



KU
ACM

Competitive Programming Lectures-1

— Lecturer: Deniz Soylular / Enes Ak —

Before starting...



What is competitive programming?



Why competitive programming?



Our aim and method

- Our main **aim** is to prepare you for a contest just like the one we are preparing right now.
- Our **method** will be solving a lot of questions and introducing concepts during the process.
- Check out **Competitive Programmer's Handbook**

Time to Decide:

THE CHOICE IS YOURS

Competitive
Programming



Boring
Programming



Competitive Section-1

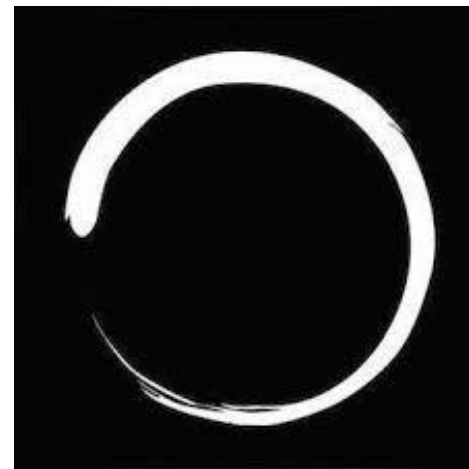
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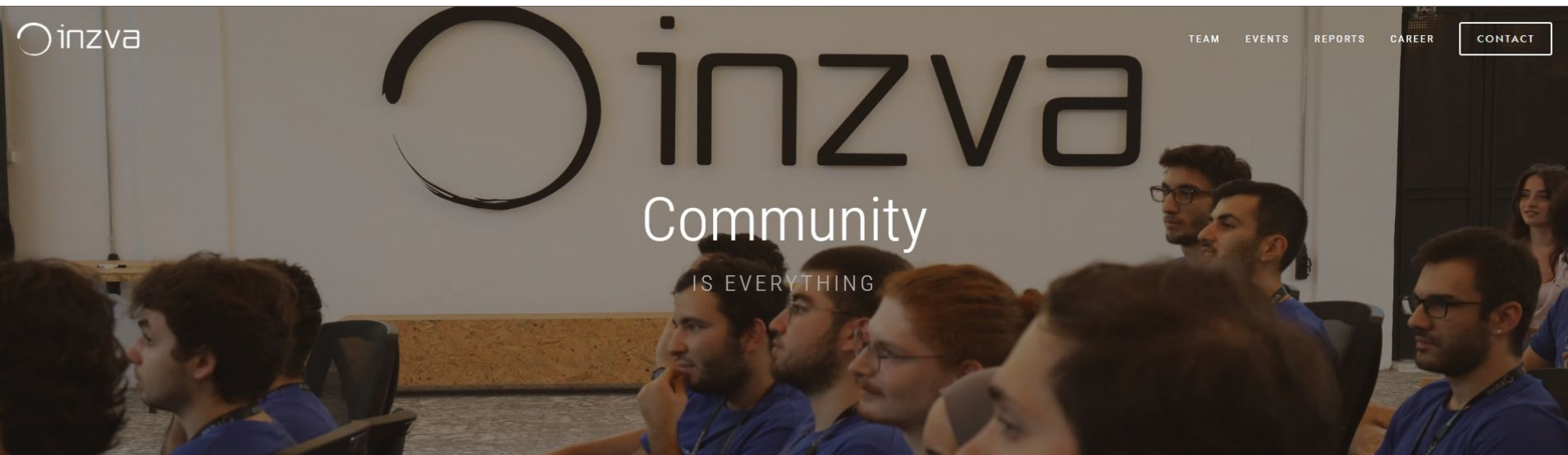
Introduction to Algoleague

Time to open the computers!

<https://algoleague.com/>



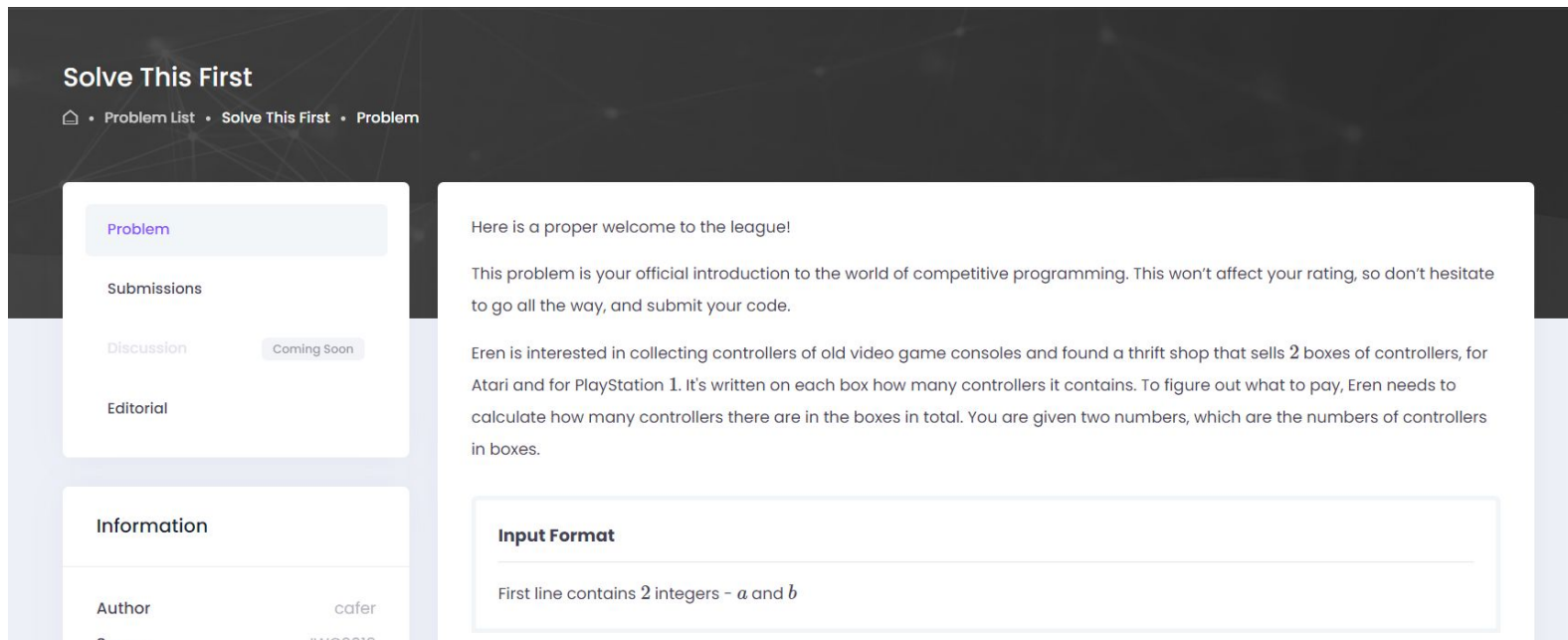
inzva.com

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A tech community dedicated to artificial intelligence and algorithms based in Istanbul, supported by [an education foundation](#).

A non-profit project of [BEV Foundation](#), inzva was established in 2017 in [Beykoz Kundura](#) to create a community of talented computer science enthusiasts. Over the last 6 years, inzva has provided over **5000 students** with the opportunity to improve themselves through study groups, projects, and camps that focus on studies of algorithms and artificial intelligence studies completely free of charge.

Let's Solve a Question Together!



The screenshot shows a web interface for a competitive programming problem. The header is dark with the title 'Solve This First' in white. Below the header is a breadcrumb trail: 'Problem List • Solve This First • Problem'. The main content area is divided into two columns. The left column contains a sidebar with links: 'Problem' (highlighted in purple), 'Submissions', 'Discussion' (with a 'Coming Soon' badge), and 'Editorial'. Below these is an 'Information' section showing the author 'cafer' and the source 'WUCC16'. The right column contains the problem description. It starts with a welcome message, followed by an introduction to the problem, and then the problem statement about Eren and video game controllers. At the bottom of the right column is an 'Input Format' section stating that the first line contains two integers a and b .

Solve This First

Problem List • Solve This First • Problem

Problem

Submissions

Discussion Coming Soon

Editorial

Information

Author: cafer
Source: WUCC16

Here is a proper welcome to the league!

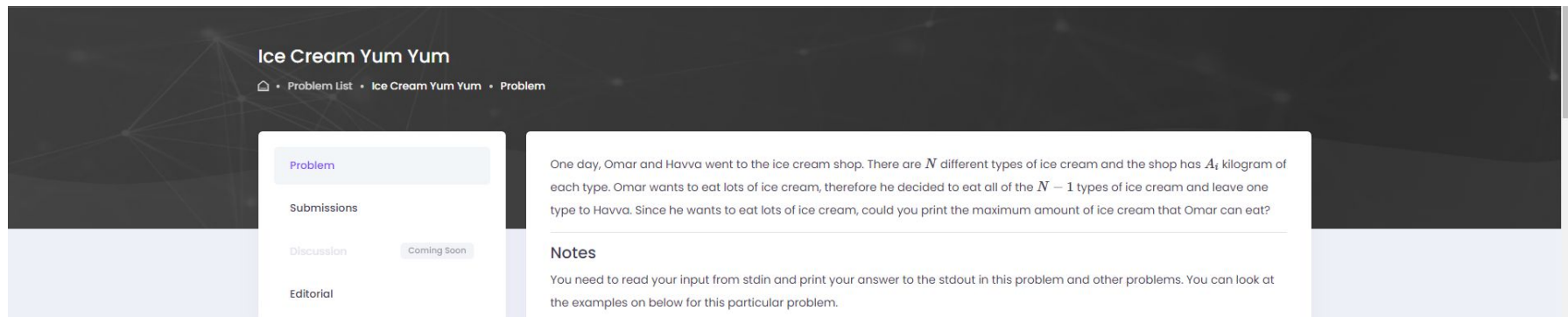
This problem is your official introduction to the world of competitive programming. This won't affect your rating, so don't hesitate to go all the way, and submit your code.

Eren is interested in collecting controllers of old video game consoles and found a thrift shop that sells 2 boxes of controllers, for Atari and for PlayStation 1. It's written on each box how many controllers it contains. To figure out what to pay, Eren needs to calculate how many controllers there are in the boxes in total. You are given two numbers, which are the numbers of controllers in boxes.

Input Format

First line contains 2 integers - a and b

Let's Solve One More



The screenshot shows a web interface for a programming problem. At the top, the title "Ice Cream Yum Yum" is displayed in white on a dark background. Below the title is a breadcrumb trail: a home icon, "Problem List", "Ice Cream Yum Yum", and "Problem". On the left side, there is a vertical menu with four items: "Problem" (highlighted with a light blue background), "Submissions", "Discussion", and "Editorial". To the right of the "Discussion" item is a small grey button that says "Coming Soon". The main content area on the right contains the problem description and a "Notes" section.

Ice Cream Yum Yum

🏠 • Problem List • Ice Cream Yum Yum • Problem

- Problem
- Submissions
- Discussion Coming Soon
- Editorial

One day, Omar and Havva went to the ice cream shop. There are N different types of ice cream and the shop has A_i kilogram of each type. Omar wants to eat lots of ice cream, therefore he decided to eat all of the $N - 1$ types of ice cream and leave one type to Havva. Since he wants to eat lots of ice cream, could you print the maximum amount of ice cream that Omar can eat?

Notes

You need to read your input from stdin and print your answer to the stdout in this problem and other problems. You can look at the examples on below for this particular problem.

Big-O Notation

- Roughly, Python can do 10^9 manipulations in one second.
- There are faster languages (e.g. C++).

Optimization Example - Fibonacci Numbers

1 1 2 3 5 8 13 21 34 55 ...

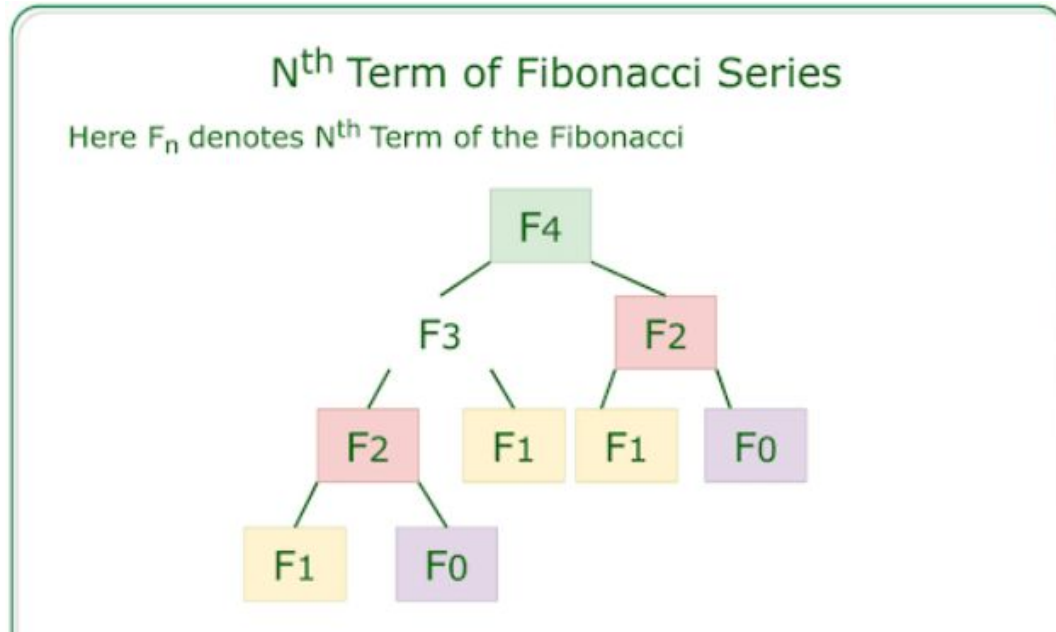
- Let $F(n)$ be the n th fibonacci number
- $F(n) = F(n-1) + F(n-2)$
- **Question:** How to print the n -th fibonacci number?

Naive Solution - Basic Recursion

```
1 def F(n):
2     if n == 1:
3         return 1
4     elif n == 2:
5         return 1
6     else:
7         return F(n-1) + F(n-2)
8
9
10 n = int(input("Calculated fibonacci number: "))
11 print(F(n))
12
13 # 1 1 2 3 5 8 13 21 34 55
14
```

What is the complexity of this algorithm?

Problem With the Naive Approach



What if we memorized these values?

Memoization!

```
fibonacciNums = dict()
fibonacciNums[1] = 1
fibonacciNums[2] = 1

def Fibonacci(n):
    if n in fibonacciNums:
        return fibonacciNums[n]
    else:
        result = Fibonacci(n - 1) + Fibonacci(n - 2)
        fibonacciNums[n] = result
        return result

n = int(input("Enter the n to learn n-th fibonacci number: "))

print(Fibonacci(n))
```

Memorize everything?

- Space constraint!

Fibonacci Iterative

```
n = int(input("Enter the n to learn n-th fibonacci number: "))

f1 = 1
f2 = 1
|
for i in range(3, n + 1):
    f2, f1 = (f1 + f2), f2

print(f2)
```

What is the complexity of this algorithm?

Using Matrices and Better Formulas

$$\begin{bmatrix} 1 & 1 \\ 1 & 0 \end{bmatrix}^n = \begin{bmatrix} F_{n+1} & F_n \\ F_n & F_{n-1} \end{bmatrix}$$

The complexity for this algorithm is $O(\log n)$!

$$F(2n) = F(n)[2 \cdot F(n+1) - F(n)]$$

$$F(2n + 1) = F(n)^2 + F(n+1)^2$$

Fast Exponentiation

How to calculate a^b as fast as possible?

Feedback Form





**IF YOU THINK
CODING
IS HARD
TRY
COMPETITIVE
PROGRAMMING**