Harry Chen

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Summary

I am an undergraduate student studying Engineering Science at the University of Toronto. I have four years of experience in computer graphics and numerical analysis and have independently completed more than 70 related projects, experiments, and demos. I have strong knowledge and skills in mathematics, physics, and programming, as validated by my academic performance and awards in more than 20 national problem-solving competitions. My recent programming projects focus on physically based modeling and interactive visualization. I am also passionate about applying STEM to visual arts.

Education

St. Robert CHS | Ontario Secondary School Diploma (2018 - 2022)
I completed high school in Ontario with a top-6 grade average of 99%. I received a final grade of 100 in physics, 100 in programming, and 99 in calculus.

University of Toronto | BASc in Engineering Science (2022 - 2027)
I completed my first term in my first year of the engineering science undergraduate program with a GPA of 3.83 out of 4. I received a final grade of 99 in calculus, 95 in linear algebra, 96 in classical mechanics, and 98 in programming.

Skills

I have experience with a number of programming topics, including programming languages like C++, Python, MATLAB, and JavaScript, markup languages like LaTeX, HTML/CSS, and Markdown, programming frameworks like OpenGL and PyTorch, Linux and Windows operating systems, and Git for source control. I am self-taught in multivariable calculus, linear algebra, probability theory, classical mechanics, and solid mechanics through online resources, and I am familiar with their applications in computer graphics, robotics, and machine learning.

C++ (since 2018)
I am a fluent C++ programmer and have used C++ as my main programming language for five years. I am familiar with C++ syntax, dynamic memory, standard libraries, object-oriented programming, and features in recent C++ versions.

OpenGL (since 2019)
I use OpenGL as my main tool to interact with GPUs. I'm familiar with the OpenGL rendering pipeline and the GLSL language. I have experience with C++ (GLFW, GLEW, GLM), WebGL, and PyOpenGL interfaces.

Python (since 2020)
I am experienced with the Python programming language for data processing, machine learning, and writing automation scripts. External modules I'm familiar with include NumPy, SciPy, Matplotlib, PyTorch, PIL, Requests, and Pygame.

Experiences

Autonomous Drone Racing | University of Toronto Aerospace Team (2022 - present)
I'm an active member of the UTAT Autonomous Drone Racing (ADR) team of the University of Toronto, which consists of largely graduate students. I have completed an 8-week workshop about the Robot Operating System (ROS) and fundamentals of visual localization, trajectory planning, and control theory. I'm currently working on the path planning subteam to implement the "Geometrically Constrained Trajectory Optimization for Multicopters" paper.

Math Club Executive | St. Robert Catholic High School (2019 - 2022)
I had been an executive of my high school's math club since my second high school year. My main responsibilities were preparing and teaching lessons about math topics and moderating the "Math Circle" Discord online community.

Canadian Team Mathematics Competition | The Center for Education in Mathematics and Computing, University of Waterloo (2018 - 2022)
I was the youngest math team member in my high school's history and was trained to compete in the annual CTMC in teams of 6. I specialized in analytical geometry, functions, and combinatorics. My high school received 3rd place, 1st place, and 2nd place, in 2019, 2021, and 2022, respectively, out of more than 50 participating schools in 2019 and more than 30 participating schools in 2021 and 2022.

Teaching Assistant | York Region District School Board (2018 - 2020)
I completed more than 120 hours of volunteer work for the International and Indigenous Languages Program at YRDSB. I volunteered for Richmond Hill H.S. in my 9th-grade year,

where I guided ways and delivered teaching materials. In my 10th-grade year, I assisted a 5th-grade student learning Mandarin at Langstaff S.S.

Programming Projects

Finite Element Analysis (December 2022 - present)
https://github.com/harry7557558/Graphics/tree/master/simulation/fem/statics_le
I experimented with solving 3D trusses using the stiffness method after learning about trusses in university, and I soon moved to write C++ code from scratch to analyze stress and deflection in solids. I researched strain and stress formulations, experimented with linear and quadratic tetrahedral elements of various shapes, different preconditioners for the conjugate gradient method, and mesh generation from implicit objects. I also implemented an OpenGL GUI to visualize results.

Spirula Online Function Grapher (March 2022 - October 2022)
https://harry7557558.github.io/spirula/
I was inspired by raymarching demos on Shadertoy to create a WebGL online graphing calculator for 3D implicit surfaces. I implemented an equation parser based on the Shunting-Yard algorithm that supports defining custom variables and functions. The parser generates code for a GLSL function with automatic differentiation, which is visualized by raymarching in screen space. I also independently developed a regression-based anti-aliasing technique. The function grapher was heavily updated in October 2022 to include complex arithmetic, a formula for fast gradient estimation that I derived, and improved mobile compatibility.

CIV102 Bridge Project (November 2022)
This is my project for the CIV102 course that requires designing and building a matboard paper bridge to support the highest load. I wrote Python code and implemented coordinate compression for integrating piecewise polynomials, which was used to analyze the bending moment and shear profile in a beam. I used the `rectpack` package to set constraints to make sure all components can fit into the given matboard. I optimized the bridge using simulated annealing modified to consider gradient estimate. I built the physical bridge based on the design in a team of 3 members.

Pendulum Lab (September 2022 - November 2022)
I studied the damping of a simple pendulum by analyzing experimental data. I used OpenCV to track the position of the mass from videos and fitted the angle-time data to a quadratically damped oscillator model using SciPy. I attempted to recreate experimental data by integrating a differential equation model. I also developed a model for the relationship between the Q-factor and pendulum length to fit experimental data.

Stable Fluids (August 2022 - September 2022)
https://harry7557558.github.io/Graphics/simulation/fluid_grid/jacobi_pressure/index.html
I implemented a web-based fluid simulation demo after reading Jamie Wong's blog post. I attempted a multigrid pressure solver and vorticity confinement.

XPBD Cloth Simulation (August 2022)
https://github.com/harry7557558/Graphics/tree/master/simulation/mass_spring/xpbd_cloth
I implemented the Extended Position Based Dynamics (XPBD) method and applied it to simulating mass-spring models and cloth models. I researched solid elasticity and implemented the energy function and its analytical gradient. I compared XPBD results with the results of a conventional semi-implicit Euler solver.

GAN Neural Network (July 2022)
https://harry7557558.github.io/Graphics/fitting/dcgan/ffhq_convtrans/webgl/index.html
I implemented a GAN neural network in PyTorch and trained it on the FFHQ face database. I manually exported it to a webpage, which loads binary weights into WebGL. I derived a mapping function that results in a uniform distribution when applied to linearly interpolated noise and used it to keep the diversity of faces in animation.

"*Man of La Mancha*" Media Project (May 2022)
https://harry7557558.github.io/art/molm/index.html
I made this artwork for a high school English course. I procedurally modeled several objects and rendered them using Monte Carlo path tracing in WebGL. I implemented the Cook-Torrance reflectance model, refractive materials, and emissive materials.

Neural Network Written from Scratch (April 2022)
https://github.com/harry7557558/Graphics/tree/master/fitting
I tried to implement neural networks in C++ from scratch to see if they can overperform machine learning frameworks. I implemented dense, convolutional, and RBF layers, and SGD, Adam, and BFGS optimizers. I generated a grid of SDF values from a polygon mesh using breast-first search and fitted it to a SIREN neural model. I improved the algorithm by using quasi-random sampled data points in mini-batch training. I did several tests with different random number seeds and found that compared to TensorFlow, my code achieved half of the loss in a quarter of the time on average.

SVG to Desmos (March 2022)
https://github.com/harry7557558/svg-to-desmos
After seeing other people's projects exporting SVG images to the Desmos graphing calculator, I was intrigued to write my own but focus on size optimization. I wrote a Python script that parses SVG paths into Bézier splines, and applied arc-length parameterized discretization using

Gaussian quadrature and the secant method. I compressed the paths using FFT and merged shapes with the same colors using an R-tree and a greedy algorithm. I was able to fit the entire Twemoji list (4000+ emojis, 7MB SVG) into a single Desmos graph with a size of less than 3 MB.

Implicit Mesh Smoothing Experiment (February 2022)
https://github.com/harry7557558/Graphics/tree/master/simulation/heatequ
I experimented with Laplacian and Taubin smoothing for polygon meshes using implicit methods. I implemented a conjugate gradient and a BiCGSTAB solver for the linear system arising in the finite difference method. I attempted to derive a partial differential equation that is independent of mesh resolution and does not cause shrinkage.

AVI4M Independent Study Project (November 2021 - January 2022)
https://harry7557558.github.io/AVI4M-ISP/index.html
I created this project for a high school art course. I developed an SDF visualization tool using volume rendering techniques and used it in CSG modeling. I implemented octree-based adaptive marching cubes for surface reconstruction and developed disambiguation techniques. I initially wrote path tracing rendering code from scratch. I later rendered the models in Blender to save time and meet the deadline.

Volume Rendering Demo (October 2021)
https://harry7557558.github.io/Graphics/raytracing/webgl_volume/index.html
I played with volume rendering of medical imaging datasets in WebGL 2. I processed several popular CT and MRI scanning datasets into raw bytes using NumPy. I implemented volume rendering modes like MIP, X-ray, isosurface, volumetric integration, gradient-dependent transfer function, etc.

Symbolic Procedural Noise Analysis (August 2021)
https://github.com/harry7557558/Graphics/tree/master/modeling/procedural/noise_stat
I tried to normalize noises used in procedural modeling to a fixed mean and variance on values and gradients. To simplify work and overcome the speed issue with SymPy, I implemented a Python class for the product of polynomials and trigonometric series that supports symbolic summation, multiplication, differentiation, and integration. I used it to compute the analytical variance of several noises and their gradients and validated my results using quasi-Monte Carlo simulation in C++.

IdentiEgg (July 2021)
https://harry7557558.github.io/art/dyed-egg/index.html
I was inspired by WordPress identicon to generate identicon eggs. To make the shapes of the eggs match real-world eggs, I traced real-world eggs, fitted them to a linear least squares model,

and plotted the parameter points in R^3. I noticed the parameters are within an ellipsoid, so I applied principal component analysis to find the equation of the ellipsoid and derived an equation to generate uniformly distributed points in it without rejection sampling. I wrote code to minimize the height of the center of mass of eggs so they can be physically rested on a plane.

SPH Fluid Simulation (June 2021)
https://github.com/harry7557558/Graphics/tree/master/simulation/fluid
I tried the Smoothed Particle Hydrodynamics (SPH) method for simulating 2D and 3D liquids. I implemented a particle system, a grid for fast neighbor lookup, the semi-implicit Euler solver with splitting, and iterative solvers.

Color Function Fitting (May 2021)
https://github.com/harry7557558/Graphics/tree/master/UI/color_functions
I tried to fit Wolfram colormap functions and export them to personal projects. I implemented linear least squares for polynomial and trigonometric series models with varying numbers of terms. I also fit them to a frequency-dependent trigonometric model by setting the frequency to a numerical optimization parameter.

Adaptive Parametric Surface Triangulation (December 2020)
https://github.com/harry7557558/Graphics/blob/master/triangulate/parametric_surface_adaptive_dist.h
I tried to find a way to discretize parametric surfaces adaptively. I implemented quadtree with orthogonal approximation error for subdivision criterion. I tried the method on several artistic 3D models.

"*In Your Eyes*" Art Project (December 2020)
https://harry7557558.github.io/Graphics/UI/Homework/AVI3M/index.html
I generated 3D renderings of an eye model for a high school art project. The model was an implicit surface triangulated by the marching cube method, and I merged vertices that are too close with the help of the disjoint set data structure. I implemented Monte Carlo path tracing for rendering and played with specular, refractive, and glossy materials. I received a perfect score on this project.

Rigid Body Balancing (November 2020)
https://github.com/harry7557558/Graphics/tree/master/simulation/balance
I tried to find ways to place a rigid body on a plane to minimize the height of its center of mass. I did that for 2D shapes by finding the convex hull of Bézier splines. For 3D meshes, I extended the Nelder-Mead optimization algorithm to a unit sphere and used it to find a local optimal orientation.

Fitting Bézier Curves to Parametric Curves (October 2020)
https://github.com/harry7557558/Graphics/tree/master/fitting/parametric2bezier
I tried to fit Bézier splines to mathematical parametric curves without too many pieces. I researched, implemented, and compared techniques for finding the distance from a point to a cubic Bézier spline. I initially fit the curve with Gaussian quadrature and linear least squares. I later wrote code to discretize the parametric curve with the handling for different types of singularities, while minimizing the number of curve samples.

Ellipse Fitting Experiments (June 2020)
https://github.com/harry7557558/Graphics/tree/master/fitting/old
I derived analytical solutions to least squares fitting to 2D points for lines and circles but faced challenges for ellipses. I formulated several generalized eigenvalue problems as biased solutions and compared them with a quasi-Newton solution based on exact ellipse distance. I wrote anti-aliased rendering in C++ from scratch to visualize the results.

STL and PLY viewer (May 2020 - September 2021)
https://github.com/harry7557558/Graphics/blob/master/UI/ply_viewer.cpp
I created a 3D model viewer for personal use and maintained it for more than one year. It is based on Win32 GUI with software rasterization. It implements different shading modes, restoring the connectivity of STL models, and calculating physical quantities like the center of mass and inertia tensor using the divergence theorem.

ASM2O Cumulative Performance Task (April 2020 - May 2020)
https://github.com/harry7557558/Graphics/tree/master/UI/Homework/ASM2O
For this high school art project, I implemented a 3D stick figure animation engine based on Win32 GUI that supports inserting, editing, and removing keyframes for each node.

2D Light Transport Simulation (March 2020)
https://github.com/harry7557558/Graphics/tree/master/raytracing/light2d
I implemented Monte-Carlo path tracing with stratified sampling to simulate light transport in 2D, and I tested it on scenes composed of refractive glass objects and light sources. My C++ code was capable of loading objects from SVG images, calculating analytical intersection to cubic Bézier curves, and determining whether a point is within a shape enclosed by Bézier splines.

Chemical Equation Balancer (November 2019)
https://harry7557558.github.io/tools/chemequ.html
I learned the solution to homogeneous linear systems and applied it to balancing chemical equations. I implemented a chemical equation parser in JavaScript, a rational number class, and a

Gaussian elimination solver. I applied integer congruence properties to find multiple solutions for linear systems with a solution space rank higher than 1.

3D Matrix Visualizer (July 2019)
https://harry7557558.github.io/tools/matrixv.html
I wrote an online tool to visualize transformation matrices in computer graphics on an HTML5 canvas, which has several built-in 3D models and visualization of eigenpairs. It was updated in October 2022 to use the shifted QR algorithm for more accurate and stable eigenpair calculation. Currently, this tool has more than 300 Google search clicks per month according to Google Search Console.

"*The Glass*" (May 2019)
https://github.com/harry7557558/Ray-Tracing
I created an animation for a high school art project and rendered it using ray tracing. I learned about matrix and vector algebra and object-oriented programming in C++. I also did motion capture using a cell phone camera.

Fishing Game (December 2018)
I created a fishing game for a school presentation demonstrating sustainable fishing. Using Scratch, I made characters, animations, interactions, sounds, and start and finish screens. The player must balance the desire for more fish and nature's capability to maximize the number of fish caught.

Online Community Involvements

Shadertoy (August 2019 - present)
https://harry7557558.github.io/shadertoy/, https://www.shadertoy.com/user/harry7557558
I created and shared more than 40 technical and/or artistic WebGL shaders on the platform Shadertoy and received a total of more than 10,000 views, more than 500 likes, and more than 100 positive comments. Some selected shaders are listed below.

The Man, Earth, and the Gamma (August 2022). A path-traced rendering of a scene consisting of a stick figure, miniature earth with texture encoded by a SIREN neural network, and a 3D plot of the Gamma function on the complex plane, with a multi-scattering reflectance surface.

Sea Cucumber on Beach (August 2022). A metaball modeling experiment about growing spikes on arbitrary implicit surfaces.

Torus Wave (July 2022). An artistic cold golfing experiment.

Galaxy Eye (July 2022). Rendering a precomputed artistic volume, with refraction, emission, and scattering.

Marble Egg (July 2022). Path-traced rendering of an egg with procedurally modeled texture. Demonstrate subsurface scattering.

Functional Conch (June 2022). Modeling and real-time rendering of a conch on a beach with implicitly defined geometry and color.

Neural Tooth 2 (May 2022). Rendering a CT-scanned volume represented by a neural network. Received 30 likes.

Linear Regression AA (April 2022). Demonstrating an anti-aliasing technique of my invention by applying it to four different images.

ShallowWaterEqu_3b1d (February 2022). Numerically solving the shallow water equation.

Uniform Random Showcase 2D (January 2022). A showcase of generating uniformly randomly distributed points on 12 different shapes by parameter transformation.

isp-glassball-11-mix (October 2021) A path-traced rendering of colored glowing rings above scattering medium inside a glass ball.

Nautilus Shell (September 2021) CSG modeling of a nautilus shell with internal structures with a focus on anatomical accuracy. Rendered in real-time using raymarching.

Piecewise Linear Simplex Terrain (September 2021) A procedural modeling experiment.

Mathematica Color Schemes (May 2021) Showcase colormap functions fitted from the official Wolfram language list using linear least squares.

Numerical Gradient Comparison (June 2020) Investigating and comparing the accuracy of several sampling techniques for finite difference gradient estimation in 3D using both theoretical and empirical approaches.

Implicit Star (April 2020) Rendering a 5th-degree algebraic surface in the shape of a star, which I developed.

Triangled (April 2020) A raymarching artwork with animation and synthetic sound.

Exponential Regression (March 2020) Fit COVID-19 daily cases of several countries at the start of the pandemic to the exponential of linear and quadratic functions.

I heart Fourier (February 2020) Calculating the orthogonal Euclidean distance to a trigonometric spline that represents a fusion of a heart shape and the English word “Love.”

Fitting Arc Using Bézier (January 2020) Apply least squares fitting to fit a cubic Bézier curve to a circular arc of arbitrary length.

Implicit Heart (August 2019) Rendering an implicit surface using raymarching.

Desmos Graphing Calculator (October 2019 - present)

https://harry7557558.github.io/desmos/index.html

I created more than 50 graphs within the Desmos online graphing calculator and published them on my website and the Unofficial Desmos Discord community. More than half of them investigate or showcase solutions to problems I encountered in mathematics and programming.

A number of them are creative artworks, including the first-place winner of the 2021 Desmos Global Math Art Contest *Ammonite*. Some selected graphs are listed below.

LDS Dependency 3D (July 2022). Investigating the dependency of adjacent terms of the van der Corput sequence by plotting three consecutive terms in R^3. Includes an implementation of 3D perspective projection.

Value Noise Distribution (July 2022). Deriving the probability density function of the linear interpolation of two standard uniform random variables and applying it to generate noise with a standard uniform distribution.

Forest Tutorial and *Seashells Tutorial* (April 2022). Two demos created for a presentation in my high school about creating art using mathematical functions. The former demonstrates implicit curves, and the latter demonstrates parametric and polar curves.

Ammonite (January 2022). My submission for the 2021 Desmos Global Math Art Contest, which won first place in the 17-18 age group. Details can be found under the Awards section.

Random points inside union of two circles (December 2021). Demonstrate generating uniformly randomly distributed points in the union of two circles with the same radius, as an answer to an online forum question.

3D Parametric Surface Template (December 2021). Plotting parametric surfaces in the Desmos graphing calculator. Includes an implementation of 3D perspective projection.

RYB Color Wheel Girl (August 2021). An artistic graph showing a color wheel inside a silhouette of the head of a girl. Intended to test Desmos's newly-added custom color feature.

Torus projection (September 2020). Studying the outline of the orthographic projection of a torus. Includes a parametric equation I derived.

Desmos 3D (April 2020). Showcasing 3D graphing on a 2D graphing calculator. Includes rendering of planar implicit curves, explicit surfaces, parametric curves, parametric surfaces, and implicit surfaces.

Offsetting Curves (March 2020). Showcasing offsetting the graphs of parametric, polar, and, explicit, and implicit curves. Involves calculating the tangents and normals of these curves.

DMOJ: Modern Online Judge (2019 - 2022)

https://dmoj.ca/user/Moana/solved

I was active on the DMOJ competitive programming platform during my high school years. I participated in more than 20 contests, which are partially listed under the Competitions section. I practiced algorithmic problem-solving with a focus on advanced mathematics and computational geometry and practiced solving problems from national and international computing olympiads, where some problems I solved are listed below. As of January 2023, my main account ranked 66th by points out of more than 140,000 registered users worldwide.

Bubble Cup V9 A Cowboy Beblop at his computer (November 2022). Requires determining whether two 3D polygons are linked.

Baltic OI '16 P3 - Spiral (October 2022). From the Baltic Olympiad in Informatics. Requires evaluating a two-dimensional piecewise polynomial series in constant time.

UTS Open '15 #3 - Pogo (July 2022). Solved using dynamic programming and matrix binary exponentiation.

Baltic OI '04 P5 - Rectangles (July 2022). Solved using coordinate compression.

JOI '19 Open P2 - Remittance (July 2022). From the Japanese Olympiad in Informatics. Solved by solving a sparse linear system using the Gauss-Seidel method.

TLE '17 Contest 4 P6 - Fax's Christmas Bash (December 2021). Solved using the segment tree data structure.

NOI '10 P6 - Happily Growing (August 2021). From the Chinese National Olympiad in Informatics. Solved using dynamic programming and greedy algorithms. I am the only person who has solved this problem on DMOJ as of January 2023.

Balkan OI '11 P1 - Two Circles (May 2021). Solved using polygon clipping and binary search.

CCO '08 P6 - Landing (March 2021). From the Canadian Computing Olympiad. Solved using Delaunay triangulation.

CCO Preparation Test 3 P3 - Arrow (January 2021). Solved using linear programming.

Root Solver (September 2020). Solved first using bisection search and again using the QR eigenvalue algorithm.

NOI '05 P6 - Lemon Tree Under the Moon (September 2020). From the Chinese National Olympiad in Informatics. Requires determining the exact area of the union of a list of circles with different sizes.

ICPC PACNW 2016 E - Enclosure (June 2020). Solved using convex hull and Golden section search.

UTS Open '15 #6 - Tetrahedra (April 2020). Requires determining the exact surface area of the union of two tetrahedra.

A Times B (April 2020). Solved using Fast Fourier Transform.

Competitions

I participated in several academic problem-solving competitions and received awards, which are listed below.

Euclid Mathematics Competition | The Center for Education in Mathematics and Computing, University of Waterloo (2019 - 2022)
The Euclid mathematics competition is heavily valued by admission to STEM-related undergraduate programs at the University of Waterloo. In 2019, I was among the top 25% of all participants. In 2022, I received the group III honor roll and was at the 99.7th percentile among all participants with a nonzero score.

Canadian Open Mathematics Challenge | Canadian Mathematics Society (2018 - 2021)
The COMC is intended to select members for the Canadian Mathematical Olympiad (CMO), which leads to the International Mathematics Olympiad (IMO). In 2018, I was among the top 3 in my high school out of all grades. In 2019, I was among the 25% highest scores in Canada. In 2020, I was among the top 25%, above the deadline of the Canadian Mathematical Olympiad Qualification Round (CMOQR) cutoff. I was among the 25% highest scores in 2021.

Canadian Intermediate and Senior Mathematics Competition | The Center for Education in Mathematics and Computing, University of Waterloo (2018 - 2021)
The CIMC and CSMC contests consist of 9 written problems to be solved in 2 hours. In CIMC 2018, I received the V honor roll and first place in my high school. In CIMC 2019, I received the group IV honor roll and first place in my high school. In CSMC 2020, I received the group V honor roll and was invited to the Auckland mathematics workshop. In CSMC 2021, I received the group V honor roll.

Pascal/Cayley/Fermat Mathematics Competitions | The Center for Education in Mathematics and Computing, University of Waterloo (2019 - 2021)
Each competition requires solving 25 multiple-choice problems in 60 minutes. In Pascal 2019, I received the group II honor roll and first place in my high school. In Cayley 2020, I received the group IV honor roll. In Fermat 2021, I received the group III honor roll.

Fryer/Galois/Hypatia Mathematics Competitions | The Center for Education in Mathematics and Computing, University of Waterloo (2019 - 2021)
Each competition consists of 4 problems (with parts) to be solved in 75 minutes. In Fryer 2019, I received the group I honor roll with a perfect mark. In Hypatia 2021, I received the group III honor roll.

Sir Isaac Newton Exam | Department of Physics & Astronomy, University of Waterloo (2019-2022)
This 2-hour prize exam requires solving 12 multiple-choice physics problems that focus on creative solutions more than computation. In 2019, I was the 96th percentile among all contestants, and I was both the 1st place winner and the youngest participant in my high school. In 2021, I was the 97th percentile among all participants and the 2nd place in my high school.

Canadian Computing Competition | The Center for Education in Mathematics and Computing, University of Waterloo (2020 - 2022)
This competition was a part of member selection for the International Olympiad in Informatics (IOI), which requires solving 5 algorithmic problems in 3 hours. In the 2020 junior contest, I achieved a perfect score. I received the group II honor roll and the group IV honor roll in the 2021 and 2022 senior contests, respectively.

DMOJ: Modern Online Judge (2019 - 2022)
I participated in a list of rated and unrated algorithmic problem-solving contests on the DMOJ online programming platform. Participants in some of these contests include internationally recognized competitive programmers like Gennady Korotkevich and Benjamin Qi. Some contests I participated in are listed below.

- A Math Contest (Jul. 2022) Ranked 42nd out of 461 contestants.
- DMOPC '21 September Contest (Sep. 2021) Ranked 57th out of 220 contestants.
- An Unrated Contest (Sept. 2021) Ranked 13th out of 158 contestants.
- Another Contest 8 (Aug. 2021) Ranked 24th out of 125 contestants.
- CPC '21 Contest 1 (Jul. 2021) Ranked 46th out of 199 contestants.
- An Animal Contest 2 (May 2021) Ranked 31st out of 174 contestants.
- DMOPC '20 April Contest (Apr. 2021) Ranked 34th out of 208 contestants.
- An Animal Contest 1 (Apr. 2021) Ranked 29th out of 109 contestants.
- Riolku's Mock CCC (Feb. 2021) Ranked 59th out of 310 contestants.
- Appleby Contest '20 (Feb. 2021) Ranked 49th out of 310 contestants.
- UTS Open '21 (Feb. 2021) Ranked 70th out of 278 contestants.
- DMOPC '20 January Contest (Feb. 2021) Ranked 46th out of 270 contestants.
- Wesley's Anger Contest 6 (Jan. 2021) Ranked 64th out of 216 contestants.
- DMOPC '20 October Contest (Oct. 2020) Ranked 28th out of 259 contestants.
- Wesley's Anger Contest 5 (Aug. 2020) Ranked 41st out of 152 contestants.
- DMOPC '19 March Contest (Mar. 2020) Ranked 52nd out of 292 contestants.
- PIB '20 (Mar. 2020) Ranked 16th out of 88 contestants.
- DMOPC '19 February Contest (Mar. 2020) Ranked 32nd out of 213 contestants.
- Mock CCC '20 Contest 1 Senior (Feb. 2020) Ranked 38th out of 338 contestants.
- Wesley's Anger Contest 2 (Nov. 2019) Ranked 34th out of 144 contestants.

Award

2021 Desmos Global Math Art Contest, 17-18 age group | 1st place
My artwork “Ammonite” created with the Desmos graphing calculator received 1st place in the 17-18 age group, out of more than 10000 submissions from more than 100 countries. In the artwork, I created a moving underwater creature with a shell and tentacles modeled by parametric surfaces and curves, on a rippled gradient background modeled by implicit equations.

Referees

Du Do <username@ycdsb.ca> | York Catholic District School Board
Ms. Do was the coach of my high school's math team and can provide evidence about my mathematics competitions completed in high school. She also evidenced my award in the Desmos Global Math Art Contest.

Daniel Gallo <username@ycdsb.ca> | York Catholic District School Board
Mr. Gallo was my high school computer science teacher. He can provide information about my academic performance in computer science courses, as well as my projects.

Chao Qin <username@mail.utoronto.ca> |
University of Toronto Institute for Aerospace Studies
Chao is a Ph.D. student at the University of Toronto and the instructor for the UTAT Autonomous Drone Racing team. He can provide evidence about my mathematics and programming skills outside academics and my involvement in the team.