Mukul Agarwal

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Education

Purdue University (West Lafayette, IN) Aug 2023 - May 2027
B.S., Computer Science (Honors) | B.S., Mathematics

- **Awards:** Dean's List and Sem. Honors (6/6 semesters); Summer Undergraduate Research Fellowship (2025)
- **Graduate-level Coursework:** Randomized Algorithms, Complexity Theory, Algorithmic Game Theory, Machine-Learning Algorithms, Numerical Optimization, Algebra, Analysis

Experience

Undergraduate Researcher – Prof. Kent Quanrud May 2026 - Present
Purdue University *West Lafayette, IN*

- Developed randomized polynomial-time algorithms for matroid intersection coloring problem, improving approximation guarantees while weakening assumptions required by prior results. Designed a deterministic scheme for fractional instances of the problem and extended algorithms to list-coloring. *(Manuscript in preparation).*

Teaching Assistant / Course Development Assistant Jan - Apr 2025; Jan 2026 - Present
Purdue University *West Lafayette, IN*

- Led CS 381 (Analysis of Algorithms) weekly recitations and a 150+ student final review of reductions in NP; developed original homework, recitation, and exam problems on dynamic programming, string matching and network flow.
- Developed CS 250 (Computer Architecture) assignments, project handouts, and automated testing software in Spring 2025 to streamline an existing project and reduce burden on students and course staff.

Projects

MiniML – OCaml Compiler (Haskell)

- Built a compiler in Haskell for a strict OCaml subset with algebraic effects, deep handlers, and one-shot resumptions.
- Implemented CPS-based lowering of effect handlers and captured continuations.

Headless Photo CMS (TypeScript, Bun, PostgreSQL, S3, MCP)

- Built a headless photo CMS with PostgreSQL metadata, local/S3 storage, and access-controlled HTTP endpoints.
- Added Streamable HTTP MCP tools for uploads, retrieval, and metadata editing, tested in GitHub Actions.

AVL Tree Lookup Profiling and Benchmarks (C/C++, x86-64 Assembly) Jan - May 2025

- Built synthetic workloads and a benchmark harness comparing AVL lookups against C++ standard-library containers and an adapted V8 dictionary.
- Applied profiling-guided low-level optimizations, contributing to a team implementation that improved lookup performance by over 20% versus a naive AVL baseline.

Technical Skills

- **Languages:** C, C++, Rust, Python, Haskell, OCaml, Scala.
- **Technologies:** Nix/NixOS, Git, Docker, WebAssembly, GitHub Actions, Perf, Valgrind

Academic Activities & Seminars

- **CS Theory Reading Group (Summer 2025):** Organized an undergraduate and graduate theory reading group at Purdue; presented on shortest path algorithms that use matrix multiplication/min-sum product.
- **Mathematics Directed Reading Program (2025):** Studied Montgomery & Vaughan's *Multiplicative Number Theory* (Jan - Apr 2025) and Silverman's *Rational Points on Elliptic Curves* (Sep - Dec 2025); presented proofs/sketches of Dirichlet's and Mordell's Theorems.