CodeForces #162
Div1-E
RodeSideTrees

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Problem summary

- You should process queries:
  Type1: Plant a tree with height h. (h<=10)
  Type2: Cut the x-th tree from west. (x<=10)

- After each query, you should calculate the length of LIS of height of tree(from west to east).

- Before each query, trees grow 1 meter.

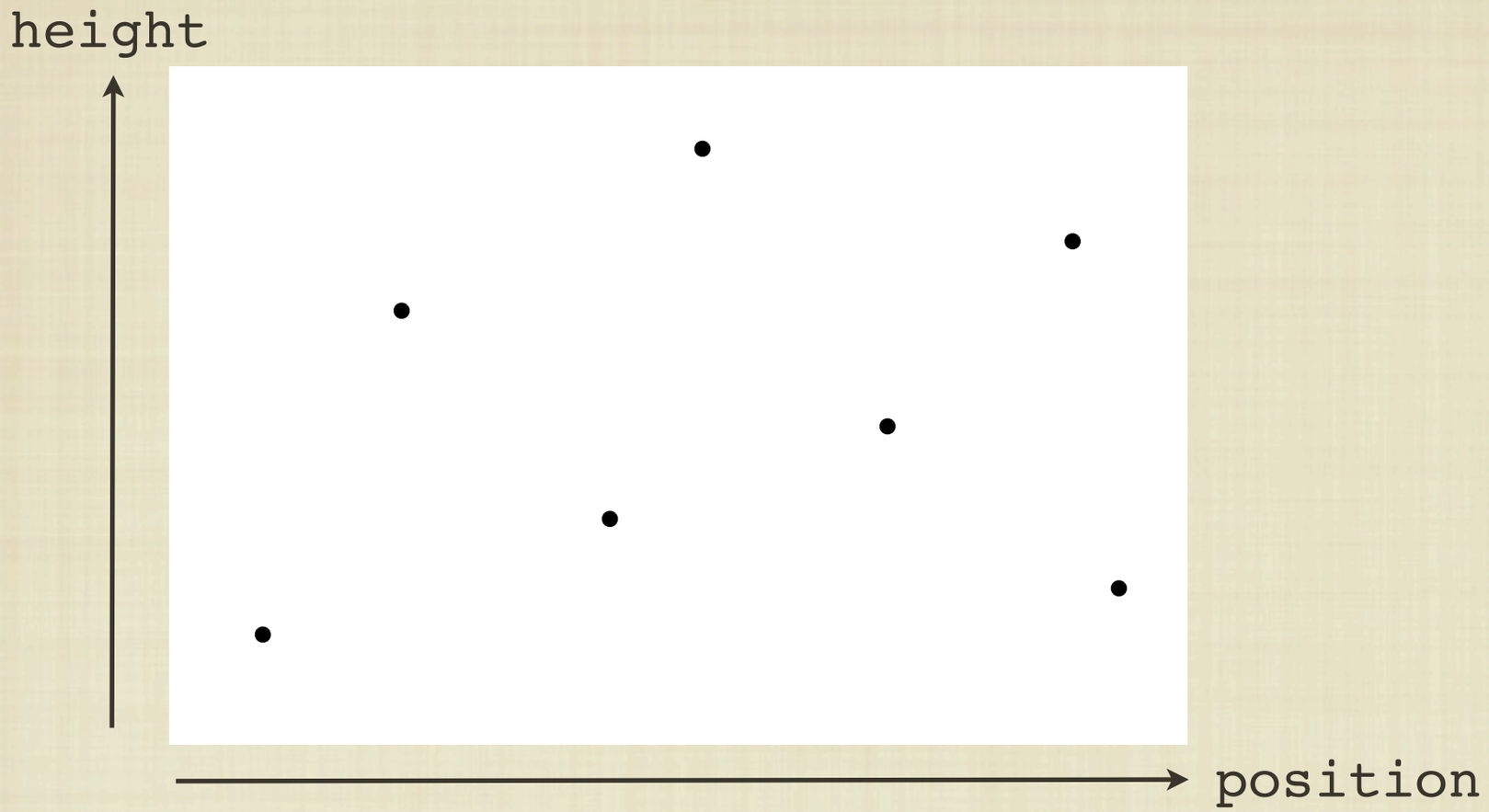
- N: The number of trees ≦ 10^5
  M: The number of queries ≦ 2*10^5

Solution

- When you want to plant a tree with height h at time t, you should plant a tree with height h-t instead. Then you can ignore the growth of the trees.

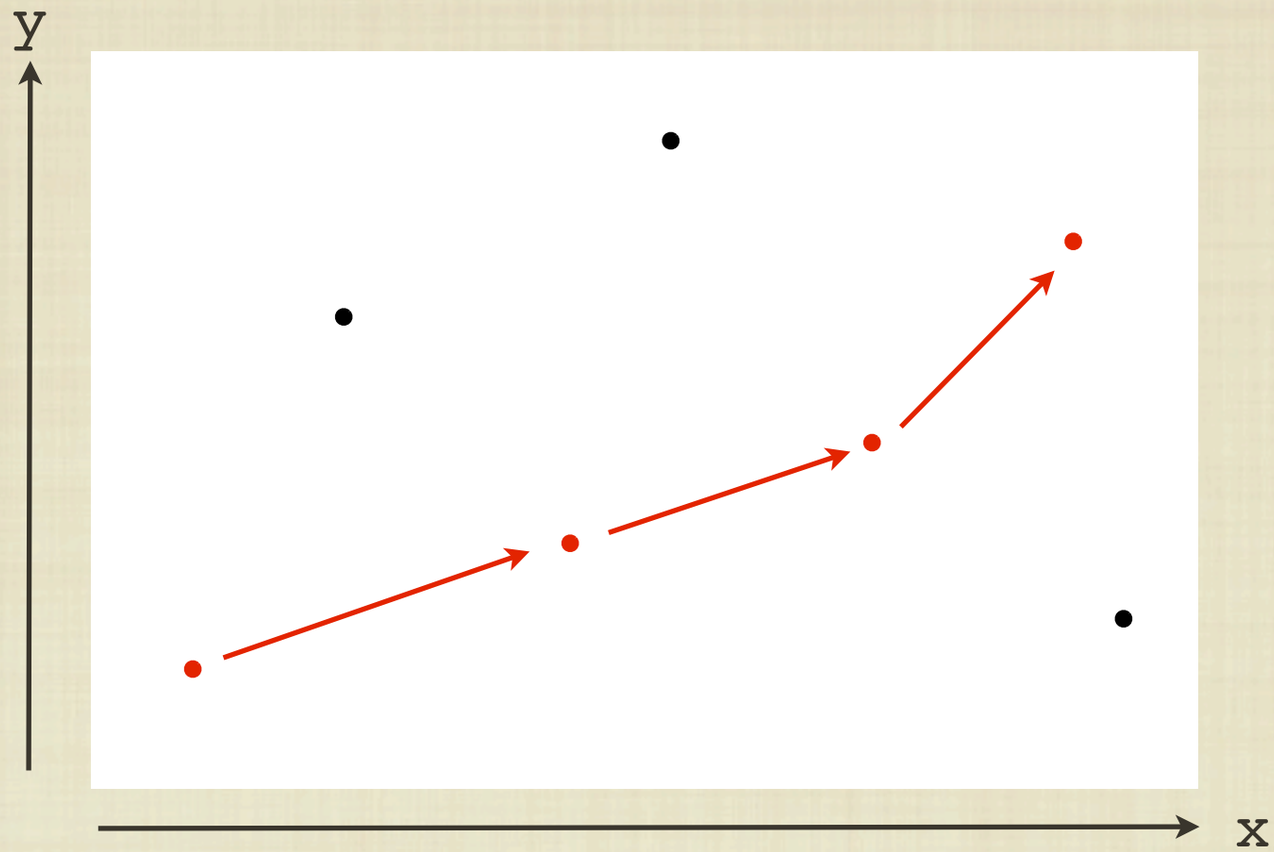
- And plot trees on a x-y plane: x-coordinate is the position and y-coordinate is the modified height (h-t).

Solution



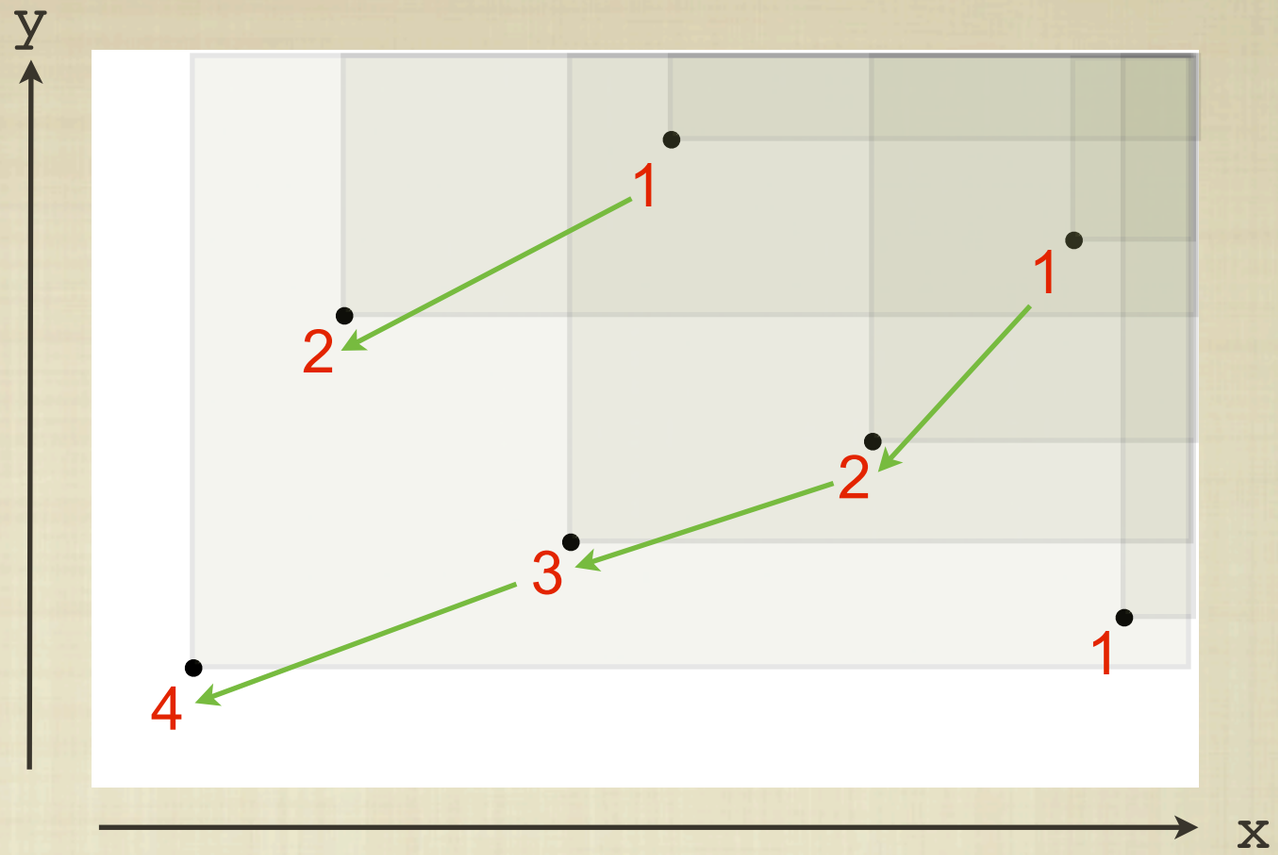
- like this picture
- then.....

Solution



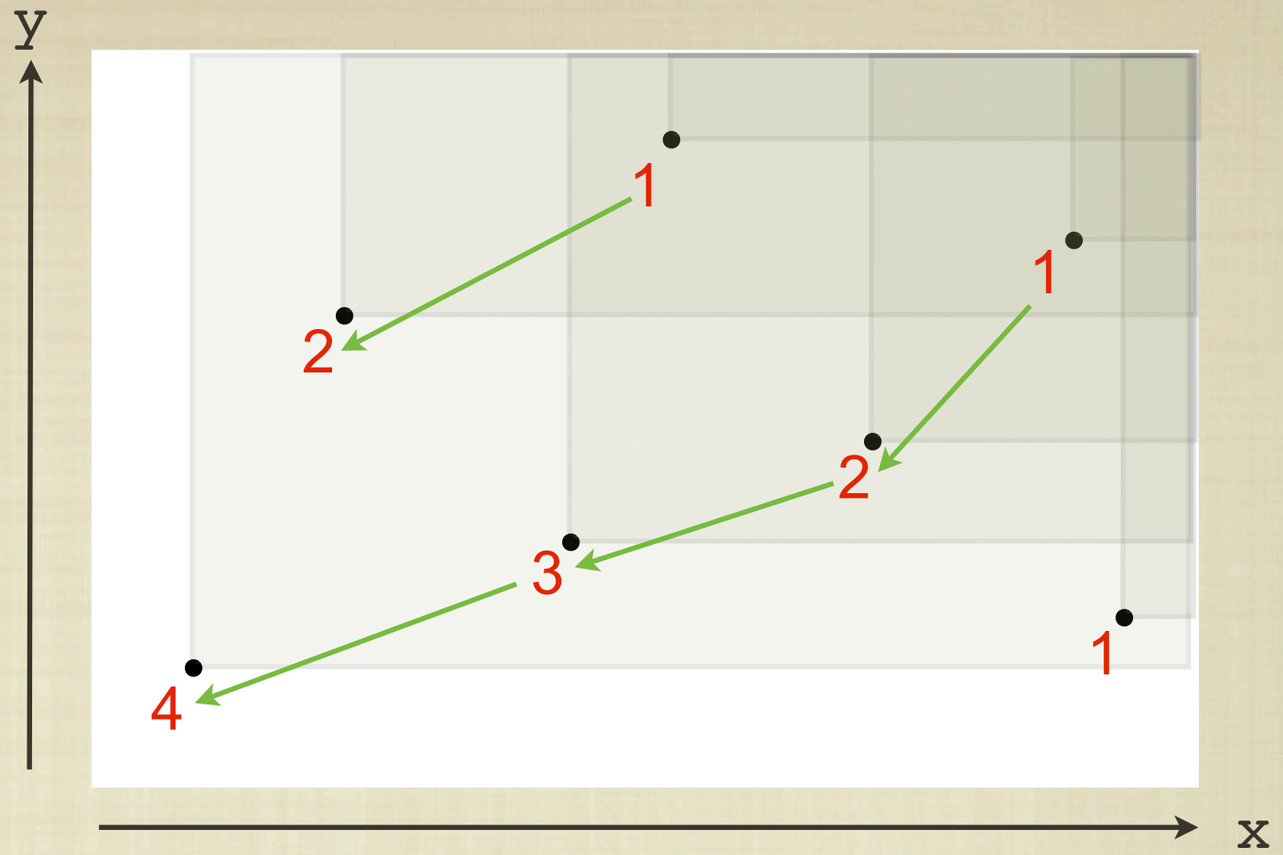
- LIS is the longest sequence of points P_1, P_2, ... such that
- x(P_1) < x(P_2) < ...
- y(P_1) < y(P_2) < ...

Solution



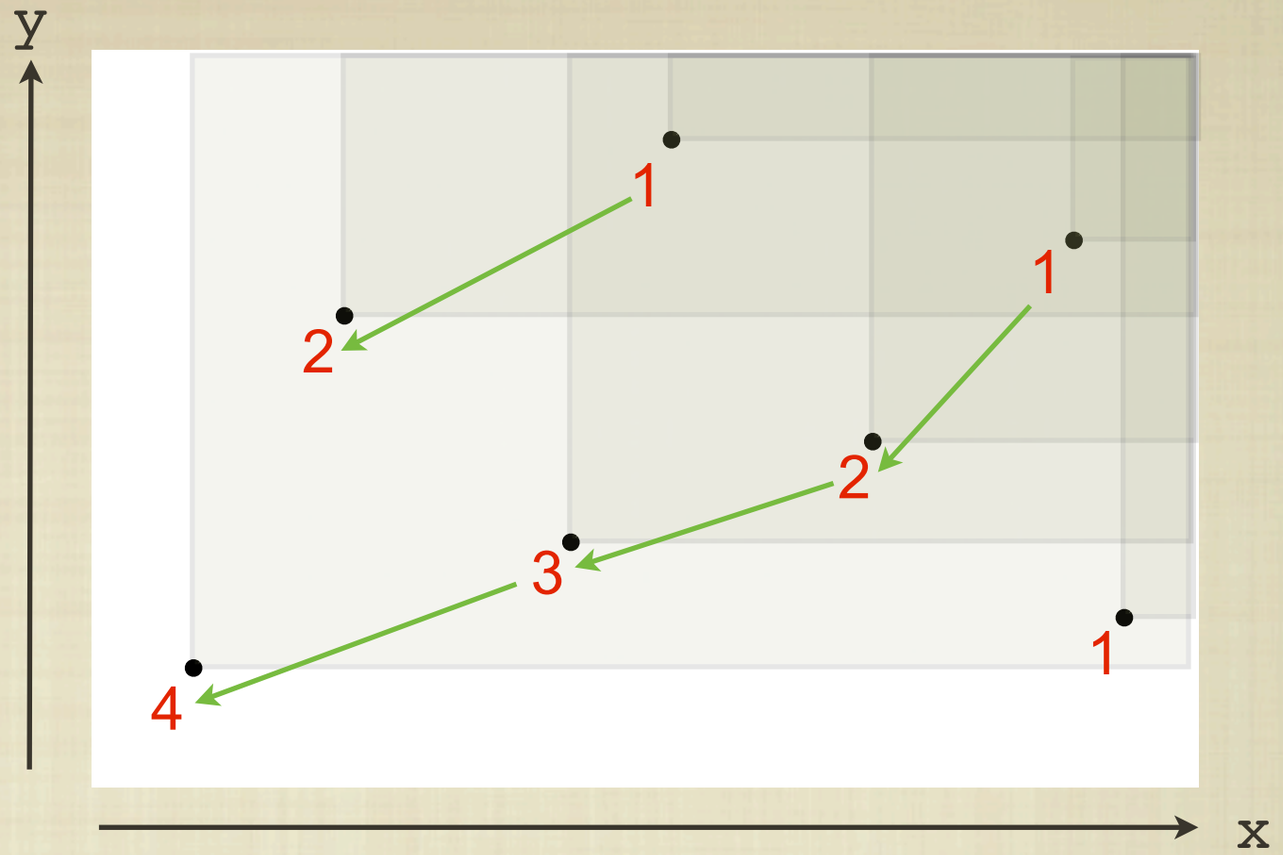
- At each point write the length of the longest increasing sequence that starts from the point.
- The value written on point p = (the maximal value written in the rectangle whoselower-left corner is p) + 1.

Solution



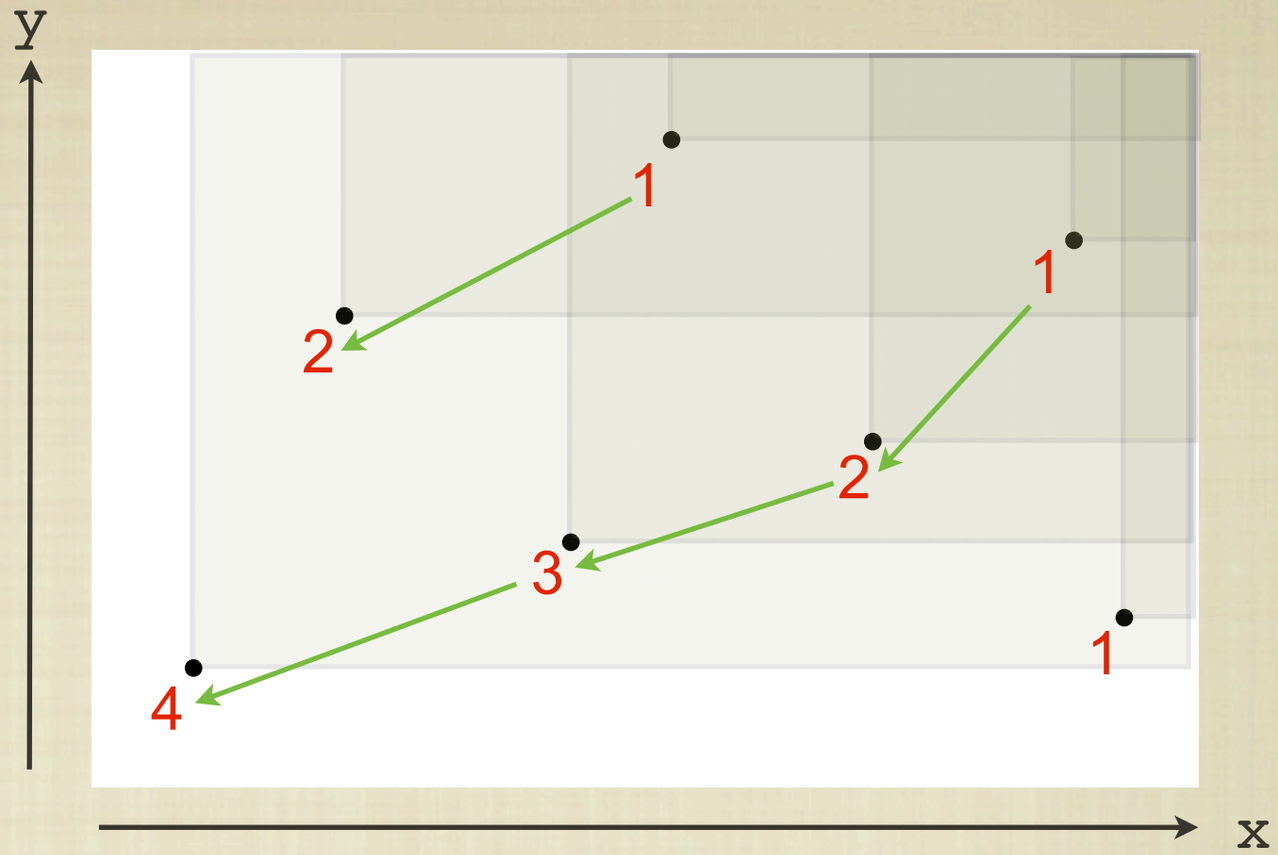
- How should we process queries?

Solution



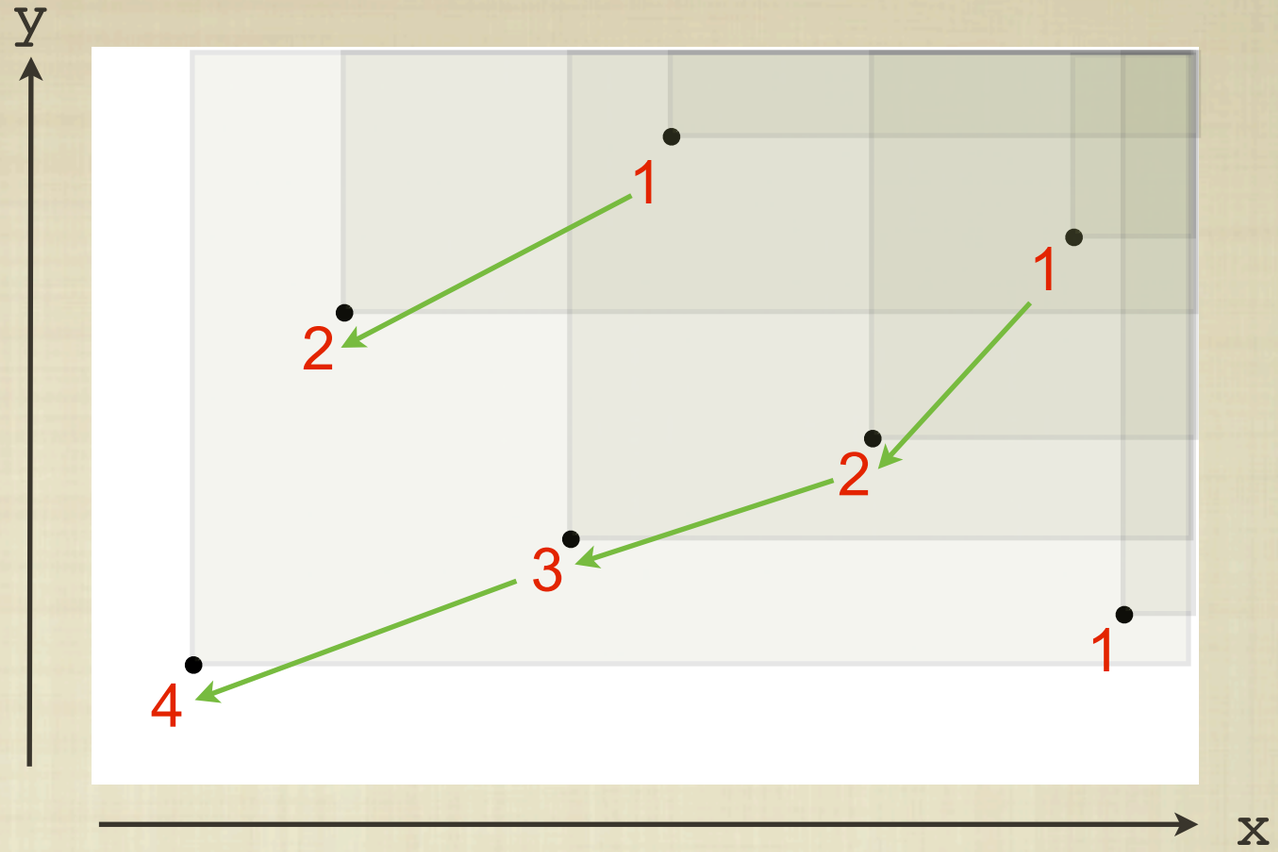
- Planting query -> plot a new point
- The new point will be one of the ten points that have the smallest y-coordinate.
- To process this query, erase all values written below the new point first and rewrite the values to those points from top to bottom.

Solution



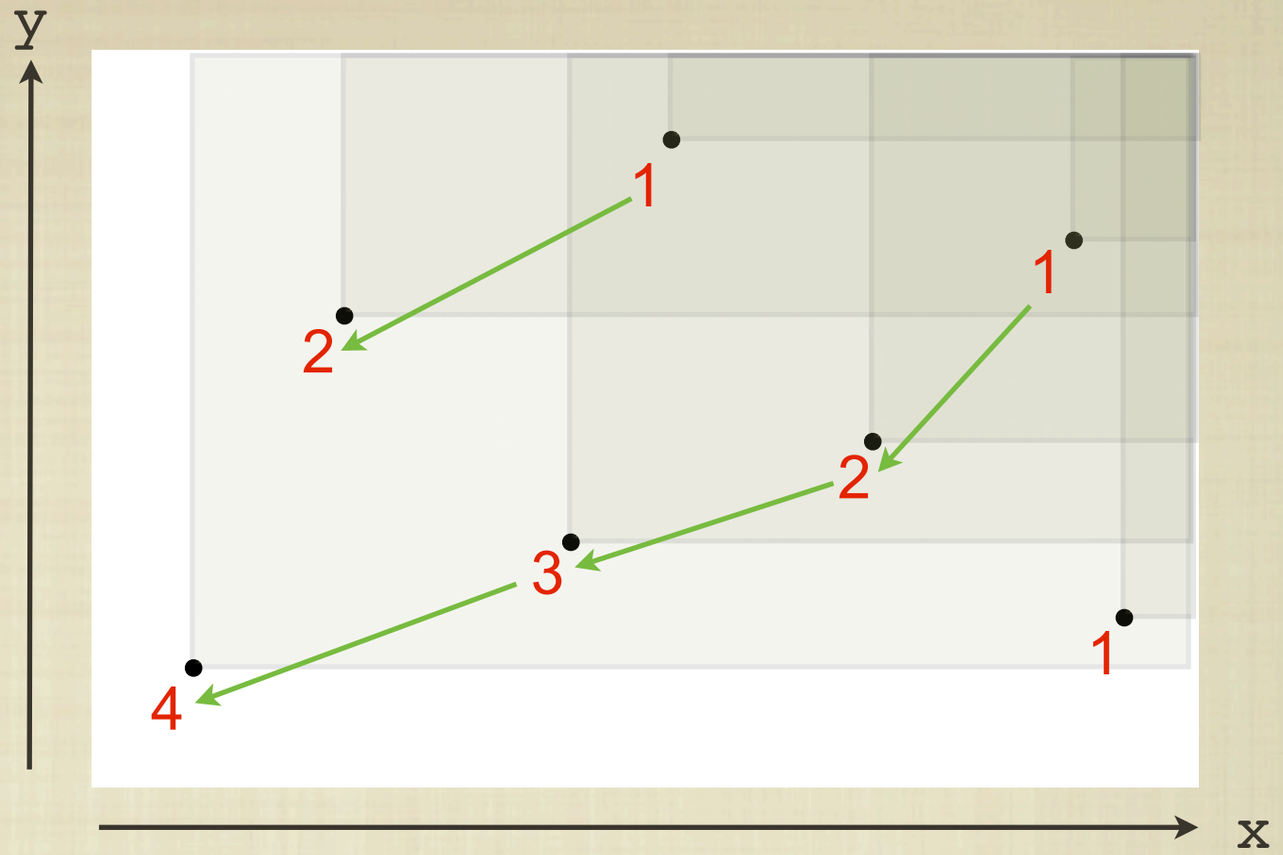
- Cutting query -> remove a point
- Similarly the removed point will be one of the ten points that have the smallest x-coordinate.
- So you can erase all values written on those points and rewrite correct values from right to left.

Solution



- What data structures do we need?
- 2D segtree?
  -> too slow :(

Solution



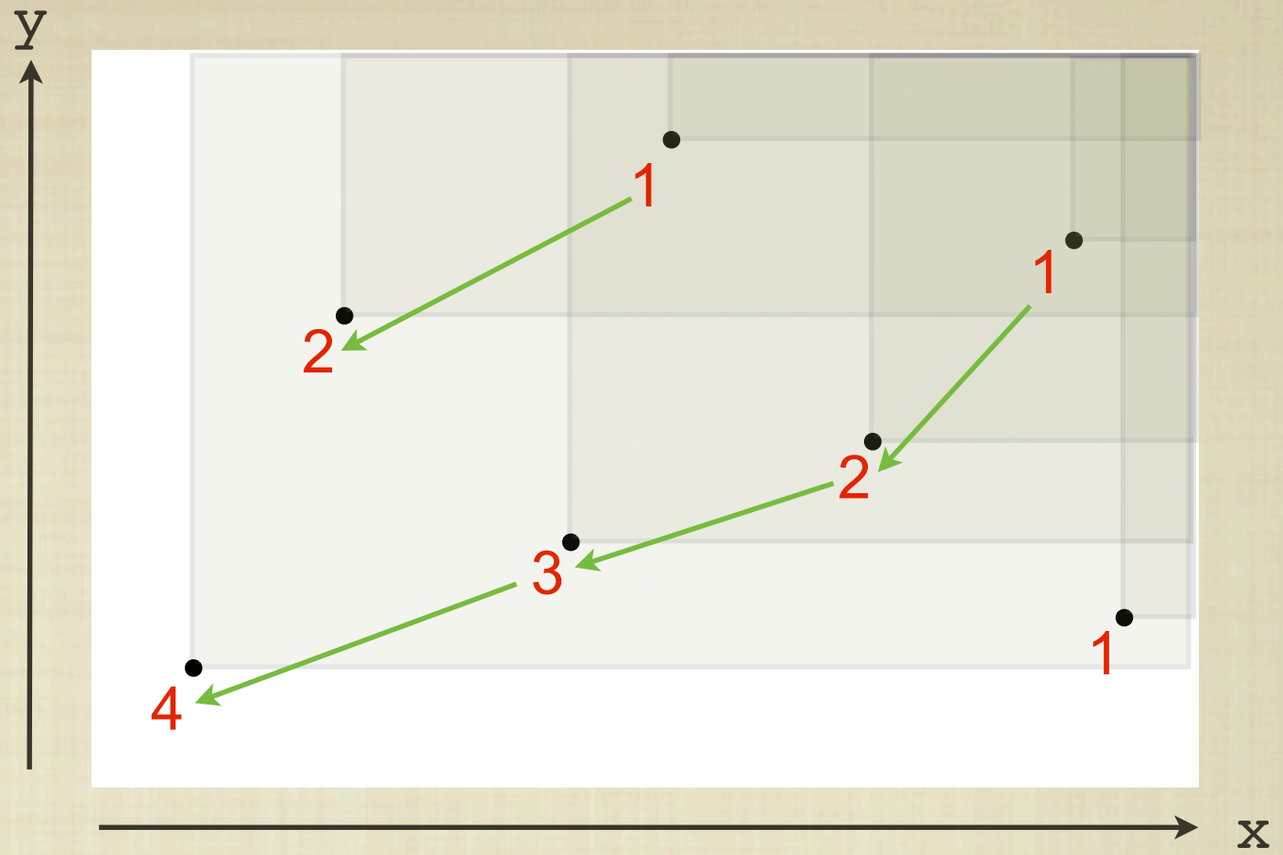
- Make two segment trees: let's call them segx and segy.

  segx : x-directional segtree
  segy : y-directional segtree

- For planting queries use segx.

- For cutting queries use segy.

Solution



- The i-th leaf of segx contains the value written on the point whose x-coordinate is x and non-leaf nodes of the segment trees have the maximum of children of the node.
- Define segy similarly.

Time Complexity

- O(N * 10 * log N)

Thank you for watching!