Arnav Kumar

a8kumar@uwaterloo.ca arnavcs arnavcs.github.io Arnav Kumar

Skills

Programming: Python, C++, Rust, Go, JavaScript, TypeScript, Haskell, Racket, Java, Bash, LaTeX
Tools: WebGL, Three.js, Pandas, Matplotlib, NumPy, Tensorflow, Scikit-learn, OpenCV, Linux, Unix, Godot, Protobuf

Education

Candidate for BSc. Computer Science (4th year) @ University of Waterloo 2022 - Present
Waterloo, ON.

- 4.0 GPA, all advanced level courses, and term distinction.
- Received the Ronald G. Dunkley National Scholarship ($18,000), the President's Entrance Scholarship ($3,500), the NSERC undergraduate research scholarship ($6,000), and the Cenovus Energy STEM Scholarship ($18,500).

Experience

Software Engineer (Graphics, 3D Geometry) @ Arcol.io Sep 2025 - Dec 2025
San Francisco, USA

- Designed and implemented a Rust terrain triangle mesh generation algorithm based on Delaunay triangulation and interpolation between terrain contours.
- Performed prototyping, iteration, and proof-of-concepts to choose and implement the most suitable approach.
- Rendered generated terrain and contour lines, sent over the Wasm ABI to TypeScript, with Three.js and WebGL.

Software Engineer @ Trend Micro Jan 2025 - Apr 2025
Kanata, ON.

- Engineered utility functions for Alicloud's Object Storage Service and Parameter Store, optimizing cloud workflows and enhancing secure data management.
- Developed serverless functions to send scan metrics and results to the backend, helping identify details about customer errors and significantly cutting customer costs.

Combinatorics Researcher @ University of Waterloo May 2024 - Aug 2024
Waterloo, ON.

- Authored a paper (The dimension of sparse random graph orders) in pre-print in arXiv (https://arxiv.org/abs/2504.19029).
- Worked on novel research exploring random graph orders and poset dimension utilizing configuration models, approximation techniques, convergence in probability, devising constructions, and computationally searching for counterexamples.
- Developed two theorems about the nature of poset dimension for bipartite posets based on the dimension of induced subposets and for random graph orders.

Achievements

- 335th (top 10%), with score 26, **William Lowell Putnam Mathematical Competition** 2022
- 10th in Canada, **Asian Pacific Mathematics Olympiad (APMO)** 2022
- 18th in Canada, 2 time qualifier, **Canadian Mathematical Olympiad (CMO)** ..... 2021 - 2022

Projects

4D Raytracing Pathtracer | *C++*

- Implemented SDF raymarching in 4D space with CPU pathtracing to contruct GIF renders of the scene.
- Encoded the render such that every frame in the GIF, the camera sends out rays into a 3D affine subspace of the 4D space, which are scattered into 4D space upon colliding at a surface.
- Designed and wrote a powerful material system with microfacet BRDFs, glass, volumetric fog, and more with the ability to assign more than one material to a geometry.

Software Rasterizer | *C++*

- Recreated the whole rasterization process on the CPU, including perspective transformation, triangle rasterization, depth buffering, and perspective correct interpolation.

Software Raytracer | *C++*

- Implemented the Möller–Trumbore algorithm for fast ray-triangle intersection
- Programmed Lambertian diffuse, specular refraction, and specular reflection behaviour, and support for spherical environment mapping

Renovating the Labyrinth (Game) | *JavaScript*

- Solo submission made in 72 hours with vanilla JavaScript on an HTML canvas for the UW Game Dev Club's fall 2024 game jam; voted winner of the technical achievement award.
- Built a real time optimized ray caster with ordered Bayer matrix dithering.
- Programmed 2D rigid body collision behaviour and a randomized Prim's algorithm for map generation.