

- You are given a permutation of the numbers 1 to $n \leq 1000$ that you need to sort.
- In a single step, you can take three consecutive numbers out of the sequence and re-insert them somewhere else.
- Output a sequence of up to 5000 steps that sorts the sequence.

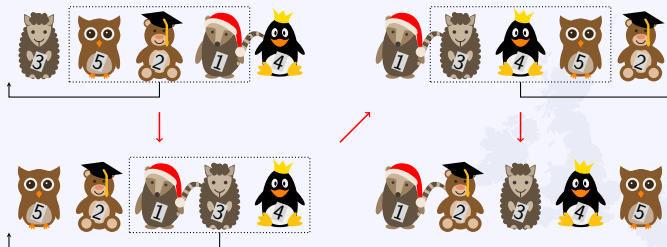


Illustration of Sample Output 1.

- Two people want to withdraw $\text{€}n \leq 10\,000$ from a cash machine.
- Machine can dispense coins and notes of values $\text{€}1$, $\text{€}2$, $\text{€}5$, $\text{€}10$, $\text{€}20$, $\text{€}50$, $\text{€}100$, $\text{€}200$, and $\text{€}500$.
- Check if there exists a way of dispensing $\text{€}n$ that cannot be split evenly into two piles of $\text{€}n/2$.
- Output the coins and notes dispensed such that they cannot be split evenly, or report that the split is always possible.



For $n = 52$, the machine could dispense
a $\text{€}50$ note and $\text{€}2$ coin.

Photo by Jeroen Op de Beek

- You are given a road network (a tree) with $n \leq 10^5$ places, and a set of $m \leq 5 \cdot 10^5$ bridges connecting places from the tree.
- The roads have given lengths up to 10^6 , bridges have length 0.
- Find the shortest tour that crosses all bridges, and uses each road at most once. It is guaranteed that this is possible.



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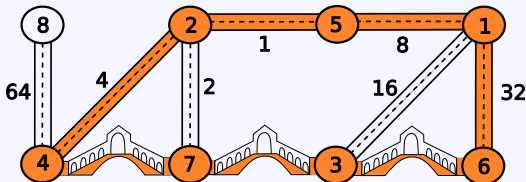
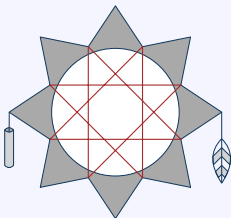
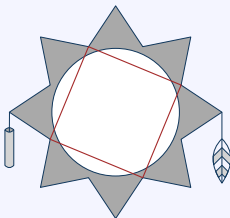


Illustration of Sample Input 1, with a shortest tour of length 45 highlighted.

- Given a wheel with $n \leq 10^9$ evenly spaced notches.
- Wrap a string of yarn around it by starting at notch 1, and repeatedly connecting the yarn k notches ahead until you reach notch 1 again.
- What value of k maximizes the amount of used string?



A dreamcatcher with 8 notches, wrapped in a string of yarn for $k = 2$ and $k = 3$.



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- You have a string of $n \leq 100$ red/green/blue lights.
- Every time you touch a light bulb, it randomly takes one of the three colours, each with equal probability.
- You want the lights to have *any* identical colour.
- What is the expected number of times you need to touch a light bulb to make all of them have the same colour?

Example: Given two lights rb , an optimal strategy is to keep touching the first light until it turns blue. This takes 3 steps on average.



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- $n \leq 10^5$ people visit a restaurant and need to pay.
- Each person has their own share b_i and an amount of cash a_i .
- One person will pay the entire bill and receive the cash from all others.
- Choose that person so they do not have to pay more than their own share b_i .
- There may be no such person.



KIT teams having a celebration dinner after
NWERC.

Photo by Christopher Weyand

- You are given a permutation $(a_i)_{1 \leq i \leq n}$ of the numbers 1 to $n \leq 5 \cdot 10^5$.
- You want to turn it into a “mountain-shaped” permutation $(b_i)_{1 \leq i \leq n}$, meaning it is first increasing and then decreasing.
- You want to keep as many indices of the permutation the same, so maximize the number of i such that $a_i = b_i$.
- What is the smallest number of indices that need to change?



Illustration of Sample Input 1. Free Pexels
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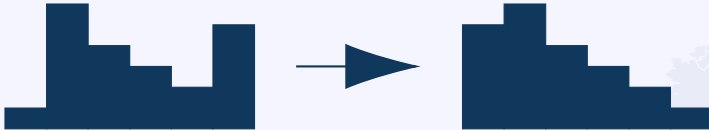


Illustration of Sample 1, where it's optimal to swap the first and last element.
The answer is therefore 2.

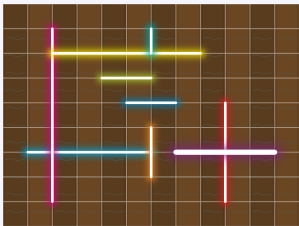


- You need to find a strategy with no risk for moving furniture around in the registration room.
- The room has at most 64 slots to place furniture, at least one slot has furniture, at least one slot is empty.
- This strategy must be such that if it is applied twice, you return to the original state. It must also not have any state as a fixed point.
- The possible states of a room with n slots and k pieces of furniture can be represented as a bitstring of n bits and k ones.
- The strategy is thus a perfect matching on this set of states, if one exists.
- This is a multi-pass problem with up to 10 000 test cases per run.

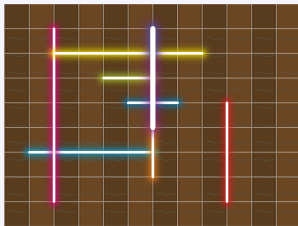


The registration area at NWERC 2024.
Photo by Maarten Sijm

- Given $n \leq 2 \cdot 10^5$ axis-aligned segments in 2D (neon light tubes).
- Horizontal lights do not touch other horizontal lights, same for vertical.
- Can you move/rotate one light to form a square?
- Up to 20 000 test cases per run, with at most $2 \cdot 10^5$ tubes in total.



Example initial light configuration.



The purple neon light was moved to make a 4×4 square.



Mulled wine stall at the Leipzig Christmas Market. CC BY-SA 4.0 by Joachim Köhler on Wikimedia Commons

- There are $n \leq 10^5$ people living in an apartment, but they only have $k (\leq n)$ keys to share.
- If a person comes home while someone is home, they will be let in. Otherwise, they need a key.
- Given the times when each person is out, determine when each person should take a key with them.



The DOMjudge team working in a shared flat.
Photo provided by the DOMjudge team

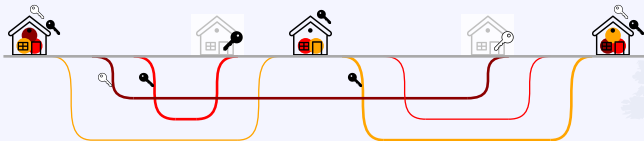


Illustration of Sample Input 1, with 3 people, 2 keys, and a total of 5 trips.
Trips where the person brings a key are shown in bold. Twice, a person comes home to an empty house and has to use their key to open the door.

- Create an $h \times w$ ($h, w \leq 100$) grid consisting of letters 'K', 'I' and 'T' such that
 - each letter occurs a given number of times (k , i and t times, $k + i + t = h \cdot w$); and
 - there is exactly one occurrence of the word "KIT".
- Words can be read in 8 directions: horizontally, vertically, diagonally.



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I	K	I	I	T
K	K	T	K	T
I	T	I	T	I
K	T	T	K	I

A possible answer for the case $h = 4, w = 5, k = 6, i = 7, t = 7$.

- Given are $n \leq 100$ top-10 lists.
- Find the artist with the highest number of appearances.
- In case of a tie, look at most 1st-place positions.
- When still a tie, look at most 2nd-place positions.
- And so on. . .
- If they are tied for all 10 positions, output “tie”.



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