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Research Interests

My primary research interests lie in **optimization methods for large-scale machine learning** and **scalable bayesian inference**, with applications in areas such as extreme classification and clustering, ranking, recommender systems, deep learning. I have experience building parallel, asynchronous optimization algorithms in distributed memory settings for a variety of machine learning models. More recently, I am interested in applying tools from random projections and sketching into improving optimization algorithms.

Education

PhD - Computer Science, UC Santa Cruz **Aug 2013 - Dec 2019**
(Transferred from Purdue University 2013 - 2014)
Thesis Advisor: **S.V.N. Vishwanathan**
Thesis Title: *Hybrid-Parallel Parameter Estimation for Frequentist and Bayesian Models*
Thesis Committee: **S.V.N. Vishwanathan**, **Manfred K. Warmuth**, **David P. Helmbold**

Masters - Computer Science, Georgia Institute of Technology **Aug 2009 - May 2011**

MSc (Integrated) - Software Engineering, PSG College of Technology, India **2003 - 2008**

Research & Professional Experience

Graduate Student Researcher - *UC Santa Cruz* **Aug 2014 - present**

- Working on distributed stochastic optimization algorithms to scale Factorization Machines on large data and large number of dimensions **(In Submission)**.
- Proposed a new distributed asynchronous bayesian inference algorithm for Large-Scale Mixture Models (ESVI: Extreme Stochastic Variational Inference), which is both model and data parallel. (**Accepted for AISTATS 2019**).
- Developed a scalable, distributed stochastic optimization algorithm (DS-MLR: Doubly Separable Multinomial Logistic Regression) that can run multinomial logistic regression on massive datasets with large number of examples and classes. DS-MLR is hybrid-parallel (de-centralizes both data and the model simultaneously) and asynchronous **(Accepted for KDD 2019)**.

Graduate Student Researcher - *Purdue University* **Aug 2013 - May 2014**

- Proposed a new Learning to Rank algorithm (RoBiRank) inspired by Robust Binary Classification, which directly bounds NDCG. Extended it to the Latent Collaborative Retrieval setting and developed a distributed stochastic optimization algorithm that can scale to large datasets. RoBiRank was deployed and tested at LinkedIn (internship) on part of the live traffic. Online evaluation results were promising. (**Accepted for NIPS 2014**).

Applied Scientist Intern - *Amazon AI (Palo Alto)* **Summer 2017**
(Mentors: Anima Anandkumar, Zack Lipton)

- Researched and implemented temporal video recommendation models using Deep Neural Networks. Developed a prototype of the recommender system using MXNet Gluon deep-learning framework.

Research Intern - *Adobe Research (STL)* **Summer 2016**
(Mentors: Hung Bui, Branislav Kveton)

- Researched and developed models to cluster user-behavior in Adobe analytics data using both click (user url) as well as content (user meta-data) information.

Research Intern - *Microsoft (Cloud and Information Services Lab)* **Summer 2015**
(Mentors: Sathiya Keerthi Selvaraj, Dhruv Mahajan)

- Worked on the problem of extrapolating learning curves in machine learning. The goal was to study if it was feasible to use information from the models learnt on various sizes of small bites of data to extrapolate performance of the algorithm on the full data. Developed, implemented and evaluated

a new prototype using non-linear curve-fitting to predict performance on full-data.

Research Intern - *Search Relevance (SNA), LinkedIn* **Summer 2014**
(Mentors: Viet Ha-Thuc, Shakti Sinha)

- Explored machine learning methods to resolve issues of sample bias and position bias present in learning to rank systems with implicit feedback. Proposed a new ranking framework to combine models incrementally.

Graduate Student Researcher - *ITAP, Purdue University* **Aug 2013 - Aug 2014**

- Applied machine learning on educational mobile & web apps data to infer relevance of user posts to the lecture topics. Results helped improve student engagement in classrooms (**Accepted for EDM 2014)**.

Independent Research - *Info Lab, Stanford University* **Summer 2012**
(Mentors: Aditya Parameswaran, Hector Garcia-Molina)

- Explored the scope of using learning methods in crowd-sourcing systems, to improve label complexity and quality of judgements among workers. In addition, empirically analyzed the effects of using various interfaces for categorization of items in a taxonomy.

Graduate Student Researcher - *Sonification Lab, Georgia Tech* **Aug 2009 - May 2011**
(Collaborators: Bruce Walker, Benjamin Davison, Myounghoon Jeon, Jeff Wilson)

- Prototyped tools to demonstrate key ideas that came up in two research projects Auditory Menus and In-Vehicle Assistive Technology (IVAT). Used machine learning for driver mood detection & providing alerts (**Work was presented in several demos and accepted for proceedings in ICAD 2010, CSUN 2010, AutomotiveUI 2011, ASSETS 2011)**.

Graduate Student Researcher - *Dept of Maths & Computer Applications, PSG Tech* **2007 - 2008**

- Worked on developing effective cache replacement policies for Location-Dependent Data in mobile environments and implementing tools for evaluating them (**Accepted for DCCA Jordan 2007 and PETRA 2008)**.

Software Engineer - *Yahoo!, Sunnyvale* **Jul 2011 - Jul 2013**

- Worked for the Personalization group, on an entity detection/resolution system used by all personalization services. Used machine learning and NLP to detect word/phrase boundaries and rank extracted entities. Built a Knowledge Graph from scratch to power Yahoo! search products.
- Worked on the Web of Objects project, to create a semantic knowledge base of entities to enable personalization. Designed features for Entity Matching models and wrote tools to evaluate them.
- Worked on Apache Oozie (a widely used job scheduler for Hadoop), implementing several features and fixing bugs in the system.

Software Engineering Intern - *Intel, Chandler* **Summer 2010**

- Developed a searching & indexing infrastructure to help silicon engineers find relevant product design information. Gathered requirements, developed the system, and deployed in production.

Application Developer - *ThoughtWorks, Bangalore* **Jun 2008 - Jul 2009**

- Designed and implemented web-services for the train ticket retailing system - thetrainline.com. Worked in a fully agile setup following iterative test-driven software development.

Publications

- Parameswaran Raman, Sriram Srinivasan, Shin Matsushima, Xinhua Zhang, Hyokun Yun, S.V.N. Vishwanathan. "**Scaling Multinomial Logistic Regression via Hybrid-Parallelism**," *KDD* 2019. **Accepted as Oral Presentation (9.16 % acceptance rate)**.
- Parameswaran Raman*, Jiong Zhang*, Shihao Ji, Hsiang-Fu Yu, S.V.N. Vishwanathan, Inderjit S. Dhillon. "**Extreme Stochastic Variational Inference: Distributed and Asynchronous** ," *AISTATS* 2019.

- Hyokun Yun, Parameswaran Raman, S.V.N. Vishwanathan. "**Ranking via Robust Binary Classification and Parallel Parameter Estimation in Large-Scale Data**," *NIPS*. 2014.

- Mariheida Córdova Sánchez, Parameswaran Raman, Luo Si, Jason Fish. "**Relevancy Prediction of Micro-blog Questions in an Educational Setting**," in *Proceedings of the 7th International Conference on Educational Data Mining, EDM*. 2014.

- Parameswaran Raman, Jiasen Yang. "**Optimization on the Surface of the (Hyper)-Sphere**" Tech Report *arXiv: 1909.06463*. 2014.

- Myounghoon "Philart" Jeon, Parameswaran Raman, Jung-Bin Yim, J B, Bruce N. Walker. "**Participatory Design Process for an In-Vehicle Affect Detection and Regulation System for Various Drivers** ," in *Proceedings of the 13th International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS)*. 2011.

- Myounghoon "Philart" Jeon, Jonathan Schuett, Jung-Bin Yim, Parameswaran Raman, Bruce N. Walker. "**ENGIN (Exploring Next Generation IN-vehicle INterfaces): Drawing a New Conceptual Framework through Iterative Participatory Processes**," in *Proceedings of the 3rd International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI)*. 2011.

- Myounghoon "Philart" Jeon, Benjamin Davison, Jeff Wilson, Parameswaran Raman, Bruce N. Walker. "**Advanced Auditory Menus for Universal Access to Electronic Devices**," in *Proceedings of CSUN International Technology & Persons with Disabilities Conference*. 2010.

- Parameswaran Raman, Benjamin Davison, Myounghoon "Philart" Jeon, Bruce N. Walker. "**Reducing repetitive development tasks in auditory menu displays with the auditory menu library**," in *Proceedings of the 16th International Conference on Auditory Display (ICAD)*. 2010.

- Parameswaran Raman, Narayanan Ramakrishnan, Manohar Ganesan, Gourab Kar, Dr Gregory D. Abowd. "**PiX-C: Express and Communicate (Augmenting Communication with Visual Input for Children in the Autism Spectrum)**," in *Poster presented at ACM Symposium on User Interface Software and Technology (UIST)*. 2010.

- Mary Magdalene Jane, Parameswaran Raman, Maytham Safar, Nadarajan R. "**PINE-guided cache replacement policy for location-dependent data in mobile environment**," in *Proceedings of the First international conference on Pervasive Technologies Related to Assistive Environments, PETRA*. 2008.

- Parameswaran Raman, Raghavendra Prasad, Nadarajan R, Mary Magdalene Jane. "**Weighted Angular Distance Based Cache Replacement Strategy for Location-Dependent Data in Wireless Environment**," in *Proceedings of the DCCA Conference, Jordan*. 2007.

Community Activities

- Reviewer: UAI 2014, AISTATS 2015, COLT 2015, JMLR 2015, TPAMI 2015, AISTATS 2016, ICML 2016, NIPS 2018, ICML 2019, NeurIPS 2019, ICML 2020
- PC member: AAAI 2020
- Book Chapter Reviewer: *"Mathematics for Machine Learning", Marc Peter Deisenroth, A Aldo Faisal, and Cheng Soon Ong*, Cambridge University Press, 2020, ISBN: 9781108455145

- Developed and taught undergrad bootcamp on Unix & Shell commands at UC Santa Cruz, Fall 2015
- Teaching Assistant for CMPS 242 - Grad Level Machine Learning course at UC Santa Cruz (Instructor: S.V.N. Vishwanathan)

Selected Talks

- Oral Presentation, ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD 2019)
  Scaling Multinomial Logistic Regression via Hybrid Parallelism
- Guest Lecture, PSG College of Technology, Coimbatore India (Summer 2018)
  Recipes for PhD - A Machine Learning Perspective
- Guest Lecture, AMS 250 - High Performance Computing course at UC Santa Cruz (Spring 2018)
  Distributed Machine Learning: Approaches and Challenges
- Machine Learning Lab Seminar, UC Santa Cruz (Fall 2017)
  Extreme Stochastic Variational Inference (ESVI): Distributed Inference for Large Scale Mixture Models
- Machine Learning Lab Seminar, UC Santa Cruz (Spring 2017)
  Large-Scale Distributed Bayesian Matrix Factorization using Stochastic Gradient MCMC
- Machine Learning Lab Seminar, UC Santa Cruz (Spring 2016)
  Cover Trees for Nearest Neighbor Search
- Machine Learning Lab Seminar, UC Santa Cruz (Fall 2015)
  Tutorial on Variational Inference

Honors & Awards

- Graduate Research Assistantship (2014 - current), PhD, UC Santa Cruz
- Graduate Research Assistantship (2009 - 2011), Masters, Georgia Tech
- Travel award for Neural Information Processing Systems (NIPS), 2014
- Travel award for Tripods Summer School on Foundations of Data Analysis at UW Madison, 2018
- Travel award for Machine Learning in Science and Engineering (MLSE) conference at CMU, 2018
- Winner of Facebook Hackathon at Georgia Tech & finalist at FB HQ, 2010
- Finalist for the poster presentation at UIST Student Innovation Contest, 2010

Computer Skills

- *Programming Languages*: C++, Java, Python, Matlab, Lisp
- *Deep Learning frameworks*: Tensorflow, MXNet
- *Parallel Programming*: MPI, Open MP, Intel TBB
- *Scientific Computing / Numerical Lin Algebra*: PETSc/TAO, Eigen
- *Distributed Data Processing*: Hadoop, Pig, Apache Spark
- *Quintessential tools*: Unix