Karan Sapra

Curriculum Vitae

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Education

2011–2016 **Ph.D. candidate in Computer Engineering**, *Clemson University*, Clemson.

2008–2011 **Bachelor in Computer Engineering**, *Clemson University*, Clemson.
Minor: Mathematical Science

Ph.D. Dissertation

Title *Framework for Life-cycle enrichment of HPC Applications towards Exascale Heterogeneous Architecture*

Advisor Professor Melissa C. Smith

Description This dissertation explores the idea of mapping algorithms and applications to heterogeneous based supercomputers for performance, energy and energy per flop. We propose a High Performance Computing run-time framework for assisting in mapping of algorithms including post-processing task to these large scale heterogeneous super-computing machines for efficient computing.

Research Experience

2013–Present **Algorithm-to-Architecture(A2A) Mapping**.
Developing performance and energy mapping for application and algorithms to architecture.

2013–Present **Global GPU-optimized Gene Network Alignment (G3NA)**.
Developing algorithms on global gene alignment for large-scale organism network for GPUs and multi-core architectures. Access to Video and Website.

2014–Present **Heterogeneous Functional Partitioning (HFP) Framework**.
Framework for efficient data-movement, power consumption and scaling use of resources in heterogeneous exascale environment.

2015–Present **HPC enabled Laparoscopic Surgery**.
Framework for use of GPU-based supercomputing cluster for assistance in Laparoscopic surgery with DaVinci Robot.

2011-Present **Overcoming Keyloggers and Screendumps**.
Creating an application for rendering keyloggers and screendumps ineffective using DirectX and GPUs. In the process of Copyright Licensing in association with Clemson University.

2013–2014 **High Level Prediction Modeling in GPU**.
Developed prediction models for multicore and GPU paradigms.

2011–2013 **Load balancing in Cloud**.
Developed multiple techniques for load balancing in cloud using Markov Decision Process, load-aware and prediction based load balancing.

2011–2013 **Redundancy Elimination in Cloud Network**.
Developed an end-to-end prediction model to reduce traffic in cloud networks.

2011–2013 **Collusion Detection in P2P**.
Developed a technique to detect and thwart collusion in P2P Networks using graph theory.

2011–2013 **Routing in Sensor Networks**.
Developed and implemented an algorithm for improving routing in sensor network.

2009–2011 **Fast Image Mosaicking using Optical Flow**.
Developed an algorithm for fast image mosaicking using optical flow for robots.

Professional Experience

2014 **Research Intern**, *Oak Ridge National Laboratory Internship*, Oak Ridge, TN, Summer 2014, Fall 2014.

- Lead Development in Functional Partitioning (FP) framework for efficient use of resources for exascale GPU-CPUs enabled heterogeneous supercomputer.

2011–Present **Research Assistant**, *Clemson University*, Clemson, SC.

- Development and Deployment of Global GPU-enabled Gene Network Alignment (G3NA).
- Performance and energy modeling on accelerators.
- Development of Algorithms for load balancing in Cloud, Routing, and thwarting collusion in P2P.

2009-2011 **Co-op Intern**, *ADTRAN*, Huntsville, Al,
Fall 2009, Summer 2010, Spring 2011, Summer 2011.

- 1st Term: Network programming, code writing, and testing for ADTRAN equipment responsible for voice and data communication.
- 2nd Term: Worked on Adtran operating system: Improved, cleaned, and debugged errors in the core OS for ADTRAN.
- 3rd Term: Developed scripts in Python and created a GUI Manager for smoke test automation.
- 4th Term: Continued working on Smoke Test GUI (TMC) and developing automation scripts in python.

2009 **Internship**, *Hi-Tech Robotics Systemz*, Gurgoan, India,
Summer 2009.
Created various image processing projects in C++ for image feature matching, tracking and artificial intelligence for robots.

Teaching and Instructional Assistance

2013 **Instructional Assistant**, *Clemson University*, Clemson,SC,
Fall 2013.

- Instructional assistant support for ECE 327 (Undergraduate level course) and ECE 893 (Graduate level course): Digital computer design and High performance Computing using GPGPU and other multi- and many-core accelerator.

2013-2014 **Teaching Assistant**, *Clemson University*, Clemson,SC,
Spring 2013, Fall 2013.

- Teaching assistant for ECE 429/629 (Graduate level course): Organization of computers.

Students Mentored

Jamar Robinson, *Ph.D.*, ECE, Clemson University, Graduation: Dec'18.
Anagha Joshi, *M.Sc.*, ECE, Clemson University, Graduation: Aug'17.
Prantit Lokre, *M.Sc.*, ECE, Clemson University, Graduation: May'16.
Chirantan Sharma, *M.Sc.*, ECE, Clemson University, Graduation: May'16.
Chinmay Joshi, *M.Sc*, ECE, Clemson University, Graduation: May'17.
Ben Hindman, *B.Sc.*, ECE, Clemson University, Graduation: Aug'16.

VIS-REU Students at Clemson

Kyle Kathleen, *Genomics Dept.*, Florida State University, Graduation: Dec'18.
Amari Lewis, *B.Sc.*, ECE, Winston-Salem State University, Graduation: Aug'16.
Asher Sampong, *Bio-Science*, Fort Valley State University, Graduation: Aug'17.

Technical Skills

Programming Languages	C, C++, Matlab, Ocaml, Verilog, Prolog, Java
Scripting Languages	Lex/Flex, YACC, Bison, Python
IDE, Libraries, Frameworks	CUDA, DirectX, MPI, OpenMP, P-threads, OpenACC, OpenGL, MFC, OpenCV, Blepo, SQL, CPLEX, .Net, MariaDB

Honor, Awards, and Activities

2013-2015	Volunteer as a part of Future Engineering Group to assist elementary and high school students to develop software applications and motivate them to pursue a future in Science/Mathematics
2011	1st place in IEEE Student Paper Contest
2010	2nd place in IEEE Student Paper Contest
2008	Clemson Dean List
2008	Ranked in Top 100 in National Science Olympiad in the city of New Delhi
2000-2008	Participated and awards in multiple Inter High School and collegiate programming competitions
2006	Received award for Excellence and Leadership in Sports (High School)
2004	Represented New Delhi State in a National Netball Tournament (Finalist)

Organizations

2009-Present	TAU BETA PI
2011-Present	IEEE, Member
2013-Present	ACM, Member

Publications

Accepted

[1] ***K. Sapra***, F. Feltus, M. Smith and J. Levine: G3NA-V: GPU-enabled tool for mining and aligning complex gene interaction graphs, GPU Technical Conference (GTC), 2016, San Jose, California.

[2] V. Pallipuram, M. Smith, N. Sarma, R. Anand, E. Weill, ***K. Sapra***: Subjective versus objective: classifying analytical models for productive heterogeneous performance prediction, The Journal of Supercomputing, 2015.

[3] F. Feltus, M. Smith and ***K. Sapra***: G3NA-V: GPU-enabled tool for mining and aligning complex gene interaction graphs, Invited Theatre Talk, Nvidia Booth, Supercomputing (SC), 2015, Texas, Austin.

[4] ***K. Sapra***: Framework for Lifecycle Enrichment of HPC Applications on Exascale Heterogeneous Architecture, Ph.D. Doctoral Showcase, Supercomputing (SC), 2015, Texas, Austin.

[5] ***K. Sapra***, Z. Ronaghi, R. Izard, E. Duffy, M. C. Smith, KC Wang, D. Kwartowitz: HPC Enabled Real-Time Remote Processing of Laparoscopic Surgery, Accepted Poster, Supercomputing (SC), 2015, Texas, Austin.

[6] H. Shen, Y. Lin, ***K. Sapra***, and Z. Li: Enhancing Collusion Resilience in Reputation Systems, IEEE Transactions on Parallel and Distributed Systems (TPDS), 2015.

[7] ***K. Sapra***, F. Feltus and M. Smith: G3NA: A GPU Optimized Global Gene Network Alignment Tool and In-situ Visualization, GPU Technical Conference (GTC), Mar 2015, Silicon Valley, California.

[8] A. Sampong, J. Levine, A. Feltus, M. Smith, A. Joshi and ***K. Sapra***: Visualizing Gene-Interactions within the Rice and Maize Network, AGU Fall Meeting, 2014, Poster Presentation, San Francisco, California.

[9] ***K. Sapra***, S. Gupta, R. Miller, V. Anantharaj, S. Atchley, SS. Vazhkudai, D. Tiwari and M. Smith: End-to-End Computing using Functional Partitioning: A Community Earth System Model (CESM) Case Study, Smoky Mountain Conference, Sept 2014, Gatlinburg, Tennessee.

[10] L. Chen, H. Shen and ***K. Sapra***: RIAL: Resource Intensity Aware Load Balancing in Clouds, IEEE International Conference on Computer Communication (INFOCOM), April 2014, Toronto, Canada.

[11] C. Qiu, H. Shen, S. Soltani, ***K. Sapra***, H. Jiang and J. Hallstrom, CEDAR: A Low-latency and Distributed Strategy for Packet Recovery in Wireless Network, IEEE/ACM Transactions on Networking (TON), accepted on June 18, 2014.

[12] L. Chen, H. Shen and ***K. Sapra***, Distributed Autonomous Virtual Resource Management in Datacenters Using Finite-Markov Decision Process, Proc. of ACM Symposium on Cloud Computing (SOCC), Nov 2014, Seattle, Washington.

[13] Z. Li, H. Shen, ***K. Sapra***: Leveraging Social Networks to Combat Collusion in Reputation Systems for Peer-to-Peer Networks, IEEE Transactions on Computers, vol.62, no. 9, pp. 1745-1759, Sept. 2013.

[14] K. Chen, H. Shen and ***K. Sapra***, G. Liu: A Social Network Integrated Reputation System for Cooperative P2P File Sharing, International Conference on Communications and Network (ICCCN), July 2013, Nassau, Bahamas.

[15] C. Qui, H. Shen, S. Soltani, ***K. Sapra***, H. Jiang and J. Hallstorm: CEDAR: An Optimal and Distributed Strategy for Packet Recovery In Wireless Network, IEEE International Conference on Computer Communication (INFOCOM), April 2013, Turin, Italy.

[16] ***K. Sapra***, B. Husain, R. Brooks and M. Smith: Circumventing Keyloggers and Screendump, MALWARE Conference (MALCON), Aug 2013, Fajardo, Puerto Rico.

[17] ***K. Sapra***: Taxonomy Cube: A multi-Dimension Application-to-Architecture mapping, Early Dissertation Showcase, Supercomputing Conference (SC), Nov 2013 Denver, Colorado.

[18] L. Yu, ***K. Sapra*** and H. Shen and Lin Ye: Cooperative End-to-End Traffic Redundancy Elimination for Reducing Cloud Bandwidth Cost, IEEE International Conference on Network Protocols (ICNP), Oct 2012, Austin, Texas.

[19] Z. Li, H. Shen and ***K. Sapra***: Collusion Detection in Reputation Systems for Peer-to-Peer Networks, The 41st International Conference on Parallel Processing (ICPP), Sept 2012, Pittsburg, Pennsylvania.

[20] Z. Li, H. Shen and ***K. Sapra***: Leveraging Social Networks to Combat Collusion in Reputation Systems for Peer-to-Peer Networks, Proc. of IEEE International Parallel and Distributed Processing Symposium (IPDPS), May 2011, Anchorage, Alaska.

[21] ***K. Sapra*** and S. Birchfield: Fast image mosaicking using optical flow, Proc. of IEEE Southeastcon (SECON), Mar 2011, Nashville, Tennessee.

Submitted

[1] ***K. Sapra***, M.Smith: Qualitative vs Quantitative Analysis for Application-to-Architecture mapping , International Conference of SuperComputing (ICS), Submitted.

[2] ***K. Sapra***, S. Gupta, R. Miller, V. Anantharaj, S. Atchley, SS. Vazhkudai, D. Tiwari and M. Smith: Exploiting On-Node Heterogeneity for Efficient End-to-End Computing, International Conference of SuperComputing (ICS), Submitted.

[3] L. Yu, ***K. Sapra***, H. Shen and Lin Ye: Cooperative End-to-End Traffic Redundancy Elimination for Reducing Cloud Bandwidth Cost, IEEE Transaction of Networking (TON), Submitted.

[4] H. Shen, ***K. Sapra*** and Z. Li Collusion Detection in Reputation Systems for Peer-to-Peer Networks, IEEE Transaction on Parallel and Distributed Systems (TPDS), Submitted.

In Preparation

[1] ***K. Sapra***, M.Smith, A. Feltus, J. Levine: G3NA-V visualizing and analyzing extremely large co-expression biological networks , IEEE Conference on Visual Analytics Science and Technology, Due: March 21, 2016.

[2] B. Husain, ***K. Sapra***, M.Smith and J. Levine: A multi-GPGPU implementation and visualization of SEIR using GIS for infection prediction, IEEE Conference on Visual Analytics Science and Technology, Due: March 21, 2016.

[3] ***K.Sapra***, M.Smith: A regression and statistical based approach for analyzing energy, performance and scalability for application porting to accelerators. IEEE Journal of Supercomputing, Target: May, 2016.