9.2.1

(A)

Feature	A	B	C
Processor Speed	3.06	2.68	2.92
Disk Size	500	320	640
Main-Memory Size	6	4	6

$[3.06 + 500\alpha + 6\beta]$ $[2.68 + 320\alpha + 4\beta]$ $[2.92 + 640\alpha + 6\beta]$

$$\cos\theta(A,B) = \frac{(3.06)(2.68) + (500\alpha)(320\alpha) + (6\beta)(4\beta)}{\sqrt{(3.06)^2 + (500\alpha)^2 + (6\beta)^2}\sqrt{(2.68)^2 + (320\alpha)^2 + (4\beta)^2}}$$

$$= \frac{8.2008 + 160{,}000\alpha^2 + 24\beta^2}{\sqrt{9.3636 + 250000\alpha^2 + 36\beta^2}\sqrt{7.1824 + 102400\alpha^2 + 16\beta^2}} \quad (1)$$

$$\cos\theta(B,C) = \frac{(2.68)(2.92) + (320\alpha)(640\alpha) + (4\beta)(6\beta)}{\sqrt{(2.68)^2 + (320\alpha)^2 + (4\beta)^2}\sqrt{(2.92)^2 + (640\alpha)^2 + (6\beta)^2}}$$

$$= \frac{7.8256 + 204{,}800\alpha^2 + 24\beta^2}{\sqrt{7.1824 + 102400\alpha^2 + 16\beta^2}\sqrt{8.5264 + 409{,}600\alpha^2 + 36\beta^2}} \quad (2)$$

$$\cos\theta(A,C) = \frac{(306)(2.92) + (500\alpha)(640\alpha) + (6\beta)(6\beta)}{\sqrt{7.3636 + 250000\alpha^2 + 36\beta^2}\ \sqrt{8.5264 + 409{,}600\alpha^2 + 36\beta^2}} \quad -(3)$$

(b) $\alpha = \beta = 1$

$$\cos\theta(A,C) = \frac{(306)(292) + (500)(640) + 36}{\sqrt{93636 + 25{,}000 + 36}\ \sqrt{8.5264 + 409{,}600 + 36}}$$

$$= \frac{893524 + 320000 + 36}{\sqrt{25{,}045.3636}\ \sqrt{409{,}644.5264}}$$

$$= \frac{(320044.9352)}{(158.257)\ (640.034)} = 3.1596$$

$$\cos(A,C) = \frac{320044.9352}{(500.045)\ (640.034)}$$

$$\theta_{AC} = \cos^{-1}(0.1748)$$

$$\text{Cosine}(B,C) = \frac{7.8256 + 204800 + 24}{\sqrt{7.1824 + 102400 + 16}\ \sqrt{8.5264 + 409600 + 36}}$$

$$\theta_{B,C} = \cos^{-1}\left(\frac{7.8256 + 204800 + 24}{\sqrt{7.1824 + 102400 + 16}\ \sqrt{8.5264 + 409,600 + 36}}\right)$$

$$= 0.2824$$

$$\text{Cosine}(\theta_{AB}) = \frac{8.2008 + 160,000 + 24}{\sqrt{9.3636 + 250000 + 36}\ \sqrt{7.1824 + 102400 + 16}}$$

$$\theta_{AB} = \cos^{-1}\left(\frac{8.2008 + 160,000 + 24}{\sqrt{9.3636 + 250000 + 36}\ \sqrt{7.1824 + 102400 + 16}}\right)$$

$$= 0.1323$$

(c) From Eq (1), (2), (3) Substitute $\alpha = 0.01$ $\beta = 0.5$

$$\text{Cosine}(A,B) = \frac{8.2008 + (160,000)(0.01)^2 + (24)(0.5)^2}{\sqrt{9.3636 + (250000)(0.01)^2 + 36(0.5)^2}\ \sqrt{8.5264 + (409600)(0.01)^2 + 36(0.5)^2}}$$

$$\theta_{AB} = 7.7433$$

$$\text{Cosine}(B,C) = \frac{7.8256 + 2041800(0.01)^2 + 24(05)^2}{\sqrt{7.1824 + 62400(0.01)^2 + 16(05)^2}\ \sqrt{8.5264 + 409600(0.01)^2 + 131(05)^2}}$$

$$\theta_{BC} = 14.262328$$

$$\text{Cosine}(A,C) = \frac{(3.06)(292) + (500)(640)(0.01)(001) + 36(05)^2}{\sqrt{9.3636 + 250000(001)^2 + 36(05)^2}\ \sqrt{8.5264 + 409600(001)^2 + 131(05)^2}}$$

$$\theta_{AC} = 7.4516238$$

(iii) Avg Disk Size $= \frac{500 + 320 + 640}{3} = \frac{1460}{3} = 486.66$

Scale factor for disk size $= \frac{1}{486.66}$ (or) $\frac{3}{1460}$ $= 0.002$

$=$

Avg memory size $= \frac{6.144 + 16}{3} =$

Scale factor for memory size $= \frac{3}{11}$ or $\frac{1}{5.33} = 0.875$

$$\cos\theta_{AB} = \frac{8.2008 + 160{,}000(0.002)^2 + 24(0.1875)^2}{\sqrt{9.3636 + 250000(0.002)^2 + 36(0.1875)^2}\sqrt{71824 + 102400(0.002)^2 + 16(0.1875)^2}}$$

$$\theta_{AB} = 6.01123$$

$$\cos\theta_{BC} = \frac{7.8256 + 204800(0.002)^2 + 24(0.1875)^2}{\sqrt{9.3636 + 250000(0.002)^2 + 36(0.1875)^2}\sqrt{85264 + 409600(0.002)^2 + 36(0.1875)^2}}$$

$$\theta_{BC} = 10.638672$$

$$\cos\theta_{AC} = \frac{(306)(292) + (500)(640)(0.02)^2 + 36(0.1875)^2}{\sqrt{9.3636 + 250000(0.002)^2 + 36(0.1875)^2}\sqrt{8.5264 + 409600(0.002)^2 + 36(0.1875)^2}}$$

$$\theta_{AC} = 5.26111$$

Problem 9.2.3

(a)

A = 4

B = 2

C = 5

Avg. Ratings = $\frac{4+2+5}{3} = \frac{11}{3} = 3.66$

~~A = 4~~

Normalize A

A = 4 - 3.66 = 0.33

B = 2 - 3.66 = -1.66

C = 5 - 3.66 = +1.33

(b) Processor speed

$(3.06)(0.33) + (2.68)(-1.66) + (2.92)(1.33)$

$1.0098 + (-4.4488) + 3.8836$

$= 0.445$

Disk Size

$500(0.33) + (320)(-1.66) + (640)(1.33)$

$165 + (-531.2) + (851.2)$

$= 485$

Main memory

$(6)(033) + (4)(41.61) + (6)(133)$

$1.98 - 6.64 + 7.98$

$= 3.32$ //

93.1

(a)

	a	b	c	d	e	f	g	h
A	4	5		5	1		3	2
B		3	4	3	1	2	1	
C	2		1	3		4	5	3

Jaccard (A, B) = 4/8 = 1/2 = 0.5

Jaccard (B, C) = 4/8 = 1/2 = 0.5

Jallard (A, C) = 4/8 = 1/2 = 0.5

(b)

Cosine distance (A,B) = $1 - \frac{4}{\sqrt{6}\sqrt{6}} = \frac{6-4}{6} = \frac{2}{6} = \frac{1}{3}$

Cosine distance (B,C) = $1 - \frac{4}{\sqrt{6}\sqrt{6}} = \frac{6-4}{6} = \frac{2}{6} = \frac{1}{3}$

Cosine distance (A,C) = $1 - \frac{4}{\sqrt{6}\sqrt{6}} = \frac{6-4}{6} = \frac{2}{6} = \frac{1}{3}$

(c)

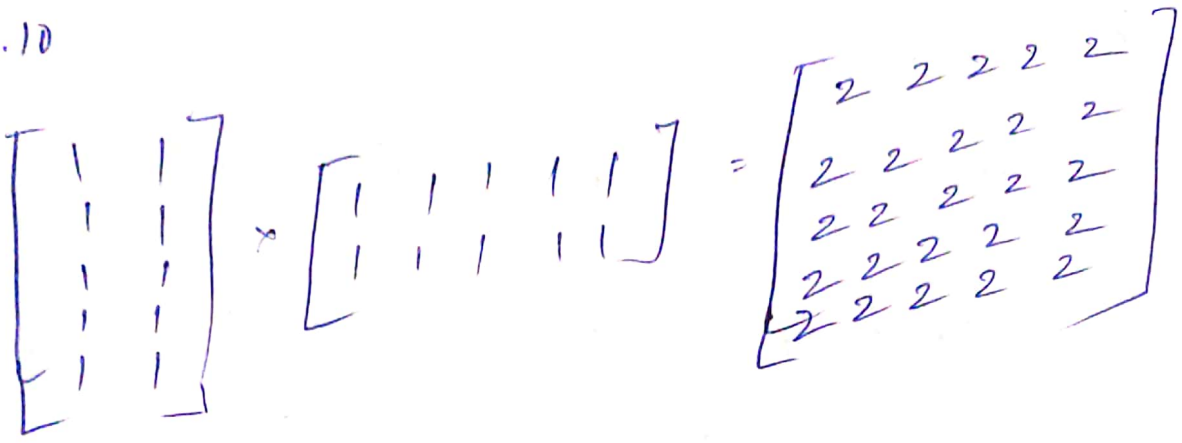
	a	b	c	d	e	f	g	h
A	1	1	0	1	0	0	1	0
B	0	1	1	1	0	0	0	0
C	0	0	0	1	0	1	1	1

Jaccard (A,B) = $1 - \frac{2}{5}$

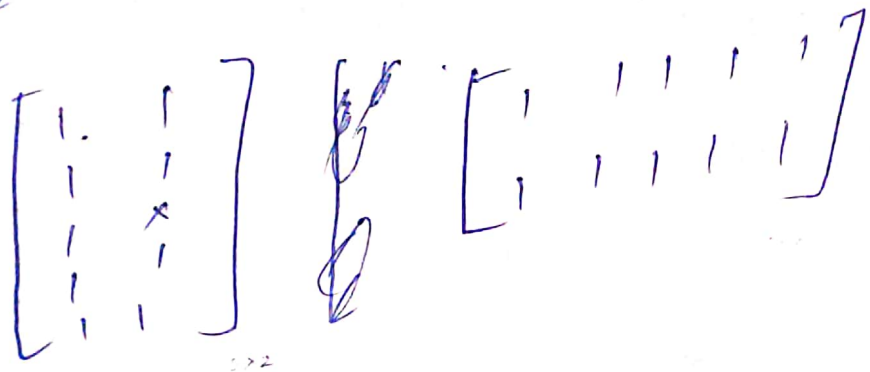
Jaccar (B,C) 2 5

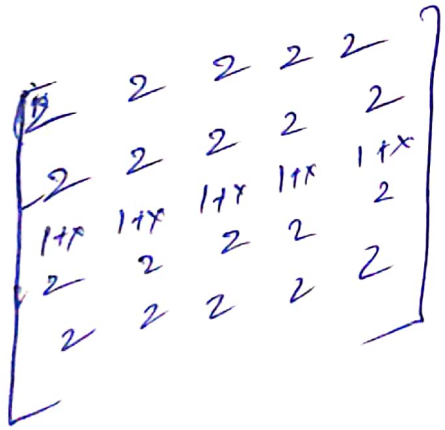
9.4.1

→ fig 9.10



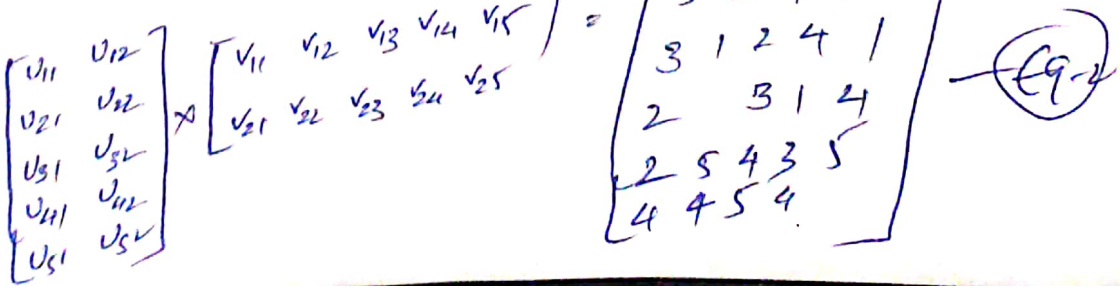
$v_{22} = x$





→ Eq-1

from fig 9.9



→ Eq-2

Sum of Square

$$f(x) = (2-(x+1))^2 + (3-(x+1))^2 + (1-(x+1))^2 + (4-(x-3))^2$$

to minimize $f(x)$ we make $\frac{d(f(x))}{dx} = 0$

$$-2(x+1) - 2(x+2) - 2(x) - 2(x-3) = 0$$

Solving for $x = 3/2$

Substituting x

$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1.5 \\ 1 & 1 \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 2 & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 & 2 \\ 2.5 & 2.5 & 2.5 & 2.5 & 2.5 \\ 2 & 2 & 2 & 2 & 2 \\ 2 & 2 & 2 & 2 & 2 \end{bmatrix}$$

(b)

$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 & y & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 2 & 2 & y+1 & 2 \\ 2 & 2 & 2 & y+1 & 2 \\ 2 & 2 & 2 & y+1 & 2 \\ 2 & 2 & 2 & y+1 & 2 \\ 2 & 2 & 2 & y+1 & 2 \end{bmatrix}$$

Note: Applying transformation for V_{14} instead of V_{41}

$$f(y) = (4-(y+1))^2 + (4-(y+1))^2 + (1-(y+1))^2 + (3-(y+1))^2 + (4-(y+1))^2$$

To minimize the $f(y)$ we make $\frac{d(f(y))}{dy} = 0$

$$\frac{d(f(y))}{dy} = -2(y-3) - 2(y-3) - 2y - 2(y-2) - 2(y-3)$$

$$-2y+6 \quad -2y+6 \quad -2y \quad -2y+4 \quad -2y+6$$

$$-10y + 22 = 0$$

$$10y = 22$$

$$y = 11/5$$

$$\begin{bmatrix} 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \\ 1 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 1 & 1 & 2\cdot 2 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 2 & 2 & 2 & 3\cdot 2 & 2 \\ 2 & 2 & 2 & 3\cdot 2 & 2 \\ 2 & 2 & 2 & 3\cdot 2 & 2 \\ 2 & 2 & 2 & 3\cdot 2 & 2 \\ 2 & 2 & 2 & 3\cdot 2 & 2 \end{bmatrix}$$