Ramana Nagasamudram

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Research summary

Computer programs evolve constantly. It's challenging to obtain strong guarantees that code revisions preserve intended behaviors, especially in the absence of precise specifications. My research addresses this problem by developing tools and techniques for verifying relations like equivalence between programs.

Education

Ph.D. in Computer Science, Stevens Institute of Technology, Hoboken, NJ — Aug 2019–present
Advisors: Dave Naumann, Anindya Banerjee (unofficial)
Thesis title: *Auto–active relational verification and alignment completeness*

M.S. in Computer Science, Stevens Institute of Technology, Hoboken, NJ — Aug 2017–May 2019

B.S. in Mechanical Engineering, University at Buffalo, Buffalo, NY — Aug 2012–May 2016
Minor in Mathematics

Research projects and related publications

Relational verification of heap–manipulating programs

- Solely developed an auto–active verification tool for relating object–based programs (≈ 15k LOC OCaml).
- Verified case studies on compiler optimizations, security, and data abstraction (14 benchmark problems).

WhyRel: A Prototype for Relational Verification (research abstract)
Ramana Nagasamudram
International Symposium on Formal Methods (FM), Doctoral Symposium 2021
Best presentation award

A Relational Program Logic with Data Abstraction and Dynamic Framing
Anindya Banerjee, **Ramana Nagasamudram**, David A. Naumann, Mohammad Nikouei
ACM Transactions on Programming Languages and Systems (TOPLAS) 2022

The WhyRel Prototype for Modular Relational Verification of Pointer Programs
Ramana Nagasamudram, Anindya Banerjee, David A. Naumann
International Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS) 2023
★ *Best paper nomination; invited to the International Journal on Software Tools for Technology Transfer*

Verification of distributed systems and C programs

- Wrote machine–checked correctness proofs of a C library for distributed systems (≈ 20k LOC Coq).
- Collaborated with, and received academic funding from Siemens (Aug 2021–May 2022).
- Conducted a two day internal workshop at Siemens on interactive theorem proving and C verification.

Verifying a C Implementation of Derecho's Coordination Mechanism using VST and Coq
Ramana Nagasamudram, Lennart Beringer, Ken Birman, Mae Milano, David A. Naumann
NASA Formal Methods Symposium (NFM) 2024

Alignment in relational verification

- Designed a relational program logic for forward simulation properties and proved completeness results.
- Formalized key results of an algebraic approach to relating programs in the Coq proof assistant.

Alignment Completeness for Relational Hoare Logics
Ramana Nagasamudram, David A. Naumann
IEEE Logic in Computer Science (LICS) 2021

An Algebra of Alignment for Relational Verification
Timos Antonopoulos, Eric Koskinen, Ton Chanh Le, **Ramana Nagasamudram**, David A. Naumann, Minh Ngo
ACM SIGPLAN Symposium on Principles of Programming Languages (POPL) 2023

Alignment Complete Relational Hoare Logics for Some and All
Ramana Nagasamudram, Anindya Banerjee, David A. Naumann
In submission

Assistantships and experience

- **Teaching/Course Assistant**, Stevens Institute of Technology, Hoboken, NJ

Programming Languages	Aug–Dec 2022, Aug–Dec 2023, Feb–May 2024
Algorithmic Complexity	Feb–May 2023
Type Systems for Programming Languages	Feb–May 2019
Algorithms, Design and Implementation	Aug–Dec 2018

- **Graduate Research Assistant**, Stevens Institute of Technology, Hoboken, NJ

with Dave Naumann — May 2019–Aug 2019
Formalized the semantics of a simple imperative language with objects in Coq.

with Jeffrey Nickerson — Aug 2017–May 2019
Built an automated tool in Python to analyze and rank 3D models for use in an online design competition.

- **Senior Analyst**, CapGemini, Bengaluru, India — Jan–Aug 2017
Maintained a large legacy Java application that converts between 3D CAD formats.

Academic service

Artifact Evaluation Committee: POPL 2023, ICFP 2023, ICFP 2024
Sub–reviewer: POPL 2023, ECOOP 2024
Student Volunteer: POPL 2021

Funding Awards

Fellowship for High Assurance, Siemens Corporate Research — Aug 2021–May 2022
Provost Doctoral Fellowship, Stevens Institute of Technology — Aug 2019–May 2020

Additional education

Oregon Programming Languages Summer School, University of Oregon — Jun 2019
Summer School on Formal Techniques, SRI International — Jun 2022

Skills

Programming Languages: OCaml, C, Scheme, Haskell, Python, Erlang, LaTeX
Formal verification: Coq, Verified Software Toolchain (VST), Why3, Isabelle/HOL

Open–source software artifacts

WhyRel (GitHub), BiKAT (Zenodo), VerifiedSST (Zenodo)