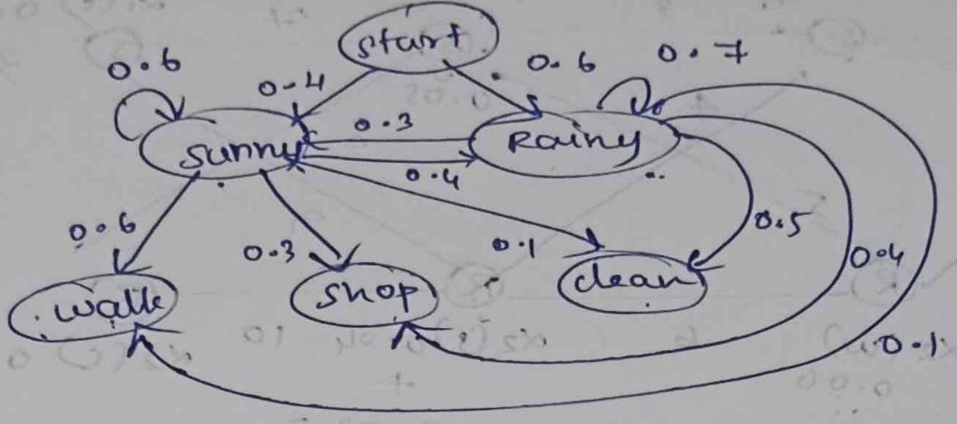


A -> Transition

B -> Emmission

$\pi(R) = 0.6$

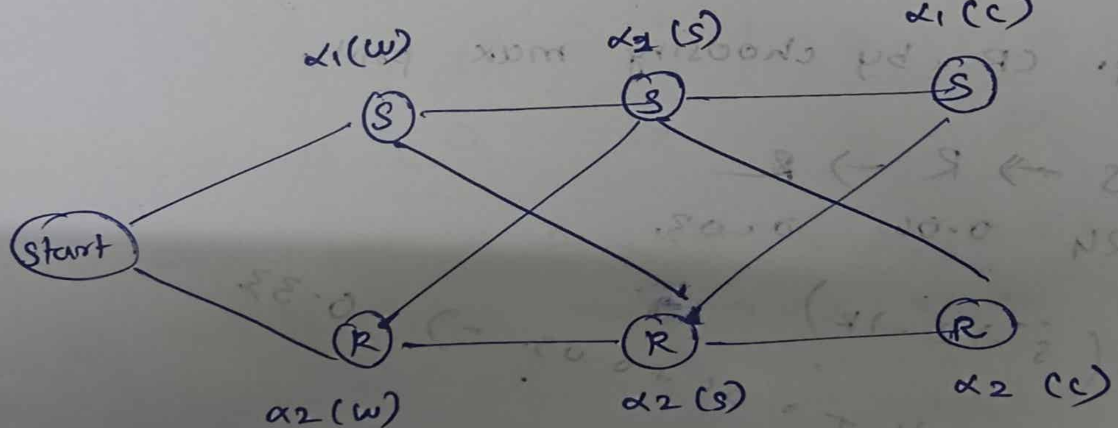
$\pi(S) = 0.4$

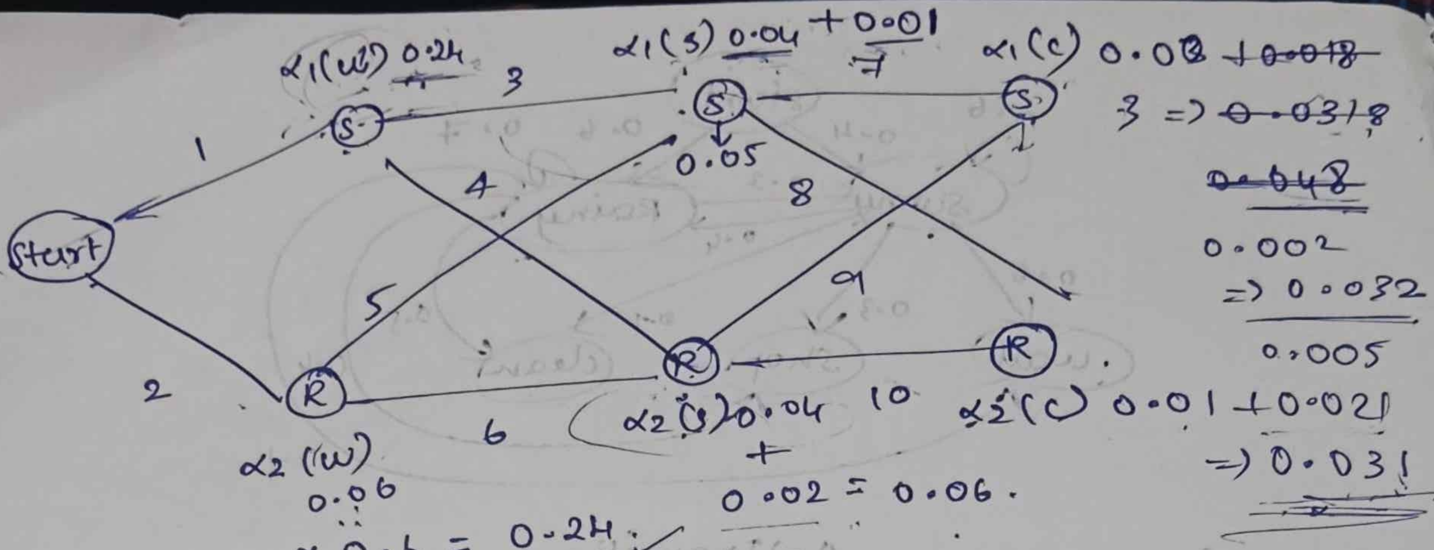
~~B -> W S C R S~~

$$A = \begin{array}{c} \\ R \\ S \end{array} \begin{array}{c} \begin{array}{cc} R & S \end{array} \\ \begin{bmatrix} 0.7 & 0.3 \\ 0.4 & 0.6 \end{bmatrix} \end{array}$$

$$B \rightarrow \begin{array}{c} \\ R \\ S \end{array} \begin{array}{c} \begin{array}{ccc} W & S & C \end{array} \\ \begin{bmatrix} 0.1 & 0.4 & 0.5 \\ 0.6 & 0.3 & 0.1 \end{bmatrix} \end{array}$$

No. of observations : 3.





(1) => $0.4 * 0.6 = 0.24$.

(2) => $0.6 * 0.1 = 0.06$.

(3) => $0.24 * 0.6 * 0.3 = 0.04$

(4) => $0.24 * 0.4 * 0.4 = 0.04$.

(5) => $0.06 * 0.3 * 0.3 = 0.01$

(6) => $0.06 * 0.7 * 0.4 = 0.02$

(7) => $0.06 * 0.6 * 0.1 = 0.003$

(8) => $0.05 * 0.4 * 0.5 = 0.01$

(9) => $0.05 * 0.4 * 0.1 = 0.0018 \simeq 0.002$.

(10) => $0.06 * 0.3 * 0.1 = 0.0018$

=> $0.06 * 0.7 * 0.5 = 0.021$

Hidden seq. CR by choosing max prob.

S => R -> R

0.24 0.06 0.03,

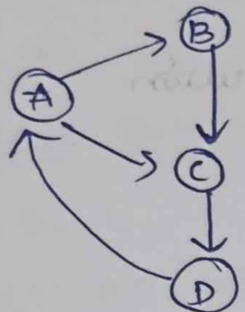
P(S -> R -> R)

0.24 + 0.06 + 0.03. => 0.33.

② . Page Rank :

To calculate the page rank for the directed graph with nodes A, B, C, D & the gn. edges

A → B , A → C , B → C , C → D , D → A .



a) Represent the graph as a transition matrix ie; probability of transitions from one - to - other node.

$$M = \begin{array}{c|c} & \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{array}{c} A \\ B \\ C \\ D \end{array} & \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1/2 & 0 & 0 & 0 \\ 1/2 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \end{array}$$

col. wise vanthu always one col. vanthu 1, one tha irukanu

Max . prob is 1 , No. of edges = 2 , so, 1/2 .

b) Initialize the page rank vector.

$$p^0 = \begin{bmatrix} 1/4 \\ 1/4 \\ 1/4 \\ 1/4 \end{bmatrix} \Rightarrow \begin{bmatrix} 0.25 \\ 0.25 \\ 0.25 \\ 0.25 \end{bmatrix}$$

Total node → 4 ⇒ 1/4

i) Applying dampling factor (d) for the prob. a user randomly jump to any page.

α (or) $d = 0.85$ (constant)

Page rank formula becames.

$$p^{(k+1)} = d \cdot M \cdot p^{(k)} + (1-d) \cdot v$$

v -> vector that is uniform distribution

$$v = \begin{bmatrix} 1/4 \\ 1/4 \\ 1/4 \\ 1/4 \end{bmatrix}$$

$$p^{(k+1)} = 0.85 \times \underset{4\times4}{\begin{bmatrix} 0 & 0 & 0 & 1 \\ 1/2 & 0 & 0 & 0 \\ 1/2 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix}} \times \underset{4\times1}{\begin{bmatrix} 0.25 \\ 0.25 \\ 0.25 \\ 0.25 \end{bmatrix}} + (1-0.85) \times \begin{bmatrix} 0.25 \\ 0.25 \\ 0.25 \\ 0.25 \end{bmatrix}$$

$$p^{(k+1)} = 0.85 \times \begin{bmatrix} 0.25 \\ 0.25/2 \\ 0.25/2 + 0.25 \\ 0.25 \end{bmatrix} + 0.15 \begin{bmatrix} 0.25 \\ 0.25 \\ 0.25 \\ 0.25 \end{bmatrix}$$

$$= \begin{bmatrix} 0.2125 \\ 0.10625 \\ 0.31875 \\ 0.2125 \end{bmatrix} + \begin{bmatrix} 0.0375 \\ 0.0375 \\ 0.0375 \\ 0.0375 \end{bmatrix}$$

$$p^{(k+1)} \Rightarrow \begin{bmatrix} 0.25 \\ 0.14375 \\ 0.35625 \\ 0.25 \end{bmatrix} \Rightarrow P(1)$$

$$P(2) = 0.85 \times \begin{bmatrix} 0 & 0 & 0 & 1 \\ 1/2 & 0 & 0 & 0 \\ 1/2 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} 0.25 \\ 0.14 \\ 0.35 \\ 0.25 \end{bmatrix} + 0.15 \begin{bmatrix} 0.25 \\ 0.25 \\ 0.25 \\ 0.25 \end{bmatrix}$$

$$\Rightarrow \begin{bmatrix} 0.25 \\ 0.14 \\ 0.26 \\ 0.34 \end{bmatrix}$$

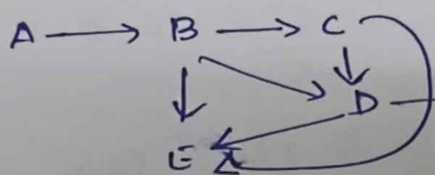
upto do for P(5) i.e; K = 4.

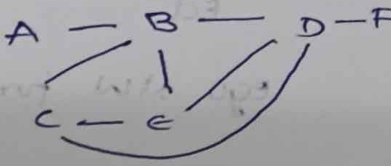
③ K-core graph.

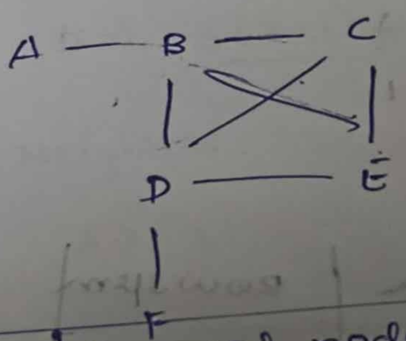
A, B, C, D, E, F

Edges: AB, BC, BE, BD, CD, CE, DE, DF

a) Compute the K-core collapse sequence for K = 1, 2, 3, 4.







K = 1
K = 2
K = 3
K = 4

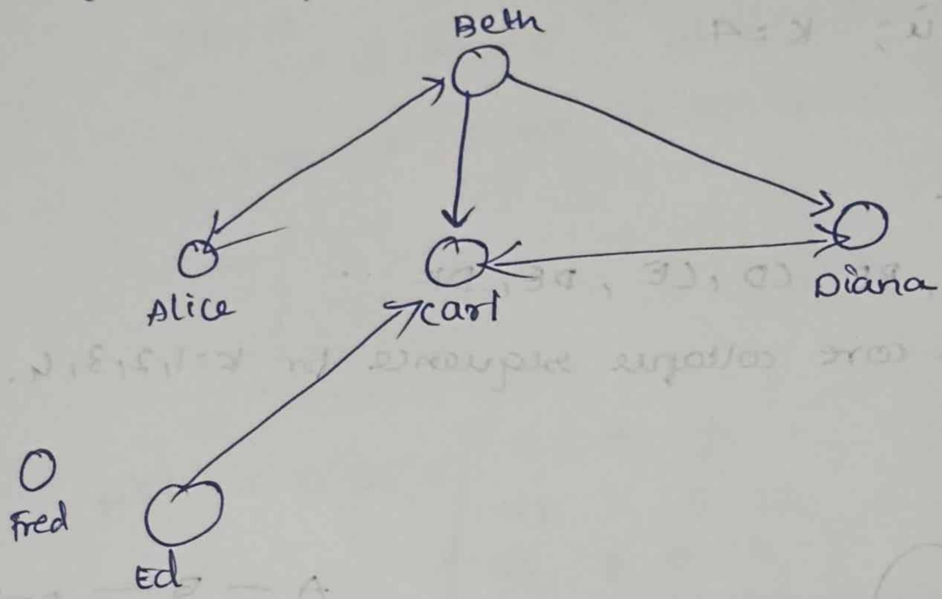
		Removed nodes	Remaining nodes.
K=1	A, F	—	A, B, C, D, E, F
K=2	—	A, F	B, C, D, E
K=3	C, E	—	B, C, D, E
K=4	B, D	C, E	B, D.

4 NW Analysis.

Ego analysis.

Extract ego NW and analyze as independent

(Directed graph)



Ego NW for Alice.

Alice	Alice	Beth	Row sum
Alice	0	1	1
Beth	1	0	1

Ego NW for Beth

~~Beth~~	Carl	Alice	Diana	Row sum	Beth
Beth	1	1	1	3	0
Carl	0	0	1	1	0
Alice	0	0	0	1	1
Diana	1	0	0	1	0

Fred has no connections -> so independent.

⑤ Whole NW Analysis

consider a NW with 4 nodes. The neighbors of each node are connected as follow.

Node A	- 2 neighbors	with	1	connection b/w them
Node B	- 3 "	"	3	" "
Node C	- 1 "	"	0	" "
Node D	- 3 "	"	2	" "

Total possible $\Rightarrow \frac{n(n-1)}{2}$ -> n-> neighbors

$$A \Rightarrow \frac{2(2-1)}{2} = \frac{2(1)}{2} = 1$$

$$B \Rightarrow \frac{3(3-1)}{2} = \frac{6}{2} = 3$$

$$C \Rightarrow \frac{1(1-1)}{2} = 0$$

$$D \Rightarrow \frac{3(3-1)}{2} = 3.$$

Max possible connections.

an: Neighbors: conn. among neighbors.

Neighbors	conn. among neighbors
A -> 2	A -> 1
B -> 3	B -> 3
C -> 1	C -> 0
D -> 3	D -> 2

$CC(A) = 1/1 = 1$

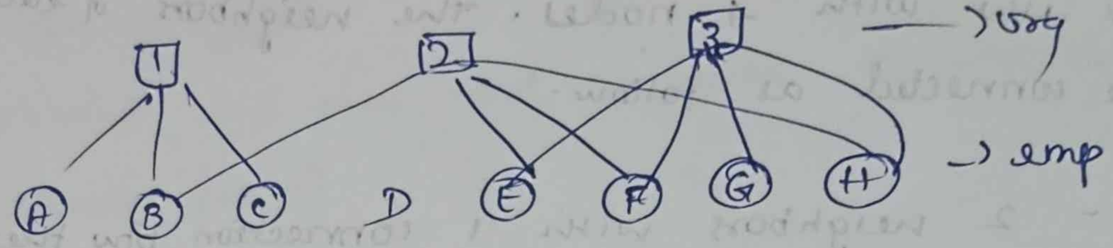
$CC(B) = 3/3 = 1$

$CC(C) = 0/0 = 0$

$CC(D) = 2/3 = 0.67$

Avg. clustering $= \frac{1 + 1 + 0.67}{4} = 0.667$

⑥ Two mode NW analysis



Adj. matrix

	1	2	3
A	1	0	0
B	1	1	0
C	1	0	0
D	0	0	0
E	0	1	1
F	0	1	1
G	0	0	1
H	0	1	1

density for 2 mode NW analysis

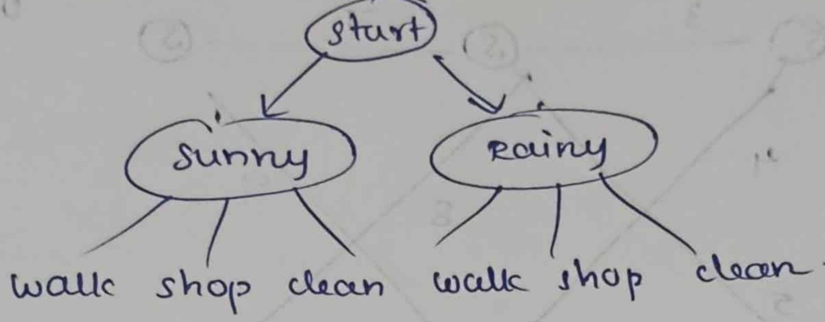
$$\Rightarrow \frac{L}{M \times n}$$

m → no of nodes

n → " " org

$$\Rightarrow \frac{11}{3 \times 8} = \frac{11}{24}$$

(7) viterbi.



$\pi(R) = 0.6$
$\pi(S) = 0.4$ } Initial prob (π)

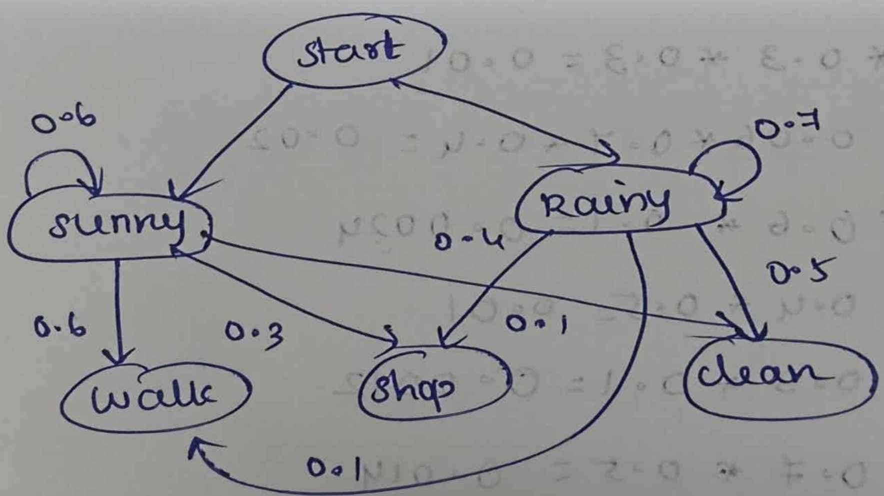
Transition prob: A

Emission prob: B

$$A : \begin{array}{c} \\ R \\ S \end{array} \begin{array}{cc} R & S \\ \end{array}$$

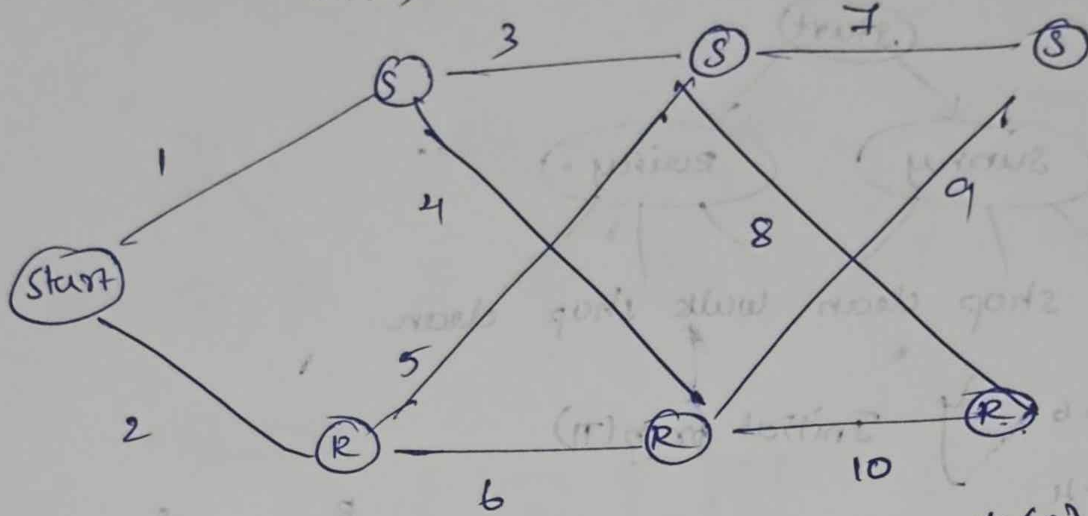
$$A : \begin{array}{c|cc} & R & S \\ \hline R & 0.7 & 0.3 \\ S & 0.4 & 0.6 \end{array}$$

$$B : \begin{array}{c|ccc} & W & S & C \\ \hline R & 0.1 & 0.4 & 0.5 \\ S & 0.6 & 0.3 & 0.1 \end{array}$$



No. of observations : 3.

$\alpha_1(w) = 0.24$ $\alpha_1(s) = 0.04,\ 0.01$ $\alpha_1(c) = 0.0024,\ 0.0012$



$\alpha_2(w) = 0.06$ $\alpha_2(s) = 0.04,\ 0.02$ $\alpha_2(c) = 0.01,\ 0.014$

1 ⇒ $0.4 * 0.6 = 0.24$

2 ⇒ $0.6 * 0.1 = 0.06$

3 ⇒ $0.24 * 0.6 * 0.3 = 0.04$

4 ⇒ $0.24 * 0.4 * 0.4 = 0.04$

5 ⇒ $0.06 * 0.3 * 0.3 = 0.01$

6 ⇒ ~~0.06*~~ $0.06 * 0.7 * 0.4 = 0.02$

7 ⇒ $0.04 * 0.6 * 0.1 = 0.0024$

8 ⇒ $0.04 * 0.4 * 0.5 = 0.01$

9 ⇒ $0.04 * 0.3 * 0.1 = 0.0012$

10 ⇒ $0.04 * 0.7 * 0.5 = 0.014$

S → R → R

0.24 0.02 0.014