David Doty CV

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Associate Professor
Department of Computer Science
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Research interests

- DNA nanotechnology, chemical reaction networks, algorithmic self-assembly, distributed computing, algorithmic information theory

Academic positions

- **University of California, Davis**, Davis, California, USA
  Jul. 2015 – present
  Associate Professor of Computer Science 2021 – present
  Assistant Professor of Computer Science 2015 – 2021
  member of Graduate Group in Applied Mathematics
  member of Graduate Group in Biomedical Engineering
- **California Institute of Technology**, Pasadena, California, USA
  Sep. 2010 – Jul. 2015
  Senior Research Fellow/Postdoctoral Scholar in Computing and Mathematical Sciences
  Supervisor: Erik Winfree
- **Western University (formerly University of Western Ontario)**, London, Ontario, Canada
  Sep. 2009 – Sep. 2010
  Postdoctoral Fellow in Computer Science
  Supervisor: Lila Kari

Education

- **Iowa State University**, Ames, Iowa, USA
  Ph.D. in Computer Science, 2009
  Ph.D. Thesis: *Applications of the theory of computation to nanoscale self-assembly*
  Advisors: Jack H. Lutz and James I. Lathrop
- **Iowa State University**, Ames, Iowa, USA
  M.S. in Computer Engineering, 2002
  Master's Thesis: *Genetic algorithm-based simulation of electric power markets*
  Advisor: Gerald B. Sheblé
- **Iowa State University**, Ames, Iowa, USA
  B.S. in Computer Engineering, 2001
  Honors Thesis: *Evolving 3-D tic-tac-toe strategies*
  Honors Advisor: Daniel Ashlock

Awards and Honors

- ACM Senior Member
- UC-Davis College of Engineering Outstanding Junior Faculty Research Award, 2020
- NSF CAREER award, 2019
- Best paper award at DISC 2014, "Speed faults in computation by chemical reaction networks", with Ho-lin Chen, Rachel Cummings, and David Soloveichik
- Aalto Science Fellowship, 2012, 3-year postdoc fellowship to pursue independent research at Aalto University, Helsinki, Finland, awarded to 3 recipients out of 167 applicants (declined)
- CCC-CRA-NSF Computing Innovation Fellowship, 2010, 2-year postdoc fellowship
- Iowa State Univ. Teaching Excellence Award, 2007
- Pioneer Hi-Bred/National Science Foundation Graduate Research Fellowship (2005–2006)
- National Science Foundation Integrative Graduate Education and Research Traineeship (IGERT) Fellowship (2002–2004)
- Iowa State Univ. Electrical and Computer Engineering Graduate Excellence Fellowship (2002)

Publications

- Official publications list: https://web.cs.ucdavis.edu/~doty/papers/
- Google Scholar
- DBLP

Invited talks

- https://web.cs.ucdavis.edu/~doty/papers/#talks

Grants

- **Principal investigator**
  - *Engineering DNA and RNA computation through simulation, sequence design, and experimental verification*, $380,000, NSF CISE/CCF/FET grant, 2022-2026, NSF award #CCF-2211793
  - *Engineerable molecular computing: flying like an airplane, not like a bird*, $400,000, NSF CISE/CCF/FET grant, 2019-2023, NSF award #CCF-1900931
  - *CAREER: Chemical computation that is error-free, uniform, and composable*, $532,000, NSF CAREER award, 2019-2024, NSF award #CCF-1844976
  - *Kinetics and Thermodynamics of Chemical Computation*, $266,000, NSF CISE/CCF/AF grant, 2016-2019, NSF award #CCF-1619343
  - *Theory of Molecular Programming: Computability and Complexity*, $425,000, NSF CISE/CCF/AF grant, 2012-2015, (co-PI: Damien Woods), NSF award #CCF-1219274
- **Co-principal investigator**
  - *Compiling Ordinary (Discrete) Algorithms to Ordinary Differential Equations*, $400,000 (UC Davis portion $132,917), DoE EXPRESS grant, 2023-2025, (PI: David Soloveichik, co-PIs: David Doty, Sarfraz Khurshid) DoE award DE-SC0024467
  - *Student Travel Support for BIRS Workshop on Programming Chemical Reaction Networks*, $5000, NSF CISE/CCF/AF grant, 2014, (PI: Lulu Qian, co-PIs: David Doty, Chris Thachuk), NSF award #CCF-1442454
  - *Scaling Up Programmable and Algorithmic DNA Self-Assembly*, $400,000, NSF CISE/CCF/AF grant, 2012-2015, (PI: Erik Winfree, co-PIs: David Doty, Damien Woods), NSF award #CCF-1162589
  - *Future directions for molecular programming: DNA17 special session*, $15,000, NSF, 2011, (PI: Erik Winfree, co-PIs: David Doty, Niles Pierce, Damien Woods), NSF award #CCF-1143993
  - *Student Travel Support for DNA17*, $12,000, NSF, 2011, (PI: Erik Winfree, co-PIs: David Doty, Niles Pierce, Damien Woods), NSF award #CCF-1137770

Students supervised

- **Ph.D.**
  - Lia Noori, currently Ph.D. student in Computer Science, UC-Davis
  - Mina Latifi, currently Ph.D. student in Computer Science, UC-Davis
  - Josh Petrack, currently Ph.D. student in Applied Mathematics, UC-Davis
  - Mahsa Eftekhari, Ph.D. in Computer Science, 2022, UC-Davis
  - Eric Severson, Ph.D. in Applied Mathematics, 2021, UC-Davis
  - David Haley, Ph.D. in Applied Mathematics, 2021, UC-Davis
- **M.S.**
  - Aaron Ong, M.S. in Computer Science, 2021, UC-Davis, Winner of the GGCS Best Master Researcher Award 2022
  - Amanda Belleville, M.S. in Computer Science, 2017, UC-Davis
  - Shaopeng Zhu, M.S. in Computer Science, 2017, UC-Davis
- **Undergraduate**

- Raj Bapat, 2023, UC-Davis undergraduate REU project, SIMD implementation of Smith-Waterman algorithm for DNA sequence design
- Amy Law, 2022, UC-Davis undergraduate REU project, time complexity of computation with mass-action chemical reaction networks
- Venkat Bollapragada, 2022, UCLA undergraduate REU project, DNA structure design software
- Ho-Chih Ma, 2022, UC-Davis undergraduate REU project, DNA structure design software etworks
- Cesar Alonso Guzman Avina, 2021–2022, UC-Davis undergraduate REU project, DNA structure design software
- Sarah Yuniar, 2021–2022, UC-Davis undergraduate REU project, DNA structure design software
- Rishabh Mudradi, 2021–2022, San Jose State, undergraduate REU project, DNA structure design software
- Anelise Cho, 2020–2021, UC-Davis undergraduate project through AvenueE and VIP programs, project on surface CRNs
- Benjamin Lee, 2019–2021, UC-Davis undergraduate REU project, DNA structure design software and DNA sequence design software
- Andres Rojas, 2018, UC-Davis undergraduate project, population protocol simulation
- Vishal Chakraborty, 2016-2017, UC-Davis Honors thesis and REU project, theory of chemical reaction networks
- Nicholas Schiefer, 2015, Caltech SURF (Summer undergraduate research fellowship), theory of algorithmic self-assembly/chemical reaction networks
- Aakash Indurkhya, 2013, Caltech SURF (Summer undergraduate research fellowship), theory of computation with chemical reaction networks
- Felix Zhou, 2012, Caltech SURF (Summer undergraduate research fellowship), experiments with algorithmic self-assembly of DNA single-stranded tiles
- Nathaniel Bryans, 2010, University of Western Ontario summer research project, theory of algorithmic self-assembly

◇ **High school**

- Aaron Lin, 2023, project with DNA structure design software
- Pranav Gupta, 2022, project with DNA structure design software
- Edwin Chang, 2022, project with DNA structure design software
- Elian Malessy, 2022, project with web app for simulating automata
- David Wang, 2022, project with web app for simulating automata
- Andrea Jia, 2021, project with DNA structure design software
- Rishabh Mudradi, 2020-2021, project with DNA structure design software
- Jupinder Parmar, 2016-2018, project with theoretical algorithmic self-assembly

◇ **Thesis/Qualifying exam committee** Anastasia Ershova (external committee member for Harvard), Christian Pratt, Stephen Imbach, Jack Wesley, Talley Amir (external committee member for Yale CS department), Kyle Ray, Sung Kook Kim, Anshuman Chabra, Jonathan Marrs, Ronaldo Ortez, Boya Wang (external committee member for UT-Austin ECE department), David Grzan, Greg Wimsatt, Luiz Irber, David Gier, Alexandra Jurgens, Samuel Loomis, Ariadna Venegas-Li, Anastasiya Salova, Thong Le, Julia Matsieva, Adam Rupe, Haochen Wu, Paul Riechers, Rafael Bravo

Service

◇ **Program committee co-chair**

- **SAND 2023**: 2nd Symposium on Algorithmic Foundations of Dynamic Networks
- **UCNC 2020**: 19th Conference on Unconventional Computation/Natural Computation
- **DNA 2018**: 24th Meeting on DNA Computing and Molecular Programming

◇ **General conference co-chair**

- **FNANO 2021**: 18th Annual Conference on Foundations of Nanoscience: Self-assembled Architectures and Devices

◇ **Program committee member**

- **DNA** (2014–2023, 2012, 2011): International Meeting on DNA Computing and Molecular Programming
- **ICALP** (2022): International Colloquium on Automata, Languages, and Programming
- **DISC** (2020, 2017): International Symposium on DIStributed Computing
- **OPODIS** (2017): International Conference on Principles of Distributed Systems
- **SAND** (2022): Symposium on Algorithmic Foundations of Dynamic Networks
- **CiE** (2016): Computability in Europe Conference
- **UCNC** (2020, 2019, 2015, 2012): Conference on Unconventional Computation/Natural Computation
- **VEMDP** (2018): International Workshop on Verification of Engineered Molecular Devices and Programs, affiliated with CAV (Conference on Computer Aided Verification)

◇ **Workshop chair**

- Minisymposium on Algorithmic Chemical Reaction Networks, at **CanaDAM 2015**: 5th Canadian Discrete and Algorithmic Mathematics Conference

◇ **Organizing committee**

- Programming with Chemical Reaction Networks: Mathematical Foundations, 2014 Workshop at Banff International Research Station for Mathematical Innovation and Discovery
- **DNA 2011**: 17th Meeting on DNA Computing and Molecular Programming

◇ **Journal referee**: *Nature Communications*, PNAS: *Proceedings of the National Academy of Sciences*, CACM: *Communications of the ACM*, SICOMP: *SIAM Journal on Computing*, ACS SynBio: *ACS Synthetic Biology*, *PLOS ONE*, *Journal of the Royal Society: Interface*, *IEEE Transactions on Information Theory*, JoVE: *Journal of Visualized Experiments*, DIST: *Distributed Computing*, JCB: *Journal of Computational Biology*, *Algorithmica*, JCSS: *Journal of Computer and System Sciences*, I&C: *Information and Computation*, IPL: *Information Processing Letters*, TCS: *Theoretical Computer Science*, ToCS: *Theory of Computing Systems*, NaCo: *Natural Computing*, *IEEE Transactions on NanoBioscience*, *International Journal of Computer Mathematics*, *Mathematics and Computers in Simulation*, *BioSystems*, *IET Nanobiotechnology*, *Information*, *Chaos*, *Advanced Science Letters*

◇ **Conference reviewer**: DNA: *DNA Computing and Molecular Programming*, STOC: *ACM Symposium on Theory of Computing*, FOCS: *IEEE Symposium on Foundations of Computer Science*, SODA: *ACM-SIAM Symposium on Discrete Algorithms*, PODC: *ACM Symposium on Principles of Distributed Computing*, DISC: *International Symposium on DIStributed Computing*, ICALP: *International Colloquium on Automata, Languages, and Programming*, ESA: *European Symposium on Algorithms*, SPAA: *ACM Symposium on Parallelism in Algorithms and Architectures*, CCC: *International Conference on Computational Complexity*, STACS: *International Symposium on Theoretical Aspects of Computer Science*, POPL: *Principles of Programming Languages*, ISAAC: *International Symposium on Algorithms and Computation*, CiE: *Computability in Europe*, RECOMB: *Research in Computational Molecular Biology*, CMSB: *International Conference on Computational Methods in Systems Biology*, COCOON: *International Computing and Combinatorics Conference*

◇ **National Science Foundation panelist:** 2013, 2017, 2019, 2021, 2022

- **University service**:
  - University of California, Davis:
    - Undergraduate affairs, Computer Science, 2017-present
    - Faculty liason to CS Club, 2017-present
    - Faculty search, Computer Science, 2021, 2020, 2017
    - Faculty representative committee, Computer Science, 2021
    - Academic personnel committee, Computer Science, 2021
    - Graduate admissions, Computer Science, 2018, 2016
  - California Institute of Technology:
    - Graduate admissions, Computer Science, 2014, 2013
- **Media**: Video introducing algorithmic self-assembly to a (mostly) lay audience, made to accompany a review article on the same subject: https://vimeo.com/54214122
- **Interviews**:
  - Machine Intelligence Research Institute: Luke Muehlhauser, on algorithmic self-assembly http://intelligence.org/2014/04/23/dave-doty/
- **Outreach**:
  - Story consultant for Isa, made-for-TV movie on SyFy, 2014 (main character is a gifted Latina high school student interested in computer science and mathematics)
  - Judge for 2013 Caltech SURF (Summer Undergraduate Research Fellowship) poster competition
  - Speaker and discussion leader at 2012 Siemens Competition in Math, Science, and Technology
  - Hosted Pasadena high school biology students in lab for educational seminar about careers in science
- **Professional memberships**
  - International Society for Nanoscale Science, Computation, and Engineering (ISNSCE)
  - Association for Computing Machinery (ACM), Special Interest Group in Algorithms and Computation Theory (SIGACT)

Teaching experience

- **Instructor**, University of California, Davis (as faculty), Fall 2015 – present
  - Theory of Computation (graduate)
  - Theory of Computation (undergraduate)
  - Theory of Molecular Computation (graduate)
  - Developed software to support grading and feedback:
    - **Simulators for Theory of Computing:** http://web.cs.ucdavis.edu/~doty/automata/ Web applications for simulating deterministic and nondeterministic finite automata, regular expressions, context-free grammars, and Turing machines. They are used by my Theory of Computation students for creating and testing automata to submit for homework. In conjunction with Gradescope (https://gradescope.com/), this enables automated grading of homework, with immediate feedback to the students to enable them to learn and improve immediately.
- **Instructor**, Iowa State University (as a Ph.D. student), Summer 2006 – Spring 2009
  - Theory of Computation (undergraduate)
  - Introduction to Object-Oriented Programming in Java
  - Data Structures in Java
  - Programming for non-CS-majors in Java

- **Graduate teaching assistant**, Iowa State University, Summer 2001, Spring 2002, Fall 2004 – Spring 2005, Summer 2007
  - Introduction to Circuits for non-EE-majors
  - System Modeling, Simulation, and Optimization
  - Programming for non-majors in Java
  - Introduction to Object-oriented Programming in Java
  - Data Structures in Java
- **Developed course materials** for introductory programming and data structures courses on a grant from Caterpillar, Inc. during Summer 2005, Iowa State University
- **Tutor**, Iowa State University, Spring 1999, Spring 2000
  - Classical Physics
  - Introduction to Digital Design
  - Algorithm Design and Analysis