

Vijay Chidambaram

Curriculum Vitae

Address: Department of Computer Science GDC 6.436,
2317 Speedway, Austin, TX 78712

Email: vijay@cs.utexas.edu

WWW: <http://cs.utexas.edu/~vijay>

Google Scholar: <http://goo.gl/mt27fh>

EDUCATION

- 2011-15 PhD in Computer Science. University of Wisconsin-Madison
Advisors: Prof. Andrea Arpaci-Dusseau, Prof. Remzi Arpaci-Dusseau
- 2009-11 Masters in Computer Science. University of Wisconsin-Madison
- 2005-09 Bachelor of Computer Science. College of Engineering, Guindy, Chennai, India

WORK EXPERIENCE

- University of Texas at Austin**, Austin, TX **Aug 2016-present**
Assistant Professor
- VMware Research Group**, Palo Alto, CA **Oct 2015-Aug 2016**
Post-doc Researcher
- Microsoft Research**, Silicon Valley, CA **June-Aug 2014**
Research Intern with Mahesh Balakrishnan
- Microsoft Research**, Redmond, WA **June-Aug 2013**
Research Intern with James Mickens
- Microsoft Research**, Redmond, WA **June-Aug 2012**
Research Intern with Ed Harris

HONORS AND AWARDS

- Best Paper Award ATC 2018 2018
- Best Paper Award FAST 2018 2018
- NSF CAREER Award 2018
- Best Poster Award ApSys 2017 2017
- Best Paper Award FAST 2017 2017
- ACM SIGOPS Dennis M. Ritchie Dissertation Award 2016
- Microsoft Graduate Research Fellowship 2014
- Alumni Scholarship, University of Wisconsin-Madison 2009

PRESS ARTICLES ON RESEARCH

Protocol aware recovery for consensus-based storage. *The Morning Paper*. Feb 2018.

Link: <https://bit.ly/20vNB9H>

Application crash consistency and performance with CCFS. *The Morning Paper*. Mar 2017.

Link: <https://bit.ly/2K5LYep>

All File Systems are Not Created Equal: On the Complexity of Crafting Crash Consistent Applications. *The Morning Paper*. Feb 2016.

Link: <http://blog.acolyer.org/2016/02/11/fs-not-equal/>

Data Integrity and Availability: The Challenge of Scale for Modern Storage Systems. *IEEE Computing Now*. May 2012.

Link: <http://www.computer.org/portal/web/computingnow/archive/may2012>

CONFERENCE PUBLICATIONS

1. Rohan Kadekodi, Sekwon Lee, Sanidhya Kashyap, Taesoo Kim, Aasheesh Kolli, **Vijay Chidambaram**. SplitFS: Reducing Software Overhead in File Systems for Persistent Memory. *Proceedings of the 27th ACM Symposium on Operating Systems Principles, Ontario, Canada, Oct 2019*. **SOSP 2019**.
2. Sekwon Lee, Jayashree Mohan, Sanidhya Kashyap, Taesoo Kim, **Vijay Chidambaram**. RECIPE : Reusing Concurrent In-Memory Indexes for Persistent Memory. *Proceedings of the 27th ACM Symposium on Operating Systems Principles, Ontario, Canada, Oct 2019*. **SOSP 2019**.
3. Jayashree Mohan, Ashlie Martinez, Soujanya Ponnappalli, Pandian Raju, **Vijay Chidambaram**. Finding Crash-Consistency Bugs with Bounded Black-Box Crash Testing. *Proceedings of the 13th Symposium on Operating Systems Design and Implementation, Carlsbad, CA, Oct 2018*. **OSDI 2018**.
4. Yige Hu, Zhiting Zhu, Ian Neal, Youngjin Kwon, Tianyu Cheng, **Vijay Chidambaram**, Emmett Witchel. TxFS: Leveraging File-System Crash Consistency to Provide ACID Transactions. *Proceedings of the 2018 USENIX Annual Technical Conference, Boston, MA, Jul 2018*. **ATC 2018**. **Best Paper Award**.
5. Ramnatthan Alagappan, Aishwarya Ganesan, Eric Lee, Aws Albarghouthi, **Vijay Chidambaram**, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Protocol-Aware Recovery for Consensus-Based Storage. *Proceedings of the 16th USENIX Conference on File and Storage Technologies, Oakland, CA, Feb 2018*. **FAST 2018**. **Best Paper Award**. Was also presented as an invited talk at **ATC 2019**.
6. Pandian Raju, Rohan Kadekodi, **Vijay Chidambaram**, Ittai Abraham. PebblesDB: Building Key-Value Stores using Fragmented Log-Structured Merge Trees. *Proceedings of the 26th ACM Symposium on Operating Systems Principles, Shanghai, China, Oct 2017*. **SOSP 2017**.
7. Thanumalayan Sankaranarayanan Pillai, Ramnatthan Alagappan, Lanyue Lu, **Vijay Chidambaram**, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Application Crash Consistency and Performance with CCFS. *Proceedings of the 15th USENIX Conference on File and Storage Technologies, Feb 2017*. **FAST 2017**. **Best Paper Award**. Was also presented at **ATC 2017** in the Best of the Rest Track.
8. Thanumalayan Sankaranarayanan Pillai, **Vijay Chidambaram**, Ramnatthan Alagappan, Samer Al Kiswany, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. All File Systems Are Not Created Equal: On the Complexity of Crafting Crash-Consistent Applications. *Proceedings of the 11th Symposium on Operating Systems Design and Implementation, Oct 2014*. **OSDI 2014**.
9. James Mickens, Ed Nightingale, Jeremy Elson, Bin Fan, Asim Kadav, **Vijay Chidambaram**, Osama Khan, Krishna Nareddy, and Darren Gehring. Blizzard: Fast, Cloud-scale Block Storage for Cloud-oblivious Applications. *Proceedings of the 11th USENIX Symposium on Networked Systems Design and Implementation, April 2014*. **NSDI 2014**.
10. **Vijay Chidambaram**, Thanumalayan Sankaranarayanan Pillai, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Optimistic Crash Consistency. *Proceedings of the 24th ACM Symposium on Operating Systems Principles, Farmington, Pennsylvania, Nov 2013*. **SOSP 2013**.
11. **Vijay Chidambaram**, Tushar Sharma, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Consistency Without Ordering. *Proceedings of the 10th Conference on File and Storage Technologies, San Jose, CA, Feb 2012*. **FAST 2012**.
12. **Vijay Chidambaram**, Yueh-Hsuan Chiang, Bilge Mutlu. Designing Persuasive Robots: How Robots Might Persuade People Using Vocal and Nonverbal Cues. *Proceedings of the 7th ACM/IEEE International Conference on Human-Robot Interaction, Boston, MA, 2012*. **HRI 2012**.
13. Abhishek Rajimwale, **Vijay Chidambaram**, Deepak Ramamurthi, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Coerced Cache Eviction: Dealing with Misbehaving Disks through Discreet-Mode Journaling. *Proceedings of the IEEE/IFIP 41st International Conference on Dependable Systems & Networks, Hong Kong, China, 2011*. **DSN 2011**.

JOURNAL PUBLICATIONS

14. Jayashree Mohan, Ashlie Martinez, Soujanya Ponnappalli, Pandian Raju, **Vijay Chidambaram**. CrashMonkey and ACE: Systematically Testing File-System Crash Consistency. *ACM Transactions on Storage*, Volume 15, Number 2. **TOS 2019**.
15. Yige Hu, Zhiting Zhu, Ian Neal, Youngjin Kwon, Tianyu Cheng, **Vijay Chidambaram**, Emmett Witchel. TxFS: Leveraging File-system Crash Consistency to Provide ACID Transactions. *ACM Transactions on Storage*, Volume 15, Number 2. **TOS 2019**.
16. Thanumalayan Sankaranarayana Pillai, Ramnatthan Alagappan, Lanyue Lu, **Vijay Chidambaram**, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Application Crash Consistency and Performance with CCFS. *ACM Transactions on Storage*, Volume 13, Number 3, Oct 2017. **TOS 2017**.
17. Thanumalayan Sankaranarayana Pillai, Vijay Chidambaram, Ramnatthan Alagappan, Samer Al-Kiswany, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Crash consistency. *Communications of the ACM*, Volume 58, Number 10, Oct 2015. **CACM 2015**.
18. Thanumalayan Sankaranarayana Pillai, Vijay Chidambaram, Ramnatthan Alagappan, Samer Al-Kiswany, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Crash consistency. *ACM Queue*, Volume 13, Number 7, Jul 2015. **Queue 2015**.
19. Thanumalayan Sankaranarayana Pillai, Vijay Chidambaram, Joo Young Hwang, Andrea C. Arpaci-Dusseau, Remzi H. Arpaci-Dusseau. Towards efficient, portable application-level consistency. *Operating Systems Review*, Volume 48, Number 1, Jan 2014. **OSR 2014**.

WORKSHOP PUBLICATIONS

20. Jayashree Mohan, Melissa Wasserman, **Vijay Chidambaram**. Analyzing GDPR Compliance Through the Lens of Privacy Policy. *Proceedings of Poly'19: Towards Polystores that manage multiple Databases, Privacy, Security and/or Policy Issues for Heterogenous Data - VLDB 2019 Workshops*. **Poly 2019**.
21. Supreeth Shastri, Melissa Wasserman, **Vijay Chidambaram**. The Seven Sins of Personal-Data Processing Systems under GDPR. *Proceedings of the 11th USENIX Workshop on Hot Topics in Cloud Computing*, Jul 2019. **HotCloud 2019**.
22. Aashaka Shah, Vinay Banakar, Supreeth Shastri, Melissa Wasserman, **Vijay Chidambaram**. Analyzing the Impact of GDPR on Storage Systems. *Proceedings of the 11th USENIX Workshop on Hot Topics in Storage and File Systems*, Boston, MA, Jul 2019. **HotStorage 2019**.
23. Pandian Raju, Soujanya Ponnappalli, Evan Kaminsky, Gilad Oved, Zachary Keener, **Vijay Chidambaram**, Ittai Abraham. mLMS: Making Authenticated Storage Faster in Ethereum. *Proceedings of the 10th USENIX Workshop on Hot Topics in Storage and File Systems*, Boston, MA, Jul 2018. **HotStorage 2018**.
24. Dhathri Purohith, Jayashree Mohan, **Vijay Chidambaram**. The Dangers and Complexities of SQLite Benchmarking. *Proceedings of the 8th ACM The Eighth SIGOPS Asia-Pacific Workshop on Systems*, Sep 2017. **ApSys 2017**.
25. Jayashree Mohan, Dhathri Purohith, Matt Halpern, **Vijay Chidambaram**, Vijay Janapa Reddi. Storage on Your Smartphone Uses More Energy Than You Think. *Proceedings of the 9th USENIX Workshop on Hot Topics in Storage and File Systems*, Jul 2017. **HotStorage 2017**.
26. Ashlie Martinez, **Vijay Chidambaram**. CrashMonkey: A Framework to Automatically Test File-System Crash Consistency. *Proceedings of the 9th USENIX Workshop on Hot Topics in Storage and File Systems*, Jul 2017. **HotStorage 2017**.
27. Santiago Gonzalez, **Vijay Chidambaram**, Jivko Sinapov, Peter Stone. CC-Log: Drastically Reducing Storage Requirements for Robots Using Classification and Compression. *Proceedings of the 9th USENIX Workshop on Hot Topics in Storage and File Systems*, Jul 2017. **HotStorage 2017**.

28. Yige Hu, Youngjin Kwon, **Vijay Chidambaram**, Emmett Witchel. From Crash Consistency to Transactions. *Proceedings of the 16th Workshop on Hot Topics in Operating Systems, May 2017*. **HotOS 2017**.
29. Himanshu Chauhan, Irina Calciu, **Vijay Chidambaram**, Eric Schkufza, Onur Mutlu, Pratap Subramanyam. NVMOVE: Helping Programmers in Moving to Byte-Based Persistence. *Proceedings of the 4th Workshop on Interactions of NVM/Flash with Operating Systems and Workloads, Nov 2016*. **INFLOW 2016**.
30. Ramnatthan Alagappan, **Vijay Chidambaram**, Thanumalayan Sankaranarayana Pillai, Aws Al-barghouthi, Andrea C. Arpaci-Dusseu, Remzi H. Arpaci-Dusseu. Beyond Storage APIs: Provable Semantics for Storage Stacks. *Proceedings of the 15th Workshop on Hot Topics in Operating Systems, May 2015*. **HotOS 2015**.
31. Thanumalayan Sankaranarayana Pillai, **Vijay Chidambaram**, Jooyoung Hwang, Andrea C. Arpaci-Dusseu, Remzi H. Arpaci-Dusseu. Towards efficient, portable application-level consistency. *Proceedings of the 9th Workshop on Hot Topics in Dependable Systems, Farmington, Pennsylvania, Nov 2012*. **HotDep 2013**.
32. Thanumalayan S, **Vijay Chidambaram**, Ranjani Parthasarathi. Design-space exploration of flash augmented architectures. *Student Research Symposium, 15th annual IEEE International Conference on High Performance Computing, Bangalore, India, 2008*. **HiPC 2008**.

OTHER PUBLICATIONS

33. Matt Hall, **Vijay Chidambaram**, Ramakrishnan Durairajan. vFiber: Virtualizing Unused Optical Fibers (Poster). *15th USENIX Symposium on Networked Systems Design and Implementation*. **NSDI 2018**.
34. Jayashree Mohan, Rohan Kadekodi, **Vijay Chidambaram**. Analyzing IO Amplification in Linux File Systems (Poster). *8th ACM The Eighth SIGOPS Asia-Pacific Workshop on Systems, Sep 2017*. **ApSys 2017**. **Best Poster Award**.
35. **Vijay Chidambaram**. Is Ordering of Disk Updates Required to Maintain File-System Crash-Consistency? *Tiny Transactions on Computer Science (TinyTOCS), Vol 2, 2013*.
36. **Vijay Chidambaram**, Tushar Sharma, Andrea C. Arpaci-Dusseu, Remzi H. Arpaci-Dusseu. Consistency Without Ordering (Extended Edition). *UW-Madison Computer Science Technical Report 1709, 2012*.

PATENTS

1. *Operating method of storage device and data writing method for writing data into storage device*. JooYoung Hwang, Andrea Arpaci-Dusseu, Remzi Arpaci-Dusseu, Thanumalayan Sankaranarayana Pillai, Vijay Chidambaram. **US20160132251**. Published May 2016.
2. *Block storage by decoupling ordering from durability*. James Mickens, Amar Phanishayee, Vijay Chidambaram. **US20150220439**. Published Aug 2015.

OUTREACH ACTIVITIES

A Crash Course on Distributed Systems.

A one-day workshop on the fundamentals of distributed systems for practitioners, Jun 2018

The Many Facets of Computer Science.

- *Liberal Arts and Science Academy (LASA) High School, Nov 2017*

- *First Bytes Program For High School Kids, Jun 2017*

Grad School and Research. College of Engineering, Guindy. Mar 2017.

INVITED TALKS

mLSM: Making Authenticated Storage Faster in Ethereum.

- *HatchCrypto, Jul 2018*

PebblesDB: Building Key-Value Stores using Fragmented Log-Structured Merge Trees.

- *University of Washington Systems Seminar, Apr 2018*

- *Microsoft Research, Apr 2018*

- *UT Austin Industry Affiliates Program, Nov 2017*

- *Google, Jul 2017*

- *Facebook, Jul 2017*

- *Uber, Jul 2017*

- *VMware, Jul 2017*

- *NetApp, Jul 2017*

Storage and File Systems.

- *Undergrad Multicore OS Implementation (CS 378) by Simon Peter, May 2017*

- *Graduate Multicore OS Implementation (CS 378) by Simon Peter, Oct 2016*

Optimistic Crash Consistency.

- *Advanced Operating System (CS 380L) by Chris Rossbach, Mar 2017*

NVMOVE: Helping Programmers in Moving to Byte-Based Persistence.

- *Hewlett Packard, Dec 2016*

Performance and Reliability in Modern Storage Systems.

- *Purdue University, Apr 2015*

- *John Hopkins University, April 2015*

- *University of California-Irvine, Apr 2015*

- *University of Texas at Austin, Apr 2015*

- *University of Michigan at Ann Arbor, Mar 2015*

- *University of Illinois at Urbana-Champaign, Mar 2015*

- *Microsoft Research, Cambridge, Mar 2015*

- *Microsoft Research, Redmond, Mar 2015*

- *University of Columbia, Mar 2015*

- *Georgia Institute of Technology, Mar 2015*

- *University of Rochester, Mar 2015*

- *VMware Research Group, Feb 2015*

- *IBM Research Almaden, Feb 2015*

- *Samsung Research, Feb 2015*

Application Crash Vulnerabilities.

- *Systems Design and Implementation (SDI) / Intel Science Technology Center (ISTC) seminar, CMU, Jan 2014*

Optimistic Crash Consistency.

- *Wisconsin Institute on Software-defined Datacenters in Madison (WISDoM) Workshop, May 2014*

- *Wisconsin SyNS Conference '13, Nov 2013*

Combating Loss of Ordering in the Storage Stack.

- *Wisconsin Institute on Software-defined Datacenters in Madison (WISDoM) Workshop, Nov 2012*

Coerced Cache Eviction: Dealing with Misbehaving Disks through Discreet-Mode Journaling.

- *Wisconsin Systems Seminar, Apr 2011*

CONFERENCE TALKS

Optimistic Crash Consistency at Symposium on Operating Systems Principles (SOSP '13), Farmington, PA. November 2013.

Designing Persuasive Robots: How Robots Might Persuade People Using Vocal and Nonverbal Cues at Conference on Human-Robot Interaction (HRI '12). March 2012.

Consistency Without Ordering at Conference on File and Storage Technologies (FAST '12), Feb 2012.

Coerced Cache Eviction: Dealing with Misbehaving Disks through Discreet-Mode Journaling at Conference on Dependable Systems & Networks, June 2011.

RESEARCH FUNDING AND EQUIPMENT GRANTS (TOTAL: \$770,500)

1. Vijay Chidambaram. *Building IO-Efficient Systems Infrastructure*. VMware. \$100,000. 2018
2. Vijay Chidambaram. *Building IO-Efficient Systems Infrastructure*. Google. \$36,000. 2018
3. Vijay Chidambaram. *Building IO-Efficient Systems Infrastructure*. National Science Foundation, 2018-2023. \$550,000
4. Vijay Chidambaram. *Analyzing Energy Consumption of Storage on Mobile Devices*. University of Texas at Austin Special Research Grant, 2017. \$750
5. Vijay Chidambaram. *Performance and Reliability in Modern Storage Systems*. VMware. 2017. \$18,750
6. Vijay Chidambaram. *Performance and Reliability in Modern Storage Systems*. Facebook Academic Program, 2016. \$40,000
7. Vijay Chidambaram. *Performance and Reliability in Modern Storage Systems*. VMware Early Career Faculty Award, 2016. \$25,000

TEACHING EXPERIENCE

CS 380D: Distributed Systems , UT Austin (Score: 4.2/5)	Spring 2018
CS 378: Virtualization , UT Austin (Score: 4.6/5)	Fall 2017
CS 380L: Graduate Operating Systems , UT Austin (Score: 4.7/5)	Fall 2016
CS 537: Introduction to Operating Systems , UW-Madison <i>Graduate Student Instructor</i>	Fall 2014
CS 736: Advanced Operating Systems , UW-Madison <i>Guest Lecture on Optimistic Crash Consistency</i>	Feb 2014
CS 537: Operating Systems , UW-Madison <i>Guest Lecture on Journaling</i>	Nov 2013
CS 736: Advanced Operating Systems , UW-Madison <i>Guest Lecture on Optimistic Crash Consistency</i>	Oct 2013
CS 302: Introduction to Computer Programming , UW-Madison <i>Teaching Assistant</i>	Fall 2009

PROFESSIONAL ACTIVITIES**Organizing Roles:**

Co-Chair for Artifact Evaluation at SOSP	2019
Co-Poster Chair for OSDI	2018

Reviewing Roles:

PC Member for FAST, NSDI, SOSP, ATC, PLOS, DRSS	2019
NSF Panelist	2018
PC Member for FAST, SYSTOR, ATC, OSDI (Light PC)	2018
PC Member for ACM Student Research Competition (co-located with SOSP)	2017
PC Member for SOCC, MASCOTS, MSST, WWW, HotStorage, NVMW	2017
External Reviewer for ASPLOS, Eurosys	2017
PC Member for HotStorage, NVMW	2016
Reviewer for Transactions on Storage, Transactions on Computer Systems	2016
Reviewer for Transactions on Architecture and Code Optimization	2016
Reviewer for Transactions on Dependable and Secure Computing	2015

GRADUATE STUDENT RESEARCHERS

Jayashree Mohan - Arrived: Fall 16 (Intern: MSR Cambridge, MSR India)
Soujanya Ponnappalli - Arrived: Fall 17 (Intern: MSR Cambridge, VMware Research)
Rohan Kadekodi - Arrived: Fall 17 (Intern: MSR India, VMware Research)
Aashaka Shah - Arrived: Fall 18 (Intern: MSR India)
Sekwon Lee - Arrived: Fall 18 (Intern: HP Labs)

MASTERS STUDENT MATRICULATION

Pandian Raju	Spring 18 (Rubrik)
Dhathri Purohith	Spring 18 (Nutanix)
Tianyu Cheng	Spring 17 (Apple)

UNDERGRADUATE RESEARCHERS

Ashlie Martinez (CRA Best Undergrad Researcher 2018 Award). <i>CrashMonkey</i> .	Fall 17 - Spring 18
Carolyn Tran. <i>Implementing FLSM in RocksDB</i> .	Fall 17 - Spring 18
Chris Sun. <i>Implementing FLSM in RocksDB</i> .	Fall 17 - Spring 18
Sonika Garg. <i>CrashMonkey</i> .	Fall 17 - Spring 18
Souvik Banerjee. <i>Implementing FLSM in RocksDB</i> .	Fall 17
Subrat Mainali. <i>CrashMonkey</i> .	Fall 17
Tom Gong. <i>Using Static Analysis to Determine Fsync Purpose</i> .	Spring 17
Bhavin Gupta. <i>Using Static Analysis to Determine Fsync Purpose</i> .	Spring 17
Eric Lee. <i>Modeling CTRL in TLA+</i> .	Spring 17
Eric Lee. <i>Building User-Space Storage Transactions</i> .	Fall 17 - Spring 18

DEPARTMENTAL SERVICE

PhD Admissions Committee	2016 - 2018
Faculty Recruiting Committee	2018 - 2019
Diversity Committee	2018 - 2019

RPE COMMITTEES

Yige Hu. <i>TxFs: Leveraging File-System Crash Consistency to Provide ACID Transactions</i> .	Summer 18
Harsh Pareek. <i>Towards Listwise Ranking Functions in Learning to Rank</i> .	Spring 17
Tyler Hunt. <i>Ryoan: A Distributed Sandbox for Untrusted Computation on Secret Data</i> .	Fall 16
Gurbinder Gill. <i>Abelian: A Compiler and Runtime for Graph Analytics on Distributed, Heterogeneous Platforms</i> .	Fall 16
Youngjin Kwon. <i>Coordinated and Efficient Huge Page Management with Ingens</i> .	Fall 16

GRADUATE THESIS PROPOSAL

Jia Chen. <i>Program Analysis for Resource Usage Vulnerability Detection</i> .	Summer 18
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Esha Choukse. *Efficient OS-transparent Main Memory Compression.* Spring 18
Song Zhang. *System Resilience for Partitioned Global Address Space.* Fall 17

UNDERGRADUATE THESIS DEFENSE

Ashwin Madhavan. *On Transactional Programming.* Spring 18.
Alex Upshaw. *Implementing Support for Intel SGX on Barrelfish.* Spring 18.
Carolyn Tran and Chris Sun. *Implementing FLSM in RocksDB.* Spring 18.
Eric Lee. *Building User-Space Storage Transactions.* Spring 18.
Ashlie Martinez. *CrashMonkey: A Framework to Test File-System Crash Consistency.* Fall 17.
Ian Neal. *The Advantages of a Transactional Interface: Porting Applications to TxFS.* Spring 17.