George Tsoukalas

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Research interests

Automated mathematical reasoning, theorem-proving, program synthesis, neurosymbolic programming

Education

University of Texas at Austin Austin, TX

PhD in Computer Science August 2023 – Present
Advisor: Professor Swarat Chaudhuri. *GPA: 4.00.*

Rutgers University New Brunswick, NJ
BS in Mathematics & Computer Science September 2019 – May 2023
Advisor: Professor He Zhu. *GPA: 4.00. Summa Cum Laude.*

Honors and scholarships

Best Paper Award (ICML AI for Math Workshop Organizing Committee) 2024

Kenneth and Rosalind Wolfson Award (Rutgers Mathematics) 2023

Weill Scholarship (Rutgers Mathematics) 2022
John Bogart Prize (Rutgers Mathematics) 2022
David Martin Weiss Memorial Award (Rutgers Mathematics) 2021

Publications

PutnamBench: Evaluating Neural Theorem-Provers on the Putnam Mathematical Competition
George Tsoukalas, Jasper Lee, John Jennings, Jimmy Xin, Michelle Ding, Michael Jennings, Amitayush Thakur, Swarat Chaudhuri.
NeurIPS Datasets & Benchmarks Track, 2024.
ICML AI for Math Workshop, 2024. **Best Paper Award.**

An In-Context Learning Agent for Formal Theorem-Proving
Amitayush Thakur, **George Tsoukalas**, Yeming Wen, Jimmy Xin, Swarat Chaudhuri.
Conference on Language Modeling, 2024.

***k*-NIM trees: Characterization and Enumeration**
Charles R. Johnson, George Tsoukalas, Greyson C. Wesley, Zachary Zhao.
Preprint, 2022.

Research experience

Trustworthy Intelligent Systems Lab

Advisor: Dr. Swarat Chaudhuri (UT Austin) August 2023 – Present

Researching neurosymbolic techniques for formal theorem-proving, conjecturing, and autoformalization. Developed PutnamBench, a next-gen evaluation benchmark for benchmarking automated methods for formal olympiad problems. Contributed to COPRA, an LLM-based search methodology for formal theorem-proving in competition mathematics & software verification.

Automated Reasoning Lab

Advisor: Dr. He Zhu (Rutgers University) September 2022 – May 2023

Researched differentiable programming techniques for loop invariant synthesis. Utilized the Z3 theorem-prover and the Code2Inv framework for automated invariant checking.

Numerical Semigroups REU

Advisor: Dr. Christopher O'Neill (SDSU) June 2022 – August 2022

Researched connections between numerical semigroups and the Kunz Cone. Uncovered several key properties of symmetries of the Kunz Cone and their action on unimaximal faces.

Matrix Analysis REU

Advisor: Dr. Charles Johnson (William & Mary) June 2021 – August 2021

Researched generalized notions of graph adjacency matrices, including questions of eigenvalue assignments and disparity. Characterized k-NIM trees, extending a prior characterization of 1-NIM trees. Employed singularity analysis to enumerate k-NIM trees according to the newly found characterization.

Talks and tutorials

PutnamBench: A Multilingual Competition-Mathematics Benchmark for Formal Theorem-Proving July 2024

ICML AI for Math Workshop. **Best Paper Award**.

Skills

Programming

Proficient in: Python, Lua, Java, C, Ocaml, Prolog, Javascript.

Mathematical Software

Proficient in: Lean, Isabelle, Coq, Sage, Maple, MatLab.

Teaching and Service

Lean Directed Reading Group January 2024 - May 2024

Organized a reading group about the Lean theorem prover for undergraduates. Followed introductory mathematics material in Lean, with regular weekly assignments, to a group of 10 UT Austin undergraduate students.

Undergraduate Grader September 2020 - May 2021

Graded sections of introduction real analysis. Gave timely feedback to instructor regarding common misconceptions in homework. Provided helpful comments regarding incorrect solutions to students on an individual basis.

Undergraduate Tutor September 2020 - May 2021

Tutored peers in introductory proof-based mathematics and real analysis. Hosted weekly office hours available to all mathematics students in the university.

Reviewer

NeurIPS MathAI Workshop 2024

Neural Information Processing Systems (NeurIPS) 2024

ICML AI for Math Workshop 2024