

Freshmen Programming Contest 2021

Solutions presentation

May 9, 2021

A: Alleys Construction

Problem Author: Cristian - Alexandru Botocan



Problem:

- Given a number n for each query, you have to compute the number of possible ways in which alleys can be built for n houses

Statistics: 10 submissions, 0 accepted, 6 unknown

Solution:

- The first observation is that for each number n you have to calculate the $C_{n/2}$ (Catalan number of $(n/2)$)
 - The formula for Catalan number of n is $C(n) = \frac{1}{n+1} \cdot \binom{2n}{n} = \frac{1}{n+1} \cdot \frac{2n!}{n!(2n-n)!}$
 - Since all the n numbers will be even, we will not have any issues to compute $n/2$

C: Coatis and Owls

Problem Author: Maarten Sijm



- Problem: calculate the winner of a battlefield with squads of pikemen.
- Solution: simulate the game in $\mathcal{O}(n)$ time.
 - In other words: do not remove elements from the list in $\mathcal{O}(n)$ time!
- Pitfalls:
 - Using float instead of double for division/ceiling
 - Java: Scanner is too slow

Statistics: 40 submissions, 9 accepted, 14 unknown

D: Distribution Center

Problem Author: Alin Dondera



Problem:

- Find all squares in the grid from which it is impossible to move a crate to any destination.

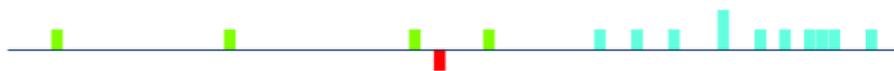
Statistics: 13 submissions, 2 accepted, 9 unknown

Solution: do a modified BFS from the destinations

- Add all destinations to the queue and mark all other squares as dead squares
- Everytime we pop a position from the queue:
 - If already visited, we skip it
 - Else we add neighbouring *non-dead* squares in the queue

E: Efficient Grading

Problem Author: Alin Dondera



Problem:

- Given a number of exams, find the minimum amount of time needed to grade them. Also give the minimum amount of TAs needed for this time to be achieved.

Statistics: 16 submissions, 4 accepted, 11 unknown

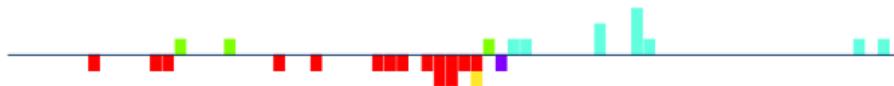
Solution: Calculate the time needed to grade all exams, assuming that at the end there will be exactly k TAs. Do this for all $1 \leq k \leq n$ and select the best result.

- The main observation here is that the best strategy for training k TAs is a greedy one. If we want to train a TA, it's best to do it as early as possible

For the first part of the problem, we will assume that all TAs are available from the beginning.

F: Fraud Checking

Problem Author: Maarten Sijm



Problem:

- Test whether two pieces of code are *similar*, and if so, give the list of replacements.

Statistics: 30 submissions, 3 accepted, 10 unknown

Solution:

- Split the lines of code into lists of words
 - If some lists have different lengths, exit
- Iterate over the words of both pieces of code
- Remember which word in code 1 maps to which word in code 2, and vice versa
 - If the same word later maps to something else, exit

G: Gardening

Problem Author: Dragos Vecerdea



Problem:

- Given a tree (encoded as string) parse it and remove leaves until tree is empty.

Statistics: 33 submissions, 4 accepted, 18 unknown

Parsing

- Recursive function
 - keep a global index (current position)
 - read character
 - create node
 - move to next character

H: Heraldic Prediction

Problem Author: Angel Karchev



Problem:

- Find an even number m within the given interval, for which $m + p^2$ is composite for every prime p .

Statistics: 29 submissions, 2 accepted, 21 unknown

Solution: Spotting the Pattern.

- The case where $p \neq 3$:

I: Icarus' Rebirth

Problem Author: Cristian - Alexandru Botocan



Problem:

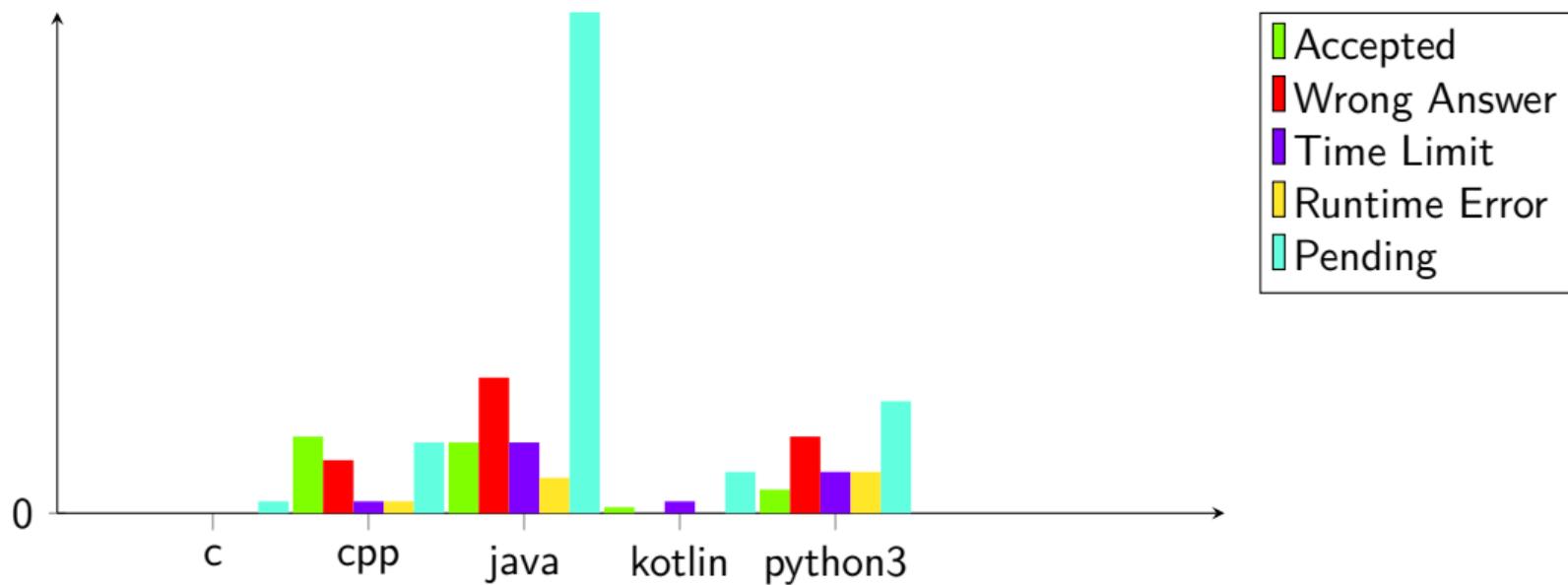
- Given a string, we have to compute the minimum steps which we have to do get to the last character of the word if we start from the first character of the word.

Statistics: 29 submissions, 4 accepted, 15 unknown

Solution:

- We can model this problem as a bidirectional graph traverse problem

Language stats



Other stats

- 323 commits
- 219 secret testcases
- 44 accepted jury solutions, 21 WA and 8 TLE
- The minimum number of lines the jury needed to solve all problems is

$$23 + 11 + 17 + 14 + 10 + 18 + 10 + 1 + 21 = 125$$

(average: 13.9 lines per problem)

Thanks to:

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- Alin Dondera
- Angel Karchev
- Cristian - Alexandru Botocan
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- Maarten Sijm