Tips on Competitive Programming

Section 1.1–1.2

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Competitive Programming

Core directive: "Given well-known computer science problems, solve them as quickly as possible!"

What does this mean?

- "well-known" = no open research problems
- "computer science" = algorithms and data structures
- "solve" = matches output on test cases in reasonable run time
- "quickly" = natural human desire to compete

Tip 1: Type Code Faster!

No kidding!

Typing skills are important

- However, accuracy matters as much as speed
- Try the test: http://www.typingtest.com
- Goal: at least 50 awpm (adjusted words per minute)
- Stretch goal: 80+ awpm

Learn keyboard positions of programming symbols

- Grouping: `( ) { } [ ] ' " : ;`
- Operators: `< > & | ! + - * /`
- Don't become dependent on a particular keyboard!

Tip 2: Quickly Identify Problem Types

By the end of this course, you should be able to quickly categorize problems by their problem type: (* = more frequent)

- "Ad hoc" (*)
- Complete search (*)
- Divide and conquer
- Greedy
- Dynamic programming (*)
- Graph (*)
- Mathematics (*)
- String processing
- Computational geometry
- "Harder/rarer"

Tip 2: Quickly Identify Problem Types

At the beginning of a contest, briefly read all the problems and attempt to categorize them by difficulty:

- Easy: Solve it quickly and get some points on the board!
- Moderate: Spend the bulk of your time here unless you're aiming for the win, in which case you should solve these quickly and move on.
- Hard: Stretch goals unless you're aiming for the win, in which case you should spend the bulk of your time here.
- **Challenge:** Intended to be difficult even for the best teams. Avoid these unless you are aiming for the win.

You may need to re-evaluate your categorization of particular problems later.

Tip 3: Do Algorithm Analysis

- Remember Big-O analysis from CS 240?
- It's now your best friend!

- Do some basic analysis to determine feasibility
- Look for assumptions about the input size in the problem statement
- Choose the simplest solution that will work
- Check out Table 1.4 in the textbook

Tip 4: Master Programming Languages

- C++ is preferred for the major contests
- However, familiarity with other languages always helps
- Try to learn all the features of your chosen language
- Use shortcuts, macros, and libraries

- **DURING CONTESTS ONLY:** Avoid commenting
  - **OR:** Use comments as stubs
  - Come back and add documentation afterwards!

- For CS 240 students, we recommend using Java for contests this semester to avoid issues with C/C++ incompatibilities

Tip 5: Master the Art of Testing Code

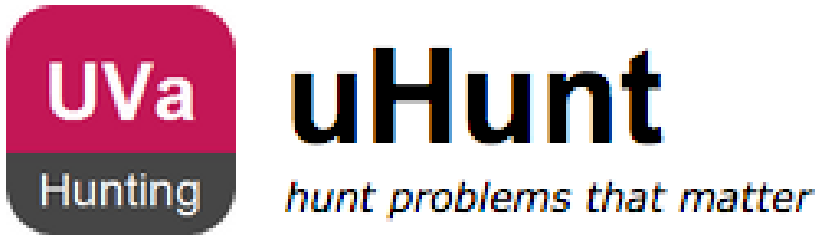
We've all experienced it: you think you're done and you submit, but then you don't get AC.

Other possibilities:

- PE: Presentation Error
- RTE: Runtime Error
- TLE: Time Limit Exceeded
- MLE: Memory Limit Exceeded
- WA: Wrong Answer

Debugging is a very important acquired skill in CS; cultivate it deliberately!

Tip 6: Practice!



See your UVa stats at http://uhunt.felix-halim.net

- Just click your name on the weekly scoreboard

Goal: complete the textbook's starred exercises

- Scroll down to table of contents, click each chapter

Other practice sites:

- http://naipc.uchicago.edu/practices/
- http://www.spoj.com/
- https://www.topcoder.com/

Problem solving process

Work first to solve the problem on your own

- Frustration level 1: Ask for hints and/or suggestions
- Frustration level 2: Have someone look at your code
- Frustration level 3: Look at someone else's code

Go away for a few days (or wait until next week)

- Solve the problem from scratch on your own

After you've solved the problem

- Study other solutions and improve yours
- Internalize (not memorize) your solution

Personal Notebook

Things to include:

- Common algorithms and data structures (e.g., from CS 240)
- Commonly-used reference pages (STL, etc.)
- Your coded problem solutions
  - Document them first!
- Common code snippets
  - Frequently-used methods, debug macros, boilerplate, etc.

Avoid:

- Unfamiliar code (it won't help you)

Basic idea: Include anything you had to **search for** while solving problems, because you won't have internet access during competitions

Tip 7: Teamwork

If you are here just for fun (or the course), then have fun!

- Working in teams can be fun too!

If you are here to compete in the official contest, then pay close attention to the next few slides.

- The ACM ICPC contest is a **team** contest.

Tip 7: Teamwork

One possible team composition:

- Problem solver (*"the professor"*)
  - Often the most theory/math-minded member
  - Quickly comes up with ideas on how to solve problems
  - Writes psuedocode solutions on paper
- Coder (*"the code jockey"*)
  - Often the member with the highest attention to detail
  - Translates psuedocode solutions quickly and accurately
  - Handles the actual testing and submission process
- Debugger (*"the hacker"*)
  - Often the most engineering-focused member
  - Can quickly identify ways that code could break
  - Works with solver and coder to identify and fix defects

You will only have **ONE** computer per team - learn to share it!

Tip 7: Teamwork

Before the competition:

- Evaluate your strengths and weaknesses
- Form a team with people who have complementary strengths
- Spend time practicing with your team
- **Practice coding and debugging on paper**
- Practice inventing edge/corner test cases
- Solve a **LOT** of problems
  - Try to solve a wide range of problem types
  - Try to solve at least a few hard problems
- Assemble and curate your notebooks
- Hang out with your team outside class

Tip 7: Teamwork

During the competition:

- **Don't panic!**
- Have a well-defined game plan for the first 15 minutes
  - Read all the problems
  - Type in boilerplate code and solve the easiest problem
  - Ask the administrators early about hardware/software issues
- Use the "submit and print" strategy
- Be flexible and adapt to the circumstances
  - It's a marathon, not a sprint
  - Re-evaluate problems occasionally throughout competition
  - Check the scoreboard often for hints
  - Keep in mind that there is no partial credit
- **Take pride in your work, and have fun!**

Today's Contest

Form groups of 2-3 people.

- If you are in CS 240, consider finding other CS 240 students and form groups to use Java instead of C++.
- If you are planning to compete more seriously in the regional contest, try to form a group with the two others that you wish to work with at the actual contest.
- Use only **ONE** computer per team. Before you begin, talk amongst your team about how you will share the computer.

You need to register for the online qualifier contest **TODAY**!

We need to finalize teams for the regional contest within the next couple of weeks.