

Rebel Solution

Greedy Solution:

Let us binary search on the answer, that is, the initial units required. Let u be the initial units. Let us assume bhairava defends all the enemies from the start without skipping any villain. Let us assume after defending the first i villains, bhairava's units become less 0. Which means,

$$u + \sum_{j=1}^i a_j < 0$$

Then bhairava cannot move any further and must have skipped one villain.

Who should he skip?

It turns out that skipping the villain with minimum units till now is the most profitable. Then bhairava's units now become

$$u + \sum_{j=1}^i a_j - \min(a_1 \dots a_i)$$

Now, he should continue defending the remaining villains without skipping anyone. If again his units becomes less than 0 then more initial units are required. Else if he does not lose Sumathi, then we can check for lesser initial units, which suggests a perfect binary search solution.

Time Complexity: $O(n \cdot \log(n \cdot \sum_{i=1}^n a_i))$ per test case.

Dp Solution:

This solution checks the minimum initial units required by skipping each villain. If u_j is the negative of initial number of units required to defend villains $j \dots n$ without skipping any villain, then,

$$u_{j-1} = \min(0, u_j + a_{j-1})$$

For examples, if $a = [-1]$ then $u_1 = -1$ and $-u_1$, that is, 1 is the initial units required to defend all the villains without skipping anyone. This can be precomputed and stored in an array. Let s_i denote the sum of the units of first i villains. Let us iterate from $1 \dots n$. Then for skipping the k^{th} villain, minimum initial units u required is,

$$u = -\min(0, \min(s_1 \dots s_{k-1}, s_{k-1} + u_{k+1}))$$

$\min(s_1 \dots s_{k-1})$ can be calculated while iterating from the start. It is similar to the kadane's algorithm.

Time Complexity: $O(n)$ per test case.