

# Joseph P. Near

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## Research Interests

My research interests include data privacy, security, programming languages, and software engineering. My research to date focuses on the theory, design, and implementation of algorithms and programming systems (programming languages, static analyses, and runtime systems) that enable *provable security and privacy*.

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## Education

- 2010–2015 **Ph.D. computer science**, *Massachusetts Institute of Technology*, Cambridge, MA, USA.  
Thesis: “Domain-Specific Static Analysis for Web Applications.”  
Advisor: Daniel Jackson
- 2008–2010 **M.S. computer science**, *Massachusetts Institute of Technology*, Cambridge, MA, USA.  
Thesis: “An Imperative Extension to Alloy and a Compiler for its Execution.”  
Advisor: Daniel Jackson
- 2003–2008 **B.S. computer science**, *Indiana University*, Bloomington, IN, USA.  
Advisor: Daniel Friedman

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## Academic Appointments

- 2018-present **Assistant Professor**, *University of Vermont*, Burlington, VT.
- 2015-2018 **Postdoctoral Researcher**, *University of California, Berkeley*, Berkeley, CA.  
Advised by Professor Dawn Song.
- 2008-2015 **Research Assistant**, *Massachusetts Institute of Technology*, Cambridge, MA.  
Advised by Professor Daniel Jackson.

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## Awards

- 2018 **DARPA Riser**.
- 2015 **Distinguished Paper Award**, *International Conference on Software Engineering (ICSE) 2015*.
- 2009-2013 **National Science Foundation Graduate Research Fellowship**.
- 2007 **Undergraduate Instructor of the Year**, *Department of Computer Science, Indiana University*.
- 2007 **Member, Phi Beta Kappa**.
- 2004 **Research Grant, Hutton Honors College**, *Indiana University*.

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## Publications

### Refereed Conferences & Workshops

- [1] Lun Wang, **Joseph P. Near**, Neel Somani, Peng Gao, Andrew Low, David Dao, and Dawn Song. Data capsule: A new paradigm for automatic compliance of data privacy regulations. In *POLY19*

Workshop @ VLDB 2019, 2019.

- [2] Om Thakkar, Lun Wang, **Joseph P. Near**, Roger Iyengar, Abhradeep Guha Thakurta, and Dawn Song. Towards differential privacy for practical convex optimization. In *Proceedings of the 40th IEEE Symposium on Security and Privacy*, 2019.
- [3] **Joseph P. Near**, David Darais, Chike Abuah, Tim Stevens, Pranav Gaddamadugu, Lun Wang, Neel Somani, Mu Zhang, Nikhil Sharma, Alex Shan, and Dawn Song. Duet: An expressive higher-order language and linear type system for statically enforcing differential privacy. *Proceedings of the ACM on Programming Languages*, 3(OOPSLA), 2019.
- [4] Noah Johnson, **Joseph P. Near**, and Dawn Song. Towards practical differential privacy for SQL queries. In *Proceedings of the 34th International Conference on Very Large Data Bases*, 2018.
- [5] **Joseph P. Near** and Daniel Jackson. Finding security bugs in web applications using a catalog of access control patterns. In *Proceedings of the 38th ACM/IEEE International Conference on Software Engineering (ICSE)*, pages 947–958. ACM, 2016.
- [6] Aleksandar Milicevic, **Joseph P. Near**, Eunsuk Kang, and Daniel Jackson. Alloy\*: A general-purpose higher-order relational constraint solver. In *Proceedings of the 37th ACM/IEEE International Conference on Software Engineering (ICSE)*. ACM, 2015.
- [7] **Joseph P. Near** and Daniel Jackson. Derailer: interactive security analysis for web applications. In *Proceedings of the 29th ACM/IEEE international conference on Automated Software Engineering (ASE)*, pages 587–598. ACM, 2014.
- [8] **Joseph P. Near** and Daniel Jackson. Rubicon: bounded verification of web applications. In *Proceedings of the ACM SIGSOFT 20th International Symposium on the Foundations of Software Engineering (FSE)*, page 60. ACM, 2012.
- [9] **Joseph P. Near**, Aleksandar Milicevic, Eunsuk Kang, and Daniel Jackson. A lightweight code analysis and its role in evaluation of a dependability case. In *Proceedings of the 33rd International Conference on Software Engineering (ICSE)*, pages 31–40. IEEE, 2011.
- [10] **Joseph P. Near** and Daniel Jackson. An imperative extension to alloy. In *Proceedings of the 2nd International Conference on Abstract State Machines, Alloy, B and Z (ABZ)*, pages 118–131. Springer Berlin Heidelberg, 2010.
- [11] **Joseph P. Near**. From relational specifications to logic programs. In *Proceedings of the 26th International Conference on Logic Programming (ICLP) (Technical Communications)*, volume 7. Springer Berlin Heidelberg, 2010.
- [12] Derek Rayside, Zev Benjamin, Rishabh Singh, **Joseph P. Near**, Aleksandar Milicevic, and Daniel Jackson. Equality and hashing for (almost) free: Generating implementations from abstraction functions. In *Proceedings of the 31st International Conference on Software Engineering (ICSE)*, pages 342–352. IEEE Computer Society, 2009.
- [13] **Joseph P. Near**, William E Byrd, and Daniel P Friedman.  $\lambda$ leantap: A declarative theorem prover for first-order classical logic. In *Proceedings of the 24th International Conference on Logic Programming (ICLP)*, pages 238–252. Springer Berlin Heidelberg, 2008.

#### Refereed Journals

- [14] Aleksandar Milicevic, Joseph P. Near, Eunsuk Kang, and Daniel Jackson. Alloy\*: a general-purpose higher-order relational constraint solver. *Formal Methods in System Design*, Jan 2017.
- [15] Emina Torlak, Mana Taghdiri, Greg Dennis, and **Joseph P. Near**. Applications and extensions of alloy: past, present and future. *Mathematical Structures in Computer Science*, 23(04):915–933, 2013.

## Theses

- [16] **Joseph P. Near**. *Domain-Specific Static Analysis for Web Applications*. PhD thesis, Massachusetts Institute of Technology, 2015.
- [17] **Joseph P. Near**. An imperative extension to alloy and a compiler for its execution. Master's thesis, Massachusetts Institute of Technology, 2010.

## Technical Reports

- [18] Noah M. Johnson, **Joseph P. Near**, Joseph M. Hellerstein, and Dawn Song. Chorus: Differential privacy via query rewriting. *CoRR*, abs/1809.07750, 2018.
- [19] Noah M. Johnson, **Joseph P. Near**, and Dawn Xiaodong Song. Towards practical differential privacy for SQL queries. *CoRR*, abs/1706.09479, 2017.
- [20] Aleksandar Milicevic, **Joseph P. Near**, Eunsuk Kang, and Daniel Jackson. Alloy\*: A higher-order relational constraint solver, 2014.
- [21] **Joseph P. Near** and Daniel Jackson. Symbolic execution for (almost) free: Hijacking an existing implementation to perform symbolic execution. MIT CSAIL Technical Report MIT-CSAIL-TR-2014-007, 2014.

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## Grants

- 2019 – 2020 **UVM OVPR REACH**, *Differentially Private Deep Learning via Automatic Differentiation*, Co-PI, \$30,000 over 1 year.
- 2018 – 2019 **UVM OVPR EXPRESS**, *A Platform for Privacy-Preserving Deep Learning*, PI, \$3,000 over 1 year.
- 2015 – 2020 **DARPA Contract N66001-15-C-4066**, *Helio: Program Synthesis for Efficient, Privacy-Preserving Distributed Computation*, Subcontractor with PI Dawn Song, \$3,011,703 over 5 years (\$139,035 to UVM).
- 2017 – 2018 **Center for Long-Term Cybersecurity**, *Allegro: A Framework for Practical Differential Privacy of SQL Queries*, Co-authored with PI Dawn Song, \$150,000 over 2 years.
- 2016 **Berkeley Deep Drive**, *Secure and Privacy-Preserving Deep Learning*, Co-authored with PI Dawn Song, \$80,000 over 1 year.

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## Selected Presentations

### Secure, Privacy-Preserving Data Analytics & Machine Learning

University of Colorado, Boulder	March 2018
Colorado School of Mines	February 2018
University of Nebraska, Lincoln	February 2018
Syracuse University	February 2018
Cal Poly, San Luis Obispo	February 2018
University of Vermont	February 2018

### Differential Privacy at Scale

USENIX Enigma Conference	January 2018
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### Towards Practical Differential Privacy for SQL Queries

DIMACS/Northeast Big Data Hub Workshop on Overcoming Barriers to Data Sharing including Privacy and Fairness	October 2017
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### Uber's Differential Privacy Tool

Mozilla Privacy Lab	September 2017
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### Privacy-Preserving Data Analytics & Machine Learning

RISELab Summer Retreat	June 2017
<b>Finding Security Bugs in Web Applications Using a Catalog of Access Control Patterns</b> International Conference on Software Engineering (ICSE)	May 2016
<b>Helio: Secure, Privacy-Preserving Collaborative Data Analytics</b> AMPLab Winter Retreat	January 2016
<b>Derailer: Interactive Static Security Analysis for Web Applications</b> International Conference on Automated Software Engineering (ASE) Indiana University	October 2014 August 2014
<b>Rubicon: Bounded Verification of Web Applications</b> International Symposium on the Foundations of Software Engineering (FSE) MIT-CSAIL Programming Languages and Software Engineering Seminar	October 2012 September 2012
<b>A Lightweight Code Analysis and its Role in Evaluation of a Dependability Case</b> International Conference on Software Engineering (ICSE)	May 2011
<b>From Relational Specifications to Logic Programs</b> International Conference on Logic Programming (ICLP)	July 2010
<b>An Imperative Extension to Alloy</b> International Conference on Abstract State Machines, Alloy, B and Z (ABZ)	February 2010
<b>A Shallow Scheme Embedding of <math>\perp</math>-Avoiding Streams</b> Symposium in Honor of Mitchell Wand	August 2009
<b><math>\lambda</math>leanTAP: A Declarative Theorem Prover for First-Order Classical Logic</b> International Conference on Logic Programming (ICLP)	December 2008

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## Media Coverage

*"Uber's New Tool Lets Its Staff Know Less About You."*

By Andy Greenberg. WIRED, September 13, 2017.

<https://www.wired.com/story/uber-privacy-elastic-sensitivity/>

*"Uber Unveils New Privacy Tool That Protects Individual User Data."*

By Kate Conger. Gizmodo, September 13 2017.

<https://gizmodo.com/uber-unveils-new-privacy-tool-that-protects-individual-1796865515>

*"Patching up Web applications."*

By Larry Hardesty. MIT News, April 15, 2016.

<http://news.mit.edu/2016/patching-web-applications-0415>

*"MIT Researchers Forge New Weapon for Code Warriors."*

By John P. Mello Jr. TechNewsWorld, Apr 20, 2016.

<https://www.technewsworld.com/story/83389.html>

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## Teaching

- Fall 2019 **CS 295B: Data Privacy**, University of Vermont.
- Spring 2019 **CS 295F: Compiler Construction**, University of Vermont.
- Fall 2018 **CS 295B: Data Privacy**, University of Vermont.
- Fall 2015 **Co-Instructor, 294-116: Secure and Intelligent Programming**, University of California, Berkeley.

- January 2010 **Co-Instructor, So You've Always Wanted to Learn Haskell?**, *Massachusetts Institute of Technology, short IAP course.*
- Spring 2009 **Teaching Assistant, 6.005: Elements of Software Construction**, *Massachusetts Institute of Technology.*  
Rating 5.5/6.0.
- Fall 2005 – **Undergraduate Instructor, C311: Programming Languages**, *Indiana University.*
- Spring 2008 “Outstanding Instructor” rating 3.7/4.0.  
(6 semesters) Awarded “Undergraduate Instructor of the Year,” 2007.
- 1998 – 2008 **Summer Class Instructor: programming, video & image editing**, *Bloomington Montessori School.*  
(10 summers)

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## Service

- Program Committee
- **ICDCS**: International Conference on Distributed Computing Systems (2016)
- Journal Reviewer
- Software: Practice and Experience (2018)
  - Transactions on Knowledge and Data Engineering (2018)
  - IET Software (2017)
  - Journal of Software: Evolution and Process (2017)
  - Software Testing, Verification and Reliability (2014)
- External Reviewer
- **CCS**: ACM Conference on Computer and Communications Security (2018)
  - **Oakland**: IEEE Symposium on Security & Privacy (2017)
  - **ICFP**: International Conference on Functional Programming (2015)
  - **FM**: International Conference on Formal Methods (2015)
  - **OOPSLA**: Object-Oriented Programming, Systems, Languages & Applications (2010)
- Subject Matter Expert
- NIST Differential Privacy Synthetic Data Challenge (2018-2019)
  - NIST Unlinkable Data Challenge (2018)