Hasso Plattner Institut
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Sommersemester 2017

Woche 14 – (Adv.) Competitive Programming

Abgabe 31.07.2017 17:00 Uhr, über das Judge-Interface

Aufgabe 1 (forbiddenforestritual)**.** (100 Points – 30 seconds timelimit)

Harry Potter has finally found a solution to ~~all his problems~~ his bad eyesight: A ritual to given anyone perfect vision. The downside of the ritual is that it requires sacrificing a dark tree. A dark tree is a tree which doesn't get any sunlight because all trees surrounding it are larger than itself. After talking with Hermione about his idea, Harry is very disheartened: According to Hogwarts, A History, it has been magically determined that there exists exactly one dark tree in the forbidden forest but it has never been found. Since he cannot check the height of all the trees, he asks you if you could use some of your muggle science to help him. In his letter to you he mentions some more peculiar facts about the forbidden forest: a) no two neighbouring trees share the same height; b) the forest is a perfect square; and c) each square meter of forest contains exactly one tree.

Note that you must measure as little trees as possible, otherwise Harry will get unlucky and either die a horrible death or get caught.

Implementation Given n ($0 < n \leq 10^6$), the length of one border of the forest, find the location of the dark tree. You can ask Harry to measure the height h ($0 \leq h < 2^{32}$) of a tree at a specific location.

In this task, your program will not read any input. Instead you will include some code in your program which will be responsible for loading any input and then calling back into your program.

In you program, please include the following lines at the top...

```
#define TESTCASE 1     // 1 = sample, 2 = largeSample,
                       // ignored on the judge
#include "runner.h"    // This must be *exactly* "runner.h",
                       // don't use any other value
```

...and implement the function `forest_search`. You can find the prototype, as well as functions you should call from your implementation, in `runner.h`. The

file `runner.h`, as well as several supporting files, are provided on moodle and should be placed in the same directory as your source code. The "unlucky check" implemented in the runner corresponds to the hard test set.

The supplied files were tested on macOS (64bit Clang), Linux (64bit Ubuntu GCC) and Windows (64bit Visual Studio). If you encounter any problems, please don't hesitate to reach out via the forum or directly via email to `mail@timnn.me`.

Submission You must select "C++ Forbidden Forest Ritual" as the language of your submission. This will happen automatically once you click submit, if you have JavaScript enabled (you can confirm this by looking at the `Language:` line of the confirmation alert). Submit only your source code, the `runner.h` file will be provided by the judge.

Points There are three groups of test sets:

- *easy:* For the first group of tests, worth 20 Points, you can assume that $n \leq 1000$ and that Harry will never get unlucky.
- *medium:* For the second group of tests, worth 40 Points, you can assume that $n \leq 50000$ and that Harry will get unlucky if he measures more than $7n \log_2 n$ trees.
- *hard:* For the third group of tests, worth 40 Points, you can assume that Harry will get unlucky if he measures more than $14n$ trees.

Samples

```
// Interpret the matrizes as a grid:
* -- +x
|
|
+y

// Forest 1
2 3 4
1 0 5
2 3 4

// Forest 2
1 2 3
0 5 4
```

```
1 2 3

// Forest 3
11  9  7  0 30
13 99  9 20 40
15 11 10 30 50
17 18 20 35 60
19 21 23 25 30
```

The solutions are $(1, 1)$, $(0, 1)$ and $(3, 0)$ respectively, in (x, y) koordinates.