



Arranging Adapters

Time limit: 4s Problem Author: Michael Zündorf

- Given $1 \leq n \leq 2 \cdot 10^5$ chargers, each $3 \leq w \leq 10^9$ cm wide, how many fit into a powerstrip comprising a row of $1 \leq s \leq 10^5$ sockets, each of width 3 cm?
- Every charger has the plug at the end, and may be rotated by 180° before plugging in.
- Chargers may extend outwards and touch, but may not overlap.

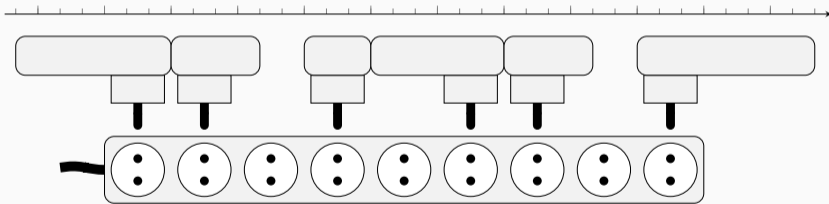


Illustration of Sample Input 2. The first six chargers can be plugged in as shown, but it is impossible to plug in all seven chargers simultaneously.



Brickwork

Time limit: 7s Problem Author: Michael Zündorf

- Given an infinite supply of $1 \leq n \leq 3 \cdot 10^5$ types of bricks, is it possible to build a *stable* wall of width $1 \leq w \leq 3 \cdot 10^5$?
- A wall is *stable* when we can alternate two types of rows such that the only places two bricks above each other end at the same place is at the end of the wall.
- If it is possible, also find a suitable layout.
- If it is impossible, print "impossible".



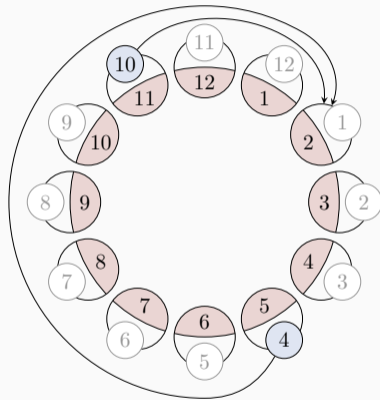
An unstable (left) and stable (right) wall using the brick types of Sample Input 1.



Chair Dance

Time limit: 8s Problem Author: Michael Zündorf

- Simulate deterministic a game of *Musical Chairs*.
- $2 \leq n \leq 5 \cdot 10^5$ players are sitting on as many chairs arranged in a circle numbered modulo n .
- The game master gives three types of commands:
 - “+ x ”: The player on chair i moves to chair $i + x$.
 - “* x ”: The player on chair i moves to chair $i \cdot x$.
 - “? x ”: Tell us the number of the player on chair x .
- When multiple players go to the same chair, the one moving the shortest distance in clockwise direction gets it. The others are out.
- Simulate up to $5 \cdot 10^5$ commands and answer the query commands (answering -1 if the chair is empty).



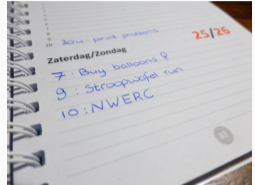
Sample Input 1 at the fourth command.
Players 4 and 10 both need to move to chair 2. Player 10 needs to travel less, so gets to take the seat. Player 4 is out.



Date Picker

Time limit: 1s Problem Author: Jeroen Bransen

- A meeting is about to be scheduled for which you have to indicate availability.
- You know your availability on each hour of each day.
- Select at least d days in the first poll and at least h hours in the second poll.
- Assume the meeting will be scheduled in a random indicated slot.
- Maximize the probability that you can attend.



A filled agenda.

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XXXXXXXX . . XX . . XXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX . . . . XXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXX . . XX . . XXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXX . . . X . . XXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

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Your availability in Sample Input 1. You need to pick at least $d = 2$ days and $h = 5$ hours, so the maximum probability that you can attend is 0.8.



Exponentiation

Time limit: 3s Problem Author: Reinier Schmiermann

- Given are $2 \leq n \leq 1000$ variables x_i , initially all set to 2023.
- Execute $1 \leq m \leq 1000$ instructions:
 - Operation: “! i j ”: Replace x_i by $x_i^{x_j}$.
 - Query: “? i j ”: Answer which of x_i and x_j is larger.

$$x_1 = (2023^{2023})^{2023^{2023}},$$

$$x_2 = (2023^{2023^{2023}})^{2023},$$

$$x_3 = 2023,$$

$$x_4 = 2023^{2023}.$$

The values of the variables at the end of the first sample.



Image by callmetak on Freepik



Fixing Fractions

Time limit: 5s Problem Author: Michael Zündorf

- Given is a fraction a/b , try to make it equal to c/d by cancelling some digits in a and b ($1 \leq a, b, c, d < 10^{18}$).
- If possible, print the leftover digits.
- If it is impossible, print "impossible".



Source: The Internet™.

$$\frac{\cancel{1}6\cancel{3}}{\cancel{3}2\cancel{6}} = \frac{1}{2}$$

Illustration of Sample Input 1, where you can cancel digits 3 and 6 from 163/326 to obtain 1/2.



Galaxy Quest

Time limit: 5s Problem Author: Mike de Vries

- Given are $1 \leq n \leq 10^5$ planets in 3D space with $|x|, |y|, |z| \leq 10^3$.
- There are $1 \leq m \leq 10^5$ bidirectional straight-line highways between pairs of planets.
- You can travel over highways by accelerating or decelerating at 1 m/s^2 , taking 1 litre per second.
- You must come to a full stop at the end of each highway.
- Answer $1 \leq q \leq 10^5$ queries, asking for the minimal amount of fuel needed to get to planet c in time at most $1 \leq t \leq 10^3$.
- If a mission is impossible, output "impossible".

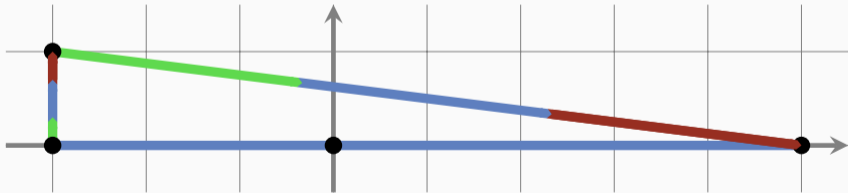


Illustration of Sample Input 1, showing highways in blue, and a route from planet 1 to planet 3. The green start of a highway indicates acceleration, and the red end indicates deceleration.



Higher Arithmetic

Time limit: 4s

Problem Author: Paul Wild

- Given are $1 \leq n \leq 10^5$ integers $1 \leq a \leq 10^6$.
- Create an expression value using $+$, \times , and parentheses.
- Use each of the integers exactly once and maximize the value.

$$3 \cdot ((1 + 2) \cdot 4)$$

Illustration of Sample Output 1, an expression of maximal value using each of the integers 1, 2, 3, and 4 exactly once.



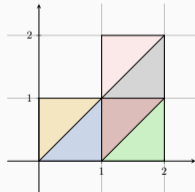
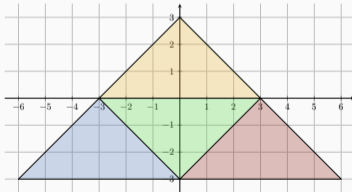
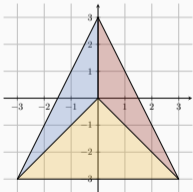


Isolated Island

Time limit: 8s

Problem Author: Michael Zündorf

- Given are $1 \leq n \leq 10^3$ fences (line segments, $|x|, |y| \leq 10^6$).
- A man lives in each resulting region.
- The unbounded region is the ocean.
- The distance from a region to the ocean is the number of regions to cross to get there.
- Crossing through fenceposts or intersection points is not possible.
- Are there two neighbouring regions at the same distance from the ocean?



Illustrations of the samples. In Sample Input 1 (left), every man has direct access to the ocean.

In Sample Input 2 (middle), no pair of neighbours has the same distance to the ocean.

In Sample Input 3 (right), some pairs of neighbours have the same distance to the ocean (e.g., on the left).



Jogging Tour

Time limit: 8s Problem Author: Paul Wild

- Given are $2 \leq n \leq 12$ locations of bakeries with $0 \leq x, y \leq 10^6$.
- We want to make a route through all 12 of them that is as short as possible.
- The route follows the Manhattan distance between consecutive locations on an orthogonal grid.
- Choose an orientation of the grid to minimize the total length.

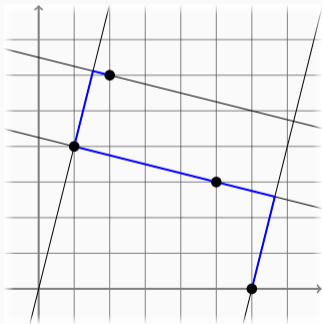


Illustration of Sample Input 2 with a possible street layout that gives the shortest possible path that visits all bakeries in some order.



Klompdansen

Time limit: 5s Problem Author: Maarten Sijm

- Given is a $n \times n$ grid of dance tiles ($3 \leq n \leq 500$).
- The dance alternates moves similar to a knight in chess.
 - The first move (a, b) goes a along one axis and b along the other axis.
 - The second move (c, d) goes c along one axis and d along the other axis.
- You start in the top left corner with either of the two moves.
- How many tiles can you reach during *some* performance of the dance?

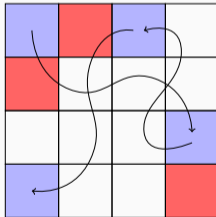


Illustration of Sample Input 3, showing a dance that begins in the top left corner of a 4×4 grid and ends in the bottom left corner, visiting the blue squares along the way. There are 13 reachable squares in total. The three squares highlighted in red cannot be part of any dance performance.



Lateral Damage

Time limit: 2s Problem Author: Paul Wild

- Interactively play *Battleships* with an $n \times n$ grid ($5 \leq n \leq 100$).
- Sink $1 \leq k \leq 10$ aircraft carriers (size 1×5) in at most 2500 shots.
- The interactor is adaptive: the positions of the ships may be determined during the interaction, and may depend on where you decide to shoot.

	1	2	3	4	5	6	7
1						×	
2						⋮	
3	⋮			×	×	×	
4						⋮	
5							
6							
7							

Illustration of Sample Interaction 1 after the first four shots were fired.



The original *Battleships* game, before the upgrade to a 100×100 grid.
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