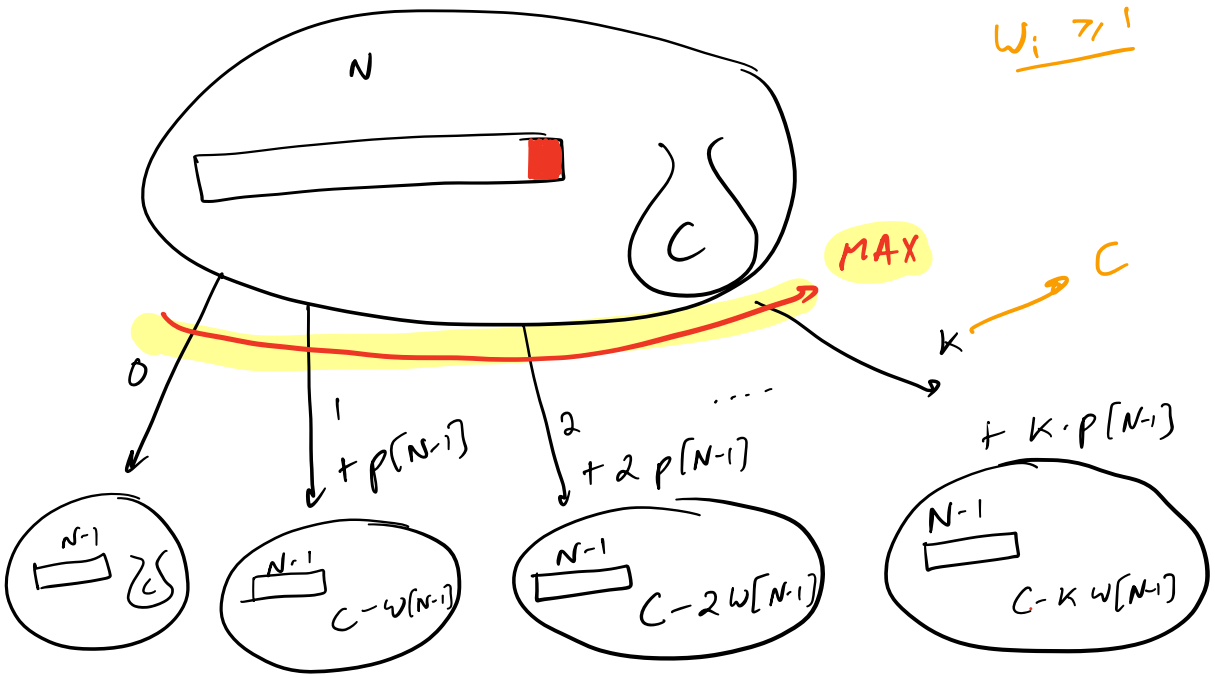
0 - N Knapsack / Unbounded Knapsack

→ Same as 0-1 Knapsack

→ Every item has ∞ copies!



(idx, cp)

~N x ~C → #US → NC

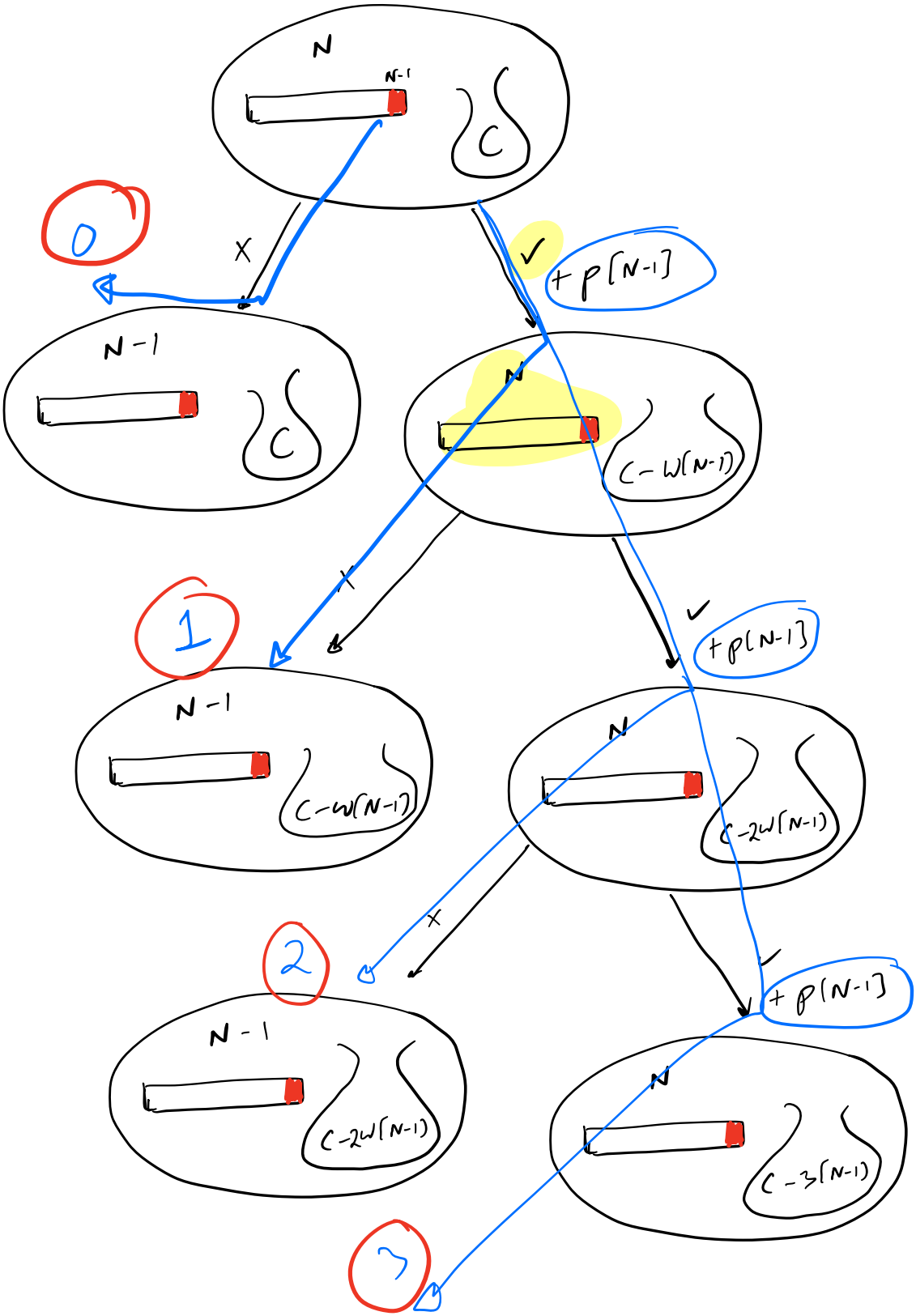
TRPS → O(C)

TC = O(NC²)

SC = O(NC)

$1 <= N, C <= 10^3$

10^9


N
N-1
C
0
X
✓
+p[N-1]
N-1
C
N
C-w[N-1]
1
X
✓
+p[N-1]
N-1
C-w[N-1]
N
C-2w[N-1]
2
X
✓
+p[N-1]
N-1
C-2w[N-1]
N
C-3[N-1]
3

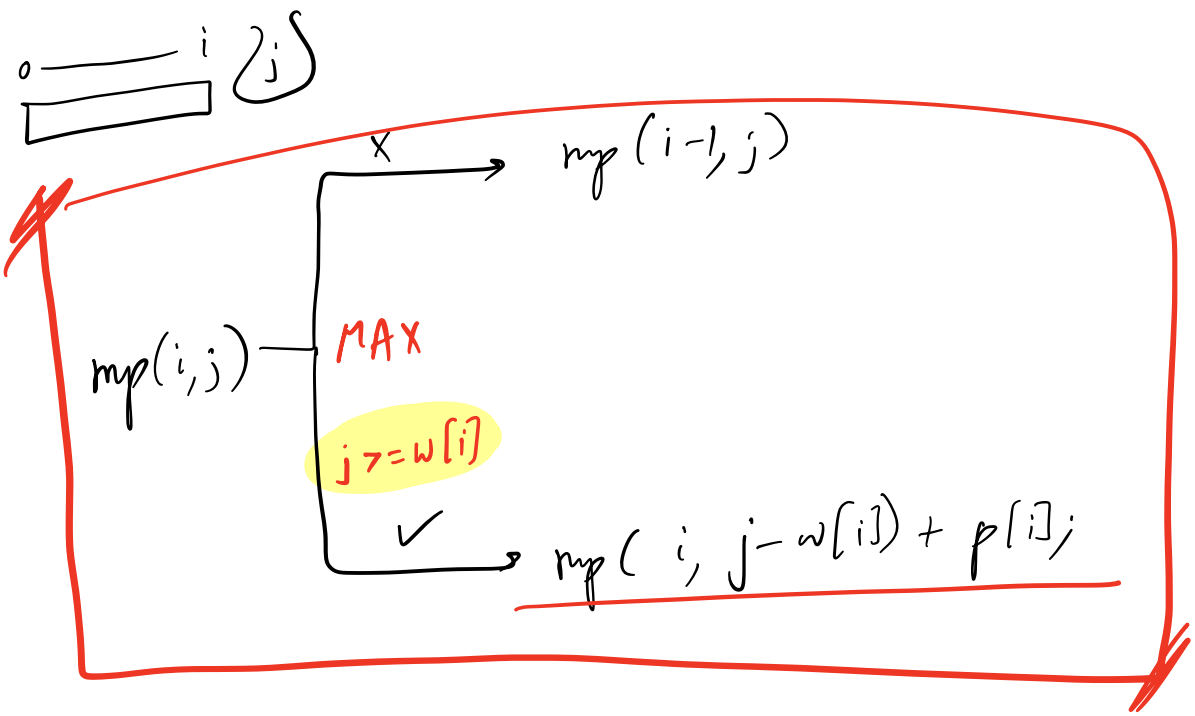
TRPS → O(1)

VS → NC

TC = O(NC)

SC = O(NC)

mp(i, j) → max price considering items [0 – i] with j as the remaining cap of the bag



BC

i < 0 : ret 0;

j == 0 : ret 0;

→ W = 0 ; P > 0

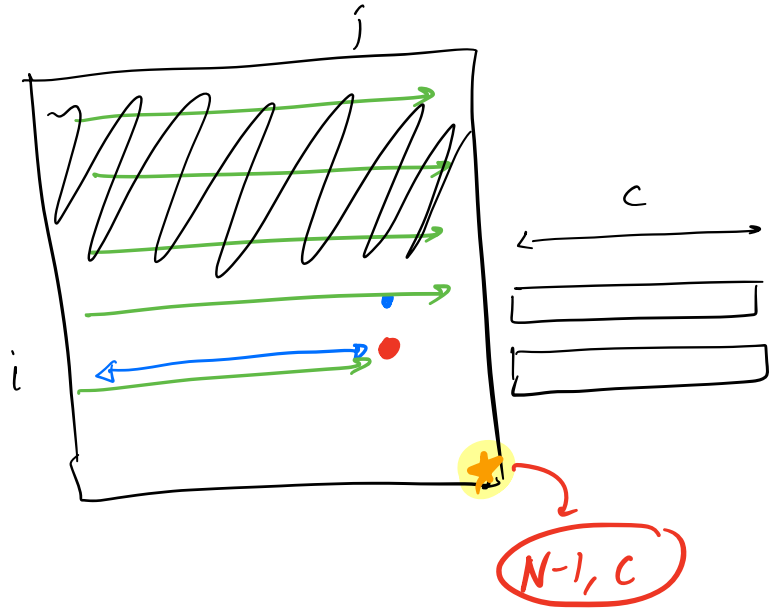
↓

ANS = P

Bottom Up

TC: O(NC)

SC: O(C)



Q Given an array of Size N.
+ve elements

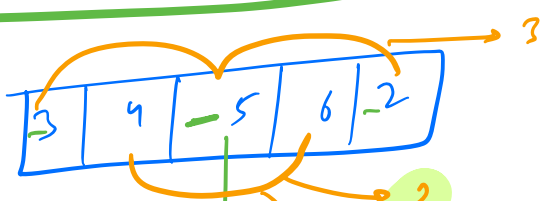
You have to flip the sign of some element such that resultant sum of element of the array should be MINIMUM NON-NEGATIVE.

find the min no of elements that need to be flipped!

$1 <= N <= 10^3$

$1 <= A_i <= 10^7$

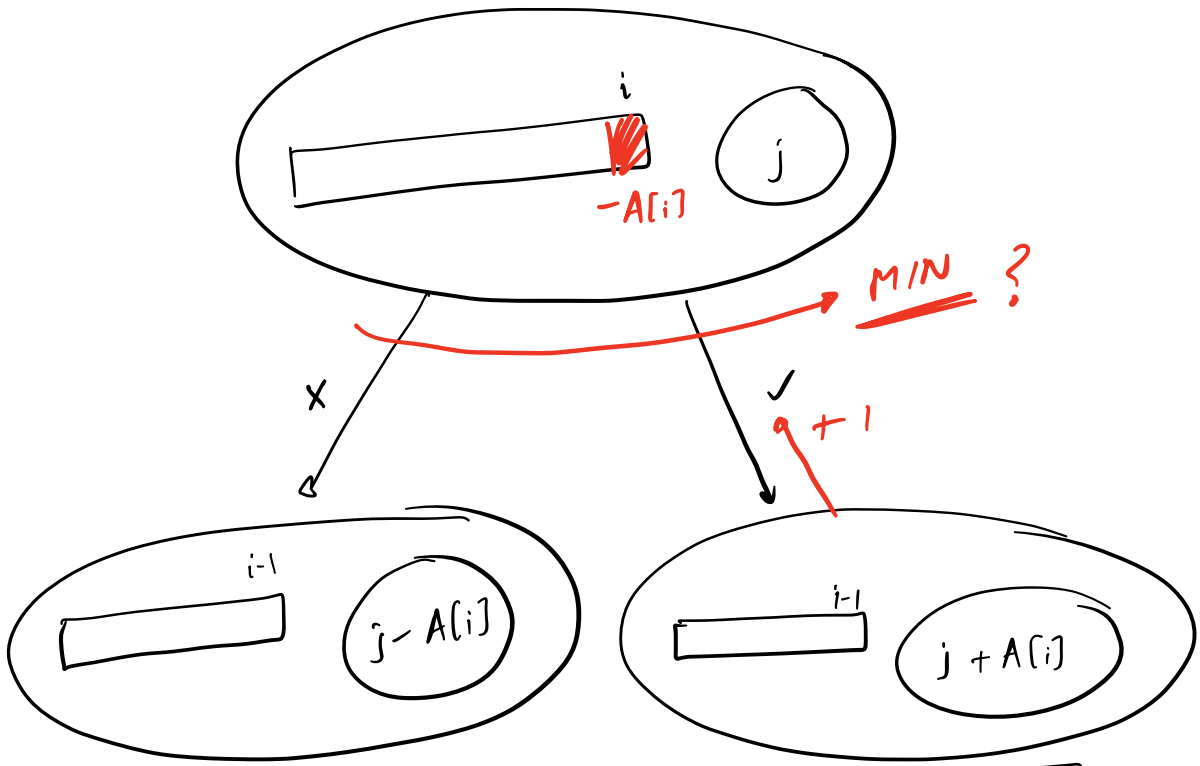
A:



Min N.N → 0

ANS !!!

$dp(i, j)$ → the min no. of flips required considering the items $[0-i]$ to get the sum j



$dp(i, j)$ — MIN —
- ✗ → $dp(i-1, j - A[i])$
- ✓ → $dp(i-1, j + A[i]) + 1$

f(j = 0 ⟶ ∞)

call(N-1, j) != ∞

ANS ✓

HM < pair(int, int), int > dp

9

0/1 Knapsack

$1 <= N <= 500$

$1 <= w[i] <= 10^6$

$1 <= p[i] <= 50$

$1 <= C <= 10^6$

$TC = O(NC)$

500×10^6

$\sim 5 \times 10^8$ ops

TLE!

500×25000

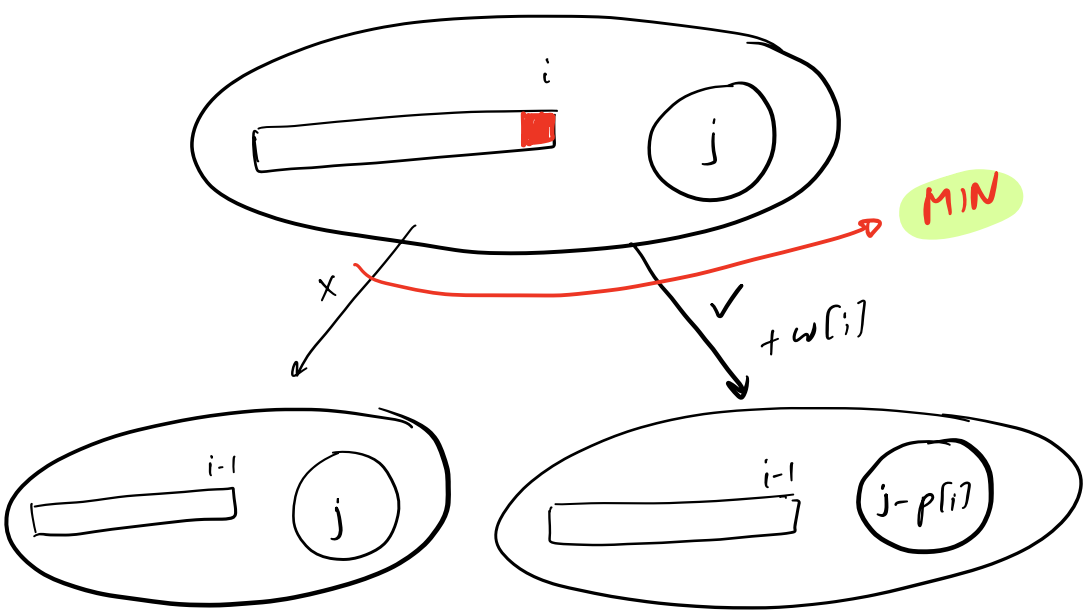
12500000

1.25×10^7

dp(idx, cap) → profit

dp(idx, profit) → cap

dp(i, j) → Considering the items [0 — i], what is the MIN CAP of the bag req'd to get j profit



#VS → N × 25000

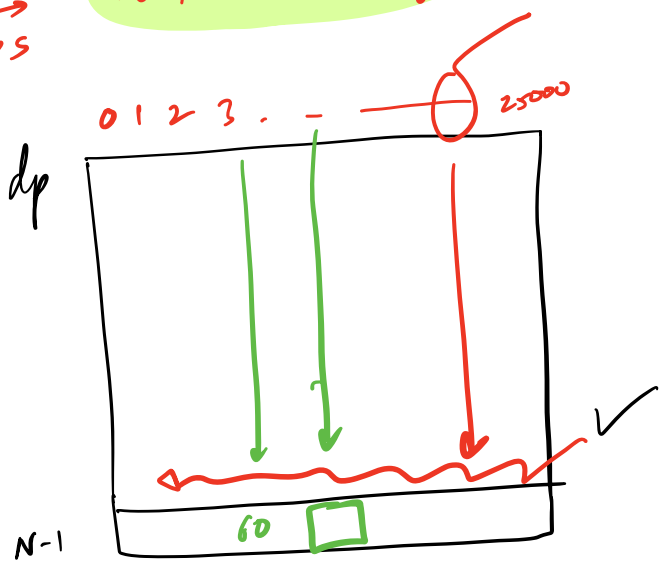
500 × 25000

~ 1.25×10^7

TRPS → O(1)

TC → ops ~ 1.25×10^7 ops

C = 70



dp[N-1][250] = 100

to get 250 profit

MIN Cp → 100!

dp[N-1][150] = 60 → dp[N-1][200] = 65

to get 150 profit

MIN Cp → 60!

BS ? HW

```
for( j = 25000; j >= 0; j--) {
    if( dp[N-1][j] <= C) {
        ret j;
    }
}
```