Karim Ali

Assistant Professor · University of Alberta

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Research Areas

My primary research interest is to develop and evaluate static analysis techniques that are applicable in real-world settings by exploring three aspects: scalability, precision, and usability. My interests span programming languages and software systems.

Academic Appointments

Assistant Professor, Department of Computing Science, University of Alberta, Canada — *Jul 2017–Present*
Research Assistant Professor, Department of Computing Science, University of Alberta, Canada — *Jul 2016–Jul 2017*

Education

Ph.D., Computer Science, University of Waterloo, Canada — *2014*
- Advisor: Ondřej Lhoták
- Thesis: The Separate Compilation Assumption
- Committee: Jan Vitek, Frank Tip, Reid Holmes, and Werner Dietl

MMath, Computer Science, University of Waterloo, Canada — *2010*
- Advisor: Raouf Boutaba
- Thesis: Algorizmi - A Configurable Virtual Testbed to Generate Datasets for Offline Evaluation of Intrusion Detection Systems
- Reviewers: Ian MacKillop and Urs Hengartner

B.Sc., Computer Science, The American University in Cairo, Egypt — *2007*
- Advisors: Sherif G. Aly and Sherif El-Kassas
- Thesis: A Jabber Framework for Building Communication Capable Java Mobile Applications
- Minor: Mathematics

Professional Experience

Postdoctoral Researcher, Secure Software Engineering, Technische Universität Darmstadt, Germany — *Oct 2014–Jul 2016*
Software Engineer, Execution Team, ITWorx, Egypt — *Jun 2007–Dec 2007*
Researcher, Software Engineering, The American University in Cairo, Egypt — *May 2007–Dec 2007*

Awards and Honours

Dahl-Nygaard Junior Prize, Association Internationale pour les Technologies Objets (AITO) — *2021*
ACM SIGPLAN Distinguished Paper Award, ACM SIGPLAN Symposium on Principles of Programming Languages (POPL) — *2019*
Student's Choice Award, University of Alberta, Canada — *2018*
ACM SIGSOFT Distinguished Paper Award, International Symposium on Software Testing and Analysis (ISSTA) — *2017*
Distinguished Artifact Award, European Conference on Object-Oriented Programming (ECOOP) — *2014*
B.Sc. Summa Cum Laude Honors, The American University in Cairo, Egypt — *2007*

Research Funding

Analysis-Driven Inlining Algorithms — *2020–2023*
- IBM Centre for Advanced Studies Research Fellowship
- Sole PI
- Amount: CAD$90,000

Improving JVM Startup Performance Through Static Analysis — *2020–2023*
- IBM Centre for Advanced Studies Research Fellowship
- Sole PI
- Amount: CAD$90,000

Automatic Verification of Comparators and Hash Functions *2019–2020*
- Mitacs Accelerate (in collaboration with Synopsys)
- Sole PI
- Amount: CAD$30,000

Validating the Correct Usage of Cryptography Libraries *2018–2020*
- IBM Centre for Advanced Studies Research Fellowship
- Sole PI
- Amount: CAD$60,000

Scalable and Precise Program Analysis for Modern Software Systems *2017–2022*
- Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant
- Sole PI
- Amount: CAD$125,000

Improving the Inlining Algorithms in the IBM Just-in-Time (JIT) Compiler *2017–2020*
- IBM Centre for Advanced Studies Research Fellowship
- Sole PI
- Amount: CAD$90,000

Publications

Note: underlined names indicate students whom I have (co-)supervised in an official capacity. Double-underlined names indicate students whom I led to publish their course projects. Authors are ordered according to their contributions. "Hamdan" is my middle name and was used as my last name for an earlier journal publication.

Refereed Journal Articles

Abdul Ali Bangash, Hareem Sahar, Abram Hindle, and **Karim Ali**. "On the Time-Based Conclusion Stability of Software Defect Prediction Models". *International Journal on Empirical Software Engineering*, 25(6), pp. 5047–5083, 2020. (Impact Factor: 3.156). *EMSE '20*

Lisa Nguyen Quang Do, James R. Wright, and **Karim Ali**. "Why Do Software Developers Use Static Analysis Tools? A User-Centered Study of Developer Needs and Motivations". *IEEE Transactions on Software Engineering*, (accepted to appear), 2020. (Impact Factor: 6.112). *TSE '20*

Karim Ali, Xioani Lai, Zhaoyi Luo, Ondřej Lhoták, Julian Dolby, and Frank Tip. "A Study of Call Graph Construction for JVM-Hosted Languages". *IEEE Transactions on Software Engineering*, (accepted to appear), 2019. (Impact Factor: 6.112). *TSE '19*

Stefan Krüger, Johannes Späth, **Karim Ali**, Eric Bodden, and Mira Mezini. "CrySL: An Extensible Approach to Validating the Correct Usage of Cryptographic APIs". *IEEE Transactions on Software Engineering*, (accepted to appear), 2019. (Impact Factor: 6.112). *TSE '19*

Lisa Nguyen Quang Do, Stefan Krüger, Patrick Hill, **Karim Ali**, and Eric Bodden. "Debugging Static Analysis". *IEEE Transactions on Software Engineering*, 46(7), pp. 697–709, 2020. (Impact Factor: 3.331). *TSE '18*

Karim Ali, Marianna Rapoport, Ondřej Lhoták, Julian Dolby, and Frank Tip. "Type-Based Call Graph Construction Algorithms for Scala". *ACM Transactions on Software Engineering and Methodology*, 25(1), 9:1–9:43, 2015. (Impact Factor: 2.057). *TOSEM '15*

Sherif Aly, Sarah Nadi, and **Karim Hamdan**. "A Java-Based Programming Language Support of Location Management in Pervasive Systems". *International Journal of Computer Science and Network Security*, 8(6), pp. 329–336, 2008. (Impact Factor: 1.486). *IJCSNS '08*

Refereed Conference Publications

Daniil Tiganov, Jeff Cho, **Karim Ali**, and Julian Dolby. "SWAN: A Static Analysis Framework for Swift." *ACM Joint Meeting on European Software Engineering Conference and Symposium on the Foundations of Software Engineering*, pp. 1640–1644, 2020. (Acceptance Rate: 26/44 = 59%). *ESEC/FSE '20 Tool Paper*

Stefan Krüger, **Karim Ali**, and Eric Bodden. "CogniCrypt$_{GEN}$ - Generating Code for the Secure Usage of Crypto APIs". *International Symposium on Code Generation and Optimization*, pp. 185–198, 2020. (Acceptance Rate: 26/95 = 27%). *CGO '20*

Abdul Ali Bangash, Hareem Sahar, Shaiful Alam Chowdhury, Alexander William Wong, Abram Hindle, and **Karim Ali**. "What do developers know about machine learning: a study of ML discussions on StackOverflow". *International Conference on Mining Software Repositories*, pp. 260–264, 2019. (Acceptance Rate: 14/27 = 52%). — *MSR '19 Mining Challenge*

Artem Chikin, José Nelson Amaral, **Karim Ali**, and Ettore Tiotto. "Toward an Analytical Performance Model to Select between GPU and CPU Execution". *IEEE International Workshop on High-Level Parallel Programming Models and Supportive Environments*, pp. 353–362, 2019. — *HIPS '19*

Johannes Späth, **Karim Ali**, and Eric Bodden. "Context-, Flow-, and Field-Sensitive Data-Flow Analysis Using Synchronized Pushdown Systems". *ACM SIGPLAN Symposium on Principles of Programming Languages*, 48:1–48:29, 2019. (Acceptance Rate: 77/267 = 29%). — *POPL '19* 🏆 *Distinguished Paper*

Stefan Krüger, Johannes Späth, **Karim Ali**, Eric Bodden, and Mira Mezini. "CrySL: An Extensible Approach to Validating the Correct Usage of Cryptographic APIs". *European Conference on Object-Oriented Programming*, 10:1–10:27, 2018. (Acceptance Rate: 26/66 = 39%). — *ECOOP '18*

Lisa Nguyen Quang Do, Stefan Krüger, Patrick Hill, **Karim Ali**, and Eric Bodden. "VISUFLOW: A Debugging Environment for Static Analyses". *International Conference on Software Engineering (Companion Volume)*, pp. 89–92, 2018. (Acceptance Rate: 30/72 = 42%). — *ICSE '18 Tool Paper*

Stefan Krüger, Sarah Nadi, Michael Reif, **Karim Ali**, Mira Mezini, Eric Bodden, Florian Göpfert, Felix Günther, Christian Weinert, Daniel Demmler, and Ram Kamath. "CogniCrypt: Supporting Developers in using Cryptography". *International Conference on Automated Software Engineering*, pp. 931–936, 2017. — *ASE '17 Tool Paper*

Johannes Späth, **Karim Ali**, and Eric Bodden. "IDE^{al}: Efficient and Precise Alias-Aware Dataflow Analysis". *ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages and Applications*, 99:1–99:27, 2017. (Acceptance Rate: 66/223 = 30%). — *OOPSLA '17*

Mona Nashaat, **Karim Ali**, and James Miller. "Detecting Security Vulnerabilities in Object-Oriented PHP Programs". *IEEE International Working Conference on Source Code Analysis and Manipulation*, pp. 159–164, 2017. — *SCAM '17*

Taylor Lloyd, Artem Chikin, Erick Ochoa, **Karim Ali**, and José Nelson Amaral. "A Case for Better Integration of Host and Target Compilation When Using OpenCL for FPGAs". *International Workshop on FPGAs for Software Programmers*, pp. 1–9, 2017. — *FSP '17*

Lisa Nguyen Quang Do, **Karim Ali**, Ben Livshits, Eric Bodden, Justin Smith, and Emerson Murphy-Hill. "Just-in-Time Static Analysis". *International Symposium on Software Testing and Analysis*, pp. 307–317, 2017. (Acceptance Rate: 31/118 = 26%). — *ISSTA '17* 🏆 *Distinguished Paper*

Lisa Nguyen Quang Do, **Karim Ali**, Ben Livshits, Eric Bodden, Justin Smith, and Emerson Murphy-Hill. "Cheetah: Just-in-Time Taint Analysis for Android Apps". *International Conference on Software Engineering - Companion Volume*, pp. 39–42, 2017. (Acceptance Rate: 18/57 = 32%). — *ICSE '17 Tool Paper*

Johannes Späth, Lisa Nguyen Quang Do, **Karim Ali**, and Eric Bodden. "Boomerang: Demand-Driven Flow-Sensitive, Field-Sensitive, and Context-Sensitive Pointer Analysis". *European Conference on Object-Oriented Programming*, 22:1–22:26, 2016. (Acceptance Rate: 25/79 = 32%). — *ECOOP '16*

Steven Arzt, Sarah Nadi, **Karim Ali**, Eric Bodden, Sebastian Erdweg, and Mira Mezini. "Towards Secure Integration of Cryptographic Software". *ACM SIGPLAN Symposium on New Ideas in Programming and Reflections on Software at SPLASH*, pp. 1–13, 2015. (Acceptance Rate: 17/37 = 46%). — *Onward! '15*

Karim Ali, Marianna Rapoport, Ondřej Lhoták, Julian Dolby, and Frank Tip. "Constructing Call Graphs of Scala Programs". *European Conference on Object-Oriented Programming*, pp. 54–79, 2014. (Acceptance Rate: 27/101 = 27%). — *ECOOP '14* 🏆 *Distinguished Artifact*

Karim Ali and Ondřej Lhoták. "Averroes: Whole-Program Analysis without the Whole Program". *European Conference on Object-Oriented Programming*, pp. 378–400, 2013. (Acceptance Rate: 29/116 = 25%). — *ECOOP '13*

Karim Ali and Ondřej Lhoták. "Application-Only Call Graph Construction". *European Conference on Object-Oriented Programming*, pp. 688–712, 2012. (Acceptance Rate: 30/140 = 21%). — *ECOOP '12*

Other Refereed Publications

Karim Ali, Issam Aib, and Raouf Boutaba. "P2P-AIS: A P2P Artificial Immune Systems architecture for detecting DDoS flooding attacks". *Global Information Infrastructure Symposium*, 2009. — *GIIS '09*

Karim Ali and Raouf Boutaba. "Applying Kernel Methods to Anomaly-based Intrusion Detection Systems". *Global Information Infrastructure Symposium*, 2009. — *GIIS '09*

Selected Invited Talks

"Scalable and Precise Static Analysis. For Real!" Dahl-Nygaard Junior Prize Keynote, 2021. *ECOOP '21*

"Is Program Analysis The Silver Bullet Against Software Bugs?" Java Pathfinder Workshop, 2020. *JPF '20*

"U Can't Inline This". IFIP Working Group 2.4 on Software Implementation Technology, 2020. *IFIP '20*

"Scalable and Precise Detection of Security Vulnerabilities". Amazon, Palo Alto, CA, USA, 2019. *Amazon '19*

"Scalable and Precise Detection of Security Vulnerabilities". Google, Mountain View, CA, USA, 2019. *Google '19*

"Is Program Analysis The Silver Bullet Against Software Bugs?" Papers We Love Conference, St. Louis, MI, USA, 2019. *PWLConf '19*

"U Can't Inline This". TURBO Workshop at SPLASH, 2018. *TURBO '18*

"SWAN: A Program Analysis Framework for Swift". NJR Workshop at SPLASH, 2018. *NJR '18*

"Designing Tomorrow's Static Analyses - Addressing Scalability, Precision, and Usability". University of Colorado Boulder, 2016. *Boulder '16*

"Designing Tomorrow's Static Analyses - Addressing Scalability, Precision, and Usability". Rochester Institute of Technology, 2016. *RIT '16*

"Designing Tomorrow's Static Analyses - Addressing Scalability, Precision, and Usability". Iowa State University, 2016. *ISU '16*

"Evaluating Call Graph Construction for JVM-hosted Language Implementations". IFIP Working Group 2.4 on Software Implementation Technology, 2015. *IFIP '15*

"Averroes - Letting go of the library!" Samsung Research America, Mountain View, CA, USA, 2015. *SRA '15*

"Whole-Program Analysis Without the Whole Program". McGill University, 2015. *McGill '15*

Patents

"Assessment of the Benefit of Post-Inlining Program Transformation in Inlining Decisions". Andrew James Craik, Erick Ochoa, José Nelson Amaral, and Karim Ali, U.S. Patent P201803683US01, Jun 2019.

"Hybrid Computing Device Selection Analysis". Artem Chikin, José Nelson Amaral, and Karim Ali, U.S. Patent P201803063, Aug 2018.

Professional Service

Program Committee Organization

ECOOP PC Co-Chair, European Conference on Object-Oriented Programming *2022*
SPLASH-I Co-Chair, ACM SIGPLAN Conference on Systems, Programming, Languages and Applications: Software for Humanity *2018*
SPLASH-I Co-Chair, ACM SIGPLAN Conference on Systems, Programming, Languages and Applications: Software for Humanity *2017*
ESSoS Artifact Evaluation Co-Chair, International Symposium on Engineering Secure Software and Systems *2017*
FSE Demonstration Track Co-Chair, ACM SIGSOFT Symposium on the Foundations of Software Engineering *2017*
SOAP Program Committee Co-Chair, ACM SIGPLAN International Workshop on the State Of the Art in Program Analysis @ PLDI *2017*

Program Committee Member

ICSE, International Conference on Software Engineering *2022*
ICCQ, International Conference on Code Quality *2022*
OOPSLA, ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages and Applications *2021*
ICSE NIER, International Conference on Software Engineering *2021*
OOPSLA, ACM SIGPLAN Conference on Object-Oriented Programming, Systems, Languages and Applications *2020*
ECOOP, European Conference on Object-Oriented Programming *2020*
MSR Mining Challenge, International Conference on Mining Software Repositories *2020*
ISSTA, International Symposium on Software Testing and Analysis *2019*
SOAP, ACM SIGPLAN International Workshop on the State Of the Art in Program Analysis @ PLDI *2019*
SEAD, International Workshop on Software Security from Design to Deployment @ ASE *2019*
ECOOP, European Conference on Object-Oriented Programming *2018*
ISSTA, International Symposium on Software Testing and Analysis *2018*
CASCON, International Conference on Computer Science and Software Engineering *2017*
Onward!, ACM International Symposium on New Ideas, New Paradigms, and Reflections on Programming and Software @SPLASH *2017*

Artifact Evaluation Committee Member

ISSTA, International Symposium on Software Testing and Analysis *2016*
PLDI, ACM SIGPLAN Conference on Programming Language Design and Implementation *2015*
ECOOP, European Conference on Object-Oriented Programming *2015*
ECOOP, European Conference on Object-Oriented Programming *2014*

Workshop Organization

PLMW Co-Chair, Programming Languages Mentorship Workshop @ OOPSLA *2019, 2020*
Panathon Co-Organizer, Program Analysis Hackathon @ ECOOP *2018, 2019*
BenchWork Co-Organizer, Workshop on Benchmarking @ ECOOP/ISSTA *2018*
CDP Co-Organizer, Compiler-Driven Performance Workshop @ CASCON *2017*
SOAP Co-Organizer, ACM SIGPLAN International Workshop on the State Of the Art in Program Analysis @ PLDI *2017*
WALA Hackathon Co-Organizer, Program Analysis Hackathon @ PLDI *2017*
DECAF Co-Organizer, Workshop on Designing Code Analysis Frameworks @ ISSTA *2016*
Co-Organizer, Workshop on WALA @ PLDI *2015*

Journal Reviewer

TSE, IEEE Transactions on Software Engineering *2013, 2019*
TOPLAS, ACM Transactions on Programming Languages and Systems *2018, 2019*
SCP, Science of Computer Programming *2015*

Other

CANOSP Co-Founder, Canada Open-Source Projects *2019–Present*
Reverse EXPO Co-Organizer, Annual Computing Science Industry/Academia Conference at the University of Alberta *2018–2019*
Associate Editor, IEEE Software Blog *2017–2020*
Steering Committee Member, Undergraduate Capstone Open Source Projects (UCOSP) *2018*
Faculty Mentor, Undergraduate Capstone Open Source Projects (UCOSP) *2018*
Web Chair, European Conference on Object-Oriented Programming (ECOOP) *2018*
Web Chair, International Symposium on Software Testing and Analysis (ISSTA) *2018*
Subreviewer, International Conference on Compiler Construction (CC) *2017*

Students

Graduate Students, University of Alberta

Ph.D. **Jiaqi He**, Formal Verification of Neural Networks *2020–Present*
Ph.D. **Ifaz Kabir**, Designing Programming Languages for Non-Volatile Memory *2018–Present*
Ph.D. **Abdul Ali Bangash**, Detecting Energy-Inefficient Code via Program Analysis *2018–Present*
(Main supervisor; Co-supervised with Abram Hindle)
Master's **Jeff Cho**, Static Analysis for Games *2020–Present*
Master's **David Seekatz**, Constructing Precise Library Summaries *2019–Present*
Master's **Ahmed Elkhair**, Proving Program Equivalence via Symbolic Execution *2019–2021*
Master's **Kristen Newbury**, Automatic Hot-Fixing of Crypto APIs Misuses *2018–2020*
CodeQL Analysis Engineer at Github

Master's	**Erick Ochoa**, Guiding Inlining Decisions Using Post-Inlining Transformations (Main supervisor; Co-supervised with José Nelson Amaral)	*2017–2019* *Compiler Engineer at Theobroma Systems*

Graduate Students, Paderborn University (Co-supervised with Eric Bodden)

Ph.D.	**Stefan Krüger**, Designing Language Support for Detecting Crypto APIs Misuses	*2015–2020* *Software Consultant at CQSE GmbH*
Ph.D.	**Lisa Nguyen Quang Do**, User-Centered Tool Design for Data-Flow Analysis	*2015–2019* *Software Engineer at Google*
Ph.D.	**Johannes Späth**, Synchronized Pushdown Systems for Pointer and Data-Flow Analysis	*2015–2019* *Research Associate at Fraunhofer IEM*

Graduate Students, TU Darmstadt

Master's	**Manuel Benz**, Interprocedural Data Dependency Graphs	*2016* *Ph.D. at the University of Paderborn, Germany*
Master's	**Michael Appel**, Call Graph Summaries for the Android SDK	*2016*

Undergraduate Students

UAlberta	**Daniil Tiganov**, Program Analysis for Swift	*2019–Present*
UAlberta	**Cijie Xia**, Just-in-Time Compiler Optimizations	*2020* *Ph.D. at the University of Toronto*
UAlberta	**Revan MacQueen**, Symbolic Verification of Neural Networks	*2018–2019* *Master's at the University of Alberta*
UAlberta	**Jeff Cho**, Program Analysis for Swift	*2017–2019* *Master's at the University of Alberta*
UAlberta	**Supakorn 'Jamie' Rassameemasmuang**, Formal Verification of String Equations	*2019* *Undergraduate at the University of Alberta*
UAlberta	**Spencer Killen**, Inlining Optimization in JIT Compilers	*2019* *Master's at the University of Alberta*
UAlberta	**Alexander MacKenzie**, Automated Benchmark Creation for Program Analysis Tools	*2017–2018* *Undergraduate at the University of Alberta*
UofT	**Bryan Tam**, Program Analysis for Swift	*2018* *Undergraduate at the University of Toronto*
SFU	**Leo Li**, Program Analysis for Swift	*2017–2018* *Master's at the University of Toronto*
UofT	**Swapnil Shah**, Automated Benchmark Creation for Program Analysis Tools	*2018* *Software Engineer at Okera*
UNB	**Tyler Pavlovic**, Automated Benchmark Creation for Program Analysis Tools	*2018* *Application Developer at ACOA*
Western	**Alex Li**, Automated Benchmark Creation for Program Analysis Tools	*2018*
Dalhousie	**Yaser Alkayale**, Program Analysis for Swift	*2017* *Software Engineer at Microsoft*
SFU	**Lydia Wu**, Program Analysis for Swift	*2017* *Master's at UC Berkley*
SFU	**Chen Song**, Program Analysis for Swift	*2017* *Ph.D. at UT Austin*
UAlberta	**Stuart Hoye**, Developing GitHub Classroom Management Tools	*2017* *Application Consultant at Ontracks*
UAlberta	**Noah Weninger**, Program Analysis for Swift	*2017* *Master's at UBC*

Teaching

Instructor

CMPUT 664	**Secure Software Engineering**, University of Alberta, Canada	*Winter 2020–Present*
CMPUT 416	**Foundations of Program Analysis**, University of Alberta, Canada	*Winter 2019–Present*

CMPUT 229 **Computer Organization and Architecture I**, University of Alberta, Canada *Winter 2017–Present*
CMPUT 620 **Static Program Analysis**, University of Alberta, Canada *Fall 2016–Fall 2017*
SAS **Static Analysis Seminar**, Technische Universität Darmstadt, Germany *Winter 2015*

Co-Instructor

APSA **Applied Static Analysis**, Technische Universität Darmstadt, Germany *Spring 2016*

Substitute Lecturer

DECA **Designing Code Analyses**, Technische Universität Darmstadt, Germany *Fall 2014*
CS 241 **Foundations of Sequential Programs**, University of Waterloo, Canada *Spring 2013*

Graduate Teaching Assistant

CS 241 **Foundations of Sequential Programs**, University of Waterloo, Canada *2011–2013*
CS 444/644 **Compiler Construction**, University of Waterloo, Canada *2011–2013*
CS 446/646 **Software Design and Architectures**, University of Waterloo, Canada *Spring 2011*
CS 456/656 **Computer Networks**, University of Waterloo, Canada *2008–2010*
CS 125 **Introduction to Programming Principles**, University of Waterloo, Canada *Winter 2008*
CS 448 **Security Engineering**, The American University in Cairo, Egypt *Fall 2007*

Undergraduate Teaching Assistant

CS 448 **Security Engineering**, The American University in Cairo, Egypt *Fall 2007*
CS 330 **Computer Architecture**, The American University in Cairo, Egypt *2005–2006*
CS 106 **Fundamentals of Computer Science**, The American University in Cairo, Egypt *2004–2005*

Volunteer Work

CyberPatriot Technical Mentor, Strathcona High School, Edmonton, Alberta, Canada *2016–2018*
Graduate Student Ambassador, University of Waterloo, Canada *Fall 2013*
Tour Guide, Computer Science Open House, University of Waterloo, Canada *Winter 2012*
President, Egyptian Students Association, University of Waterloo, Canada *2010–2011*
Ushers Committee Leader, Honors Assembly, The American University in Cairo, Egypt *Spring 2007*
Academic Committee Head, ACM Chapter, The American University in Cairo, Egypt *Spring 2007*