

David Kotz

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Education

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| Ph.D | Computer Science | Duke University | 1991 |
| M.S. | Computer Science | Duke University | 1989 |
| B.A. | Computer Science and Physics | Dartmouth College | 1986 |

Employment

Dartmouth College, Administration

2009–2015 Associate Dean of the Faculty for the Sciences

Dartmouth College, Research leadership

2016– Core Director (Emerging Technologies and Data Analytics), Center for Technology and Behavioral Health
2008–2011 Principal Investigator, Institute for Security, Technology, and Society
2004–2007 Executive Director, Institute for Security Technology Studies
2003–2004 Director of Research and Development, Institute for Security Technology Studies

Dartmouth College, Department of Computer Science

2010– Champion International Professor
2003– Professor
1997–2003 Associate Professor
1991–1997 Assistant Professor

Sabbaticals:

Fall 2008 – Spring 2009: Indian Institute of Science, Bangalore, India
Winter 1995: Syracuse University, Department of Electrical and Computer Engineering
Fall 1994: University of Virginia, Department of Computer Science

Consultant:

Expert witness for patent and intellectual-property cases (see page 35)

Brief biography

David Kotz is the Champion International Professor in the Department of Computer Science at Dartmouth College. He served as Associate Dean of the Faculty for the Sciences for six years and as the Executive Director of the Institute for Security Technology Studies for four years. He served on the US Healthcare IT Policy Committee from 2013-17. His research interests include security and privacy, pervasive computing for healthcare, and wireless networks. He has published over 130 refereed journal and conference papers and obtained over \$65m in grant funding. He is PI of a \$10m grant from the NSF Secure and Trustworthy Cyberspace program and leads a five-university team investigating Trustworthy Health & Wellness technology (see thaw.org). He is an IEEE Fellow, a Senior Member of the ACM, a 2008 Fulbright Fellow to India, and an elected member of Phi Beta Kappa. After receiving his A.B. in Computer Science and Physics from Dartmouth in 1986, he completed his Ph.D in Computer Science from Duke University in 1991 and returned to Dartmouth to join the faculty. For more information see <http://www.cs.dartmouth.edu/~dfk/>.

Honors and Awards

While on the faculty at Dartmouth College:

- ACM SIGMOBILE Test-of-Time Paper Award, March 2017; for our paper [RC68](#). Award Citation: “This paper was the first to systematically demonstrate how to measure and understand a production-scale wireless network, which was previously considered an impenetrable black box. This led to an incredible amount of follow-on work, with the measurement methods and analysis mechanisms proposed in this paper still being used. This paper was also the spark for the creation of the CRAWDAD data repository, which has been of immense value to the wireless research community.”
- Graduate Faculty Mentoring Award, Dartmouth College, April 2015.
- Champion International Professorship (endowed chair), July 2010–date.
- Phi Beta Kappa, initiated by Dartmouth College, Alpha chapter of New Hampshire, June 2010.
- IEEE Fellow status (“for contributions to parallel and distributed systems and wireless networks”) awarded November 2008 by the Institute of Electrical and Electronic Engineers.
- Fulbright Research Scholar to India, August 2008 – April 2009.
- Senior Faculty Fellowship (extra sabbatical term, chosen competitively), Spring 2009.
- Honorary degree: Master of Arts, Dartmouth College, 2004.
- Friedman Family Fellow (an award for newly promoted faculty), 2003–2004.
- J. Kenneth Huntington Memorial Award for Newly Promoted Faculty, 2003.
- Elizabeth R. and Robert A. Jeffe 1972 Fellow (an award for newly tenured faculty), 1997–1998.
- Class of 1962 Junior Faculty Fellowship (extra sabbatical term, chosen competitively), Winter 1995.

While a graduate student at Duke University:

- DARPA/NASA Research Assistantships in Parallel Processing 1989–1990, 1990–1991.
- Microelectronics Center of North Carolina Graduate Fellow 1986–1987.
- NSF Graduate Fellow Honorable Mention 1986, 1987.

While an undergraduate student at Dartmouth College:

- Magna cum Laude B.A., 1986.

Funding

AWARDED – CURRENT (in approximate reverse-chronological order)

- Dartmouth SYNERGY**, \$49,970 for 2017–18. Co-PI
A pilot study of an eHealth-delivered health coaching intervention. With John Batsis (PI).
- NIH/NIDA P30**, \$6,207,898 for 2016–2021 Core Director
Technology-based Treatments for Substance Use Disorders. With Lisa Marsch (PI), Alan Budney, Sarah Lord, and others.
- NSF CNS**, \$1,457,622 for 2016–2019 (Dartmouth share \$1,082,976) PI
Smart earpiece for supporting healthy eating behaviors. With colleagues at Dartmouth (Ryan Halter, Kofi Odame, Xing-Dong Yang) and Clemson (Jacob Sorber, Kelly Caine).
- NSF SaTC**, \$10,000,000 (Dartmouth share \$4,000,000) for 2013–2018 PI
Enabling trustworthy cybersystems for health and wellness. With Kevin Fu (U.Michigan), Carl Gunter (UIUC), and Avi Rubin (JHU). Learn more at thaw.org.
- NSF CNS**, \$2,712,286 for 2013–2018 (Dartmouth share \$1,815,866) PI
Computational Jewelry for Mobile Health. With Ryan Halter, Andrés Molina-Markham, Sarah Lord (Dartmouth); Jacob Sorber and Kelly Caine (Clemson). Learn more at amulet-project.org.
- NIDRR**, \$44,900 (for me) for 2012–2017 Team member
Development Center to Enhance Evidence-Based Supported Employment Through a Technology-Based Management System. With Sarah Lord (PI), Dartmouth Center for Technology and Behavioral Health.
- Association for Computing Machinery**, \$165,000 for 2009–2017 PI
CRAWDAD: Community Resource for Archiving Wireless Data At Dartmouth.
 With Tristan Henderson.

AWARDED – PAST (in approximate reverse-chronological order)

- NSF (CISE)**, \$336,178 for 2011–15 (Dartmouth portion \$156,178) PI
Collaborative Research: Foundation for Trusted and Scalable Mobile Healthcare
 With Ashutosh Sabharwal (Rice); collaboration with Kolin Paul, Sanjiva Prasad, Manish Sharma (IIT Delhi).
- Intel Corporation**, \$109,020 for 2009–2015 PI
mHealth Privacy Roadmap.
- NSF IIS/HCC**, \$499,670 for 2010–14 (Dartmouth portion \$98,221) Co-PI
HCC: Small: Contextualized and Automated Usability Testing for Mobile Applications.
 With Guanling Chen (PI).
- HHS/ONC (SHARP)**, \$15 million for 2010–14 (Dartmouth portion \$1,513,725) Co-PI
Strategic Healthcare IT Advanced Research Projects on Security (SHARPS).
 With Carl Gunter (PI), Mark Frisse, John Mitchell, Avi Rubin.
- NSF (Trustworthy Computing)**, \$3 million for 2009–2013 PI
Trustworthy Information Systems for Healthcare (TISH).
 With Denise Anthony, Andrew Gettinger, Eric Johnson, and Sean Smith.
- NSF (CISE) supplement**, \$34,795 for 2012–13 PI
Workshop: Securing Information Technology for Healthcare. With Denise Anthony.
- Dartmouth Conference Award**, \$35,000 for 2012–13 PI
Securing Information Technology in Healthcare: Part II (SITH2)
 With Denise Anthony and Tom Candon.

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| <i>David Kotz (Funding)</i> | 4 |
| NSF (Cyber Trust) , \$300,000, plus \$16,000 REU supplement, plus \$27,088 supplement, for 2009–11. <i>CT-ISG: Dartmouth Trace Sanitization Framework.</i> | PI |
| Fulbright Fellowship (India) \$42,693 for 2008–09. <i>Measuring and modeling wireless networks.</i> | PI |
| Senior Faculty Grant , Dartmouth College. Approximately \$80,000 for Spring 2009 <i>Measuring and modeling wireless networks.</i> | PI |
| DHS-NCSD (Institute for Security Technology Studies) , \$2,314,597 for 2006–11. <i>Dartmouth Internet Security Testbed.</i> With George Cybenko and Guanling Chen. | PI |
| Intel Corporation , \$25,000 for 2007–08. <i>A Community Resource for Archiving Wireless Data At Dartmouth: CRAWDAD.</i> | PI |
| Intel University Research Council , \$142,089 for 2007–09. <i>Data Assurance in Medical Sensor Applications.</i> | PI |
| DHS-NCSD (Institute for Security Technology Studies) , \$622,625 for 2007–08. <i>Metrosense: scalable secure sensor systems.</i> With Andrew Campbell (PI) and George Cybenko. | Co-PI |
| NIST (Institute for Security Technology Studies) , \$1,112,800 for 2006–07. <i>Scalable Secure Sensor Systems.</i> With Andrew Campbell (PI) and George Cybenko. | Co-PI |
| DHS-HSARPA Cybersecurity program, \$1,598,545 for 2005–07. <i>M.A.P. (Measure, Analyze, Protect): security through measurement for wireless LANs.</i> With Andrew Campbell, Guanling Chen, Tristan Henderson. | PI |
| Department of Justice – BJA (Institute for Security Technology Studies) , \$650,932 for 2005–06. <i>Digital Living: Sensors, Privacy, and Trust.</i> With Denise Anthony, Andrew Campbell, and Tristan Henderson. | PI |
| Department of Justice – BJA (Institute for Security Technology Studies) , \$598,015 for 2005–06. <i>Communications, Networking and Application Development.</i> With Susan McGrath (PI), Daniela Rus. | Co-PI |
| NSF Computing Research Infrastructure program, \$500,000 for 2005–08, plus REU supplement \$12,405. <i>CRI: A Community Resource for Archiving Wireless Data At Dartmouth: CRAWDAD.</i> With Tristan Henderson. | PI |
| McKinsey&Company , \$24,882 for 2004. <i>Study of Behavior on the Wireless Network.</i> With Denise Anthony. | PI |
| Intel University Research Council , \$225,327 for 2004–2008. <i>Modeling High-Throughput Wireless Networks Using Real-World Data.</i> With Tristan Henderson and Sergey Bratus. | PI |
| DHS Science & Technology (Institute for Security Technology Studies) , \$1,013,507 for 2003–2006. <i>The Kerf toolkit for intrusion analysis.</i> With Jay Aslam and Daniela Rus. | PI |
| DHS Science & Technology (Institute for Security Technology Studies) , \$2,961,580 for 2003–2006. <i>An Integrated Approach to Communication, Automated Information Management, and Sensing for Emergency and Disaster Response.</i> With Sue McGrath (PI) and Daniela Rus. | Co-PI |

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| <i>David Kotz (Funding)</i> | 5 |
| Cisco Systems , \$89,500 for 2003-04. <i>The impact of VoIP on a campus-scale wireless network.</i> With Brad Noblet. | PI |
| DoCoMo Labs USA , \$120,228 for 2003–2006. <i>Evaluation of location-prediction algorithms.</i> | Solo PI |
| Cisco Systems , \$13,139 for 2002. <i>A detailed analysis of usage patterns in the campus-wide wireless network.</i> | Solo PI |
| Department of Justice (Institute for Security Technology Studies) , \$491,876 for 2001–2002. <i>Infrastructure for Distributed Collaboration in Detecting Network Attacks.</i> With Jay Aslam and Daniela Rus. | PI |
| USENIX Association , \$16,000 for 2001–2002. With student Guanling Chen. <i>USENIX Student Scholar</i> | Advisor |
| Cisco Systems , \$65,529 for 2000–2001. <i>Wireless networks and context-sensitive computing.</i> | Solo PI |
| Department of Justice (Institute for Security Technology Studies) , \$153,379 for 2000–2001. <i>Assessing and Mining of Data from Network Sensors.</i> With Jay Aslam and Daniela Rus. | PI |
| DoD DURIP , \$435,000 for 2000–01. <i>Instrumentation for Wireless Agent Networks and Sensor Webs.</i> With George Cybenko (PI), Robert Gray, and Daniela Rus. | Co-PI |
| Honda Motor Company Research Initiation Award, \$30,000 for 1999–2001. <i>Wireless Support Services for Honda Cars.</i> With George Cybenko, Robert Gray, and Daniela Rus (PI). | Co-PI |
| NSF Institutional Infrastructure, \$1,360,031 for 1998–2003. <i>Systems Science for Physical Geometric Algorithms.</i> With David Nicol (PI), Bruce Donald, and Dan Rockmore. | Co-PI |
| Dartmouth College , \$1,000 for 1998. <i>Humanities Institute Tangled Web: Ethical Dilemmas of the Internet</i> | Associate Fellow |
| DARPA CoABS, \$2,105,884 for 1998–2002, \$306,074 plus \$399,999 for 2001–02, <i>Resource Control in Large-Scale Mobile-Agent Systems.</i> With George Cybenko, Robert Gray, and Daniela Rus. | PI |
| Air Force Rome Labs , \$40,000 for 1998, \$79,000 for 1999. <i>Mobile Information Agents.</i> With Daniela Rus. | Co-PI |
| USENIX Association , \$22,691 for 1997–98, \$14,967 for 1998–99, \$7,704 for 1999–2000. <i>Snowflake: Application-specific Distributed Virtual Computers.</i> With student Jon Howell. | Advisor |
| DoD MURI , \$5,200,000 for 1997–2002. <i>Transportable Agents for Reconfigurable Wireless Networks: The ActComm Project.</i> With G. Cybenko (PI), D. Rus, P. R. Kumar, T. Başar, G. Agha, H. T. Kung, E. Entin, G. Hjalmtysson. | Investigator |
| NASA GSRP , \$22,000 for 1996–97. <i>The Galley Parallel File System.</i> With student Nils Nieuwejaar. <i>We turned down the funding due to Nils' impending graduation.</i> | Advisor |

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| DOE ASCI program (Sandia National Lab), \$841,133 for 1996–2003. <i>An Extensible File System for High-Performance Parallel Computing.</i> | Solo PI |
| ONR , \$99,863 for 1995, \$38,846 for 1996, \$60,000 for 1996–97, \$95,124 for 1997–98, \$100,000 for 1998–99. Co-PI <i>Autonomous Information Agents: Intelligent, Extensible, and Adaptable Tactical Picture Agents.</i> With Daniela Rus (PI) and George Cybenko. | |
| NASA Ames , \$99,990 + IBM/Dartmouth matching funds \$55,230, for 1994–95. <i>SCORPIO: A Testbed for Tomorrow's Multiprocessor File Systems</i> | Solo PI |
| NSF CISE , \$98,997 + \$19,286 equipment supplement + \$5,000 REU supplement, for 1994–97. <i>High-performance File Systems for Scientific Multiprocessing.</i> | Solo PI |
| Digital Equipment Corporation , \$52,037 for 1994–97. <i>Large-Address-Space Operating Systems, Parallel I/O, and Algorithms on a Digital 2100 Server.</i> With Thomas H. Cormen and Clifford Stein. | PI |
| NASA Ames , \$149,622 for 1993–96. <i>Characterizing the Workload of Multiprocessor File Systems.</i> | Solo PI |
| NASA GSRP , \$66,000 for 1993–96 (renewed twice). <i>High Performance through a Unified Memory Hierarchy.</i> With student Preston Crow. | Advisor |
| Digital Equipment Corporation , workstation approx. \$20,000 for 1993. <i>A Unified Memory Hierarchy for Distributed Computing.</i> | Solo PI |
| NSF , \$29,689 for 1993. <i>Issues and Obstacles in the Implementation of Parallel Algorithms and the Use of Parallel Machines: a Proposal to fund a School on Parallel Programming.</i> With Fillia Makedon (PI) and Donald B. Johnson. | Senior Investigator |
| NSF ILI-LLD , \$100,000 for 1993–95. <i>It's Never Too Early: Teaching Parallel Computing to Freshmen.</i> With Fillia Makedon (PI) and Donald B. Johnson. | Co-PI |
| Dartmouth College Burke Award, \$15,000 for 1991–94. | Solo PI |
| DARPA/UMIACS Research Assistantship, \$28,185 for 1989–90, \$29,379 for 1990–91. <i>High Performance File System Design for MIMD Parallel Processors.</i> | Student |
| MCNC Graduate Fellowship, \$19,308 for 1986–87. | Student |

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| Total grants awarded \$65,079,247 |
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GRANT MANAGEMENT (in approximate reverse-chronological order)






I was the PI on block funding at the Institute for Security Technology Studies (now the Institute for Security, Technology, and Society) at Dartmouth. I was responsible for setting the overall research direction, overseeing the selection and review of projects, budgeting funds, and ensuring technical quality of the overall program. I list above only those portions of these grants where I was project lead or co-lead, actually conducting the research. I list below the total amount of block funding I managed as PI.

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| NCSD (Department of Homeland Security) , \$6.5 million for 2006–11. | Co-PI |
| NIST (Department of Commerce) , \$3 million for 2006–08. | PI |
| BJA (Department of Justice) , \$5 million for 2005–07. | PI |
| HSARPA (Department of Homeland Security) , \$51 million for 2000–06. | 2004–06 PI |
| Total \$65.5 million. | |

Publications

Readers of this vita in electronic PDF format can click the icons below. Others may find those papers at URL <http://www.cs.dartmouth.edu/~dfk/papers/>.

REFEREED JOURNAL ARTICLES (in approximate reverse-chronological order)

- RJ1. Reza Rawassizadeh and David Kotz. *Datasets for mobile, wearable and IOT research*. *GetMobile: Mobile Computing and Communications*, 20(4):5–7, April 2017, DOI [10.1145/3081016.3081018](https://doi.org/10.1145/3081016.3081018).  PDF
- RJ2. Reza Rawassizadeh, Timothy Pierson, Ronald Peterson, and David Kotz. *NoCloud: Experimenting with network disconnection by design*. *IEEE Pervasive Computing*, 2017. Accepted for publication.
- RJ3. David Kotz, Carl A. Gunter, Santosh Kumar, and Jonathan P. Weiner. *Privacy and security in mobile health – a research agenda*. *IEEE Computer*, 49(6):22–30, June 2016, DOI [10.1109/MC.2016.185](https://doi.org/10.1109/MC.2016.185).  PDF
- RJ4. Minh Shin, Cory Cornelius, Apu Kapadia, Nikos Triandopoulos, and David Kotz. *Location privacy for mobile crowd sensing through population mapping*. *Sensors*, June 2015, DOI [10.3390/s150715285](https://doi.org/10.3390/s150715285). Revision of [RC37](#).  PDF
- RJ5. Tristan Henderson and David Kotz. *Data citation practices in the CRAWDAD wireless network data archive*. *D-Lib Magazine*, 21(1/2), Jan/Feb 2015, DOI [10.1045/january2015-henderson](https://doi.org/10.1045/january2015-henderson).  PDF
- RJ6. Shrirang Mare, Jacob Sorber, Minh Shin, Cory Cornelius, and David Kotz. *Hide-n-Sense: preserving privacy efficiently in wireless mHealth*. *Mobile Networks and Applications (MONET)*, 19(3):331–344, June 2014, DOI [10.1007/s11036-013-0447-x](https://doi.org/10.1007/s11036-013-0447-x). Special issue on Wireless Technology for Pervasive Healthcare. Revision of [RC26](#).  PDF
- RJ7. Keren Tan, Chris McDonald, Bennet Vance, Chrisil Arackaparambil, Sergey Bratus, and David Kotz. *From MAP to DIST: the evolution of a large-scale WLAN monitoring system*. *IEEE Transactions on Mobile Computing*, 13(1):216–229, January 2014, DOI [10.1109/TMC.2012.237](https://doi.org/10.1109/TMC.2012.237).  PDF
- RJ8. Denise Anthony, Andrew Campbell, Thomas Candon, Andrew Gettinger, Carl A. Gunter, M. Eric Johnson, David Kotz, Lisa Marsch, Andrés Molina-Markham, Karen Page, and Sean Smith. *Securing information technology in healthcare*. *IEEE Security & Privacy*, 11(6):25–33, Nov/Dec 2013, DOI [10.1109/MSP.2013.104](https://doi.org/10.1109/MSP.2013.104). Invited paper.  PDF
- RJ9. Sasikanth Avancha, Amit Baxi, and David Kotz. *Privacy in mobile technology for personal healthcare*. *ACM Computing Surveys*, 45(1), November 2012, DOI [10.1145/2379776.2379779](https://doi.org/10.1145/2379776.2379779).  PDF
- RJ10. Cory Cornelius and David Kotz. *Recognizing whether sensors are on the same body*. *Journal of Pervasive and Mobile Computing*, 8(6):822–836, December 2012, DOI [10.1016/j.pmcj.2012.06.005](https://doi.org/10.1016/j.pmcj.2012.06.005). Revision of [RC23](#).  PDF
- RJ11. Minkyong Kim and David Kotz. *Identifying unusual days*. *Journal of Computing Science and Engineering (JCSE)*, 5(1):71–84, 2011, DOI [10.5626/JCSE.2011.5.1.071](https://doi.org/10.5626/JCSE.2011.5.1.071).  PDF
- RJ12. Minh Shin, Cory Cornelius, Dan Peebles, Apu Kapadia, David Kotz, and Nikos Triandopoulos. *AnonySense: A system for anonymous opportunistic sensing*. *Journal of Pervasive and Mobile Computing*, 7(1):16–30, February 2011, DOI [10.1016/j.pmcj.2010.04.001](https://doi.org/10.1016/j.pmcj.2010.04.001). Revision of [RC39](#).  PDF
- RJ13. Ming Li and David Kotz. *Towards collaborative data reduction in stream-processing systems*. *International Journal of Communication Networks and Distributed Systems (IJCNDS)*, 2(4):375–400, 2009, DOI [10.1504/IJCNDS.2009.026555](https://doi.org/10.1504/IJCNDS.2009.026555). Invited paper. Revision of [RC38](#).  PDF
- RJ14. Tristan Henderson, David Kotz, and Ilya Abyzov. *The changing usage of a mature campus-wide wireless network*. *Computer Networks*, 52(14):2690–2712, October 2008, DOI [10.1016/j.comnet.2008.05.003](https://doi.org/10.1016/j.comnet.2008.05.003). Revision of [RC61](#). Later revised as [SW1](#).  PDF
- RJ15. Guanling Chen, Ming Li, and David Kotz. *Data-centric middleware for context-aware pervasive computing*. *Pervasive and Mobile Computing*, 4(2):216–253, April 2008, DOI [10.1016/j.pmcj.2007.10.001](https://doi.org/10.1016/j.pmcj.2007.10.001).  PDF

- RJ16. Ming Li and David Kotz. *Group-aware stream filtering for bandwidth-efficient data dissemination*. *International Journal of Parallel, Emergent and Distributed Systems (IJPEDS)*, 23(6):429–446, December 2008, DOI [10.1080/17445760801930955](https://doi.org/10.1080/17445760801930955). [PDF](#)
- RJ17. Soumendra Nanda and David Kotz. *Mesh-Mon: A multi-radio mesh monitoring and management system*. *Computer Communications*, 31(8):1588–1601, May 2008, DOI [10.1016/j.comcom.2008.01.046](https://doi.org/10.1016/j.comcom.2008.01.046). Acceptance rate 30%. [PDF](#)
- RJ18. Yong Sheng, Guanling Chen, Hongda Yin, Keren Tan, Udayan Deshpande, Bennet Vance, David Kotz, Andrew Campbell, Chris McDonald, Tristan Henderson, and Joshua Wright. *MAP: A scalable monitoring system for dependable 802.11 wireless networks*. *IEEE Wireless Communications*, 15(5):10–18, October 2008, DOI [10.1109/MWC.2008.4653127](https://doi.org/10.1109/MWC.2008.4653127). [PDF](#)
- RJ19. Calvin Newport, David Kotz, Yougu Yuan, Robert S. Gray, Jason Liu, and Chip Elliott. *Experimental evaluation of wireless simulation assumptions*. *SIMULATION: Transactions of The Society for Modeling and Simulation International*, 83(9):643–661, September 2007, DOI [10.1177/0037549707085632](https://doi.org/10.1177/0037549707085632). Revision of [RC57](#). [PDF](#)
- RJ20. Minkyong Kim and David Kotz. *Periodic properties of user mobility and access-point popularity*. *Journal of Personal and Ubiquitous Computing*, 11(6):465–479, August 2007, DOI [10.1007/s00779-006-0093-4](https://doi.org/10.1007/s00779-006-0093-4). Invited paper; special issue of papers from LoCA 2005. Revision of [TR14](#). [PDF](#)
- RJ21. Denise Anthony, Tristan Henderson, and David Kotz. *Privacy in location aware computing environments*. *IEEE Pervasive*, 6(4):64–72, Oct–Dec 2007, DOI [10.1109/MPRV.2007.83](https://doi.org/10.1109/MPRV.2007.83). [PDF](#)
- RJ22. Ron Oldfield and David Kotz. *Improving data access for computational grid applications*. *Cluster Computing*, 9(1):79–99, January 2006, DOI [10.1007/s10586-006-4899-7](https://doi.org/10.1007/s10586-006-4899-7). [PDF](#)
- RJ23. Libo Song, David Kotz, Ravi Jain, and Xiaoning He. *Evaluating next cell predictors with extensive Wi-Fi mobility data*. *IEEE Transactions on Mobile Computing*, 5(12):1633–1649, December 2006, DOI [10.1109/TMC.2006.185](https://doi.org/10.1109/TMC.2006.185). Revision of [TR21](#). [PDF](#)
- RJ24. David Kotz and Kobby Essien. *Analysis of a campus-wide wireless network*. *Wireless Networks*, 11(1–2):115–133, January 2005, DOI [10.1007/s11276-004-4750-0](https://doi.org/10.1007/s11276-004-4750-0). Revision of [TR37](#). [PDF](#)
- RJ25. Jason Liu, Yougu Yuan, David M. Nicol, Robert S. Gray, Calvin C. Newport, David Kotz, and Luiz Felipe Perrone. *Empirical validation of wireless models in simulations of ad hoc routing protocols*. *Simulation: Transactions of The Society for Modeling and Simulation International*, 81(4):307–323, April 2005, DOI [10.1177/0037549705055017](https://doi.org/10.1177/0037549705055017). “Best of PADS 2004” special issue. Revision of [RC59](#). [PDF](#)
- RJ26. Kazuhiro Minami and David Kotz. *Secure context-sensitive authorization*. *Journal of Pervasive and Mobile Computing*, 1(1):123–156, March 2005, DOI [10.1016/j.pmcj.2005.01.004](https://doi.org/10.1016/j.pmcj.2005.01.004). Revision of [TR27](#). [PDF](#)
- RJ27. Javed Aslam, Sergey Bratus, David Kotz, Ron Peterson, Daniela Rus, and Brett Tofel. *The Kerf toolkit for intrusion analysis*. *IEEE Security and Privacy*, 2(6):42–52, November/December 2004, DOI [10.1109/MSP.2004.113](https://doi.org/10.1109/MSP.2004.113). Revision of [RP23](#). Later revised as [TR18](#). [PDF](#)
- RJ28. Jonathan Bredin, Rajiv T. Maheswaran, Çağrı Imer, Tamer Başar, David Kotz, and Daniela Rus. *Computational markets to regulate mobile-agent systems*. *Autonomous Agents and Multi-Agent Systems*, 6(3):235–263, May 2003, DOI [10.1023/A:1022923422570](https://doi.org/10.1023/A:1022923422570). Revision of [RC72](#). [PDF](#)
- RJ29. David Kotz, George Cybenko, Robert S. Gray, Guofei Jiang, Ronald A. Peterson, Martin O. Hofmann, Daria A. Chacón, Kenneth R. Whitebread, and James Hendler. *Performance analysis of mobile agents for filtering data streams on wireless networks*. *Mobile Networks and Applications (MONET)*, 7(2):163–174, April 2002, DOI [10.1145/506882.506889](https://doi.org/10.1145/506882.506889). Invited paper. Revision of [TR45](#). [PDF](#)
- RJ30. Robert S. Gray, George Cybenko, David Kotz, Ronald A. Peterson, and Daniela Rus. *D’Agents: Applications and performance of a mobile-agent system*. *Software—Practice and Experience*, 32(6):543–573, May 2002, DOI [10.1002/spe.449](https://doi.org/10.1002/spe.449). Invited paper. [PDF](#)
- RJ31. Ron Oldfield and David Kotz. *Armada: a parallel I/O framework for computational grids*. *Future Generation Computing Systems (FGCS)*, 18(4):501–523, March 2002, DOI [10.1016/S0167-739X\(01\)00076-0](https://doi.org/10.1016/S0167-739X(01)00076-0). [PDF](#)

- RJ32. David Kotz, Robert Gray, and Daniela Rus. *Future directions for mobile-agent research*. *IEEE Distributed Systems Online*, 3(8), August 2002. Based on a conversation with Jeff Bradshaw, Colin Harrison, Guenter Karjoth, Amy Murphy, Gian Pietro Picco, M. Ranganathan, Niranjan Suri, and Christian Tschudin. Revision of [TR33](#). [PDF](#)
- RJ33. David Kotz. *Disk-directed I/O for MIMD multiprocessors*. *ACM Transactions on Computer Systems*, 15(1):41–74, February 1997, DOI [10.1145/244764.244766](#). Identical to [IB9](#). Revision of [TR70](#). [PDF](#)
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- TR65. Nils Nieuwejaar, David Kotz, Apratim Purakayastha, Carla Schlatter Ellis, and Michael Best. *File-access characteristics of parallel scientific workloads*. Technical Report PCS-TR95-263, Dartmouth Computer Science, August 1995. Revision of [RC91](#). Later revised as [RJ39](#). [PDF](#)
- TR66. David Kotz. *Interfaces for disk-directed I/O*. Technical Report PCS-TR95-270, Dartmouth Computer Science, September 1995. [PDF](#)
- TR67. Apratim Purakayastha, Carla Schlatter Ellis, and David Kotz. *ENWRICH: a compute-processor write caching scheme for parallel file systems*. Technical Report CS-1995-22, Dept. of Computer Science, Duke University, October 1995. Later revised as [RC80](#). [PDF](#)
- TR68. Saurab Nog and David Kotz. *A performance comparison of TCP/IP and MPI on FDDI, fast Ethernet, and Ethernet*. Technical Report PCS-TR95-273, Dartmouth Computer Science, November 1995. Revised January 8, 1996. [PDF](#)
- TR69. David Kotz and Nils Nieuwejaar. *Dynamic file-access characteristics of a production parallel scientific workload*. Technical Report PCS-TR94-211, Dept. of Math and Computer Science, Dartmouth College, April 1994. Revised May 11, 1994. Later revised as [RC91](#). [PDF](#)
- TR70. David Kotz. *Disk-directed I/O for MIMD multiprocessors*. Technical Report PCS-TR94-226, Dartmouth Computer Science, July 1994. Revised November 8, 1994. Revision of [RC92](#). Later revised as [RJ33](#). [PDF](#)
- TR71. David Kotz, Song Bac Toh, and Sriram Radhakrishnan. *A detailed simulation model of the HP 97560 disk drive*. Technical Report PCS-TR94-220, Dartmouth Computer Science, July 1994. [PDF](#)
- TR72. David Kotz. *A data-parallel programming library for education (DAPPLE)*. Technical Report PCS-TR94-235, Dartmouth Computer Science, November 1994. Later revised as [RC84](#). [PDF](#)
- TR73. Apratim Purakayastha, Carla Schlatter Ellis, David Kotz, Nils Nieuwejaar, and Michael Best. *Characterizing parallel file-access patterns on a large-scale multiprocessor*. Technical Report CS-1994-33, Dept. of Computer Science, Duke University, October 1994. Later revised as [RC85](#). [PDF](#)
- TR74. Nils Nieuwejaar and David Kotz. *A multiprocessor extension to the conventional file system interface*. Technical Report PCS-TR94-230, Dartmouth Computer Science, September 1994. Later revised as [TR62](#). [PDF](#)
- TR75. David Kotz and Ting Cai. *Exploring the use of I/O nodes for computation in a MIMD multiprocessor*. Technical Report PCS-TR94-232, Dartmouth Computer Science, October 1994. Revised 2/20/95. Later revised as [RC87](#). [PDF](#)
- TR76. Thomas H. Cormen and David Kotz. *Integrating theory and practice in parallel file systems*. Technical Report PCS-TR93-188, Dept. of Math and Computer Science, Dartmouth College, March 1993. Revised 9/20/94. Revision of [RC95](#). [PDF](#)
- TR77. David Kotz. *Throughput of existing multiprocessor file systems*. Technical Report PCS-TR93-190, Dept. of Math and Computer Science, Dartmouth College, May 1993. [PDF](#)

- TR78. David Kotz and Preston Crow. *The expected lifetime of “single-address-space” operating systems*. Technical Report PCS-TR93-198, Dept. of Math and Computer Science, Dartmouth College, October 1993. Revised version appeared in SIGMETRICS '94, and revised again on March 15, 1996. Later revised as [RC90](#). [PDF](#)
- TR79. David Kotz, Fillia Makedon, Matt Bishop, Scot Drysdale, Donald Johnson, and Takis Metaxis. *Parallel computer needs at Dartmouth College*. Technical Report PCS-TR92-176, Dartmouth Computer Science, Hanover, NH 03775, January 1992. [PDF](#)
- TR80. David Kotz. *Multiprocessor file system interfaces*. Technical Report PCS-TR92-179, Dept. of Math and Computer Science, Dartmouth College, March 1992. Revised version appeared in PDIS'93. Later revised as [RC94](#). [PDF](#)
- TR81. Owen Astrachan, Vivek Khara, and David Kotz. *The Duke Internet programming contest*. Technical Report CS-1990-21, Dept. of Computer Science, Duke University, December 1990. Later revised as [RC93](#). [PDF](#)
- TR82. David Kotz. *The architecture of the Butterfly Plus parallel processor*. Technical Report CS-1988-6, Dept. of Computer Science, Duke University, January 1988. [PDF](#)
- TR83. Carla Schlatter Ellis and David Kotz. *Prefetching in file systems for MIMD multiprocessors*. Technical Report CS-1988-23, Dept. of Computer Science, Duke University, November 1988. Later revised as [RC99](#). [PDF](#)
- TR84. Neil Sullivan, Jonathan B. Rosenberg, Mark T. Jones, David Kotz, R. James Nusbaum, James W. O'Neil, and Herve Tardif. *Prism: A distributed VLSI design system*. Technical Report CS-1987-21, Dept. of Computer Science, Duke University, June 1987.
- TR85. David Kotz and Carla Ellis. *Evaluation of concurrent pools*. Technical Report CS-1987-30, Dept. of Computer Science, Duke University, October 1987. Later revised as [RC98](#). [PDF](#)

SOFTWARE ARTIFACTS (in approximate reverse-chronological order)

- SW1. David Kotz, Tristan Henderson, Ilya Abyzov, and Jihwang Yeo. *CRAWDAD dataset dartmouth/campus (v. 2009-09-09)*. Downloaded from <http://crawdad.org/dartmouth/campus/20090909>, September 2009, DOI [10.15783/C7F59T](#). Revision of [RJ14](#). [PDF](#)

PATENTS AND PATENT APPLICATIONS (in approximate reverse-chronological order)

- P1. David Kotz, Ryan Halter, Cory Cornelius, Jacob Sorber, Minh Shin, Ronald Peterson, Shrirang Mare, Aarathi Prasad, Joseph Skinner, and Andrés Molina-Markham, *Wearable computing device for secure control of physiological sensors and medical devices, with secure storage of medical records, and bioimpedance biometric*. U.S. Patent 9,595,187: Priority date 2011-12-23; Filing date 2012-12-24; Grant date 2017-03-14. [PDF](#)
- P2. Timothy J. Pierson, Xiaohui Liang, Ronald Peterson, and David Kotz, *Apparatus for Securely Configuring A Target Device and Associated Methods*. Patent application PCT/US2016/039009: Priority date 2015-06-23; Filing date 2016-06-23; Publication date 2016-12-29. [HTML](#)
- P3. Xiaohui Liang, Tianlong Yun, Ron Peterson, and David Kotz, *Secure System For Coupling Wearable Devices To Computerized Devices with Displays*. Patent application PCT/US2015/045651: Priority date 2014-08-18; Filing date 2015-08-18; Publication date 2016-02-25. [HTML](#)
- P4. Shrirang Mare, Andrés Molina-Markham, Ronald Peterson, Cory Cornelius, and David Kotz, *System, Method and Authorization Device for Biometric Access Control to Digital Devices*. Patent application PCT/US2014/031484: Priority date 2013-03-21; Filing date 2014-03-21; Publication date 2014-09-25. [HTML](#)
- P5. David Kotz, Daniela Rus, David Maramros, and John C. Artz, *Methods and apparatus for personalized content presentation*. Patent application PCT/US2001/049518: Priority date 2000-12-26; Filing date 2001-12-26; Publication date 2002-07-04. [HTML](#)

SOFTWARE ARTIFACTS (in approximate reverse-chronological order)

My research involves building software systems and simulations. I believe that it is important to distribute this software for others to use, either to extend their own research or to better understand my own. All are available from my home page at <http://www.cs.dartmouth.edu/~dfk/>.

- SW1. CRAWDAD archive: a Community Resource for Archiving Wireless Data At Dartmouth. <http://crawdad.org/>. 2005–present.
- SW2. HP 97560 disk simulation module, used in STARFISH and several other research projects. 1994.
- SW3. Parallel-I/O archive, bibliography, mailing list, and WWW page. <http://www.cs.dartmouth.edu/pario/>. 1989–2005.
- SW4. STARFISH parallel file-system simulator, The basis for my work in the mid-1990s. Used by at least two other research groups. 1992–1996. Third release October 1996.
- SW5. DATA-Parallel Programming Library for Education DAPPLE, a C++ class library that provides the illusion of data-parallel programming on sequential computers. 1994.
- SW6. RAPID-TRANSIT parallel file-system simulator. The basis for my Ph.D dissertation. 1987–1991.
- SW7. `gnuplot` plotting software. Major contributor 1987–1991.

Media coverage

I list here the most significant instances.

The National Academy of Engineering quoted me in a brief story about the Auracle project on their *Engineering Innovation Podcast and Radio Series*, hosted by WTOP News. [Listen](#) on their website.

Many media outlets covered our mHealth agenda paper (RJ3), including [ScienceDaily](#), [Healthcare IT News](#), [FierceHealthcare](#), [EurekAlert](#), [Newswise](#), and [FierceBiotech](#).

Quoted in *US News* about privacy of health-tracking apps, 2016.

Over 300 media outlets covered our Wanda paper (RC8), including [National Public Radio \(NPR\)](#), [ABC News](#), [Boston Herald](#), [Chicago Daily Herald](#), [Daily Mail](#), [FierceMobileHealthcare](#), [New York Times](#), [San Francisco Chronicle](#), [Seattle Times](#), [The Hindu](#), [The Independent](#), and the [Washington Post](#), 2016.

Articles about our ZEBRA paper (RC10) appeared in Communications of the ACM (CACM), VICE Motherboard, Gizmag, The Register UK, Planet Biometrics, Computer Business Review, Fierce Health IT, Daily Science News, Senior Tech Insider, Motherboard, Homeland Security Newswire, Dartmouth's Graduate Forum, and NFC World (follow links [here](#)), 2014. Project renamed CSAW (Continuous Seamless Authentication with Wristbands).

Articles announcing our [Amulet project](#) on [Dartmouth Now](#), [Clemson news](#), and [many others](#).

Articles announcing our [Trustworthy Health and Wellness project](#) on [Dartmouth Now](#), [Associated Press](#), [Vermont Public Radio](#), and [others](#).

Articles on our bioimpedance-as-biometric paper (RC19) appeared in [Technology Review](#), [Popular Science](#), [Popular Mechanics](#), [NextGov](#), [ThirdFactor](#), [ARS Technica](#) and [In Vivo](#) magazine, The most thorough coverage was in [The Dartmouth](#) and [Dartmouth Now](#). August 2012.

Panelist on *The Exchange*, a call-in show on New Hampshire Public Radio. [How Safe Is Safe?](#) September 12, 2005.

Interviewed in Waters magazine [You're Hit; Wall Street and Global Capital Markets are Prepared for Another Physical Attack, But is the Industry Ready for Cyber-Terrorism?](#), October 1, 2004.

Interviewed on BBC's The World [Tech report](#), August 2, 2004, about terrorists' use of the Internet.

Interviewed in The New York Times story [A New Kind of Revolution In the Dorms of Dartmouth](#), September 23, 2003.

Interviewed on [Discovery Channel Canada](#)'s technology show "Gadget Grrls." October 2002.

Expert guest on [CREN Tech Talk](#), a technical talk show hosted by the Corporation for Research and Educational Networking on Thursday, September 12, 2002.

Josh McHugh, [Unplugged U.](#), Wired Magazine, October 2002. This feature article is about the wireless network at Dartmouth College, and mentions my research [RC68] several times.

Invited Talks and Colloquia

CONFERENCES AND WORKSHOPS (*in approximate reverse-chronological order*)

(Invited presentations other than those for accepted papers.)

- 2017: [ACM Workshop on Wearable Systems and Applications \(WearSys\)](#), Niagara Falls, June 2017.
- 2015: [Medical Informatics World](#), Boston, May 2015.
- 2015: [Workshop on Networked Healthcare Technology \(NetHealth\)](#), Bangalore India, January 2015.
- 2014: [Privacy & Security Symposium at the mHealth Summit](#), Washington DC, December 2014.
- 2014: [Workshop on Mobile Medical Applications – Design and Development \(WMMADD\)](#), Memphis TN, November 2014.
- 2014: AAAS Workshop on Exploring Legal Challenges to Fulfilling the Potential of mHealth in a Safe and Responsible Environment, Washington DC, October 2014.
- 2014: [USENIX Summit on Health Information Technologies](#), San Diego CA, August 2014.
- 2013: [Wireless Health](#), Baltimore, MD, November 2013.
- 2012: [Workshop on Networked Healthcare Technology \(NetHealth\)](#), Bangalore, India, January 2012.
- 2011: [WiREless Systems: Advanced Research and Development \(WISARD\)](#), Bangalore, India, January 2011.
- 2010: [Workshop on Scenarios for Network Evaluation Studies \(SCENES\)](#), San Francisco, November 2010.
- 2009: [COMmunication Systems and NETworkS \(COMSNETS\)](#), Bangalore, India, January 2009.
- 2009: [WiREless Systems: Advanced Research and Development \(WISARD\)](#), Bangalore, India, January 2009.
- 2007: [The Colloquium for Information Systems Security Education \(CISSE 2007\)](#), Boston, MA, June 2007.
- 2006: MSR Summit on Corporate/Campus Networks (EdgeNet 2006), Snoqualmie, WA, June 2006.
- 2005: [City WLAN 2005](#) (Keynote speech), Oulu, Finland, August 2005.
- 2005: Intel Security Workshop, Hillsboro, OR, July 2005.
- 2005: [Wireless Traffic Measurements and Modeling workshop](#) (panel session), June 2005.
- 2005: [First Workshop on Wireless Network Measurements](#) (Keynote speech), Riva del Garda, Italy, April 2005.
- 2004: EDUCAUSE ([award presentation](#)), October 2004.
- 2003: First ACM International Workshop on Wireless Mobile Applications and Services on WLAN Hotspots (panel chair), September 2003.
- 2002: Mobile Agents (keynote), October 2002.
- 1999: Dartmouth Workshop on Transportable Agents, October 1999.
- 1996: Third International Conference of the Austrian Center for Parallel Computation (keynote).
- 1996: CUNY Workshop on the First-year Computer-Science Curriculum (talk).
- 1995: Gordon Research Conference on High-Performance Computing and National Information Infrastructure (talk).
- 1995: International Parallel Processing Symposium (panel discussion).
- 1995: OSF/RI Research Symposium (talk).
- 1995: Wellesley Forum on Parallel Computing Curricula (talk).
- 1995: Frontiers '95 Workshop on Scalable I/O (talk).
- 1994: International Conference on Parallel Processing (panel discussion).
- 1992: Parallel Computing Curriculum Development Workshop, Colgate University (talk).
- 1990: DARPA/UMIACS Workshop on Parallel Processing (talk).
- 1989: DARPA/UMIACS Workshop on Parallel Processing (talk).
- 1987: BBN Butterfly User's Group Meeting (talk).

ACADEMIA (*in approximate reverse-chronological order*)

(Name of my host is in parentheses.)

- 2017: New York University – Center for Drug Use and HIV Research (CDUHR) (Noelle Leonard)
- 2016: University of Washington (Shrirang Mare) [see [video](#)]
- 2016: Amherst College (Aarathi Prasad)
- 2016: University of Massachusetts Amherst (Brian Levine)

2016: University of Massachusetts Boston (Xiaohui Liang)
2016: Healthcare Privacy Working Group
2016: NIDA National Clinical Trials Network
2014: University of Memphis (MD2K.org) (Santosh Kumar)
2014: Stanford University (John Mitchell)
2014: UC Berkeley (Anthony Joseph)
2013: Clemson University (Jacob Sorber)
2013: Medical University of South Carolina (Frank Treiber)
2012: Indiana University (Apu Kapadia)
2011: St Andrews University (Tristan Henderson)
2009: University of Auckland, New Zealand (Gerard Rowe)
2009: University of Adelaide, Australia (Cheryl Pope)
2009: University of Sydney, Australia (Lavy Libman)
2009: Reva Institute of Technology & Management, Bangalore (Vijay Kumar, CSE)
2009: Indian Institute of Technology, Guwahati (G. Sajith, CSE)
2009: National Degree College, Bangalore (M. K. Sridhar)
2009: Indian Institute of Technology, Delhi (Sandeep Sen, CSE)
2009: Indian Institute of Science, Bangalore (Y. N. Srikant, CSA)
2009: Indian Institute of Science, Bangalore (Y. N. Srikant, CSA)
2009: Indian Institute of Technology, Bombay (Varsha Apte, CSE)
2008: Indian Institute of Technology, Madras (Krishna Sivalingam, CSE)
2008: Madras Institute of Technology (S. Srikanth, AU-KBC Research Centre)
2008: Indian Institute of Science, Bangalore (Y. N. Srikant, CSA)
2008: Indian Institute of Technology, Kharagpur (Indranil Sen Gupta, SIT)
2008: Indian Institute of Technology, Kanpur (Rajat Moona, CSE)
2008: Indian Institute of Science, Bangalore (Anurag Kumar, ECE)
2008: Rutgers University Distinguished Lecture Series (Marco Gruteser)
2007: University of Massachusetts Lowell (Guanling Chen)
2007: Indian Institute of Science, Bangalore (Anurag Kumar)
2006: Cornell University (Emin Gün Sirer)
2006: Georgia Institute of Technology (Mustaque Ahamad)
2006: University of California, Berkeley (Kris Pister)
2005: Duke University (Owen Astrachan)
2004: Colorado School of Mines (Jason Liu)
2002: Boston University (Mark Crovella)
2002: Stanford University (Mary Baker)
2002: U.C. Berkeley (Randy Katz)
2001: Institute for Security Technology Studies (Garry Davis)
1998: University of Geneva, Switzerland (Alex Villazon)
1998: Ecole Polytechnique Fédérale de Lausanne, Switzerland (Roger Hersch)
1996: University of Vienna (Peter Brezany)
1996: University of New Hampshire (Phil Hatcher)
1995: University of Connecticut (Phyllis Crandall)
1995: Duke University (Carla Ellis)
1995: University of North Carolina (Nyland, Lastra, Prins, Chatterjee)
1995: Georgia Tech (Karsten Schwan)
1995: Cornell University (Ken Birman)
1995: University of Rochester (Michael Scott)
1995: Rochester Institute of Technology (Nan Schaller)
1995: University of Illinois Urbana-Champaign (Dan Reed, Andrew Chien)

1995: Syracuse University (ACM Chapter)
 1994: University of Virginia (Andrew Grimshaw)
 1994: University of Maryland (Joel Saltz)
 1994: University of Toronto (Michael Stumm)
 1994: Syracuse University (Alok Choudhary)
 1994: UC Santa Cruz (Darrell Long)
 1994: Princeton University (Kai Li)
 1994: Johns Hopkins University (Magda Konstantinidou)
 1994: University of Michigan (Peter Chen)
 1994: University of Wisconsin (David DeWitt)
 1994: Carnegie Mellon University (Garth Gibson) (2 talks)
 1991: University of Pittsburgh (job talk)
 1991: Dartmouth College (job talk)
 1991: University of North Carolina (job talk)
 1991: University of Kentucky (job talk)
 1991: Syracuse University (job talk)
 1991: University of South Carolina (job talk)
 1991: University of Cincinnati (job talk)
 1991: University of Tennessee (job talk)

INDUSTRY (*in approximate reverse-chronological order*)

(Name of my host is in parentheses.)

2016: Intel Labs (Cory Cornelius)
 2015: Medical Mutual Insurance, Falmouth ME (annual meeting)
 2012: Microsoft Research, Redmond (Stefan Saroiu)
 2011: Microsoft Research India, Bangalore (Krishna Chintalapudi)
 2009: Nokia Research Lab, Bangalore (Archana Sunderashan)
 2009: Tata Consulting Services (TCS) Innovation Lab, Bangalore (P. Balamuralidhar)
 2009: IBM Research Lab, Bangalore (Shivkumar Kalyanaraman)
 2009: Bell Labs India, Bangalore (Vikram Srinivasan)
 2008: Microsoft Research, Bangalore (Venkat Padmanabhan)
 2008: Intel Research, Bangalore (Vittal Kini)
 2007: Microsoft Research, Bangalore (Venkat Padmanabhan)
 2007: Infosys, Bangalore (V. P. Kochikar)
 2007: Intel Research, Bangalore (Vittal Kini)
 2006: IBM T.J. Watson Research Center (Apratim Purakayastha)
 2005: BAE Systems (Rich Ashooh)
 2004: Microsoft Research
 2004: Google
 2004: McKinsey & Company
 2004: Cisco Systems
 2004: Cisco Systems (Matt Schmitz)
 2003: Intel Research Seattle (Gaetano Borriello)
 2003: Intel Labs, Hillsboro (Abel Weinrib)
 2003: HP Labs (John Barton)
 2003: Microsoft Research (Jon Howell)
 2002: Intel (Julie Coppernoll)
 2002: Cisco Systems (Joe DeStefano, Bill Rossi)
 2002: Airgo Networks (Skip Stritter)

2002: Handspring (Debbie Chyi, Arun Mathias)
 2002: DoCoMo Labs USA (Ravi Jain)
 2001: Mitsubishi Electric Research Lab (David Wong)
 2000: IBM T.J. Watson Research Center (Apratim Purakayastha)
 1997: General Magic, Inc. (James White)
 1993: Thinking Machines Corporation (Mike Best)
 1993: MasPar Computer Corporation (Russ Tuck)
 1992: IBM T.J. Watson Research Center (Marc Snir, Peter Corbett)
 1992: Intel SSD (Denise Ecklund)
 1992: nCUBE (Mike del Rosario)
 1992: Hewlett Packard Labs (John Wilkes)
 1992: Center for High Performance Computing (Richard LaRowe, Jr.)

GOVERNMENT (*in approximate reverse-chronological order*)

2017: NSF Smart and Connected Health — vision meeting
 2017: NSF Secure and Trustworthy Cyberspace — semi-annual PI meeting
 2016: U.S. Department of State — Workshop on *Cyber Security: Data Manipulation*
 2015: National Science Foundation
 2015: [NSF Workshop on Wireless Security](#)
 2014: [NSF Workshop on Mobile Community Measurement Infrastructure](#)
 2014: [NIH and NSF National Workshop on Computing Challenges in Future Mobile Health \(mHealth\) Systems and Applications](#)
 2014: [USA Science Festival](#) (NSF booth)
 2014: [NSF Workshop on Research Frontiers in Medical Cyber-Physical Systems](#)
 2013: [NSF Workshop on Future Directions in Wireless Networking](#)
 2011: [NSF Indo-US Workshops on Developing a Research Agenda in Pervasive Communications and Computing Collaboration \(PC3\)](#)
 2011: [NSF Workshop on Pervasive Computing at Scale \(PeCS\)](#) [report]
 2008: US/DoD – Finland/Tekes Collaborative Workshop, Washington, DC
 2005: [NSF workshop on Grand Challenges in Distributed Systems](#) [report]
 2002: Argonne National Laboratory (Rajeev Thakur)
 1999: Air Force Research Lab, Rome, NY (Rick Metzger)
 1999: Sandia National Laboratories, Albuquerque (David Womble)
 1997: Sandia National Laboratories, Livermore (Joe Durant)
 1996: Sandia National Laboratories, Albuquerque (David Womble)
 1995: Argonne National Laboratory (Ian Foster)
 1994: NASA Ames Research Center (Bill Nitzberg)
 1994: Sandia National Laboratories (David Womble)
 1992: Army Research Office (Ken Clark)
 1991: ICASE (job talk)

TUTORIALS (*in approximate reverse-chronological order*)

Parallel-I/O Issues for High-Performance Distributed Computing, with Thomas H. Cormen.
 IEEE Symposium on High-Performance Distributed Computing (1995).

Parallel File Systems and Current Work.

Dartmouth Institute for Advanced Graduate Studies, School for Parallel Computation (1994).

Consulting (expert witness)

On behalf of the party marked with asterisk.*

| | |
|--|-------------------|
| <i>CallWave Communications* vs. Google and others</i> Attorney: Suparna Datta, Pepper Hamilton | 2014–date |
| <i>Skyhook Wireless* vs. Google</i> Attorney: Steven Cherensky, Tensegrity Attorney: Sam Lu, Irell & Manella Deposed in 2011 and 2014; case settled before trial. | 2013–2015 2011 |
| <i>Wi-LAN* vs. Research in Motion (RIM)</i> Attorney: James Hietala, Carlson Caspers | 2011 |
| <i>TMC Patents* vs. HP and Compaq</i> Attorney: Jeffrey M. Gold, Morgan Lewis & Brockius | 2002 |
| <i>Previo vs. Connected Corporation*</i> Attorney: Howard Susser, of Mintz Levin Cohn Ferris Glovsky and Popeo | 2001 |
| <i>Palm vs. Kessel Electronics*</i> Attorney: Sanny Kwong, of Hong Kong Studying computer codes for copyright suit on behalf of Kessel Electronics (Hong Kong). | 2001 |
| <i>EMC Corporation* vs. StorageApps</i> Attorney: Peter Dichiara, of Hale and Dorr | 2001 |
| <i>SeaChange International* vs. nCUBE</i> Attorney: Steven Katz, of Fish & Richardson Deposed and attended trial but did not need to testify. | 2000 |

Professional Activities

IEEE Fellow and member of IEEE Computer Society.

Senior Member of Association for Computing Machinery (SIGOPS, SIGMOBILE).

Member of USENIX, University Campus Liaison for Dartmouth College, 1992–date.

Advisory Board member for NSF-funded effort *Provenance-based Data Analytics Cyberinfrastructure for High-frequency Mobile Sensor Data*; Principal Investigator: Santosh Kumar, University of Memphis.

Associate Editor for *Pervasive and Mobile Computing*, 2007–2012.

Associate Editor for *IEEE Transactions on Mobile Computing*, 2005–2011.

Chair of ACM Special Interest Group on Operating Systems (SIGOPS), 2001–2003.

Secretary-treasurer of ACM Special Interest Group on Operating Systems (SIGOPS), 1999–2001.

Vice-chair of IEEE Technical Committee on Operating Systems (TCOS), 1997–1998.

Area Editor of “Context-aware mobile computing” in SIGMOBILE’s flagship publication *Mobile Computing and Communications Review* (MC2R), 2002–2003.

Co-editor of Special Issue of *Concurrency Practice and Experience* on “High-performance agent systems,” 1999.

CONFERENCE COMMITTEES (in approximate reverse-chronological order)

Program committee, [CCS 2017](#): ACM Conference on Computer and Communications Security

Program committee (external), [MobiSys 2016](#): Int’l Conference on Mobile Systems, Applications, and Services

Program co-chair, [HealthTech 2015](#): USENIX Summit on Health Information Technologies Safety, Security, Privacy, and Interoperability of Health Information Technologies

Program committee, [HealthTech 2014](#): USENIX Summit on Health Information Technologies Safety, Security, Privacy, and Interoperability of Health Information Technologies

General co-chair, [MobiSys 2014](#): International Conference on Mobile Systems, Applications, and Services

Program committee, [NetHealth 2014](#): COMSNETS Workshop on Networked Healthcare Technology

Program committee, [ACM DEV4](#): ACM Symposium on Computing for Development (end of 2013)

Program committee, [MobiSys 2013](#): International Conference on Mobile Systems, Applications, and Services

General co-chair, [SITH 2013](#): Securing Information Technology in Healthcare: Part III

General co-chair, [COMSNETS 2013](#): International Conference on COMMunication Systems and NETworkS

General co-chair, [SITH 2012](#): Securing Information Technology in Healthcare: Part II

Program committee, [NetHealth 2012](#): COMSNETS Workshop on Networked Healthcare Technology

Program committee, [mHealthSys 2011](#): Workshop on Mobile Systems, Applications, and Services for Healthcare

Program committee, [HealthSec 2011](#): USENIX Workshop on Health Security and Privacy

Program committee, [NetHealth 2011](#): COMSNETS Workshop on Networked Healthcare Technology

Program committee, [HealthSec 2010](#): USENIX Workshop on Health Security and Privacy

General co-chair, [SITH 2010](#): Securing Information Technology in Healthcare

Program committee, [HotPlanet 2010](#): ACM International Workshop on Hot Topics in Planet-scale Measurements

Instigator and Co-organizer, [mHealth India 2009](#): Workshop on mobile computing in healthcare, for India

Program committee, [ICDCN 2009](#): International Conference on Distributed Computing and Networking

Program committee, [Mobility Models 2008](#): Workshop on Mobility Models, colocated with MobiHoc 2008

Program committee, [Mobicom 2007](#): International Conference on Mobile Computing and Networking

Program committee, [MobiSys 2006](#): International Conference on Mobile Systems, Applications, and Services

Program co-Chair, [MobiSys 2005](#): International Conference on Mobile Systems, Applications, and Services

Program committee, [Mobicom 2004](#): International Conference on Mobile Computing and Networking

Program committee, [WMASH 2003](#): Workshop on Wireless Mobile Applications and Services on WLAN Hotspots

Program committee, [MobiSys 2003](#): International Conference on Mobile Systems, Applications, and Services

Program committee, [MDM 2003](#): International Conference on Mobile Data Management

Program committee, [COOPIS 2002](#): International Conference on Cooperative Information Systems

Steering Committee Chair: “Mobile Agents” series of conferences

Program committee, [FAST 2002](#): File systems And Storage Technology

Steering committee chair, [SOSP 2001, 2003](#): Symposium on Operating Systems Principles

General Chair, [MA 2001](#): Mobile Agents

Program chair, [ASA/MA 2000](#): Joint Symposium on Agent Systems and Applications, and on Mobile Agents

Co-organizer, [DWTA 2000](#): Dartmouth Workshop on Transportable Agents

General chair, [SOSP '99](#): Symposium on Operating Systems Principles

Steering committee, [WMCSA 1998–99](#): Workshop on Mobile Computing Systems and Applications

Co-organizer, [DWTA 1999](#): Dartmouth Workshop on Transportable Agents

Program committee, [ASA/MA 1999](#): Joint Symposium on Agent Systems and Applications, and on Mobile Agents

Co-organizer and Program Committee member: [Workshop](#) “Agent-Based High Performance Computing: Problem Solving Applications and Practical Deployment” at Autonomous Agents '99

Program Committee member, [MAC3 1999](#): Workshop on Mobile Agents in the Context of Competition and Cooperation at Autonomous Agents '99

Program Committee member, [MA 1998](#): International Workshop on Mobile Agents

Treasurer, [DWTA 1997](#): Dartmouth Workshop on Transportable Agents

Program Committee chair, [IOPADS 1997](#): Workshop on I/O in Parallel and Distributed Systems

Program Committee chair, [FPCC 1997](#): Forum on Parallel Computing Curricula, held in conjunction with SPAA

General co-chair, [DWTA 1996](#): Dartmouth Workshop on Transportable Agents

Program Committee member, [PDIS 1996](#): Int'l Conference on Parallel and Distributed Information Systems

Tutorials Committee member, [Supercomputing '96](#)

Program Committee member, ACPC 1996: International Conference of the Austrian Center for Parallel Computation

Working Group member, SDCR: ACM Workshop on Strategic Directions in Computing Research, Working Group on Storage I/O for Large-Scale Computing, June 1996

Program Committee member, IOPADS 1996: Workshop on I/O in Parallel and Distributed Systems

General co-chair, IOPADS 1996: Workshop on I/O in Parallel and Distributed Systems

Program Committee member, SIGMETRICS 1996: Conference of Measurement and Modeling of Computer Systems

Organizing Committee member, FCRC 1996: Federated Computing Research Conference

Local Arrangements Committee chair, DAGS 1993: Dartmouth Institute for Advanced Graduate Studies, Symposium on Parallel I/O and Databases

Program Committee member, DAGS 1992, 1993: Dartmouth Institute for Advanced Graduate Studies Symposium on Parallel Computing

Steering Committee member, DAGS 1992–94: Dartmouth Institute for Advanced Graduate Studies

OTHER PROFESSIONAL COMMITTEES (*in approximate reverse-chronological order*)

Health Information Technology Policy Committee: 2013–2017. The [HIT Policy Committee](#) makes recommendations to the National Coordinator for Health IT on the development and adoption of a nationwide health information infrastructure, including standards for the exchange of patient medical information.

NIH review panel member, 2016: Precision Medicine Initiative Cohort Program Participant Technologies Center study section

NSF review panel member: 1995, 1996, 2005, 2009, 2010, 2011, 2013, 2014, 2015, 2016, 2017.

IEEE Fellows selection committee: 2012.

USENIX Scholastic Committee: Evaluating research-funding proposals from graduate students, 1997–2000.

Computer Science Advisory Committee member: Computer Management Group (CMG), 1995. Selecting awardees for CMG Fellowships.

DARTMOUTH COLLEGE COMMITTEES (*in approximate reverse-chronological order*)

Dartmouth College Leadership:

Associate Dean of Faculty for the Sciences, 2009–2015.

Chair, Science Divisional Council, 2009–2015.

Chair, Dartmouth Centers Forum: 2006–2007.

Executive Director of the Institute for Security Technology Studies (ISTS), 2004–2007.

Director of Research and Development at ISTS, 2003–2004.

Director of the Center for Mobile Computing, 1997–2007.

Dartmouth College Committees and Councils:

Science strategy working group, co-chair, 2016.

Pre-health advising working group, 2014–2015.

BASIC 50th anniversary planning committee: 2013–2014.

Learning 21: Steering Committee, 2012–2013.

Executive Working Group on Information Technology, 2012–2015.

Strategic planning workgroup on Graduate Studies of the Future, 2011–12.

Budget Committee, 2010–2015.

Faculty Advisory Group on Blitz Transition project: 2010–2011.
 Council on Undergraduate Research: 2010–2015.
 Academic Planning Committee, 2009–2015.
 Council on Computing, 2009–2015.
 Council on Sponsored Activities, 2009–2015.
 Conflict of Interest Committee, 2009–2015.
 Committee on Withdrawals, 2009–2015.
 Montgomery Endowment Steering Committee, 2009–2015.
 Research Computing Oversight Committee, 2009–2011.
 Enterprise Systems Review Committee, 2009–2010.
 Committee on NEASC Reaccreditation (Standard 4), 2009–2010.
 Study group on Communication and Collaboration Tools (Chair), Spring 2010.
 Committees on IT consolidation (research, infrastructure, support), Winter 2010.
 Ad-hoc committee to review technology transfer and entrepreneurship, Fall 2009.
 Security Oversight Committee (Computing Services): 2005.
 ISTS Faculty Advisory Committee, 2002–2007 (Chair, 2003–2007).
 Alumni Council (Faculty Representative), 2002–2004.
 Computing Technology Venture Fund, 2001–2002.
 Ad-hoc committee to bring a wireless network to campus, 1999–2001.
 Ad-hoc committee on Academic Computing, leading to “eLearning center” proposal, 1999–2000.
 Accreditation subcommittee on Computing and Information Environment, 1999.
 Dartmouth Outing Club, Board of Directors, 1993–1999.
 Council on Libraries, 1992–1994, 1998–1999.
 College Course Steering Committee, 1997–1999.
 Council on Honorary Degrees, 1996.

Dartmouth Departmental Committees:

Ph.D Student Recruiting Committee (publicity), 2007–08.
 Assistant Chair of Computer Science. 2002–2003.
 CS Faculty Recruiting Committee. 1993–1994, 1995–1996, 1999–2000, 2002–04, 2006–07, 2016–17; chair 2000, 2003, 2007 and 2017.
 Advisor to CS Ph.D students, 2000.
 Equipment Committee, 1992–2000, chair 1995–1996 and 1997–2000.
 Building Committee, chair 1997–1999, Summer 2001, Winter-Spring 2002, chair 2002–2003.
 Advisor to CS undergraduates, 1993–1994, 1995–1998.
 CS Curriculum Committee. 1995–1998.
 CS Undergraduate Program Committee. 1993–1994.
 Computer Science Colloquium Chair, 1992–93.
 John G. Kemeny Prize committee, judging for an undergraduate programming prize, 1992, 1998, 1999.
 Chair of “Parallel Needs” (PaN) Committee, 1991–1992.

Dartmouth College Alumni Committees:

VOX Alumni Network Advisory Committee, 1997–2002.

Academic Activities

RESEARCH STUDENTS (*in approximate reverse-chronological order*)

Ph.D students (completed): *See list of their theses on page 20.*

Shrirang Mare, 2009–2016; now a postdoc at University of Washington.
 Aarathi Prasad, 2009–2016; now an Assistant Professor at Skidmore College.
 Cory Cornelius, 2009–13; now at Intel Labs.
 Keren Tan, 2006–2011; now at Facebook.
 Udayan Deshpande, 2003–2008; now at icebrg.io, a cybersecurity firm.
 Ming Li, 2002–2008; now at Oracle.
 Soumendra Nanda, 2004–2008; now at BAE Systems.
 Libo Song, 2002–2008; now at Google.
 Kazuhiro Minami, 1999–2006; now an Associate Professor at the Institute of Statistical Mathematics in Japan.
 Guanling Chen, 1999–2004; now an Associate Professor of Computer Science at Univ. Massachusetts, Lowell.
 Ron Oldfield, 1997–2003; now Manager, Scalable Analysis and Visualization, Sandia National Laboratories.
 Jonathan Bredin, 1996–2001; now at Two Sigma Investments, after a tenured professorship at Colorado College.
 Jon Howell, 1995–2000; now at Google, after many years at Microsoft Research.
 Nils Nieuwejaar, 1993–1996; now at EMC.

Ph.D students (current):

Shengjie Bi, Auracle wearable platform for mHealth. 2016–present.
 Taylor Hardin, Amulet wearable platform for mHealth. 2016–present.
 Rui Liu, trustworthy mobile-health systems. 2016–present.
 Varun Mishra, Amulet wearable platform for mHealth. 2016–present.
 Travis Peters, trustworthy mobile-health systems. 2014–present.
 Timothy Pierson, trustworthy mobile-health systems. 2012–present.

M.S. students (completed): *See list of their theses on page 20.*

George Boateng, 2016–17; now at Dartmouth.
 Tianlong Yun, 2014–2016; now at Google.
 Rima Narayana Murthy, 2011–2014; recently at Oracle.
 Zhenhui Jiang, 2004–2005; now at Bridgewater Consulting.
 Jue Wang, 2003–2004; now at Visa, Inc.
 Ting Cai, 1997; now at Microsoft.
 Saurab Nog, 1996; now at Amazon.
 Preston Crow, 1992–1994; now at EMC.

Post-docs supervised:

Reza Rawassizadeh 2016–2017 (Ph.D from University of Vienna, Austria).
 Xiaohui Liang 2014–2015 (Ph.D from Univ. Waterloo). Now an Assistant Professor at UMass Boston.
 Andrés Molina-Markham 2012–2014 (Ph.D from Univ. Massachusetts). Now Lead Cyber Security Researcher at MITRE.
 Jacob Sorber 2010–12. Now an Associate Professor at Clemson University.
 Anna Shubina 2008–2010. Now research staff at Dartmouth College.
 Minh Shin 2007–2010. Now an Associate Professor at Myongji University, Korea.
 Michael Locasto 2008. Now a Senior Computer Scientist at SRI International.
 Apu Kapadia 2006–2008. Now an Associate Professor at Indiana University.
 Sergey Bratus 2002–2005, 2007–2008. Now a Research Associate Professor at Dartmouth College.
 Vijay Bhuse 2007. Now an Assistant Professor at Grand Valley State University, after several years in industry.
 Yong Sheng 2006–2007. Now at Pinterest.
 Tristan Henderson 2003–2006. Now on the faculty at the University of St. Andrews, Scotland.
 Minkyong Kim 2004–2006. Now at Samsung, Korea.
 Arnab Paul 2005. Now a Research Scientist at Intel.
 Marco Cremonini 2000–2001. Now on the faculty at the University of Milan.

Undergraduate honors theses supervised:

2017: Alexandra Dalton.
 2017: Emily Greene.
 2017: David Harmon.
 2016: Anna Knowles.
 2016: George Boateng.
 2016: Bingyue Wang.
 2013: Rebecca Lau, Shloka Kini.
 2012: Emma Smithayer.
 2011: Phillip Fazio.
 2008: Jeff Fielding.
 2004: Cal Newport.
 2003: Clara Lee.
 2002: Chris Masone, Abe White.
 2001: Ammar Khalid, Arun Mathias, Ayorkor Mills-Tettey, Pablo Stern.
 2000: Debbie Chyi, Jay Artz.
 1999: Cenk Ergan.
 1998: Eric White.
 1996: Scott Silver, Joel Thomas.
 1995: Ken Harker, Song Bac Toh.
 1992: Jim Gochee, Brendan Hahn.

Undergraduate Presidential Scholars supervised:

Yining Chen, Winter/Spring, 2016/2017.
 Emma Oberstein, Summer/Winter, 2016/2017.
 Emily Greene, Summer/Winter, 2015/2016.
 Cal Newport, Summer/Fall 2002.
 Tiffany Wong, Winter/Spring 2000.
 Debbie Chyi, Fall/Winter, 1998/1999.
 Jeff Steeves, Summer/Fall, 1997/1998.
 Matt Carter, Summer/Winter, 1996/1997.
 Dawn Lawrie, Summer/Fall 1995.
 Sriram Radhakrishnan, Winter/Spring 1994.
 Song Bac Toh, Spring/Fall 1993.

Thesis committee member:

Dartmouth College

| | | | |
|-----------------------|------|------------------------|------|
| Jason Reeves | 2016 | | |
| Scout Sinclair | 2013 | Peter Johnson | 2015 |
| Priya Natarajan | 2011 | Chrisil Arackaparambil | 2011 |
| Song Ye | 2008 | Chris Masone | 2008 |
| Yurong Xu | 2008 | Meiyuan Zhao | 2005 |
| Guanhua Yan | 2005 | Fang Pei (MS) | 2004 |
| Nick Goffee (MS) | 2004 | Soumendra Nanda (MS) | 2004 |
| Jason Liu | 2003 | Qun Li | 2004 |
| Katya Pelekov | 2001 | Mark Montague | 2002 |
| Bob Gray | 1997 | Alex Colvin | 1999 |
| Pichet Chintrakulchai | 1995 | Len Wisniewski | 1995 |
| Peter Su | 1993 | John van Meter | 1993 |
| Larry Raab | 1992 | Deb Banerjee | 1992 |

elsewhere

| | | |
|-------------------|------|---|
| Vincent Messerli | 1998 | Ecole Polytechnique Fédérale de Lausanne, Switzerland |
| Rajesh Bordawekar | 1996 | Syracuse University |
| Rajeev Thakur | 1995 | Syracuse University |
| Orran Krieger | 1994 | University of Toronto |

TEACHING (in approximate reverse-chronological order)

Graduate courses taught at Dartmouth College:

- CS 88/188 Seminar (Parallel Computing)
- CS 88/188 Seminar (Transportable agents and extensible operating systems)
- CS 88/188 Seminar (Electronic Commerce and Market-based control)
- CS 88/188 Seminar (Wireless networks and hand-held computers)
- CS 88/188 Seminar (Context-aware mobile computing)
- CS 88/188 Seminar (Pervasive computing)
- CS 108 Advanced Operating Systems (3 times)

Undergraduate courses taught at Dartmouth College:

- CS 9 Introduction to Computer Science, Honors Section
- CS 23 Software Design and Implementation (2 times)
- CS 37 Computer Architecture (4 times)
- CS 50 Software Design and Implementation (1 time)
- CS 58 Operating Systems
- CS 78 Computer Networks (4 times)
- CS 98 Engineering Projects in Community Service (2 times)
- CS 99 Current Trends and Ethical Issues in Computer Science (3 times)

Other Activities

Married, with three children (born 1996, 1999, and 2001).

Member of the Montshire Corporation for [Montshire Museum](#) (2012–present).

Member of the Board of Trustees for [Crossroads Academy](#) (2011–present).

Member of the Advisory Council for the [Dartmouth Outing Club](#) (2009–2013).

Member of the Upper Valley Subcommittee of the [Connecticut River Joint Commission](#) (2006–2013), as appointed by the Town of Lyme, NH.

Volunteer Land Steward with [Upper Valley Land Trust](#) (2000–2011, 2014, 2016).

Co-founded an annual computer programming contest held in real-time over the Internet. Participation grew from 60 teams from 37 institutions in 5 countries in Fall 1990, to 495 teams in Fall 1993.

Member of Duke team, 1989 and 1990 ACM International Programming Contests. Finished fourth in 1989 (Louisville, KY) and eighth in 1990 (Washington, DC).

Volunteer with the National Park Service in Olympic National Park, Summer 1986. Spent the summer in the backcountry, contacting visitors and maintaining trails.

Director of Freshman Trips for Dartmouth College, 1985: Made all arrangements for three-day outdoor trips for over 800 incoming freshmen. Wrote the database and support software, used 1983–1989.

Trip Leader for Dartmouth's "DOC Trips" (was "Freshman Trips"), a program to take incoming freshmen on three-day outdoor trips. 1983, 1991, 1992, 1993, 1995, 1998.