

Joonwon Choi

PhD Candidate at MIT CSAIL

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Research Interests

Formal verification of hardware using the Coq proof assistant:

- ▶ Kami: a framework to implement, specify, prove, and synthesize hardware components based on modularity.
- ▶ Hemiola: a framework for structural design and proof of hierarchical cache-coherence protocols based on serializability.
- ▶ An end-to-end proof between hardware and software; I have worked particularly on the correctness proof of a pipelined RISC-V processor.

Current Position

PhD Candidate, MIT CSAIL

Sep 2014 – Present

Advisors: Adam Chlipala and Arvind

Education

MIT CSAIL

Sep 2014 – Jun 2016

Master of Science in Electrical Engineering and Computer Science

Seoul National University

Mar 2006 – Feb 2013

Bachelor of Science in Computer Science and Engineering

Double major in Mathematical Sciences

graduated with honors (summa cum laude)

Publications

- [1] Kami: A Platform for High-Level Parametric Hardware Specification and its Modular Verification.
Joonwon Choi, Muralidaran Vijayaraghavan, Benjamin Sherman, Adam Chlipala, Arvind.
Proceedings of the ACM SIGPLAN International Conference on Functional Programming (ICFP'17).
September 2017. [paper](#)
- [2] An Inlining Approach to Formal Hardware Semantics.
Joonwon Choi
M.S. Thesis in Electrical Engineering and Computer Science. Massachusetts Institute of Technology. [thesis](#)
Thesis Supervisor: Arvind
- [3] Crellvm: Verified Credible Compilation for LLVM.
Jeehoon Kang, Yoonseung Kim, Youngju Song, Juneyoung Lee, Sanghoon Park, Mark Dongyeon Shin, Yonghyun Kim, Sungkeun Cho, **Joonwon Choi**, Chung-Kil Hur, and Kwangkeun Yi.
Proceedings of the ACM SIGPLAN Conference on Programming Language Design and Implementation (PLDI'18). June 2018. [paper](#)
- [4] EverCrypt: A Fast, Verified, Cross-Platform Cryptographic Provider.
Jonathan Protzenko, Bryan Parno, Aymeric Fromherz, Chris Hawblitzel, Marina Polubelova, Karthikeyan Bhargavan, Benjamin Beurdouche, **Joonwon Choi**, Antoine Delignat-Lavaud, Cédric Fournet, Natalia Kulatova, Tahina Ramanananandro, Aseem Rastogi, Nikhil Swamy, Christoph M. Wintersteiger, and Santiago Zanella-Beguelin.
IEEE Symposium on Security and Privacy (SP'20). May 2020. [paper](#)

Drafts

- [1] Hemiola: A Framework for Structural Design and Proof of Cache-Coherence Protocols.
Joonwon Choi and Adam Chlipala.
- [2] Integration Verification Across Software and Hardware for a Simple Embedded System.
Andres Erbsen, Samuel Gruetter, Joonwon Choi, Clark Wood, Adam Chlipala.

Current Research Projects

Hemiola: A Framework for Structural Design and Proof of Cache-Coherence Protocols

- We have been designing a framework, called Hemiola, to design, verify, and synthesize hierarchical cache-coherence protocols. On top of the framework, hardware developers can design cache-coherence protocols without worrying about possible complex interleavings among different transactions, standing for different concurrent memory accesses. We establish the once-and-for-all property, known as serializability, that any invariant of a protocol under serialized execution is also an invariant under the interleaved executions that are necessary for good performance. To demonstrate usability of our framework, we provide complete correctness proofs for hierarchical, noninclusive cache-coherence protocols as case studies. We also demonstrate that the case-study protocols are indeed hardware-synthesizable, by using a compilation/synthesis toolchain in Hemiola.

Honors & Awards

Kwanjeong Educational Fellowship	Sep 2014 – May 2019
MIT Emerson Scholarship for Private Music Study	Sep 2014 – May 2018
Top Honor (summa cum laude) Certification Seoul National University	Feb 2013
Presidential Science Scholarship	Mar 2006 – Feb 2013

Teaching Experience

MIT 6.887: Formal Reasoning About Programs Teaching Assistant	Spring 2017
SNU 4190.310: Programming Languages Teaching Assistant	Fall 2013

Working Experience

Microsoft Research Cambridge, United Kingdom Research Intern	Jul 2018 – Sep 2018
ROSAEC, Korea Research Associate	Mar 2013 – Jul 2014
allm Games, Korea Software Engineer (Skilled Industry Personnel as alternative military service)	Apr 2009 – Oct 2011
Google, Korea Software Engineering Intern (SWE Intern)	Jan 2009 – Apr 2009
SK Communications, Korea Intern (Software Developer)	Jul 2007 – Aug 2007

Last updated: September 3, 2020
<http://joonwon.net/c/docs/cv.pdf>