# Logan Weber

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## 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*

<span style="font-variant: small-caps">Web Application</span> *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**

<span style="font-variant: small-caps">Jared Roesch, Steven Lyubomirsky, **Logan Weber**, Josh Pollock, Marisa Kirisame, Tianqi Chen, Zachary Tatlock</span> *2018*

MAPL 2018

**Learning to Compile Programs to Neural Networks**

<span style="font-variant: small-caps">**Logan Weber**, Jesse Michel, Alex Renda, Michael Carbin</span> *2024*

ICLR 2024

## Preprints

**A Theory of Equivalence-Preserving Program Embeddings**

<span style="font-variant: small-caps">**Logan Weber**\*, Jesse Michel\*, Alex Renda, Saman Amarasinghe, Michael Carbin</span> *2023*

ArXiv

**A Theory of Semantic Program Embeddings**

<span style="font-variant: small-caps">Jesse Michel, **Logan Weber**, Saman Amarasinghe, Michael Carbin</span> *2021*

ArXiv

**Relay: A High-Level Compiler for Deep Learning**

<span style="font-variant: small-caps">Jared Roesch, Steven Lyubomirsky, Marisa Kirisame, **Logan Weber**, Josh Pollock, Tianqi Chen, Zachary Tatlock</span> *2019*

ArXiv

## Writing

**Formal Verification of a Closest Pair Algorithm**

<span style="font-variant: small-caps">**Logan Weber**</span> *2022*

MIT 6.850 (Geometric Computing) Final Project

**Towards An Algorithm for Reeb Graph Construction on Constructive Solid Geometry**

<span style="font-variant: small-caps">**Logan Weber**</span> *2021*

MIT 6.838 (Shape Analysis) Final Project

**Fast(ish) Algorithms for Integer Programming**

<span style="font-variant: small-caps">**Logan Weber** and Josh Pollock</span> *2020*

MIT 6.854 (Advanced Algorithms) Final Project

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

<span style="font-variant: small-caps">**Logan Weber**</span> *2020*

Master's Thesis

**TinyML: How TVM Is Taming Tiny**

<span style="font-variant: small-caps">**Logan Weber** and Andrew Reusch</span> *2020*

Post on TVM, OctoML, and Arm Blogs

## Experience

**Oregon Programming Languages Summer School Attendee** *Eugene, OR*

<span style="font-variant: small-caps">University of Oregon</span> *June 2022*

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

**Oregon Programming Languages Summer School Attendee** *Virtual*

<span style="font-variant: small-caps">University of Oregon</span> *June 2021*

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

**Part-Time Research Engineer** *Seattle, WA*

<span style="font-variant: small-caps">OctoML Inc</span> *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 *January 2018 - August 2019*

- Developed intermediate representation for Apache TVM that enabled expression of models with sophisticated control flow.
- Developed methods for performing and analyzing machine learning experiments in a reproducible and scalable manner.
- Developed methods for running and optimizing machine learning models on microcontrollers.

**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 $\mu$TVM *December 2019*

**Arm Research Summit** *Austin, Texas, USA*

Poster Presenter for $\mu$TVM *September 2019*

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

Presenter for $\mu$TVM *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, $\mu$TVM.
- Guided participants through implementation of lazy execution for $\mu$TVM.

# 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*