TREVOR VINCENT, PHD

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HIGHLIGHTS

Experienced C++,C (well over 100,000 lines+ in each) and python programmer with expert-level knowledge in numerical solution techniques for partial differential equations and a broad knowledge of machine learning algorithms and quantum computing algorithms. I have been the lead developer on a number of projects, led teams of programmers, and worked on several different programming teams.

Lead high performance computing (HPC) engineer on the Borealis Quantum Supremacy demonstration that made the front page of the Globe and Mail newspaper. The Canadian prime minister came to visit Borealis in person. This demonstration was responsible for getting Xanadu the necessary funding to become a unicorn (billion dollar valuation) company. Link to Nature paper.

Developed code to study the merger of neutron stars on supercomputers for a Nobel-prize winning scientific collaboration LIGO (ligo.org).

Chess master (title earned in 2008). Former Manitoba chess champion (six consecutive times) and former Canadian scholastic National chess champion.

Fast learner that doesn't shy away from complicated or tough challenges.

EXPERIENCE

MindKing Inc. (https://mindking.ai) Nov. 2022 - Now
Founder/Consultant

- Developed a quantum error correction unionfind decoder for qc.design. View it on GitHub.
- Developed a fast C++ graph library for qc.design. View it on GitHub.
- Developed a Kokkos-based GPU Clifford state simulator for qc.design. View it on GitHub.

Xanadu Quantum Technologies Dec. 2019 - Nov 2022
High Performance Computing (HPC) Specialist

- I was the lead High Performance Computing (HPC) engineer on the Borealis Quantum Advantage demonstration (Nature 606 (7912), 75-81) which made the front page of the Globe and Mail (Canada's most widely read newspaper). Borealis is the world's only quantum computer on the cloud with a peer-reviewed advantage claim. Our current prime minister visited Xanadu to see Borealis in person. I was responsible for the theory and supercomputer simulations behind the project.
- Creator, Lead Inventor (pending patent), author and developer of the task-based tensor network simulator Jet. View it on Github. The underlying algorithms are presented in a scientific paper published in the journal Quantum.
- Lead developer of Pennylane-Lightning-Kokkos, the first AMD-GPU quantum simulator, which runs on multi-threaded CPUs, AMD GPUs and NVIDIA GPUs, as well as any other hardware supported by the Kokkos library. This resulted in a partnership between Xanadu and AMD. View it on Github.
- Creator and lead developer of the first benchmark regression analyzer software called 'Benchmark'. Benchmark pinpoints any speed/memory regressions in a software and presents its analysis through a web dashboard as well as notifying users on Slack that caused the regressions. It currently analyzes the software Pennylane live at: benchmarks.pennylane.ai
- Helped optimize C++ and python code in crucial parts of several Xanadu libraries: Pennylane, Pennylane-Lightning, Pennylane-Lightning-GPU and TheWalrus.

Canadian Institute for Theoretical Astrophysics Sept. 2013 - Aug. 2019
PhD Researcher in Computational Astrophysics

- Developed next generation numerical methods for solving the Einstein field equations (a non-linear set of partial differential equations) on supercomputers and implemented them in a $\sim$ 100,000-line C code available on GitHub.
- Worked on a team (10+developers) to develop a task-based parallelism framework for numerical relativity called SpECTRE, available on GitHub.
- Member of the Nobel-prize winning LIGO collaboration, working on extracting neutrino and matter emission properties from gravitational wave and electromagnetic counterpart signals of binary neutron star mergers.

University of Winnipeg 2009-2013
Summer Research Scientist

- Developed a state-of-art GPU-accelerated (via CUDA) C++ code for the diffusion and collision of water molecules around randomly oriented axons in 3d brain-matter. This was coupled with a numerical solve of the Bloch partial differential equations to obtain the magnetic resonance imaging signal in realistic environments. The simulator has been used in 2 scientific publications, used in a PhD thesis by Morgan Mercredi, and used in Honours thesis by Michael Honke.
- Developed a semi-analytical model for estimating axon distribution properties from magnetic resonance imaging signals signals.

SKILLS

Highly Proficient: C++, C, Python, MPI, CUDA, Bash, Git, CMake, Emacs, GDB, Linux, OpenMP, Taskflow, Kokkos, LAPACK/BLAS/MKL, Github workflows, CI Matlab, Mathematica

Working Knowledge: html, CSS, javascript, flask, Java, Fortran, AWS, oneTBB, Vtune, Charm++, Paraview, Visit, papi, perf, pthreads

EDUCATION

University of Toronto, Toronto, ON *Sept. 2013 - August 2019*
PhD in Physics, specializing in computational astrophysics. PhD work was funded by an NSERC CGSD scholarship ($105,000) and a NSERC CGSM scholarship ($30,000). During my PhD, I taught several first-year physics lab courses, with each lab containing $\approx$ 50 students.
Advisor: Prof. Harald Pfeiffer

University of Winnipeg, Winnipeg, MB *Sept 2008 - Sept 2013*
Bachelors of Science in Physics. Undergraduate work was funded by 15 scholarships. Winner of the Governor General Academic Medal for the highest graduating GPA in the university.

SELECTED AWARDS

NSERC CGSD Scholarship ($105000)	*2015*
NSERC CGSM Scholarship ($30000)	*2014*
Governor General's Academic Medal	*2013*
CIHR Undergraduate Research Award ($5000)	*2013*
NSERC Undergraduate Research Award ($5000)	*2012*
NSERC Undergraduate Research Award ($5000)	*2011*
NSERC Undergraduate Research Award ($5000)	*2010*

PUBLICATIONS

13 (and one more forthcoming) publications in a variety of journals including Nature and Science Advances. See trevorvincent.com for a link to my Google Scholar.