### AGGLOMERATIVE CLUSTERING

End Ser (x) PROBLEM

Given the dataset la, b, c, d, e y and the following distance matrix.

Construct a dendrogram by single linkage, complete linkage, average linkage hierarchical clustering using agglomerative clustering model.

กับ	a	b	C	d	e	First offer un
a	0	9	3	6	11	- sletale
b	9	0	7	5	10	6= (0,0) 10
C	3	7	0	9	2	
d	6	5	9	0	8	-: 3
e	11	10	2	8	0	
						Chroter Har

Single Linkage:  $d(A,B) = \min (d(\alpha,y): x \in A, y \in B)$ 

Complete Linkage:
d(A,B) = max (d(n,y): nEA, yeB)

Average Linkage:- $d(A,B) = avg(d(x,y):x \in A, y \in B)$   $= \sum d(x,y):x \in A, y \in B$  |A||B|

Solution:

Step-1:- Construct a idendrogram by using the single linkage.

((d) 5) b ((d) 5) c min ( d(c) b) d (e) b)

ation -	-1:-				
	a	16	C	d	e
a	10	9	3	6	111
Ь	9	0	7	5	10
C	3	7	0	9	2
d	6	5	9	0	8
e	11	10	2	8	0

STEP-1:

Iter

Find the minimum distance in the above table.

d(c,e)=2

STEP-2:-

Cluster the data objects c and e.

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book of the diagonal

Sporter , ser Masso.

Single Linkage:

of (A) 13) = (ava

1					
204	a	× 6:	c,e	d	
a	0	9	?	6	
8 b	19	0	(2)	5	
c,e	?	?	0	?	100
(d	6	5	?	0	

STEP-3:- 200 ( ( ) ) SE

Find the distance for cluster &c, e 4 using single linkage.

$$d(\{c,e^3,\{a^3\}) = min(d(c,a),d(e,a))$$
  
=  $men(3,11) = 3$   
 $d(\{e,e^3,\{b^3\}) = min(d(c,b),d(e,b))$   
=  $min(7,10) = 7$ .

$$d(lc,e3,ld3) = min(d(c,d),d(e,d))$$
  
= min(9,8) = 8.

	a	6	c,e	d
a	0	9	*3	6
b	9	0	*7	5
c,e	*3	*+	0	*. 8
d	6	5	*8	0

Iteration - 2:

Find the mirrium distance in the above table. STEP-1:  $d(\mathcal{E}c, e^{\gamma}, a) = 3$ 

STEP -2:

Cluster the data objects c, e and a.

	a,c,e	Ь	d	
a,e,e	0	?	?	
6	?	0	5	
d	?	5	0	-

Bow & bo &

STEP-3:- (600000) Find the distance for eluster la, c, e y using single linkage.

d (la,c,e3,b) = min (d(a,b), d (lc,e3,63)  $= \min(9,7) = 7.$ 

d (la, e, ey, d) = min (d(a,d), d (lc, ey, d)) = min (6, 8)

	ace	Ь	d
ace	0	* 7	-6
Ь	*-	0	3
d	* 6	5	0

Iteration - 3 :-

STEP-1 :-

Find the minimum distance in the above table. d (b,d) = 5

STEP-2 :

We oreste cluster 3 combaining b and d data objects.

	ace	b, d
ace	0	?
b,d	?	0

StEP-3:

Fånd the distance for duster 25, d 3 ming single linkage.

d (26, d3, = min (d(b, (a, c, d), d(d, (a, c, d)) La, c, e3)

2 min (7,6) = 6.

+	ace	bd
ace	0	*6
bd	*(6	0,0

Iteration - 4:-Fond the minimum distance in the above StEP -1: d (a,b,c,d,e)=6. table. STEP-2:-We create cluster & combaining abode data objects. abede abede and the savetain mountains and has STEP-3: Final Dendrogram. casted the whole object a and 12e a a a a day

## COMPLETE LINKAGE abcde 3 6 (11) a d e

## Iteration - 1:

Find the maximum distance in the above 8tep-1: table

cluster the data object c ande. Step-2:

	a	6	c,e	d
a	0	9	?	6
Ь	q	0	?	5
c,e	?	?	0	?
d	6	5	?	0

Find the distance for cluster Sc, ez us

Complete linkage.

$$d(le,e3,b) = man(d(e,b),d(e,b))$$
  
= man(4,10) = 10.

$$d(\{c,e\},a) = \max(d(c,a),d(e,a))$$
= max (3,11) = 11

	a	Ь	c,e	ol
a	0	9	*11	6
Ь	9	0	*10	(5)
c,e	* 11	*10	0	*9
d	6	5	*9	6

Iteration - 2:-

Grep-1:-Find the minimum distance in the above table. d(b,d) = 5

STEP -2:-

Cluster the data object b, d.

	a	b,d	c,e
a	0	?	11
b,d	?	0	?
c,e	11	?	0

STEP - 3:-

Find the distance for cluster & b, d y using Complete linkage.

$$d(Sb,dy,a) = mlan(d(b,a),d(d,a))$$

$$= mlan(9,6) = 9$$

$$d(\ell b, dy, \ell c, ey) = man(d(b, c, e), d(d, e, e))$$
  
= man(to, q) = 10.

	a	bid	c,e
a	0	*9	11
bid	*9	0	* 10
c,e	11	*10	0

### Revation - 3:

STEP-1: find the minimum distance in the above table. d(a,db,d) = 9

Step-2:-Cluster the data object a,b,d.

	abd	ce
abd	0	3.
ce	?	0

STEP-3:-Fird the distance for cluster & abd 3 using complete linkage.

d({a,b,dy, {c,ey}} = max (da,c,e), d(b,d,c,e))
= max(.11,10) = 11

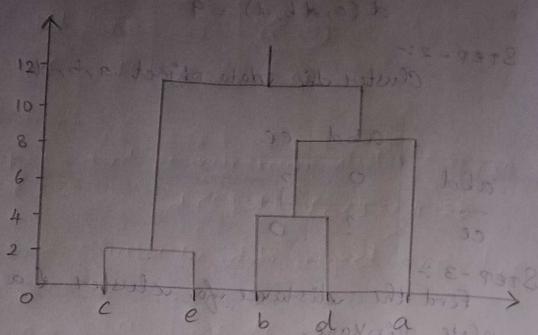
	abd	ce
abd	0	*(1)
ee	* !!	0

Iteration - 4:-

Step-1:- Find the minimum distance in the above stable.

d (a,b,c,d,e) = 11

Step-2:-Cluster the data object a, b, c, d, e.



# AVERAGE LINKAGE:-

	a	b	cı	d	e
a	0	9	3	6	u
6	9	0	7	5	10
C	3	7	0	9	2
d	6	5	9	0	18
e	u	10	2	8	0

Iteration - 1:

Step-1: Find the minimum distance in the above table. d(c,e) = 2

Step-2: Christier the data object. conde.

	a	Ь	c,e	d
a	0	9	?	6
Ь	.9	0	?	5
c,e	?	?	0	37
d	6	5	2	0

8tep-3: Ford the distance for cluster &c, e3 using average linkage.

$$d(\{c,e\},a) = \frac{d(c,a) + d(e,a)}{2 \times 1} = \frac{3+11}{2} = \frac{14}{2} = 7.$$

$$d(S(c, e^3, b)) = \frac{d(c, b) + d(e, b)}{2 \times 1} = \frac{7 + 10}{2} = \frac{17}{2} = 8.5$$

$$d(Sc, e^{g}, d) = \frac{d(c, d) + d(e, d)}{2 \times 1} = \frac{9+8}{2} = \frac{17}{2} = 8.5.$$

	a	Ь	c, e	d
a	0	9	*-1	6
b	9	0	*8.5	5
c, e	+7	* 8.5	0	*8.5
d	6	5	*8.5	0

Iteration - 2:

Step-1:- Find the minimum distance in the above table. d(b,d)=5

Step-2:- Cluster the data object b and d.

	a	b,d	c,e
a	0	?	#
b, d	?	0	?
c,e	7	sh? d	0,

8 tep -3: Find the distance for eluster & b, dy using average linkage.

$$d(\{b,d\},a) = d(b,a) + d(d,a) = 9+6 = 15 = 4.5$$
 $2 \times 1$ 

$$d(\{b,d\},\{c,e\}) = d(b,c) + d(b,e) + d(d,c) + d(d,e)$$

$$2 \times 2$$

$$= \frac{7 + 10 + 9 + 8}{4} = \frac{34}{4} = 8.5.$$

$$a \quad b,d \quad c,e$$

$$a \quad 0 \quad *4.5 \quad 4$$

$$b,d \quad *7.5 \quad 0 \quad *8.5$$

$$c,e \quad 7 \quad *8.5 \quad 0$$

Iteration -3:

Step-1:- Find the trinimum distance from the above table.

d[{c,ey,a}] = 7

Step-2:- Cluster the data object c, e, a.

	ace	bd
ace	0	?
bd	?	0

Step- 3: Find the distance for electer Sa, b, e, al, e 3 lesting average linkage. d ( care, e3, (6,d3) = d (a,b) + d (a,d) + d (e,b) +d(c,d)+d(e,b)+d(e,d)  $9+6+70+9+10+8 = \frac{49}{6} = 8-16$ o. \$8.16 Devation - 4: Step-1: Find the minimum distance from the above take. d (abcde) = 8-16 Step-2: aluston the data object a, b, c, d, e. abede abede 8.16 Step-3: Final dendrogram. of (((e3, e) = +