

IOI 2010 Tasks

Day 1 Task 3: Quality of Living



Cities in Alberta tend to be laid out as rectangular grids of blocks. Blocks are labeled with coordinates 0 to $R-1$ from north to south and 0 to $C-1$ from west to east.

The quality of living in each particular block has been ranked by a distinct number, called *quality rank*, between 1 and $R \cdot C$, where 1 is the best and $R \cdot C$ is the worst.

The city planning department wishes to identify a rectangular set of blocks with dimensions H from north to south and W from west to east, such that the median quality rank among all blocks in the rectangle is the best. H and W are *odd* numbers not exceeding R and C respectively. The *median quality rank* among an odd number of quality ranks is defined to be the quality rank m in the set such that the number of quality ranks better than m equals the number of quality ranks worse than m .

You are to implement a procedure **rectangle**(R, C, H, W, Q) where R and C represent the total size of the city, H and W represent the dimensions of the set of blocks, and Q is an array such that $Q[a][b]$ is the quality rank for the block labeled a from north to south and b from west to east.

Your implementation of **rectangle** must return a number: the best (numerically smallest) possible median quality rank of an H by W rectangle of blocks.

Each test run will only call **rectangle** once.

Example 1

$R=5, C=5, H=3, W=3,$

$Q=$

5	11	12	16	25
17	18	2	7	10
4	23	20	3	1
24	21	19	14	9
6	22	8	13	15

For this example, the best (numerically smallest) median quality rank of 9 is achieved by the middle-right rectangle of Q shown in bold. That is, $\text{rectangle}(R, C, H, W, Q) = 9$

Example 2

$R=2, C=6, H=1, W=5,$

$Q=$

6	1	2	11	7	5
9	3	4	10	12	8

For this example the correct answer is 5.

Subtask 1 [20 points]

Assume R and C do not exceed 30.

Subtask 2 [20 points]

Assume R and C do not exceed 100.

Subtask 3 [20 points]

Assume R and C do not exceed 300.

Subtask 4 [20 points]

Assume R and C do not exceed 1 000.

Subtask 5 [20 points]

Assume R and C do not exceed 3 000.

Implementation Details

- Use the [RunC programming and test environment](#)
- Implementation folder: /home/ioi2010-contestant/quality/ (prototype: [quality.zip](#))
- To be implemented by contestant: quality.c or quality.cpp or quality.pas
- Contestant interface: quality.h or quality.pas
- Grader interface: *none*
- Sample grader: grader.c or grader.cpp or grader.pas
- Sample grader input: grader.in.1 grader.in.2 etc.
Note: The first line of input contains: R,C,H,W The following lines contain the elements of Q, in row-major order.
- Expected output for sample grader input: grader.expect.1 grader.expect.2 etc.
- Compile and run (command line): `runc grader.c` or `runc grader.cpp` or `runc grader.pas`
- Compile and run (gedit plugin): *Control-R*, while editing any implementation file.
- Submit (command line): `submit grader.c` or `submit grader.cpp` or `submit grader.pas`
- Submit (gedit plugin): *Control-J*, while editing any implementation or grader file.