

K Nithin Varma

Curriculum Vitae

IIT Madras
Tamil Nadu, India 600036
☎ (+91) 9110732140
✉ nithinvarmak2305@gmail.com
📄 n1thin.github.io/
ee18b052@smail.iitm.ac.in

Education

- 2023–ongoing **California Institute of Technology,**
Computing + Mathematical Sciences (CMS), Ph.D..
- 2018–2023 **Indian Institute of Technology Madras,**
Dual Degree Electrical Engineering, B.Tech+Masters.
CGPA – 9.3/10

Research Experience : latest updates

- 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.
- Oct 2022–Feb 2023 **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.
- May 2022–Jan 2023 **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.
- June 2021–Dec 2021 **Symmetry based Reed Muller Decoding, Prof. Andrew Thangaraj, IIT Madras.**
- Worked on finding efficient ways of decoding 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 syndrome polynomial to irreducible forms using Affine Symmetry which results in reduction in syndrome 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*.
- o Studied the paper Stochastic Mirror Descent on Overparameterized Nonlinear Models and analysed the results.
 - o Implemented Stochastic Mirror Descent, which has implicit regularization properties on Neural Networks.
 - o 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*.
- o Studied Papers on Deep Image Prior, Deep Decoders and MIMO channel Estimation
 - o Simulated Denoising of Pilot symbols using Deep Learning in Massive MIMO Systems for Channel Estimation.
 - o Analyzed how asymptotically deep decoder achieves MMSE performance with lower complexity.
- March 2021–May 2021 **Musical Instrument Classification using Deep Learning**, *Course Project*.
- o Implemented Light weight Convolutional Neural Network (CNN) to classify Sounds from Musical Instruments
 - o Using Mel spectrogram and Cut-Mix algorithm, the sequential data is converted to an image and enabled the use of CNN techniques.
 - o The model achieved better performance than other existing models with comparable number of parameters by pruning the Neural Network.

Achievements

- o Secured All India Rank of 553 in JEE Advanced Examination from among 1.55 Lakh students in 2018.
- o Among the top 1% percentile of applicants to receive the KVPY Scholarship for the year of 2018.
- o 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.