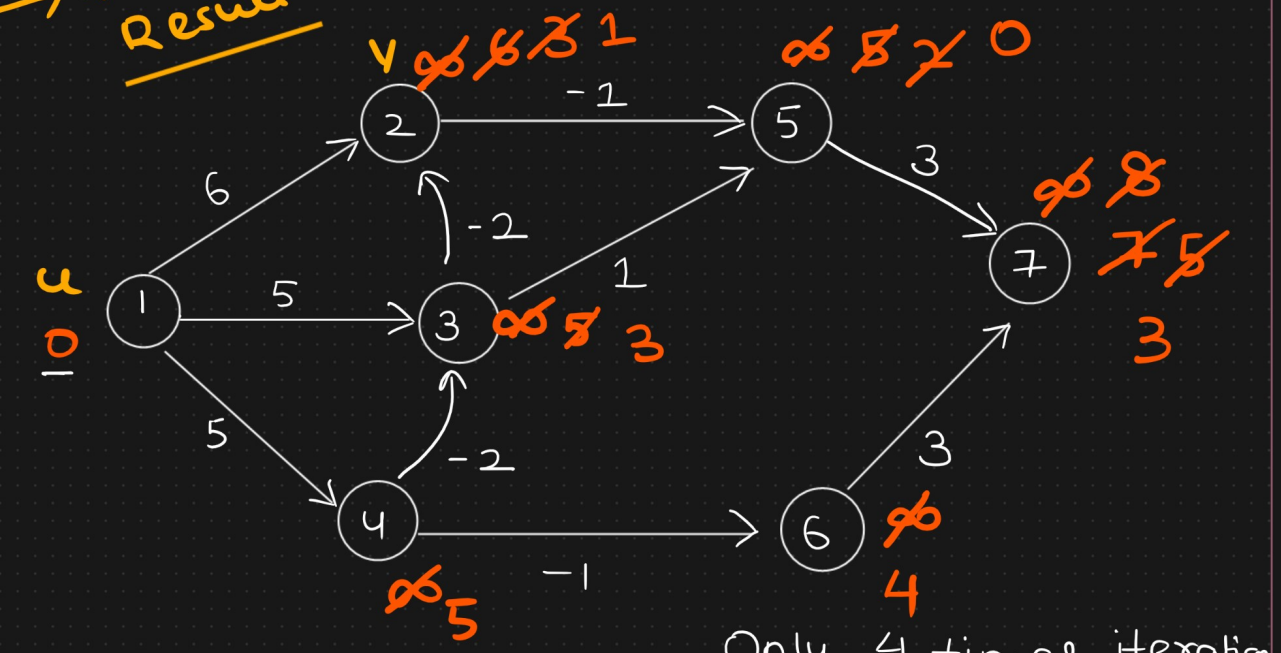
Bellman ford Algorithm

↳ Single source shortest Path

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

→ final Result



Only 4 times iteration

Single source = 1

Relaxation

if $d[u] + c(u,v) < d[v]$:

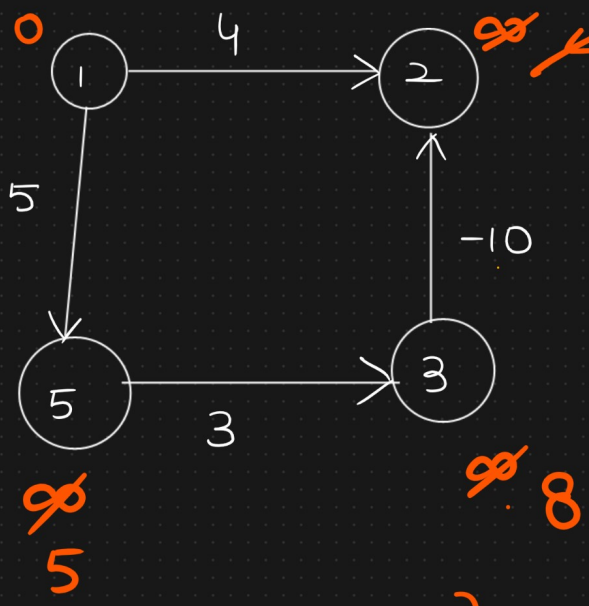
$d(v) = d(u) + c(u,v)$

(Decrease key operation)

$|V| - 1 = 7 - 1 = 6$

(# times, relaxation for all the edges)

Edgelist = (1,2) (1,3) (1,4) (2,5) (3,2) (3,5) (4,3) (4,6) (5,7) (6,7)



Edgelist = (1,2) (1,5)
(3,2) (5,3)

Relaxation for
3 times

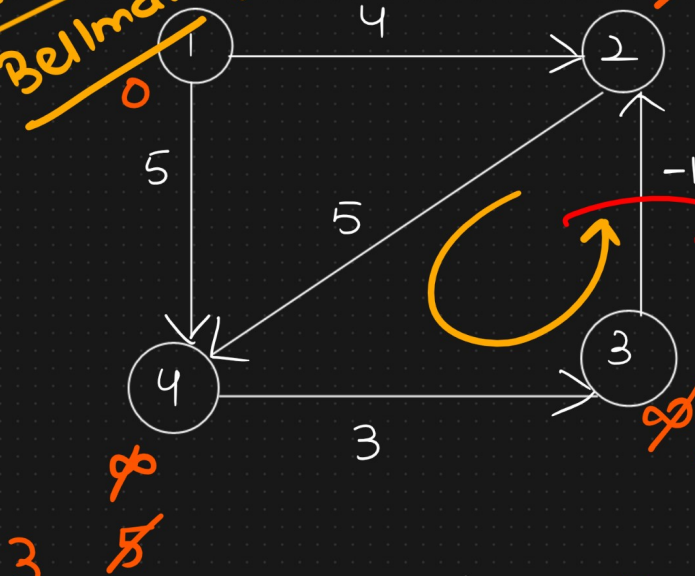
1 — 0
2 — -2
3 — 8
5 — 5

(After iterating 3 times)

Major change

-4
-2
∞ 4

Drawback of Bellman ford



Edgelist = (1,2) (1,4)
(2,4) (3,2)
(4,3)

Relaxation = 3 times

1 — 0
2 — -2
3 — 6
4 — 3

Bellman ford fails to give correct result.

Time complexity

$\Theta((|V|-1)(|E|))$

$|V| = n$

$\Theta(V \cdot E) = \Theta(n^2)$

$|V| = |E| = n$

Graph → complete graph

$$|E| = \frac{V*(V-1)}{2}$$

$$\Theta\left(V * \left(\frac{V*(V-1)}{2}\right)\right)$$

$\Rightarrow \Theta(V^3)$

Deterministic algorithm

↳ End to end solution (Polynomial time)

(Present)

P type Problem

Polynomial	Exponential (2^n)
Linear Search	0/1 Knapsack
Binary Search	Matrix chain
Bubble Sort	Satisfiability
Insertion Sort	Sum of subset

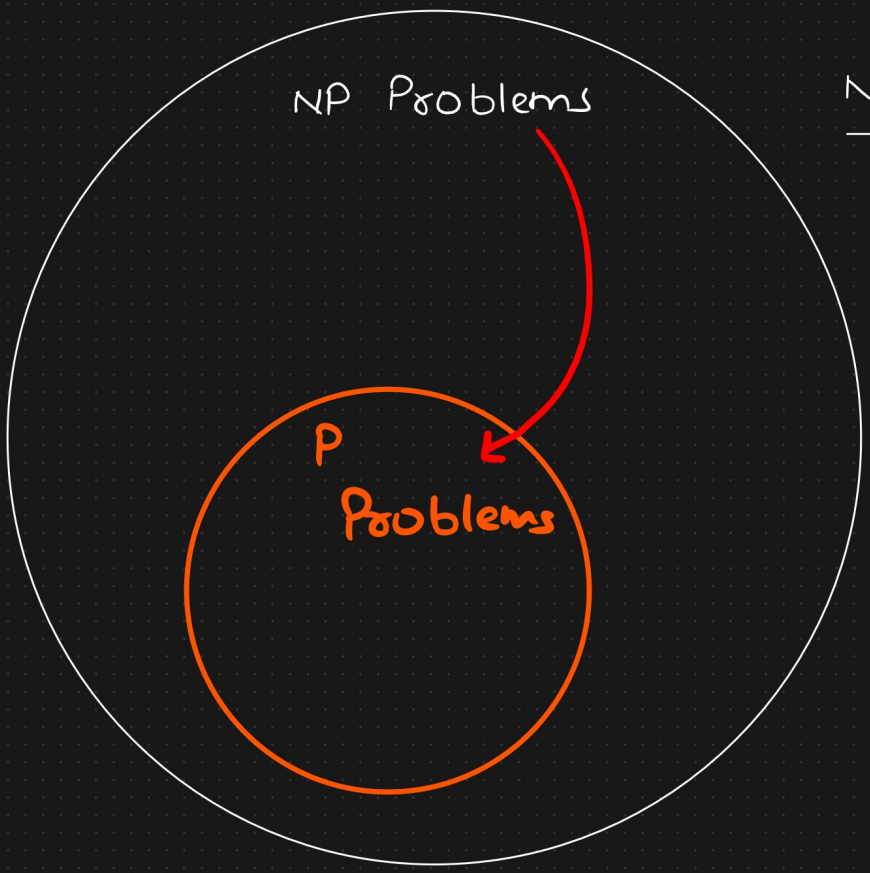
Talk
↳ Exponential time complexity

Researcher → Polynomial Time complexity

NP Problem

↳ Non-Deterministic Polynomial Time Solution

Present
(Don't know end to end solutions)



NP Superset of P or equal

Base Problem

↳ common to all the exponential time problems

(NP-Hard)

Satisfiability → Base problem

$x_i = f(x_1, x_2, x_3)$ — 0/1 0/1 0/1

Standard Equation

$$(x_1 \vee \bar{x}_2 \vee x_3) \wedge (\bar{x}_1 \vee x_2 \vee \bar{x}_3)$$

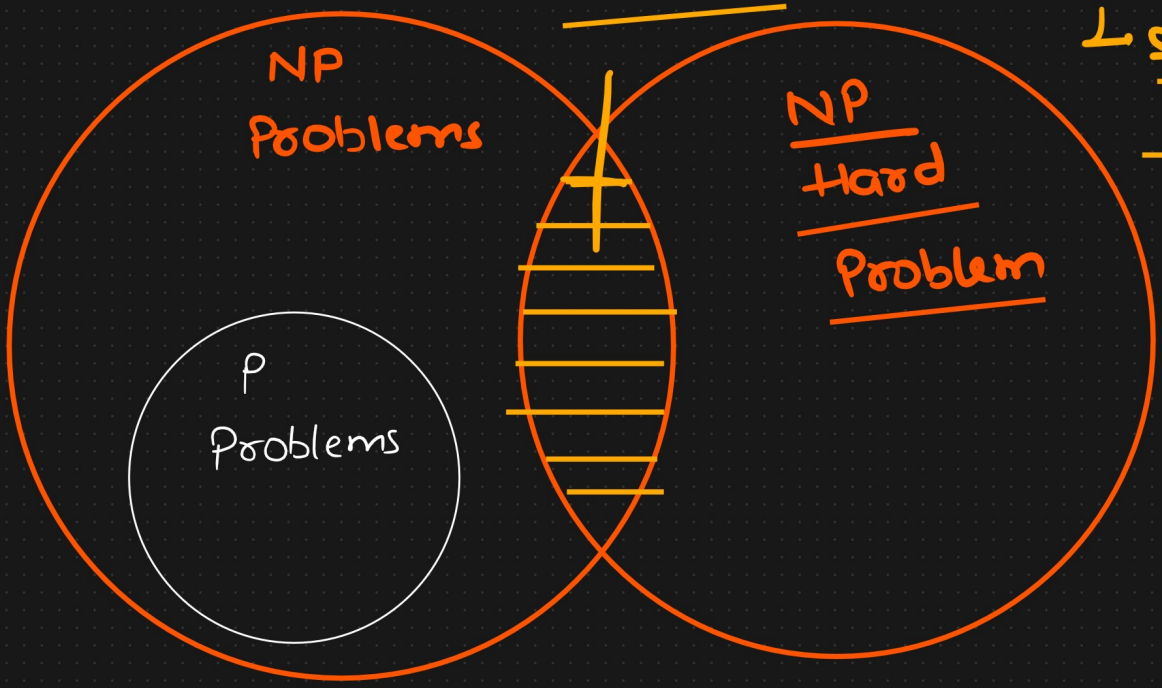
↳ True

Exponential

$\Theta(2^n)$

NP complete Problem

↳ Satisfiability



↳ Reducible

Satisfiability $\propto$ 0/1 knapsack