down → Divisive



→ Agglomerative clustering is an unsupervised M.L technique that divides the population into clusters such that data points in the same cluster are more similar.

* Agglomerative Clustering (Single linkage)

	P_1	P_2	P_3	P_4	P_5
P_1	0				
P_2	9	0			
P_3	3	7	0		
P_4	6	5	9	0	
P_5	11	10	(2) minimum	8	0

	P_1	P_2	$[P_3\ P_5]$	P_4
P_1	0			
P_2	9	0		
$[P_3 P_5]$	3 min	7	0	
P_4	6	5	8	0

$\Rightarrow d(P_1, [P_3, P_5])$

$\Rightarrow \min(d(P_1, P_3), d(P_1, P_5))$

$\Rightarrow \min(3, 11) \Rightarrow 3$

$\Rightarrow d(P_2, [P_3, P_5])$

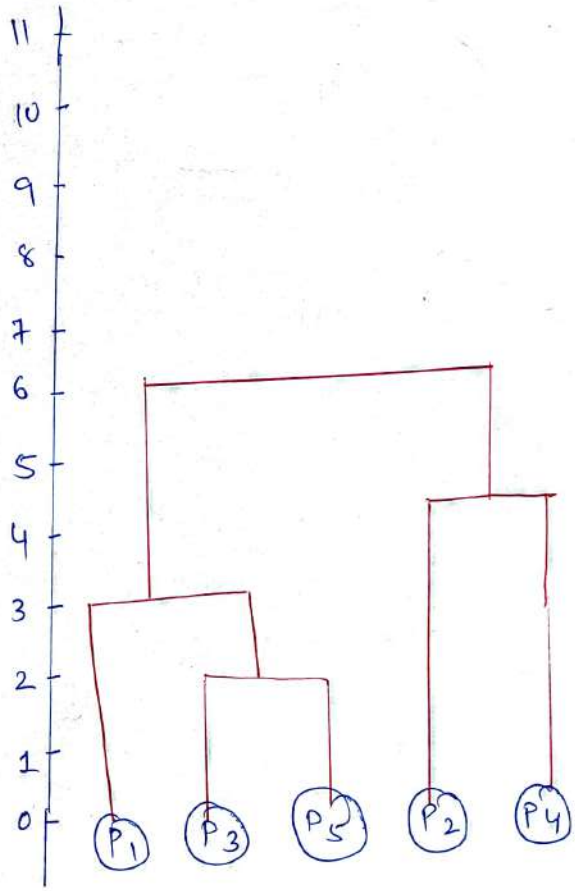
$\Rightarrow \min(d(P_2, P_3), d(P_2, P_5))$

$\Rightarrow \min(7, 10) \Rightarrow 7$

$\Rightarrow d(P_4, [P_3, P_5])$

$\Rightarrow \min(d(P_4, P_3), d(P_4, P_5))$

$\Rightarrow \min(9, 8) \Rightarrow 8$



$d(P_2, [P_1, P_3, P_5])$

$\Rightarrow \min(d(P_2, P_1), d(P_2, P_3), d(P_2, P_5))$

$\Rightarrow \min(9, 7, 10)$

$\Rightarrow 7$

	$[P_1 P_3 P_5]$	P_2	P_4
$[P_1 P_3 P_5]$	0		
P_2	7	0	
P_4	6	5	0

$d(P_4, [P_1, P_3, P_5])$

$\Rightarrow \min(d(P_4, P_1), d(P_4, P_3), d(P_4, P_5))$

$\Rightarrow \min(6, 9, 8)$

$\Rightarrow 6$

$d([P_1 P_3 P_5], [P_2 P_4])$

$\Rightarrow \min(d(P_2, P_1), d(P_2, P_3), d(P_2, P_5), d(P_4, P_1), d(P_4, P_3), d(P_4, P_5))$

$\Rightarrow \min(9, 7, 10, 6, 9, 8)$

$\Rightarrow 6$

	$[P_1 P_3 P_5]$	$[P_2 P_4]$
$[P_1 P_3 P_5]$	0	
$[P_2 P_4]$	6	0

* Agglomerative clustering (complete linkage)

	P_1	P_2	P_3	P_4	P_5
P_1	0				
P_2	9	0			
P_3	3	7	0		
P_4	6	5	9	0	
P_5	11	10	2	8	0

$d(P_2, [P_3, P_5])$

$\Rightarrow \max(d(P_2, P_3), d(P_2, P_5))$

$\Rightarrow \max(7, 10)$

$\Rightarrow 10$

$d(P_1, [P_3 P_5])$

$\Rightarrow \max(d(P_1, P_3), d(P_1, P_5))$

$\Rightarrow \max(3, 11)$

$\Rightarrow 11$

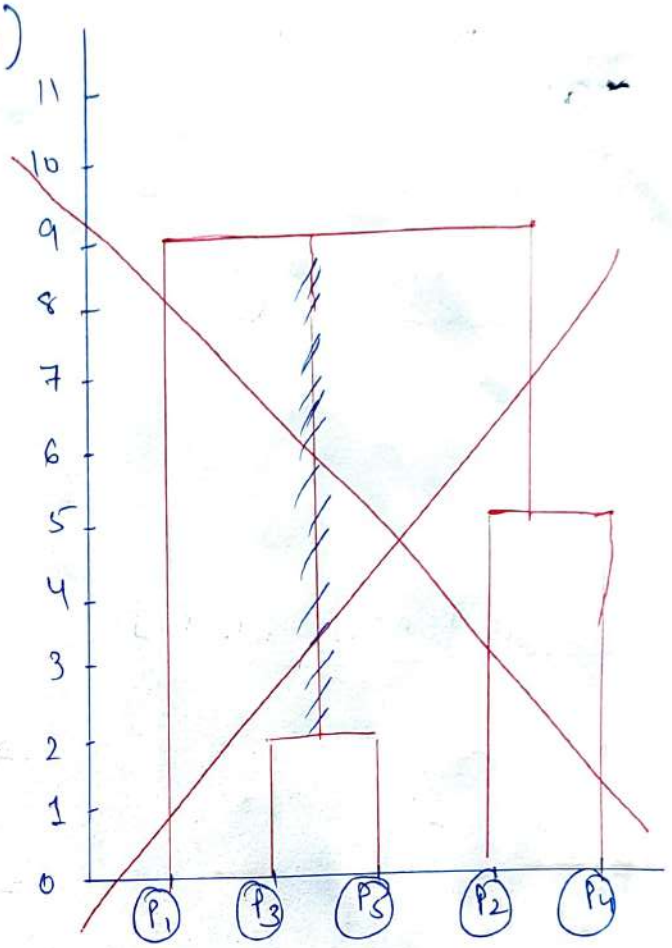
	P_1	P_2	$[P_3 P_5]$	P_4
P_1	0			
P_2	9	0		
$[P_3 P_5]$	11	10	0	
P_4	6	5	9	0

$d(P_4, [P_3, P_5])$

$\Rightarrow \max(d(P_4, P_3), d(P_4, P_5))$

$\Rightarrow \max(9, 8)$

$\Rightarrow 9$



	P_1	$[P_3\ P_5]$	$[P_2\ P_4]$
P_1	0		
$[P_3 P_5]$	11	0	
$[P_2 P_4]$	9	10	0

$d([P_3 P_5], P_1)$

$\Rightarrow \max(d(P_1, P_3), d(P_1, P_5))$

$\Rightarrow \max(3, 11)$

$\Rightarrow 11.$

$d([P_2 P_4], P_1)$

$\Rightarrow \max(d(P_2, P_1), d(P_4, P_1))$

$\Rightarrow \max(9, 6)$

$\Rightarrow 9$

$d([P_2 P_4], [P_3, P_5])$

$\Rightarrow \max(d([P_2, P_4], d[P_3, P_5])$

$\Rightarrow \max(d(P_2, P_3), d(P_2, P_5), d(P_4, P_3), d(P_4, P_5))$

$\Rightarrow \max(7, 10, 9, 8)$

$\Rightarrow 10$

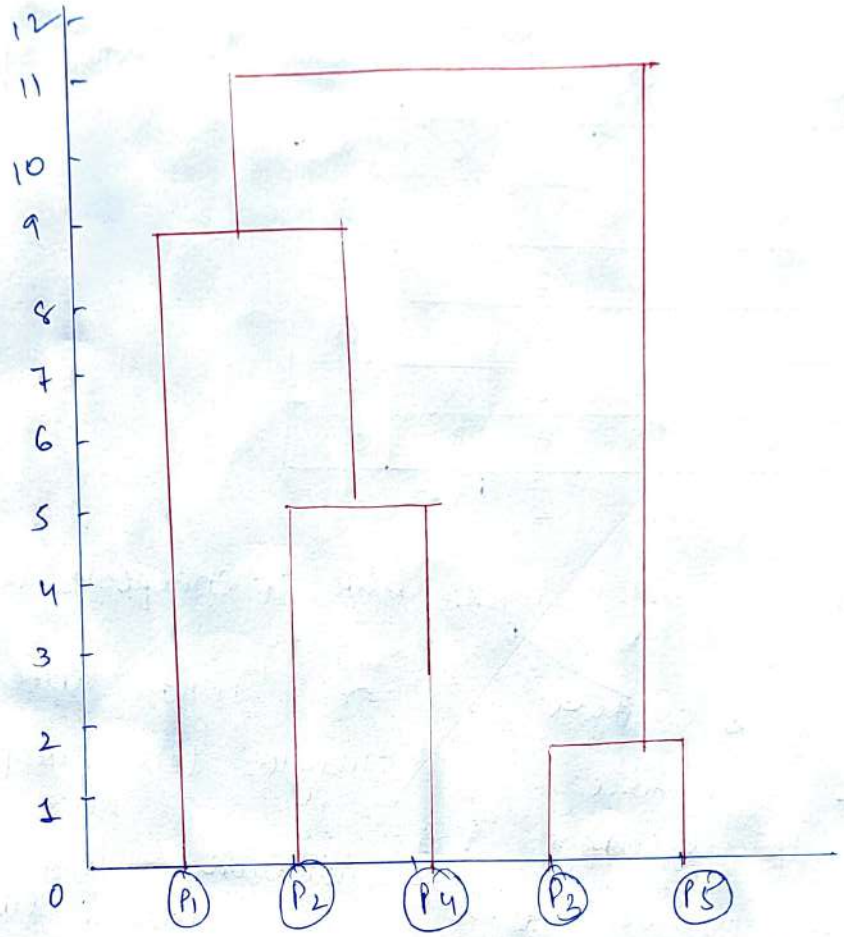
$d([P_1, P_2 P_4], [P_3, P_5])$

$\Rightarrow \max(d(P_3, P_1), d(P_3, P_2), d(P_3, P_4), d(P_5, P_1), d(P_5, P_2), d(P_5, P_4))$

$\Rightarrow \max(3, 7, 9, 11, 10, 8)$

$\Rightarrow 11$

	$[P_1, P_2 P_4]$	$[P_3 P_5]$
$[P_1, P_2 P_4]$	0	
$[P_3 P_5]$	11	0



HW Example:-

For given distance matrix, draw single link & complete linkage dendogram. (May 2013).

	1	2	3	4	5
1	0				
2	2	0			
3	6	3	0		
4	10	9	7	0	
5	9	8	5	4	0