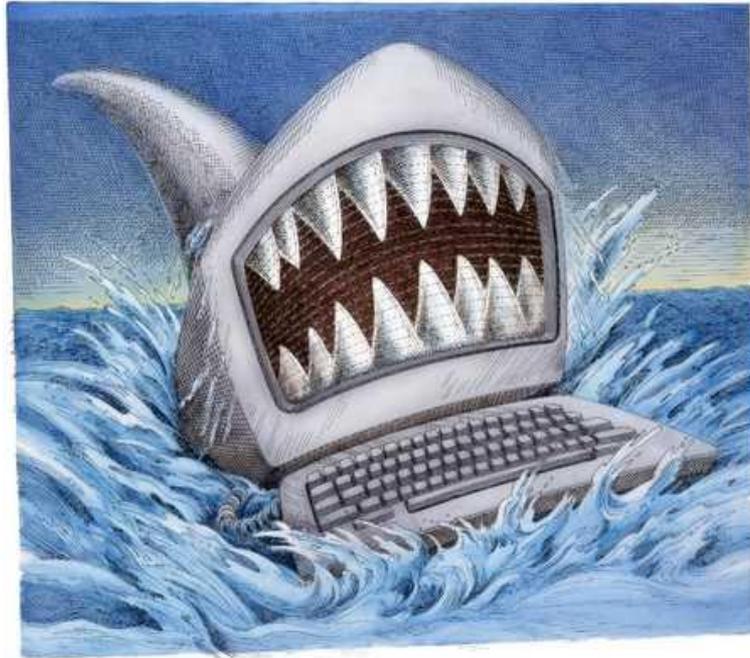


Competitive Programming = Money

Cian Ruane & Noah Donnelly



What is competitive programming?

- Time-limited competition
- You're given a number of problems to solve
- You get a score based on how many problems you solve, or how well you solve them
- Competitions are sometimes online, sometimes on-site
- Some are in teams, some are individual
- Many competitions only allow entries in certain programming languages

TLDR: Different competitions have different rules, but the problems are usually along the same lines

Example Competitions

In **Google Hashcode**, a team of 2-4 was given 1 problem to attempt over 4 hours.

Submissions were done online, but many hubs were organised (including one in DCU).

You could write your code in any language.

In the **NWERC 2015**, 3-person teams were given 11 problems to solve over 5 hours in Java, C, or C++.

Teams competed on-site, in Linköping University, Sweden.

All competitors were university students.

Why should I be interested?

Click to add text

Money.

Competitive programming
looks good on a CV

A good CV is helpful in
getting a job

Money



It's good practice in
programming, algorithms,
teamwork, and humility
(being beaten by better
programmers)

monee



You can sometimes get to
travel to competitions

There's nothing more money
than going on a vaycay



mon·ey (mŭn'ē)

Competitive programming
problems and programming
interview problems are pretty
much the same thing

Except competitive programming problems are harder

Money.



You learn to be faster & more
efficient at problem solving,
coding, and testing

Better programmer =
better pay



MONEY

Competitive Programming = Money

You can see the benefits of competitive programming.

So let's go through how it's done.

But first, who are we?

Noah Donnelly (*cac*) - Redbrick Secretary

CPSSD1

I like languages, programming, dogs, and long walks on the beach.

I was on the team representing Ireland at the International Olympiad of Informatics 2015.

<http://mycode.doesnot.run>

Cian Ruane (*induxi0n*) - Redbrick PRO

CPSSD1

I like computer security, cats, fig rolls, and getting caught in the rain.

I wasn't on the team representing Ireland at the International Olympiad of Informatics 2015.

(But I was close)

Our combined profit from
competitive programming:

ZERO

But we've both got
internships from it.

And a number of women*.

*zero is still a number

Now we're going to teach
you how to come 74th in
the NWEREC like we did.

'Cause that's

money.

Chapter 1: Some sample problems.

What does a problem look like?

Description: We need to add together how much money we're making

Inputs: Two integers, x and y , with how much money we've made in the past week

Output: An integer z , which is the sum of x and y

Example:

Input: 3 2

Output: 5

The background of the image consists of numerous US dollar bills falling from the top, creating a sense of motion and abundance. The bills are rendered in a slightly blurred, 3D style, with various denominations visible, though the focus is on the overall effect of falling money.

THAT'S MONEY

MAKE GIFS AT GIFSOUP.COM

How it works

Your solution is run through ***test cases***.

These are separate run-throughs of your solution, with different input values. The output values of your program are compared with what the ***judge*** expects.

Usually, each test case will have a ***time limit*** (eg. 1 second). If your solution doesn't give the answer by then, it's marked as wrong.

You will be able to see how your solution fared, eg. if it crashed, went over time, or if it gave an incorrect answer.

The judge, like your lecturer,
is never* wrong.

*we'd trust the judge more than the lecturer

Real World Problem - AIPO Prelim 2015 Q6

Count the divisors of every value in the range $[L, U]$ (both L and U included) and return the biggest divisor count you can find.

Input

The first line will contain an integer C with the number of ranges to process. The next C lines will contain a pair of integers L, U .

You have to count the divisors for each number in the range and output the biggest count.

Constraints

$$1 \leq C \leq 10$$

$$L \leq U$$

$$1 \leq L, U \leq 10000000$$

$$0 \leq U - L \leq 1000$$

Output

For each range a line containing the biggest divisor count found.

Real World Problem - AIPO Prelim 2015 Q6

Sample Input

```
5
1 10
1000 1000
9999900 10000000
35 999
25 25
```

Sample Output

```
4
16
256
32
3
```

[pause for scrub audience to fail to solve problem]

Look at the Constraints

The problem told us these facts:

$$1 \leq C \leq 10$$

$$L \leq U$$

$$1 \leq L, U \leq 10000000$$

$$0 \leq U - L \leq 1000$$

Translation:

There will be between 1 and 10 ranges given

Each will have a range, $L - U$

L and U will be less than ten bajillion

There will be a maximum of 1000 numbers in the range between L and U

We can brute force it!

Brute force is the dum dum way of doing it: try every possibility and see what works.

We can write an algorithm to get the number of divisors of a number in $O(n)$ time ($O(\sqrt{n})$) with optimisation, or maybe even better if we start doing prime factorisation, but we're lazy)

$O(n)$ is doable $10 \cdot 1000$ times

PROBLEM SOLVED

You said “ $O(n)$ time”? 🤔?

look up “big o notation” on Bing and it’ll do you good

**TIME FOR
A HARDER
PROBLEM**

Palindrome - IOI 2000, Beijing, Day 1

A palindrome is a symmetrical string, that is, a string read identically from left to right as well as from right to left. You are to write a program which, given a string, determines the minimal number of characters to be inserted into the string in order to obtain a palindrome. As an example, by inserting 2 characters, the string "Ab3bd" can be transformed into a palindrome ("dAb3bAd" or "Adb3bdA"). However, inserting fewer than 2 characters does not produce a palindrome.

Input

The first line contains one integer: the length of the input string N , $3 \leq N \leq 5000$. The second line contains one string with length N . The string is formed from uppercase letters from 'A' to 'Z', lowercase letters from 'a' to 'z' and digits from '0' to '9'. Uppercase and lowercase letters are to be considered distinct.

Output

The first line contains one integer, which is the desired minimal number.

Example

Input:

5

Ab3bd

Output:

2

Algorithm for 'Palindrome'

```
int calcPalindromeCost(char s[], int start, int end){
    if(start == end) return 0;
    if(end-start == 1) return (s[start] == s[end]) ? 0 : 1;

    if(s[start]==s[end]){
        return calcPalindromeCost(s, start+1, end-1);
    }else{
        return min(calcPalindromeCost(s, start+1, end) + 1,
                   calcPalindromeCost(s, start, end-1) + 1);
    }
}
```

This can be optimised with “memoization”

It will save us re-computing things several times

It is part of what is called “dynamic programming”

You can either come up with the algorithm on the day, or learn it in advance.

It's easier to write an algorithm if you don't have to make it up as you go along.

Learn algorithms

Love algorithms

Become algorithms

Also don't forget about data structures

Learn the logic of lists, maps, sets, graphs, linked lists, heaps, queues, trees, and every variation you can find thereof

They come up all the time in real life programming problems too

You should look all this stuff up on
Yahoo! when you're not listening in
other talks

Algorithms +
data structures

= Money

TIME FOR A

HARDERER

PROBLEM

Simple Encryption, ACM ICPC 2010, Kuala Lumpur

Given X , print a Y such that:

- $X^Y \equiv Y \pmod{10^{12}}$

Constraints:

- $0 < X < 50001$

Y must be a 12-digit number, with no leading zeroes.

We have no idea how you solve this.

One team in that competition got this problem correct.

“He still has no idea why his solution turns out to be efficient.”

Competitive programming can introduce you to really hard problems like this one. That’s good.

You’ll learn a lot trying to solve problems above your head, and asking how other people solved those problems.

Choose your fights

1. Take time in the beginning to read every problem, and choose which ones look easiest.
2. While you're coding the ones you can solve, start thinking about the more difficult ones.
3. In some competitions, you can get partial marks for solving some but not all test cases. If this is the case, it might be worth writing a brute force algorithm to get *some* points.
4. In group competitions, it's likely that it'll be faster if you all take separate problems, rather than working together on one.

Competitive programming gets tough

It can take **work**, **thought**, or even **effort**

But it's worth it for the dolla dollas

“where do i sign up” - u, if u r cool

Training:

- [projecteuler dot net](https://projecteuler.net)
- [onlinejudge dot org](https://onlinejudge.org)
- [spoj dot com](https://spoj.com)
- [rosalind dot info](https://rosalind.info)
- [topcoder dot com](https://topcoder.com)
- [hackerrank dot com](https://hackerrank.com)
 - this one is legit because it has “hacker” in its name

There are loads of competitions, that’s where we really get to throw some code.

We’ve competed in the AIPO, Call to Code, Bayan Programming Contest, COCI, USACO, IOI, AIB Datahack, Google Hash Code, Codejam, UKIEPC, NWERC.

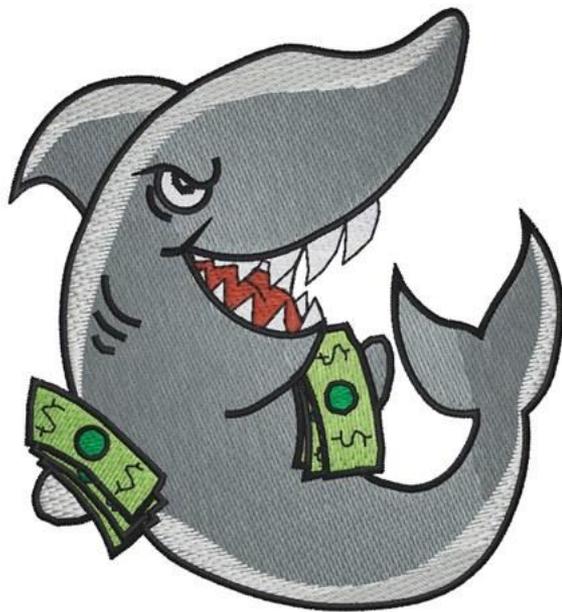
Don’t compete in any of those.

That’s our turf.

HOWEVER

We're hosting our own programming competition here in DCU in aid of Childline.

Keep an eye on the Redbrick announce emails, and check redbrick.dcu.ie/~cac/comp



Any Questions?

These slides will be available at
redbrick.dcu.ie/~cac/comp

Bonus

Problems

Chef and Gift - CodeChef AUG14 PRGIFT

Today is chef's friend's birthday. He wants to give a gift to his friend. So he was desperately searching for some gift here and there.

Fortunately, he found an array a of size n lying around. The array contains positive integers. Chef's friend likes even numbers very much. So for the gift, chef will choose a consecutive non-empty segment of the array. The segment should contain exactly k even integers. Though it can have any number of odd integers.

He will then pick that segment and gift it to his friend.

But there is a problem. It might not be always possible for the chef to choose such a segment. Please tell whether it is possible for chef to select some gift or not?

Chef and Gift - CodeChef AUG14 PRGIFT

Input

First line of the input contains a single integer T denoting number of test cases.

For each test case, first line contains two space separated integers n, k .

Next line contains n space separated integers denoting content of array a .

It is also guaranteed that all the numbers in the array a are distinct.

Output

For each test case, print a single line containing "YES" or "NO" (without quotes) corresponding to the situation.

Constraints

- $1 \leq T \leq 10$
- $1 \leq n \leq 50$
- $0 \leq k \leq n$
- $1 \leq a_i \leq 100$

Aggressive Cows - USACO Feb 2005 Gold Division

Farmer John has built a new long barn, with N ($2 \leq N \leq 100,000$) stalls. The stalls are located along a straight line at positions x_1, \dots, x_N ($0 \leq x_i \leq 1,000,000,000$).

His C ($2 \leq C \leq N$) cows don't like this barn layout and become aggressive towards each other once put into a stall. To prevent the cows from hurting each other, FJ want to assign the cows to the stalls, such that the minimum distance between any two of them is as large as possible. What is the largest minimum distance?

Aggressive Cows - USACO Feb 2005 Gold Division

Input

t – the number of test cases, then t test cases follows.

* Line 1: Two space-separated integers: N and C

* Lines 2..N+1: Line i+1 contains an integer stall location, xi

Output

For each test case output one integer: the largest minimum distance.

Path Finding In the Country - SPOJ PFIND

Rahat lives in a strange country. Name of the cities of this country are also strange. Instead of traditional naming, here, cities are named by number like 1, 2, 3N. Cities are named according to their size. That is, city 1 is the smallest city, city 2 is 2nd smallest.... city N is the largest city of the country.

People of the country are very concerned about traffic. To avoid collision and jam, every road is one directional. Rule of visiting from one city to another are:

- When visiting from a city to a larger city, you must have to journey through bus.
- When visiting from a city to a smaller city, you must have to journey through train.

Rahat lives in city 1. He wants to go in city N. As he likes journey very much, he wants to know, in how many ways he can complete his journey.

He dislikes riding on train. So he will not ride on train during his journey.

Path Finding In the Country - SPOJ PFIND

Input

Input set starts with an integer ($T \leq 101$), denoting the test case. Then T test case follows.

Each case starts with two integer ($1 \leq N \leq 10^5$, $0 \leq M \leq \min(10^5, (N*(N-1))/2)$), where N denotes number of cities and M denotes number of roads in that city. Then M lines follow. Each line denotes two integers ($1 \leq u, v \leq N$, $u \neq v$) which indicates there is a road between u and v for bus transportation.

Output

For each case, print total way Rahat can make to arrive on city N . As the answer can be very big, print the answer modulo 1000000007. For correct format, look at the sample output.

Path Finding In the Country - SPOJ PFIND

Input:

1

4 3

1 2

2 3

3 4

Output:

Case 1: 1