Vivek L. Kale

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U.S. Citizen

Education

University of Illinois at Urbana-Champaign, Urbana, IL, Ph.D., Computer Science, 2015
Advisor: William D. Gropp
GPA: 3.96/4.00
Lawrence Scholar Fellowship

Highlights of Courses

- Designing and Building Scientific Applications
- Parallel Software Patterns
- Distributed Systems
- Performance Optimization
- Parallel Computer Architecture
- Programming Languages
- Algorithms
- Artificial Intelligence
- Introduction to Software Engineering

Technical Skills

Languages: C, C++, python, Fortran, bash, csh, VHDL, Matlab, Java

Tools: LaTeX, gnuplot, emacs, autoconf, cmake, svn, git

Libraries for Parallelism: POSIX threads (Pthreads), MPI (mpich3), OpenMP (gomp), OpenACC (pgi), CUDA

Performance Profiling Tools: OpenSpeedShop, hpcToolkit, PMPI, Intel VTune, nvprof

Platforms: Intel Xeon, IBM Power7, AMD Opteron, NVIDIA Kepler, Intel Xeon Phi

Experience

University of Southern California Computer Scientist December '16 - present

- Working in team to manage computational performance aspects of running an application program involving Fast Fourier Transformation and image reconstruction algorithms.
- Doing optimizations for MPI+CUDA application code involving low-overhead loop scheduling and loop optimizations such as loop unrolling.
- Incorporating low-overhead loop scheduling techniques in application code.

Charmworks, Inc. Research Assistant / Developer January '16 - November '16

- Extended loop scheduling library that is part of Charm++ library to incorporate low-overhead loop scheduling.

- Experimentation in applying hybrid loop scheduling strategies within Charm++.
- Assisted with business aspects of developing software for performance optimization.

University of Illinois Postdoctoral Associate Jul '15 – Dec '15
- Developing library that allows application programmers to use strategies from dissertation.
- Adapting a plasma physics application code to work on a GPGPU processor and Intel Xeon Phi.
- Incorporating over-decomposition and locality-aware scheduling into strategies from dissertation.

Lawrence Livermore Nat'l Lab Lawrence Scholar Feb '12 – Jun '14
- Created a software system for automated performance optimization and application programmer usability of low-overhead hybrid scheduling strategies.
- Developed a ROSE-based custom compiler for automatically transforming MPI+OpenMP applications to use low-overhead scheduling techniques and runtime.
- Assessed further opportunities for performance improvement of low-overhead schedulers, including improvement of spatial locality of low-overhead schedulers.

Lawrence Livermore and Berkeley Nat'l Lab Scholar Jun '10 - Sept '10 / Jun '11 - Sept '11
- Experimented with different OpenMP parameters of implemented MPI+OpenMP application code to understand performance optimizations on LLNL supercomputers.
- Analyzed results for the performance tests developed on NERSC machines, and compared with collectives in reference to MPI (mpich2) runtime system.
- Modified OpenMP gomp runtime system in order to integrate low-overhead schedulers within it.

Goldman-Sachs Summer Analyst Jun '09 – Sept '09
- Wrote code for testing trading system infrastructure functions under extreme market conditions.
- Analyzed performance bottlenecks of system infrastructure functions.

Research Overview

I have worked on low-overhead dynamic scheduling strategies for performance tuning MPI+OpenMP codes on multi-core processors. The strategies have been applied to dense matrix factorization codes, specifically Communication-avoiding LU and Communication-avoiding QR. I have applied the strategies to regular mesh computations and Lattice-Boltzmann simulations and n-body simulations. The scheduling strategies developed can be beneficial to mitigate the amplification problem, a problem shown to cause serious performance bottlenecks for bulk-synchronous and loosely synchronous MPI applications running on next-generation supercomputers.

List of Publications

1. Vivek Kale and William D. Gropp ***User-defined Schedules for OpenMP*** OpenMPCon 2017. Stony Brook, New York, USA.
2. Vivek Kale, Harshitha Menon-Gopalakrishnan and Karthik Senthil. ***Using Low-overhead Loop Scheduling for Charm++ Application to Improve Performance of Scientific Applications*** Technical Report. University of Southern California. June 2017.
3. Vivek Kale and William D. Gropp. ***Composing Low-Overhead Scheduling Strategies for Improving Performance of Scientific Applications*** Technical Report. University of Illinois at Urbana-Champaign. 2016.

4. Vivek Kale and William D. Gropp. ***Composing Low-Overhead Scheduling Strategies for Improving Performance of Scientific Applications*** IWOMP 2015. Aachen, Germany.
5. Vivek Kale, Simplice Donfack, Laura Grigori, William D. Gropp. *Balancing the Tradeoff Between Load Balancing and Locality to Improve Performance of Scientific Applications* SC' 14. New Orleans, USA.
6. Vivek Kale, Amanda Randles, William D. Gropp. ***Locality-Optimized Mixed Static/Dynamic Scheduling for Load Balancing on SMPs*** EuroMPI/ASIA 2014. Kyoto, Japan.
7. Vivek Kale, Todd Gamblin, Torsten Hoefler, Bronis R. de Supinski, William D. Gropp. ***Slack-conscious Lightweight Loop Scheduling for Scaling Past the Noise Amplification Problem*** SC '12 Poster. Salt Lake City, Utah.
8. Simplice Donfack, Vivek Kale, Laura Grigori, William D. Gropp. ***Hybrid Static/Dynamic Scheduling for Already Optimized Dense Matrix Factorizations*** IPDPS 2011. Shanghai, China.
9. Vivek Kale, Abhinav Bhatele, William D. Gropp. ***Weighted Locality-sensitive Scheduling for Noise Mitigation on Multicore Clusters*** HiPC 2011. Bangalore, India.
10. Vivek Kale, William D. Gropp. ***Load Balancing for Regular Meshes on a Cluster of SMPs with MPI*** EuroMPI 2010. Stuttgart, Germany. *(Selected as a Best Paper)*
11. Torsten Hoefler, James Dinan, Darius Buntinas, Pavan Balaji, Brian Barrett, Ron Brightwell, William Gropp, Vivek Kale, Rajeev Thakur. ***MPI+MPI: A New Hybrid Approach to Parallel Programming with MPI Plus Shared Memory*** EuroMPI 2012. Madrid, Spain.
12. Amanda Randles, Vivek Kale, Jeff Hammond, William D. Gropp, Efthimios Kaxiras. ***Performance Analysis of the Lattice Boltzmann Model Beyond Navier-Stokes*** IPDPS 2013. Boston, MA.
13. Vivek Kale. ***Towards Using and Improving the NAS Parallel Benchmarks: A Parallel Patterns Approach*** ParaPLoP 2010. Carefree, Arizona.
14. Vivek Kale and Edgar Solomonik. ***Parallel Sorting Pattern*** ParaPLoP 2010. Carefree, Arizona.
15. Vivek Kale. ***The Correlation between Parallel Patterns and the NAS Parallel Benchmarks*** ICSE 2010. Johannesberg, South Africa.
16. Vivek Kale. ***Enabling Simulation of Renewable Energy Solutions through Supercomputers*** Technical Report 2009. TR0210-373. University of Illinois at Urbana-Champaign.

Membership of Organizations

- Society for Industrial and Applied Mathematics
- Association for Computing Machinery
- Institute of Electrical and Electronics Engineers

Teaching Experience

1. Teaching Assistant for Programming Studio (CS 242) at University of Illinois at Urbana-Champaign for three semesters.
2. Grader and Teaching Assistant for Probability Theory course (Math 363) at University of Illinois at Urbana-Champaign for three semesters.

Awards

- Lawrence Scholar Fellowship at Lawrence Livermore National Laboratory: A fellowship allowing a PhD student to conduct their dissertation research at the Lawrence Livermore National Laboratory in Livermore, California.
- 2015 Heidelberg Laureate Forum Participant: Forum providing an opportunity for graduate students and postdocs in Mathematics and Computer Science to interact with people who have shaped these two fields. Invitations to the forum are based on an application process.