

Problem 3506: Find Time Required to Eliminate Bacterial Strains

Problem Information

Difficulty: Hard

Acceptance Rate: 60.97%

Paid Only: Yes

Tags: Array, Math, Greedy, Heap (Priority Queue)

Problem Description

You are given an integer array `timeReq` and an integer `splitTime`.

In the microscopic world of the human body, the immune system faces an extraordinary challenge: combatting a rapidly multiplying bacterial colony that threatens the body's survival.

Initially, only one **white blood cell** (**WBC**) is deployed to eliminate the bacteria. However, the lone WBC quickly realizes it cannot keep up with the bacterial growth rate.

The WBC devises a clever strategy to fight the bacteria:

* The `i`th bacterial strain takes `timeReq[i]` units of time to be eliminated. * A single WBC can eliminate **only one** bacterial strain. Afterwards, the WBC is exhausted and cannot perform any other tasks. * A WBC can split itself into two WBCs, but this requires `splitTime` units of time. Once split, the two WBCs can work in **parallel** on eliminating the bacteria. * Only one WBC can work on a single bacterial strain. Multiple WBCs **cannot** attack one strain in parallel.

You must determine the **minimum** time required to eliminate all the bacterial strains.

Note that the bacterial strains can be eliminated in any order.

Example 1:

Input: `timeReq = [10,4,5]`, `splitTime = 2`

****Output:**** 12

****Explanation:****

The elimination process goes as follows:

* Initially, there is a single WBC. The WBC splits into 2 WBCs after 2 units of time. * One of the WBCs eliminates strain 0 at a time $t = 2 + 10 = 12$. The other WBC splits again, using 2 units of time. * The 2 new WBCs eliminate the bacteria at times $t = 2 + 2 + 4$ and $t = 2 + 2 + 5$.

****Example 2:****

****Input:**** timeReq = [10,4], splitTime = 5

****Output:**** 15

****Explanation:****

The elimination process goes as follows:

* Initially, there is a single WBC. The WBC splits into 2 WBCs after 5 units of time. * The 2 new WBCs eliminate the bacteria at times $t = 5 + 10$ and $t = 5 + 4$.

****Constraints:****

$2 \leq \text{timeReq.length} \leq 105$ $1 \leq \text{timeReq}[i] \leq 109$ $1 \leq \text{splitTime} \leq 109$

Code Snippets

C++:

```
class Solution {
public:
    long long minEliminationTime(vector<int>& timeReq, int splitTime) {

    }

};
```

Java:

```
class Solution {  
    public long minEliminationTime(int[] timeReq, int splitTime) {  
  
    }  
}
```

Python3:

```
class Solution:  
    def minEliminationTime(self, timeReq: List[int], splitTime: int) -> int:
```