

Claire Le Goues

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School of Computer Science
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Research Interests and Approach

My research interests span software engineering and programming languages, and especially in how to construct, maintain, evolve, improve/debug, and assure high-quality software systems.

Appointments

Carnegie Mellon University Pittsburgh, PA, USA
2013 – present Assistant Professor
 School of Computer Science (SCS)
 Institute for Software Research (ISR)

Education

University of Virginia Charlottesville, VA, USA
2013 **Doctor of Philosophy in Computer Science**
 Dissertation: Automatic Program Repair Using Genetic Programming
 Advisor: Westley Weimer
2009 **Master of Science in Computer Science**
 Thesis: Specification Mining With Few False Positives
Harvard University Cambridge, MA, USA
2006 **Bachelor of Arts in Computer Science**
 Thesis: Algebraic Type Isomorphisms
 Advisor: Greg Morrisett

Industrial Employment

Microsoft Research Redmond, WA, USA
2009 **Research Intern**, Research in Software Engineering (RiSE) group
IBM (*various*)
2006–2007 **Software Engineer**, XML Technologies/Compilation Cambridge, MA, USA
2005 **Research Intern**, Collaborative User Experience (CUE) Cambridge, MA, USA
2004 **Research Intern**, Architect’s Workbench Hawthorne, NY, USA

Honors, Awards, Fellowships

2016 Best Reviewer Award, Intl. Symposium on Search-Based Software Engineering
2015 Featured Article, IEEE Transactions on Software Engineering
2015 Distinguished Reviewer, Intl. Conference on Automated Software Engineering (ASE)
2013 Google Faculty Research Award
2012 Bronze, ACM SIGEVO “Humies” for Human-Competitive Results Produced by Genetic and Evolutionary Computation
2012 Featured Article, IEEE Transactions on Software Engineering
2009 Gold, ACM SIGEVO “Humies” for Human-Competitive Results Produced by Genetic and Evolutionary Computation
2009 IFIP TC2 Manfred Paul Award, Intl. Conference on Software Engineering
2009 Best Paper, Genetic and Evolutionary Computation Conference
2009 ACM Distinguished Paper, Intl. Conference on Software Engineering
2009 Best Short Paper, Workshop on Search-Based Software Testing

Professional Service and Affiliations

Local Service at Carnegie Mellon University

Member, SCS Undergraduate Review Committee	2016–present
Co-Director, REUSE@CMU	2016–present
Director, Undergraduate Minor in Software Engineering	2014–present
Member, SE Teaching/Tenure Track Faculty Hiring Committees	2015–present
Member, SE PhD Graduate Admissions Committee	2013–present

International Service

Organization

2018	PC Co-chair, Foundations of Software Engineering, New Ideas and Emerging Results Track (FSE-NIER)
2017	Co-organizer, Dagstuhl Seminar 17022, Automated Program Repair
2017	Graduate Track Program Chair, Symposium on Search Based Software Engineering (SSBSE)
2016	Review Process Chair, Automated Software Engineering (ASE)
2015	Local Arrangements Chair, Systems, Programming, Languages and Applications: Software for Humanity (SPLASH)
2014–present	Steering Committee Member, Symposium on Search Based Software Engineering (SSBSE)
2014	PC Co-chair, Symposium on Search Based Software Engineering (SSBSE)

Program Committee Membership

.....	2018
ICSE	Intl. Conference on Software Engineering
.....	2017
ICSE	Intl. Conference on Software Engineering
ESEC/FSE	Joint meeting of the European Software Engineering Conference and the ACM Symposium on the Foundations of Software Engineering
ISSTA-Tools	Demonstrations Track, Intl. Symposium on Software Testing and Analysis.
.....	2016
ICSE	Intl. Conference on Software Engineering
ISSTA	Intl. Symposium on Software Testing and Analysis
MSR	Working Conference on Mining Software Repositories
SSBSE	Intl. Symposium on Search-Based Software Engineering
GECCO-GI	GECCO Workshop on Genetic Improvement
.....	2015
ASE	IEEE/ACM Intl. Conference on Automated Software Engineering
Onward!	Onward! Essays
SSBSE	Intl. Symposium on Search-Based Software Engineering
ICST/Tools	Tools Track, Intl. Conference on Software Testing
ICSME/Tools	Tools Track, Intl. Conference on Software Maintenance and Evolution
ICSME	Intl. Conference on Software Maintenance and Evolution
NasBASE	North American Conference on Search-Based Software Engineering
ICSE/Tools	Tools Track, Intl. Conference on Software Engineering
ICSE NIER	New Ideas and Emerging Results, Intl. Conference on Software Engineering
GECCO-GI	GECCO Workshop on Genetic Improvement
.....	2014
ICSME	Intl. Conference on Software Maintenance and Evolution
ICSE NIER	New Ideas and Emerging Results, Intl. Conference on Software Engineering

Guest reviewing and refereeing

..... 2017	
ACM TSE	IEEE Transactions on Software Engineering
JARS	Journal of Automated Reasoning
ESEM	Empirical Software Engineering
..... 2016	
ACM TSE	IEEE Transactions on Software Engineering
JARS	Journal of Automated Reasoning
ESEM	Empirical Software Engineering
..... 2015	
ACM TOSEM	ACM Transactions on Software Engineering and Methodology
JSEP	Journal of Software: Evolution and Process
ACM TSE	IEEE Transactions on Software Engineering
Computing	Journal of Computing
..... 2014	
IEEE SW	IEEE Software
JSS	Journal of Systems and Software
JSEP	Journal of Software: Evolution and Process
TOSEM	Transactions on Software Engineering and Methodology

Research Funding

Listed amounts denote the CMU portion of multi-institutional awards.

SHF: Small: Evolution of Self-adaptive Systems using Stochastic Search

NSF: The National Science Foundation

Duration: July 1, 2016–June 30, 2020

With: David Garlan (CMU)

Amount: \$499,948

SHF: Medium: Collaborative Research: Semi and fully automated program repair and synthesis via semantic code search

NSF: The National Science Foundation

Duration: July 1, 2016–June 30, 2020

With: Yuriy Brun (UMass-Amherst)
Kathryn Stolee (NCSU)

Amount: \$411,996

CMU REU Site in Interdisciplinary Software Engineering

NSF: The National Science Foundation

Duration: 1/16–12/18

With: Joshua Sunshine (CMU)

Amount: \$360,000

Intelligent Model-Based Adaptation for Mobile Robotics

DARPA: The Defense Advanced Research Projects Agency

Duration: 11/15 – 9/19

With: Jonathan Aldrich (CMU)
Joydeep Biswass (UMass-Amherst)
David Garlan (CMU)
Christian Kaestner (CMU)
Manuela Velosa (CMU)

Amount: \$7,996,519

Cooperative, Trusted Repair for Cyber Physical System Resiliency

AFRL: Air Force Research Lab

Duration: 01/15–09/17

With: Stephanie Forrest (UNM)

Miryung Kim (UCLA)

Westley Weimer (UVA)

Amount: \$215,972

Demonstrating the Feasibility of Automatic Program Repair Guided by Semantic Code Search

NSF: National Science Foundation

Duration: 07/14–06/16

With: Yuriy Brun (UMass-Amherst)

Kathryn Stolee (Iowa State)

Amount: \$95,932

Human-friendly automatic bug repair via source code and repository mining

Google: Faculty Research Award

Duration: 01/14–01/15

With: *Sole PI*

Amount: \$81,924

Publications

Books and chapters

- [B2] Claire Le Goues and Shin Yoo, eds. *Search-Based Software Engineering - 6th International Symposium, SSBSE 2014, Fortaleza, Brazil, August 26-29, 2014. Proceedings*. Vol. 8636. Lecture Notes in Computer Science. Springer, 2014. ISBN: 978-3-319-09939-2. DOI: 10.1007/978-3-319-09940-8.
- [B1] Claire Le Goues, Anh Nguyen-Tuong, Hao Chen, Jack W. Davidson, Stephanie Forrest, Jason Hiser, John C. Knight, and Matthew Van Gundy. “Moving Target Defenses in the Helix Self-Regenerative Architecture”. In: *Moving Target Defense II - Application of Game Theory and Adversarial Modeling*. Springer, 2013, pp. 117–149. DOI: 10.1007/978-1-4614-5416-8_7.

Refereed Journal Articles

- [J5] Claire Le Goues, Neal Holtschulte, Edward K. Smith, Yuriy Brun, Premkumar T. Devanbu, Stephanie Forrest, and Westley Weimer. “The ManyBugs and IntroClass Benchmarks for Automated Repair of C Programs”. In: *IEEE Trans. Software Eng.* 41.12 (2015), pp. 1236–1256. DOI: 10.1109/TSE.2015.2454513.
- [J4] Claire Le Goues, Stephanie Forrest, and Westley Weimer. “Current challenges in automatic software repair”. In: *Software Quality Journal* 21.3 (2013), pp. 421–443. DOI: 10.1007/s11219-013-9208-0.
- [J3] Claire Le Goues, ThanhVu Nguyen, Stephanie Forrest, and Westley Weimer. “GenProg: A Generic Method for Automatic Software Repair”. In: *IEEE Trans. Software Eng.* 38.1 (2012), pp. 54–72. DOI: 10.1109/TSE.2011.104.
- [J2] Claire Le Goues and Westley Weimer. “Measuring Code Quality to Improve Specification Mining”. In: *IEEE Trans. Software Eng.* 38.1 (2012), pp. 175–190. DOI: 10.1109/TSE.2011.5.
- [J1] Westley Weimer, Stephanie Forrest, Claire Le Goues, and ThanhVu Nguyen. “Automatic program repair with evolutionary computation”. In: *Communications of the ACM Research Highlight* 53.5 (May 2010), pp. 109–116.

Refereed Conference Publications

- [C16] Christopher Steven Timperley, Susan Stepney, and Claire Le Goues. “An investigation into the use of mutation analysis for automated program repair”. In: *Proceedings of the 9th International Symposium on Search Based Software Engineering (to appear)*. SSBSE ’17. 2017.
- [C15] Xuan-Bach D. Le, Duc Hiep Chu, David Lo, Claire Le Goues, and Willem Visser. “S3: Syntax- and Semantic-Guided Repair Synthesis via Programming by Examples”. In: *Proceedings of the 11th Joint Meeting of the European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering (to appear)*. ESEC/FSE ’17. 2017.

- [C14] C. Omar, I. Voysey, M. Hilton, J. Sunshine, C. Le Goues, J. Aldrich, and M. Hammer. “Toward Semantic Foundations for Program Editors”. In: *2nd Summit on Advances in Programming Languages*. SNAPL ’17. 2017, 11:1–11:12.
- [C13] Vinicius Paulo L. Oliveira, Eduardo F. D. Souza, Claire Le Goues, and Celso G. Camilo-Junior. “Improved Crossover Operators for Genetic Programming for Program Repair”. In: *Proceedings of the 8th International Symposium on Search Based Software Engineering*. SSBSE ’16. 2016, pp. 112–127.
- [C12] Tien-Duy B. Le, David Lo, Claire Le Goues, and Lars Grunske. “A Learning-to-rank Based Fault Localization Approach Using Likely Invariants”. In: *International Symposium on Software Testing and Analysis*. ISSTA ’16. 2016, pp. 177–188. ISBN: 978-1-4503-4390-9. DOI: 10.1145/2931037.2931049.
- [C11] Y. Tian, D. Wijedasa, D. Lo, and C. Le Goues. “Learning to rank for bug report assignee recommendation”. In: *IEEE 24th International Conference on Program Comprehension*. ICPC ’16. 2016, pp. 1–10. DOI: 10.1109/ICPC.2016.7503715.
- [C10] X. B. D. Le, D. Lo, and C. Le Goues. “History Driven Program Repair”. In: *IEEE 23rd International Conference on Software Analysis, Evolution, and Reengineering (SANER)*. Vol. 1. 2016, pp. 213–224. DOI: 10.1109/SANER.2016.76.
- [C9] Zack Coker, Michael Maass, Tianyuan Ding, Claire Le Goues, and Joshua Sunshine. “Evaluating the Flexibility of the Java Sandbox”. In: *Proceedings of the 31st Annual Computer Security Applications Conference*. ACSAC ’15. 2015, pp. 1–10.
- [C8] Yalin Ke, Kathryn T. Stolee, Claire Le Goues, and Yuriy Brun. “Repairing Programs with Semantic Code Search”. In: *Proceedings of the 30th IEEE/ACM International Conference on Automated Software Engineering (ASE)*. (ASE). Lincoln, NE, USA, 13, 9, pp. 295–306. DOI: 10.1109/ASE.2015.60.
- [C7] Edward K. Smith, Earl Barr, Claire Le Goues, and Yuriy Brun. “Is the Cure Worse than the Disease? Overfitting in Automated Program Repair”. In: *Proceedings of the 10th Joint Meeting of the European Software Engineering Conference and ACM SIGSOFT Symposium on the Foundations of Software Engineering*. ESEC/FSE ’15. 2015, pp. 532–543. DOI: 10.1145/2786805.2786825.
- [C6] Claire Le Goues, Stephanie Forrest, and Westley Weimer. “Representations and Operators for Improving Evolutionary Software Repair”. In: *Genetic and Evolutionary Computation Conference*. 2012, pp. 959–966.
- [C5] Claire Le Goues, Michael Dewey-Vogt, Stephanie Forrest, and Westley Weimer. “A Systematic Study of Automated Program Repair: Fixing 55 out of 105 bugs for \$8 Each”. In: *International Conference on Software Engineering*. 2012, pp. 3–13.
- [C4] Ethan Fast, Claire Le Goues, Stephanie Forrest, and Westley Weimer. “Designing better fitness functions for automated program repair”. In: *Genetic and Evolutionary Computation Conference*. 2010, pp. 965–972.
- [C3] Stephanie Forrest, Westley Weimer, ThanhVu Nguyen, and Claire Le Goues. “A genetic programming approach to automated software repair”. In: *Genetic and Evolutionary Computation Conference*. 2009, pp. 947–954. ISBN: 978-1-60558-325-9.
- [C2] Westley Weimer, ThanhVu Nguyen, Claire Le Goues, and Stephanie Forrest. “Automatically Finding Patches Using Genetic Programming”. In: *International Conference on Software Engineering*. 2009, pp. 364–367.
- [C1] Claire Le Goues and Westley Weimer. “Specification Mining with Few False Positives.” In: *Tools and Algorithms for the Construction and Analysis of Systems*. 2009, pp. 292–306. ISBN: 978-3-642-00767-5.

Refereed Short Publications

- [S9] Xuan-Bach D. Le, Duc Hiep Chu, David Lo, Claire Le Goues, and Willem Visser. “JFix: Semantics-based repair of Java programs via Symbolic PathFinder”. In: *International Symposium on Software Testing and Analysis - Tools Track (to appear)*. ISSTA-Tools ’17. 2017.
- [S8] Mauricio Soto, Zack Coker, and Claire Le Goues. “Analyzing the Impact of Social Attributes on Commit Integration Success”. In: *Proceedings of the 14th International Conference on Mining Software Repositories*. MSR ’17. Buenos Aires, Argentina, 2017, pp. 483–486.
- [S7] David Lo Le Dinh Xuan Bach and Claire Le Goues. “Empirical Study on Synthesis Engines for Semantics-based Program Repair”. In: *Proceedings of the 32nd IEEE International Conference on Software Maintenance and Evolution - Early Research Achievements*. ICSME-ERA ’16. 2016, pp. 423–427.

- [S6] David Lo Le Dinh Xuan Bach Quang Loc Le and Claire Le Goues. “Enhancing Automated Program Repair with Deductive Verification”. In: *Proceedings of the 32nd IEEE International Conference on Software Maintenance and Evolution - Early Research Achievements*. ICSME-ERA ’16. 2016, pp. 428–432.
- [S5] Rijnard van Tonder and Claire Le Goues. “Defending against the attack of the micro-clones”. In: *IEEE 24th International Conference on Program Comprehension*. ICPC ’16. 2016, pp. 1–4. DOI: 10.1109/ICPC.2016.7503736.
- [S4] Mary Beth Kery, Claire Le Goues, and Brad A. Myers. “Examining Programmer Practices for Locally Handling Exceptions”. In: *Proceedings of the 13th International Conference on Mining Software Repositories*. MSR ’16. 2016, pp. 484–487. ISBN: 978-1-4503-4186-8. DOI: 10.1145/2901739.2903497.
- [S3] Mauricio Soto, Ferdian Thung, Chu-Pan Wong, Claire Le Goues, and David Lo. “A Deeper Look into Bug Fixes: Patterns, Replacements, Deletions, and Additions”. In: *Proceedings of the 13th International Conference on Mining Software Repositories*. MSR ’16. 2016, pp. 512–515. ISBN: 978-1-4503-4186-8. DOI: 10.1145/2901739.2903495.
- [S2] Zack Coker, David Garlan, and Claire Le Goues. “SASS: Self-Adaptation Using Stochastic Search”. In: *Proceedings of the 10th IEEE/ACM International Symposium on Software Engineering for Adaptive and Self-Managing Systems*. SEAMS ’16. 2015, pp. 168–174. DOI: 10.1109/SEAMS.2015.16.
- [S1] Claire Le Goues, K. Rustan M. Leino, and Michal Moskal. “The Boogie Verification Debugger (Tool Paper)”. In: *Proceedings of the 9th International Conference on Software Engineering and Formal Methods*. 2011, pp. 407–414. DOI: 10.1007/978-3-642-24690-6_28.

Refereed Workshop Publications

- [W3] Westley Weimer, Stephanie Forrest, Miryung Kim, Claire Le Goues, and Patrick Hurley. “Trusted Software Repair for System Resiliency”. In: *46th Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops*. DSN Workshops ’16. 2016, pp. 238–241. URL: <http://dx.doi.org/10.1109/DSN-W.2016.64>.
- [W2] Claire Le Goues, Stephanie Forrest, and Westley Weimer. “The case for software evolution”. In: *Proceedings of the Workshop on Future of Software Engineering Research, at the 18th ACM SIGSOFT International Symposium on Foundations of Software Engineering*. FoSER 2010. 2010, pp. 205–210. DOI: 10.1145/1882362.1882406.
- [W1] ThanhVu Nguyen, Westley Weimer, Claire Le Goues, and Stephanie Forrest. “Using Execution Paths to Evolve Software Patches”. In: *Second International Conference on Software Testing Verification and Validation*. ICST ’09, Workshops Proceedings. 2009, pp. 152–153. DOI: 10.1109/ICSTW.2009.35.

Non-Refereed Publications

- [N3] Claire Le Goues and Shin Yoo. “Guest editorial for special section on research in search-based software engineering”. In: *Empirical Software Engineering* 22.2 (2017), pp. 849–851. ISSN: 1573-7616. DOI: 10.1007/s10664-017-9504-6. URL: <http://dx.doi.org/10.1007/s10664-017-9504-6>.
- [N2] Sunghun Kim, Claire Le Goues, Michael Pradel, and Abhik Roychoudhury. “Automated Program Repair (Dagstuhl Seminar 17022)”. In: *Dagstuhl Reports* 7.1 (2017). Ed. by Sunghun Kim, Claire Le Goues, Michael Pradel, and Abhik Roychoudhury, pp. 19–31. ISSN: 2192-5283. DOI: 10.4230/DagRep.7.1.19. URL: <http://drops.dagstuhl.de/opus/volltexte/2017/7176>.
- [N1] Stephanie Forrest and Claire Le Goues. “Evolutionary software repair (Invited Tutorial)”. In: *Genetic and Evolutionary Computation Conference, GECCO ’12, Philadelphia, PA, USA, July 7-11, 2012, Companion Material Proceedings*. Ed. by Terence Soule and Jason H. Moore. ACM, 2012, pp. 1345–1348. ISBN: 978-1-4503-1178-6. DOI: 10.1145/2330784.2330943.

Formal Presentations and Panels

Scalable Semantic Code Search for High-Quality Program Repair

–University of Washington, *Seattle*, WA, Jan 2017

–Microsoft Research, *Redmond*, WA, Jan 2017

–Dagstuhl Seminar 17022, Automated Program Repair, *Wadern*, Germany, Jan 2017

Overview on Search-based Program Patching

-Dagstuhl Seminar 17022, Automated Program Repair, *Wadern, Germany*, Jan 2017

Invited Keynote: Automatic patch generation

-PWLConf, co-located with StrangeLoop 2016

St. Louis, MO, Sep 2016

Video available: https://www.youtube.com/watch?v=sRkfMe0_5cA

Invited Keynote: Passing tests is easy: when full coverage isn't enough

-9th International Workshop on Search Based Software Testing (SBST), co-located with ICSE 2016

Austin, TX, May 2016

Invited Panelist: 30 years of ASE

-30th IEEE/ACM International Conference on Automated Software Engineering (ASE)

Moderated by Lars Grunske

Automatic Program Repair Using Genetic Programming

-University of Massachusetts, Amherst, *Amherst, MA*, Jan 2014

-Virginia Polytechnic Institute and State University (Virginia Tech), *Blacksburgh, VA*, Sep 2012

Bloat vs. overfitting in test-driven GP for program repair

-28th Crest Open Workshop, Genetic Programming for Software Engineering

University College London, *London, UK*, Oct 2013

Question your assumptions: the bleeding edge of search-based program repair

-Lille 1 University/INRIA Lille Norde-Europe, *Lille, France*, Oct 2013

Specification Mining with few false positives

-King's College London, Nov 2009

Student Supervision

Postdoctoral Advisor

current Christopher Timperley started November, 2016

PhD Advisor

current	Deborah Katz	Ph.D. in Computer Science, entered 2012
	Zack Coker	Ph.D. in Computer Science, entered 2013
	Mauricio Soto	Ph.D. in Software Engineering, entered 2014
	Rijnard van Tonder	Ph.D. in Software Engineering, entered 2014
	Afsoon Afzal	Ph.D. in Software Engineering, entered 2015
	Cody Kinneer	Ph.D. in Software Engineering, entered 2016

PhD Dissertation Committee Member

current	Paulo Casanova	School of Computer Science, CMU
	Milda Zizyte	College of Engineering, CMU
	Xuechen (Jerry) Lei	College of Engineering, CMU
2017	Gabriel Moreno	School of Computer Science, CMU
	Jason Tsay	School of Computer Science, CMU
2014	David Kelk	University of Ontario Institute of Technology

Masters Advisor

2017	Jon Kotheimer	Heinz College of Public Policy, CMU
2016	Ted Smith	University of Massachusetts - Amherst

Teaching Activities

Instructor of Record	Carnegie Mellon University	
17-654	Analysis of Software Engineering (Masters)	Spring 2017
15-313	Foundations of Software Engineering (undergraduate)	Fall 2016
17-808	Software Engineering Research (Ph.D.)	Fall 2016
15-819O	Special Topics in Programming Languages: Program Analysis (Ph.D)	Spring 2016
15-313	Foundations of Software Engineering (undergraduate)	Fall 2015
17-808	Software Engineering Research (Ph.D.)	Fall 2015
17-654	Analysis of Software Engineering (Masters)	Spring 2015
15-313	Foundations of Software Engineering (undergraduate)	Fall 2014
17-808	Software Engineering Research (Ph.D.)	Fall 2014
17-654	Analysis of Software Engineering (Masters)	Spring 2014
17-808	Software Engineering Research (Ph.D.)	Fall 2013
	<i>University of Virginia</i>	
CS444/6444	High Performance and Parallel Computation (undergraduate/graduate)	Spring 2013

Software and Software Artifacts

Linked project pages list project collaborators. Other code and data can be found at <http://squareslab.github.io>.

JFix: Semantics-based repair for Java programs. Implements S3.

<https://xuanbachle.github.io/semanticsrepair/>

RepairBox: A framework for performing empirical studies on automated repair of C programs.

<https://github.com/squaresLab/RepairBox>

SearchRepair: A semantic-search-based automated program repair technique.

<https://github.com/ProgramRepair/SearchRepair>

ManyBugs and IntroClass: benchmarks for research in automated repair of C programs.

<http://repairbenchmarks.cs.umass.edu>

GenProg: framework for search-and evolutionary-computation-based repair of C programs.

<http://genprog.cs.virginia.edu>

Boogie Verification Debugger (BVD): tool to assist in debugging failed program verification activities.

<http://boogie.codeplex.com/>

Professional Associations

ACM	Association for Computing Machinery
ACM SIGSOFT	ACM Special Interest Group on Software Engineering
IEEE	The Institute of Electrical and Electronics Engineers
IEEE Women	IEEE Women in Engineering