Vignesh Subramanian

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EDUCATION

University of California, Berkeley *August 2017 - Present*
Doctor of Philosophy in Electrical Engineering and Computer Science
Research Interests: Machine Learning Theory, Applications in wireless communication, control, object detection and social good
Grade Point Average: 4.0/4.0
Research Adviser: Prof. Anant Sahai

Indian Institute of Technology Bombay, India *July 2010 - June 2015*
Master of Technology in Electrical Engineering, specializing in Communication and Signal Processing
Bachelor of Technology in Electrical Engineering
Minor in Computer Science and Engineering
Research Adviser: Prof. Sibi Pillai, Prof. Rajbabu Velmurugan
Cumulative Performance Index: 9.86/10

PUBLICATIONS

Vidya Muthukumar, Adhyyan Narang, **Vignesh Subramanian**, Mikhail Belkin, Daniel Hsu, Anant Sahai *Classification vs regression in overparameterized regimes: Does the loss function matter?*, Journal of Machine Learning Research (JMLR), 2020

Vignesh Subramanian, Moses Won, Gireeja Ranade *Learning a Neural-Network Controller for a Multiplicative Observation Noise System*, IEEE International Symposium on Information Theory (ISIT) , 2020

Anant Sahai, Joshua Sanz, **Vignesh Subramanian**, Caryn Tran, Kailas Vodrahalli *Blind interactive learning of modulation schemes: Multi-agent cooperation without co-design*, IEEE Access, Special Section: Artificial Intelligence for Physical-layer Wireless, 2019

Vidya Muthukumar, Kailas Vodrahalli, **Vignesh Subramanian**, Anant Sahai: *Harmless interpolation of noisy data in regression*, IEEE Journal on Selected Areas in Information Theory, Special Issue on Deep Learning: Mathematical Foundations and Applications to Information Science, 2019

Anant Sahai, Joshua Sanz, **Vignesh Subramanian**, Caryn Tran, Kailas Vodrahalli: *Learning to communicate with limited co-design*, 57th Annual Allerton Conference on Communication, Control, and Computing, 2019

Vignesh Subramanian, Laura Brink, Nikunj Jain, Kailas Vodrahalli, Akhil Jalan, Nikhil Shinde, Anant Sahai: *Some new numeric results concerning the Witsenhausen Counterexample*, 56th Annual Allerton Conference on Communication, Control, and Computing, 2018

WORK EXPERIENCE

WorldQuant Research (India) Private Limited
Quantitative Researcher *July 2015 - June 2016*
Senior Quantitative Researcher *July 2016 - July 2017*

- Built quantitative models for predicting future returns on financial assets by analyzing price volume data, analyst ratings and news reports
- Worked on optimal portfolio allocation problem using clustering and mean-variance convex optimization techniques

AWARDS

- Recipient of the **EECS Department Fellowship** awarded to promising first year graduate students for the academic year 2017-2018
- Awarded **Institute Gold Medal** for exemplary academic performance, 2015
  Awarded for achieving Institute Rank 1 based on highest cumulative grade points among 400 students
- Received **Institute Silver Medal** for outstanding academic record, 2015
  Awarded for achieving Department Rank 1 based on highest cumulative point index among 67 students in the Electrical Engineering department

RESEARCH PROJECTS

Classification versus Regression for Minimum Norm Interpolating Solutions
Collaborators: Prof Anant Sahai; UC Berkeley, Prof. Daniel Hsu; Columbia University, Prof. Mikhail Belkin; Ohio State University *August 2019 - Present*

- Analyzed the classification and regression loss of minimum norm interpolating solutions in the overparameterized setting.
- Related the classification error to statistical signal processing concepts of shrinkage and false-discovery and computed sharp upper and lower bounds for these quantities
- Showed the existence of a regime where asymptotically classification performs well but regression does not

Machine learning for Physical Layer Wireless Communication
Collaborators: Prof. Anant Sahai, UC Berkeley *August 2018 - Present*

- Designed a blind interactive learning protocol for modulation schemes in the multi-agent setting without codesign
- Experimentally verified the universality and robustness of the protocol and showed that it achieves bit error rates similar to the optimal baseline
- Working on integrating other parts of the communication pipeline including equalization and error correcting codes to enable end-to-end learning of communication schemes

Learning Stabilizing Control under Multiplicative Noise
Collaborators: Prof. Gireeja Ranade, UC Berkeley *July 2019 - Januray 2020*

- Exploring use of neural networks to discover control strategies for stabilizing a system under multiplicative noise
- Proposed an architecture and training procedure tailored for the control problem that enables the network to generalize and output controls for rollouts longer than the training horizon
- Showed that the neural network based control strategy beats current best known strategies including optimal linear strategies

Neural Network based Control for Witsenhausen problem
Collaborators: Prof. Anant Sahai, UC Berkeley *Jan - August 2018*

- Revisited the classical decentralized stochastic control problem of Witsenhausen using neural networks
- Concluded that biasing architectures towards favorable solutions is required to escape the local minimas of the non-convex problem
- Numerically showed that in higher dimensions it is possible to outperform the best known one dimensional strategy

MASTER'S THESIS

Compressed Sensing in Radio Astronomy *July 2014 - June 2015*
Guides: Prof. Sibi Raj Pillai & Prof. V. Rajbabu, IIT Bombay

- Analyzed iterative shrinkage-thresholding algorithms for recovering images of astronomical sources from a set of highly incomplete Fourier measurements
- Formulated the simultaneous reconstruction of multiple images as a joint minimization problem and proposed an alternating algorithm to solve the problem
- Tested the alternating algorithm on images that are sparse in either spatial or wavelet domain and concluded that simultaneous reconstruction results in better performance as compared to independent reconstructions

INTERNSHIP EXPERIENCE

Machine Learning for Object Detection and Tracking *May - Aug 2021*
Plus, Cupertino

- Worked on state of the art image based anchor-free object detection and tracking implementation in PyTorch

Scheduling Algorithms for Wireless Communication *May - Jul 2013*
Guide: Anand Muralidhar, Bell Labs Alcatel Lucent, Bangalore

- Analyzed the performance of scheduling algorithms for device to device communication in cellular networks
- Implemented and tested a novel *coloring algorithm* in Python and concluded that it increases total network throughput by up to 70% as compared to existing schemes like CSMA/CA
- Theoretically proved approximate optimality of the greedy coloring algorithm by obtaining bounds on its performance

TEACHING EXPERIENCE

Graduate Student Instructor, Optimization Models, UC Berkeley

Spring 2020: Head of Content Team *Jan 2020-May 2020*
Spring 2019: Member of Content Team *Jan-May 2019*

- Responsible for leading a team of five members to develop weekly assignments, discussion sheets and exams for $\sim$ 250 students
- Taught weekly discussion sections explaining concepts related to linear algebra and convex optimization
- Designed ipython notebooks to visualize and explain singular value decomposition and principal component analysis

Graduate Student Instructor, Machine Learning, UC Berkeley

Fall 2020: Member of Content Team *Aug 2020 - Present*

- Responsible for developing weekly assignments and exams for $\sim$ 300 students
- Designed ipython notebooks to visualize and explain linear regression using overparameterized linear models analysis

COURSE PROJECTS

Accelerating Learning of Modulation Schemes *August - Dec 2019*

Project for CS285, Deep Reinforcement Learning, Decision Making, and Control

- Investigated whether meta learning techniques can reduce sample complexity for learning modulation schemes using neural network based agents.
- Used Meta Agnostic Meta Learning to pre-train an initialization for the neural network that on testing achieved a factor of 100 speedup and enabled few shot learning of modulation schemes

Cutting Planes Methods for Portfolio Optimization *August - Dec 2017*

Project for EECS 227B, Convex Optimization

- Formulated the portfolio optimization problem as a mixed integer quadratic program by introducing real world motivated integer constraints on the number of assets and asset price-amount invested relationship
- Employed cutting plane methods to solve a mixed integer quadratic program by converting it into a series of mixed integer linear programs for which efficient solvers exist
- Computed the optimal portfolio using publicly available data on the Indian stock market from 2016 that achieved returns of 35% and a Sharpe ratio of 0.8 for the year 2017 on back-testing.

GRADUATE LEVEL COURSES

Probability and Stochastic Processes	Machine Learning
Convex Optimization	Deep Reinforcement Learning
Information Theory	Sequential Decision Making
Mathematics of Data Science	Stochastic Control Systems
Theoretical Statistics	

PROGRAMMING SKILLS

Python, PyTorch, Tensorflow, C++, MATLAB

STANDARDIZED TEST SCORES

GRE General Verbal: 164/170, Quantitative: 170/170, Analytical Writing: 4/6

ToEFL iBT Reading: 30, Listening: 30, Speaking: 23, Writing: 29, Total: 112/120

EXTRA-CURRICULAR ACTIVITIES

- Participated in the Ultimate Frisbee Intramural League, UC Berkeley 2019
- Secured first position as a team of 5 in the Chess General Championships for two consecutive years, IIT Bombay, 2011-2012
- Hobbies: Hiking, Cooking, Badminton