Kihong Heo

Post-doctoral Researcher
Department of Computer and Information Science
University of Pennsylvania
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Research Interests

My research aims to develop program reasoning systems for safe and reliable software. In particular, I am working on the following topics:

- AI-based program analysis system for detecting deep semantic software bugs
- General-purpose program debloating system for secure and efficient software
- Scalable program synthesis system for automatic software generation and repair

Education

Seoul National University Mar 2009 – Aug 2017
Ph.D. in Computer Science and Engineering
Dissertation: Selectively Sensitive Static Analysis by Impact Pre-analysis and Machine learning
Advisor: Kwangkeun Yi

Seoul National University Mar 2005 – Feb 2009
B.S. in Computer Science and Engineering

Experience

University of Pennsylvania Jul 2017 – Present
Post-doctoral Researcher
Advisor: Mayur Naik

Facebook Apr 2017 – Jun 2017
Research Scientist (contingent)

Research Projects

- **Chisel: A system for Debloating C/C++ Programs** 2017 – Present
  https://chisel.cis.upenn.edu
- **Petablox: Declarative Program Analysis for Big Code** 2017 – Present
  http://petablox.org
- **Sparrow: a static analyzer for C program** 2011 – Present
  http://www.github.com/ropas/sparrow

- **Inferbo: Infer-based buffer overrun analyzer** 2016 – 2017
  `https://github.com/facebook/infer`
- **Selective X-sensitive Analysis** 2013 – 2017
  `http://ropas.snu.ac.kr/sparrow`
- **Global Sparse Analysis Framework** 2011 – 2012
  `http://ropas.snu.ac.kr/sparseanalysis`

Publications

1. Continuously Reasoning about Programs via Differential Bayesian Inference.
   Kihong Heo, Mukund Ragothaman, Xujie Si, and Mayur Naik.
   In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2019.
2. Resource-aware Program Analysis via Online Abstraction Coarsening.
   Kihong Heo, Hakjoo Oh, and Hongseok Yang.
   In *ACM/IEEE International Conference on Software Engineering (ICSE)*, 2019.
3. Effective Program Debloating via Reinforcement Learning.
   Kihong Heo, Woosuk Lee, Pardis Pashakhanloo, and Mayur Naik.
   In *ACM Conference on Computer and Communications Security (CCS)*, 2018.
4. User-Guided Program Reasoning Using Bayesian Inference.
   Mukund Ragothaman, Sulekha Kulkarni, **Kihong Heo**, and Mayur Naik.
   In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2018.
5. Accelerating Search-Based Program Synthesis Using Learned Probabilistic Models.
   Woosuk Lee, **Kihong Heo**, Rajeev Alur, and Mayur Naik.
   In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2018.
6. Learning Analysis Strategies for Octagon and Context Sensitivity from Labeled Data Generated by Static Analyses.
   Kihong Heo, Hakjoo Oh, and Hongseok Yang.
   Formal Methods in System Design, 53(2), 189–220, 2018.
7. Adaptive Static Analysis via Learning with Bayesian Optimization.
   Kihong Heo, Hakjoo Oh, Hongseok Yang, and Kwangkeun Yi.
   ACM Transactions on Programming Languages and Systems, 40(4), 2018.
8. Difflog: Beyond Deductive Methods in Program Analysis.
   Mukund Ragothaman, Sulekha Kulkarni, Richard Zhang, Xujie Si, **Kihong Heo**, Woosuk Lee, and Mayur Naik.
   In *1st Workshop on Machine Learning for Programming (ML4P)*, 2018.
9. Automatically Generating Features for Learning Program Analysis Heuristics.
   Kwonsoo Chae, Hakjoo Oh, **Kihong Heo**, and Hongseok Yang.
   In *ACM Conference on Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA)*, 2017.
10. Machine-Learning-Guided Selectively Unsound Static Analysis.
    Kihong Heo, Hakjoo Oh, and Kwangkeun Yi.
    In *International Conference on Software Engineering (ICSE)*, 2017.

11. Selective Conjunction of Context-sensitivity and Octagon Domain toward Scalable and Precise Global Static Analysis.
Kihong Heo, Hakjoo Oh, and Kwangkeun Yi.
Software—Practice & Experience, 47(11), 1677–1705, 2017.

12. Sound Non-Statistical Clustering of Static Analysis Alarms.
Woosuk Lee, Wonchan Lee, Dongok Kang, **Kihong Heo**, Hakjoo Oh, and Kwangkeun Yi.
ACM Transactions on Programming Languages and Systems, 39(4), 16:1–16:35, 2017.

13. Learning a Variable-Clustering Strategy for Octagon from Labeled Data Generated by a Static Analysis.
Kihong Heo, Hakjoo Oh, and Hongseok Yang.
In *International Static Analysis Symposium (SAS)*, 2016.

14. Selective X-Sensitive Analysis Guided by Impact Pre-Analysis.
Hakjoo Oh, Wonchan Lee, **Kihong Heo**, Hongseok Yang, and Kwangkeun Yi.
ACM Transactions on Programming Languages and Systems, 38(2), 6:1–6:45, 2016.

15. Widening with Thresholds via Binary Search.
Sol Kim, **Kihong Heo**, Hakjoo Oh, and Kwangkeun Yi.
Software—Practice & Experience, 46(10), 1317–1328, 2016.

16. Selective Context-sensitivity Guided by Impact Pre-analysis.
Hakjoo Oh, Wonchan Lee, **Kihong Heo**, Hongseok Yang, and Kwangkeun Yi.
In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2014.

17. Global Sparse Analysis Framework.
Hakjoo Oh, **Kihong Heo**, Wonchan Lee, Woosuk Lee, Daejun Park, Jeehoon Kang, and Kwangkeun Yi.
ACM Transactions on Programming Languages and Systems, 36(3), 8:1–8:44, 2014.

18. A Sparse Evaluation Technique for Detailed Semantic Analyses.
Yoonseok Ko, **Kihong Heo**, and Hakjoo Oh.
Computer Languages, Systems & Structures, 40(3-4), 99–111, 2014.

19. Design and Implementation of Sparse Global Analyses for C-like Languages.
Hakjoo Oh, **Kihong Heo**, Wonchan Lee, Woosuk Lee, and Kwangkeun Yi.
In *ACM Conference on Programming Language Design and Implementation (PLDI)*, 2012.

Software

I have contributed to the following open-source software:

- Chisel: an automated program debloating system
`https://github.com/aspire-project/chisel`
- Sparrow: a static analyzer for C programs
`https://github.com/ropas/sparrow`
- Petablox: declarative program analysis framework for Big Code
`https://github.com/petablox-project/petablox`
- Infer: a static analyzer for Java, C, C++, and Objective-C
`https://github.com/facebook/infer`

- Euphony: a probabilistic model-guided program synthesizer
  `https://github.com/wslee/euphony`

Talks

- Program Transformation for Reducing Software Complexity
  Invited talk, Korea University, 07/09/2018
- User-Guided Program Reasoning using Bayesian Inference
  Invited talk, KAIST. 07/06/2018
- Interactive Alarm Ranking System using Bayesian Inference
  Invited talk, Korea University. 01/04/2018
- Machine-Learning-Guided Selectively Unsound Static Analysis
  Invited talk, Naver. 06/26/2017
- Inferbo: Infer-based buffer-overrun analyzer
  Invited talk, Korea University. 04/14/2017
- Inferbo: Infer-based buffer-overrun analyzer
  Invited talk, KAIST. 03/24/2017
- Selectively Sensitive Static Analysis by Impact Pre-analysis and Machine Learning
  Invited talk, Codemind. 02/20/2017

Teaching Experience

- 4541.664 Program Analysis (Graduate) Seoul National University
  Teaching Assistant Spring 2010
- 4190.210 Programming Languages (Undergrad) Seoul National University
  Teaching Assistant Spring 2009

Service

- **ERC Member**, Programming Language Design and Implementation (PLDI), 2019
- **AEC Member**, Computer Aided Verification (CAV), 2019
- **AEC Member**, Static Analysis Symposium (SAS), 2019
- **AEC Member**, Static Analysis Symposium (SAS), 2018

References

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