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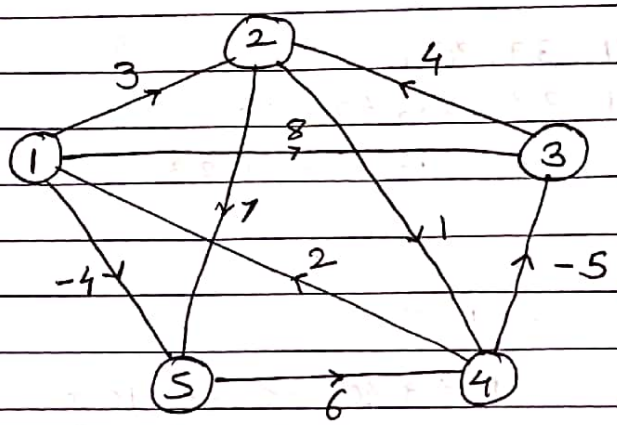
Floyd - Warshall - DP



$A[i,j] = \min(A[i,j], A[i,k] + A[k,j])$

$A =$

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

Path Matrix

P_0 :

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

Pass 1 : Vertex no. (1) in between

A_1 :

0	3	8	∞	-4
∞	0	∞	1	7
∞	4	0	∞	∞
2	(5)	-5	0	(-2)
∞	∞	∞	6	0

P_1 :

	1	2	3	4	5
1	-	1	1	-	1
2	-	-	-	2	2
3	-	3	-	-	-
4	4	(1)	4	-	(1)
5	-	-	-	5	-

Pass 2 : Vertex ② in between

A_2 :

0	3	8	(4)	-4
∞	0	∞	1	7
∞	4	0	(5)	(11)
2	(5)	-5	0	-2
∞	∞	∞	6	0

P_2 :

-	1	1	(2)	1
-	-	-	2	2
-	3	-	(2)	(2)
4	1	4	-	1
-	-	-	5	-

Pass 3 : Vertex ③ in between

A_3 :

0	3	8	4	-4
∞	0	∞	1	7
∞	4	0	5	11
2	(-1)	-5	0	-2
∞	∞	∞	0	0

P_3 :

-	1	1	2	1
-	-	-	2	2
-	3	-	2	2
4	(3)	4	-	1
-	-	-	5	-

Pass 4: Vertex ④ in between

A_4 :

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

P_4 :

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

Pass 5: Vertex ⑤ in between

A_5 :

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

P_5 :

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

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Path tracing : 1 - 2

For 1-2, cost is 3 according to original diag but acc to cost matrix it is 1

From path matrix → 1 → 2 is 3 ⇒ 1-3-2

From 1-3 → value is 4 ⇒ 1-4-3-2
From 1-4 → value is 5 ⇒ 1-5-4-3-2
For 1-5 → value is 1 ⇒ STOP

$dist^2(2) = \min(dist^1(2), \min_i(dist^1[i] + cost[i, 2]))$

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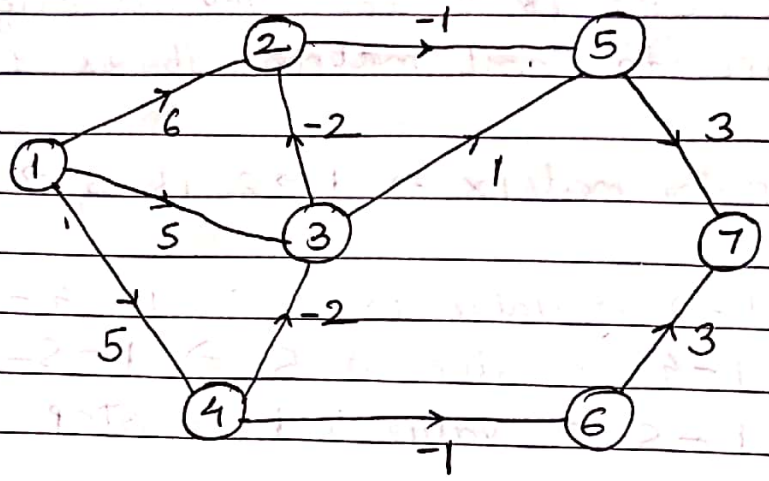
Bellman Ford (Single Source, Dynamic)
-ve edges



no. of edges bet^n	V → 1	2	3	4	5	6	7
~~0~~	1	0	6	5	5	∞	∞	∞
			1,2	1,3	1,4	-	-	-
2	2	0	3	3	5	5	4	∞
			1,3,2	143	1,4	125	146	-
3		~~0~~	~~3~~	3	5	2	4	7
			~~1432~~	1432	143			
4		0	3	3	5	0	4	3
5		0	3	3	5	0	4	3
6								

$dist^2(2) = \min(6, 0+6, 6+0, 5-2, 5+\infty, \infty, \infty)$
$= 3$

$dist^2(3) = \min(5, 0+5, 6+\infty, 5+0, 5-2, \infty, \infty)$
$= 3$

$dist^2(4) = \min(5, 0+5, 6+\infty, \infty, 5, \infty, \infty)$
$= 5$

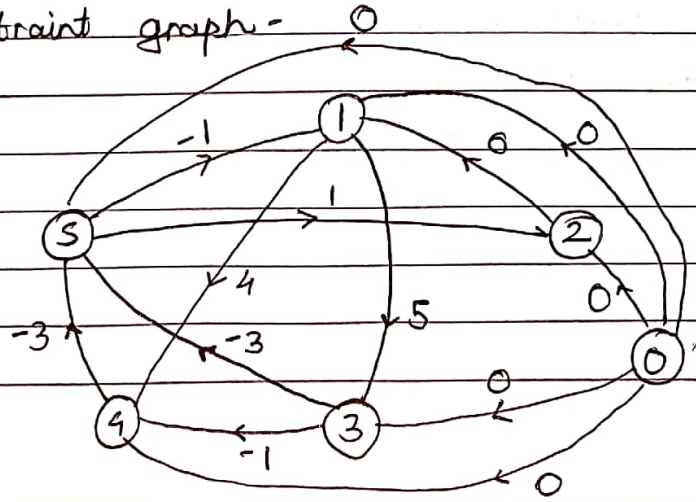
Ex-

$$\underset{A}{\begin{bmatrix} 1 & -1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & -1 \\ 0 & 1 & 0 & 0 & -1 \\ -1 & 0 & 1 & 0 & 0 \\ -1 & 0 & 0 & 1 & 0 \\ 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 0 & 1 \\ 0 & 0 & 0 & -1 & 1 \end{bmatrix}} \underset{x}{\begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{bmatrix}} \leq \begin{bmatrix} 0 \\ -1 \\ 1 \\ 5 \\ 4 \\ -1 \\ -3 \\ -3 \end{bmatrix}$$

System of Difference constraints

$x_1 - x_2 \leq 0$ $\quad$ $x_4 - x_1 \leq 4$
$x_1 - x_5 \leq -1$ $\quad$ $-x_3 + x_4 \leq -1$
$x_2 - x_5 \leq 1$ $\quad$ $-x_3 + x_5 \leq -3$
$-x_1 + x_3 \leq 5$ $\quad$ $-x_4 + x_5 \leq -3$

Constraint graph-



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	0	1	2	3	4	5
1	0	0	0	0	0	0
2	0	-1	0	0	-1	-3
3	0	-4	-2	0	-1	-4
4	0	-5	-3	0	-1	-4

Syntax - Refers to the way words are arranged together, and the relationship between them.

Ex of Syntax tree -

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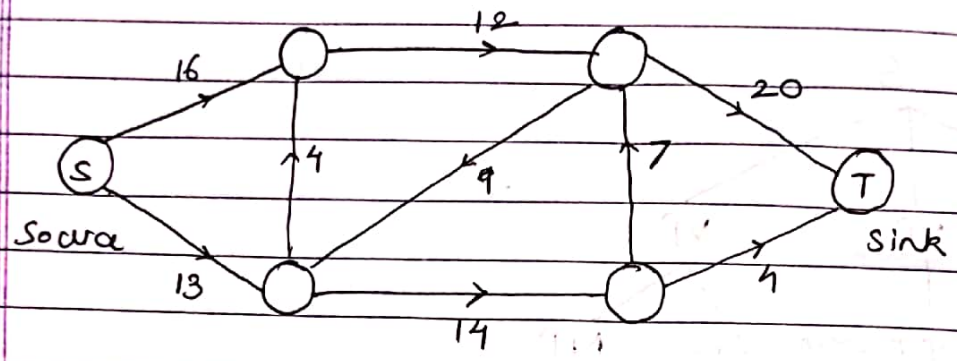
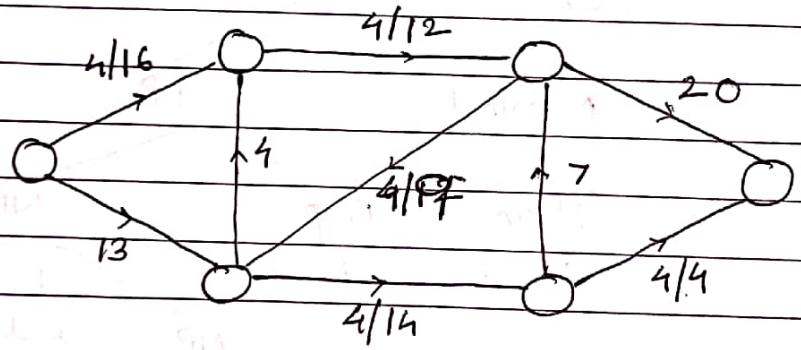
Ford Fulkerson Algorithm for Max NW Flow (Network)



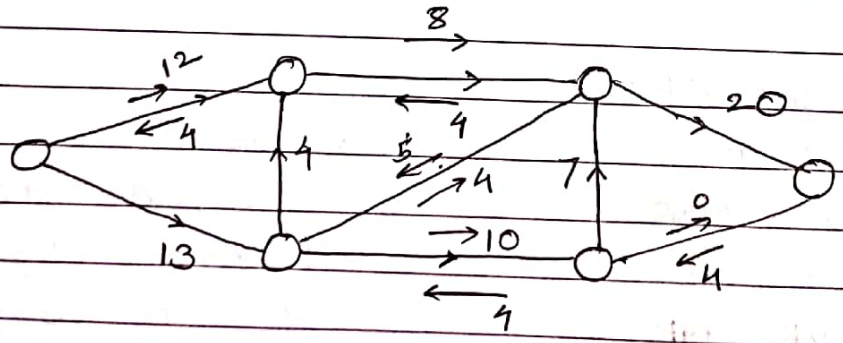
Going through the path $16 \to 12 \to 9 \to 14 \to 4$

$\Rightarrow$ 4 will be consumed

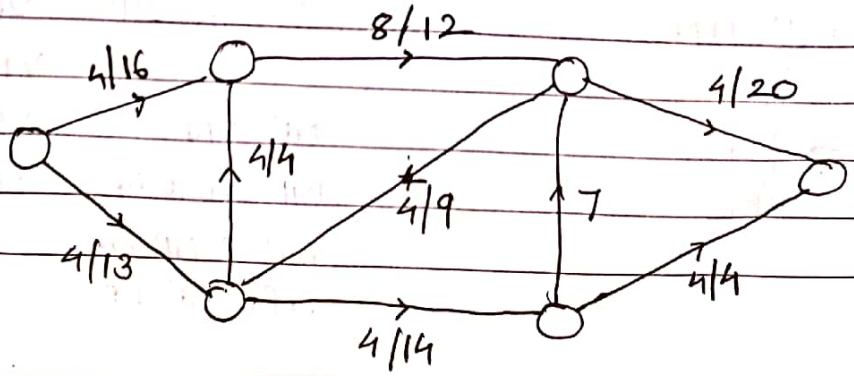


Flow = 4

Residual graph



Going through the path $13 \to 4 \to 12 \to 20$

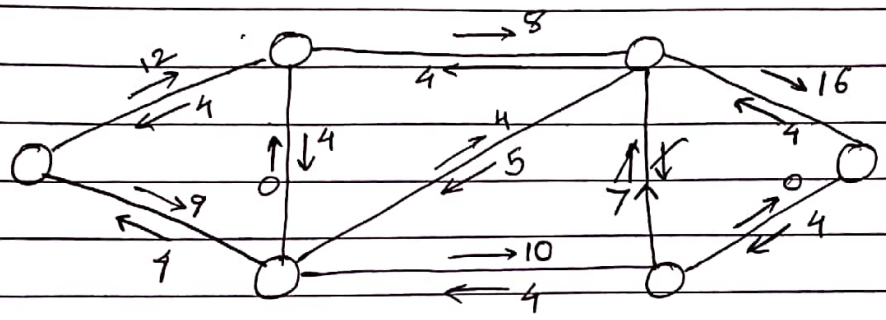


Flow = 8

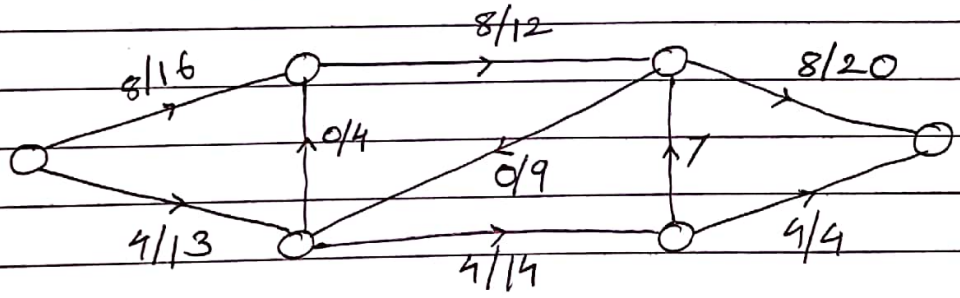
Concepts -

- Source / Sink
- Augmented Path - DFS
- Residual network
- Forward flow
- Backward flow

Residual graph



Going through $16 \rightarrow 4 \rightarrow 9 \rightarrow 20$



Flow = 12

Residual Gf