K Nithin Varma

Curriculum Vitae

IIT Madras
Tamil Nadu, India 600036
(+91) 9110732140
nithinvarmak2305@gmail.com
n1thinv.github.io/
ee18b052@smail.iitm.ac.in

Education

2018–2023 **Indian Institute of Technology Madras**,
Dual Degree Electrical Engineering, B.Tech+Masters.
CGPA – 9.15/10

Research Experience

Oct 2022–ongoing **Implicit regularization of Mirror Descent** , *Prof. Babak Hassibi, Caltech*.

- Looked into the implicit regularization properties of mirror descent algorithms in overparameterized learning models.
- By using *Convex Gaussian Minmax Theorem*(CGMT) the primary optimisation can be converted to a dual Auxiliary optimisation, which is much easier to work with.
- Simplified the dual Auxiliary optimisation to a convex optimisation problem under a convex constraint.
- This simplified view was used to characterize the distributions of the solution, which match the empirical results in practice and our work is in preparation to be submitted to ISIT 2023, with first authorship.

June 2022–ongoing **Bandits with Safety Constraints**, *Prof. Anima Anandkumar, Caltech*.

- Worked on linear bandit optimisation with unknown reward and unknown nonlinear safety constraints.
- Proposed algorithms which achieve sub linear regret of $O(\sqrt{T})$ while adhering to safety constraints with high probability.
- In preparation to be submitted to ICML 2023, with first authorship.

May 2022–ongoing **Optimal control for Queue Channel under Feedback**, *Prof. Krishna Jagannathan, IIT Madras*.
The Queue Channel model is motivated from the Quantum Queue Channel, where the erasure probability of bits is waiting time dependent.

- Analysed the pumping bit rate policies under feedback of queue length, which characterises the channel quality.
- Proved that the optimal control to maximize throughput is a bang-bang policy.
- In preparation to be submitted to ITW 2023, with first authorship.

June 2021–Dec 2021 **Symmetry based Reed Muller Decoding**, *Prof. Andrew Thangaraj, IIT Madras*.
Researching efficient ways of decoding in Reed Muller(RM) codes using symmetries of RM codes in particular the Linear Affine group and Plotkin Constructions.

- Literature Review of the recent advancements in this field, with emphasis on achieving Maximum Likelihood(ML) decoding for second order RM codes.
- Investigated ideas to reduce the syndrone polynomial to irreducible forms using Affine Symmetry which results in reduction in syndrone decoding complexity.
- Proved impossibility results for extending current methods to other codes in the Reed Muller family.
- Implemented a modified Viterbi like Algorithm using the structure of RM codes which is more efficient than the brute force ML decoding algorithm.

May 2021–July 2021 **Research &Development Intern**, Texas Instruments R&D.

- Worked on Link Equalization in PCIe Protocol for a Retimer.
- Designed novel algorithms to equalize the channel from ISI by building adaptive filters for the receiver and transmitter using a modified Block LMS algorithm in High-Speed Communication Links.
- Studied the performance of using different equalizers like CTLE, DFE and FFE.

Other Projects

March 2022–ongoing **Information theoretic generalization bounds**, *Course Project*.

- Looked into literature of Information theoretic bounds for stochastic optimisation algorithms to characterize algorithm stability and generalization.
- Improved the existing generalization bounds using f-divergences.
- Currently looking into characterizing stochastic langevin dynamics for different gradient based algorithms using this framework.

Sept 2021–Nov 2021 **Stochastic Mirror Descent on Overparameterized Neural Networks**, *Course Project*.
- Studied the paper Stochastic Mirror Descent on Overparameterized Nonlinear Models and analysed the results.
- Implemented Stochastic Mirror Descent, which has implicit regularization properties on Neural Networks.
- Using limited training data using different Bregman divergence loss functions, showed that overparametrized models can generalize better.

March 2021–May 2021 **Massive MIMO denoising using Deep decoder**, *Course Project*.
- Studied Papers on Deep Image Prior, Deep Decoders and MIMO channel Estimation
- Simulated Denoising of Pilot symbols using Deep Learning in Massive MIMO Systems for Channel Estimation.
- Analyzed how asymptotically deep decoder achieves MMSE performance with lower complexity.

March 2021–May 2021 **Musical Instrument Classification using Deep Learning**, *Course Project*.
- Implemented Light weight Convolutional Neural Network (CNN) to classify Sounds from Musical Instruments
- Using Mel spectrogram and Cut-Mix algorithm, the sequential data is converted to an image and enabled the use of CNN techniques.
- The model achieved better performance than other existing models with comparable number of parameters by pruning the Neural Network.

Achievements

- Secured All India Rank of 553 in JEE Advanced Examination from among 1.55 Lakh students in 2018.
- Among the top 1% percentile of applicants to receive the KVPY Scholarship for the year of 2018.
- Awarded the Caltech SURF fellowship to carry out a fully funded research internship at Caltech over the summer of 2022.

Skills

Languages Python (proficient), C/C++, JAVA ,MATLAB

Frameworks Keras, PyTorch, Tensorflow, OpenCV, SageMath

Others LtSpice, Verilog, AVR Studio

Relevant Courses

Classroom Linear Algebra, Probability, Information Theory, Error Control Coding, Machine Learning, Convex Optimisation,Reinforcement Learning, Theoretical Computer Science, Algorithms, Estimation Theory, Stochastic Modelling and Queuing Theory, Concentration inequalities.

Audit Deep Learning, Wireless Communication

Extra Curriculars

Aug 2022–Nov 2022 **Machine Learning**, *Teaching assistant*.
As a teaching assistant of Machine Learning course at IIT Madras, my responsibility was to guide students in their course projects and take weekly tutorial sessions for students.

Aug 2018–June 2019 **Avanti Fellows**, *Student Mentor*.
As a mentor at JNV Pondicherry, my responsibility was to guide two XI standard students through their preparation for IIT-JEE examination.

Oct 2018–June 2019 **Entrepreneurship-Cell**, *Associate Manager*.
As an Associate Manager at E-Cell IIT Madras, I was a part of the organizing team for conducting the events at E-Summit which aims at fostering Entrepreneurship.

Oct 2018–June 2019 **Sports**, *Professional Badminton Player*.
I'm a part of the Institution Team and represented IIT Madras at various sporting events.