EAS507 HW1
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(1)

(a) Boolean

	a	b	c	d	e	f	g	h
A	1	1	0	1	1	0	1	1
B	0	1	1	1	1	1	1	0
C	1	0	1	1	0	1	1	1

Jaccard distance

$AB = \frac{4}{8} = \frac{1}{2}$

$AC = \frac{4}{8} = \frac{1}{2}$

$BC = \frac{4}{8} = \frac{1}{2}$

Cosine similarity

$AB = \frac{4}{\sqrt{6}\sqrt{6}} = \frac{4}{6} = \frac{2}{3}$

$AC = \frac{4}{\sqrt{6}\sqrt{6}} = \frac{2}{3}$

$BC = \frac{4}{\sqrt{6}\sqrt{6}} = \frac{2}{3}$

distance

$1 - \frac{2}{3} = \frac{1}{3}$

$1 - \frac{2}{3} = \frac{1}{3}$

$1 - \frac{2}{3} = \frac{1}{3}$ ※

(B) Let 3, 4, 5 ⇒ 1

2, 1, blank ⇒ 0

	a	b	c	d	e	f	g	h
A	1	1	0	1	0	0	1	0
B	0	1	1	1	0	0	0	0
C	0	0	0	1	0	1	1	1

Jaccard distance

$AB = \frac{3}{5}$

$AC = \frac{4}{6} = \frac{2}{3}$

$BC = \frac{5}{6}$

Cosine similarity

$AB = \frac{2}{\sqrt{4}\sqrt{3}} = \frac{2}{2\sqrt{3}} = \frac{\sqrt{3}}{3}$

$AC = \frac{2}{\sqrt{4}\sqrt{4}} = \frac{2}{4} = \frac{1}{2}$

$BC = \frac{1}{\sqrt{3}\sqrt{4}} = \frac{1}{\sqrt{12}} = \frac{2\sqrt{3}}{12} = \frac{\sqrt{3}}{6}$

distance

$\frac{3-\sqrt{3}}{3}$

$\frac{1}{2}$

$\frac{6-\sqrt{3}}{6}$ ※

(c) Avg $A = \frac{4+5+5+1+3+2}{6} = \frac{20}{6} = \frac{10}{3}$

Avg $B = \frac{3+4+3+1+2+1}{6} = \frac{14}{6} = \frac{7}{3}$

Avg $C = \frac{2+1+3+4+5+3}{6} = \frac{18}{6} = 3$

1) (c) Normalized matrix

	a	b	c	d	e	f	g	h
A	$\frac{2}{3}$	$\frac{5}{3}$		$\frac{5}{3}$	$-\frac{7}{3}$		$-\frac{1}{3}$	$-\frac{4}{3}$
B		$\frac{2}{3}$	$\frac{5}{3}$	$\frac{2}{3}$	$-\frac{4}{3}$	$-\frac{1}{3}$	$-\frac{4}{3}$	
C	-1		-2	0		1	2	0

Avg $A = \frac{10}{3} = 3\frac{1}{3}$

$B = \frac{7}{3} = 2\frac{1}{3}$

$C = 3$

Cosine similarity

$$AB = \frac{\frac{5}{3}\times\frac{2}{3} + \frac{2}{3}\times\frac{5}{3} + (-\frac{4}{3})(-\frac{7}{3}) + \frac{4}{9}}{\sqrt{\frac{4}{9}+\frac{25}{9}+\frac{25}{9}+\frac{49}{9}+\frac{1}{9}+\frac{16}{9}}\ \sqrt{\frac{4}{9}+\frac{25}{9}+\frac{4}{9}+\frac{16}{9}+\frac{1}{9}+\frac{16}{9}}}$$

$$= \frac{1}{9}\ \frac{10+10+28+4}{\sqrt{\frac{120}{9}}\ \sqrt{\frac{66}{9}}}$$

$$= \frac{52}{2\sqrt{30\times 66}} = \frac{52}{12\sqrt{55}} = \frac{13}{3\sqrt{55}} = 0.584 \text{ ※}$$

$$AC = \frac{-\frac{2}{3} + -\frac{2}{3}}{\sqrt{\frac{120}{9}} + \sqrt{1+4+1+4}} = \frac{-\frac{4}{3}}{\frac{1}{3}\sqrt{1200}} = \frac{-4}{20\sqrt{3}} = \frac{-\sqrt{3}}{15} = -0.1$$

$$BC = \frac{-\frac{10}{3} - \frac{1}{3} - \frac{8}{3}}{\sqrt{\frac{66}{9}}\ \sqrt{10}} = \frac{-19}{2\sqrt{165}} = -0.7395$$

distance:

$AB = 1 - 0.584 = 0.416$

$AC = 1 - (-0.12) = 1.12$

$BC = 1 - (-0.7395) = 1.7395$ ※