RUDRAJIT DAS

First Year PhD Student

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EDUCATION

• PhD in Computer Science

University of Texas at Austin (Advisor: Inderjit Dhillon)

Aug 2019 –

Currently funded by **NSF-BigData grant**

• Combined Bachelor's and Master's (B.Tech + M.Tech) Degree in Electrical Engineering - **GPA: 9.52/10**

Indian Institute of Technology (IIT) Bombay
(Advisor: Subhasis Chaudhuri - Director of IIT Bombay)

June 2014 – May 2019

Thesis: *Some Probabilistically Provable Theoretical Aspects of Neural Networks and Algorithmic Aspects of Large-Scale Optimization*
Awarded **Undergraduate Research Award** (**URA-03**) for exceptional work in final thesis

RESEARCH INTERESTS

Mainly interested in the development of efficient and principled machine learning and deep learning algorithms.

PUBLICATIONS & COMPETITIONS

- ***Nonlinear Blind Compressed Sensing under Signal-Dependent Noise***
  Rudrajit Das and Ajit Rajwade - Accepted in **IEEE International Conference on Image Processing (ICIP) 2019**.
- ***Sparse Kernel PCA for Outlier Detection***
  Rudrajit Das, Aditya Golatkar and Suyash Awate - Accepted for **oral presentation** in **IEEE International Conference on Machine Learning and Applications (ICMLA) 2018**.
- ***On the Separability of Classes with the Cross-Entropy Loss Function*** (Pre-print)
  Rudrajit Das and Subhasis Chaudhuri
- ***Extremal Eigenvalue Analysis of the Hessian and a Learning Rate Choice for Stochastic Gradient Descent*** (Pre-print)
  Rudrajit Das and Subhasis Chaudhuri
- ***iFood Challenge, FGVC Workshop, CVPR 2018***
  Parth Kothari*, Arka Sadhu*, Aditya Golatkar*, **Rudrajit Das*** (* denotes equal contribution). Finished 2nd & 3rd in the public and private leaderboards respectively, with team name "Invincibles". Invited to present our method at **CVPR 2018**.

KEY COURSES

- **UT Austin** (currently ongoing) - Deep Probabilistic Modeling, NLP.
- **IIT Bombay** - Advanced Machine Learning, Computer Vision, Advanced Image Processing, Medical Image Processing, Speech Processing, Optimization, Markov Chains, Estimation & Identification, Applied Linear Algebra, Concentration Inequalities, Complex Analysis, Differential Equations.

TECHNICAL SKILLS

- **Languages**: Python, MATLAB, C++/C, Java.
- **Deep Learning**: PyTorch, Keras.

KEY PROJECTS

- ***Biased SGD for Faster Training of Deep Networks***
  Showed that the biased SGD algorithm proposed in "AutoAssist: A Framework to Accelerate Training of Deep Neural Networks" by Zhang et al. achieves $O(1/k)$ and $O(1/\sqrt{k})$ convergence for strongly convex and convex loss functions respectively, which is the same as that of vanilla SGD but with much fewer gradient computations.
- ***Adversarial Robustness in NLP***
  The problem of finding adversarial examples in NLP by replacing words with their synonyms or sentences with their paraphrases is a discrete optimization problem. Working on formulating it (approximately) as a continuous optimization problem which can be solved using gradient-based methods.
- ***A Randomized Algorithm to Detect and Escape Saddle Points***
  Proposed a novel randomized algorithm to detect and escape saddle points without requiring to compute the Hessian. Its complexity is logarithmic wrt the dimension and approximately linear wrt the inverse of the magnitude of the minimum (negative) eigenvalue of the Hessian.
- ***On the Existence of Sparse Bases for Deep Learning Kernels***
  Derived a probabilistic proof to suggest the possibility of the existence of sparse bases for the final layer of binary classification networks before sigmoid with the cross-entropy loss using only a few (transformed by the "kernel") training points. The number of training points constituting the sparse basis is much lesser than the dimension of the transformed input.
- ***Multiple Instance Learning in Breast Cancer Histology Images***
  Worked on self-supervised learning using the proxy tasks of colorization with different loss functions, to learn good embeddings which can be used for deep attention based multiple instance learning. Experiments suggest that self-supervision using the proxy task of colorization with the MS-SSIM loss provides a good initialization for segmentation leading to faster training as well as lesser overfitting.
- ***Sentence Compression using Deep Learning***
  Built a 3-layer bidirectional LSTM model for sentence compression by formulating it as a binary classification problem (which words to retain/delete). Compared it with the method proposed in "Sentence Compression by Deletion with LSTMs" by Google NLP Research & got marginally better results.

INTERNSHIPS

PRAIRIE AI Summer School - Grenoble, France (July '18)

- One of the few undergraduates selected for this AI summer school, co-organized by Inria and NAVER LABS Europe. Presented a poster entitled "Existence of Sparse Basis for Deep Learning Kernels?"

Institute for Biomechanics, ETH Zürich -
Under Dr. Patrik Christen, D-HEST (May '17 - July '17)

- Proposed a stable linear model (with closed form solution) and a fuzzy boolean network for bone re-modelling. Also developed an automated 2D-3D image registration framework for histology images. Devised an efficient sampling strategy and a good cost function to deal with the highly non-convex nature of the problem.