Tushar Muralidharan

Curriculum Vitae

Education

2021–2024	**Bachelor of Philosophy (Honours) - Science**, *The Australian National University*, Specialized in Mathematics.
	Supervisor: Assoc. Prof. Adam Piggott
2020	**Dual Enrolment**, *Princeton University*.
	Completed COS 226 – Algorithms and Data Structures
2016–2020	**High School Diploma**, *Montgomery High School*, *GPA − 4.0 W*.

Experience

Vocational

2022–2024	**Teaching Assistant**, The Australian National University.
	Taught workshops and marked assignments and exams for Foundations of Computing (COMP1600), Logic (COMP2620), Discrete Mathematical Models (MATH1005), Mathematics and Applications 2 (MATH1014), ensuring fair grading practices.
2023–2024	**Chess Coach**, Canberra Academy of Chess.
	Taught Chess classes for primary and secondary school children, arbitrated school tournaments and resolved competitive disputes.
2019	**Developer Intern**, Pharmvista, East Hanover.
	Developed a series of webpages for marketing a line of organic melatonin supplements, managed web hosting services, liaised with various team members for documentation.
	Detailed achievements:
	○ Published website for Melat-8® supplements
	○ Worked on website spam-prevention measures including CAPTCHA
	○ Restructured website organization system in WebHost Manager and cPanel
	○ Recovered from unexpected data breach

Miscellaneous

2019–2020	**Programmer**, FIRST Robotics Team 1403, Cougar Robotics.
	Designed computer vision system for our FIRST World Championship robot, cooperated with other sub-teams, managed sub-team of 5 new students, worked with strict competition format and deadlines. Allowed me to exhibit analytical skills and teamwork.
2019–2020	**Treasurer**, *Computer Science Club*, Montgomery High School.
	Taught workshops in Java and Python, led team-building activities to foster a welcoming community, managed club activities and schedules, worked with outreach to find speakers and partners.

2016 **Technology Support Volunteer**, *Wayne Public Library*.
Provided one-on-one technology help to elderly individuals in the community. Helped to solve problems with mobile devices, laptops, and watches, and aided with dexterity problems.

Projects

Jul 2024 **ScramBLD (Fork)**.
Forked and enhanced the ScramBLD project by implementing support for the Old Pochmann (OP) blindsolving method, a parity algorithm instead of pseudo-swapping UB and UL in edge memo, and treating edge flips and corner twists as cycles in OP mode instead of hardcoded algorithms.

Apr 2022 **Overleaf Dark Mode**.
A Chrome extension with over 6,000 users and a 4.8-star rating that provides a dark mode for the online LaTeX editor Overleaf.

Feb 2022 **Wordle AI**.
An AI for the daily word game Wordle. The AI can guess the WORDLE in an average of 3.42 turns, which was shown to be theoretically optimal.

Jan 2022 **ANU Timetable**.
A web app used by ANU students that tells users the time of their next ANU lecture or tutorial and allows them to create shareable links, Google Maps directions, and take notes.

Jan 2022 **Universal Ranks**.
A scoring system to rank all-round chess ability by combining FIDE ratings from three time formats into a single score. The scoring method ensures that rating improvements always increase the score, with sharper increases at higher ratings. Built with a backend in Express and a frontend using Vue.js and Vuetify.

Oct 2021 **ChessMemory**.
A blindfold Chess puzzle trainer inspired by Human Benchmark's Visual Memory Test, that uses Chess puzzles from the lichess.org puzzle database. The website is featured on the lichess.org open database website.

Aug 2021 **Cublino**.
A Java implementation of the Cublino game with a playable JavaFX GUI, featuring AI opponents with three difficulty levels (Easy, Medium, and Hard) that utilize a heuristic minimax algorithm with alpha-beta pruning and dynamic depth. This project was developed in collaboration with Anthony Gambale and Pippa Newman.

Jan 2021 **BetterGenesis**.
A web app used by Montgomery High School students to lets users view their grades in an enhanced, more-informative dashboard with grade calculators and trend tracking. The backend consists of an Express web server with industry standard AES-256 encryption, and the frontend is made in Vue.js with Vuetify.

Oct 2020 **Othello AI**.
An AI that plays https://en.wikipedia.org/wiki/Reversi, a classic board game, using a heuristic evaluation function with the minimax algorithm and alpha-beta pruning. The AI evaluates GameState based on six factors: mobility, frontier discs, disc difference, placement, stability, and corner control, with dynamic weighting for each.

Nov 2019 **Seam Carving**.
A Java implementation of the Seam Carving algorithm for content-aware image resizing, as part of Princeton University's COS 226 course. The algorithm calculates energy values for pixels and uses dynamic programming to remove horizontal and vertical seams of minimal energy, preserving key features while resizing the image without distortion.

Papers

Oct 2023 — **Quadratic Reciprocity via Quadratic and Cyclotomic Fields**, *Algebraic Number Theory – ASC*.
Supervisor: Dr. Angus McAndrew

Jun 2023 — **Elementary proofs of Gauss' triangular number theorem and a partition identity of Ramanujan**, *Analytic Number Theory – ASC*.
Supervisor: Dr. Angus McAndrew

Feb 2023 — **Exploring Projective Algebraic Geoemtry**, *Ideals, Varieties, and Algorithms – ASC*.
Supervisor: Dr. Angus McAndrew

Oct 2022 — **Representation Theory of the Finite Group $\mathrm{GL}_2(\mathbb{F}_p)$**, *Groups, Rings, and Linear Algebra – ASE*.
Supervisor: Dr. Angus McAndrew

May 2022 — **Chaotic Motion in a Double Pendulum System and Convective Transport in Phase Space**, *Applied Mathematics I – ASE*.
Supervisor: Dr. Hooman Hezaveh

Talks

Oct 2024 — **Non-Positive Curvature and the Word Problem in Group Theory**, *Final Talk – Honours*.
Supervisor: Assoc. Prof. Adam Piggott

May 2024 — **Cayley Graphs and Semi-Direct Products**, *Practice Talk – Honours*.
Supervisor: Assoc. Prof. Adam Piggott

Jun 2023 — **Quadratic Reciprocity via Quadratic and Cyclotomic Fields**, *Algebraic Number Theory – ASC*.
Supervisor: Dr. Angus McAndrew

Jun 2023 — **Partitions**, *Analytic Number Theory – ASC*.
Collaborators: Lekh Bhatia, Adrian Lo
Supervisor: Dr. Angus McAndrew

Awards

2023 — Helpful Member in Official Mathematics Discord Server

2022 — First Place in ANU Chess Club Blitz Tournament

2021 — Fourth Place in ASD-ANU Co-Lab Capture the Flag Competition

2020 — National AP Scholar

2019 — AP Scholar with Distinction

2019 — National Merit Scholarship Commended Student

2018 — Best Website – Junior Achievement of New Jersey Hackathon

2016 — Top 500 Rubik's Cube Average in Australia – World Cube Association

2016 — Presidential Academic/High Achievers Award

2016 — Outstanding Academic Achievement

Computer Skills

Advanced	LaTeX, NODE.JS, JAVA, JAVASCRIPT, HTML, CSS
Intermediate	PYTHON, C++, SageMath, macOS, Microsoft Windows, Word, Excel, Adobe Photoshop
Basic	C, C#

Communication Skills

2023	Problem-Writing Committee of the ANU Integration Bee
2018	Oral Presentation at the FBLA State Leadership Conference
2018	Hosted the MontyHacks Hackathon as Staff
2018	Taught at the Annual Kids' Tech Night at Montgomery High School

Languages

English	**First Language**	
Tamil	**Basic**	*Basic words and phrases only*
Spanish	**Basic**	*Basic words and phrases only*

Interests

- Chess
- Speedcubing
- Memory Training (Memorized Pi to 100 decimal places)
- Puzzles