

Jam Kabeer Ali Khan

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RESEARCH INTERESTS

I am interested in the theory and implementation of programming languages, and formal methods, and their applications to specific domains, such as Security, Verification and Quantum Computing.

EDUCATION

Sept 2021 – June 2025	University of Hong Kong Major in Computer Science, Minor in Mathematics Fully-Funded Tuition Scholarship	Hong Kong SAR
Jan 2024 – May 2024	Northeastern University Semester Exchange Programming Languages (A), Number Theory (A), Networks & Distributed Systems (A-), Algorithms (A).	Boston, USA
Sept 2018 – July 2020	Nixor College GCE A-levels: 4 A*s & 2 As Regional Distinction in Computer Science, Physics Fully-Funded Scholarship	Karachi, Pakistan

PUBLICATIONS & MANUSCRIPTS

Draft	Internalizing Separate Compilation and Linking via First-Class Environments Jam Kabeer Ali Khan, Jinhao Tan, Bruno C. d. S. Oliveira
Submitted@POPL'26	Foundational Constraint Solving for Expressive Refinement Typing Jam Kabeer Ali Khan, Petros Markopoulos, Nico Lehmann, Ranjit Jhala
Submitted@POPL'26	Polymorphic First-Class Environments Jinhao Tan, Jam Kabeer Ali Khan, Bruno C. d. S. Oliveira
ArXiv	Traq: Estimating the Quantum Cost of Classical Programs Anurudh Pedhuri, Jam Kabeer Ali Khan, Gilles Barthe, Michael Walter.
LICS'26	Complete Relational Logic for Infinite-Dimensional Quantum Programs with Unbounded Assertions Gilles Barthe, Minbo Gao, Jam Kabeer Ali Khan, Matthijs Muis, Ivan Renison, Keiya Sakabe, Michael Walter, Yingte Xu, Tianshi Yu, Li Zhou.
PLDI'25 SRC	Capabilities as First-Class Modules with Separate Compilation Jam Kabeer Ali Khan 🏆 Gold Award (Undergraduate Category)

PRESENTATIONS & TALKS

PLanQC '26	Traq: Estimating the Quantum Cost of Classical Programs [Slides] [Extended Abstract] [Talk]
PLDI '25 SRC	Capabilities as First-Class Modules with Separate Compilation [Talk] [Poster]
HKU Seminar	Maximal Violation of a Measurement Protocol with Simplex Bell Inequality [Slides]

RELEVANT EXPERIENCE

Jan 2026 – Present	Independent Research Research (<i>Lean4</i> , <i>Rust</i>); Supervised by Ranjit Jhala	Remote
- Designed and implemented a Lean 4 framework for constraint solving of refinement types. - Novel results include deterministic proof term synthesis and certifying predicate abstraction. - Mechanization of foundational verifiers to emit CHCs and evaluation of solver on FluxRS VCs. - Design and implementation of prophecy variables in FluxRS.		

Oct 2025 – Present	Standard Chartered - Full-time <i>Functional Programmer (Haskell)</i>	Hong Kong
	- Contributed to an industrial compiler for Mu, a strict variant of Haskell used for quant finance. - Optimized the Shake build system powering Mu's library infrastructure. - Contributed to a protoc plugin to compile Protobuf to Haskell.	
Apr 2025 – Sept 2025	Max Planck Institute for Security & Privacy <i>Research Intern</i> ; Supervised by Gilles Barthe ; collaborated with Michael Walter	Germany
	- Investigated compiler correctness in probabilistic/unitary settings and quantum cost analysis; contributed to TRAQ Haskell package. - Formalized mathematical infra (Dirac notation, Orthonormal Bases) in Lean4. - Designed an extraction mechanism from an interactive prover using OCaml to well-typed Lean4 specifications.	
Aug 2024 – Apr 2025; Nov 2025 – present (part-time)	HKU Programming Languages Group <i>Research</i> ; Supervised by Bruno C. d. S. Oliveira	Hong Kong
	- Research on the design and implementation of source languages with first-class environments. - Coq mechanization of type-directed elaboration and semantics preservation from source to core calculus. - Prototypes in OCaml and Haskell with property-based testing, along with mechanized proofs in Rocq.	
June 2024 – Aug 2024	HKU Quantum Information and Computation Lab <i>Research Intern</i> ; Supervised by Ravishankar Ramanathan	Hong Kong
	Utilized semi-definite programming and sum-of-squares decomposition to design DI-QKD protocols with self-testing properties.	

SOFTWARE

- **Flex: Foundational Constraint Solver** *Lean4* [\[GitHub\]](#)
Certified *Constraint Horn Clause* (CHC) solving to enable expressive refinement typing.
- **EnvML: Polymorphic First-Class Environments** *Haskell* [\[Playground\]](#) [\[GitHub\]](#)
An ML-like source language with elaboration to a core calculus, a variant of System F with first-class environments.
- λ_{SCE} : **Mechanization and Implementation** *OCaml, Lean4*
A novel calculus with mechanized proofs of type-soundness, semantics preservation, and separate compilation correctness.
- **CQOTL: Relational Prover for Classical-Quantum Programs** *OCaml, Lean4* [\[Lean4 Mechanization\]](#) [\[GitHub\]](#)
An interactive prover based on a sound and complete relational logic for classical-quantum programs with backend to Lean4.
- **Traq: Tool to estimate quantum speedups in classical programs** *Haskell* [\[GitHub\]](#)
A Haskell package with probabilistic source language, CPL, to perform source-level quantum cost analysis.

TEACHING EXPERIENCE

Fall '23, Fall '24	Teaching Assistant , University of Hong Kong COMP2396 Object-Oriented Programming in Java
Spring '23	Teaching Assistant , University of Hong Kong ENGG1340 Computer Programming (C++)

OTHER EXPERIENCE

Apr 2022 – Oct 2022	HKU Sleep Lab <i>Student Research Assistant</i>	Hong Kong
June 2023 – Aug 2023	ActusRayPartners Limited Hedge Fund <i>Technology Intern</i>	Hong Kong
Mar 2023 – Nov 2023	All Round Education Academy <i>Software Developer (Freelance)</i>	Hong Kong
Feb 2022 – Aug 2023	Tutor (Math & CS) , All Round Education Academy	Hong Kong

HONORS & AWARDS

2025	PLDI'25 SRC Gold Award
2022 – 2024	HKU Undergraduate Entrance Scholarship for Outstanding Academic Talents
2021 – 2024	HKSAR Government Scholarship Fund
2024	Rosita King Ho Scholarship
2023	Cathay Hackathon: 2 nd runner-up
2021	HKU Foundation Entrance Scholarship
2020	Top in Sindh and Balochistan (GCE A-levels CS & Physics)
2018–20	100% merit scholarship to attend GCE A-levels at Nixor College.

SKILLS

Languages	Haskell, OCaml, C++, Racket, Java, Python
Proof Assistants	Rocq, Lean4
Tools	Git & L ^A T _E X

REFERENCES

Gilles Barthe

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Scientific Director
Max Planck Institute for Security and Privacy
Bochum, Germany
 [Google Scholar](#)

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