Random Cool Stuff

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1 Warm-Up

This is the Bronze contest from November, 2007. Devise an algorithm to solve each problem and figure out its runtime complexity.

1.1 Problem 1: Exploration [Jeffrey Wang, 2007]

There are N ($1 \le N \le 50,000$) landmarks located on the x-axis ($-100,000 \le x_i \le 100,000$). Bessie starts at the origin and is able to travel at 1 distance unit per minute. Bessie must visit the landmarks in a particular order: the closer the landmark is to the origin, the earlier she must visit it. How many landmarks can she visit in T minutes ($1 \le T \le 1,000,000,000$)? No two landmarks are the same distance from the origin.

1.2 Problem 2: Speed Reading [Jeffrey Wang, 2007]

There are K ($1 \le K \le 1,000$) cows and they are each reading a book with N ($1 \le N \le 100,000$) pages as fast as possible while trying to understand it. Cow i can read at speed S_i ($1 \le S_i \le 100$) pages per minute and can read T_i ($1 \le T_i \le 100$) minutes before requiring to rest R_i ($1 \le R_i \le 100$) minutes. Find the number of minutes it will take for each cow to finish the book.

1.3 Problem 3: Avoid the Lakes [Jeffrey Wang, 2007]

Farmer John's farm was flooded in the most recent storm, a fact only aggravated by the information that his cows are deathly afraid of water. His insurance agency will only repay him, however, an amount depending on the size of the largest "lake" on his farm.

The farm is represented as a rectangular grid with N ($1 \le N \le 100$) rows and M ($1 \le M \le 100$) columns. Each cell in the grid is either dry or submerged, and exactly K ($1 \le K \le N * M$) of the cells are submerged. As one would expect, a lake has a central cell to which other cells connect by sharing a long edge (not a corner). Any cell that shares a long edge with the central cell or shares a long edge with any connected cell becomes a connected cell and is part of the lake.

2 Random Tips

This is taken directly from the USACO training pages article on "Crafting Winning Solutions." There is much more available there (and the tips are excellent! check it out, and if you don't have access to it, you should try solving more training problems :)).

2.1 Hmmmmm...

A good way to get a competitive edge is to write down a game plan for what you're going to do in a contest round. This will help you script out your actions, in terms of what to do both when things go right and when things go wrong. This way you can spend your thinking time in the round figuring out programming problems and not trying to figure out what the heck you should do next... it's sort of like precomputing your reactions to most situations.

Mental preparation is also important.

Game Plan For A Contest Round

Read through ALL the problems FIRST; sketch notes with algorithm, complexity, the numbers, data structs, tricky details, ...

- Brainstorm many possible algorithms - then pick the stupidest that works!
- DO THE MATH! (space and time complexity, and plug in actual expected and worst case numbers)
- Try to break the algorithm - use special (degenerate?) test cases
- Order the problems: shortest job first, in terms of your effort (shortest to longest: done it before, easy, unfamiliar, hard)

Coding a problem - For each, one at a time:

- Finalize algorithm
- Create test data for tricky cases
- Write data structures
- Code the input routine and test it (write extra output routines to show data?)
- Code the output routine and test it
- Stepwise refinement: write comments outlining the program logic
- Fill in code and debug one section at a time
- Get it working & verify correctness (use trivial test cases)
- Try to break the code — use special cases for code correctness
- Optimize progressively — only as much as needed, and keep all versions (use hard test cases to figure out actual runtime)

3 Challenge Problem!

(Brian Dean, 2012 modified): You are given N ($1 \leq N \leq 1,000,000,000,000,000$), N odd) empty stacks. There are K ($1 \leq K \leq 25,000$) instructions. Each instructions have an A and a B and adds a hay bale to each of the stacks in the range $A..B$. Find the median hay stack height.