STEFAN ZETZSCHE

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RESEARCH INTERESTS

Research Scientist specializing in the intersection of generative AI and formal methods. Focused on combining generative AI with symbolic reasoning to advance interactive and automated theorem proving, alignment, formal verification, and synthesis of reliable, verifiable code. Recent work includes leveraging formal methods to curate high-quality datasets and guide LLM fine-tuning for specification, synthesis, and proof tasks.

EXPERIENCE

Amazon Web Services, Applied Scientist — Dec 2022 – Present (as of July 2025)

- Work in the Automated Reasoning Group on formal verification, programming languages, theorem proving, and AI-assisted reasoning using **Lean** and **Dafny**.
- Co-developed SampCert, a **12K+ line Lean formalization of differential privacy**, underpinning AWS Clean Rooms; **awarded the PLDI 2025 Distinguished Artifact Award**.
- Contributed to CLEVER, **a benchmark for verified code generation in Lean**; evaluated LLM synthesis methods on specification and proof generation tasks.
- Helped develop **neuro-symbolic safeguards** for Amazon Bedrock Guardrails, **integrating formal methods with language models** to reduce hallucinations in large-scale AI applications deployed on AWS.
- Utilized Dafny as a **verification-aware intermediate language** for LLM code generation, enabling natural language-driven synthesis of **formally verified code compiled to Python** without exposing formal syntax.
- Mentored PhD-level interns from Cambridge, Imperial, MIT, Oxford, and UCL on **LLM fine-tuning for proof and code generation, and auto-(in)formalization**; collaborated with external academics through Amazons research engagement; gave talks at universities and institutions (e.g., Jane Street).

Meta, Software Engineer Intern — Jul 2022 – Sep 2022

- Extended an OCaml-based **static analyzer** for Hack, Facebooks main web language (over 100M lines of code).

Amazon Web Services, Applied Scientist Intern — Aug 2021 – Nov 2021

- Implemented a quantum circuit optimizer in Dafny, formalizing rewrite rules and proving semantic preservation.

SELECTED PUBLICATIONS

- *CLEVER: A Curated Benchmark for Formally Verified Code Generation.* Preprint, 2025. Under review at NeurIPS 2025 and AI for Math workshop at ICML 2025.
- *Verified Foundations for Differential Privacy.* PLDI 2025. **Distinguished Artifact Award**.
- *Dafny as Verification-Aware Intermediate Language for Code Generation.* Dafny Workshop at POPL 2025.

EDUCATION

PhD Computer Science, University College London — 2018 – 2023

- Thesis: *Canonical Algebraic Generators in Automata Learning.* Used **algebraic and category theoretical methods** to guide **efficient learning of automata** modelling the semantics of simple imperative programs.
- Member of the Programming Principles, Logic, and Verification group. Supervised by Alexandra Silva.

MSc Mathematics, University of Hamburg — 2016 – 2018

- Thesis: *Generalised Duality Theory for Monoidal Categories and Applications.* Graduated with Distinction (1.0).

BSc Mathematics, University of Hamburg — 2014 – 2016

- Thesis: *Isomorphism Classes of Vertex-Transitive Tournaments.* Minor in Computer Science.

TEACHING & SERVICE

Teaching: Logic, Discrete Mathematics, Computability and Complexity, Theory of Computation, Principles of Programming, Analysis, Linear Algebra.
Service: Artifact evaluation (CAV, ICFP, PLDI, POPL, SPLASH), reviews (CALCO, ICML, SPIN), program committee (CAV), organizer (Dafny workshop at POPL), mentor (POPL, SPLASH).

TECHNICAL SKILLS

Dafny, Lean, OCaml, Python, SMT; theorem proving, formal verification, static analysis, program synthesis, LLMs (fine-tuning, prompt engineering), auto-(in)formalization, data curation