	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 Final 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	5476	1364	1777	6355	4500	821
DEL	5476	0	4243	3777	1163	1304	4686
SHA	1364	4243	0	1070	5039	3161	871
BJ	1777	3777	1070	0	4756	3026	956
MUM	6355	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

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

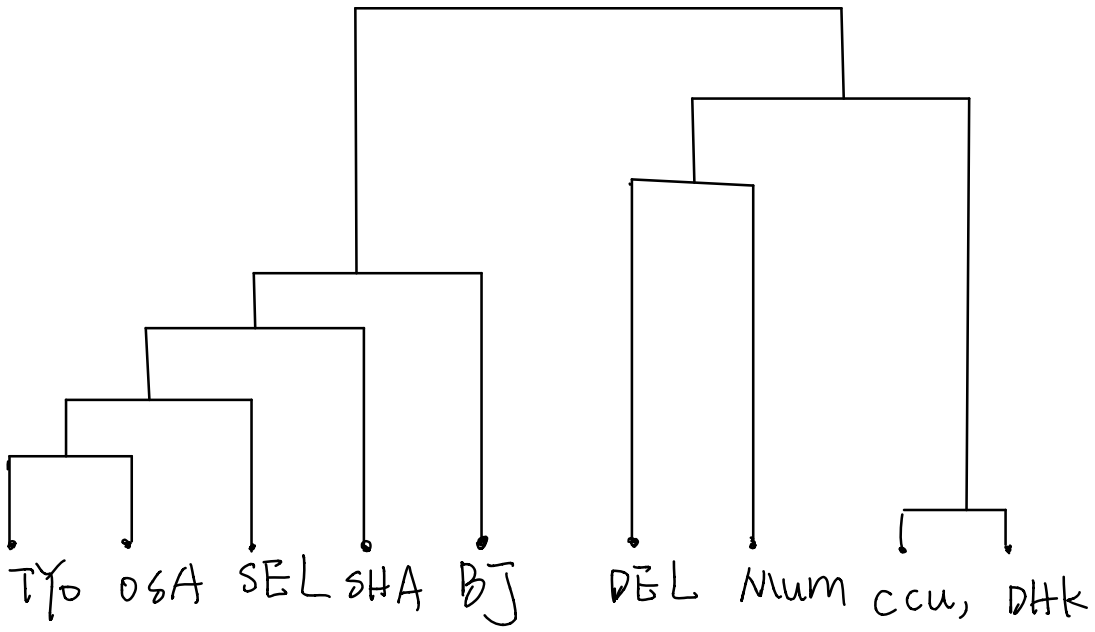
↓ merge DEL and Mum

	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/Num and DHK/ccu

	TYO/OSA/SEL/SHA/BJ	DEL/Num/DHK/ccu
TYO/OSA/SEL/SHA/BJ	0	3026
DEL/Num/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 2 need to cut the 2 longst 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	$\frac{2}{5}$	14.5	

cluster 1 (C_1): TYO, BJ, OSA, SEL

cluster 2 (C_2): DEL, SHA, mum, DHK, CCU

② New cluster center:

$$C_1 = \left(\frac{35.7+39.9+34.7+37.6}{4}, \frac{139.7+116.4+135.5+122.7}{4}\right)$$

$$= (36.8, 129.7)$$

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

$= (25.1, \quad 90.1)$

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,