# Siddharth Bhat

## Education

PhD **University of Edinburgh**.
(2022 - Ongoing)

Master by **International Institute of Information Technology Hyderabad India**.
Research (2020 - 2021)

Undergraduate **International Institute of Information Technology Hyderabad India**.
2015 - 2020

## Publications

Lambda the Ultimate SSA: **Siddharth Bhat**, Tobias Grosser. CGO 2021

QSSA: An SSA based IR for Quantum Computing: Anurudh Peduri, **Siddharth Bhat**, Tobias Grosser. CC 2021

Optimizing Geometric Multigrid Computation using a DSL Approach: Vinay Vasista, Kumudha KN, **Siddharth Bhat**, Uday Bondhugula. Supercomputing (SC), Nov 2017

Word Embeddings as Tuples of Feature Probabilities: **Siddharth Bhat**, Alok Debnath, Souvik Banerjee, Manish Shrivastava Representation Learning for NLP, 2020

## Internship Experience

Summer 2023 **Microsoft Research**, *Redmond*.
Retrieval Augmented theorem proving for the Fstar proof assistant.

Summer 2022 **Adjoint School**, *Glasgow*.
Researched Markov categories and their relationship to probabilistic programming.

Winter 2019 **Teaching Assistant for Natural Language: Applications**, *IIIT-H*.
Monitored projects, took sessions on word embeddings, involving `word2vec`, `GloVe`, `fasttext`.

Summer 2019 **Intern at Tweag.io**, *Paris, France*.
Re-implemented portions of GHC(Glasgow Haskell Compiler) runtime for `Asterius (link)`, a Haskell to WebAssembly compiler. Involved Haskell, C, and WebAssembly.

Winter 2018 **Teaching Assistant for Principles of Programming Languages**, *IIIT-H*.
Course covers the book "Essentials of Programming Languages" by Dan Friedman. Helped write lecture notes, set assignments, graded assignments and exams.

Summer 2018 **Visiting research intern at ETH Zurich**, *Zurich, Switzerland*.
Investigating formal verification of polyhedral compilation. `PolyIR (Link)` is a formal specification of polyhedral programs.

Summer 2018 **GSoC mentor, Polly Labs**.
Mentoring a project to enable Polly's loop optimisations into Chapel.

Mar-Dec '17 **ETH Zurich, Research Intern at SPCL**, *Zurich, Switzerland*.
Worked on Polly, a polyhedral loop optimizer for LLVM.

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| Jan-Mar '17 | **Course content contributor**, *IIIT-H*. |
| | Wrote lecture notes for the Intro to programming course (link) |
| Summer 2016 | **Research Intern**, *IISC Bangalore*, Bangalore. |
| | Worked on PolyMage, DSL compiler for optimising loop transforms. Contributed to ISL and PLUTO. Implemented tiling patterns, optimised PolyMage for stencils. |
| Summer 2016 | **Selected for GSoC 2016**, *Google*. |
| | Binding SymEngine, a symbolic math library to Haskell. Had to drop this to intern at IISc, Bangalore. Still maintain the library (symengine.hs) |
| Summer 2015 | **GSoC 2015**, *Google*. |
| | Worked on VisPy, a pure Python graphics library which uses OpenGL internally for performace. Successfully completed. |

## Open Source Contributions

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| Coq | Submitted issues, bug-fixes, helped improve developer documentation. |
| VE-LLVM | Collaboration with VE-LLVM, a formal semantics of the LLVM compiler toolchain in Coq |
| Polly | Implementing support for Fortran, added unified memory abilities to the CUDA backend within Polly, a polyhedral loop optimiser for LLVM. (Link to commits) |
| Symengine.hs | GSoC 2016. Haskell bindings to SymEngine, a C++ symbolic manipulation library. |
| VisPy | GSoC 2015. Rewrote scene graph for performance. Added visuals, high level API for easy use of plotting. Implemented auto-resizing with **Cassowary**, a linear optimisation library. |
| Rust | Contributed to the Rust compiler and ecosystem. Found compiler errors, fixed libraries. Was part of *Piston*, group of Rust programmers that experimented with writing game engines. |
| Haskell | Contributed to the Haskell ecosystem. Reported and fixed bugs in *stack*, *stackage*, *diagrams*, *GHC*, etc. (Link to GHC commits). |
| PLUTO | Source to Source C optimiser for loop nests. Improved the PLUTO API that had gone out of sync with master. Discovered bugs in PLUTO for diamond tiling transforms |
| PolyMage | DSL Compiler than generates C code. Uses **Polyhedral Compilation** Extended the compiler to add stencils, time iterated-stencils. |
| PPSSPP | PPSSP is a C++ open source PSP emulator. Wrote most of the touch handling code. Implemented atomic locks for audio performance. |

## My Projects

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| Lean-MLIR | Formal semantics for the MLIR compiler framework, defined within the Lean4 proof assistant. |
| lz | An MLIR based compiler backend for the Lean4 proof assistant. |
| Lean4 Metaprogramming Book | A textbook on metaprogramming in Lean4. I wrote the chapters on tactics and metaprogramming for embedded DSLs. |
| Lean-to | A Jupyter kernel for the Lean4 proof assistant. |
| Simplexhc | A custom compiler for a subset of Haskell. The goal is to try and apply *polyhedral compilation* ideas to compile a lazy, pure, functional programming language. with LLVM as a backend. Has **64 stars** on github. |
| Sublime Bookmarks | A plugin for sublime text to quickly jump between pieces of your codebase. **26k downloads** and counting. |

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| Cellular Automata | A collection of Cellular Automata written in Haskell. Uses **Comonads** for abstraction. **130 stars** on Github. |
| Teleport | A simple tool to switch between projects written in Haskell. Shows how to write "real world Haskell". Published as a **Literal Haskell tutorial**. **90 stars** on github |
| TIMi | A visual interpreter of the **template instantiation machine** to understand evaluation of lazy functional languages. **51** stars on github. |

## Miscellaneous

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| Barvinok | Talk at ETH Zurich: Slides describing the barvnok algorithm to count lattice points in polyhedra |
| FunctionalConf '19 | Talk on implementing embedded probabilistic programming languages in Haskell (Slides) |
| Haskell Exchange 2020 | Talk on optimizing `smallpt-hs` (a port of a raytracer to haskell) to beat `C++` performance (Slides) |
| FPIndia | Talk explaning the paper egg: fast and extensible equality saturation. (Slides) |
| Theory seminar, winter '19 | Talk on impossibility of compass-straightedge constructions using field theory. |
| math.se | Answer on **math.stackexchange. 4724 reputation, top 2% this year**. General interest in algebra and geometry. |

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