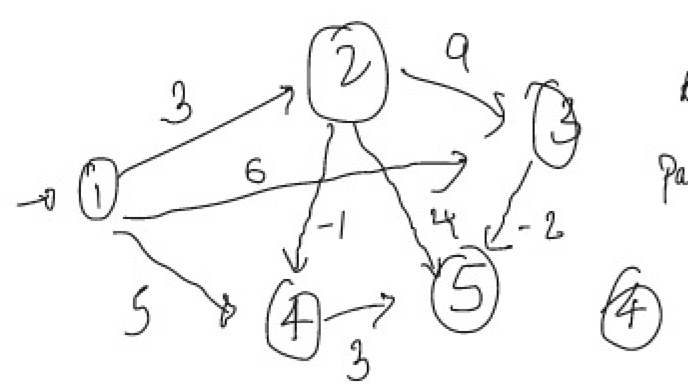
Bellman Ford

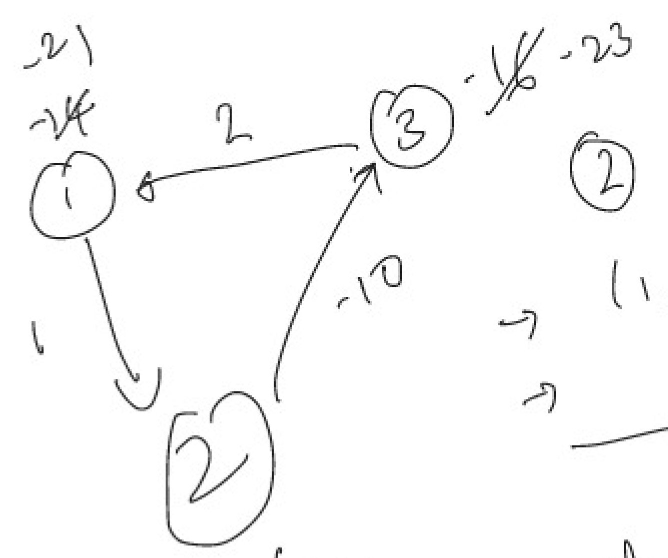
- → Make a list of all edges.
- → Relax all the edges.
- → Repeat the step 2, $(V-1)$ times.
- → Repeat the step once more (to check for -ve weight cycle)



	1	2	3	4	5
Key →	0	3	6	2	4
Parent →	-1	1	1	2	3

(1, 2) (2, 3) (1, 3) (1, 4) (2, 4) (4, 5) (3, 5) (2, 5) $\}$ (V-1)

relaxation (u, v) → $O(1)$
key(u) + c(u, v) < key(v) *
→ key(v) = key(u) + c(u, v) $O(E)$
*
$O(V)$
⇓
$O(VE)$



1 + 2 = 10

~~-8~~

→ (1, 2) (2, 3) (3, 1)

→

1	2	3
-7	1	-9
3	1	2

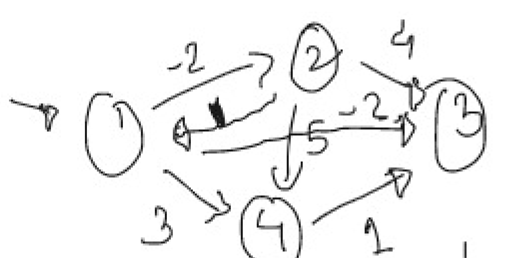
-6 -13 -ve edge weight cycle

⇒ Failure of Bellman ford

⟺ Output (V^{th} iteration) != Output ($V-1^{th}$ iteration)

Floyd Warshall (All pairs Shortest Path)

$O(V^3)$

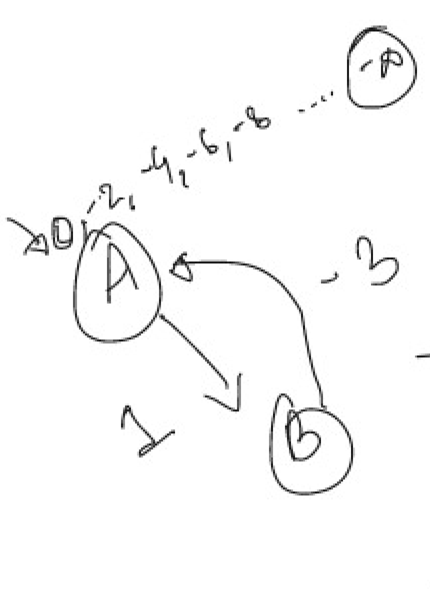


$$A^0 = \begin{array}{c|cccc} & 1 & 2 & 3 & 4 \\ \hline 1 & 0 & -2 & -2 & 3 \\ 2 & 1 & 0 & 4 & 5 \\ 3 & \infty & \infty & 0 & \infty \\ 4 & \infty & \infty & 1 & 0 \end{array} \qquad A^1 = \begin{array}{c|cccc} & 1 & 2 & 3 & 4 \\ \hline 1 & 0 & -2 & -2 & 3 \\ 2 & 1 & 0 & -1 & 5 \\ 3 & \infty & \infty & 0 & \infty \\ 4 & \infty & \infty & 1 & 0 \end{array}$$

$$A^2 = \begin{array}{c|cccc} & 1 & 2 & 3 & 4 \\ \hline 1 & 0 & -2 & -2 & 3 \\ 2 & 1 & 0 & -1 & 5 \\ 3 & \infty & \infty & 0 & \infty \\ 4 & \infty & \infty & 1 & 0 \end{array}$$

(directedge / i→1→j / i→2→j / i→2→1→j / i→1→2→j)

$$A^k(i,j) = \min \left\{ \begin{array}{l} A^{k-1}(i,j) \\ A^{k-1}(i,k) + A^{k-1}(k,j) \end{array} \right\}$$



→ No graph Algo can solve

```
for(k=0; k<V; k++)
    for(i=0; i<V; i++)                → O(V^3)
        for(j=0; j<V; j++)
            if (Graph[i][j] > Graph[i][k]+Graph[k][j])
                Graph[i][j]= Graph[i][k] + Graph[k][j];
```

miro