**«The way home»**

If we consider small restrictions, the solution to the problem may be as follows. Let's build a graph that corresponds to a city without development. The vertices of the graph will correspond to crossroads, and the edges will correspond to roads. Then delete all the edges in the graph that fall into built-up blocks(the complexity of this procedure is equal to O(n \* city area)). In the resulting graph, we will start a breadth-first search from the point (0, 0) to determine the distances to all possible locations of the future Mayor's house and choose the closest one. By restoring the path when implementing a search in width in the standard way, you can find the points of rotation of the path.

If the area of the city is large, but there are not many blocks of development, then you can use *coordinate compression*. To do this, when building the graph, we will use only the horizontal and vertical lines where the city hall, future houses, or the boundaries of building blocks are located.

In the case of maximum restrictions, the solution to the original problem can be as follows. We will solve the problem separately for each possible location of the future Mayor's house. Let the house in question have coordinates (*xi*, *yi*). We will assume that что *xi* ³ 0, *yi* ³ 0. it is Easy to understand what needs to be changed in the solution to consider the cases of negative coordinates as well.

Let's look at the ways that go out of the city hall to the North. There are two possible paths:

1. Go North, then turn right (to the East), and then left (again to the North); in this case, any segment of the path can have a length equal to 0;
2. Go North, crossing the horizontal street where the Mayor's house will be located, then turn right (to the East), and then right again (back to the South).

Comparing these two paths, we can say that the first path is always shorter than the second.

Next, we will find out how far we can travel from the point (0, 0) to the North (see figure 1). To do this, we will go through all the blocks of development and cross them with a ray that goes from the origin to the North. Let's assume that we can pass without hindrance to the point (0, R). If the house in question is located on this segment, the problem is solved.

Similarly, consider a ray that goes from point (*xi*, *yi*) to the South, and find a point (*xi*, *S*) with a minimum positive ordinate S, such that from this point we can easily reach the Mayor's house. If S > R, there is no path of the first type. Otherwise, we will try to find the minimum value of t on the segment [S, R], such that we can travel from point (0, t) to point (*xi*, *t*).

To do this, consider all blocks that intersect with the band 0 ≤ *x* ≤ *xi*. Consider their projections on the *Оу* axis, find the union of these projections (open intervals), and find a point Y on the *Оу* axis with a minimum coordinate at least S, not covered by the union of intervals.

To do this, you can sort the beginning and end of the intervals together and go through these points, counting the *balance*. If Y is at most R, then the path you are looking for has a right turn at point (0, Y) and a left turn at point (xi, Y). Otherwise, there is no path of the first type, and you need to go to the search for the second type of path.

If *R* ≤ yi, then there is no path of the second kind either. Otherwise, consider a ray that goes from point (*xi*, *yi*) to the North (see Fig. 2), and find the farthest point S on it, which can be easily reached from point (*xi*, *yi*).

Consider the segment [*x*i, min{*R*, *S*}] and find the minimum point Y on it that is not covered by the union of interval projections discussed above. If such a point Y exists, then of all the paths that exit from point (0, 0) to the North, the shortest path has turns at points (0, Y) and (*xi*, *Y*). Otherwise, there are no such paths.

Note that if *Y* = *yi*, the second turn is not necessary.

This algorithm has an asymptotic complexity O(*kn* log *n*).

