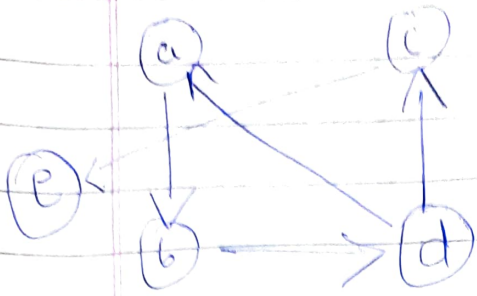


# Warshall's Algorithm



	a	b	c	d	e
a	0	1	0	0	0
b	0	0	0	1	0
c	0	0	0	0	1
d	1	0	1	0	0
e	0	0	0	0	0

$$R^{(0)} = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$R^{(1)} = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$R^{(2)} = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

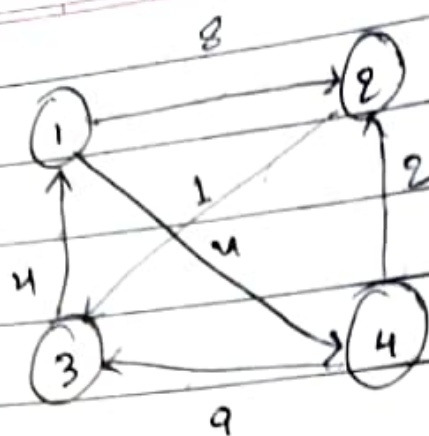
$$R^{(3)} = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

R(4)

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

Transitive closure

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



$$R^0 =$$

	1	2	3	4
1	0	8	$\infty$	4
2	$\infty$	0	1	$\infty$
3	4	$\infty$	0	$\infty$
4	$\infty$	2	9	0

Vertex 1

$$\begin{matrix} (3,1) \\ (1,2) \end{matrix} \left\{ \begin{matrix} (3,2) = 12 \end{matrix} \right.$$

$$\begin{matrix} (3,1) \\ (1,4) \end{matrix} \left\{ \begin{matrix} (3,4) = 8 \end{matrix} \right.$$

$$R^1 =$$

	1	2	3	4
1	0	8	$\infty$	4
2	$\infty$	0	1	$\infty$
3	4	12	0	8
4	$\infty$	2	9	0

Vertex 2

$$R^2 =$$

	1	2	3	4
1	0	8	9	4
2	$\infty$	0	1	$\infty$
3	4	12	0	8
4	$\infty$	2	3	0

Vertex 3

	1	2	3	4
1	0	8	9	4
2	5	0	1	9
$R^3$ : 3	4	12	0	8
4	7	2	3	0

Vertex 4.

$$9 + 3 = (12, 1)$$

1 is low

	1	2	3	4
1	0	6	7	4
2	5	0	1	9
$R^1$ : 3	4	10	0	8
4	7	2	3	0

#

$$\text{In } R^3 \quad 2 + 4 = 6, 8$$

6 is low