

	TYO	DEL	SHA	BJ	MUM	OSA	DHK	CCU	SEL
TYO	0	5847	1767	2099	6740	403	4894	5138	1156
DEL	5847	0	4243	3777	1163	5476	1425	1304	4686
SHA	1767	4243	0	1070	5039	1364	3161	3403	871
BJ	2099	3777	1070	0	4756	1777	3026	3266	956
MUM	6740	1163	5039	4756	0	6355	1895	1664	5608
OSA	403	5476	1364	1777	6355	0	4500	4744	821
DHK	4894	1425	3161	3026	1895	4500	0	244	3793
CCU	5138	1304	3403	3266	1664	4744	244	0	4038
SEL	1156	4686	871	956	5608	821	3793	4038	0

- ① Find shortest path. is 244
 ② merge CCU and DHK.

merge CCU and DHK

	TYO	DEL	SHA	BJ	MUM	OSA	DHK/CCU	SEL
TYO	0	5847	1767	2099	6740	403	4894	1156
DEL	5847	0	4243	3777	1163	5476	1304	4686
SHA	1767	4243	0	1070	5039	1364	3161	871
BJ	2099	3777	1070	0	4756	1777	3026	956
MUM	6740	1163	5039	4756	0	6355	1664	5608
OSA	403	5476	1364	1777	6355	0	4500	821
DHK/CCU	4894	1304	3161	3026	1664	4500	0	3793
SEL	1156	4686	871	956	5608	821	3793	0

Merge
 TYO and OSA

	TYO/OSA	DEL	SHA	BJ	MUM	DHK/CCU	SEL
TYO/OSA	0	5847	1767	2099	6740	4500	821
DEL	5847	0	4243	3777	1163	1304	4686
SHA	1767	4243	0	1070	5039	3161	871
BJ	2099	3777	1070	0	4756	3026	956
MUM	6740	1163	5039	4756	0	1664	5608
DHK/CCU	4500	1304	3161	3026	1664	0	3793
SEL	821	4686	871	956	5608	3793	0

merge TYO/OSA and SEL

	TYO/OSA/SEL	DEL	SHA	BJ	MUM	DHK/CCU
TYO/OSA/SEL	0	4086	871	956	5608	3793
DEL	4086	0	4243	3777	1163	1304
SHA	871	4243	0	1070	5039	3161
BJ	956	3777	1070	0	4756	3026
MUM	5608	1163	5039	4756	0	1664
DHK/CCU	3793	1304	3161	3026	1664	0

merge TYO/OSA/SEL
 and SHA

	TYO/OSA/SEL/SHA	DEL	BJ	MUM	DHK/CCU
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TYO/OSA/SEL/SHA	0	4086	956	5608	3161
DEL	4086	0	3777	1163	1304
BJ	956	3777	0	4756	3026
Mum	5608	1163	4756	0	1664
DHK/ccu	3161	1304	3026	1664	0

↓ merge TYO/OSA/SEL/SHA and BJ

	TYO/OSA/SEL/SHA/BJ	DEL	Mum	DHK/ccu
TYO/OSA/SEL/SHA/BJ	0	3777	4756	3026
DEL	3777	0	1163	1304
Mum	4756	1163	0	1664
DHK/ccu	3026	1304	1664	0

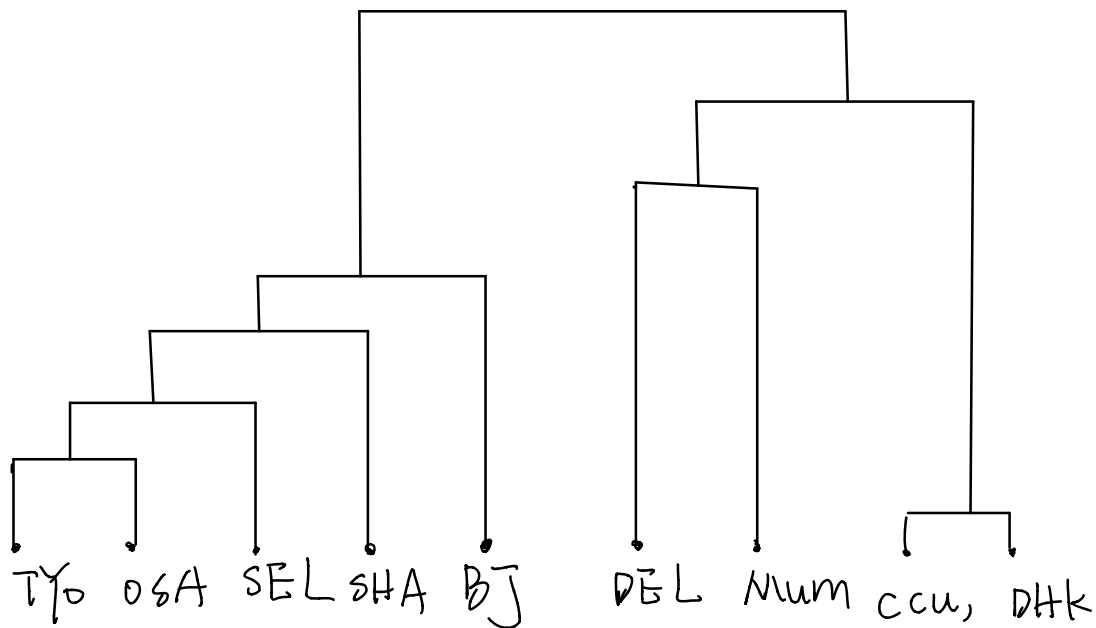
↓ merge DEL and Mum

	TYO/OSA/SEL/SHA/BJ	DEL/Mum	DHK/ccu
TYO/OSA/SEL/SHA/BJ	0	3777	3026
DEL/Mum	3777	0	1304
DHK/ccu	3026	1304	0

↓ merge DEL/mum and DHK/ccu

	Tyo/OSA/SEL/SHA/BJ	DEL/mum/DHK/ccu
Tyo/OSA/SEL/SHA/BJ	0	3026
DEL/mum/DHK/ccu	3026	0

Find dendrogram is



If you want k clusters, just cut the $(k-1)$ longest links.

(2) I want 3 clusters, so I need to cut the 2 longest link,

so that cluster 1: TYO, OSA, SEL, SHA, BJ

cluster 2: DEL/mum

cluster 3: CCU, DHK.

(b) $k=2$, $C_1 = (38.0, 127.0)$, $C_2 = (27.0, 117.0)$

① Find the closest point.

city	dis to C_1	dis to C_2	
TYO	12.9	24.3	
DEL	50.6	39	
SHA	8.7	6.1	
BJ	10.7	12.9	
Mum	57.3	44.8	
OSA	9.1	20	
DHK	39.2	26.7	
CCU	41.5	28.9	
SEL	2.5	14.5	

cluster 1

C_{C1}

TYO, BJ, OSA, SEL

cluster 2

C_{C2}

DEL, SHA, Mum, DHK, CCU

② New cluster center:

$$C_1 = \left(\frac{35.7 + 39.9 + 34.7 + 37.6}{4}, \frac{139.7 + 116.4 + 135.5 + 127}{4} \right)$$

$$= (36.8, 129.7)$$

$$C_2 = \left(\frac{28.7 + 31.2 + 19.1 + 23.8 + 22.6}{5}, \frac{77.2 + 121.5 + 72.9 + 90.4 + 88.4}{5} \right)$$

$$= (25.1, 90.1)$$

③

city	dis to C_1	dis to C_2	
TYO	10.1	50.7	
DEL	53.1	13.4	
SHA	9.9	32.0	
BJ	13.5	29.9	
MUM	59.5	18.2	
OSA	6.2	46.4	
DHK	41.4	1.3	
CCU	43.6	2.9	
SEL	2.8	38.9	

cluster 1
(C_1)

TYO, SHA, BJ, OSA, SEL.

cluster 2
(C_2)

DEL, MUM, DHK, CCU,