

Asim Kadav

Contact Information	1210, W. Dayton St., Madison, WI 53706 USA	Cell: 608-698-5025 E-mail: kadav@cs.wisc.edu
Education	PhD in Computer Sciences , (2007 - Present) Dissertation title: Making operating systems resilient to hardware Advisor: Prof. Mike Swift PhD Minor in Human Factors in Engineering. University of Wisconsin- Madison. Masters in Computer Sciences with thesis , Dec 2010 GPA:3.92/4.00 Thesis Title: Live Migration of Direct-Access Devices. University of Wisconsin- Madison. Bachelors in Computer Sciences with distinction , May 2004 National Institute of Technology, Nagpur, India.	
Research Interests	Operating Systems - Device Drivers, Software Reliability, Virtual Machines and File Systems.	
Honors and Awards	Travel Grants for OSDI 2008, SOSP 2009, OSDI 2010, Linux Plumbers Conference 2011 and ASPLOS 2012. Best Paper Award, Hot Storage 2009. “Fast Tracked” paper, WIOV 2008. Summer Research Fellowship, Dept. of Computer Sciences, University of Wisconsin, May 2008. Outstanding performance award from IBM Systems and Technology Labs, April 2007. Award from Oracle Corporation for consistent performance, April 2005.	
Work Experience	Microsoft Research Redmond , Seattle, WA <i>Research Intern</i> Worked on Microsoft’s storage product (Details Confidential). <i>Research Intern</i> Worked on Microsoft’s storage product (Details Confidential). Microsoft Research Silicon Valley Center , Mountain View, CA <i>Research Intern</i> Designed and implemented a prototype of Differential RAID system(described below) in the Windows 7 volume manager.	Jan 2012 - February 2012 May 2011 - August 2011 June 2009 - August 2009

IBM Systems and Technology Labs, Pune, India

Systems Software Engineer

February 2006 - July 2007

Member of India development team of IBM's parallel clustered file system product- GPFS (General Parallel File System) and was involved in developing the product for 64 bit Solaris SPARC V9.

Oracle Corporation, Bangalore, India

Technical Analyst

June 2004 - February 2006

Development of storage and database solutions including fault tolerant and self adaptive systems, resource monitoring, database cloning, data re-organization, performance tuning and query optimization.

Journal Publications Mahesh Balakrishnan, **Asim Kadav**, Vijayan Prabhakaran, Dahlia Malkhi. Differential RAID: Rethinking RAID for SSD Reliability. To appear in *Proceedings of ACM Transactions on Storage*, June 2010.

Asim Kadav and Michael M. Swift. Live Migration of Direct-Access Devices. In *Proceedings of ACM SIGOPS Operating Systems Review*, Volume 43, Issue 3. July 2009.

Conference Publications **Asim Kadav** and Michael M. Swift. Understanding Modern Device Drivers. *Proceedings of the 17th ACM Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS 2012)* London, UK, March 2012.

Mahesh Balakrishnan, **Asim Kadav**, Vijayan Prabhakaran, Dahlia Malkhi. Differential RAID: Rethinking RAID for SSD Reliability. In *Proceedings of Fifth ACM European Conference on Computer Systems. (Eurosys' 10)*, Paris, France, April 2010.

Asim Kadav, Matthew J. Renzelmann, Michael M. Swift. Tolerating Hardware Device Failures in Software. In *Proceedings of ACM Symposium on Operating System Principles (SOSP '09)*, Big Sky, MT, October 2009.

Workshop Publications **Asim Kadav**, Mahesh Balakrishnan, Vijayan Prabhakaran, Dahlia Malkhi. Differential RAID: Rethinking RAID for SSD Reliability. In *Proceedings of Workshop on Hot Topics in Storage and File Systems. (HotStorage' 09)*. **Best Paper Award**. Also, appeared in ACM Operating Systems Review Volume 43, Issue 4.

Asim Kadav and Michael M. Swift. Live Migration of Direct-Access Devices. In *Proceedings of Workshop on I/O Virtualization - 2008, WIOV'08*, co-located with OSDI 2008. **Outstanding Paper Award**.

Seminars and Talks "Tolerating hardware device failures in software" at *Symposium on Operating System Principles, 2009, SOSP '09*, Big Sky, MT. October 2009 and *Linux Plumbers Conference*, Santa Rosa, CA, September 2011.

"Differential RAID: Rethinking RAID for SSD reliability" at Microsoft Research - Silicon Valley Center, End of internship talk. August 2009.

"Live Migration of Direct-Access Devices" at *Workshop on I/O Virtualization - 2008, WIOV'08*, co-located with OSDI 2008. December 2008.

“General Large file system implementation issues” at IBM Systems and Technology Labs, June 2006.

Other Publications **Asim Kadav**, Chelsea Wanta et. al., “Improving the online video chat experience”, In *Proceedings of International Conference in Human Computer Interaction*, Orlando, FL, July 2011. Winner of *Qualcomm Wireless Innovation Prize* and *Visions of Ubicomp: Best Narration Award*.

Matthew J. Renzelmann, **Asim Kadav**, Michael M. Swift, “Testing device drivers without hardware” Poster at *USENIX Operating System Design and Implementation (OSDI '10)*, Vancouver, BC, October 2010.

Asim Kadav and Mehul M. Joshi, “Setting up a multicluster environment using General Parallel File System” published at IBM DeveloperWorks. (<http://www.ibm.com/developerworks/systems/library/es-multiclustergps/index.htm>) [May 2007]

Asim Kadav, Disclosure(IP) “System for Clock Aware Generation of Speed Dial Lists” published at ip.com [IPCOM000152213D]. [November 2006]

Asim Kadav, “Approaches to Dynamic Program Analysis” (poster) towards the proceedings of “*Workshop on Next Generation Programming Environments & Languages*” organized by IBM Research Labs-India.[November 2006]

Service External Review Committee: SIGMETRICS 2010, USENIX ATC 2011. SOSP 2009 Shadow PC.

Teaching Experience Teaching assistant at University of Wisconsin for CS 302: Introduction to Object-Oriented Programming & CS 552: Introduction to Computer Architecture. [Sept 2007 - May 2008]

Full time training on Distributed Systems and Memory Management at IBM.[June 2006] and on Database Fundamentals for Quality Team at Oracle Corporation.[June 2005]

Research Projects **SymDrive: Testing Device Drivers without Hardware** **Feb 2010 - Present**

In this project, we developed *SymDrive*, a system to test device drivers using Symbolic Execution. The benefit symbolic execution provides is the ability to test a driver without requiring any of the different device hardware or chipset the driver supports. The system also incorporates a specification system that allows the developer to test a set of conditions each time the driver interacts with the kernel. This allows for thorough testing of drivers rather than just bug-finding.

Understanding Modern Device Drivers **Nov 2010 - Present**

Modern research offers a limited view of what drivers can do, mostly depicting bugs and broken code which are hardly representative of the almost 5 million lines of code (in case of Linux). In this project, we study the *form*, *function* and abstractions of all device drivers. We find that many assumptions made by driver research do not apply to all drivers. For example, we find that at least 42% of drivers have code that is not captured by a class definition and 14% of drivers do significant computation over data. We also find that 8% of all driver code is substantially to code elsewhere, and may be removed with new abstractions or libraries.

Differential RAID: Rethinking RAID for SSD Reliability**June 2009 - August 2009**

At Microsoft Research, Silicon Valley, I worked on a RAID prototype designed for SSDs. Due to their wearout characteristics, SSDs do not work reliably with RAID-5 since RAID-5 causes all drive constituents to wear out at the same time reducing reliability. We developed Differential RAID, which uses parity to unevenly wear out individual SSDs in a RAID array, thereby increasing overall system reliability.

Tolerating Hardware Device Failures in Software**Oct 2008 - Oct 2009**

In this project, we built *Carburizer*, a system to detect hardware dependence bugs in driver code and automatically fix them. Hardware dependence bugs are those where the software assumes correct hardware behavior and uses them unsafely in critical control and data paths. We detected and fixed 1000 bugs in Linux driver code relating to livelocks, panics and unsafe memory references. Additionally, Carburizer also fixes error reporting, interrupt issues and provides for automatic recovery in case of hardware failures.

Live Migration of Direct-Access Devices**May 2008 - Oct 2008**

This project aimed at providing migration support for direct-access devices which is currently not possible. Existing solutions require one to either detach the device pre-migration or transfer all I/O to a virtual device. We designed and implemented shadow driver migration that successfully achieved live migration for directly attached network devices and is extensible to any class of devices.

Reliability Analysis of ZFS**Aug 2007 - Dec 2007**

In this project, we studied the ZFS structure and simulated on-disk block corruption. The study found that ZFS provides robust tolerance to corruption but we also detected couple of cases where recovery was broken. This was my class project and an extended version appeared in FAST '10.