Varad Deshmukh

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Research Interests

Topological Data Analysis, Time Series Analysis and Machine Learning

Education

University of Colorado, Boulder, Boulder, CO

Ph.D., Computer Science   August 2017–June 2022 (Expected)
- Advisor: Prof. Elizabeth Bradley
- GPA - 3.93/4.0
- Courses: Deep Learning, Networks Analysis and Modeling, Chaotic Dynamics.

University of California, Santa Barbara, Santa Barbara, CA

M.S., Computer Science   September 2011–April 2013
- Topic: *Matrix Reduction Techniques for Ordinary Differential Equations in Chemical Systems*
- Advisors: Prof. John Gilbert and Prof. Linda Petzold
- GPA - 3.9/4.0

College of Engineering, Pune, Pune, India

B.Tech., Computer Engineering   June 2007–June 2011
- Project Topic: *Techniques for Benchmarking of Computer Micro-Architecture*
- Advisors: Dr. Shrirang Karandikar and Mr. Shirish Gosavi
- GPA - 9.2/10.0

Invited Talks

1. **Deshmukh V**, Bradley E and Bagenal F. Nonlinear time-series analysis of solar-wind data from Voyager 2 and New Horizons, *Voyager/New Horizons Workshop, 2018; John Hopkins University Applied Physics Laboratory, Laurel, MD.*

2. **Varad Deshmukh**, Elizabeth Bradley, Joshua Garland and James Meiss. Using curvature to understand the structure of dynamics, *Santa Fe Institute, 2019; Santa Fe, NM.*

Contributed Talks

1. **Varad Deshmukh**, Elizabeth Bradley, James Meiss and Thomas Berger. Leveraging Topological Data Analysis and Deep Learning for Solar Flare Prediction, *Machine Learning in Heliophysics, Amsterdam, Netherlands, 2019* (In prepration).

2. Joshua Garland, **Varad Deshmukh**, Elizabeth Bradley. Nonlinear Time-Series Analysis of a Paleoclimate Temperature Record from Antarctica, *SIAM Dynamical Systems, Snowbird, UT, 2019.*

3. **Varad Deshmukh**, Elizabeth Bradley, Joshua Garland and James Meiss. Curvature Based Parameter Selection for Delay-Coordinate Reconstruction, *SIAM Dynamical Systems, Snowbird, UT, 2019.*

Inventions

1. **Varad Deshmukh**, Stephen Muckle, Bryan Huntsman, Veena Sambasivan, Srivatsa Vaddagiri. 2016. Temporary frequency adjustment of mobile device processors based on task migration. U.S. Patent 9,400,518, filed October 10, 2013, and issued July 26, 2016.

Publications

1. **Varad Deshmukh**, Nishchay Mhatre and Shrirang Karandikar. "FIRA - A novel method for benchmarking the cache hierarchy." *COMPUTE 2012 : 1st Annual Conference of ACM Pune Professional Chapter, Pune*, 2012.

2. **Varad Deshmukh**, Nishchay Mhatre and Shrirang Karandikar. "Techniques for Benchmarking of CPU Micro-Architecture for Performance Evaluation." 18th *Annual International Conference on High Performance Computing: Student Research Symposium, Bangalore*, 2011.

3. Nishchay Mhatre, Mohit Karve, Rahul Bedarkar, Shravan Aras, Sanjeev MK, Gautam Akiwate, **Varad Deshmukh**. "Modular Generic Low Cost On Board Computer System for Nano/Pico Satellites." 62nd *International Astronautical Congress, Cape Town*, 2010.

RESEARCH EXPERIENCE	*Solar Flare Prediction*	*June 2018 – Present*

RESEARCH EXPERIENCE

Solar Flare Prediction — *June 2018 – Present*

- Currently developing solar flare prediction models using a combination of Topological Data Analysis (TDA) and Deep Learning.
- Using the TDA approach for feature extraction together with ML models such as Multilayer Perceptrons, Convolutional Neural Networks, and Support Vector Machines.
- Developing Autoencoder and Principal Component Analysis models for representation learning to classify sunspots.

Application of Curvature to Dynamical Systems — *January 2018 – Present*

- Applying local and aggregated curvature to understand the behavior of dynamical systems such as identification of unstable hyperbolic equilibrium points. Demonstrated applications of aggregated curvature in delay co-ordinate embedding: the process of reconstructing a higher dimensional dynamical system from scalar time-series data.
- Developed a novel curvature-based heuristic to estimate the embedding delay.

Matrix Reduction Techniques for Ordinary Differential Equations — *June 2012 – April 2013*

- Developed model order reduction techniques to speed up numerical simulation of ODEs.
- Combined novel threshold-based Jacobian reduction techniques with a graph-based sparse matrix solver to optimize the linear solver procedure of implicit ODE schemes.

Swayam – Pico-satellite Design — *May 2008 – May 2011*

- Control Systems team lead for design and construction of a communication pico-satellite for enabling communication between ships and ground stations, launched by the Indian Space Research Organization in June, 2016.
- Developed models for satellite orbit, geomagnetic field, and passive magnetic control system to study satellite dynamics post-launch. The passive magnetic control system is the first of its kind for Indian satellites.
- Project web-site : `http://www.coep.org.in/csat/`

INDUSTRY EXPERIENCE

National Renewable Energy Laboratory, Golden, CO

Intern — *May 2018 – August 2018*

- Worked on wind time-series scenario generation for stochastic economic dispatch of the grid.
- Developed machine learning models based on sparse identification (SINDy) and inferencing stochastic differential equations (Ornstein-Uhlenbeck process) to generate scenarios.
- Provided statistical comparison of generated scenarios with real data.

International Business Machines, Austin, TX

Hardware Performance Analyst — *August 2015 – June 2017*

- Worked on Hardware Performance Modeling for IBM Power server systems.
- Modeled PCIe, PowerBus and L3 Cache for bottleneck analysis and optimizations.
- Generated and analysed hardware traces for CPU-GPU and in-memory database workloads.

Qualcomm Inc., San Diego, CA

Software Engineer — *June 2013 – August 2015*

- Worked on Android and Linux Kernel optimization for Qualcomm chipsets.
- Improved application launch latencies and system boot-time via framework/kernel optimization.
- Tuned kernel memory management features – zram, zswap, low memory killer and page cache.

Qualcomm Inc., San Diego, CA

Engineering Intern — *June 2012 – September 2012*

- Worked on Linux Kernel performance development for UX improvement.
- Developed a power-optimal feature to enable core frequency scaling based on thread migrations.

Tata Computational Research Laboratories, Pune, India

Intern — *May 2010 – August 2010*

- Investigated compiler vectorization and cache locality optimization for GCC on x86 architecture.
- Optimized a seismic application using an innovative cache-optimal vectorizable data structure.

TEACHING EXPERIENCE	*Teaching Assistant* CSCI 3104 - Algorithms University of Colorado, Boulder	Fall 2017
	Teaching Assistant CS 140 - Parallel Scientific Computing University of California, Santa Barbara	Winter 2013
	Reader CS 240 - Applied Parallel Computing University of California, Santa Barbara	Spring 2012

AWARDS &
ACHIEVEMENTS

- Dean Graduate Assistantship Award at University of Colorado, Boulder, 2017
- Best Paper Award at the 18th Annual International Conference on High Performance Computing, Bangalore: Student Research Symposium, 2011
- Computing Division Winner at the Jed-I Project Challenge, Indian Institute of Science, 2011
- Indian Institute of Technology - Joint Entrance Examination, 2007 – All India Rank 1503