Mark Santolucito

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Research Interests

Program Synthesis/Verification, Reactive Systems, Software Engineering, Machine Learning, 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 Hudak†, Ruzica Piskac	*May 2015*

Amherst College	Amherst, MA
Computer Science B.A. & Music B.A., Cum Laude	*May 2013*

Advisors: Scott Kaplan, Jason Robinson

Work Experience

Barnard College, Columbia University	New York, NY
Tenure Track Assistant Professor	*Fall 2020–*

Amazon	New York, NY
SDE Intern - AWS Security Automation	*Summer 2018*

Applied my research on configuration file analysis to automatically build CloudFormation verification tools for code quality and security.

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.

Grants

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 Institute of Technology

Student Travel Grant (CCF-2122164)

National Science Foundation	*2021-2022*

$10,000 - Student Travel Grant for 2021 Formal Methods in Computer-Aided Design (FMCAD)

CRII: SHF: RUI (CCF-2105208)

National Science Foundation	*2021-2023*

$174,000 - *Exploring Human-in-the-loop Program Synthesis Through Live Coding*

Collabratory Fellows Fund

Data Science Institute, Columbia University	*2020-2022*

$104,000 - *Accessible and Inclusive Data Capture and Display: Creative Embedded Systems for Multi-Sensory Data Engagement*, with co-PI Seth Cluett at the Columbia University Computer Music Center

Awards and Honors

Theres and Dennis M. Rohan Fellow

Yale University	*2017-2018*

Awarded graduate funding on the recommendation of the Computer Science department.

Heidelberg Laureate Forum
Young Researcher Award   *Oct. 2017*
Invited with full funding to attend the 5th HLF in Heidelberg, Germany with Turing Award winners and Fields 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.
Best Undergraduate Thesis
Amherst College   *May 2013*
Awarded to "the student who has written the best Computer Science thesis of the graduating class."
Lerner Piano Prize
Amherst College   *May 2013*
Awarded to "the student who has achieved an exceptional level of ability and expressivity in the musical arts."

Academic Talks

Invited

Harness.io   *Jan 2020*
Program Synthesis for Software Systems

Facebook Faculty Networking & Communications Event, San Francisco, CA   *June 2019*
Automated Firewall Repair and Verification.

Xerox PARC, Palo Alto, CA   *Oct 2018*
Language Learning for Verification of Configuration Files

Verification and Synthesis for Software Evolution at ETAPS, Greece   *Apr 2018*
Learning Models of Configuration Correctness.

Learning in Verification Workshop at ETAPS, Greece   *Apr 2018*
Using Machine Learning to Synthesize Specifications for Configuration Files

Instituto Superior Técnico (IST), Portugal   *May 2017*
Language Learning for Verification of Configuration Files.

Saarland University, Germany   *Sept 2016*
Verifying Configuration Files with Examples.

Monthly Music Hackathon, NYC, NY   *Jan 2015*
Workshop on Algorithmic Composition with Euterpea.

Symposium

IBM PL Day, Yorktown Heights, NY   *Dec 2018*
Learning to Verify Infrastructure as Code.

New England Programming Languages Symposium, Cambridge, MA   *Sept 2018*
Digital Signal Processing Programming-by-Example.

IBM PL Day, Yorktown Heights, MA   *Dec 2017*
Synthesizing Functional Reactive Programs.

Teaching and Supervising Experience

Courses designed and taught

COMS3930: Creative Embedded Systems   *Barnard College*
Spring 2021, 2022

COMS3998: New Directions in Computing: Arts and Computing in NYC   *Barnard College**
*cross-institutional with Fashion Institute of Technology. Fall 2021

COMS1002: Methods and Problems in Computer Science	*Barnard College*
Summer 2021	
COMS3430: Computational Sound	*Barnard College*
Fall 2020, 2021	
COMS1002: Computing in Context: Computing in the Arts Track	*Columbia University*
(Track Instructor) Fall 2020, 2021	
CPSC334: Creative Embedded Systems	*Yale University*
(Co-Instructor) Fall 2019	
CS101: Intro to Computer Science	*Geumgang University*
Spring 2016	
CS201: Object Oriented Programming	*Geumgang University*
Spring 2016	
CS032: Computer Music	*Geumgang University*
Spring 2016	

Reading groups

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

Columbia research students advised

Joseph Rebagliati (MS Bridge): Fall 2021 -
Yuhao Dong (MS Bridge): Fall 2021 -
Krystal Briggs (MS Bridge): Fall 2021 -
Alexandra Shanabrook (CC): Fall 2021 -
Justin Kim (SEAS): Fall 2021 -
Shmuel Berman (SEAS): Fall 2020 -
Wonhyuk Choi (MS) [2, 7]: Fall 2020 - Fall 2021
Michel Vazirani (CC) [2, 7]: Fall 2020 - Summer 2021
Keith Owens (SEAS): Spring 2021
Bryanna Geiger (SEAS): Spring 2021
Claire Jenkins (SEAS): Fall 2020

Barnard research students advised

Whitney Deng: Fall 2021 -
Avighna Suresh: Fall 2021 -
Eliana Shaepre: Summer 2021, Spring 2021
Kat Pompermayer [3]: Summer 2021 -
Catherine Ji [3]: Summer 2021 -
Hannah Macias [3]: Summer 2021
Oraly Peña Valdez: Summer 2021
Miranda Karger: Summer 2021
Christina Duan: Summer 2021

Other research students advised

Takudzwanashe Mhuru (Amherst College): Summer 2021 - Spring 2022
Nicholas Shoemaker (Yale University) [10]: 2019
Kairo Morton (MIT) [13]: 2019
Elven Shum (Yale University) [13]: 2019
Drew Goldman (Roslyn High School) [19]: 2018
Kate Rogers (Yale University) [20]: 2017
Aeden Lombardo (Yale University) [20]: 2017
Aaron Shim (Yale University) [22]: 2016

Student recognition

Shmuel Berman: Winner of Blockchain and Cyberdefense Design Challenge run by Ronghui Gu. Third place in ACM student research competition at OOPSLA. Recipient of Columbia Work Exemption Program scholarship.

Service

Professional Service

Served on NSF Panel in 2021

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

Program Committees
1. Workshop on Programming Languages and Interactive Entertainment (PLIE 2021)
2. The 8th Workshop on Synthesis (SYNT 2019)
3. The 2nd International Workshop on Machine Learning techniques for Programming Languages (ML4PL 2018)

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. Workshop on Reactive and Event-based Languages & Systems (REBLS 2020, 2021).
3. New Interfaces for Musical Expression (NIME 2019, 2020, 2021)
4. 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

University Service

Barnard College
Science Pathways Scholars Program (SP2). Computer Science Representative.
Faculty Governance and Procedures Committee (Barnard). (2021-2022).
Co-founder with Lydia Chilton and faculty advisor for Design at Columbia.
Columbia University

Columbia Computer Science DEI Coordination Committee. Barnard Representative.

Community Outreach Talks and Workshops

Teachers College, Columbia University, NYC, NY   *Nov 2021*
Guest lecture in MSTU 4133, Computing and Cognition

Fashion Institute of Technology, NYC, NY   *Oct 2019*
Programming Digital Embroidery

NYC CS Fair, NYC, NY   *Mar 2019*
How to Play Your Laptop Like an Instrument: Live Coding for Music

Yale Computer Science Society, New Haven, CT   *Feb 2018*
Panel Discussion - An Inside Look: CS Graduate School

Code441 Hackathon, Hamilton, Bermuda   *Dec 2018*
Applications of Association Rule Learning and Neural Networks

Roslyn High School, NY   *Nov 2017*
Majoring in Computer Science - the Why and How.

Publications (⬛ indicates published proceedings, ↓ᴬ�z indicates alphabetic author ordering)

[1] ⬛ **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.
Proceedings forthcoming.

[2] ⬛ **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.

[3] ⬛ **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.
Proceedings forthcoming.

[4] ⬛ **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.

[5] ⬛ **The FMCAD 2021 student forum**.
Mark Santolucito.
In *Formal Methods in Computer Aided Design, FMCAD*, July 2021.

[6] ⬛ **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.

[7] ⬛ **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.

[8] ⬛ **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 at ETAPS*, April 2021.

[9] **Using wearables for data driven decision making in education**.
Mark Santolucito, Dan Hoffman, Seungoh Paek, and Maria Hwang.

Under submission, 2021.

[10] ⬛ **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*, November 2020.

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

[12] ⬛ **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.

[13] ⬛ **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.

[14] ⬛ ↓ᴬᵤ **Synthesizing functional reactive programs**.
Bernd Finkbeiner, Felix Klein, Ruzica Piskac, and *Mark Santolucito*.
In *Haskell Symposium*, October 2019.

[15] ↓ᴬᵤ **System design with TSL**.
Bernd Finkbeiner, Felix Klein, Ruzica Piskac, and *Mark Santolucito*.
In *SYNT workshop at CAV*, July 2019.

[16] ⬛ ↓ᴬᵤ **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.

[17] ⬛ **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.

[18] ⬛ **Studio report: Yale open music initiative**.
Scott Petersen, *Mark Santolucito*, and Konrad Kaczmarek.
In *International Computer Music Conference (ICMC)*, 2019.

[19] ⬛ **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.

[20] ⬛ **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.

[21] **Statically verifying continuous integration configurations**.
Mark Santolucito, Jialu Zhang, Ennan Zhai, and Ruzica Piskac.
CoRR, abs/1805.04473, 2018.
http://arxiv.org/abs/1805.04473.

[22] ⬛ **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.

[23] ⬛ ↓ᴬᵤ **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.

[24] ▤ 🏆 **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.

[25] ▤ **Probabilistic automated language learning for configuration files**.
Mark Santolucito, Ennan Zhai, and Ruzica Piskac.
In *International Conference on Computer Aided Verification (CAV)*, 2016.

[26] ▤ ↓ᴬ_Z **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.

[27] **Using javascript as an intermediate language for FRP**.
Mark Santolucito and Ruzica Piskac.
Poster at ICFP Student Research Competition, 2015.

[28] ▤ **Media Modules: Intermedia Systems in a Pure Functional Paradigm**.
Mark Santolucito, Donya Quick, and Paul Hudak.
In *International Computer Music Conference (ICMC)*, 2015.

[29] 🏆 **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.

[30] **Communalizing the interfaces of single player games**.
Mark Santolucito and Maria Hwang.
Extended abstract in Digital Games Research Association Conference, 2014.

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

[32] ▤ **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.