Stanford University

CP Trainer's Guide to ICPC World Finals

Christian Lim

6pm PT, April 26, 2024

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Education

Stanford University

Part-time Jobs

Full-time Job

Google Research

TWO SIGMA

Workshops

Stanford ENGINEERING | Stanford Computer Forum

Coach/Judge

icpc International Collegiate Programming Contest

icpc.foundation

advancing the art and sport of competitive programming

https://www.yongwhan.io

Christian Yongwhan Lim

- Christian and Grace Consulting **Owner**;
- ICPC **Internship Manager**;
- ICPC **North America Leadership** Team;
- ICPC **North America Championship** Operations;
- ICPC North America Programming Camp **Trainer**;
- ICPC NAQ and Regionals **Judge**;
- ICPC World Finals CLI Symposium **Co-lead**;
- ICPC North America Curriculum Committee **Co-lead**;
- Columbia ICPC **Head Coach**;
- **Adjunct** (Associate in CS) at Columbia;

https://www.yongwhan.io

Overview

- **Part I: Competitive Programming**
- **Part II: International Collegiate Programming Contest (ICPC)**
- **Part III: World Finals**
- **Part IV: North America Championship (NAC)**

Part I: Competitive Programming

Why Competitive Programming?

- **To solve standard problems efficiently!**
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- **To become a better programmer!**
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  - This can help you with an early start on an interview preparation!
- **But, most importantly, TO HAVE FUN!**
  - Solving problems can be fun!

Meta Hacker Cup (YES, recruiting…!)

International Collegiate Programming Contest (ICPC)

Popular Contest Sites

AtCoder

CODEFORCES β
Sponsored by Telegram

topcoder ™

Popular Practice Sites

Popular Tutorial Sites

usaco.guide

cp-algorithms.com

More on Growing Short List of Useful Websites

- Please take a look as needed: **bit.ly/christian-terse-guide**

- Alternatively, you can also get to this from **u.icpc.global/training**!

Programming Zealots @Discord

- Break into **CodeForces** rating of **2200+** as fast as you can!

- Join discord, if you have not already!!!

  https://bit.ly/programming-zealot

Programming Zealots @CodeForces

- Also, join CodeForces group, if you have not already!!!

bit.ly/cf-zealots

Success Pathways

- **Programming Zealots @ CodeForces**
- **800 - 2100 (A - N)**
  - **For those who are just starting**
  - To gain some experiences with an explicit goal to enjoy the process of solving new problems;
  - To make it to the ICPC **North America Championship** (NAC)!

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- **800 - 2100 (A - N)**
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  - To gain some experiences with an explicit goal to enjoy the process of solving new problems;
  - To make it to the ICPC **North America Championship** (NAC)!
- **2200 - 3500 (O - ZB)**
  - **For those who are more serious**
  - To make it to the ICPC **World Finals** (and potentially winning a medal)!

Practice Strategy

- If your goal is to get to a rating of **X**, you should practice on problems that are **X + 300** typically, with a spread of 100. So, picking problems within the range of:

  {X + 200, X + 300, X + 400}

  would be sensible!

- So, if you want to target becoming a **red (grandmaster)**, which has a lower-bound of 2400, you should aim to solving {2600, 2700, 2800}.
- **(Eventual) Target**: You should focus on solving it for 30 minutes or less!

Practice Strategy (con't)

- You should focus on solving each problem for **30 minutes or less**; if you cannot, you should consider solving a problem with a lower rating.
- You should aim to solve **~5 problems** each day within this range to expect a rank up within six months.

Practice Strategy (con't)

- You should focus on solving each problem for **30 minutes or less**; if you cannot, you should consider solving a problem with a lower rating.
- You should aim to solve **~5 problems** each day within this range to expect a rank up within six months.
- If you cannot solve a problem, here is a sample recipe you can follow:
  - Look at editorial for **hints**, and try to solve the problem.
  - Look at editorial for **full solutions**, and try to solve the problem.
  - Look at **accepted code**, and try to solve the problem.
  - Make sure you **revisit after two weeks** and see if you can solve it.

Programming Contests

- **CodeForces**
- **AtCoder**

- **Universal Cup**: https://ucup.ac/register

- **Quarterly Contests** from ICPC Curriculum Committee, starting **June 2024**

Training Resources

- **U ICPC**: https://u.icpc.global/training/
- **CP Algorithms**: https://cp-algorithms.com/
- **USACO Guide**: https://usaco.guide/

- **Kattis**: https://open.kattis.com/
- **Methods to Solve**: https://cpbook.net/methodstosolve?oj=kattis&topic=all&quality=all
- **CSES**: https://cses.fi/problemset/
- **solved.ac**: https://solved.ac/en

Part II: ICPC

International Collegiate Programming Contest (ICPC)

- If you would like to train as an official ICPC Foundation intern (unpaid), please reach out to me at **christian.lim@icpc.global**.
  - Weekly masterclass on Sundays!
  - Weekly problem set!
  - Weekly 1:1 mentorship!

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  - Weekly masterclass on Sundays!
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- Or, book a 1:1 time slot using

bit.ly/yongwhan-quickchat

Part III: World Finals

ICPC World Finals @Stanford University

- You can look up the previous results from https://cphof.org.
- For **Stanford**, in last 5 years, we have the following results:
  - **2023** (47th) @ **Luxor**, Egypt: **Rank 36** (5/11)
  - **2022** (46th) @ **Luxor**, Egypt: **Rank 26** (6/11)
  - **2021** (45th) @ **Dhaka**, Bangladesh: **Missed** (N/A)
  - **2020** (44th) @ **Moscow**, Russia: **Rank 46** (5/15)
  - **2019** (43th) @ **Porto**, Portugal: **Rank 21** (6/11)

- You. YES, **YOU**(!) **should** train hard to get to be the next **world finalists!**
  - You, and only you, can drive the change here!

ICPC Training

- So, **exactly**, **how should you do this?**
  - **@Kattis**: simulate (**virtually participate**) previous:
    - **World Finals** (WF) problems,
    - **North America Championships** (NAC) problems,
    - **North America Invitation Programming Contests** (NAIPC) problems,
    - Other strong **European** and **Asian** regionals/championships.

  - **@ICPC U**: look at practice contests from https://u.icpc.global/training

Practice “Strategy”

- The **real keys** to success are:
  - “Upsolving” questions after each session.
  - If solutions are unclear,
    - **STUDY** the algorithms,
    - **IMPLEMENT** them, to make sure you know how to do that,
    - **CHECK** whether you retained them after few weeks,
    - **REPEAT** as many times as needed to learn the algorithms.
  - The **discussions** and **upsolvings** are most probably more important than the simulations! They let you train concepts you DO NOT KNOW!
  - Then, **rinse and repeat** with other problem sets!

Must topics to master (decider for NAC/WF medals)

- **Discrete Fourier / Number Theoretic Transform** (DFT/NTT)
  - World Finals at Dhaka had a tricky problem using it.
- **Geometry**: New ICPC World Finals judges may put more emphasis on it.
  - sweep-line
  - convex hull (trick)
- **Flow** (Dinic)
- **Mobius Inversion** / Inclusion-Exclusion Principle
- **String**: Aho-Corasick; Lyndon factorization (of course, Z-function, KMP, ...)
- **DP Optimization**: Knuth; Divide and Conquer; Convex Hull Trick;

Some key learnings from World Finals at Luxor, Egypt

- **Upsolving** is the key for success.
- Identifying the **weakest** topics and iteratively improving are important.
- Holding a **training camp** is crucial to enforce learning fast.
- Solving **Kattis** questions (e.g., WF, NAC, NAIPC), is key.
  - I am in the process of preparing bounty lists to solve.
- Having **multiple coaches** is important.
  - Continue to recruit professors or student coaches.

Part IV: NAC

ICPC North America Championship (NAC)

- It started in 2020 for the first time!
  - 2024: To be determined in **May 2024**!
    - Hopeful that Stanford will be TOP 6 for bronze, silver, or gold!
  - 2023: **Rank 7** (solved 9)
  - 2022: **Rank 8** (solved 6)
  - 2021: **Honorable** (solved 4)
  - 2020: **Rank 16** (solved 5)
- Prior to that, there was unofficial contest called **North American Invitational Programming Contest** (NAIPC), which was active from 2014 to 2019!

2024 North America Programming Camp (NAPC)

- I am one of the trainers! (https://www.cecs.ucf.edu/NAC-NAPC/trainers)
  - **Jingbang Chen** (Waterloo)
  - **Zachary Friggstad** (Alberta)
  - **Andrew He** (MIT)
  - **Ce Jin** (MIT)
  - **Christian Yongwhan Lim** (Columbia)
  - **Quanquan Liu** (Yale)
  - **Etienne Vouga** (UT Austin)
- **You can get more information from** https://u.icpc.global/training/napc
  - You **should** get the training materials from there!

Columbia University Local Contest (CULC)

- 3rd **Columbia University Local Contest** (CULC)
  - **Individual**, not team, contest!
  - Date: **Saturday, April 27, 2024**
  - Time: **2pm ET ~ 7pm ET**
  - **Online**

- **https://bit.ly/spring2024-culc-flyer**

Any Questions?

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- Please find this slide deck from: https://github.com/yongwhan/yongwhan.github.io/tree/master/stanford/2024

Contact Information

- **Email**: yongwhan@yongwhan.io

- **Personal Website**: https://www.yongwhan.io/

- **LinkedIn Profile**: https://www.linkedin.com/in/yongwhan/
  - Feel free to send me a connection request!
  - Always happy to make connections with awesome students! :)