

SEONGMIN LEE

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Research Summary

The overarching objective of my research is to *ensure software correctness in complex and critical modern software systems* through **scalable program analysis** and **reliable software testing**. To achieve this, I leverage **interdisciplinary statistical methods**, such as *causal inference, biostatistics, and machine learning*, to analyze the dynamic behavior of software in operational environments. My work has been published in top-tier software engineering venues, including ICSE, FSE, and JSS, and I have served as a program committee member for leading conferences, such as ICSE, FSE, and ASE.

Academic Positions

University of California, Los Angeles (UCLA)	United States
Postdoctoral Researcher, Software Evolution and Analysis Laboratory (SEAL)	Jun. 2025 – Present
Group head: Prof. Miryung Kim	
Max Planck Institute for Security and Privacy (MPI-SP)	Germany
Postdoctoral Researcher, Software Security Research group	Sep. 2022 – Jun. 2025
Group head: Dr. Marcel Böhme	

Education

Korea Advanced Institute of Science and Technology (KAIST)	Republic of Korea
Doctor of Philosophy, School of Computing	Sep. 2016 – Aug. 2022
Advisor: Prof. Shin Yoo	
Bachelor of Science, School of Computing	Feb. 2012 – Aug. 2016
Bachelor of Science, Department of Mathematical Sciences	

Publications

*Each marker text contains the hyperlink to the corresponding paper.

Refereed Journal Articles

- SCP'25** **Seongmin Lee**, Dave Binkley, Robert Feldt, Nicolas Gold, and Shin Yoo. Causal program dependence analysis. 240:103208
- JSS'21** **Seongmin Lee**, David Binkley, Robert Feldt, Nicolas Gold, and Shin Yoo. Observation-based approximate dependency modeling and its use for program slicing. 179:110988
- JSS'20** **Seongmin Lee**, David Binkley, Nicolas Gold, Syed Islam, Jens Krinke, and Shin Yoo. Evaluating lexical approximation of program dependence. 160:110459

Refereed Conference Publications

- FSE'26** Ardi Madadi, **Seongmin Lee**, Cornelius Aschermann, and Marcel Böhme. In bugs we trust? On measuring the randomness of a fuzzer benchmarking outcome. In *Proceedings of the ACM International Conference on the Foundations of Software Engineering*, FSE'26
- ICSE'26** **Seongmin Lee** and Marcel Böhme. Dependency-aware residual risk analysis. In *Proceedings of the 48th IEEE/ACM International Conference on Software Engineering*, ICSE'26
- SP'26** Haoxin Tu, **Seongmin Lee**, Yuxian Li, Peng Chen, Lingxiao Jiang, and Marcel Böhme. Cottontail: Large language model-driven concolic execution for highly structured test input generation. In *Proceedings of the 47th IEEE Symposium on Security and Privacy*, SP'26
- ICLR'25** **Seongmin Lee** and Marcel Böhme. How Much is Unseen Depends Chiefly on Information About the Seen. In **Spotlight** *Proceedings of the 13th International Conference on Learning Representations (ICLR'25)*

ICSE'25 **Seongmin Lee**, Shreyas Minocha, and Marcel Böhme. Accounting for Missing Events in Statistical Information Leakage Analysis. In *Proceedings of the IEEE/ACM 47th International Conference on Software Engineering (ICSE'25)*. Association for Computing Machinery

ICSE'24 *Danushka Liyanage, ***Seongmin Lee**, Chakkrit Tantithamthavorn, and Marcel Böhme. Extrapolating Coverage Rate in Greybox Fuzzing. In *Proceedings of the IEEE/ACM 46th International Conference on Software Engineering (ICSE'24)*, ICSE '24, pages 1–12. Association for Computing Machinery
(*Co-first authors with equal contribution)

FSE'23 **Seongmin Lee** and Marcel Böhme. Statistical Reachability Analysis. In *Proceedings of the 31st ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE'23)*, ESEC/FSE 2023, pages 326–337. Association for Computing Machinery

SCAM'19 **Seongmin Lee**, David Binkley, Robert Feldt, Nicolas Gold, and Shin Yoo. MOAD: Modeling Observation-Based Approximate Dependency. In *2019 19th International Working Conference on Source Code Analysis and Manipulation (SCAM'19)*, pages 12–22

ICST'19 **Seongmin Lee**, Shin Hong, Jungbae Yi, Taeksu Kim, Chul-Joo Kim, and Shin Yoo. Classifying False Positive Static Checker Alarms in Continuous Integration Using Convolutional Neural Networks. In *2019 12th IEEE Conference on Software Testing, Validation and Verification (ICST'19)*, pages 391–401

Preprints

ArXiv'25 *Jing Liu, ***Seongmin Lee**, Eleonora Losiouk, and Marcel Böhme. Can LLM generate regression tests for software commits?
(Major revision accepted at **FSE'26**; *Co-first authors with equal contribution)

Invited Articles

GI'20 William B. Langdon, Westley Weimer, Justyna Petke, Erik Fredericks, **Seongmin Lee**, Emily Winter, Michail Basios, Myra B. Cohen, Aymeric Blot, Markus Wagner, Bobby R. Bruce, Shin Yoo, Simos Gerasimou, Oliver Krauss, Yu Huang, and Michael Gerten. Genetic Improvement @ ICSE 2020. 45(4):24–30

Refereed Workshop Publications

FSE'25 Kieun Kim, **Seongmin Lee**, and Shin Hong. Refining Fuzzed Crashing Inputs for Better Fault Diagnosis. In *Proceedings of the 33rd ACM International Conference on the Foundations of Software Engineering, FSE Companion '25*, pages 1248–1249. Association for Computing Machinery

ICST'21 Saeyoon Oh, **Seongmin Lee**, and Shin Yoo. Effectively Sampling Higher Order Mutants Using Causal Effect. In *2021 IEEE International Conference on Software Testing, Verification and Validation Workshops (ICSTW)*, pages 19–24

ICSE'20 **Seongmin Lee**. Scalable and approximate program dependence analysis. In *Proceedings of the ACM/IEEE 42nd International Conference on Software Engineering: Companion Proceedings*, ICSE '20, pages 162–165. Association for Computing Machinery

ICSE'18 **Seongmin Lee**, David Binkley, Nicolas Gold, Syed Islam, Jens Krinke, and Shin Yoo. MOBS: Multi-operator observation-based slicing using lexical approximation of program dependence. In *Proceedings of the 40th International Conference on Software Engineering: Companion Proceedings*, ICSE '18, pages 302–303. Association for Computing Machinery

KCC'17 Gabin An, Jinhan Kim, **Seongmin Lee**, and Shin Yoo. Pyggi: Python general framework for genetic improvement. pages 536–538

SBSE'17 **Seongmin Lee** and Shin Yoo. Hyperheuristic Observation Based Slicing of Guava. In Tim Menzies and Justyna Petke, editors, *Search Based Software Engineering*, pages 175–180. Springer International Publishing

SBSE'16 Jeongju Sohn, **Seongmin Lee**, and Shin Yoo. Amortised Deep Parameter Optimisation of GPGPU Work Group Size for OpenCV. In Federica Sarro and Kalyanmoy Deb, editors, *Search Based Software Engineering*, pages 211–217. Springer International Publishing

Grants and Fellowships

- Title: *Statistical Security Analysis for Large, Evolving Software*

Funding Agency: CASA - Cyber Security in the Age of Large-Scale Adversaries

Grant ID: DFG under Germany's Excellence Strategy - **EXC 2092 CASA - 390781972**

Amount: Salary according to the remuneration group E 14 TV-L (full time, ~€136,000)

Duration: 2024.01.01 – 2025.12.31

Role: Sole Principal Investigator (PI)

Awards and Honors

- **Spotlight Paper Award**, 13th International Conference on Learning Representations (ICLR'25), 2025
 - *Title of Paper: How Much is Unseen Depends Chiefly on Information About the Seen*
- **Distinguished Artifact Reviewer Award**, 33rd USENIX Security Symposium, 2024
- **PhD Dissertation Award**, School of Computing, KAIST, 2022
 - *Title of Dissertation: Statistical Program Dependence Approximation*
- **2021 Naver Ph.D. Fellowship Award**: Awarded by NAVER Corp. to Ph.D. candidates who have published an outstanding research paper or have excellent publication performance, 2021
- Government-sponsored Scholarship, Ministry of Science and ICT of Korea, 2016 - 2022
- Government-sponsored Scholarship, Ministry of Science and ICT of Korea, 2012 - 2016

Teaching Experience

Lecturer

- Advanced Automatic Testing (Co-Lecturing with Dr. Flavio Toffalini and Dr. Yannic Noller), Faculty of Computer Science, Ruhr University Bochum Spring 2025
- MPI Reading Group on Software Security (Co-Lecturing with Dr. Marcel Böhme and Ardi Madadi), Faculty of Computer Science, Ruhr University Bochum Spring 2025

Teaching Assistant

- Automated Software Testing (CS453), School of Computing (SoC), KAIST Spring 2019
- Artificial Intelligence Based Software Engineering (CS454), SoC, KAIST Fall 2018
- Introduction to Logic for Computer Science (CS402), SoC, KAIST Spring 2018
- Artificial Intelligence Based Software Engineering (CS454), SoC, KAIST Fall 2017
- Introduction to Logic for Computer Science (CS402), SoC, KAIST Spring 2017
- Special Topics in Computer Science (Search Based Software Engineering) (CS492), SoC, KAIST Fall 2016

Advising and Mentorship

Ph.D. Student

- **Ardi Madadi** (MPI-SP) Feb. 2025 – Jun. 2025
Co-advised with Dr. Marcel Böhme on the statistical analysis of fuzzer benchmarking to ensure the reliability of coverage- and bug-based fuzzer benchmarking. A **full conference paper** where Ardi is the first author has been accepted to FSE'26.
- **Danushka Liyanage** (Monash University, moved on to University of Sydney Postdoc, 2024) Nov. 2022 – Dec. 2023
Co-advised with Dr. Marcel Böhme on extrapolating the coverage rate of the Greybox Fuzzing using the statistical model. A **full conference paper** where Danushka is the first author has been accepted to ICSE'24.

Undergraduate Student

- **Jing Liu** (Shanghai University, moved on to MPI-SP Ph.D. student, 2025) Apr. 2024 – Jun. 2025
Co-advised with Dr. Marcel Böhme on the LLM-based regression test generation for the software testing. A **full conference paper** where Jing is the first author has been submitted to FSE'26.
- **Shreyas Minocha** (Rice University, moved on to Georgia Tech Ph.D. student, 2024) Feb. 2023 – Jul. 2024
Primary advisor on the statistical information leakage analysis to suggest the accurate and safe information leakage estimator. A **full conference paper** has been accepted to ICSE'25.
- **Saeyoon Oh** (KAIST, moved on to FuriosaAI) Jul. 2020 – Apr. 2021
Co-advised with Dr. Shin Yoo on the effective sampling of higher-order mutants for mutation testing. A **workshop paper** where Saeyoon is the first author has been accepted to ICST'21.

Service to the Community

Academic/Professional Service

- Organizing committee: SBFT'26, SSBSE'25 (RENE/NIER Track)
- Program committee: (Main Track) FUZZING'26, FSE '26, ICSE'26, QUATIC'25, FUZZING'25, LLanMER'25, CauSE'25, ASE'24, ISSTA'24, FUZZING'24, SCAM'24, ASE'23 / (Artifact Evaluation Track) ISSTA'24, ECOOP'24, USENIX Security'24, ICSE'24, ISSTA'23, ICSME'22, ICSME'21 / (Student Research Competition Track) FSE'24 / (Tool Demonstration Track) ISSTA'25, ASE'24
- Reviewer: ASE'26, SQJ'25, TOSEM'25, TOSEM'24, TSE'24, IST'24, ASE'24, TOSEM'22, JSS'21, JSS'20 / (External) ICSE'24, FSE'24, ECOOP'24, ICSE'23, ISSTA'23

Institutional/Departmental Service

- Early Career Researcher (ECR) Board, CASA - Cyber Security in the Age of Large-Scale Adversaries 2024 – 2025

The ECR Board decides all funding allocations for the CASA Graduate School (CGS). The board has its own budget and the autonomy to dynamically adapt the programs to the changing needs of ECR members. Representing ECRs in CASA governance, the board organizes activities and meets quarterly to address priorities.

- Open Science Ambassador, MPI-SP 2023 – 2025

As representatives of the institute, Open Science Ambassadors raise awareness and provide valuable information to their colleagues about Open Science practices. They meet annually, in person or online, to discuss strategies, participate in workshops, and evaluate the status of Open Science within and beyond the Society.

Invited Talks and Presentations

- **Invited Tutorial:** “*The Magic of Statistics for Software Testing: How to Foresee the Unseen,*” 18th International Workshop on Search-Based and Fuzz Testing (SBFT'25) Apr. 2025
- *Open Peer Review in ICLR'25*, Open Science Ambassador Meeting, Max Planck Society Feb. 2025
- *Guarantees in Software Security – 2nd part: Extrapolating Software Testing*, Fuzzing and Software Security Summer School, National University of Singapore (NUS) May 2024
- *Magic of Statistics for Software Testing: How to Foreseen the Unseens*, Korea University Jan. 2025
- *Statistical Program Analysis*, Korea Advanced Institute of Science and Technology (KAIST) Jan. 2024
- *Statistical Program Analysis*, Ulsan National Institute of Science and Technology (UNIST) Jan. 2024
- *Causal Program Dependence Analysis*, Sheffield Causality and Testing Workshop Sep. 2023
- *Statistical program dependence analysis*, Handong Global University Aug. 2022
- *Observation-based approximate dependency modeling and its use for program slicing*, Korea Conference on Software Engineering Jan. 2022
- *MOBS: Multi-Operator Observation-Based Slicing using Lexical Approximation of Program Dependence*, 59th CREST Open Workshop – Multi-language Software Analysis Mar. 2018

Research Experience

Software Evolution and Analysis Laboratory (SEAL), UCLA

Jun. 2025 – Present

Postdoc

Los Angeles, CA, United States

- Working on enabling effective fuzz testing under limited observability through the observability-efficiency trade-off
- Working on estimating the likelihood of information leakage in taint analysis using statistical methods

Software Security Group, MPI-SP

Sep. 2022 – Jun. 2025

Postdoc

Bochum, Germany

- Working on structure-aware residual risk estimation to achieve more accurate and efficient software security testing – *Structure-aware Residual Risk*
- Investigating the reliability of coverage- and bug-based fuzzer benchmarking, focusing on the internal consistency of results and agreement across fuzzers/metrics – *Fuzzer Benchmarking Internal Consistency*
- Worked on unbiased estimation of the missing mass, probability, or expected number of newly discovered classes in an unknown multinomial distribution
- Worked on LLM-based regression test generation for software security testing – *Cleverest*

- Worked on applying biostatistics to information leakage analysis to suggest an accurate and safe information leakage estimator – *Statistical Information Leakage Analysis*
- Worked on extrapolating the coverage rate of Greybox Fuzzing using a statistical model – *Greybox Fuzzing Extrapolation*
- Worked on applying statistical methods to program analysis to overcome the scalability issues of static analysis – *Statistical Reachability Analysis*

Computational Intelligence for Software Engineering Laboratory (COINSE), KAIST Sep. 2016 – Aug. 2022
Ph.D. Student Daejeon, Republic of Korea

- Worked on approximating the degree of dependence between program elements using causal inference – *CPDA*
- Worked on applying statistical models to observational data to approximate program dependence – *MOAD*
- Worked on inferring type information in binary executables using RNNs in collaboration with the National Security Research Institute
- Worked on classifying false-positive alarms from a static checker in a continuous integration pipeline using CNNs in collaboration with Samsung Research
- Worked on program dependence approximation using a lexical model on source code – *MOBS*

Computational Intelligence for Software Engineering Laboratory (COINSE), KAIST Mar. 2016 – Aug. 2016
Undergraduate Research Intern Daejeon, Republic of Korea

- Worked on the amortized deep parameter optimization of GPGPU workgroup sizes for OpenCV.
- Accelerated the scalability of Observation based slicing (ORBS) by applying a code distance metric during the slicing.

Programming Language Research Group (PLRG) Lab, KAIST Jul. 2015 – Feb. 2016
Undergraduate Research Intern Daejeon, Republic of Korea

- Developed a source code translator from C# to C++ with F#.
- Developed a frontend of Scalable Analysis Framework for ECMAScript (SAFE), a Javascript static analysis tool.