A Alternating Algorithm

Time limit: 7s **Problem Author:** Bjarki Ágúst Guðmundsson

- You have $1 \leq n \leq 4 \cdot 10^5$ CPU cores and an array of $n+1$ integers ($0 \leq a_i \leq 10^9$).
- Sort them by alternating between two types of rounds:
  - First core compares a_0 and a_1, third core compares a_2 and a_3, ...
  - Second core compares a_1 and a_2, fourth core compares a_3 and a_4, ...
- Determine the number of rounds that the parallel sorting algorithm runs before the array becomes sorted.

CPUs. CC0 by Martijn Boer on Flickr

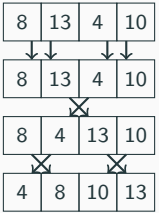


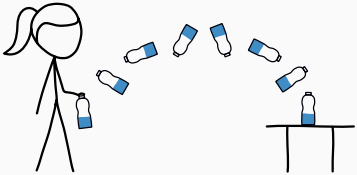
Illustration of Sample Input 1, where the array is sorted after three rounds.

B Bottle Flip

Time limit: 1s **Problem Author: Jorke de Vlas**

- Determine the optimal amount of water the bottle should contain so that our chances of landing a successful bottle flip are maximised. I.e.: minimise the height of the centre of mass.
- The bottle is a perfect cylinder of height h and radius r, and you are given the density of air d_a and the density of water d_w ($1 \leq h, r, d_a, d_w \leq 1000$, $d_a < d_w$).

Three bottles with different amounts of water.



Sketch of a bottle flip.
The bottle is filled to roughly 33%, as in Sample Input 1 ($h = 22$, $r = 4$, $d_a = 1$, $d_w = 4$, optimal height is $7\frac{1}{3}$).

C Circular Caramel Cookie

Time limit: 1s **Problem Author:** Maarten Sijm

- Calculate the minimum radius of a stroopwafel with strictly more than $1 \leq s \leq 10^9$ squares.
- The area of each square is 1 cm^2.
- The centre point of the stroopwafel always contains the common corner of the four adjacent squares in the centre (i.e., the squares are aligned to a Cartesian grid).

A traditional circular caramel cookie (stroopwafel).

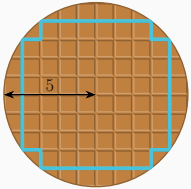


Illustration of Sample Input 2, with the blue-enclosed region depicting the 60 whole squares that the cookie contains. The required radius is exactly 5.0 cm.

D Delft Distance

Time limit: 4s **Problem Author:** Reinier Schmiermann

- Find the shortest path from the north-west to the south-east of Delft.
- You are given a $h \times w$ ($1 \leq h, w \leq 700$) map with square buildings and round towers.
- All the square buildings are axis aligned with a side length of 10 m and all round towers have a diameter of 10 m.

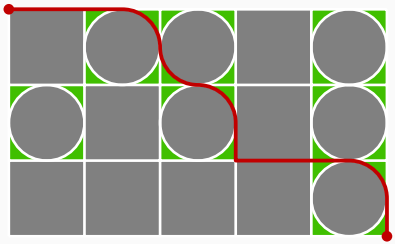


Illustration of Sample Input 1, with a shortest path shown in red. This path has length 71.4159.

Delft water tower.
CC BY-SA 3.0 by Michiel1972 on Wikipedia

E ETA

Time limit: 1s **Problem Author: Paul Wild**

- Construct a graph such that the average optimal time to reach vertex 1 is exactly $\frac{a}{b}$ ($1 \leq a, b \leq 1000$) or determine that this is impossible.
  - Use up to 10^6 vertices and edges.
  - Self loops and parallel edges are allowed.
- You are given that if there exists a valid graph, then there also exists one within these bounds.

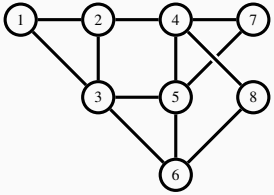


Illustration of Sample Output 3, a level where the average optimal time to reach vertex 1 is $\frac{7}{4}$.

F Faster Than Light

Time limit: 10s **Problem Author: Michael Zündorf**

- Determine whether it is possible to hit all rooms in a spaceship with a single, infinite-length beam.
- The spaceship is represented by a set of $1 \leq n \leq 2 \cdot 10^5$ axis-aligned non-intersecting rectangles ($0 \leq x_1 < x_2 \leq 10^9$ and $0 \leq y_1 < y_2 \leq 10^9$).

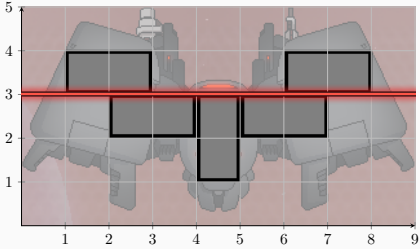


Illustration of Sample Input 1, which consists of five grey rooms. The hull beam in red hits all rooms and is the only valid solution in this case.

G Going in Circles

Time limit: 1s **Problem Author: Timon Knigge**

- Interactively determine the number of train carriages ($3 \leq n \leq 5000$) of a circular train.
- Every train carriage contains a light switch.
- Every step, you can move "`? left`" or "`? right`", or "`? flip`" a light switch.
- After every step, the interactor responds whether the light in you current carriage is off or on.
- You can use at most $3n + 500$ steps.

Train. Unsplash License by Robin Ulrich on Unsplash

High-quality Tree

Time limit: 3s **Problem Author:** Michael Zündorf

- Determine the minimum number of *robberies* to make a binary tree *strongly balanced*.
- A robbery is to take a leaf and remove it, and doing so may turn its parent vertex into a leaf.
- A tree is strongly balanced when for each vertex the height of its left and right subtree differs by at most 1.
- The tree has $1 \leq n \leq 2 \cdot 10^5$ vertices.

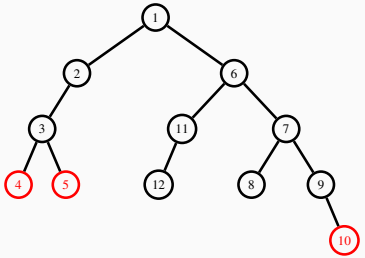


Illustration of Sample Input 2. The tree becomes strongly balanced after removing the three vertices marked in red (4, 5, and 10); the minimum number of vertices that need to be removed to make the tree strongly balanced.

I Interview Question

Time limit: 1s **Problem Author:** Paul Wild

- Solve the reverse of *Fizz Buzz*: given a transcript of part of the game (not necessarily starting at 1), find possible values of a and b ($1 \leq a, b \leq 10^6$) that could have been used to generate it.
- In the transcript, every ath number is replaced with "`Fizz`" and every bth number is replaced with "`Buzz`" (or "`FizzBuzz`" if the number is divisible by both a and b).
- The transcript starts at c and ends at d ($1 \leq c \leq d \leq 10^5$).

Fizz Buzz implemented in Hexagony.
CC BY-SA 3.0 by M L on
codegolf.stackexchange.com

```
7 8 Fizz Buzz 11
```

Sample Input 1 starts at 7 and ends at 11,
and works for $a = 3$ and $b = 5$.

```
49999 FizzBuzz 50001 Fizz
```

Sample Input 2 starts at 49 999 and ends at 50 002,
and works for $a = 2$ and $b = 125$.

J Justice Served

Time limit: 3s **Problem Author:** Michael Zündorf

- Determine the *convincingness* of each of $1 \leq n \leq 2 \cdot 10^5$ suspects.
- For every suspect, you know the time at which they arrived at the scene and the duration they stayed ($1 \leq a, t \leq 10^9$).
- A suspect A provides an alibi for suspect B if and only if A was in the room for the entire duration B was in there.
- A suspect without an alibi has convincingness 0. Otherwise, their convincingness is 1 more than the convincingness of the most convincing suspect who provides them with an alibi.

Rob. Pixabay License by Henning on Pixabay

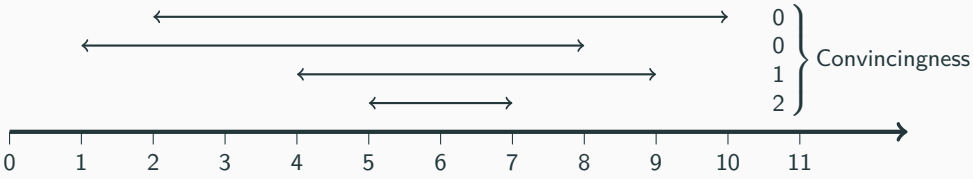


Illustration of Sample Input 1.

Kebab Pizza

Time limit: 3s **Problem Author: Wendy Yi**

- Each of $2 \leq n \leq 10^5$ people would like a pizza slice with exactly 2 out of $2 \leq k \leq 10^5$ ingredients.
- Determine whether it is possible to prepare the pizza such that every chosen ingredient is used on a single consecutive range of pizza slices while satisfying all the chosen topping combinations.

Illustration of Sample Input 1, with two toppings numbered on every slice in a possible solution.
Note that each topping only occurs on a single range of pizza slices.

Last Guess

Time limit: 2s **Problem Author:** Paul Wild

- Determine a consistent final guess of length ℓ in a *Wordle* game where you have already guessed $g - 1$ times ($2 \leq g \leq 500$, $1 \leq \ell \leq 500$).
- For every guess, the letters are marked in either green, yellow, or black.
  - Green indicates that the letter is in the hidden word and appears in the same position.
  - Yellow indicates that the letter is in the hidden word, but in a different position.
  - Black indicates that the letter has no more occurrences in the hidden word.

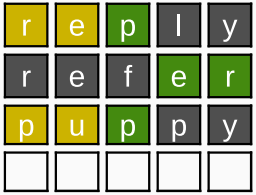


Illustration of Sample Input 1, where "upper" is the only valid last guess.