

Karim Ali

ASSISTANT PROFESSOR · UNIVERSITY OF ALBERTA

3-42 Athabasca Hall, Edmonton, Alberta, T6G 2E8, Canada

✉ karim.ali@ualberta.ca | 🏠 karimali.ca | 📧 themaplelab | 🐦 @karimhamdanali

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

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

David R. Cheriton Scholarship, University of Waterloo, Canada

2012–2014

Special Graduate Scholarship, University of Waterloo, Canada

\$20,000

2012

Queen Elizabeth II Graduate Scholarship in Science and Technology, Canada

\$2,500

2012

Special Graduate Scholarship, University of Waterloo, Canada

\$5,000

2011

Graduate Entrance Scholarship, University of Waterloo, Canada

\$1,000

2008

B.Sc. Summa Cum Laude Honors, The American University in Cairo, Egypt

2007

Best CS Group Graduation Project Award, The American University in Cairo, Egypt

2007

Shell Endowed Scholarship, The American University in Cairo, Egypt

2003–2007

30% off tuition

Research Funding

Analysis-Driven Inlining Algorithms

2020–2023

- IBM Centre for Advanced Studies Research Fellowship
- With: Sole PI
- Amount: CAD\$90,000

Improving JVM Startup Performance Through Static Analysis

2020–2023

- IBM Centre for Advanced Studies Research Fellowship
- With: Sole PI
- Amount: CAD\$90,000

Automatic Verification of Comparators and Hash Functions

2019–2020

- Mitacs Accelerate (in collaboration with Synopsys)
- With: Sole PI
- Amount: CAD\$30,000

Validating the Correct Usage of Cryptography Libraries

2018–2020

- IBM Centre for Advanced Studies Research Fellowship
- With: 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
- With: 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
- With: 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; and authors are ordered according to their contributions.

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.

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.

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.

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.

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.

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.

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.

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. 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. 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. 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. 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. 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. 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. 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. 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. 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. 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. 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. 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. ECOOP '13
- Karim Ali** and Ondřej Lhoták. “Application-Only Call Graph Construction”. *European Conference on Object-Oriented Programming*, pp. 688–712, 2012. 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

- “Hotfixing Misuses of Crypto APIs in Java Programs”. IFIP Working Group 2.4 on Software Implementation Technology, 2021. IFIP '21
- “Is Program Analysis The Silver Bullet Against Software Bugs?” Java Pathfinder Workshop, 2020. JPF '20
- “Scalable and Precise Detection of Security Vulnerabilities”. Amazon, 2019. Amazon '19
- “Scalable and Precise Detection of Security Vulnerabilities”. Google, 2019. Google '19
- “Is Program Analysis The Silver Bullet Against Software Bugs?” Papers We Love Conference, 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, 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

- 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 (Main supervisor; Co-supervised with Abram Hindle)	2018–Present
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
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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' Rassameemasuang , 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

CO-INSTRUCTOR

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

Spring 2016

SUBSTITUTE LECTURER

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

Fall 2014
Spring 2013

GRADUATE TEACHING ASSISTANT

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

2011–2013
2011–2013
Spring 2011
2008–2010
Winter 2008
Fall 2007

UNDERGRADUATE TEACHING ASSISTANT

CS 448 **Security Engineering**, The American University in Cairo, Egypt
CS 330 **Computer Architecture**, The American University in Cairo, Egypt
CS 106 **Fundamentals of Computer Science**, The American University in Cairo, Egypt

Fall 2007
2005–2006
2004–2005

Volunteer Work

CyberPatriot Technical Mentor, Strathcona High School, Edmonton, Alberta, Canada
Graduate Student Ambassador, University of Waterloo, Canada
Tour Guide, Computer Science Open House, University of Waterloo, Canada
President, Egyptian Students Association, University of Waterloo, Canada
Ushers Committee Leader, Honors Assembly, The American University in Cairo, Egypt
Academic Committee Head, ACM Chapter, The American University in Cairo, Egypt

2016–2018
Fall 2013
Winter 2012
2010–2011
Spring 2007
Spring 2007