Stanford

Mendel Rosenblum

Cheriton Family Professor and Professor of Electrical Engineering

Computer Science

CONTACT INFORMATION

- **Administrator**

  Andi Villanueva - Administrative Associate

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Bio

BIO

Rosenblum's research interests include system software, distributed systems, and computer architecture. He has published research in the area of disk storage management, computer simulation techniques, scalable operating system structure, virtualization computer security, and mobility. He is also a co-founder VMware Inc. As the Chief Scientist of VMware for the company's first 10 years he helped design and build virtualization technology for commodity computing platforms.

ACADEMIC APPOINTMENTS

- Professor, Computer Science
- Professor, Electrical Engineering

ADMINISTRATIVE APPOINTMENTS

- Faculty Director, Stanford Computer Forum, (2012- present)

HONORS AND AWARDS

- National Young Investigator Award, National Science Foundation (1992)
- Research Fellowship, Alfred P. Sloan Foundation (1994)
- ACM Doctoral Dissertation Award, Association for Computing Machinery (1992)
- ACM/SIGOPS Mark Weiser Award, Association for Computing Machinery (2002)
- ACM System Software Award, Association for Computing Machinery (2009)
- IEEE Computer Entrepreneur Award, Institute of Electrical and Electronics Engineers (2011)
- IEEE Reynold B. Johnson Information Storage Systems Award, Institute of Electrical and Electronics Engineers (2014)
- ACM Thacker Breakthrough in Computing Award, Association of Computing Machinery (2018)

BOARDS, ADVISORY COMMITTEES, PROFESSIONAL ORGANIZATIONS

- Member, American Academy of Arts & Sciences (2014 - present)
- Member, National Academy of Engineering (2013 - present)

- Fellow, Association for Computing Machinery (2008 - present)

PROFESSIONAL EDUCATION

- PhD, UC Berkeley (1992)
- MS, UC Berkeley (1989)
- BA, University of Virginia (1984)

PATENTS

- Mendel Rosenblum, Monica Lam, Constantine Sapuntzakis, Ramesh Chandra, Nickolai Zeldovich, James Chow, David Brumley. "United States Patent 7,890,689 Virtual appliance management", The Board of Trustees of the Leland Stanford Junior University, Feb 15, 2011
- Mendel Rosenblum, Edouard Bugnion, Scott Devine. "United States Patent 7,665,088 Context-switching to and from a host OS in a virtualized computer system", VMware, Inc., Feb 16, 2010
- Mendel Rosenblum, Monica Lam, Constantine Sapuntzakis, Ramesh Chandra, Nickolai Zeldovich, James Chow, David Brumley. "United States Patent 7,373,451 Cache-based system management architecture with virtual appliances, network repositories, and virtual appliance transceivers", The Board of Trustees of the Leland Stanford Junior University, May 13, 2008
- Mendel Rosenblum, Ole Agesen, Pratap Subrahmanyam, Scott Devine, Edouard Bugnion. "United States Patent 7,149,843 System and method for detecting access to shared structures and for maintaining coherence of derived structures in virtualized multiprocessor systems", VMware, Inc., Dec 12, 2006
- Mendel Rosenblum, Ole Agesen, Pratap Subrahmanyam, Scott Devine, Edouard Bugnion. "United States Patent 6,961,806 System and method for detecting access to shared structures and for maintaining coherence of derived structures in virtualized multiprocessor systems", VMware, Inc., Nov 1, 2005
- Mendel Rosenblum, Edouard Bugnion, Scott Devine. "United States Patent 6,944,699 System and method for facilitating context-switching in a multi-context computer system", VMware, Inc., Sep 13, 2005
- Mendel Rosenblum, Edouard Bugnion, Scott Devine. "United States Patent 6,496,847 System and method for virtualizing computer systems", VMware, Inc., Dec 17, 2002
- Mendel Rosenblum, Edouard Bugnion, Scott Devine. "United States Patent 6,397,242 Virtualization system including a virtual machine monitor for a computer with a segmented architecture", VMware, Inc., May 28, 2002
- Mendel Rosenblum, Edouard Bugnion, Scott Devine. "United States Patent 6,075,938 Virtual machine monitors for scalable multiprocessors", The Board of Trustees of the Leland Stanford Junior University, Jun 13, 2000

LINKS

- Platform Lab: https://platformlab.stanford.edu/index.php

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

Next generation data centers

Teaching

COURSES

2026-27

- Advanced Topics in Operating Systems: CS 240 (Aut)
- Fabric Architectures For AI Systems: CS 349F (Aut)
- Operating Systems Principles: CS 111 (Spr)

2025-26

- Advanced Topics in Operating Systems: CS 240 (Aut)
- Fabric Architectures For AI Systems: CS 349F (Spr)
- Operating Systems Principles: CS 111 (Spr)

STANFORD ADVISEES

Doctoral Dissertation Reader (AC)

Swapnil Gandhi

Orals Evaluator

Swapnil Gandhi

Master's Program Advisor

Illia Shkirko, Emery Yu

Doctoral (Program)

Jihwan Oh

Publications

PUBLICATIONS

- **Nezha: Deployable and High-Performance Consensus Using Synchronized Clocks** *PROCEEDINGS OF THE VLDB ENDOWMENT*
  Geng, J., Sivaraman, A., Prabhakar, B., Rosenblum, M.
  2022; 16 (4): 629-642
- **Breaking the Transience-Equilibrium Nexus: A New Approach to Datacenter Packet Transport**
  Liu, S., Ghalayini, A., Alizadeh, M., Prabhakar, B., Rosenblum, M., Sivaraman, A., USENIX Assoc
  USENIX ASSOC.2021: 47-64
- **lambda-NIC: Interactive Serverless Compute on Programmable SmartNICs**
  Choi, S., Shahbaz, M., Prabhakar, B., Rosenblum, M., IEEE Comp Soc
  IEEE COMPUTER SOC.2020: 67-77
- **Toward Scalable Replication Systems with Predictable Tails Using Programmable Data Planes**
  Choi, S., Park, S., Shahbaz, M., Prabhakar, B., Rosenblum, M., ACM
  ASSOC COMPUTING MACHINERY.2019: 78–84
- **lambda-NIC: Interactive Serverless Compute on SmartNICs**
  Choi, S., Shahbaz, M., Prabhakar, B., Rosenblum, M., ACM
  ASSOC COMPUTING MACHINERY.2019: 151–52
- **SIMON: A Simple and Scalable Method for Sensing, Inference and Measurement in Data Center Networks**
  Geng, Y., Liu, S., Yin, Z., Naik, A., Prabhakar, B., Rosenblum, M., Vahdat, A., USENIX Assoc
  USENIX ASSOC.2019: 549–64
- **Towards Practical Default-On Multi-Core Record/Replay** *ACM SIGPLAN NOTICES*
  Mashtizadeh, A. J., Garfinkel, T., Terei, D., Mazieres, D., Rosenblum, M.
  2017; 52 (4): 693-708
- **Towards Practical Default-On Multi-Core Record/Replay**
  Mashtizadeh, A., Garfinkel, T., Terei, D., Mazieres, D., Rosenblum, M.
  ASSOC COMPUTING MACHINERY.2017: 693-708
- **Self-Programming Networks: Architecture and Algorithms**
  Geng, Y., Liu, S., Wang, F., Yin, Z., Prabhakar, B., Rosenblum, M., IEEE
  IEEE.2017: 745–52
- **The RAMCloud Storage System** *ACM TRANSACTIONS ON COMPUTER SYSTEMS*
  Ousterhout, J., Gopalan, A., Gupta, A., Kejriwal, A., Lee, C., Montazeri, B., Ongaro, D., Park, S. J., Qin, H., Rosenblum, M., Rumble, S., Stutsman, R., Yang, et al
  2015; 33 (3)

- **Using Network Knowledge to Improve Workload Performance in Virtualized Data Centers**
  Erickson, D., Heller, B., McKeown, N., Rosenblum, M., IEEE
  IEEE.2014: 185–94
- **Copysets: reducing the frequency of data loss in cloud storage**
  Cidon, A., Rumble, Stephen, M., Stutsman, R., Katti, S., Ousterhout, J., Rosenblum, M.
  2013
- **Network interface design for low latency request-response protocols**
  Flajslik, M., Rosenblum, M.
  2013
- **Using Network Knowledge to Improve Workload Performance in Virtualized Data Centers** *Stanford University*
  Erickson, D., Heller, B., McKeown, N., Rosenblum, M.
  2013
- **Bringing Virtualization to the x86 Architecture with the Original VMware Workstation** *ACM TRANSACTIONS ON COMPUTER SYSTEMS*
  Bugnion, E., Devine, S., Rosenblum, M., Sugerman, J., Wang, E. Y.
  2012; 30 (4)
- **I/O Virtualization** *COMMUNICATIONS OF THE ACM*
  Waldspurger, C., Rosenblum, M.
  2012; 55 (1): 66-72
- **Optimizing a Virtualized Data Center** *COMPUTER COMMUNICATION REVIEW*
  Erickson, D., Heller, B., Yang, S., Chu, J., Ellithorpe, J., McKeown, N., Parulkar, G., Rosenblum, M., Whyte, S., Stuart, S.
  2011; 41 (4): 478-479
- **The Case for RAMCloud** *COMMUNICATIONS OF THE ACM*
  Ousterhout, J., Agrawal, P., Erickson, D., Kozyrakis, C., Leverich, J., Mazieres, D., Mitra, S., Narayanan, A., Ongaro, D., Parulkar, G., Rosenblum, M., Rumble, S. M., Stratmann, et al
  2011; 54 (7): 121-130
- **Fast Crash Recovery in RAMCloud** *23rd ACM Symposium on Operating Systems Principles (SOSP 2011)*
  Ongaro, D., Rumble, S. M., Stutsman, R., Ousterhout, J., Rosenblum, M.
  ASSOC COMPUTING MACHINERY.2011: 29–41
- **MARS: adaptive remote execution for multi-threaded mobile devices**
  Cidon, A., London, Tomer, M., Katti, S., Kozyrakis, C., Rosenblum, M.
  2011
- **It's time for low latency**
  Rumble, Stephen, M., Ongaro, D., Stutsman, R., Rosenblum, M., Ousterhout, John, K.
  2011
- **I/o virtualization** *ACM Queue*
  Rosenblum, M., Waldspurger, C.
  2011
- **The case for RAMClouds: scalable high-performance storage entirely in DRAM** *ACM SIGOPS Operating Systems Review*
  Ousterhout, J., Agrawal, P., Erickson, D., Kozyrakis, C., Leverich, J., Mazières, D., Rosenblum, M.
  2010; 43 (4): 92-105
- **RAMCloud: Scalable high-performance storage entirely in DRAM** *Stanford University*
  Mazières, D., Narayanan, A., Ongaro, D., Rosenblum, M.
  2009
- **Streamware: Programming general-purpose multicore processors using streams** *13th International Conference on Architectural Support for Programming Languages and Operating Systems*
  Gummaraju, J., Coburn, J., Turner, Y., Rosenblum, M.

ASSOC COMPUTING MACHINERY.2008: 297–307

- **A demonstration of virtual machine mobility in an OpenFlow network** *SIGCOMM'08*
  Parulkar, G., McKeown, N., Rosenblum, M., Erickson, D., Gibb, G., Heller, B.
  2008
- **Project Summary: Programmable Open Mobile Internet 2020** *Computer Systems Laboratory*
  Boneh, D., Goldsmith, A., Johari, R., Kimm, P., Klemmer, S., Kozyrakis, C., Rosenblum, M.
  2008
- **Architectural support for the stream execution model on general-purpose processors**
  Gummaraju, J., Erez, M., Coburn, J., Rosenblum, M., Dally, William, J.
  2007
- **Executing irregular scientific applications on stream architectures**
  Erez, M., Ahn, J. H., Gummaraju, J., Rosenblum, M., Dally, William, J.
  2007
- **Impact of virtualization on computer architecture and operating systems** *ACM SIGPLAN NOTICES*
  Rosenblum, M.
  2006; 41 (11): 1-1
- **The vMatrix: Equi-ping game server placement for pre-arranged first-person-shooter multiplayer matches** *4th IEEE/ACS International Conference on Computer Systems and Applications (AICCSA-06)*
  Awadallah, A., Rosenblum, M.
  IEEE.2006: 633–640
- **Virtualization Aware File Systems: Getting Beyond the Limitations of Virtual Disks.** *NSDI*
  Pfaff, B., Garfinkel, T., Rosenblum, M.
  2006
- **Virtualization aware file systems: Getting beyond the limitations of virtual disks** *3rd Symposium on Networked Systems Design and Implementation*
  Pfaff, B., Garfinkel, T., Rosenblum, M.
  USENIX ASSOC.2006: 353–366
- **Virtual machine monitors: Current technology and future trends** *COMPUTER*
  Rosenblum, M., Garfinkel, T.
  2005; 38 (5): 39-?
- **Shredding your garbage: Reducing data lifetime through secure deallocation** *14th USENIX Security Symposium*
  Chow, J., Pfaff, B., Garfinkel, T., Rosenblum, M.
  USENIX ASSOC.2005: 331–346
- **When Virtual Is Harder than Real: Security Challenges in Virtual Machine Based Computing Environments.**
  Garfinkel, T., Rosenblum, M.
  2005
- **Stream programming on general-purpose processors** *38th Annual IEEE/ACM International Symposium on Microarchitecture*
  Gummaraju, J., Rosenblum, M.
  IEEE COMPUTER SOC.2005: 343–354
- **Understanding data lifetime via whole system simulation** *13th USENIX Security Symposium*
  Chow, J., Pfaff, B., Garfinkel, T., Christopher, K., Rosenblum, M.
  USENIX ASSOC.2004: 321–336
- **Stream processing in general-purpose processors**
  Gummaraju, J., Rosenblum, M.
  2004
- **Data lifetime is a systems problem**

Garfinkel, T., Pfaff, B., Chow, J., Rosenblum, M.
2004

- **Parallel decompositions of a packet-processing workload** *Workshop (ANCHOR) held in conjunction with*
Seamans, E., Rosenblum, M.
2004

- **Ostia: A Delegating Architecture for Secure System Call Interposition.** *NDSS*
Garfinkel, T., Pfaff, B., Rosenblum, M.
2004

- **The reincarnation of virtual machines** *Queue - Virtual Machines*
Rosenblum, M.
2004; 2 (5): 34

- **The vMatrix: Server switching** *10th IEEE International Workshop on Future Trends of Distributed Computing Systems (FTDCS 2004)*
Awadallah, A., Rosenblum, M.
IEEE COMPUTER SOC.2004: 110–118

- **Virtual appliances for deploying and maintaining software** *17th Large Installation Systems Administration Conference*
Sapuntzakis, C., Brumley, D., Chandra, R., Zeldovich, N., Chow, J., Lam, M. S., Rosenblum, M.
USENIX ASSOC.2003: 181–194

- **A Virtual Machine Introspection Based Architecture for Intrusion Detection.** *NDSS*
Garfinkel, T., Rosenblum, M.
2003

- **Virtual Appliances for Deploying and Maintaining Software.** *LISA*
Sapuntzakis, C., Brumley, D., Chandra, R., Zeldovich, N., Chow, J., Lam, Monica, S., Rosenblum, M.
2003

- **Flexible OS Support and Applications for Trusted Computing.** *HotOS*
Garfinkel, T., Rosenblum, M., Boneh, D.
2003

- **Terra: A virtual machine-based platform for trusted computing** *ACM SIGOPS Operating Systems Review - SOSP '03*
Garfinkel, T., Pfaff, B., Chow, J., Rosenblum, M., Boneh, D.
2003; 37 (5): 193-206

- **Optimizing the migration of virtual computers** *5th Symposium on Operation Systems Design and Implementation (OSDI 02)*
Sapuntzakis, C. P., Chandra, R., Pfaff, B., Chow, J., Lam, M. S., Rosenblum, M.
USENIX ASSOC.2002: 377–390

- **The vMatrix: A network of virtual machine monitors for dynamic content distribution**
Awadallah, A., Rosenblum, M.
2002

- **Cellular disco: resource management using virtual clusters on shared-memory multiprocessors** *ACM TRANSACTIONS ON COMPUTER SYSTEMS*
Govil, K., Teodosiu, D., Huang, Y. Q., Rosenblum, M.
2000; 18 (3): 229-262

- **Rivet: A flexible environment for computer systems visualization** *COMPUTER GRAPHICS-US*
Bosch, R., Stolte, C., Tang, D., Gerth, J., Rosenblum, M., Hanrahan, P.
2000; 34 (1): 68-73

- **Performance analysis and visualization of parallel systems using SimOS and Rivet: a case study**
Bosche, R., Stolte, C., Stoll, G., Rosenblum, M., Hanrahan, P.
2000

- **Rivet: A Flexible Environment for Computer Systems Visualization** *ACM SIGGRAPH*
  Bosch, R., Stolte, C., Tang, D., Gerth, J., Rosenblum, M., Hanrahan, P.
  2000
- **Cellular Disco: resource management using virtual clusters on shared-memory multiprocessors** *17th ACM Symposium on Operating Systems Principles (SOSP '99)*
  Govil, K., Teodosiu, D., Huang, Y. Q., Rosenblum, M.
  ASSOC COMPUTING MACHINERY.1999: 154–169
- **VMware's virtual platform™**
  Rosenblum, M.
  1999
- **Visualizing application behavior on superscalar processors**
  Stolte, C., Bosche, R., Hanrahan, P., Rosenblum, M.
  1999
- **Performance isolation: Sharing and isolation in shared-memory multiprocessors** *ACM SIGPLAN NOTICES*
  Verghese, B., Gupta, A., Rosenblum, M.
  1998; 33 (11): 181-192
- **The stanford flash multiprocessor**
  Kuskin, J., Ofelt, D., Heinrich, M., Heinlein, J., Simoni, R., Gharachorloo, K., Rosenblum, M.
  1998
- **Disco: Running commodity operating systems on scalable multiprocessors** *ACM TRANSACTIONS ON COMPUTER SYSTEMS*
  Bugnion, E., Devine, S., Govil, K., Rosenblum, M.
  1997; 15 (4): 412-447
- **Coherent block data transfer in the FLASH multiprocessor** *11th International Parallel Processing Symposium (IPPS 97)*
  Heinlein, J., Bosch, R. P., Gharachorloo, K., Rosenblum, M., Gupta, A.
  IEEE COMPUTER SOC.1997: 18–27
- **Using the SimOS machine simulator to study complex computer systems** *ACM Transactions on Modeling and Computer Simulation (TOMACS)*
  Rosenblum, M., Bugnion, E., Devine, S., Herrod, Stephen, A.
  1997; 7 (1): 78-103
- **Hardware fault containment in scalable shared-memory multiprocessors** *24th Annual International Symposium on Computer Architecture*
  Teodosiu, D., Baxter, J., Govil, K., Chapin, J., Rosenblum, M., Horowitz, M.
  ASSOC COMPUTING MACHINERY.1997: 73–84
- **Implementing efficient fault containment for multiprocessors** *COMMUNICATIONS OF THE ACM*
  Rosenblum, M., Chapin, J., Teodosiu, D., Devine, S., Lahiri, T., Gupta, A.
  1996; 39 (9): 52-61
- **Compiler-directed page coloring for multiprocessors** *7th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS-VII)*
  Bugnion, E., Anderson, J. M., Mowry, T. C., Rosenblum, M., Lam, M. S.
  ASSOC COMPUTING MACHINERY.1996: 244–55
- **On CC-NUMA compute servers** *7th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS-VII)*
  Verghese, B., Devine, S., Gupta, A., Rosenblum, M.
  ASSOC COMPUTING MACHINERY.1996: 279–89
- **Increasing cache port efficiency for dynamic superscalar microprocessors** *23rd Annual International Symposium on Computer Architecture*
  Wilson, K. M., Olukotun, K., Rosenblum, M.
  ASSOC COMPUTING MACHINERY.1996: 147–157
- **Operating system support for improving data locality on CC-NUMA compute servers**

Verghese, B., Devine, S., Gupta, A., Rosenblum, M.
1996

- **Embra: Fast and flexible machine simulation** *ACM SIGMETRICS Performance Evaluation Review*
  Witchel, E., Rosenblum, M.
  1996; 24 (1): 68-79
- **COMPLETE COMPUTER-SYSTEM SIMULATION - THE SIMOS APPROACH** *IEEE PARALLEL & DISTRIBUTED TECHNOLOGY*
  Rosenblum, M., HERROD, S. A., Witchel, E., Gupta, A.
  1995; 3 (4): 34-43
- **Hive: Fault containment for shared-memory multiprocessors**
  Chapin, J., Rosenblum, M., Devine, S., Lahiri, T., Teodosiu, D., Gupta, A.
  1995
- **The impact of architectural trends on operating system performance**
  Rosenblum, M., Bugnion, E., Herrod, S. A., Witchel, E., Gupta, A.
  1995
- **Experience with Sprite LFS** *The Design and Implementation of a Log-structured file*
  Rosenblum, M.
  1995
- **Sprite LFS cleaning policies** *The Design and Implementation of a Log-structured file*
  Rosenblum, M.
  1995
- **Memory system performance of UNIX on CC-NUMA multiprocessors** *ACM SIGMETRICS Performance Evaluation Review*
  Chapin, J., Herrod, A., Rosenblum, M., Gupta, A.
  1995; 23 (1): 1-13
- **Disk Storage Manager Design** *The Design and Implementation of a Log-structured file*
  Rosenblum, M.
  1995
- **THE PERFORMANCE IMPACT OF FLEXIBILITY IN THE STANFORD FLASH MULTIPROCESSOR** *6th International Conference on Architectural Support for Programming Languages and Operating Systems*
  Heinrich, M., KUSKIN, J., Ofelt, D., Heinlein, J., Baxter, J., Singh, J. P., Simoni, R., Gharachorloo, K., NAKAHIRA, D., Horowitz, M., Gupta, A., Rosenblum, M., Hennessy, et al
  ASSOC COMPUTING MACHINERY.1994: 274–85
- **SCHEDULING AND PAGE MIGRATION FOR MULTIPROCESSOR COMPUTE SERVERS** *6th International Conference on Architectural Support for Programming Languages and Operating Systems*
  Chandra, R., Devine, S., Verghese, B., Gupta, A., Rosenblum, M.
  ASSOC COMPUTING MACHINERY.1994: 12–24
- **THE STANFORD FLASH MULTIPROCESSOR** *21st Annual International Symposium on Computer Architecture*
  KUSKIN, J., Ofelt, D., Heinrich, M., Heinlein, J., Simoni, R., Gharachorloo, K., Chapin, J., NAKAHIRA, D., Baxter, J., Horowitz, M., Gupta, A., Rosenblum, M., Hennessy, et al
  I E E E, COMPUTER SOC PRESS.1994: 302–313
- **THE DESIGN AND IMPLEMENTATION OF A LOG-STRUCTURED FILE SYSTEM** *ACM TRANSACTIONS ON COMPUTER SYSTEMS*
  Rosenblum, M., Ousterhout, J. K.
  1992; 10 (1): 26-52
- **The design and implementation of a log-structured file system** *ACM SIGOPS Operating Systems Review*
  Rosenblum, M., Ousterhout, J. K.
  1991; 25 (5): 1-15
- **The LFS Storage Manager.** *USENIX Summer*
  Rosenblum, M., Ousterhout, J. K.

1990

- **Sprite position statement: use distributed state for failure recovery**
  Welch, B., Baker, M., Douglis, F., Hartman, J., Rosenblum, M., Ousterhout, J.
  1989
- **GAFFES: The Design of a Globally Distributed File System**
  Keshav, S., Madisetti, V., Munson, E., Rosenblum, M., Gozani, S., Gray, M.
  University of California Berkeley.1987
- **MinCopysets: Derandomizing Replication In Cloud Storage** *Stanford University*
  Cidon, A., Stutsman, R., Rumble, S., Katti, S., Ousterhout, J., Rosenblum, M.
- **Complete Computer System Simulation**
  Rosenblum, M., Herrod, S. A., Witchel, E., Gupta, A.
- **Freeing your Computer from the Hardware** *Computer Science Department*
  Sapuntzakis, Constantine, P., Chandra, R., Norris, James, C., Lam, Monica, S., Rosenblum, M.