505 Milstein Center, 3009 Broadway - NYC, NY 10027

🕆 www.marksantolucito.com • May 7, 2024

Research Interests

Program Synthesis/Verification, Reactive Systems, Configuration Analysis, CS Education, Computer Music

Education

Yale University New Haven, CT Computer Science Ph.D. - Advisor: Ruzica Piskac May 2020 PhD Dissertation: A Modular Synthesis Framework for Software Deployment, Design, and Implementation Yale University New Haven, CT Computer Science M.S. - Advisors: Paul Hudakt, Ruzica Piskac May 2015 Amherst, MA

Amherst College Computer Science B.A. & Music B.A., Cum Laude Advisors: Scott Kaplan, Jason Robinson

Professional Experience in Higher Education

Barnard College, Columbia University Tenure Track Assistant Professor

Yonsei University Visiting Faculty

Fall 2020-Seoul, South Korea

New York, NY

May 2013

Summer 2023

Geumgang University Nonsan, South Korea Visiting Faculty Feb 2016-Aug 2016 Worked with other faculty and administration to design four-year curriculum map for new Computer Science major at the university. Taught three courses of my own design in a mix of Korean and English.

Professional Experience outside Higher Education

Amazon SDE Intern - AWS Security Automation Applied my research on configuration file analysis to automatically build CloudFormation verification to quality and security.	v York, NY <i>mmer 2018</i> ols for code
Academic and Professional Honors	
Gladys Brooks Junior Faculty Excellence in Teaching Award <i>Barnard College</i> Recognizes considerable individual achievements of tenure-track/tenure-eligible assistant professors.	2024
U.SKorea Presidential STEM Initiative Award <i>U.S. Fulbright Program</i> Bridging the Semiconductor Culture Gap: Towards Manufacturing-Aware Language Design.	2024-2025
Helmholtz Visiting Researcher Grant <i>CISPA Center for Information Security</i> Provably correct Code Generation with Large Language Models and Reactive Synthesis.	2024
Honorable Mention Google Bughunter Hall of Fame Identified and reported a security vulnerability via Google's Bughunter program on their Infrastructure a Cloud Composer.	<i>Nov. 2019</i> s Code tool,
^D rogram for Excellence in Science AAAS By nomination of Dean of Graduate Studies, awarded a one-year sponsored membership in AAAS/Science.	Oct. 2018

Advanced Graduate Leadership Program	
Yale University 2	018–Present
\$3000 grant to fund additional career development.	
Theres and Dennis M. Rohan Fellow	0017 0010
Yale University Awarded graduate funding on the recommendation of the Computer Science department	2017-2018
Heidelberg Leureste Forum	
Voung Researcher Award	$O_{ct} = 2017$
Invited with full funding to attend the 5th HI F in Heidelberg. Germany with Turing Award winners and Fie	lds Medalists
Robert Willets Carle Fellow	
Yale University	2014-2015
Awarded graduate funding on the recommendation of the Computer Science department	
Travel Funding Awards	
Summer schools: SSFT15, OPLSS2015, SAT/SMT2015, VTSA2017, ProbProg2017	
Conferences: USENIX Security 2019, CAV2015/16/17, ICFP2015, POPL2016, FMCAD2016, CHI2019.	
Create	
Grants	
Active Grants	
Statically Inferring Usage Bound for Infrastructure as Code	
Amazon Web Services \$80,000	2024-2025
National Science Foundation CRII: SHF: RUI	
\$173,341	2021-2024
Exploring Human-in-the-loop Program Synthesis Through Live Coding	
Collaboratory Fund (Columbia Data Science Institute & Columbia Entrepreneurship)	
\$104,019 - with CoPI Seth Cluett	2021-2024
Accessible and Inclusive Data Capture and Display: Creative Embedded Systems for Multi-Sensory Data E	Ingagement
Prior Awards Now Terminated	
Fund for Innovation in Teaching	
Barnard College Provost's Office	Fall 2021
\$6,000 - Arts and Computing in NYC, to develop and run a cross-institutional course with the Fashion	1 Institute of
Student Travel Grant (CCF-2122164)	0001 0000
National Science Foundation \$10,000 Student Travel Count for 2021 Formed Matheda in Conserver Aided Design (FMCAD)	2021-2022
\$10,000 - Student Travel Grant for 2021 Formal Methods in Computer-Alded Design (FMCAD)	
Grants Submitted for Funding	
Enforcing Temporal Constraints on Generative Agent Behavior	-
Sony	Pending
Teaching Specification Engineering through Culturally-Relevant Media Arts Program Synthesis	Donalia
	Pending
Publications (l_z^A indicates alphabetic author ordering, otherwise senior/primary advising automatic senior/primary advising advisin	thor is last)

Towards Reactive Synthesis as a Programming Paradigm. Angel Leyi Cui, Raven Rothkopf, and *Mark Santolucito*.

In PLATEAU Workshop 2024, March 2024.

Maxpy: An open-source python package for programmatic construction and manipulation of maxmsp patches.

Ranger Liu, Satch Peteron, Richard Lee, and *Mark Santolucito*. In *New Interfaces for Musical Expression NIME 2023*, October 2023.

Towards the Usability of Reactive Synthesis: Building Blocks of Temporal Logic.

Raven Rothkopf, Angel Leyi Cui, Hannah Tongxin Zeng, Arya Sinha, and *Mark Santolucito*. In *PLATEAU Workshop 2023*, March 2023.

Can reactive synthesis and syntax-guided synthesis be friends?.

Wonhyuk Choi, Bernd Finkbeiner, Ruzica Piskac, and *Mark Santolucito*. In *Programming Language Design and Implementation PLDI*, March 2022.

Learning CI configuration correctness for early build feedback.

Mark Santolucito, Jialu Zhang, Ennan Zhai, Jürgen Cito, and Ruzica Piskac. In IEEE International Conference on Software Analysis, Evolution and Reengineering SANER, March 2022.

Program synthesis for musicians: A usability testbed for temporal logic specifications.

Wonhyuk Choi, Michel Vazirani, and *Mark Santolucito*. In *Programming Languages and Systems - 19th Asian Symposium, APLAS*, October 2021.

Demo: Synthesis-enabled live coding on the web.

Kat Pompermayer, Catherine Ji, Hannah Macias, and *Mark Santolucito*. In *Programming Languages and Interactive Entertainment PLIE 2021*, October 2021.

Human-in-the-loop program synthesis for live coding.

Mark Santolucito. In FARM 2021: Proceedings of the 9th ACM SIGPLAN International Workshop on Functional Art, Music, Modelling, and Design, August 2021.

The FMCAD 2021 student forum.

Mark Santolucito. In Formal Methods in Computer Aided Design, FMCAD, July 2021.

cardcomposer: A functional programming card game.

Maria Hwang and *Mark Santolucito*. In *ITiCSE 2021: 26th ACM Conference on Innovation and Technology in Computer Science Education*, June 2021.

TSL synthesis synthesizer: Reconfigurable signal flows through program synthesis.

Michel Vazirani, Wonhyuk Choi, and *Mark Santolucito*. In *New Interfaces for Musical Expression NIME*, June 2021.

Analyzing infrastructure as code to prevent intra-update sniping vulnerabilities.

Julien Lepiller, Ruzica Piskac, Martin Schäf, and *Mark Santolucito*. In *Tools and Algorithms for the Construction and Analysis of Systems (TACAS@ETAPS)*, 2021.

Live coding sequencers.

Mark Santolucito. Hybrid Live Coding Interfaces: performance and craft, July 2020. https://hybrid-livecode.pubpub.org/pub/live-coding-sequencers.

Formal methods and computing identity-based mentorship for early stage researchers.

Mark Santolucito and Ruzica Piskac. In *ACM Technical Symposium on Computer Science Education (SIGCSE)*, March 2020.

Grammar filtering for syntax-guided synthesis.

Kairo Morton, Bill Hallahan, Elven Shum, Ruzica Piskac, and *Mark Santolucito*. In *The Thirty-Fourth AAAI Conference on Artificial Intelligence (AAAI)*, February 2020.

 J_z^A Software engineering for infrastructure and configuration (SEConfig) - workshop report. Jürgen Cito and *Mark Santolucito*. *ACM SIGSOFT Softw. Eng. Notes*, 2020.

Towards checkpoint placement for dynamic memory allocation in intermittent computing.

Nicholas Shoemaker, Ruzica Piskac, and *Mark Santolucito*. In *Tools for Automatic Program Analysis (TAPAS@SPLASH)*, 2020.

\mathbf{J}_{z}^{A} Synthesizing functional reactive programs.

Bernd Finkbeiner, Felix Klein, Ruzica Piskac, and *Mark Santolucito*. In *Haskell Symposium*, October 2019.

\downarrow_{z}^{A} System design with TSL.

Bernd Finkbeiner, Felix Klein, Ruzica Piskac, and *Mark Santolucito*. In *SYNT workshop at CAV*, July 2019.

\downarrow_{z}^{A} Temporal stream logic: Synthesis beyond the bools.

Bernd Finkbeiner, Felix Klein, Ruzica Piskac, and *Mark Santolucito*. In *International Conference on Computer Aided Verification (CAV)*, July 2019.

Live programming by example.

Mark Santolucito, William T. Hallahan, and Ruzica Piskac. In Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems, May 2019.

Studio report: Yale open music initiative.

Scott Petersen, *Mark Santolucito*, and Konrad Kaczmarek. In *International Computer Music Conference (ICMC)*, 2019.

Programming by example: Efficient, but not "helpful".

Mark Santolucito, Drew Goldman, Allyson Weseley, and Ruzica Piskac. In *PLATEAU at SPLASH*, 2018. Also presented at SYNT 2018.

Programming-by-example for audio: Synthesizing digital signal processing programs.

Mark Santolucito, Kate Rogers, Aedan Lombardo, and Ruzica Piskac. In *Functional Art and Music (FARM) at ICFP*, 2018.

Synthesizing configuration file specifications with association rule learning.

Mark Santolucito, Ennan Zhai, Rahul Dhodapkar, Aaron Shim, and Ruzica Piskac. *Proc. ACM Program. Lang.*, 1(OOPSLA), October 2017.

\downarrow_{z}^{A} Vehicle platooning simulations with functional reactive programming.

Bernd Finkbeiner, Felix Klein, Ruzica Piskac, and *Mark Santolucito*. In *Safe Control of Autonomous Vehicles Workshop at CPSWeek*, 2017. https://arxiv.org/abs/1803.10383.

Version space learning for verification on temporal differentials.

Mark Santolucito. In International Symposium on Software Testing and Analysis (ISSTA), 2017. Also presented as poster at FMCAD 2016 Student Research Competition, 3rd Place Award.

Probabilistic automated language learning for configuration files.

Mark Santolucito, Ennan Zhai, and Ruzica Piskac. In International Conference on Computer Aided Verification (CAV), 2016.

$\downarrow_{\rm Z}^{\rm A}$ Real-time interactive music in haskell.

Paul Hudak, Donya Quick, *Mark Santolucito*, and Daniel Winograd-Cort. In *Functional Art and Music (FARM) at ICFP*, 2015.

Using javascript as an intermediate language for FRP.

Mark Santolucito and Ruzica Piskac. Poster at ICFP Student Research Competition, 2015.

Media Modules: Intermedia Systems in a Pure Functional Paradigm.

Mark Santolucito, Donya Quick, and Paul Hudak. In International Computer Music Conference (ICMC), 2015.

Raid the fridge!: Promoting healthy eating habits through the game Monster Appetitie. Maria Hwang, Pantiphar Chantes, and *Mark Santolucito*.

Extended Abstract and Poster at Games Learning and Society 10, Best in Show Award, 2014.

Communalizing the interfaces of single player games.

Mark Santolucito and Maria Hwang. Extended abstract in Digital Games Research Association Conference, 2014.

Simquabbin project: Game-based environmental science education in a virtual world. *Mark Santolucito* and Scott Payne. Extended Abstract and Poster at Games Learning and Society 9, 2013.

Designing a community to support long-term interest in programming for middle school children. Kyle J. Harms, Jordana H. Kerr, Michelle Ichinco, *Mark Santolucito*, Alexis Chuck, Terian Koscik, Mary Chou, and Caitlin L. Kelleher. In *Proceedings of the 11th International Conference on Interaction Design and Children*, IDC '12, 2012.

Teaching and Supervising Experience

Courses designed and taught

<i>COMS BC3930: Creative Embedded Systems</i> Spring 2021, 2022, 2023	Barnard College
COMS BC3430: Computational Sound Fall 2020, Fall 2021, Fall 2022, Fall 2023	Barnard College
COMS W1002: Computing in Context: Computing in the Arts Track (Track Instructor) Fall 2020, 2021	Columbia University
COMS BC3997: New Directions in Computing: Program Synthesis Seminar Spring 2023	Yonsei University
COMS BC3997: New Directions in Computing: Arts and Computing in NYC cross-institutional with Fashion Institute of Technology. Fall 2021	Barnard College
COMS BC3997: New Directions in Computing: Audio Plugin Development Spring 2021	Barnard College
COMS BC1002: Methods and Problems in Computer Science Summer 2021	Barnard College
CPSC334: Creative Embedded Systems (Co-Instructor) Fall 2019	Yale University
<i>CS101: Intro to Computer Science</i> Spring 2016	Geumgang University
<i>CS201: Object Oriented Programming</i> Spring 2016	Geumgang University
<i>CS032: Computer Music</i> Spring 2016	Geumgang University

Reading groups

Category Theory for Computer Scientists - reading from Riehl and Awodey (Summer and Fall 2021), with Columbia graduate students and Barnard undergraduates.

Student co-author mentees

Raven Rothkopf (Barnard) [3, 1]: Summer 2022 - Angel Cui (Barnard) [3, 1]: Summer 2022 -

Hannah Zeng (Barnard) [3]: Summer 2022 -Richard Lee (Columbia) [2]: Summer 2022 - Fall 2022 Satch Peterson (Columbia) [2]: Summer 2022 - Fall 2022 Ranger Liu (Columbia) [2]: Summer 2022 - Fall 2022 Wonhyuk Choi (Columbia MS) [6, 11]: Fall 2020 - Fall 2021 Michel Vazirani (Columbia) [6, 11]: Fall 2020 - Summer 2021 Kat Pompermayer (Barnard) [7]: Summer 2021 Catherine Ji (Barnard) [7]: Summer 2021 Hannah Macias (Barnard) [7]: Summer 2021 Nicholas Shoemaker (Yale) [17]: 2019 Kairo Morton (MIT) [15]: 2019 Elven Shum (Yale) [15]: 2019 Drew Goldman (Roslyn High School) [23]: 2018 Kate Rogers (Yale) [24]: 2017 Aeden Lombardo (Yale) [24]: 2017 Aaron Shim (Yale) [25]: 2016

Academic Talks

Invited	
Dagstuhl Seminar 23391: The Futures of Reactive Synthesis Reactive Synthesis as a Programming Paradigm	Oct 2023
Dagstuhl Seminar 23082: Resilient Software Configuration and Infrastructure Code Analysis Static Analsis for Infrastructure as Code	Feb 2023
Isaac Newton Institute Seminar Series: Synthesis United Can reactive synthesis and syntax-guided synthesis be friends?	July 2022
<i>Harness.io</i> Program Synthesis for Software Systems	Jan 2020
Facebook Faculty Networking & Communications Event, San Francisco, CA Automated Firewall Repair and Verification.	June 2019
<i>Xerox PARC, Palo Alto, CA</i> Language Learning for Verification of Configuration Files	Oct 2018
Verification and Synthesis for Software Evolution at ETAPS, Greece Learning Models of Configuration Correctness.	Apr 2018
Learning in Verification Workshop at ETAPS, Greece Using Machine Learning to Synthesize Specifications for Configuration Files	Apr 2018
<i>Instituto Superior Técnico (IST), Portugal</i> Language Learning for Verification of Configuration Files.	May 2017
Saarland University, Germany Verifying Configuration Files with Examples.	Sept 2016
<i>Monthly Music Hackathon, NYC, NY</i> Workshop on Algorithmic Composition with Euterpea.	Jan 2015
Symposium	
<i>IBM PL Day, Yorktown Heights, NY</i> Learning to Verify Infrastructure as Code.	Dec 2018
New England Programming Languages Symposium, Cambridge, MA Digital Signal Processing Programming-by-Example.	Sept 2018
IBM PL Day, Yorktown Heights, MA Synthesizing Functional Reactive Programs.	Dec 2017

University Service

Barnard College

Science Pathways Scholars Program (SP2). Computer Science Representative. (2021-) Presidential Artificial Intelligence and Technology Task Force. (2024).

IT Committee. (2022-2024).

Faculty Governance and Procedures (FGP) Committee. (2021-2023).

Co-founder with Lydia Chilton and faculty advisor for Design at Columbia. (2020-)

Columbia University

Computer Science DEI Coordination Committee. Barnard Representative. (2022-) Computer Science Academic Committee. Barnard (non-voting) Representative. (2022-)

Professional Service

Served on NSF Panel in 2021

Organization

- 1. Dagstuhl Seminar 23082: Resilient Software Configuration and Infrastructure Code Analysis, co-organizer with Jürgen Cito, Ruzica Piskac, Andy Zaidman, and Yuanyuan Zhou
- 2. The 23rd International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI 2022). Artifact Evaluation Chair
- 3. The 21st Conference on Formal Methods in Computer Aided Design (FMCAD 2021). Student Forum Chair
- 4. CONFLANG 2021, co-organizer with Jürgen Cito, Eelce Dolstra, Gabriella Gonzalez, Yann Hamdaouim, Nicolas Jeannerod, Marcel van Lohuizen
- 5. SEConfig 2019, co-organizer with Jürgen Cito
- 6. The 5th ACM SIGPLAN International Workshop on Functional Art, Music, Modelling and Design (FARM 2017). Publicity Chair
- 7. The 4th ACM SIGPLAN International Workshop on Functional Art, Music, Modelling and Design (FARM 2016). Publicity Chair
- 8. CAV Buddy System 2015, 2016, 2017

Program Committees

- 1. Tools and Algorithms for the Construction and Analysis of Systems (TACAS 2024)
- 2. Object-oriented Programming, Systems, Languages, and Applications (OOPSLA 2023)
- 3. Workshop on Programming Languages and Interactive Entertainment (PLIE 2021)
- 4. The 8th Workshop on Synthesis (SYNT 2019)
- 5. The 2nd International Workshop on Machine Learning techniques for Programming Languages (ML4PL 2018)
- 6. Workshop on Reactive and Event-based Languages & Systems (REBLS 2020, 2021).

Journal Referee

- 1. Acta Informatica (2021).
- 2. Journal of Automated Reasoning (JAR 2021).
- 3. IEEE Signal Processing Letters (IEEE SPL 2021).
- 4. ACM Transactions on Programming Languages and System (TOPLAS 2017).

Reviewer

- 1. Technical Symposium on Computer Science Education (SIGCSE 2020, 2021, 2022).
- 2. New Interfaces for Musical Expression (NIME 2019, 2020, 2021)
- 3. The Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT 2019).

Subreviewer iFM 2018, SMT 2017, ESOP 2017, ICDCIT 2016, VSTTE 2015

Artifact Evaluation Committee USENIX Security 2020 Fall, PLDI 2018

Community Outreach Talks and Workshops

Computer Music Center, Columbia University, NYC, NY Guest lecture in MUSI GR6602, Sonic and Visual Representation of Data	Mar 2022
Barnard Computational Science Center, NYC, NY Live Coding: Play Your Laptop Like an Instrument	Dec 2021
<i>Teachers College, Columbia University, NYC, NY</i> Guest lecture in MSTU 4133, Computing and Cognition	Nov 2021
Fashion Institute of Technology, NYC, NY Programming Digital Embroidery	Oct 2019
NYC CS Fair, NYC, NY How to Play Your Laptop Like an Instrument: Live Coding for Music	Mar 2019
<i>Yale Computer Science Society, New Haven, CT</i> Panel Discussion - An Inside Look: CS Graduate School	Feb 2018
Code441 Hackathon, Hamilton, Bermuda Applications of Association Rule Learning and Neural Networks	Dec 2018
<i>Roslyn High School, NY</i> Majoring in Computer Science - the Why and How.	Nov 2017

Consultantships

CaptureAge. (2023-). Consulting on language design of simulation virtual machine for Age of Empires 2 (1999) replay system.