Logan Weber

loganweb@mit.edu | weberlo.github.io | weberlo

Education

Massachusetts Institute of Technology *Cambridge, MA*

PhD in Computer Science *Sep. 2020 - PRESENT*

- Advisor: Michael Carbin
- Research Focus: Programming Languages and Machine Learning

University of Washington *Seattle, WA*

M.S. in Computer Science *Jan. 2018 - June 2020*

- Advisor: Zachary Tatlock
- Mentors: Jared Roesch and Tianqi Chen
- Research Focus: Programming Languages, Machine Learning, and Systems

University of Washington *Seattle, WA*

B.S. in Computer Science *Sep. 2014 - Jan. 2018*

Research Projects

Neural Surrogate Compilation *Cambridge, MA*

Neural Networks For Compiling Programs to Neural Networks *Feb. 2023 - Present*

- Created an approach to developing neural surrogates of programs, called *neural surrogate compilation*, wherein a neural network that implements program functionality is generated solely from the source code of the program.
- Implemented a neural surrogate compiler using a BERT model adapted to function as a hypernetwork.
- Developed a dataset of $\approx 23,000$ executable, numeric C programs and corresponding input-output pairs, to train neural surrogate compilers.
- Evaluated our neural surrogate compiler and found it produces neural surrogates that achieve $2.6 - 5.5\times$ lower loss for a fixed data budget and achieve target losses with $1.5 - 3.3\times$ fewer epochs, compared to randomly initialized neural surrogates.

Semantic Program Embeddings *Cambridge, MA*

A Theoretical and Empirical Study of Embeddings of Program Semantics *Sep. 2020 - Jan. 2023*

- Developed a theory to characterize the conditions under which one can compute an embedding that preserves semantic equivalences between programs.
- Proved that such an embedding can only be tractably computed when the programming language has a finite number of semantic equivalence classes and an efficient canonicalizer.
- Evaluated the predictive power of the theory on a set of programming languages, showing that a Transformer model is able to learn an embedding of a tractable language, but it is unable to learn an embedding of an intractable language.
- Developed a technique for producing distance-preserving embeddings of numerical programs using orthogonal polynomials.
- Evaluated our embedding technique and found it achieved better distance preservation than a BERT-Tiny that was trained to produce distance-preserving embeddings.

MicroTVM *Seattle, WA*

Deep Learning on Bare-Metal Devices *Jan. 2019 - Sep. 2020*

- Created infrastructure in Apache TVM to support compilation and automatic optimization of machine learning models on microcontrollers.
- Acted as the core technical contributor before transferring ownership of the technology to OctoML.

Relay *Seattle, WA*

Functional and Differentiable IR for Machine Learning *Feb. 2018 - Sep. 2020*

- Aided development of an intermediate representation for machine learning, featuring a tensor-oriented, dependent type system.
- Relay is used every time someone asks Amazon Alexa a question.

Relay Dashboard *Seattle, WA*

Machine Learning Benchmarking and Analysis Framework *June 2019 - Sep. 2019*

- Aided design and developement of a system for performing scalable and reproducible machine learning experiments in a language-agnostic fashion.

Apache TVM *Seattle, WA*

Open Deep Learning Compiler Stack for CPUs, GPUs, and Specialized Accelerators *Feb. 2018 - PRESENT*

- Became the 8th most impactful contributor (by lines of code modified) out of 300+ contributors, as of 11/30/2019.
- Was awarded reviewer status by the TVM community.

Judgement-Based Grading *Seattle, WA*

Chrome Extension *Jul. 2016 - Sep. 2016*

- Built a UI over Canvas's SpeedGrader interface to implement judgement-based grading, a grading technique based on research in CS education.

Induction Tutor *Seattle, WA*

Web Application *Apr. 2016 - Jul. 2016*

- Built the first ever interface for both teaching induction to computer science students and for automating grading of induction proofs.

Publications

Relay: A New IR for Machine Learning Frameworks

Jared Roesch, Steven Lyubomirsky, **Logan Weber**, Josh Pollock, Marisa Kirisame, Tianqi Chen, Zachary Tatlock *2018*

MAPL 2018

Learning to Compile Programs to Neural Networks

Logan Weber, Jesse Michel, Alex Renda, Michael Carbin *2024*

ICLR 2024

Preprints

A Theory of Equivalence-Preserving Program Embeddings

Logan Weber*, Jesse Michel*, Alex Renda, Saman Amarasinghe, Michael Carbin *2023*

ArXiv

A Theory of Semantic Program Embeddings

Jesse Michel, **Logan Weber**, Saman Amarasinghe, Michael Carbin *2021*

ArXiv

Relay: A High-Level Compiler for Deep Learning

Jared Roesch, Steven Lyubomirsky, Marisa Kirisame, **Logan Weber**, Josh Pollock, Tianqi Chen, Zachary Tatlock *2019*

ArXiv

Writing

Formal Verification of a Closest Pair Algorithm

Logan Weber *2022*

MIT 6.850 (Geometric Computing) Final Project

Towards An Algorithm for Reeb Graph Construction on Constructive Solid Geometry

Logan Weber *2021*

MIT 6.838 (Shape Analysis) Final Project

Fast(ish) Algorithms for Integer Programming

Logan Weber and Josh Pollock *2020*

MIT 6.854 (Advanced Algorithms) Final Project

Living Life On The Low-Power Edge: Tiny Models On Tiny Devices

Logan Weber *2020*

Master's Thesis

TinyML: How TVM Is Taming Tiny

Logan Weber and Andrew Reusch *2020*

Post on TVM, OctoML, and Arm Blogs

Experience

Oregon Programming Languages Summer School Attendee *Eugene, OR*

University of Oregon *June 2022*

- Engaged in two weeks of rigorous study of programming language theory.

Oregon Programming Languages Summer School Attendee *Virtual*

University of Oregon *June 2021*

- Engaged in two weeks of rigorous study of programming language theory.

Part-Time Research Engineer *Seattle, WA*

OctoML Inc *September 2019 - September 2020*

- Researched methods for running and optimizing machine learning models on microcontrollers.
- Became OctoML's very first intern!

Graduate Research Assistant *Seattle, WA*

University of Washington, PLSE and SAMPL Labs *June 2019 - August 2019*

- Researched methods for running and optimizing machine learning models on microcontrollers.
- Researched methods for performing and analyzing machine learning experiments in a reproducible and scalable manner.

Software Engineering Intern *Santa Clara, CA*

Nvidia, Graphics Drivers Team *September 2018 - December 2018*

- Created a tool to visualize arbitrary hierarchical temporal data (e.g., to visual graphics driver performance, kernel thread scheduling, and lock contention).

Software Engineering Intern *Pittsburg, PA*

Duolingo, Core Learning Team *June 2018 - September 2018*

- Researched methods to more accurately assess learners' language proficiency.

Software Engineering Intern *Mountain View, CA*

Google, Android Camera Team *June 2017 - September 2017*

- Contributed to several open source projects for Android camera testing.

Undergraduate Research Assistant *Seattle, WA*

University of Washington, Blank Lab *March 2016 - June 2017*

- Built educational infrastructure for upper-level computer science courses.

Teaching Assistant *Seattle, WA*

UW CSE Department *March 2016 - June 2019*

- Assisted teaching and grading for upper-level computer science courses.

Hay Baler & Equipment Technician *Ellensburg, WA*

Charlton Farms Inc *June 2014 - September 2015*

- Coordinated with 2-10 other equipment operators to strategically prepare/bale 1000 acres of hay under 95-hour work weeks.

Presentation

NSF Expeditions in Computing Neurosymbolic Meeting *Cambridge, MA*

Co-Presenter for Semantic Program Embeddings Research Project *October 2022*

TVM Conference 2019 *Seattle, Washington, USA*

Presenter for μTVM *December 2019*

Arm Research Summit *Austin, Texas, USA*

Poster Presenter for μTVM *September 2019*

TVM For Fun and Profit Tutorial at ISCA 2019 *Phoenix, Arizona, USA*

Presenter for μTVM *June 2019*

Paul G. Allen School of Computer Science Research Poster Fair *Seattle, Washington, USA*

Poster Presenter for Relay (2nd Place) *May 2019*

Teaching

6.UAR, Preparation for Undergraduate Research *Massachusetts Institute of Technology*

Graduate Teaching Assistant *February 2023 - June 2023*

CSE 451, Introduction to Operating Systems *University of Washington*

Graduate Teaching Assistant *March 2019 - June 2019*

CSE 490Q, Introduction to Quantum Computing and Quantum Programming in Q# *University of Washington*

Graduate Teaching Assistant *January 2019 - March 2019*

CSE 410, Computer Systems *University of Washington*

Graduate Teaching Assistant *March 2018 - June 2018*

CSE 311, Foundations of Computing I *University of Washington*

Undergraduate Teaching Assistant *March 2017 - June 2017*

CSE 332, Data Structures and Parallelism *University of Washington*

Undergraduate Teaching Assistant *January 2017 - March 2017*

CSE 332, Data Structures and Parallelism *University of Washington*

Undergraduate Teaching Assistant *September 2016 - December 2016*

CSE 311, Foundations of Computing I *University of Washington*

Undergraduate Teaching Assistant *March 2016 - June 2016*

Service

MIT PLR Paper Selection Committee and AV Chair *Cambridge, MA*

MIT Programming Languages Review *Nov. 2023 - Present*

- Proposed and discussed papers to include in the MIT PLR program.
- Facilitated an audio and video setup for the MIT PLR, which included both remote and physical participants.

ADA TVM Tutorial Co-Organizer *Ann Arbor, MI*

Deep Learning on Bare-Metal Devices *Sep. 2019*

- Taught participants how to use TVM and the microcontroller backend, μTVM.
- Guided participants through implementation of lazy execution for μTVM.

Personal Projects

Blockly *Seattle, WA*

Virtual Reality Puzzle Game to Teach Programming Concepts *Mar. 2020 - June. 2020*

0x10c *Seattle, WA*

Rust 3D Game Engine *Sep. 2017 - Dec. 2018*

Exort *Ellensburg, WA*

Java 3D MOBA Engine Prototype *Mar. 2014 - Oct. 2014*

ModernGL *Ellensburg, WA*

Java Library for OpenGL 3.0+ *Mar. 2014 - July 2015*

Junkbot *Ellensburg, WA*

Java 2D Platformer *Sep. 2013 - Dec. 2013*

Tetris *Ellensburg, WA*

Java NES Tetris Recreation *Apr. 2013 - June 2013*

Java2D *Ellensburg, WA*

Java 2D Game Engine *Dec. 2012 - Mar. 2014*

Fallborn *Ellensburg, WA*

Java 2D Dynamic Lighting Engine *Apr. 2012 - May. 2012*