British Informatics Olympiad Final

26–28 March, 2004
Sponsored by Lionhead Studios

As the Pigeon Flies

Recent research has shown that pigeons partially navigate by man-made structures, such as roads. Plans are already afoot in the cutthroat world of pigeon racing to take advantage of this recent development, and help train homing pigeons to find the fastest route home.

A square grid is laid out on a large field, with markers at all the grid points. Pigeons are trained to fly directly between adjacent markers (horizontally, vertically or diagonally); in other words pigeons, whose routes never take them to the edge of the field, always have the choice of 8 adjacent markers. It takes a pigeon 2 seconds to fly between two grid points that are adjacent horizontally or vertically, and 3 seconds to fly the more intellectually challenging diagonals.

To add a challenge to the training, cats are tethered to some of the markers. A cat will only attack a pigeon if it is closer than all the other cats. Pigeons, thanks to evolution, are aware of cat behaviour, and will only fly to markers where there is no risk of attack; ie. those markers that are equidistant from the their two closest cats. (It is not part of the training to teach the pigeons that the cats are tethered.)

For this question you should consider that the distance between a cat and a pigeon is the sum of their horizontal and vertical distances. Eg. The distance between a cat at (1,1) and a pigeon at (3,4) is $2 + 3 = 5$. The world of pigeon racing is complex.

Write a program which, given the co-ordinates of the cats, and a start and end position for the pigeon, calculates the fastest safe route between the two points. For the input, all co-ordinates will be given as an x co-ordinate followed by a y co-ordinate; all these values will be integers between 0 and 2^{20}. The first line of the input will contain the start co-ordinates for the pigeon. The second line of the input will contain the end co-ordinates for the pigeon. The next line will contain a single integer n ($2 \leq n \leq 100$) indicating the number of cats. The remaining n lines will list the co-ordinates for the cats, each on a separate line. You should output a single number, the fastest possible time for the pigeon to travel between the start and end positions.

NB: Every x and y co-ordinate for a cat will be an even number. The start and end positions for the pigeon will be safe positions and a route, that only goes between safe markers, will exist between the start and the end.

Sample Input

```
14 10
13 18
6
10 18
12 10
14 14
16 10
16 18
22 14
```

Sample Output

```
24
```