John Hui

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EDUCATION

Columbia University, Graduate School of Arts and Sciences — New York, N.Y.
Ph.D. in Computer Science — September 2019—present
Thesis: *Sparse Synchronous Programming with Temporal Abstractions* — *expected defense: September 2024*
Advisor: Stephen A. Edwards

Columbia University, School of Engineering and Applied Sciences — New York, N.Y.
M.S. in Computer Science — September 2018—May 2019

Columbia University, Columbia College — New York, N.Y.
B.A. in Computer Science and Music — September 2014—May 2018
Honors: Phi Beta Kappa, *magna cum laude*

RESEARCH

My interests broadly revolve around the use of high-level programming languages to configure and extend interactive, low-level systems. Such systems include embedded systems, operating systems, browsers, game engines, and text editors.

Areas of interest: real-time reactive computing, language virtual machines, microcontrollers, functional programming, compilers, semantics, operating systems

Sparse Synchronous Model (SSM) *with Stephen A. Edwards* — Fall 2018—present
- Designed and formally specified a programming model for microcontroller-based reactive real-time systems, featuring logical execution time, precise timing prescriptions, and deterministic concurrency
- Implemented a standalone, compiled SSM language with constraints-based polymorphic type inference, higher-order functions, pattern-matching, and automatic memory management
- Built an SSM language runtime that uses hardware timestamping to achieve sub-100 ns timing precision
- Currently building combinator bytecode VM to explore non-strict evaluation strategies for SSM in Haskell

SeKVM *with Ronghui Gu, Jason Nieh* — Fall 2019—Spring 2021
- Verified information flow security of multiprocessor hypervisor retrofitted from Linux KVM
- Worked toward formalization of data-race-freedom theorems for weak memory hardware architectures, to ensure soundness of concurrent verification layers

Type Inference for Functional Hardware *with Richard M. Townsend, Stephen A. Edwards* — Spring 2018
- Investigated using Hindley-Milner-Damas type inference in a Haskell-to-Verilog compiler for type-driven hardware memory management and data parallelism

Android Epoxy *with Alex Van't Hof, Jason Nieh* — Fall 2017—Spring 2018
- Modified Android Binder IPC to support communication over TCP/IP

CRC32 Fuzzer *with Suman Jana* — Fall 2016
- Investigated solving CRC32 checksums using AFL fuzzer vs Z3 SMT

INDUSTRY

Roblox *Research Intern* — San Mateo, C.A.
Core Research — Summer 2023
- Implemented game engine prototype in Rust, with Luau bindings for DOM manipulation
- Worked on formal semantics for replicated scripting and speculative execution

Nuro *Software Intern* — Remote
Embedded Software Team — Summer 2020
- Designed state machine specification language for low-level transition systems
- Developed compiler with C and Promela (SPIN model checker) backends

WhatsApp *Software Engineering Intern*   Menlo Park, C.A.
Media Server Team   Summer 2017
- Deployed end-to-end distributed monitoring service using Python WhatsApp client
- Developed alarm configuration framework with extensible API

Symphony Communications *Backend Intern*   New York, N.Y.
Core Services team   Summer 2015
- Automated local Docker and Vagrant integration tests
- Designed Java Annotation library for database-agnostic data transport

TEACHING

COMS 6998: Types, Languages, and Compilers *Project Advisor and Guest Lecturer*   Spring 2023
Instructor: Stephen A. Edwards
- Advised student projects that explored definitional interpreters, session types, and Rust lifetimes
- Gave guest lecture discussing definitional interpreters and the expressive power of programming languages

COMS 3157: Advanced Programming *Instructor of Record*   Fall 2022
- Gave lectures to class of 400 students, for systems programming course covering C, UNIX, sockets, shell, and Git
- Designed and led weekly recitations with interactive exercises and demonstrations
- Led team of 22 teaching assistants, and administered multi-user Linux server used by students for coursework

COMS 4115: Programming Languages and Translators *Teaching Assistant*   Fall 2021
Instructor: Stephen A. Edwards
- Advised distinguished student project that built a toy ML compiler supporting parametric polymorphism and first-class functions

COMS 4995: Parallel Functional Programming *Teaching Assistant*   Fall 2019
Instructor: Stephen A. Edwards

COMS 6998: Formal Verification *Teaching Assistant*   Fall 2019
Instructor: Ronghui Gu

CSOR 4231: Analysis of Algorithms *Teaching Assistant*   Summer 2019
Instructor: Eleni Drinea

CSEE 4840: Embedded Systems *Teaching Assistant*   Spring 2019
Instructor: Stephen A. Edwards

COMS 4118: Operating Systems *Head Teaching Assistant*   Spring 2019
Instructor: Jae Woo Lee
- Migrated all coursework and grading infrastructure from Arch Linux to Debian Linux

COMS 4115: Programming Languages and Translators *Teaching Assistant*   Fall 2018
Instructor: Stephen A. Edwards

COMS 3157: Advanced Programming *Teaching Assistant*   Fall 2018
Instructor: Jae Woo Lee

COMS 4118: Operating Systems *Head Teaching Assistant*   Spring 2018
Instructor: Jae Woo Lee
- Wrote library of Python scripts to manage student coursework on GitHub
- Created repository of guides and tutorials for Linux kernel development

COMS 3157: Advanced Programming *Teaching Assistant*   Fall 2017
Instructor: Jae Woo Lee

COMS 4118: Operating Systems *Teaching Assistant* Spring 2017
Instructor: Jae Woo Lee
- Developed specification, solutions, and automated grading infrastructure for virtual memory assignment

COMS 3157: Advanced Programming *Teaching Assistant* Fall 2017
Instructor: Jae Woo Lee

COMS 3157: Advanced Programming *Teaching Assistant* Spring 2016
Instructor: Jae Woo Lee
- Wrote Python script to upload student grades to Canvas LMS

SOFTWARE

Fidget *Author* January 2019–present
https://github.com/j-hui/fidget.nvim 1862 stars, 56 forks
Neovim plugin written in Lua, provides extensible UI system for animated notifications and LSP progress messages

AWARDS

Andrew P. Kosoresow Memorial Award for Excellence in Teaching and Service 2018
Awarded each year by the Columbia University Department of Computer Science to up to three students

PUBLICATIONS

Timestamp Peripherals for Precise Real-Time Programming. MEMOCODE '23
John Hui, Kyle J. Edwards, and Stephen A. Edwards.
In Formal Methods and Models for Codesign, Hamburg, Germany, September 2023.

Towards Sparse Synchronous Programming in Lua. TCRS '23
John Hui and Stephen A. Edwards.
In Workshop on Time-Centric Reactive Software, San Antonio, TX, USA, May 2023.

The Sparse Synchronous Model on Real Hardware. TECS '22
John Hui and Stephen A. Edwards.
ACM Transactions on Embedded Computing Systems, December 2022.

Creating a Language for Writing Real-Time Applications for the Internet of Things. MEMOCODE '22
Robert Krook, John Hui, Bo Joel Svensson, Stephen A. Edwards and Koen Claessen.
In Formal Methods and Models for System Design, Shanghai, China, October 2022.

Formally Verified Memory Protection for a Commodity Multiprocessor Hypervisor. USENIX
Shih-Wei Li, Xupeng Li, Ronghui Gu, Jason Nieh, and John Hui. Security '21
In USENIX Security Symposium, virtual, August 2021.

Gleipnir: Toward Practical Error Analysis for Quantum Programs. PLDI '21
Runzhou Tao, Yunong Shi, John Hui, Jianan Yao, Fred Chong, and Ronghui Gu.
In Programming Language Design and Implementation, virtual, June 2021.

A Secure and Formally Verified Linux KVM Hypervisor. S&P '21
Shih-Wei Li, Xupeng Li, Ronghui Gu, Jason Nieh, and John Hui.
In Symposium on Security and Privacy, virtual, May 2021.

The Sparse Synchronous Model. FDL '20
Stephen A. Edwards and John Hui.
In Forum on Specification and Design Languages, Kiel, Germany, September 2020.

TALKS

Timestamp Peripherals for Precise Real-Time Programming. NJPLS '23
At New Jersey Programming Languages and Systems Seminar, Princeton, NJ, USA, November 2023.

	Toward Sparse Synchronous Computing on Embedded Systems.	FMCAD Student Forum '21
	At Formal Methods in Computer-Aided Design Student Forum, virtual, October 2021.	

SERVICE

Video Chair at *Programming Language Design and Implementation*	PLDI '24
AV Committee Member at *Symposium on Principles of Programming Languages*	POPL '24
Video Chair at *Systems, Programming, Languages and Applications: Software for Humanity*	SPLASH '23
Video Chair at *International Conference on Functional Programming*	ICFP '23
Video Chair at *Programming Language Design and Implementation*	PLDI '23
Student Volunteer at *Symposium on Principles of Programming Languages*	POPL '23
Student Volunteer at *Programming Language Design and Implementation*	PLDI '22