Unit : 4 : Mission Vision.

Date __/__/____

* performance Index : Nov - dec

Determine performance index
trasiation (3,1) :

Q.3) a)

⇒ Template.

6	2	7
7	2	7
1	5	6

Image.

x \ y	0	1	2	3	4
0	7	3	7	3	8
1	7	4	3	4	4
2	5	2	9	3	5
3	4	7	1	7	6
4	8	8	1	7	6
5	5	1	6	6	6

∴ Template :

6	2	7
7	2	7
1	5	6

Image (3,1).

7	1	7
8	1	7
1	6	6

performance matrix.

$p(x,y) =$

1	1	0
1	1	0
0	1	0

performance Index
$p(3,1) = \underline{\underline{5}}$

Date ___/___/___

* cross-corelation

May-Jun:

(Q.3) a) correlation factor = ?
translation (1,1).

Template.

8	1	8
1	1	2
4	8	3

Img. (y across, x down)

	0	1	2	3	4
0	2	2	6	5	1
1	4	5	9	9	4
2	7	8	1	9	3
3	9	1	1	3	8
4	5	4	9	6	9
5	1	6	4	8	5

⇒ Template.

8	1	8
1	1	2
4	8	3

Avg Intensity (T).

64	1	64
1	1	4
16	64	9

= 224

= 14.966

Img.

5	9	9
8	1	9
1	1	3

Avg intensity img.

25	81	81
64	1	81
1	1	9

= 344

= 18.547

$$11711 \cdot 11311 = 14.966 \times 18.5472$$

$$= \underline{277.5779}.$$

- product of Img & Template

		40.		
[illegible]	[illegible]	36	9	72
[illegible]	[illegible]	8	1	18
[illegible]	[illegible]	4	8	9

$= \underline{169}.$

for normalization $= \dfrac{169}{277.5779}$.

$$\boxed{\sigma = \cancel{0.5908}\ 0.6088}.$$

matching about : ~~59.08%~~ 60.88%.

Date __/__/__

Img.

⇒. Template :

9	2	8	5		2	7	5	3
3	6	7	3	-	2	6	7	1
0	9	9	8		4	4	3	6
7	9	1	5		2	9	2	5

performace matrix =

7	5	3	2
1	1	0	2
4	5	6	2
5	0	1	0

performance index = 44

——x——

Q.19)

use prewitt operator.

4	6	5
3	7	8
2	9	1

$$Avg. I = \frac{45}{7} = 6.4285$$

* Determine gradient intensity *

Using prewitt operator

$$mx = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}, \quad my = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

$$m1 = \begin{bmatrix} -4 & 0 & 5 \\ -3 & 0 & 2 \\ -2 & 0 & 1 \end{bmatrix}, \quad m2 = \begin{bmatrix} -4 & -6 & -5 \\ 0 & 0 & 0 \\ 2 & 3 & 1 \end{bmatrix}$$

$$\nabla = \sqrt{(f(x))^2 + (f(y))^2}$$

$$\therefore f(x) = \frac{|5-(-4)| + |2-(-3)| + |1-(-2)|}{3}$$

$$f(x) = \frac{1+5+1}{3} = \frac{7}{3} = 2.33$$

$$f(y) = \frac{|2-(-4)| + |9-(-6)| + |1-(-5)|}{3}$$

$$= \frac{2+3+4}{3} = \frac{9}{3} = 3$$

$$\therefore \nabla = \sqrt{(2.33)^2 + (3)^2}$$

$$\boxed{\nabla = 3.7985}$$

gradient of intensity of light

May-Jun:

Q.4) a)

Img

$$\begin{matrix} 5 & 8 & 4 \\ 6 & 2 & 3 \\ 4 & 6 & 1 \end{matrix}$$

$\Rightarrow$ Avg I $= \frac{39}{2}$

$= \underline{19.5}$

$$m_x = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \qquad m_y = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

$$m_1 = \begin{bmatrix} -5 & 0 & 4 \\ -6 & 0 & 3 \\ -4 & 0 & 1 \end{bmatrix} \qquad m_2 = \begin{bmatrix} -5 & -8 & -4 \\ 0 & 0 & 0 \\ 4 & 6 & 1 \end{bmatrix}$$

$$\nabla = \sqrt{(f(x))^2 + (f(y))^2}$$

$$f(x) = \frac{|4-(-5)| + |3-(-6)| + |1-(-4)|}{3}$$

$$f(x) = \frac{1+3+3}{3} = 7/3 = \underline{2.33}$$

$$f(y) = \frac{|4-(-5)| + |6-(-8)| + |1-(-4)|}{3}$$

$$= \frac{1+2+3}{3} = \frac{6}{3} = \underline{\underline{2}}$$

$$\therefore \nabla f = \sqrt{(2.33)^2 + (2)^2} = 3.0765$$

$= \sqrt{}$

Nov-dec! Q.4) a).

2	6	8
4	3	2
1	7	6

$Avg.x = \frac{39}{3}$

$\boxed{Avg.x = 13}$

$mx = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$ $my = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$

$m_1 = \begin{bmatrix} -2 & 0 & 8 \\ -4 & 0 & 2 \\ -1 & 0 & 6 \end{bmatrix}$ $m_2 = \begin{bmatrix} -2 & -6 & -8 \\ 0 & 0 & 0 \\ 1 & 7 & 6 \end{bmatrix}$

$\nabla = \sqrt{(f(x))^2 + (f(y))^2}$

$f(x) = \frac{|8-(-2)| + |2-(-4)| + |6-(-1)|}{3}$

$= \frac{6+2+5}{3} = 4.33$

$f(y) = \frac{|7-(-2)| + |7-(-6)| + |6-(-8)|}{3}$

$= \frac{1+1+2}{3} = \frac{4}{3} = 1.33$

$\nabla f = \sqrt{(4.33)^2 + (1.33)^2}$

$\boxed{\nabla f = 4.5296}$

Date __/__/__

Nov-dec! Q.4) a)

$$\begin{matrix} 2 & 6 & 8 \\ 4 & 3 & 2 \\ 1 & 7 & 6 \end{matrix}$$

$$Avg\text{-}I = \frac{39}{3}$$

$$\boxed{Avg\ I = 13}$$

$$mx = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix} \quad my = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$$

$$m_1 = \begin{bmatrix} -2 & 0 & 8 \\ -4 & 0 & 2 \\ -1 & 0 & 6 \end{bmatrix} \quad m_2 = \begin{bmatrix} -2 & -6 & -8 \\ 0 & 0 & 0 \\ 1 & 7 & 6 \end{bmatrix}$$

$$\nabla = \sqrt{(f(x))^2 + (f(y))^2}$$

$$f(x) = \frac{|8-(-2)| + |2-(-4)| + |6-(-1)|}{3}$$

$$= \frac{6+2+5}{3} = \underline{\underline{4.33}}$$

$$f(y) = \frac{|1-(-2)| + |7-(-6)| + |6-(-8)|}{3}$$

$$= \frac{1+1+2}{3} = \frac{4}{3} = \underline{1.33}$$

$$\nabla f = \sqrt{(4.33)^2 + (1.33)^2}$$

$$\boxed{\nabla f = 4.5296}$$

Page No. ____

Date ___/___/___

* example: sobel operator

$$\begin{bmatrix} 2 & 6 & 8 \\ 4 & \boxed{3} & 2 \\ 1 & 7 & 6 \end{bmatrix}$$

$$Avg: I = \frac{39}{3} = 13$$

$\Rightarrow$ $m_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$, $m_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$

$m_1 = \begin{bmatrix} -2 & 0 & 8 \\ -8 & 0 & 4 \\ -1 & 0 & 6 \end{bmatrix}$; $m_2 = \begin{bmatrix} -2 & -12 & -8 \\ 0 & 0 & 0 \\ 1 & 14 & 6 \end{bmatrix}$

$$\nabla F = \sqrt{(f(x))^2 + (f(y))^2}$$

$$f(x) = \frac{|8-(-2)| + |4-(-8)| + |6-(-1)|}{3}$$

$$= \frac{6+4+5}{3} = \underline{5}$$

$$f(y) = \frac{|1-(-2)| + |14-(-12)| + |8-(-8)|}{3}$$

$$= \frac{1+2+2}{3} = \frac{5}{3} = \underline{1.666}$$

$$\nabla F = \sqrt{(5)^2 + (1.66)^2}$$

$$= \underline{5.2683}$$

$\nabla F < Avg\, I.$

* If ∇F is Less than Avg I. then not on edge.

* If ΔF is greater than Avg. I, then it is on edge.

$\nabla F > Avg\, I.$

* centroids :-

moment = Intensity of light × distance from origin.

~~mom~~

$$M_{kj} = \sum M_x^k \cdot M_y^j$$

Area, $A = m_{00}$

$$x_c = \frac{m_{10}}{m_{00}}$$

$$y_c = \frac{m_{01}}{m_{00}}$$

μ_{02} = moment of inerria corresponding x-axis.

μ_{20} = moment of ineertia to y-axis.

Date ___/___/___

May- Jun: Q.3) (b):

determine centroids.

$$
\begin{array}{c|ccc}
(0,0) & 1 & 2 & 3 \\
\hline
1 & 2 & 0 & 3 \\
2 & 1 & 1 & 4 \\
3 & 2 & 1 & 3
\end{array}
\qquad y \rightarrow,\quad x \downarrow
$$

$\Rightarrow$ $M_x = \begin{bmatrix} 2 & 0 & 3 \\ 2 & 2 & 8 \\ 6 & 3 & 9 \end{bmatrix}$, $M_y = \begin{bmatrix} 2 & 0 & 9 \\ 1 & 2 & 12 \\ 2 & 2 & 9 \end{bmatrix}$

$M_x = 35$, $M_y = 39$

$M_{kj} = M_x^{k} \cdot M_y^{j}$

$M_{00} = M_x^{0} \cdot M_y^{0}$

$M_{00} = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} = 8.$

$M_{10} = M_x^{1} \cdot M_y^{0}$

$= \begin{bmatrix} 2 & 0 & 3 \\ 2 & 2 & 8 \\ 6 & 3 & 9 \end{bmatrix} = 35$

Page No.

$$M_{01} = \begin{bmatrix} 2 & 0 & 9 \\ 1 & 2 & 12 \\ 2 & 2 & 9 \end{bmatrix} = 39.$$

$\therefore$ $M_{00} = 8.$

$M_{10} = 35$

$M_{01} = 39.$

$$\left.\begin{aligned} x_c &= \frac{M_{10}}{M_{00}} = \frac{35}{8} = \underline{4.375}. \\ y_c &= \frac{M_{01}}{M_{00}} = \frac{39}{8} = \underline{4.875} \end{aligned}\right\} \text{ans.}$$

—x—

Central moments.

$M_x - x_c = M_{xc}.$

$$M_{xc} = \begin{bmatrix} -2.375 & 0 & -1.375 \\ -2.375 & -2.375 & 3.625 \\ 1.625 & -1.375 & 4.625 \end{bmatrix}$$

$M_{yc} = M_y - y_c.$

$$M_{yc} = \begin{bmatrix} -2.875 & 0 & 4.125 \\ -3.875 & -2.875 & 7.125 \\ -2.875 & -2.875 & 4.125 \end{bmatrix}.$$

$$\mu_{kj} = \Sigma\ M_{xc}^{k} \cdot M_{yc}^{j}$$

* Region Growing *

Date ___/___/___

Q.13). for the img. make two segment using region growing method.

3	4	0	0	2	4	4	2
3	1	0	2	1	3	4	1
2	0	4	4	1	2	1	5
4	3	2	0	3	2	4	8
2	4	3	2	1	1	1	6
7	6	8	8	8	8	0	5
6	8	6	7	7	6	4	5
8	7	6	7	6	8	2	8

⇒ ① finding seedpoint and threshold.

seed point := 8

∵ max. point in img.

$$\text{thresshold point} = \frac{max - min}{2}$$

$$= \frac{8-0}{2} = \underline{\underline{4}}.$$

Date

(2). Diff. matrix = seed point - each intensity.

5	4	8	8	5	4	4	6
5	7	8	6	7	5	4	7
6	8	49	4	7	6	7	3
4	5	6	8	5	6	4	0
6	4	5	6	7	7	7	2
1	2	0	0	0	0	8	3
2	0	2	1	1	2	4	3
0	1	2	1	2	0	6	0

8

(3) make two segment of img.

Diff ≥ threshold value = Segment A.

Diff < threshold value = segment B.

for seg 'A' = 4, 5, 6, 7, 8.

B = 0, 1, 2, 3.

A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	B
A	A	A	A	A	A	A	B
A	A	A	A	A	A	A	B
B	B	B	B	B	B	A	B
B	B	B	B	B	B	A	B
B	B	B	B	B	B	A	B

← segment A

← seg. B.

* Run length encoding *.

Saathi

Date __/__/__

- used for the img. or data compression.

- Img compression is done by reducing bit value

- Includes calculation of 0's and 1's

- following terminologies used in Run length encoding.

1) length : no. of 0's and 1's occurs in matrix.

2) Run : counting of subsequent bit until the bit changes.

3) string length = decoded value of binary string is known for string value length

OR. minimum no. of bits required to represent no. of length.

Q.20) · for a certain binary img, following data operates. Determine the compression Ratio using Run length encoding.

1	1	1	1	1	1
1	1	1	1	0	0
0	0	0	0	0	0
0	0	0	0	0	0
1	1	1	1	1	0

⇒ (Before compression).

Run	Bit	length	String length	
1	1	10	4	$2^0+2^1+2^2+2^3=15$
2	0	14	4	$2^0+2^1+2^2+2^3=15$
3	1	5	3	$2^0+2^1+2^2=7$
4	0	1	1	$2^0=1$

$= \underline{30}$

$2^0+2^1+2^2+2^3$

Now applying run length encoding to compress.

Run	length	Bit	total
1	1010	1	5
2	1110	0	5
3	0101	1	5
4	0001	0	5
			20

Total length = length + Bit

Compression Ratio $= \frac{\Sigma \text{length} - \Sigma \text{Total}}{\Sigma \text{length}}$

$= \frac{30-20}{30} = \frac{10}{30}$

Compression $= 0.333$

and compression Ratio $= \frac{20}{30}$

$\boxed{1 : 0.666}$

Compression Ratio $= \frac{\Sigma \text{total}}{\Sigma \text{length}}$

Date / /

Q. 4) b) Nov - dec

Run	Bitvalue	Length
1	1	12
2	0	18
3	1	7
4	0	17
5	1	10
		64.

⇒

Run	length	Bit	total.
1	01100	1	6
2	10010	0	6
3	00111	1	6
4	10001	0	6
5	01010	1	6
			30.

∴ Compression Ratio = $\frac{(64-30)}{64}$

$= 0.5312.$

$= 53.12\%.$

Compression Ratio = 1 : 2.13

$\frac{64}{30} = 2.13$

Mission Endsem:

AIR.

17/05/2024.

* simulated annealing:

Q.5) function value: = 35
updated new temp = 50
at temp = 100°c

To find: probability of accepting new solution

⇒. $\therefore \boxed{e^{\frac{-\Delta C}{T}}}$.

$\therefore \Delta C = 50 - 35$
$= 15$

$\therefore \frac{-15}{100} = -0.15$

$\therefore e^{\frac{-15}{100}}$

$= 0.86070. = 86.07\%$

Q.6). SA:

$x = 20$.
Xmax, UB = 50,
Xmin, LB = 10.
SM = 5 (Randomly generated)
Ri =, ε = 1.87.

updated value:!

Date ___/___/___

$\Rightarrow$ updated value of x

$$= x_i' = x + \sigma . \times \left(\Sigma R_i - \frac{N}{2} \right).$$

$$\therefore 6\sigma = X_{max} - X_{min}$$

$$= 50 - 10$$

$$6\sigma = 40$$

$$\sigma = \frac{40}{6} = \underline{\underline{6.66}}.$$

$$x' = x + \sigma \times \left(\Sigma R_i - \frac{N}{2} \right)$$

$$= 20 + 6.66 \times \left[8 \div 1.87 - \frac{5}{2} \right].$$

$$= 20 + 6.66 \times \left[1.87 - 2.5 \right].$$

$$= \underline{\underline{15.8042}}.$$

Date ___/___/___

May - Jun:

Q.1) b) SAG:

function value : 20.

updated New value : 30.

temp = 55°C

prob. of accepting New solu^n = ?

$\Longrightarrow$

$$= e^{\frac{-\Delta C}{T}}$$

$$\Delta C = 30 - 20$$

$$= 10$$

$$\therefore e^{\frac{-10}{55}} = e^{-0.1818}$$

$$= 0.83376 = 83.37\%$$

Nov - dec:

Q.1) b)

$x = 20$. $N = 5$

x_{min}, LB = 10, $\Sigma R_i = 1.87$.

x_{max} UB = 50.

$$= x' = x + \sigma \times \left(\Sigma R_i - \frac{N}{2}\right).$$

$$\therefore 6\sigma = X_{max} - X_{min}$$

$$= 50 - 10$$

$$6\sigma = 40$$

$$\sigma = \frac{40}{6} = 6.666.$$

$$x' = x + \sigma \times \left(\Sigma R_i - \frac{N}{2}\right).$$

$= 20 + 6.66 \times \left(51.87 - \frac{5}{2} \right)$

$= \underline{\underline{15.8042}}$.

SA. Two type of problems :-

① - for finding probablity of new soluⁿ :-

$\Rightarrow$ i) $e^{-\frac{\Delta C}{T}}$

$\therefore \Delta C =$ New temp $-$ funⁿ value.

② for finding updated value!

$\Rightarrow$ i) $x' = x + \sigma \times \left(\Sigma Ri - \frac{N}{2} \right)$.

ii) $6\sigma = X_{max} - X_{min}$.

Date ___/___/___

* Learnico:

① fun^n value: 120
new value: 142
temp: 200°C

$$\Delta C = 142 - 120$$
$$= 22.$$

$$\therefore e^{-\frac{\Delta C}{T}} = e^{-\frac{22}{200}} = e^{-0.11}$$

$$= 0.8958$$

$$= 89.58\ \%$$

② A fun^n $2x_1^2 \cdot x_2 - 3x_2$ is to be minimized using SA. If $5 \leq x_1 \leq 8$ and $3 \leq x_2 \leq 10$
The value of initial temp. could be.

⇒

-1	-1
1	-1
-1	1
1	1

8 +0

x_1	x_2	z
5	3	141
8	3	375
5	10	~~3~~470
8	10	1250.

put ~~4~~ these 4 combination in fun^n

$$2x_1^2 \cdot x_2 - 3x_2 =$$
$$2\,5^2 \cdot 3 - 3 \cdot 3 = 141$$

Date ___/___/___

$\therefore$ intinal temp $= \dfrac{141 + 375 + 470 + 1280}{4}$

$$= \frac{2236}{4} = \underline{\underline{559}}.$$

— x —

(2)

$$z = 3x_1 - x_2^2.$$

$$1 \leq x_1, x_2 < 3.$$

			x_1	x_1		z
-1	-1		1	1	=	2
1	-1		3	1	=	8
-1	1		1	3	=	-6
1	1		3	3	=	0

$$\therefore \frac{2 + 8 + (-6) + 0}{4} = \frac{4}{4} = \underline{1}.$$

<u>Initial Temp is 1</u>

— x —

Q.1)

Date ___/___/______

* ACO - may-Jun & Nov-dec

A = starting station.

what is probab. that ant can choose 1 to 3?

Initial pheromon.

distance Matrix =

	1	2	3	4	5
1	0	14	16	19	12
2	14	0	15	13	10
3	16	15	0	11	17
4	19	13	11	0	21
5	12	10	17	21	0

pheromen deposition =

	1	2	3	4	5
1	1	1	1	1	1
2	1	1	1	1	1
3	1	1	1	1	1
4	1	1	1	1	1
5	1	1	1	1	1

efficiency = $\frac{1}{(d) \text{ distance matrix}}$.

	1	2	3	4	5
1	0.00	0.0714	0.0625	0.0526	~~0.8333~~ 0.0833
2	0.0714	0.00	0.0666	0.0769	0.1
3	0.0625	0.0666	0.00	0.0909	[illegible]
4	0.0526	0.0769	0.0909	0	0.047
5	~~0.8333~~ 0.0833	0.1	~~[illegible]~~ 0.0588	0.0476	0.

Page No.

∴ from station 1 so station 1 column will be eliminated. in efficiency matrix.

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Date __/__/__

proba. of ant 1 ~~from~~ station 1.

B	C	D	E	Total -
0.00509	0.00390	0.00276	0.00694 ~~0.6943~~ =	0.01869
0.2723	0.2086	0.1476	0.3713	

(i) 1st Row: Individual = $(\text{efficiency})^2 * \text{phero}^n \text{depo.}$

$= (0.0714)^2 * 1$

$=$

(ii) 2nd Row: Relative = $\dfrac{0.00509}{0.01869}$

% probability of Ant 1 will choose path 1 to 3

is ~~20~~ 0.2086

i.e. 20.866%.

—x—

0.0588 Max dec: same que:

% prob of Ant 1 will choose path A to D.

is 0.1476.

i.e. 14.~~6~~76

Date __/__/__

ACO :-

Q.7) starting station 'A'
% prob. of ~~A~~ 1 to 3 = ?
pheremone level as 1.

⇒ distance matrix : (d)

(1)

	1	2	3	4
1	0	32	51	28
2	32	0	43	38
3	51	43	0	49
4	28	38	49	0

pheromone deposition

(2)

	1	2	3	4
1	1	1	1	1
2	1	1	1	1
3	1	1	1	1
4	1	1	1	1

efficiency matrix (η).

(3)

	1	2	3	4
1	0	0.0312	0.0196	0.0357
2	0.0312	0	0.0232	0.0263
3	0.0196	0.0232	0	0.0204
4	0.0357	0.0263	0.0204	0

Page No.

Date ___/___/___

	2	3	4	Total
(4)	0.000973	0.000384	0.00127	= ~~0.0026~~ 0.00262
	0.37137	0.1465	0.4847	

∴ The probability is 0.1465

i.e. 14.65 %

Q.8) probability of A to D = ?

⇒ ∴ The probability is 0.4847

i.e. 48.47%

Date ___/___/___

Q 9).

⟹ Distance matrix :

	A	B	C	D
A	0	32	51	28
B	32	0	43	38
C	51	43	0	49
D	28	38	49	0

A - C - D - B - A.

A to C = 51
C - D = 49,
D - B = 38
B - A = 32

Total distance travel by ant.
51 + 49 + 38 + 32
= 170.

pheromone deposition by ant 1 :-

$(\Delta\tau) = \frac{1}{170} = \underline{0.00588}$.

updated pheromon deposition by ant 1.

$= (1 - r) * t + \Delta t$

$= (1 - 0.5) * 1 + 0.00588$.

$= \underline{0.50588}$.

Page No.

Date __/__/__

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* ACO formulae :-

① Distance, Matrix : (known to us).

② pheromone deposition : (τ).
(for 1st iteraⁿ consider same amount of pheromone on all path i.e 1)

③. efficiency matrix (η) = $\dfrac{1}{\text{distance (d) matrix}}$.

④. probability :

i) 1st Row = efficiency^2 * pheromon depoⁿ.

ii) 2nd Row = $\dfrac{\text{IInd Individual (1st Row)}}{\text{Individual sum (1st row sum)}}$.

---

i) Total distance : sum

ii) pheromone deposition by ant 1 ($\Delta\tau$) or (Dt). = $\dfrac{1}{\text{Total distance}}$

iii) updated pheromone deposition

$$= (1-r) * t + Dt$$

∵ r = rate of evaporation (consider 0.5) i.e. 50%

t = current pheromone deposition (i.e. 1).

Dt = pheromone deposited by Ant 1