Colin McDonald

Email • Website • LinkedIn • Mobile Apps • Code • Publications

Education

Carnegie Mellon University — Pittsburgh, Pennsylvania
Doctor of Philosophy, Computer Science — August 2023 - Current

University of Notre Dame — Notre Dame, Indiana
Bachelor of Arts, summa cum laude, Computer Science and Philosophy — Class of 2023

Experience

Compilers Research — University of Notre Dame
Research Assistant — April 2021 - May 2022, August 2022 - May 2023

- Designed probabilistic programming language PERPL based on linear lambda calculus with algebraic datatypes
- Wrote compiler from PERPL to a differentiable graph-generating grammar for use in training machine learning models
- Implemented numerous code transformation algorithms to preprocess and optimize PERPL code
- Co-Author: Exact Recursive Probabilistic Programming. *OOPSLA*. 2023.

Amazon Managed Service for Prometheus — AWS Open Source Observability
Software Development Engineer Intern — May 2022 - August 2022

- Designed and implemented bot to monitor automated trouble tickets, improving efficiency in resolving high-severity issues
- Integrated numerous AWS services and tools, enabling bot to determine the root cause of each ticket, find relevant error logs, plot recent error metrics, and run specialized CloudWatch queries based off that information
- Reduced customer-impacting tickets' average time to resolution by 10 minutes, also saving the on-call engineer 2+ hours/week

Quantum Computing Research — Center for Research Computing, University of Notre Dame
Quantum Computing Lab Intern — December 2020 - April 2021

- Executed quantum circuits on real quantum devices using IBM Quantum Experience with IBM Qiskit
- Developed quantum circuit error estimation algorithm, producing more accurate error estimates than Qiskit's noisy simulator
- Assisted implementation of parameterized quantum circuits, enabling accelerated machine learning

Natural Language Processing Research — University of Notre Dame
Research Assistant — August 2019 - November 2020

- Adapted custom Transformer implementation for tree-to-sequence translation tasks, with novel self-attention mechanism
- Designed model to automatically generate javadocs/docstrings for functions by parsing source code
- Optimized model for GPU use in high-performace computing environment, training models 2x-6x faster
- Created data processing tools to parse and standardize millions of Java and Python functions along with their javadocs/docstrings
- Lead Author: Syntax-Based Attention Masking for Neural Machine Translation. *NAACL: SRW*. 2021.

Type Theory Research — University of Iowa
Research Assistant — May 2017 - August 2019

- Developed dependently-typed functional programming language *Cedille* with lab of grad students, post-docs, and profs
- Primary contributor to Cedille's 15,000-line code base, also writing compact core type checker in fewer than 1000 lines
- Implemented an elaborating transpiler from full language to core language, eliminating algebraic datatypes
- Co-Author: Strong Functional Pearl: Harper's Regular-Expression Matcher in Cedille. *ICFP*. 2020.
- Co-Author: Elaborating Inductive Definitions and Course-of-Values Induction in Cedille. *Unpublished.* 2019.

Clubs, Activities, and Other Involvement

- Boxed and fundraised for Bengal Bouts, contributing to club's $300,000 raised for Bangladesh missions.
- Led weekly faith-based Compass small groups and as part of ND Vision, facilitating faith sharing and intentionality
- Dorm Resident Assistant, responsible for 35 residents and leading several weekly section activities
- Worked on the CSE Undergraduate Leadership Team, organizing events and competitions for the department

Awards and Honors

2023 NDSEG Fellow • 2023 NSF GRFP Awardee (declined, NDSEG) • 2023 Phi Beta Kappa
2020 Gilman Scholar Awardee (declined, COVID-19) • 2019 U.S. Presidential Scholar