What. a. Shame!

$1 \qquad 2 \qquad 3 \qquad \text{---} \qquad N$

$-C$

| C |
| V |

| C_i |
| V_i |

| C |
| V |

| C |
| V |

$+V$ $\qquad \times$
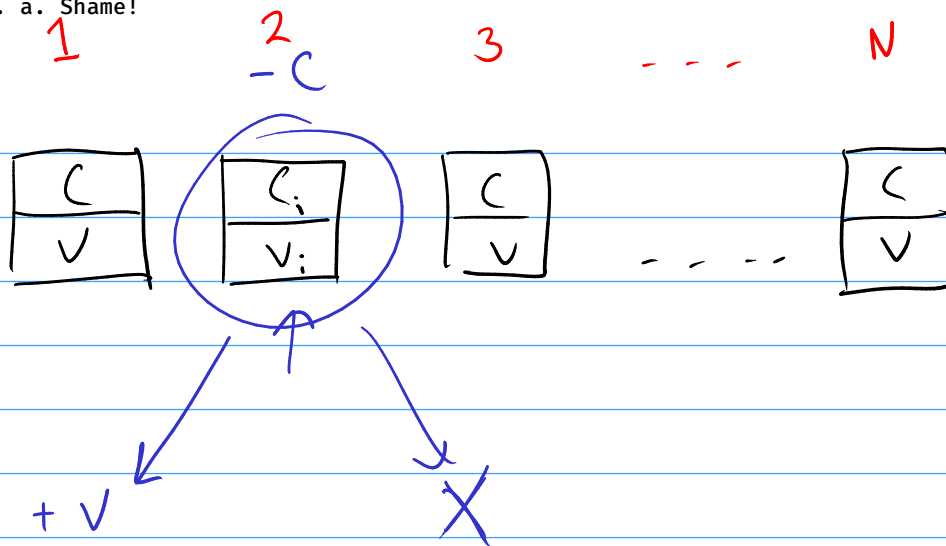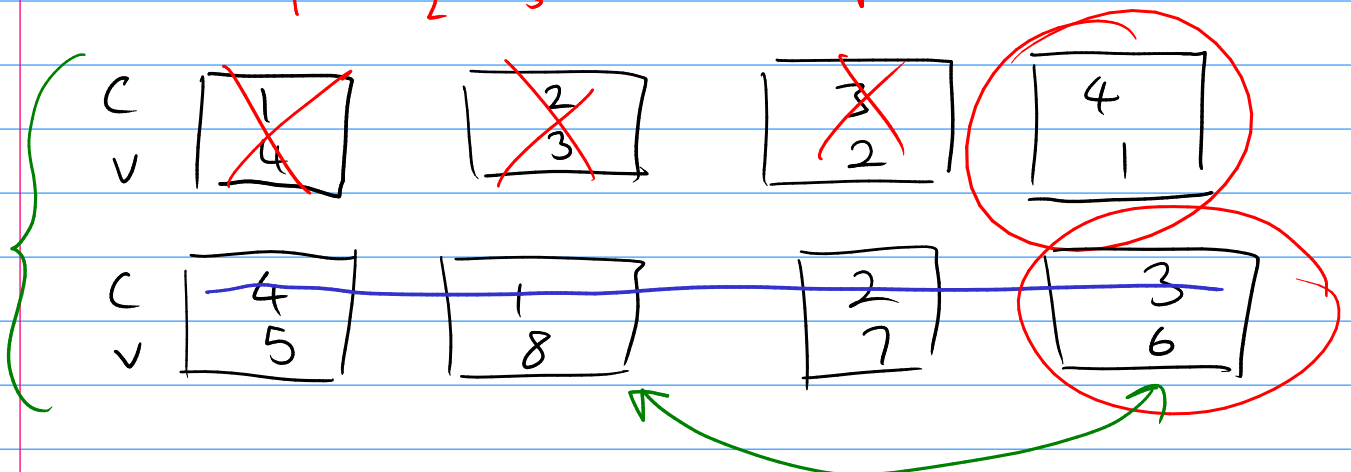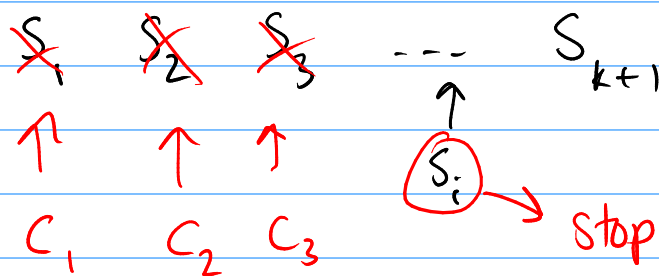
Suppose we could only take items in order

$dp[i][k] = $ max gain if take items $1 \cdots i$

and host discards k times in total

discard

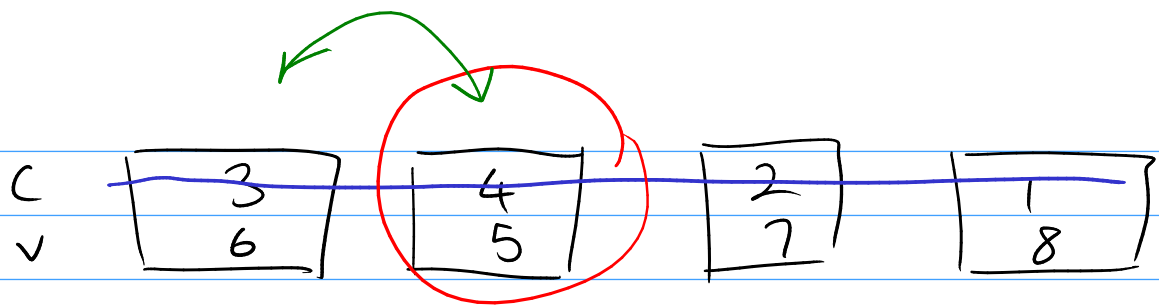$dp[i][k] = \min\left(dp[i-1][k-1], dp[i-1][k] + V(i) \right) - C(i)$

$$= \begin{array}{c} \text{Take} \nearrow \quad \text{Shame} \qquad dp(i-1)[k-1] - C(i) \\ \bigcirc \text{Min} \\ \text{Max} \quad \text{Congratulations} \quad dp(i-1)[k] - C(i) \\ \text{Ignore} \searrow dp[i-1][k] \qquad\qquad +V(i) \end{array}$$

Optimal order?

$\cancel{S_1} \quad \cancel{S_2} \quad \cancel{S_3} \quad \text{---} \quad S_{k+1}$

$\uparrow \qquad \uparrow \qquad \uparrow \qquad \uparrow$

$C_1 \qquad C_2 \quad C_3 \qquad \boxed{S_i} \to$ stop

| C | $\cancel{\boxed{\cancel{1 \atop 4}}}$ | $\cancel{\boxed{2 \atop 3}}$ | $\cancel{\boxed{\cancel{3} \atop 2}}$ | $\boxed{4 \atop 1}$ |
| V | | | | |

| C | $\boxed{4 \atop 5}$ | $\boxed{1 \atop 8}$ | $\boxed{2 \atop 7}$ | $\boxed{3 \atop 6}$ |
| V | | | | |

C
∨

| 3 | 4 | 2 | 1 |
| 6 | 5 | 7 | 8 |

Observation: You want to take the items in increasing order of value!

New   C̶   A̶   B
Old   B   A̶   C
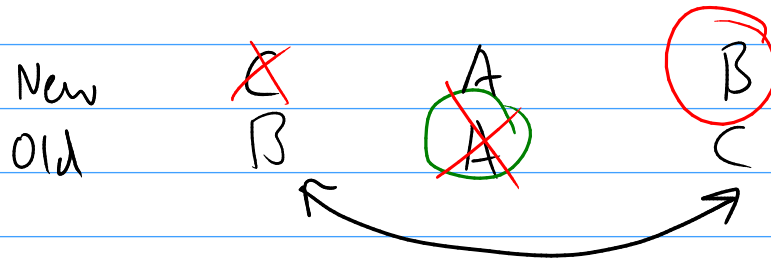
Sort items by ascending order of value
Run our original DP!
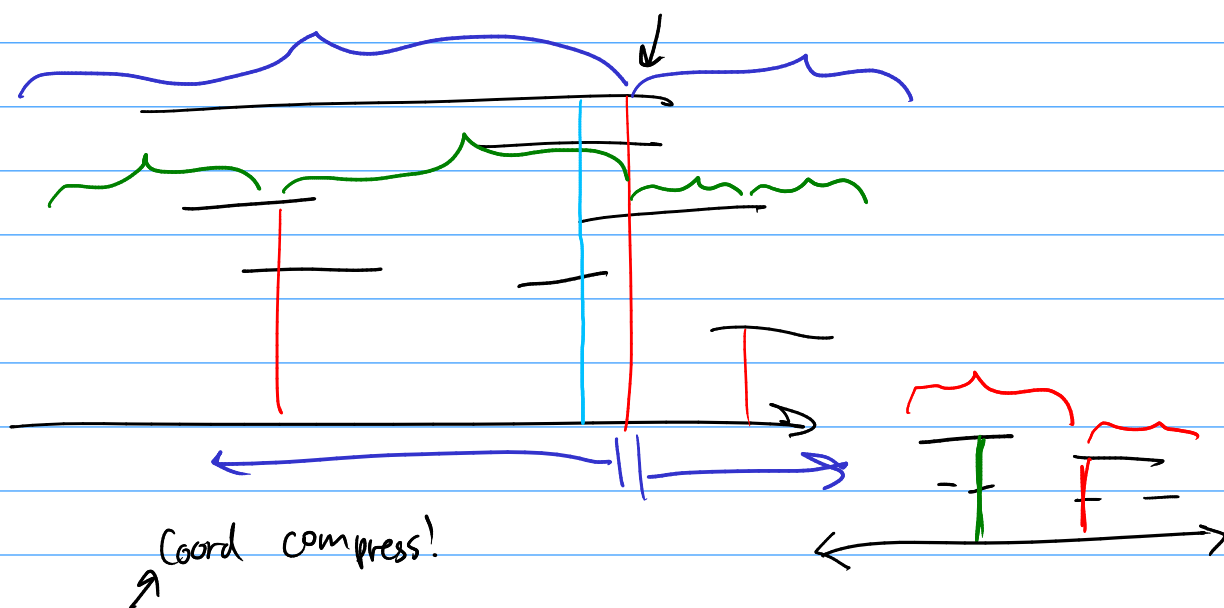
$$Ans = dp[N][k]$$

Outer Space Invaders

4
3
2
1
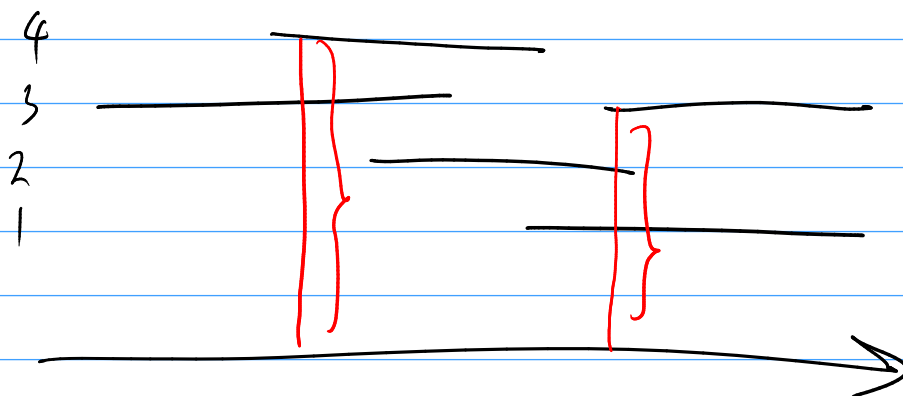
Minimise sum of heights of attacks

$$n \le 300$$

times, heights $\le 10^4$

Coord compress!

$dp[l][r] = $ Optimal answer for aliens completely in range $[l, r]$

$O(n) \rightarrow$ which ranges

Try each of the $O(n)$ starting points as our attack

$\rightarrow$ Hit everything that intersects

$dp[l][m-1] \quad dp[m][r]$