

2295. Minimum Time to Finish the Race

Difficulty : Hard

<https://leetcode.com/problems/minimum-time-to-finish-the-race>

You are given a **0-indexed** 2D integer array `tires` where `tires[i] = [fi, ri]` indicates that the i^{th} tire can finish its x^{th} successive lap in $f_i * r_i^{(x-1)}$ seconds.

- For example, if $f_i = 3$ and $r_i = 2$, then the tire would finish its 1st lap in 3 seconds, its 2nd lap in $3 * 2 = 6$ seconds, its 3rd lap in $3 * 2^2 = 12$ seconds, etc.

You are also given an integer `changeTime` and an integer `numLaps`.

The race consists of `numLaps` laps and you may start the race with **any** tire. You have an **unlimited** supply of each tire and after every lap, you may **change** to any given tire (including the current tire type) if you wait `changeTime` seconds.

Return *the **minimum** time to finish the race*.

Example 1:

Input: `tires = [[2,3],[3,4]]`, `changeTime = 5`, `numLaps = 4`

Output: 21

Explanation:

Lap 1: Start with tire 0 and finish the lap in 2 seconds.

Lap 2: Continue with tire 0 and finish the lap in $2 * 3 = 6$ seconds.

Lap 3: Change tires to a new tire 0 for 5 seconds and then finish the lap in another 2 seconds.

Lap 4: Continue with tire 0 and finish the lap in $2 * 3 = 6$ seconds.

Total time = $2 + 6 + 5 + 2 + 6 = 21$ seconds.

The minimum time to complete the race is 21 seconds.

Example 2:

Input: `tires = [[1,10],[2,2],[3,4]]`, `changeTime = 6`, `numLaps = 5`

Output: 25

Explanation:

Lap 1: Start with tire 1 and finish the lap in 2 seconds.

Lap 2: Continue with tire 1 and finish the lap in $2 * 2 = 4$ seconds.

Lap 3: Change tires to a new tire 1 for 6 seconds and then finish the lap in another 2 seconds.

Lap 4: Continue with tire 1 and finish the lap in $2 * 2 = 4$ seconds.

Lap 5: Change tires to tire 0 for 6 seconds then finish the lap in another 1 second.

Total time = $2 + 4 + 6 + 2 + 4 + 6 + 1 = 25$ seconds.

The minimum time to complete the race is 25 seconds.

Constraints:

- $1 \leq \text{tires.length} \leq 10^5$
- $\text{tires}[i].\text{length} == 2$
- $1 \leq f_i, \text{changeTime} \leq 10^5$
- $2 \leq r_i \leq 10^5$
- $1 \leq \text{numLaps} \leq 1000$