

# Course Introduction

## Introduction to Competitive Programming

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# Welcome to CS 491 CAP!

## Your Objectives:

- ▶ Describe the goals and prerequisites of this course.
- ▶ Describe the grading scheme.
- ▶ Be able to practice effectively.

# Course Goals

Why take this course?

- ▶ Primary course goal: make you good at competitive programming!
- ▶ Why should you want to do that?
  - ▶ It's fun!
  - ▶ Opportunity to learn:
    - ▶ useful data structures, algorithms, and mathematical insights;
    - ▶ practical applications of data structures and algorithms;
    - ▶ how to code and debug effectively; and
    - ▶ how to work well on a team.
  - ▶ You'll do really well on job interviews!
- ▶ But what if I'm not as good as those others?

# Am I ready for this?

## Do I Need CS 225 or 374?

- ▶ We will assume familiarity with CS 225 concepts.
- ▶ CS 374 is optional, but will help.
- ▶ Skills Needed
  - ▶ Familiarity with C, C++, or Java (CS 125)
  - ▶ Willing to learn basic data structures (CS 225).
  - ▶ Comfortable with recursion and algorithmic explanations (CS 173).
  - ▶ Most important: eagerness to learn and practice!!
- ▶ Textbooks
  - ▶ **Competitive Programming 4** by Steven and Felix
  - ▶ Optional: **Guide to Competitive Programming** by Antti Laaksonen

# Lecture Format

- ▶ Each period will have the following workflow:
  - ▶ **Lecture Video**
    - ▶ A short lecture or video or two will introduce the topic.
    - ▶ Sometimes “flipped”, sometimes in-class.
    - ▶ Meant as a big-picture introduction, not to teach the algorithm.
    - ▶ You get to teach yourself by studying the implementation!
  - ▶ **Sample Problem(s)**
    - ▶ One “easy” sample problem to do before class
    - ▶ Some more interesting problems during/after class.
    - ▶ Plenty of class time for coding and explanations.

# Assignments

- ▶ **Problem Sets** You will also get a biweekly problem set.
  - ▶ Typical format: 10 problems. You must solve at least 6 of them.
  - ▶ Submit all problems to the corresponding online judge.
  - ▶ The in-class problems together count as two problem sets for grading.
- ▶ **Contests** You can also participate in some contests.
  - ▶ A 5 hour contest will replace one problem set.

NB: Please do not copy-paste code from other sources. You are only hurting yourself if you do!

# Grading

Course is Pass/Fail: Passing is 70%.

- ▶ Attendance: 20%.
  - ▶ We will pass an attendance sheet. It will be checked for integrity.
  - ▶ You get four “excused absences” for attendance and participation.
- ▶ Completion of problems: 80%.
  - ▶ Most days

## Extra Credit

There are opportunities for extra credit here too!

- ▶ Attending a tryout counts as one contest or problem set.
- ▶ You can get points by contributing new problems to our problem sets.

# Programming Contests

- ▶ UIUC ICPC tryouts and practice
  - ▶ \*The NAQ is Sat, February 4, 2023, 1-6 pm CT
  - ▶ The top 15 scorers will be able to compete in the Regional Contest.
  - ▶ Register at <https://naq22.kattis.com/contests/naq22>; yeah, confusing.
- ▶ ACM ICPC
  - ▶ Regional contest will be Saturday, February 25, 2023.
  - ▶ North American Championship will probably be around May.
  - ▶ World Finals...?
- ▶ Online contests
  - ▶ TopCoder SRMs, CodeForces
  - ▶ Facebook Hacker Cup
  - ▶ Google Code Jam
  - ▶ TopCoder Open
  - ▶ ... and many others ...



# Online Judges

- ▶ Real contest problems
- ▶ Immediate Feedback
- ▶ Can emulate contest environment
- ▶ Code Forces <https://codeforces.com/>
  - ▶ <https://codeforces.com/group/C1FCILxvRp/contests>
- ▶ Virtual Judge: <https://vjudge.net>
  - ▶ <https://vjudge.net/group/uiuc-cs491-sp23>

## Other Judges

It's worth getting accounts here too.

- ▶ UVa Online Judge <https://uva.onlinejudge.org/>
- ▶ Open Kattis <https://open.kattis.com/>
- ▶ Peking Online Judge <http://poj.org>
- ▶ ACM ICPC Live Archive  
<https://icpcarchive.ecs.baylor.edu/>
- ▶ Sphere Online Judge (SPOJ): <http://www.spoj.com/>
- ▶ Saratov State Online Judge: <http://acm.sgu.ru/>

# Online Contests

- ▶ Occur 6–8 times per month.
- ▶ Code Forces <http://codeforces.com/>
- ▶ Top Coder Single Round Matches (SRMs).  
<https://www.topcoder.com/>

# UIUC ICPC Team Meetings

- ▶ SIG ICPC Website:  
`http://icpc.cs.illinois.edu/ipl.html`
  - ▶ Contains announcements, practice summaries, and practice resources.
- ▶ Meetings: Tuesdays from 18:00–20:00
- ▶ Tryouts
  - ▶ Two of them! (One this Saturday)
- ▶ Join the IPL Campuswire group (Use code 4080).

# 1. Read the problem statement carefully!

- ▶ Pay attention to the input/output format specification.

## 2. Abstract the problem.

## 3. Design an algorithm.

## 4. Implement and debug.

## 5. Submit.

## 6. AC!

- ▶ (else GO TO 4... or maybe even 3)

# 7. If you want to improve rapidly:

- ▶ Read the problem commentary afterwards.

- ▶ After a contest, “upsolve” any problems you couldn’t finish.

# Example Problem

- ▶ POJ 1000: A + B Problem
  - ▶ Input: two space separated integers,  $a$  and  $b$ .
  - ▶ Constraints:  $0 \leq a, b \leq 10$ .
  - ▶ Output:  $a + b$

# C Code for POJ 1000

```
#include <stdio.h>

int main() {
    int a, b;

    scanf("%d %d", &a, &b);
    printf("%d\n", a + b);
    return 0;
}
```

# C++ Code for POJ 1000

```
#include <bits/stdc++.h>

using namespace std;

int main() {
    int a, b;

    cin >> a >> b;
    cout << a+b << endl;
}
```



# Java Code for POJ 1000

```
import java.io.*;
import java.util.*;

public class Main {
    public static void main(String args[])
        throws Exception{
        Scanner cin=new Scanner(System.in);
        int a=cin.nextInt(), b=cin.nextInt();
        System.out.println(a+b);
    }
}
```

## Example Problem

- ▶ POJ 1004 — Financial Management
  - ▶ Input: 12 floating-point numbers, each on a separate line
  - ▶ Output: Average of the numbers, rounded to two decimal places
  - ▶ Note that the answer must be preceded by a dollar sign \$!

# C Code for POJ 1004

```
#include<stdio.h>

int main() {
    double sum = 0, buf;
    for(int i = 0; i < 12; i++) {
        scanf("%f", &buf);
        sum += buf;
    }
    printf("$%.2f\n", sum / 12.0);
    return 0;
}
```

# C Code for POJ 1004

```
#include <bits/stdc++.h>

using namespace std;

int main() {
    double sum = 0, buf;
    for(int i = 0; i < 12; i++) {
        cin >> buf;
        sum += buf;
    }
    printf("$%.2f\n", sum / 12.0);
    return 0;
}
```

# Java Code for POJ 1004

```
import java.util.*;

class Main {
    public static void main(String[] args) {
        Scanner in = new Scanner(System.in);
        double d = 0;
        for (int i = 0; i < 12; ++i) {
            d += in.nextDouble();
        }
        System.out.printf("%.2f\n", d/12.0);
    }
}
```

# Course Resources

- ▶ Course Website:  
<https://uiuc-cs491cap.google.io/web-sp23>
- ▶ UIUC ICPC team website: <http://icpc.cs.illinois.edu/>
- ▶ Course materials will be available on the website
- ▶ uHunt (UVa Problem Hunting Tool):  
<https://uhunt.onlinejudge.org/>

# Questions?