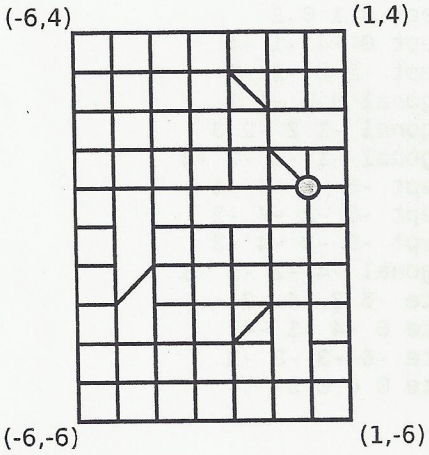
Longwood Invitational (Fall 2011)

Problem 7: Chicago Distances (Contributed by Don Blaheta, Longwood University)

Many cities are laid out with what is basically a grid of streets, with some parks (removing some of the grid streets) and some shortcut boulevards (adding some diagonals to the grid). The Manhattan borough of New York City is famous for being almost entirely a grid; Chicago is also a grid (with a lot more diagonals than Manhattan), as are most sizable cities west of the Mississippi.

A "Manhattan distance" is defined as the distance one would walk or drive if the grid were perfect and complete, with no diagonals available. Real life is messier, but since the phrase "Manhattan distance" was taken, in this problem we'll define "Chicago distances" instead.

A Chicago distance is a number of blocks between two points along actual roads that can be driven. (Diagonal roads are slightly longer than the ones aligned to the grid, but the speed limit is higher, so they still count as a single block.) Where the roads strictly conform to the grid, this will be the same as the Manhattan distance. Where there are some grid roads missing, it might be higher (to go around the park). Where there are diagonals that can be used, it might be lower. The only way to compute it is to find the best path and report its length.



Consider the city illustrated to the right. Like most grid cities, it is laid out on a Cartesian grid with zero streets and numbers that increase to the north, south, east, and west; here we consider east and north to be positive x and positive y respectively, with west and south thus being negative x and negative y. On this map the corners are labeled with their coordinates and the point (0, 0) is labelled with a grey dot. The Chicago distance between the points (−6, 3) and (−4, −2) is 7, because one could drive east two blocks and south five blocks along unbroken grid-aligned streets. However, the Chicago distance between (0, −4) and (−1, −4) is 3, because a driver would have to go north one block, then west, then south (or south then west then north, but the distance is the same). The distance from (−6, −3) and (−3, −2) is only 3, because the driver could drive east, then use the northeast diagonal, then go east again.

Input

The first line of the input file indicates the number of cities to be analyzed. Each city begins with a line containing four numbers: the westernmost and easternmost x coordinates, and the southernmost and northernmost y coordinates. These numbers will have an absolute value no greater than 255.

The next section of the city spec contains some number of lines (in arbitrary order) of the form "except x_1 y_1 x_2 y_2" or "diagonal x_1 y_1 x_2 y_2" which, respectively, remove or add segments to the grid. Each segment is guaranteed to be exactly one block in length (again, counting a 1 × 1 diagonal as one block). Next, the city specification contains some number of lines of the form "route x_1 y_1 x_2 y_2", requesting the Chicago distance between (x_1 , y_1) and (x_2 , y_2).

These two locations will be distinct and there will exist a path between them. Finally, the last line of each city specification is simply "end".

Output

The output should be the Chicago distances corresponding to each route requested in the input, each on its own line.

Example

The sample input below includes two city specifications, the first corresponding to this very small city:

and the second corresponding to the city shown on the previous page.

Input:

```
2
-1 1 -1 1
diagonal 0 0 1 1
except 0 0 1 0
route -1 0 1 0
end
-6 1 -6 4
except 0 1 0 2
except 0 -4 -1 -4
except -2 0 -2 -1
diagonal 0 0 -1 1
diagonal -1 2 -2 3
diagonal -1 -3 -2 -4
except -5 -1 -4 -1
except -5 -2 -4 -2
except -5 -3 -4 -3
diagonal -4 -2 -5 -3
route -6 3 -4 -2
route 0 -4 -1 -4
route -6 -3 -3 -2
route 0 0 0 3
end
```

Output:

```
3
7
3
3
4
```