Yitong (Tony) Zhao

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Student at Princeton International School of Mathematics and Science.

Education

Princeton International School of Math and Science (PRISMS)

Sept 2021 — current PRISMS, NJ

GPA (Freshmen - Junior): 3.99/4.00

CS-related courses:

- Precalculus (Freshmen, A)
- Principles of Computer Science (Freshmen, A)
- Applied Engineering 1 (Freshmen, A)
- AP Calculus BC (Sophomore, A)
- AP Computer Science Plus (Sophomore, A)
- Applied Engineering 2 (Sophomore, A)
- Differential Equation (Junior, A-)
- Multivariable Calculus (Junior, A)
- Linear Algebra (Junior, A)
- Artificial intelligence (Junior, A)
- Computer Science Research (Junior, A)

MIT 6.S081

June 2022 — July 2022

A course on operating systems. I completed all labs and lectures independently during the summer of 2022. I also wrote detailed notes about my approaches in each lab, which are available on my *personal website*. Here are some examples: *Lab3*, *Lab11*. My solutions to the labs are available in this *GitHub repository*.

Due to the high quality of my lab notes, they're listed as *reference material on csdiy.wiki*, a website for CS open courses.

Ray Tracing in One Weekend / the Next Week

Aug 2022 — Oct 2022

An online book focused on building ray tracers. I have built a ray tracer that contains the functionalities in the first two volumes of that book. The source code can be accessed in this *GitHub repository*. It also support some functionalities not implemented in the book, like multi-threading.

Stanford CS144

Dec 2022 — Jan 2023

A course on computer networks aiming to implement the TCP protocol from the ground up (with some basic structures provided). Due to time limits, I completed the first four labs (which finished an implementation of TCP) out of seven in my sophomore year. Like MIT 6.S081, I also post *notes about my approaches* in the lab on my personal website.

GAMES101

June 2023 — July 2023

A course on modern computer graphics largely adapted from *UCSB CS180*. I have completed all the lectures. There is also a more advanced course about real-time rendering in the series, *GAMES202*. I completed one lab and the corresponding lecture in that course.

Digital Logic Design

July 2023 New York City, NY

I attended a *summer program* held by Cooper Union on digital circuit design. My final project is a simplified flappy bird game implemented purely using logic gate chips.

Projects

Personal website

Aug 2021 — current

I started the website with solutions for competitive programming problems (especially USACO), as many existing solutions are confusing to me. One possibility for this is that outstanding competitive programmers tend to skip steps as they think they're obvious. I wrote my solutions with detailed explanations and carefully designed illustrations. I later extended the scope of the website, including my approaches to the labs in open courses. I have also contributed my writings to open-source projects and online forums:

- I have written one *article about treaps* for *OI wiki*, one of the largest online encyclopedia for algorithms and data structures.
- Another *article about the low-level implementation of function calls* was accepted for Luogu Daily. *Luogu* is one of the largest competitive programming forums in China (similar to Codeforces). Through Luogu Daily, one can publish articles on the forum.

Neural networks

Oct 2022

A fully-connected neural network built from scratch to implement the MNIST hand-written digits dataset using backpropagation algorithm.

Chess

Dec 2022 — Jan 2023 PRISMS, NJ

A group project made in my APCS+ class during my sophomore year. We developed chess software using Java with Swing as the GUI library. We then developed bots to automatically play chess and did a bot competition at the end.

Tank

Feb 2023 — Apr 2023 PRISMS, NJ

A project developed in my APCS+ class. This is a multi-player (connect through the internet) tank game. In the project, I used an event-based server-client communication protocol. We also implemented bots for the game that utilized popular algorithms (A* path-finding).

IBCP (Innovative Bot Coding Playground) (*server, or game core* [mainly developed by myself], *front end* [mainly developed by a friend])

May 2023 — current

This educational programming tank game was developed after participating in game-based programming competitions like Battlecode and Terminal, and areas for improvement were found, such as human-robot matches.

The project is:

- fun: scripts can match humans. Learners can invite friends to play against their bots. It features tank upgrading to increase complexity and special regions to promote competitiveness.
- inclusive: It supports advanced techniques from multithreading to async APIs, but it's also suitable for beginners by various debugging functionalities like setting GUI debug string and recording and replaying.
- modular: It can be customized. For example, one can configure another market rule than auction.

The project won a *second-place award and ACM award* in the North Jersey STEM fair.

Magnetic field in solenoids illustration video using Manim

Aug 2023 PRISMS, NJ

When learning magnetism in physics, I was confused by the fact that the magnetic field in a solenoid is uniform. Thus, I made an illustration video using Manim. Manim is a Python library for mathematical animations created by famous math educator Grant Sanderson.

PyAutoGrade

Sept 2023 — current PRISMS, NJ

Python script I wrote to help my CS teacher (as a TA) grade his introductory CS class assignments automatically. The project prevents potential malicious behavior in students' code, such as infinite loops, memory overflow, and file system access. It can also simulate std IO for interactive problems and output the results in a human-readable format (.csv file).

Experiences and Positions

Computer science club

Sept 2023–current PRISMS, NJ

Club leader.

- Established *club website*
- Led a project to build full adders using logic gate chips.
- Led a project to create math illustration videos for math teachers using Manim.
- Organized a trip to *PyCon*, the Python conference. Arranged a special session with CMU's admission officers during the trip.

Teaching assistance for Principles of Computer Science

Sept 2023–June 2024 PRISMS, NJ

Worked with the teacher to grade assignments and help students with their questions. An automatic grader (*PyAutoGrade*, introduced in the Projects section) was developed to help grading.

CSIRE research program

July-Aug, 2024 Stony Brook University, NY

- Worked in *Prof.Shuai Mu*'s StonySystems research lab on improving C++ memory safety and C++/Rust interoperability.
- Implemented *some Rust smart pointers in C++.*
- Under the guidance of *Ti Zhou* (PhD student in the lab), I implemented a *Rust compiler frontend* (ongoing project) using OCaml with *Menhir* as the parser generator and *OCamllex* as the Lexer generator. Developed tools to automatically convert AST printed by `ppx_deriving.show` to Mermaid diagram for easier debugging.

Honors and Achievements

Battlecode

Jan 2023

Ranked 124 in all 434 participants. Not sure about ranking for the high school and newbie groups.

USACO (USA Computing Olympiad)

Mar 2023

Entered in the gold division.

PClassic (Pennsylvania Classic)

Apr 2023 University of Pennsylvania, PA

Advanced Division: ranked at 5th place.

CMIMC (Carnegie Mellon Informatics and Mathematics Competition) Programming

Apr 2023

Ranked at 4th place for the Optimization Round. Ranked 6th place for New Language Round.

HIMCM (High School Mathematical Contest in Modeling)

Nov 2023

Meritorious. Top 202 among 967 teams. Invited to *USA regional IMMC*.

North Jersey STEM fair

Mar 2024 Kean University, NJ

142 projects in total, 17 in the computer science category.

- Second place in the computer science category ($75 cash award)
- Association for Computing Machine Award (1-year student memberships to the Association)

Software/Programming Language Skills

The specific projects that use these skills are introduced in the experiences and projects section.

- Markdown ●●●●●
- Adobe Lightroom ●●●●○
- C++ ●●●●○
- Python/Kotlin/Java ●●●●○
- OCaml ●●○○○
- Git ●●○○○
- Typst/Latex/Hexo ●●○○○
- Linux ●●○○○
- Logisim ●●○○○
- AutoCAD/OnShape ●●○○○
- Adobe Photoshop/Premiere Pro ●●○○○

Hobby

Outside CS, my primary interest lies in photography. The following image is one of my favorites, and it earned a silver medal (national) in the *Scholastic Art and Writing Awards*.

You can view my *portfolio* for more.