

Assignment 3

APRG TAs

March 2022

Question 1

Your task is to maintain a subset S of points over \mathbb{N}^2 . The points are of the form (x, y) with colour index 0 or 1. You have to support two types of queries:

1. **ADD x y c** - Add point (x, y) of colour index c to S .
2. **MAX l r** - Output $\max\{(y_1 - y_0) \mid (x_0, y_0), (x_1, y_1) \in S; c(x_0, y_0) = 0; c(x_1, y_1) = 1; l \leq x_0, x_1 \leq r\}$. If there are no points of a particular colour index in the interval $[l, r]$, output **NULL** instead.

The first line of the input is an integer Q , the number of queries. The next Q lines contain queries as described above. For queries of type 2, output the result in a new line.

Sample Input:

```
7
ADD 3 9 1
ADD 4 5 0
ADD 5 8 1
MAX 4 5
ADD 4 9 0
MAX 3 5
MAX 3 3
```

Sample Output:

```
3
4
NULL
```

Note: for this problem, we are expecting a runtime of $O(Q \log Q)$, although partial marks may be awarded for suboptimal solutions.