

# Karim Ali

ASSISTANT PROFESSOR · UNIVERSITY OF ALBERTA

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## Research Areas

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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

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**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

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**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

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**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

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**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*

*\$20,000*

**Special Graduate Scholarship**, University of Waterloo, Canada

*2012*

*\$2,500*

**Queen Elizabeth II Graduate Scholarship in Science and Technology**, Canada

*2012*

*\$5,000*

**Special Graduate Scholarship**, University of Waterloo, Canada

*2011*

*\$1,000*

**Graduate Entrance Scholarship**, University of Waterloo, Canada

*2008*

*\$3,000*

**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

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### 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

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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*, (accepted to appear), 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*, (accepted to appear), 2020. ESEC/FSE '20  
Tool Paper
- Stefan Krüger, **Karim Ali**, and Eric Bodden. “COGNICRYPT<sub>GEN</sub> - 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<sup>al</sup>: 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

## Professional Service

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### 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

**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

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

## Students

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### GRADUATE STUDENTS, UNIVERSITY OF ALBERTA

Ph.D.	<b>Jiaqi He</b> , Formal Verification of Neural Networks	2020–Present
Ph.D.	<b>Ifaz Kabir</b> , Designing Programming Languages for Non-Volatile Memory	2018–Present
Ph.D.	<b>Abdul Ali Bangash</b> , Detecting Energy-Inefficient Code via Program Analysis (Main supervisor; Co-supervised with Abram Hindle)	2018–Present
Master's	<b>Jeff Cho</b> , Automatic Verification of Comparators and Hash Functions	2020–Present
Master's	<b>Ahmed Elkhair</b> , Proving Program Equivalence via Symbolic Execution	2019–Present
Master's	<b>David Seekatz</b> , Constructing Precise Library Summaries	2019–Present
Master's	<b>Kristen Newbury</b> , Automatic Hot-Fixing of Crypto APIs Misuses	2018–2020
Master's	<b>Erick Ochoa</b> , 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.	<b>Stefan Krüger</b> , Designing Language Support for Detecting Crypto APIs Misuses	2015–2020
		<i>Software Consultant at CQSE GmbH</i>
Ph.D.	<b>Lisa Nguyen Quang Do</b> , User-Centered Tool Design for Data-Flow Analysis	2015–2019
		<i>Software Engineer at Google</i>
Ph.D.	<b>Johannes Späth</b> , Synchronized Pushdown Systems for Pointer and Data-Flow Analysis	2015–2019
		<i>Research Associate at Fraunhofer IEM</i>

### GRADUATE STUDENTS, TU DARMSTADT

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

### UNDERGRADUATE STUDENTS

UAlberta	<b>Cijie Xia</b> , Just-in-Time Compiler Optimizations	2020–Present
UAlberta	<b>Daniil Tiganov</b> , Program Analysis for Swift	2019–Present
UAlberta	<b>Revan MacQueen</b> , Symbolic Verification of Neural Networks	2018–2019
		<i>Master's at the University of Alberta</i>
UAlberta	<b>Jeff Cho</b> , Program Analysis for Swift	2017–2019
		<i>Master's at the University of Alberta</i>
UAlberta	<b>Supakorn 'Jamie' Rassameemasuang</b> , Formal Verification of String Equations	2019
		<i>Undergraduate at the University of Alberta</i>
UAlberta	<b>Spencer Killen</b> , Inlining Optimization in JIT Compilers	2019
		<i>Master's at the University of Alberta</i>
UAlberta	<b>Alexander MacKenzie</b> , Automated Benchmark Creation for Program Analysis Tools	2017–2018
		<i>Undergraduate at the University of Alberta</i>
UofT	<b>Bryan Tam</b> , Program Analysis for Swift	2018
		<i>Undergraduate at the University of Toronto</i>
SFU	<b>Leo Li</b> , Program Analysis for Swift	2017–2018
		<i>Master's at the University of Toronto</i>
UofT	<b>Swapnil Shah</b> , Automated Benchmark Creation for Program Analysis Tools	2018
		<i>Software Engineer at Okera</i>

UNB	<b>Tyler Pavlovic</b> , Automated Benchmark Creation for Program Analysis Tools	2018 <i>Application Developer at ACOA</i>
Western Dalhousie	<b>Alex Li</b> , Automated Benchmark Creation for Program Analysis Tools <b>Yaser Alkayale</b> , Program Analysis for Swift	2018 2017 <i>Software Engineer at Microsoft</i>
SFU	<b>Lydia Wu</b> , Program Analysis for Swift	2017 <i>Master's at UC Berkley</i>
SFU	<b>Chen Song</b> , Program Analysis for Swift	2017 <i>Ph.D. at UT Austin</i>
UAlberta	<b>Stuart Hoyer</b> , Developing GitHub Classroom Management Tools	2017 <i>Application Consultant at Ontracks</i>
UAlberta	<b>Noah Weninger</b> , Program Analysis for Swift	2017 <i>Master's at UBC</i>

## Teaching

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### INSTRUCTOR

CMPUT 664	<b>Secure Software Engineering</b> , University of Alberta, Canada	<i>Winter 2020–Present</i>
CMPUT 416	<b>Foundations of Program Analysis</b> , University of Alberta, Canada	<i>Winter 2019–Present</i>
CMPUT 229	<b>Computer Organization and Architecture I</b> , University of Alberta, Canada	<i>Winter 2017–Present</i>
CMPUT 620	<b>Static Program Analysis</b> , University of Alberta, Canada	<i>Fall 2016–Fall 2017</i>
SAS	<b>Static Analysis Seminar</b> , Technische Universität Darmstadt, Germany	<i>Winter 2015</i>

### CO-INSTRUCTOR

APSA	<b>Applied Static Analysis</b> , Technische Universität Darmstadt, Germany	<i>Spring 2016</i>
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### SUBSTITUTE LECTURER

DECA	<b>Designing Code Analyses</b> , Technische Universität Darmstadt, Germany	<i>Fall 2014</i>
CS 241	<b>Foundations of Sequential Programs</b> , University of Waterloo, Canada	<i>Spring 2013</i>

### GRADUATE TEACHING ASSISTANT

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

### UNDERGRADUATE TEACHING ASSISTANT

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

## Volunteer Work

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