

Joseph P. Near

Assistant Professor, University of Vermont

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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*.

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

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.

Awards

- 2019 **ACM SIGPLAN Distinguished Paper Award**, *OOPSLA 2019*.
- 2018 **DARPA Riser**.
- 2015 **ACM SIGSOFT Distinguished Paper Award**, *ICSE 2015*.
- 2009-2013 **National Science Foundation Graduate Research Fellowship**.
- 2007 **Undergraduate Instructor of the Year**, *Department of Computer Science, Indiana University*.

Publications

Peer-Reviewed Venues

- [1] Chike Abuah, Alex Silence, David Darais, and **Joseph P. Near**. Dduo: General-purpose dynamic analysis for differential privacy. *Proceedings of the 34th IEEE Computer Security Foundations Symposium (CSF)*, 2021.

- [2] Phillip Nguyen, Alex Silence, David Darais, and **Joseph P. Near**. Duetsgx: Differential privacy with secure hardware. In *Theory and Practice of Differential Privacy (TPDP)*, 2020.
- [3] Ivoline Ngong, Krystal Maughan, and **Joseph P. Near**. Towards auditability for fairness in deep learning. In *NeurIPS 2020 Workshop on Algorithmic Fairness through the Lens of Causality and Interpretability*, 2020.
- [4] Krystal Maughan and **Joseph P. Near**. Towards a measure of individual fairness for deep learning. In *Mechanism Design for Social Good (MD4SG)*, 2020.
- [5] Usman Khan, Lun Wang, Jithendaraa Subramanian, **Joseph P. Near**, and Dawn Song. Privframework: A system for configurable and automated privacy policy compliance. In *NeurIPS 2020 Workshop on Dataset Security and Curation*, 2020.
- [6] Noah Johnson, **Joseph P. Near**, Joseph M. Hellerstein, and Dawn Song. Chorus: a programming framework for building scalable differential privacy mechanisms. In *Proceedings of the 5th IEEE European Symposium on Security & Privacy (EuroS&P)*, 2020.
- [7] 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.
- [8] 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.
- [9] **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.
- [10] 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.
- [11] 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.
- [12] **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.
- [13] 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.
- [14] **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.
- [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.
- [16] **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.
- [17] **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.

- [18] **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.
- [19] **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.
- [20] 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.
- [21] **Joseph P. Near**, William E Byrd, and Daniel P Friedman. α 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.

Theses

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

Grants

- 2021 – 2025 **CRREL Program**, *AVATAR Project*, Co-I, \$608,173.
- 2021 – 2022 **Amazon Research Partnership**, *Amazon Partnership Pilot: Fairness in AI*, PI, \$175,000.
- 2020 – 2022 **DARPA CSL Program**, *CLAMPED: Collaborative Learning Architecture with Mathematical Privacy over Embedded Data*, Co-PI, \$225,606.
- 2020 – 2021 **Amazon Research Award**, *Provable Fairness for Deep Learning via Automatic Differentiation*, PI, \$91,749.
- 2020 – 2024 **DARPA SIEVE Program**, *Wizkit: Wide-scale Zero-Knowledge Interpreter Toolkit*, Co-PI, \$405,000.
- 2019 – 2020 **Industry Collaboration, Threat Stack, Inc.**, *Detecting Security Events in System Logs*, Co-I, \$100,000.
- 2019 – 2020 **UVM OVPR REACH**, *Differentially Private Deep Learning via Automatic Differentiation*, Co-PI, \$30,000.
- 2018 – 2019 **UVM OVPR EXPRESS**, *A Platform for Privacy-Preserving Deep Learning*, PI, \$3,000.
- 2015 – 2020 **DARPA Contract N66001-15-C-4066**, *Helio: Program Synthesis for Efficient, Privacy-Preserving Distributed Computation*, Co-PI, \$3,011,703 (\$139,035 to UVM).

Selected Presentations

Duet: An Expressive Higher-Order Language and Linear Type System for Statically Enforcing Differential Privacy

OOPSLA 2019	October 2019
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
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
Uber's Differential Privacy Tool	
Mozilla Privacy Lab	September 2017
Privacy-Preserving Data Analytics & Machine Learning	
RISELab Summer Retreat	June 2017
Finding Security Bugs in Web Applications Using a Catalog of Access Control Patterns	
International Conference on Software Engineering (ICSE)	May 2016
Helio: Secure, Privacy-Preserving Collaborative Data Analytics	
AMPLab Winter Retreat	January 2016
Derailer: Interactive Static Security Analysis for Web Applications	
International Conference on Automated Software Engineering (ASE)	October 2014
Indiana University	August 2014
Rubicon: Bounded Verification of Web Applications	
International Symposium on the Foundations of Software Engineering (FSE)	October 2012
MIT-CSAIL Programming Languages and Software Engineering Seminar	September 2012
A Lightweight Code Analysis and its Role in Evaluation of a Dependability Case	
International Conference on Software Engineering (ICSE)	May 2011
From Relational Specifications to Logic Programs	
International Conference on Logic Programming (ICLP)	July 2010
An Imperative Extension to Alloy	
International Conference on Abstract State Machines, Alloy, B and Z (ABZ)	February 2010
A Shallow Scheme Embedding of \perp-Avoiding Streams	
Symposium in Honor of Mitchell Wand	August 2009
αleanTAP: A Declarative Theorem Prover for First-Order Classical Logic	
International Conference on Logic Programming (ICLP)	December 2008

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>

Teaching

Spring 2021 **CS 202: Compiler Construction**, *University of Vermont.*

Fall 2020 **CS 211: Data Privacy**, *University of Vermont.*

CS 295: Secure Distributed Computation, *University of Vermont.*

Spring 2020 **CS 202: Compiler Construction**, *University of Vermont.*

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)

Professional Service

Conference Organization ○ Co-chair, **FCS: Workshop on Foundations of Computer Security** (2021)

Program Committee ○ **TPDP: Theory and Practice of Differential Privacy** (2021, 2020)

○ **FCS: Workshop on Foundations of Computer Security** (2020)

○ miniKanren Workshop (2020)

○ **ICDCS: International Conference on Distributed Computing Systems** (2016)

- Journal Reviewer
 - IEEE Transactions on Information Forensics and Security (2019, 2020)
 - IEEE Internet of Things Journal (2019)
 - Software: Practice and Experience (2018)
 - Transactions on Knowledge and Data Engineering (2018, 2020)
 - 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, 2020)
 - **Oakland**: IEEE Symposium on Security & Privacy (2017, 2020)
 - **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)