

Anirudh Badam

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Education

Princeton University

Ph.D. in Computer Science
M.A. in Computer Science
Advisor: Vivek S. Pai

Expected May 2012
April 2008

Indian Institute of Technology, Madras

B.Tech in Computer Science
Minor in Operations Research

June 2006

Honors

Siebel Scholar, Class of 2012 – awarded annually for academic excellence and demonstrated leadership to 85 top students from the worlds leading graduate schools.

Wu Prize for Excellence 2010 – awarded to Princeton University’s engineering graduate students who have performed at the highest level as scholars and researchers.

HashCache, a research project, named as one of the Top 10 Emerging Technologies of 2009 by MIT’s TechReview Magazine.

Technology for Developing Regions Fellowship, Princeton University, 2008.

Best Intern Award 2005 for Project Bluestreak, Extreme Blue Internship, IBM.

Merit Award from IIT Madras for being among the top 30 freshmen in the institute.

Ranked 5th and 57th among 200,000 students who appeared in the preliminary and main rounds, respectively, of the Indian Institute of Technology Joint Entrance Examination of 2002.

Prathiba Scholarship for excellence in high school, Govt. of India, 2002.

NCERT National Talent Search Examination Scholarship, Govt. of India, 2000.

Selected Publications

Anirudh Badam, Vivek S. Pai, “SSDAlloc: Hybrid RAM/SSD Memory Management Made Easy”, In Proc. USENIX NSDI ’11, Boston, MA, March 2011.

Anirudh Badam, Kyoungsoo Park, Vivek S. Pai, Larry L. Peterson, “HashCache: Cache Storage for the Next Billion”, In Proc. USENIX NSDI ’09, Boston, MA, April 2009.

Anirudh Badam, David W. Nellans, Vivek S. Pai, “TEAM: Transparent Expansion of Application Memory”, In Submission.

Anirudh Badam, Vivek S. Pai, “Chameleon: Better Non-volatile Memory Support via Shapeshifting Virtual Memory Pages”, In Submission.

Anirudh Badam, David W. Nellans, Vivek S. Pai, “Application Driven Flash Translation Layers”, In Submission.

Anirudh Badam, Dongsu Han, David G. Andersen, Michael Kaminsky, Konstantina Papagiannaki, Srinivasan Seshan, “The Hare and the Tortoise: Taming Wireless Losses by Exploiting Wired Reliability”, In Proc. ACM MobiHoc ’11, Paris, France, May 2011.

Anirudh Badam, Bheemarjun Reddy Tamma, Sivaram M. C. “K-Tree: A multiple tree multimedia multicast protocol”, In Proc. HiPC 2006, Bangalore, India, December 2006.

Bheemarjun Reddy Tamma, **Anirudh Badam**, Sivaram M. C., Ramesh Rao, “K-Tree: A multiple tree multimedia multicast protocol”, Computer Networks 54(11): 1864-1884 (2010).

Selected Research Projects

HashCache

October 2006 - March 2009

Princeton University

Princeton, NJ

Description: HashCache involves the development of an efficient cache indexing mechanism. We have developed a new cache indexing mechanism for caches which consumes 6–20x less memory compared to the state-of-the-art indexing mechanisms. Our research directly implies that larger amounts of data can be indexed with the same amount of memory when compared to the present day high performance indexing mechanisms. This provides benefits for high-performance HTTP proxies, network accelerators that cache packets, data deduplicators that need to index arbitrary chunks of data and object caches that cache the results of SQL queries to speed up database operations.

SSDAlloc

April 2009 - March 2011

Princeton University

Princeton, NJ

Description: SSDAlloc is an easy to use hybrid SSD/RAM object based virtual memory management tool in combination with a runtime that transparently tiers objects between DRAM and flash memory. It helps programmers build high-performance flash memory based applications (comparable to that of application rewrite) while requiring very few modifications to application code – restricted only to the memory allocation portions of the program. Compared to existing transparent DRAM and flash memory tiering mechanisms, SSDAlloc increases the performance by 4–15x. Additionally, it can increase the lifetime of the flash memory device by 32x for a given workload over existing techniques.

fio_malloc

February 2011 -

Fusion-io Inc.

Salt Lake City, UT

Description: fio_malloc is an ongoing collaboration between Fusion-io and Princeton University to use enterprise class flash memory as a DRAM substitute in the virtual memory hierarchy. DRAM has a high initial cost and a high power requirement. Therefore, applications with high throughput requirements often have high capital requirements. In this project, we aim to address the impediments inside traditional operating systems to using flash memory as high-performance swap device. Additionally, we also explore techniques to optimize flash memory management by exposing the flash transition layer directly to the OS and the application. As a result, flash memory can now be managed in workload centric ways.

Chameleon

October 2011 -

Princeton University

Princeton, NJ

Description: Chameleon is a virtual memory management mechanism that performs cross-boundary optimizations between the application, the library and the OS to provide better support for new non-volatile memories. It reorganizes virtual memory so that applications can obtain all the desirable properties from a tiering system: It provides transparency by operating via virtual memory, it provides page-fault free access to all of DRAM via virtual memory and it optimizes the usage of non-volatile memory by allowing applications to localize reads and writes at an object level as opposed to page level.

HTPPR

June 2009 - May 2011

Intel Labs

Pittsburgh, PA

Description: HTPPR aims to develop a multi-link transport protocol primarily aimed at settings where a wireless link is present along with a wired link between the nodes. Such hybrid links can be found in settings like home networks, wireless LANs inside datacenters, and long distance WiFi links that are accompanied by low bandwidth PPPoE links. HTPPR obtains better bandwidth on the lossy wireless link by leveraging the reliability of the wired link in a bandwidth efficient manner.

Reliable Video Multicast

September 2005 to May 2006

HPCN Lab, IIT Madras

Chennai, India

Description: The work involved the exploration of multiple multicast trees for reliable transmission of video in an ad-hoc wireless network. Apart from formally proving that finding the maximum number of node disjoint trees is a hard problem, we developed a competitive online algorithm for creating multiple maximally node disjoint trees which paved the way for a reliable multiple-tree multicast mechanism.

Selected Talks and Presentations

“HashCache: Cache Storage for the Next Billion”:

1. Master’s Thesis Defense, Princeton, NJ, Jan 2008.
2. Conference talk at USENIX NSDI, Boston, MA, May 2009.

“SSDAlloc: Hybrid RAM/SSD Memory Management Made Easy”:

3. Work-in-progress talk at USENIX ATC 2010, Boston, MA, Jun 2010.
4. Invited talk at NetAPP Inc., Boston, MA, Jun 2010.
5. Invited talk at IBM T.J.Watson, Hawthorne, NY, Jul 2010.
6. Workshop talk at IBM T.J.Watson Nonvolatile Memory Workshop, Hawthorne, NY, Sep 2010.
7. Invited talk at Fusion-io Inc., Salt Lake City, UT, Feb 2011.
8. Workshop talk at UCSD NVMW 2011, San Diego, CA, Mar 2011.
9. Conference talk at USENIX NSDI 2011, Boston, MA, Apr 2011.

“On Bridging the Performance and Structural Gap Between Memory Storage Layers Using New Non-volatile Memory Technologies”:

10. PhD Thesis Proposal, Princeton, NJ, Nov 2010.

“HTPPR: Tackling Wireless Losses by Exploiting Wired Reliability”:

11. Invited talk at Intel Labs Pittsburgh Open House, Pittsburgh, PA, Nov 2009.
12. Conference talk at ACM MobiHoc, Paris, France, May 2011.

Professional Experience

Research Intern at Fusion-io Inc. , Salt Lake City, Utah	February 2011 - August 2011
Research Intern at Intel Labs Pittsburgh	June 2009 - August 2009
Research Intern at HP Labs Princeton	June 2008 - August 2008
Teaching Assistant for Advanced Programming Techniques	Spring Semester 2008
Teaching Assistant for Introduction to Programming Systems	Fall Semester 2007
Research Intern at IBM Research Lab , India	May 2005 - July 2005

Patents

Larry Peterson, Vivek S. Pai, Sunghwan Ihm, **Anirudh Badam**, KyoungSoo Park. Systems and Methods for Network Acceleration and Efficient Indexing for Caching Filesystems: Final approval pending. US provisional patent was filed on March 10th 2010.

Anirudh Badam, Vivek S. Pai. SSDAlloc: Hybrid SSD/DRAM Memory Management Made Easy. US provisional patent was filed on March 15th 2011.

References

Vivek S. Pai (thesis adviser)

Associate Professor, Department of Computer Science, Princeton University

Email: vivek@cs.princeton.edu

Michael J. Freedman (thesis committee member)

Assistant Professor, Department of Computer Science, Princeton University

Email: mfreed@cs.princeton.edu

Konstantina Papagiannaki (prior internship mentor)

Head of the Internet Systems and Networking Group at Telefonica Research, Spain

Email: dina@tid.es

Michael Kaminsky (prior internship mentor)

Adjunct Research Scientist at Intel Science and Technology Center for Cloud Computing

Email: michael.e.kaminsky@intel.com

Robert Dondero (I was his teaching assistant in the past)

Lecturer, Department of Computer Science, Princeton University

Email: rdondero@cs.princeton.edu