Dheeraj Baby

Curriculum Vitae dheeraj@ucsb.edu

Research Interests

My research interests include online learning, stochastic optimization and non-parametric statistics. Through my studies, I am deeply convinced that online learning is a very powerful paradigm. Hence I have been focusing my research on two aspects: 1) Developing parameter free online learning algorithms that can efficiently cope with non-stationarities of the environment and 2) Re-viewing interesting problems in non-parameteric statistics through the lens of online learning by coming up with new reductions.

Education

University of California, Santa Barbara
PhD student, Department of Computer Science *Started October 2018*
Advisor: *Yu-Xiang Wang*

- CGPA : **4.0/4.0**

Indian Institute of Technology Madras, Chennai, India *July 2011 - June 2016*
Dual Degree, Department of Electrical Engineering
Bachelor of Technology, Electrical Engineering
Master of Technology, Microelectronics & VLSI

- Minor: Mathematics for Computer Science
- CGPA: **8.83/10**

Vivekodayam Boys' Higher Secondary School *Apr 2009 - Mar 2011*
Kerala State Senior School Certificate Examination

Publications

Dheeraj Baby and Yu-Xiang Wang, "**Adaptive Online Estimation of Piecewise Polynomial Trends**", in *Proceedings of 34th Conference on Neural Information Processing Systems (NeurIPS 2020), Vancouver, Canada.*

Dheeraj Baby and Yu-Xiang Wang, "**Online Forecasting of Total-Variation-bounded Sequences**", in *Proceedings of 33rd Conference on Neural Information Processing Systems (NeurIPS 2019), Vancouver, Canada.*

Chaitanya Peddawad, Aman Goel, Dheeraj B and Nitin Chandrachoodan, "**iitRACE: A Memory Efficient Engine for Fast Incremental Timing Analysis and Clock Pessimism Removal**", in *Proceedings of the IEEE/ACM International Conference on Computer-Aided Design*, November 2015, pp. 903-909

Research Experience

An Optimal Reduction of TV-denoising to Adaptive Online Learning (under review)

Mentor: Prof. Yu-Xiang Wang

- Constructed a reduction from the problem of estimating Total Variation (TV) bounded functions to Strongly Adaptive Online learning
- The resulting algorithm achieves minimax optimal estimation rates without prior knowledge of the TV of ground truth. The only other algorithm known to satisfy this property is Wavelet Smoothing from 1990s
- Our algorithm is found to empirically perform better than Wavelet Smoothing. It is also found to better predict the COVID trends in the states of USA when compared to Holt ES – a common de-trending method used in Time Series forecasting

Adaptive Online Estimation of Piecewise Polynomial Trends

Mentor: Prof. Yu-Xiang Wang

- Developed an online policy for forecasting sequences that belong to higher order TV class
- The policy is parameter free and achieves the optimal minimax rates of estimation

- Our algorithm is applicable to various instances of time series forecasting with non-stationary trends that assume piecewise polynomial structure. No prior information about the number and position of change points is required by the policy

Online Forecasting of Total Variation Bounded Sequences

Mentor: Prof. Yu-Xiang Wang

- Developed an online policy for forecasting sequences from the TV class with nearly linear runtime
- Proved that dynamic regret of the policy matches the known minimax rates from batch setting
- First online algorithm that can perform optimally for forecasting TV bounded sequences from noisy observations
- **Best paper honorable mention in Time Series Workshop, ICML 2019**

iitRACE: Incremental Timing Analysis Engine
TAU 2015 Contest

Mentor: Prof. Nitin Chandrachoodan

- The project included developing an academic software for performing timing analysis on complex VLSI circuits
- Developed a timer in C++ that supported incremental changes to a circuit (in standard industrial formats), performed fast timing analysis to the affected regions and removed pessimism due to common data and clock paths (CPPR) using least time and resources
- Developed novel techniques to identify and report worst slack paths in a circuit
- The timer won **international** 3^{rd} **place in TAU 2015 contest** and was presented at **ICCAD 2015**

Approximating False Loops Elimination in High Level Synthesis (HLS)

Mentor: Prof. Nitin Chandrachoodan

- Developed an approximation strategy to efficiently eliminate false loops caused by resource sharing in HLS
- Proved that False Loops Elimination is NP complete
- Reduced the problem to weighted Feedback Arc Set problem and thus opened a class of approximation algorithms for solving False Loops Elimination
- First work to establish theoretical bounds and guarantees on False Loops problem

Academic Honors

- **Branch Position 2** in Electrical Engineering (Microelectronics & VLSI) in 4^{th} year
- Secured All India Rank **274** among over 1 million candidates in All India Engineering Entrance Examination 2011
- Secured All India Rank of **162** in final level of National Science Olympiad 2011
- Ranked **12** out of 100,000+ students in KEAM (Kerala Engineering and Medical Exam) 2011

Work Experience

AWS AI Labs, Palo Alto, USA *July 2020 - September 2020*

- Developed algorithms for adversarial online learning against an RKHS under squared and absolute losses
- Proved dynamic regret guarantees
- Constructed a new lower bound for learning against an RKHS with exp-concave losses. This closes the optimality gap of algorithms such as Kernel Ridge Regression and Kernelised Online Newton Step for competing against the best predictor in hindsight that belong to an RKHS

IBM India Systems Development Lab, Bangalore, India *July 2016 - July 2018*

- Implemented various min-delay and min-area retiming algorithms for logic synthesis
- Developed a new tool that performs High Level Synthesis and scalable Formal Verification of the design debug logic

Programming Languages	C++, Python, Bash	
Teaching Experience	**Graduate Teaching Assistant** EE5332: Mapping Signal Processing Algorithms to DSP Archiectures Prof. Nitin Chandrachoodan IIT Chennai	*Aug - Nov 2015*
	Teaching Assistant CMPSC24: Problem Solving with Computers Prof. Divyakant Agarwal UC Santa Barbara	*Oct-Dec 2018*