

# ILANA SHAPIRO

## CONTACT

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## RESEARCH INTERESTS

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My interests lie in the integration of programming languages, automated reasoning, generative AI, and human-computer interaction. I aim to develop usable structural constraints on sequence models for the controllable generation of well-formed sequence data, and to apply formal reasoning methods to improve the automated reasoning tools that underlie these systems.

## EDUCATION

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**University of California, San Diego**, La Jolla, CA

2023-present

Ph.D. Computer Science

Programming Systems Group, advised by Professor Sorin Lerner

GPA: 3.96/4.0

**Pomona College**, Claremont, CA

2018-2022

B.A. Computer Science/Music (Flute) double major, minor in Mathematics

GPA: 4.0/4.0, Summa Cum Laude, Distinction in Senior Exercises

- **Computer Science Thesis:** "MusAssist: A Domain Specific Language for Music Notation"
  - Advised at Harvey Mudd College by Professor Ben Wiedermann
- **Music Thesis and Recital:** "Mieczysław Weinberg: Music Transcending Tragedy"
  - Advised by Professors Alfred Cramer, Joti Rockwell, and Eric Lindholm

## RESEARCH PROJECTS

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**Parallelizing Z3: Adaptive Cubing via Online Sampling of CDCL Conflict Traces** [\[code\]](#) [\[slides\]](#) 2025

- At Microsoft Research, I worked with Nikolaj Bjørner on a novel parallelization algorithm for the SMT solver Z3. We developed an online cube-and-conquer approach: cubes are dynamically sampled during solving from CDCL conflict-variable heuristics and distributed to worker threads based on similarity.

**Training LLMs for Verified Programming** [\[code\]](#)

2025

- At Microsoft Research, I helped train a 32B LLM specialized in program verification. I prepared and augmented Lean datasets for SFT and RL training, built a custom Dockerized Lean verification server, and evaluated model checkpoints.

**Synthesizing Composite Hierarchical Structure from Music Corpora** [\[paper\]](#) [\[code\]](#) [\[slides\]](#) [\[talk\]](#) 2025

- Published at 34th International Joint Conference on Artificial Intelligence 2025. Combined stochastic and SMT techniques to frame and solve the nested NP-hard combinatorial optimization problem of music structure summarization as an extension of the Generalized Median Graph problem.

**Lexically Constrained Decoding of Transformers** [\[paper\]](#) [\[code\]](#) [\[slides\]](#)

2025

- Adapted the constrained decoding algorithm Grid Beam Search (GBS) to impose lexical constraints on GPT2, and fine-tuned GPT2 on a corpus of Chekhov's stories. GBS + fine-tuned GPT2 subjectively outperformed GBS + GPT2 alone.

**The Impact of GitHub Copilot on Test-First Development** [\[paper\]](#) [\[code\]](#)

2024

- Conducted between-subjects pilot study to determine impact of Copilot on Test-First Development. Thematic analysis revealed that while Copilot enhanced coding speed, it resulted in superficial problem comprehension and decreased scope of the test suites.

**pgen-rs: LLM-Aided, Efficient, User-Friendly Genomic Data Wrangling** [\[paper\]](#) [\[code\]](#) [\[slides\]](#) 2024

- Developed pgen-rs, a tool enabling end-users to write genomic data wrangling requirements in natural language and execute with Rust-based high-performance genomic data processor.

**ProCon: Continuous Enumeration for Just-In-Time Bottom-Up Synthesis** [\[paper\]](#) [\[code\]](#)

2024

- Introduced continuous, rule-based enumeration for just-in-time bottom-up search in SyGuS problems, where programs are enumerated in order of continuous, nonrounded weights as determined by a probabilistic weighting function.

**MusAssist: A Domain Specific Language for Music** [\[TENOR paper\]](#) [\[thesis2\]](#) [\[code\]](#) [\[demo\]](#)

2022

- Published at 8th International Conference on Technologies for Music Notation and Representation 2023. Created DSL bridging the abstraction gap between music theoretical structures and notation. Wrote Haskell-based compiler to MusicXML.

**Mieczysław Weinberg: Music Transcending Tragedy** [[thesis1](#)][[recital](#)] 2022

- Published in Scholarship@Claremont. Wrote extensive musicology thesis examining narrative and memory in Weinberg's *Kaddish* Symphony. Presented flute recital of my transcriptions of Weinberg's cello works.

**Markov Chain Music Generation** [[JHM paper](#)][[code](#)] 2021

- Published in *Journal of Humanistic Mathematics*. Created a novel system of Markov chains using inverse transform sampling, enabling end-users to rapidly generate musical sketches.

**Virtual Ensemble Assembly: Musicality in Separation** [[WAC paper](#)][[code](#)] 2020

- Published at Web Audio Conference 2022. Assisted on Prof. Christopher Raphael's research at Indiana University Bloomington exploring synchronizing audio tracks without click tracks.

## PUBLICATIONS

\* equal contribution

**Ilana Shapiro**, Ruanqianqian (Lisa) Huang, Zachary Novack, Cheng-i Wang, Hao-Wen Dong, Taylor Berg-Kirkpatrick, Shlomo Dubnov, and Sorin Lerner. "Synthesizing Composite Hierarchical Structure from Symbolic Music Corpora." In *Proceedings of the 34th International Joint Conference on Artificial Intelligence (IJCAI '25)*, Montreal, Canada, 2025. [[paper8](#)]

**Ilana Shapiro**, Shubham Saha, Diya Lakhani, Shree Venkatesh, and Runqiu Xu. "Grid Beam Search for Constrained GPT-2 Decoding" Unpublished manuscript, 2025. [[paper7](#)]

**Ilana Shapiro**, Michael Peng, and Andrew Lara. "The Impact of GitHub Copilot on Test-First Development." Unpublished manuscript, 2024. [[paper6](#)]

Cole Kurashige,\* Savitha Ravi,\* and **Ilana Shapiro**.\* "pgen-rs: LLM-Aided Efficient and User-Friendly Genomic Data Wrangling." Unpublished manuscript, 2024. [[paper5](#)]

Kyle Thompson, **Ilana Shapiro**, Ani Canumalla. "ProCon: Continuous Enumeration for Just-In-Time Bottom-Up Synthesis." Unpublished manuscript, 2024. [[paper4](#)]

**Ilana Shapiro**. "MusAssist: A Domain Specific Language for Music Notation." *Proceedings of the International Conference on Technologies for Music Notation and Representation (TENOR'23)*, pp. 75-82, Northeastern University, Boston, MA, 2023. [[paper3](#)]

Kaitlin Pet, **Ilana Shapiro**, and Christopher Raphael. "Virtual Ensemble Assembly: Musicality in Separation." In *Web Audio Conference (WAC'22)*, Cannes, France, 2022. [[paper2](#)]

**Ilana Shapiro**. 2022. *MusAssist: A Domain Specific Language for Music Notation*. Bachelor's thesis. Pomona College. [[thesis2](#)]

**Ilana Shapiro**. 2022. *Mieczysław Weinberg: Music Transcending Tragedy*. Bachelor's thesis. Pomona College. [[thesis1](#)][[recital](#)]

**Ilana Shapiro** and Mark Huber. "Markov Chains for Computer Music Generation." In *Journal of Humanistic Mathematics, Volume 11 Issue 2 (July 2021)*, pp. 167-195. [[paper1](#)]

## INDUSTRY EXPERIENCE

**Research Intern, Amazon Web Services (Automated Reasoning Group)** Summer 2026

- Incoming research intern in the AWS Automated Reasoning Group working on SAT/SMT tasks

**Research Intern, Microsoft (Research in Software Engineering/RiSE Group)** Summer 2025

- Researching SMT parallelization algorithms and natural language reasoning for verifiable code generation. Supervised by Nikolaj Bjorner.

**Freelance Software Engineer, Stainless** Feb. 2023-Oct. 2024

- Make open-source contributions to codebases such as Stoplight Prism, node-tree-sitter, Microsoft Pyright, NPM Trends, and json-schema-benchmark.

**Software Engineer, Meta** Oct. 2022-Nov. 2022

- Improve type safety of Python and Hack code in engineering bootcamp. Impacted by the 13% company layoff as a new hire.

### **3x Software Engineering Intern, Facebook**

*Summers of 2019, 2020, 2021*

- iOS/serverside fullstack intern on Facebook Events and Groups.

### **Talks**

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“Parallelizing Z3: Adaptive Cubing via Online Sampling of CDCL Conflict Traces.” *Programming Systems Group, UC San Diego*, Nov. 2025.

“Synthesizing Composite Hierarchical Structure from Symbolic Music Corpora.” *The 34th International Joint Conference on Artificial Intelligence (IJCAI)*, Aug. 2025.

“Synthesizing Composite Hierarchical Structure from Symbolic Music Corpora.” *The 19th SoCal Programming Languages and Systems Workshop (SoCaL PLS)*, Feb. 2025.

“Deriving Structure from Music Corpora.” *Programming Systems Group, UC San Diego*, Apr. 2024.

“MusAssist: A Domain Specific Language for Music Notation.” *International Conference on Technologies for Music Notation and Representation*, May 2023.

### **TEACHING EXPERIENCE**

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**Teaching Assistant, CSE 130: Programming Languages, UCSD (N=69)** *Fall 2025*

**Teaching Assistant, CSE 130: Programming Languages, UCSD (N=126)** *Spring 2025*

**Teaching Assistant, CS 133: Database Systems, Pomona College (N=20)** *Spring 2020*

### **ACADEMIC HONORS**

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**NSF Graduate Research Fellowship, Honorable Mention** *2025*

- The NSF GRFP recognizes and supports outstanding graduate students who are pursuing full-time research-based master's and doctoral degrees in STEM fields.

**The Phi Beta Kappa Award** *2022*

- Endowed by the Pomona Chapter of Phi Beta Kappa, awarded to one senior selected for high quality of scholarship and promise of future distinction.

**The Rena Gurley Archibald High Scholarship Prize** *2022*

- Awarded to the member(s) of the Pomona College graduating class ranking highest in scholarship.

**Distinction in Senior Exercise (Computer Science)** *2022*

- Exceptional work on the senior exercise is awarded based on review by the entire faculty of the Computer Science Department at Pomona College.

**Distinction in Senior Exercise (Music)** *2022*

- Exceptional work on the senior exercise is awarded based on review by the entire faculty of the Music Department at Pomona College.

**The Katherine J. Hagedorn Prize** *2022*

- Awarded annually to the Pomona College student(s) demonstrating exceptional loyalty and dedication to their music studies.

**Phi Beta Kappa Induction (Junior Year) - Pomona College Chapter** *2021*

- 1 of 8 juniors awarded for "good moral character," distinguish in "breadth of culture," and "excellence of scholarship."

**The William F. Russell Prize** *2020*

- Awarded annually to the Pomona College prospective music major(s) showing substantial accomplishment and significant promise in their study of music.

### **SKILLS**

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**Programming Languages:** Python • Haskell • TypeScript • C++ • Java • Objective-C • SQL

**Tools/Frameworks:** LaTeX • Git • Functional and Object-Oriented Programming

**Domain Knowledge:** Programming Languages • Automated Reasoning • SAT/SMT Solvers • Stochastic/Combinatorial Optimization • Neurosymbolic Generation • User Studies

### **OUTREACH AND MENTORSHIP**

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**Presenter, Harmony Hacks @ CSU San Marcos**

*Spring 2025*

- NSF-funded event to broaden participation of women in computing. I co-hosted a Q&A to inspire high school girls to pursue careers in CS.

**Mentorship Co-Chair, GradWIC UCSD**

*Fall 2024-Spring 2025*

- Manage the UCSD Graduate Women in Computing Mentorship Program. Pair 174 mentees with mentors, personally mentor 2 students, host inclusive group activities.