Hash Me Out

Assignment 5
Data Structures and Algorithms

Problem Statement: You have a container C, which is initially empty. You have to perform 3 types of operations :

1. Add number x to the container C
2. Delete number exactly one occurrence of x from the container C if it there in the container, otherwise do not do anything
3. Compute the hash of the container C

Hash function is defined as :

$$hash = (\sum_{i=1}^{n} C_i * P^{rank(C_i)})\%(10^9 + 7)$$

Here, n is the total number of elements in the container at this time, C_i is the i^{th} element of the container and $rank(C_i)$ is defined as the number of elements from the container which are not greater than C_i.
You are given Q operations, where each operation is one of the above three.
Let you stored all the hashes you computed in an array H. You are asked to compute

$$V = \prod X^{H[i]}$$

where $H[i]$ is the i^{th} hash value you calculated

Input
First line of input contains three integers denoting the number of operations Q, the value P and the value X.
Q lines will be followed, each one containing one of the following three operations :
$A\ x$: Add element x to the container
$D\ x$: Delete element x from the container
H : Compute the hash of the container
Output
Output the value V. Since this value can be large, print its modulus $10^9 + 7$.
Constraints
$1 \leq Q, P \leq 10^6$
$0 \leq x \leq 10^9$
$1 \leq X \leq 10^9$
Time Limit: 5 seconds
Memory Limit: 256 MB

Sample Test Case

Input	Output
6 2 2 A 1 A 2 H A 3 D 2 H	16777216
11 2 2 A 3 A 2 A 3 A 2 H D 2 D 3 H D 2 A 1 H	495194301

Explanation
For first test case :
Third operation will compute hash as following:
Elements in C are - 1 2 and their corresponding ranks are 1 2
$1 * P^{rank(1)} + 2 * P^{rank(2)} = 1 * 2^1 + 2 * 2^2 = 10$
Sixth operation will compute hash as following:
Elements in C are - 1 3 and their corresponding ranks are 1 2
$1 * P^{rank(1)} + 3 * P^{rank(3)} = 1 * 2^1 + 3 * 2^2 = 14$
Answer is $2^{10} * 2^{14} = 16777216$

For second test case:
At 5th operation
Elements in C are - 2 2 3 3 and their corresponding ranks are 2 2 4 4
$2 * P^{rank(2)} + 2 * P^{rank(2)} + 3 * P^{rank(3)} + 3 * P^{rank(3)} = 2 * 2^2 + 2 * 2^2 + 3 * 2^4 + 3 * 2^4 = 112$
At 8th operation
Elements in C are - 2 3 and their corresponding ranks are 1 2
$2 * P^{rank(2)} + 3 * P^{rank(3)} = 2 * 2^1 + 3 * 2^2 = 16$
At 11th operation
Elements in C are - 1 3 and their corresponding ranks are 1 2
$1 * P^{rank(1)} + 3 * P^{rank(3)} = 1 * 2^1 + 3 * 2^2 = 14$
Answer is $(2^{112} * 2^{16} * 2^{14}) \% (10^9 + 7) = 495194301$