

DR AZALEA RAAD

Director of the UK Research Institute on Verified Trustworthy Software Systems (VeTSS)

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Senior Lecturer and UKRI Future Leader Fellow
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Nationality: British

Languages (native fluency): English, Farsi, Turkish

Languages (intermediate): German

Languages (basic): French

EMPLOYMENT

Senior Lecturer at Imperial College London **July 2022 – Present**
Department of Computing

Lecturer at Imperial College London **October 2019 – July 2022**
Department of Computing

Consultant at Bloomberg, London **September 2022 – Present**
Chief Technical Office

Consultant at Meta (formerly Facebook), London **September 2020 – July 2022**
Infer Verification Team and Incorrectness Logic Lab

Postdoctoral Researcher at MPI-SWS **July 2017 – March 2020**
Group: Programming Languages and Verification (PLV)
Managers: Derek Dreyer and Viktor Vafeiadis

Research Associate at Imperial College London **January 2017 – June 2017**
Group: Verified Trustworthy Software Specification
Manager: Philippa Gardner

FUNDING

Principal Investigator **September 2024 – August 2026**
Grant from *Defence Advanced Research Projects Agency* (DARPA)
Project Title: “Proof of Bugs for All”
Amount: \$750,000

Principal Investigator **September 2023 – August 2026**
EPSRC Standard Grant
Project Title: “SACRED-MA: Safe and Secure Remote Direct Memory Access”
Amount: £750,000

Co-Director **December 2022 – November 2026**
Directorship of the UK Research Institute Verified Trustworthy Software Systems (VeTSS)
Amount: £750,000

Principal Investigator **October 2022 – September 2023**
Research Gift by Meta
Project Title: “Automated Generation and Detection of Exploits via Incorrectness Logic”
Amount: \$50,000

Sole Investigator**October 2021 – September 2028**

UKRI Future Leader Fellowship

Project Title: “PERSEVERE: A Rigorous Foundation for Persistent Verification”

Amount: £1,500,000

Principal Investigator**April 2020 – March 2021**

UKRI VeTSS (UK Research Institute in Verified Trustworthy Software Systems)

Project Title: “Validating the Foundations of Verified Persistent Programming”

Amount: £100,000

EDUCATION**PhD in Theoretical Computer Science****October 2010 – December 2016**

Imperial College London

Thesis: Abstraction, Refinement and Concurrent Reasoning

Supervisors: Philippa Gardner and Sophia Drossopoulou

Examiners: Derek Dreyer (MPI-SWS) and Matthew Parkinson (Microsoft Research)

Master of Engineering in Computer Science**October 2006 – June 2010**

Imperial College London, graduated third in class with a First Class Honours Degree

Thesis title: Smelling of Roses (ROles - Specification , Exploration, Scrutiny)

Supervisors: Sophia Drossopoulou and Susan Eisenbach

The thesis was awarded the *Corporate Partnership Prize***PUBLICATIONS***Non-Termination Proving at Scale***Azalea Raad**, Julien Vanegue, Peter O’Hearn

Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2024 (under submission)

*Semantics of Remote Direct Memory Access: Operational and Declarative Models of RDMA on TSO Architectures*Guillaume Ambal, Brijesh Dongol, Haggai Eran, Vasileios Klimis, Ori Lahav, **Azalea Raad**

Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2024 (under submission)

*Extending the C/C++ Memory Model with Inline Assembly*Paulo Emílio de Vilhena, Ori Lahav, Viktor Vafeiadis, **Azalea Raad**

Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2024 (under submission)

*Specifying and Verifying Persistent Libraries*Léo Stefanescu, **Azalea Raad**, Viktor Vafeiadis

European Symposium on Programming (ESOP), 2024

*Intel PMDK Transactions: Specification and Concurrency***Azalea Raad**, Ori Lahav, John Wickerson, Brijesh Dongol

European Symposium on Programming (ESOP), 2024

*Challenges in Empirically Testing Memory Persistency Models*Vasileios Klimis, Alastair F. Donaldson, Viktor Vafeiadis, John Wickerson, **Azalea Raad**

International Conference on Software Engineering (ICSE), 2024

A General Approach to Under-approximate Reasoning about Concurrent Programs

Azalea Raad, Julien Vanegue, Josh Berdine, Peter O’Hearn
Conference on Concurrency Theory (CONCUR), 2023

Memento: A Framework for Detectable Recoverability in Persistent Memory

Kyeongmin Cho, Seungmin Jeon, **Azalea Raad**, Jeehoon Kang
Programming Language Design and Implementation (PLDI), 2023

The Path to Durable Linearizability

Emanuele D’Osualdo, **Azalea Raad**, Viktor Vafeiadis
Principles of Programming Languages (POPL), 2023

Finding Real Bugs in Big Programs with Incorrectness Logic

Quang Loc Le, **Azalea Raad**, Jules Villard, Josh Berdine, Derek Dreyer, Peter O’Hearn
Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2022
Winner of the distinguished paper award

View-Based Owicki-Gries Reasoning for Persistent x86-TSO

Eleni Vafeiadi Bila, Brijesh Dongol, Ori Lahav, **Azalea Raad**, John Wickerson
European Symposium on Programming (ESOP), 2022
Winner of the distinguished artifact award

Concurrent Incorrectness Separation Logic

Azalea Raad, Josh Berdine, Derek Dreyer, Peter O’Hearn
Principles of Programming Languages (POPL), 2022

Extending Intel-x86 Consistency and Persistency: Formalising the Semantics of Intel-x86 Memory Types and Non-Temporal Stores

Azalea Raad, Luc Maranget, Viktor Vafeiadis
Principles of Programming Languages (POPL), 2022

Revamping Hardware Persistency Models

Kyeongmin Cho, Sung-Hwan Lee, **Azalea Raad**, Jeehoon Kang
Programming Language Design and Implementation (PLDI), 2021

PerSeVerE: Persistency Semantics for Verification under Ext4

Michalis Kokologiannakis, Ilya Kaysin, **Azalea Raad**, Viktor Vafeiadis
Principles of Programming Languages (POPL), 2021

Persistent Owick-Gries Reasoning

Azalea Raad, Ori Lahav, Viktor Vafeiadis
Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2020

Local Reasoning about the Presence of Bugs: Incorrectness Separation Logic

Azalea Raad, Josh Berdine, Hoang-Hai Dang, Derek Dreyer, Peter O’Hearn, Jules Villard
Computer-Aided Verification (CAV), 2020

Data Consistency in Transactional Storage Systems: A Centralised Approach

Shale Xiong, Andrea Cerone, **Azalea Raad**, Philippa Gardner
European Conference on Object-Oriented Programming (ECOOP), 2020

Persistency Semantics of the Intel-x86 Architecture

Azalea Raad, Gil Neiger, John Wickerson, Viktor Vafeiadis
Principles of Programming Languages (POPL), 2020

Weak Persistency Semantics from the Ground Up

Azalea Raad, John Wickerson, Viktor Vafeiadis

Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2019

Effective Lock Handling in Stateless Model Checking

Michalis Kokologiannakis, **Azalea Raad**, Viktor Vafeiadis

Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2019

Hyperstate Space Graphs for Automated Game Analysis

Michael Cook, **Azalea Raad**

Conference on Games (Cog), 2019, **Winner of the best paper award**

Model Checking for Weakly Consistent Libraries

Michalis Kokologiannakis, **Azalea Raad**, Viktor Vafeiadis

Programming Language Design and Implementation (PLDI), 2019

On Library Correctness under Weak Memory Consistency

Azalea Raad, Marko Doko, Lovro Rožić, Ori Lahav, Viktor Vafeiadis

Principles of Programming Languages (POPL), 2019

On the Semantics of Snapshot Isolation

Azalea Raad, Ori Lahav, Viktor Vafeiadis

Verification, Model Checking and Abstract Interpretation (VMCAI), 2019

Persistence Semantics for Weak Memory

Azalea Raad, Viktor Vafeiadis

Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA), 2018

On Parallel Snapshot Isolation and Release/Acquire Consistency

Azalea Raad, Ori Lahav, Viktor Vafeiadis

European Symposium on Programming (ESOP), 2018

Inferring Design Constraints from Game Ruleset Analysis

Michael Cook, Simon Colton, **Azalea Raad**

IEEE Conference on Computational Intelligence and Games (CIG), 2018

Abstraction, Refinement and Concurrent Reasoning

Doctoral Thesis, 2017

Verifying Concurrent Graph Algorithms

Azalea Raad, Aquinas Hobor, Jules Villard, Philippa Gardner

Asian Symposium on Programming Languages and Systems (APLAS), 2016

DOM: Specification and Client Reasoning

Azalea Raad, José Fragoso Santos, Philippa Gardner

Asian Symposium on Programming Languages and Systems (APLAS), 2016

CoLoSL: Concurrent Local Subjective Logic

Azalea Raad, Jules Villard, Philippa Gardner

European Symposium on Programming (ESOP), 2015

Abstract Local Reasoning for Concurrent Libraries: Mind the Gap

Philippa Gardner, **Azalea Raad***, Adam Wright, Mark Wheelhouse

Mathematical Foundations of Programming Semantics (MFPS), 2014

(* author list in alphabetical order – Raad and Wright have joint first authorship)

Mechanic Miner: Reflection-Driven Game Mechanic Discovery And Design

Michael Cook, Simon Colton, **Azalea Raad**, Jeremy Gow

EvoGames Workshop at European Conference on Applications of Evolutionary Computation, 2013

A Sip of the Chalice

Azalea Raad, Sophia Drossopoulou

Functional Techniques for Java-like Programs (FTfJP), 2011

Ludic Considerations of Tablet-Based Evo-Art

Simon Colton, Michael Cook, **Azalea Raad**

EvoMusArt Workshop at European Conference on Applications of Evolutionary Computation, 2011

SELECTED KEYNOTE AND INVITED TALKS

Keynote Talk

September 2024

Bug Detection at Scale

International Conference on Concurrency Theory (CONCUR)

Keynote Talk

January 2024

Under-approximation for Scalable Bug Detection

ACM SIGPLAN International Conference on Certified Programs and Proofs (CPP)

Invited Talk

June 2024

Bug Detection at Scale

Symposium on Games, Automata, Logics, and Formal Verification (GandALF)

Invited Talk

September 2023

Principles of Persistent Programming

Trends in Concurrency Theory (TRENDS)

Invited Talk

September 2023

Under-approximation for Scalable Bug Detection

Young Researchers Workshop on Concurrency Theory (YR-CONCUR)

Keynote Talk

June 2023

Principles of Persistent Programming

Federated Conference on Distributed Computing Techniques (DisCoTec)

Keynote Talk

June 2023

Incorrectness Logic for Scalable Bug Detection

Mathematical Foundations of Programming Semantics (MFPS)

Invited Talk

May 2023

Incorrectness Logic for Scalable Bug Detection

Conference on High Confidence Software and Systems conference (HCSS)

Invited Talk

May 2023

Incorrectness Logic for Scalable Bug Detection

Iris Workshop

Keynote Tutorial

January 2023

Incorrectness Logic and Under-approximation: Foundations of Bug Catching

Principles of Programming Languages (POPL)

Invited Talk <i>Incorrectness Logic for Scalable Bug Detection</i> Workshop on Dependable and Secure Software Systems (DSSS)	October 2022
Invited Talk <i>Extending Intel-x86 Consistency and Persistency</i> Novel Architecture and Novel Design Automation (NANDA) Workshop	September 2022
Invited Talk <i>Scalable, Concurrent Bug Catching: Concurrent Incorrectness Separation Logic</i> Testing and Verification Symposium at Facebook, 2021	December 2021
Keynote Tutorial <i>Beyond Weak Memory Consistency: The Challenges of Memory Persistency</i> Programming Language Design and Implementation (PLDI), 2021	June 2021
Invited Talk <i>Compositional Bug Catching: Incorrectness Separation Logic</i> World Logic Day	January 2021
Invited Talk <i>Specifying and Verifying Non-Volatile Memory</i> Verification of Distributed Systems (VDS)	June 2019
Keynote Talk <i>Correctness in a Weakly Consistent Setting</i> Asian Symposium on Programming Languages and Systems (APLAS)	December 2018
Invited Talk <i>Verifying Concurrent Graph Algorithms</i> Northern Concurrency Workshop	January 2017
Invited Tutorial Talk <i>CoLoSL: Why Not Frame All the Way?</i> Mathematical Foundations of Programming Semantics (MFPS)	June 2015
Invited Talk <i>CoLoSL: Concurrent Local Subjective Logic</i> Dagstuhl Seminar 15191: <i>Compositional Verification Methods for Next-Generation Concurrency</i>	May 2015
Invited Talk <i>CoLoSL: Concurrent Local Subjective Logic</i> Theory Seminar at the University of Birmingham	April 2015
Invited Talk <i>CoLoSL: Compositional Reasoning at Last!</i> Research Visit at the Max Planck Institute for Software Systems, Saarbrücken, Germany	December 2014

RESEARCH GROUP

Post-Doctoral Researchers

- Guillaume Ambal October 2022 – Present
- Paulo de Vilhena April 2023 – Present
- Matthew griffin May 2024–Present

- Sacha-Élie Ayoun (to join in September 2024)

PhD Students

- Shing-Hin Ho January 2023 – Present
- Pedro Carrott October 2023 – Present
- Julien Vanegue (funded by Bloomberg) October 2023 – Present
- Raquel Sofia Silva to join in October 2024

Visiting Researchers

- Flavio Ascari June 2024 – July 2024

Master's Students

- Tiberiu Bucur October 2022 – June 2023
Winner of the Corporate Partnership Prize
- Ezra Sitorus October 2022 – June 2023
- Aris Zhu October 2022 – June 2023
- Rini Banerjee October 2021 – June 2022
Winner of the ARM project prize for an outstanding project in computer systems

Summer Interns

- Caroline Cronjäger 2023, 2024
- Ines Wright 2024

AWARDS AND PRIZES

Distinguished Paper Award	2022
Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA)	
Distinguished Artifact Award , European Symposium on Programming (ESOP)	2022
Imperial College President's Award for Excellence in Research (Early Career Researcher)	2021
Best Paper Award , Conference on Games (CoG) <i>Hyperstate Space Graphs for Automated Game Analysis</i>	2019
Corporate Partnership Prize for Excellence and Outstanding Achievement	2010
Gloucester Research Prize for Academic Excellence	2009
David Howarth Project Prize for Automated Generation of Compiler Test Cases	2009
Olav Beckman Project Prize	2008
Imperial College Research Prize for Cognitive Robotics Project	2007
Research Prize (Sponsored by Deutsche Bank)	2007
Prize for Excellence in First Year Computing (Sponsored by Morgan Stanley)	2007

PROFESSIONAL SERVICES

Organisation

- Organiser of the *VeTSS Annual Meeting*, 2024
- Organiser of the *VeTSS Summer School*, 2024
- Organiser of the *Future of Weak Memory* workshop at POPL, 2024

- Organiser of the *Formal Methods for Incorrectness* workshop at POPL, 2024
- Organiser of the *O’Hearn Fest* (Festschrift for Prof. Peter O’Hearn) at POPL, 2024
- Organiser of Dagstuhl seminar on *Formal Methods for Correct Persistent Programming*, 2023
- Organiser of the *VeTSS Annual Meeting*, 2023
- Organiser of the *VeTSS Summer School*, 2023
- Organiser of the *Concurrency Meeting* at the Isaac Newton Institute, 2022
- Co-chair of the *Student Research Competition at POPL*, 2022
- Organiser of Dagstuhl seminar 21462 on *Foundations of Persistent Programming*, 2021
- Co-chair of the *Student Research Competition at POPL*, 2021
- Organiser of the *Programming Languages Mentoring Workshop (PLMW)* at POPL, 2021
- Accessibility chair of *Programming Language Design and Implementation (PLDI)*, 2020
- Organiser of *Imperial Concurrency Workshop*, 2015
- Organiser of the Workshop on *Introduction to Verification and Testing (INVEST)*, 2014

Program Chair

- Conference on Verified Software: Theories, Tools, and Experiments (VSTTE), 2024

Program Committee Membership

- European Symposium on Programming (ESOP): 2024
- Principles of Programming Languages (POPL): 2023, 2020
- International Conference on Functional Programming (ICFP), 2022
- Computer-Aided Verification (CAV), 2022
- Programming Language Design and Implementation (PLDI): 2021, 2020 (external member)
- Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA): 2020, 2018 (external member)
- Verification, Model Checking, and Abstract Interpretation (VMCAI), 2021
- International Conference on Networked Systems (NETYS), 2020
- European Conference on Object-Oriented Programming (ECOOP), 2019
- Mathematical Foundations of Programming Semantics (MFPS), 2018
- Syntax and Semantics of Low-Level Languages (LOLA), 2018
- European Symposium on Programming (ESOP), 2017 (external reviewer)
- International Workshop on Aliasing, Capabilities and Ownership (IWACO), 2017
- Student Research Competition at POPL, 2020
- Student Research Competition at PLDI, 2019
- Student Research Competition at ICFP, 2019
- Student Research Competition Judge at the Asian Symposium on Programming Languages and Systems (APLAS), 2018

PhD Examinations

- Miguel Matos, University of Lisbon, 2024
- Simon Friis Vindum, Aarhus University, 2023
- Daniel Wright, University of Kent, 2023

Journal Reviews

- Journal of the American Computer Machinery, 2022
- Foundations and Trends in Programming Languages, 2020

Panel Membership

- Member of the *What I wish I had known before attending graduate school* panel at the Programming Languages Mentoring Workshop (PLMW) co-located with OOPSLA, 2019
- Member of the *Grad School and Beyond* panel at the Programming Languages Mentoring Workshop (PLMW) co-located with POPL, 2019

TEACHING

The Theory and Practice of Concurrent Programming Third year course (Imperial College London); co-designed the course	2021–Present
Models of Computation Second year course (Imperial College London)	2020–2021
Logic and Reasoning First year course (Imperial College London)	2020