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Education

Indian Institute of Technology, Kanpur *(2012 - present)*
Bachelor of Science - Masters of Science (BS – MS)
Major: Mathematics and Scientific Computing
Minor: Computer Science (Artificial Intelligence), English Literature
Cumulative Performance Index: $10/10^*$, $8.1/10^\dagger$ *(∗-MS,†-BS)*

All India Senior School Certificate Examination *(2011)*
SS Vidya Mandir, Madhupur; Aggregate : *90.6%*

Indian Certificate of Secondary Education Examination *(2009)*
Carmel School, Madhupur; Aggregate : *95.2%*

Research Interests

- Machine Learning, Optimization
- Statistical Learning Theory, Online Learning

Teaching

Teaching Assistant, Online Learning and Optimization *(Spring'17)*
Instructor: Prof. Purushottam Kar
Indian Institute of Technology, Kanpur

Internships

Non-Convex Optimization:Matrix Sensing & Factored Model [slides] *(Summer'16)*
Prof. Raman Arora, Johns Hopkins University, USA
- Studied Non-Convex Optimization problems and how their benign geometry allow algorithms to efficiently escape saddle points.
- Investigated the geometry of Matrix Sensing to show that saddle points encountered are unstable and can be eluded owing to spectral characteristics.
- Contributed to an open-source Non-Convex Optimization library in R by implementing Low rank factored models of Matrix Linear and Logistic Regression, Robust PCA and Matrix Completion.

N-body Simulation in Deterministic Annealing [poster] *(Summer'15)*
Prof. Geoffrey Fox, Indiana University, Bloomington, USA
- Contributed to an open-source library on clustering and visualization of genomic sequences which uses Deterministic Annealing to solve the optimization problem.
- Studied algorithms for solving N-body simulations like Hierarchical Treecodes, Fast Multi-Pole methods and Barnes-Hut Simulation.
- Approximated the N-body measure encountered in Deterministic Annealing by implementing Treecodes and heuristically sampling from a distribution parametrized on the distance from root node of the partition tree.

Projects

Matrix Completion with Implicit Clustering [report] *(Ongoing)*
Prof. Purushottam Kar, Indian Institute of Technology, Kanpur
Prof. Debasis Kundu, Indian Institute of Technology, Kanpur
Prof. Prateek Jain, Microsoft Research, India
- Proposed stronger modifications to the constraints of Matrix Completion (than low rank), which in turn facilitates a clustering over latent representations (items).
- Proposed an Alternating Minimization based approach to solve the non-convex optimization problem which involves solving a sparse recovery and a least-squared problem iteratively, as well as a heuristic to generate a good initialization.
- Currently working on analyzing sample complexity and convergence guarantees of the Alternating Minimization based method.

Testing for Dictionary Learning [report | slides]   *(Ongoing)*
Prof. Purushottam Kar, Indian Institute of Technology, Kanpur

- Proposed a deterministic testing routine based on incoherence, which given a set of vectors outputs YES or NO, depending on whether it is possible to learn a dictionary which allows sparse representations or not respectively.
- Formulating completeness and soundness guarantees of the property testing method based on observed incoherence of samples.
- Preforming experiments to empirically validate the hypothesis and compare it with an existing randomized testing method based on Gaussian width.

An Attempt to Escape the Deep Saddle Points [report | slides]   *(Spring'16)*
Prof. Purushottam Kar, Indian Institute of Technology, Kanpur

- Studied non-convex optimization problems like tensor decomposition, phase retrieval and how the saddle point problem can be averted using first order information.
- Extended the work on generating guarantees for Stochastic Gradient Descent to escape saddle points in the classical two-layer neural network setting.
- Implemented a two-layer neural network whose weights are obtained from tensor decomposition of the strict saddle objective.

Neural Machine Translation with Bilingual Embeddings [report | slides] *(Spring'16)*
Prof. Vinay Namboodiri, Indian Institute of Technology, Kanpur

- Constructed Bilingual Embeddings by learning word representations from comparable corpora using merge and shuffle heuristics.
- Trained a sequence to sequence learning network with soft attention based on encoder-decoder LSTMs on Europarl Machine Translation dataset.
- Tested the Neural Machine Translator plugging Bilingual Embeddings which results in slight improvement in the translational performance metric ($BLeU$).

Label Relation Graphs to Encode Prior Knowledge [report | poster]   *(Spring'16)*
Prof. Piyush Rai, Indian Institute of Technology, Kanpur

- Studied various works on incorporating knowledge such as structured label space information into visual recognition models.
- Formalized the relationships between response categories using a graph with Hierarchical & Exclusion edges, with the information extracted from Wordnet lexica.
- Trained a visual object recognition system using pre-trained VGG features by exact inference on the knowledge graph using Junction Tree Algorithm.

Cross-lingual Plagiarism Detection [report | poster]   *(Fall'15)*
Prof. Amitabh Muherjee, Indian Institute of Technology, Kanpur

- Performed joint learning of word vectors in unified multilingual distributional space from document aligned comparable corpora.
- Performed two preliminary tasks: Bilingual Lexicon Extraction and Suggested Word Translation in Context, to estimate the robustness of the multilingual word space.
- Trained a Deep Recursive Autoencoder with dynamic pooling to generate phrase representations which are fed to an SVM for paraphrase detection.

Domain Invariant Transfer Kernel Learning [report | slides]   *(Fall'15)*
Prof. Harish Karnick, Indian Institute of Technology, Kanpur

- Proposed to implement a learning model which generalizes across training and testing data with different distributions.
- Designed a family of spectral kernels by extrapolating target eigensystem on source samples to reduce the Nystrom Approximation error in the RKH Space.

- Plugged the obtained domain-invariant Kernel matrix into an SVM which outperformed the traditional SVM on benchmarked text and image datasets.

Aspect based Sentiment Analysis [report | poster] *(Spring'15)*
Prof. Amitabh Mukerjee, Indian Institute of Technology, Kanpur
- Attempted Sem-Eval'15 challenge involving identification of an opinion bearing entity-attribute pair E#A in a text, and adjudging its polarity.
- Constructed features based on word-vectors, n-grams, parse trees, POS tag and out-of-domain, publicly available sentiment lexica (wordnet, sentiwordnet).
- Trained a Conditional Random Field(CRF) for sequential learning of aspect term, and a Maximum Entropy Classifier to adjudge the polarity.

Forest Cover-type Classification Problem [report] *(Spring'14)*
Prof. Amit Mitra, Indian Institute of Technology, Kanpur
- Attempted the Kaggle challenge of classifying forest cover type by building classification models based on the dataset.
- Employed various classification techniques such as Neural Networks, SVM, Logistic Regression, Naive-Bayes classifier, CART and Random Forests (best : 87%).

Phonotactic Constraints in McGurk Fusion [report | poster] *(Fall'14)*
Prof. Amitabh Mukerjee, Indian Institute of Technology, Kanpur
- Established the role of Phonotactic constraints towards producing a bias in McGurk Effect in cognitive audio-visual speech perception.
- Conducted experiments to conclude that Phonotactic constraints can diminish McGurk fusion rate when phonetic licensing biases against the fusion expected.

Causal Relationships Between Econometric Parameters [report] *(Fall'14)*
Prof. Amit Mitra, Indian Institute of Technology, Kanpur
- Used Time Series Econometric modelling to analyze the data of the policy macroeconomic variables using Augmented Dicky-Fuller and Granger Causality test.
- Established that both FDI inflows and Exports have a direct causal linkage with the GDP of India but there is no reciprocal causality between them.

Random Graph models of Social Networks [slides] *(Spring'15)*
Prof. A K Lal, Indian Institute of Technology, Kanpur
- Studied Random Graphs and their properties; in particular degree distributions, scale-free graphs and small-world networks.
- Studied about phase transitions and random graph models such as Erdos-Renyi model, configuration model and preferential attachment model.

Philosophical Problems from the Standpoint of AI [report] *(Spring'15)*
Prof. A.V. Ravishankar Sharma, Indian Institute of Technology, Kanpur
- Compiled a brief summary of the paper "Some philosophical problems from the standpoint of artificial intelligence" by John McCarthy and Patrick J. Hayes
- Attempted to review, formalize and put forth a concise version of the paper while keeping the main ideas intact.

Software Development Intern, Aurus Network Infotech Pvt. Ltd. *(Summer'14)*
- Worked with a team of developers towards building a novel e-commerce educational platform, based on the PHP framework Yii.
- Developed the Relevance Algorithm module to sort courses based on an aggregated scoring system parametrized on sale, recency and rating-reviews.

Scholastic Achievements

- M.S. Department Rank - 1/30; B.S. Department Rank - Under 7/50.
- Selected for Summer Research programme, offered by Johns Hopkins University.
- Awarded an A* grade, for exceptional performance in Natural Language Processing.
- Awarded the second best project in Natural Language Processing course for Cross Lingual Plagiarism Detection.
- Recipient of Inspire and Masters T.A. Scholarship awarded by Department of Science and Technology, Government of India.
- Ranked in Top 0.5% (amongst 0.5 million candidates) in IIT-JEE 2012.
- Ranked in Top 0.3% (amongst 1.1 million candidates) in AIEEE 2012.

Relevant Coursework

Machine Leaning and Statistics:

- Artificial Intelligence Programming
- Learning with Kernels
- Probabilistic Machine Learning
- Online Learning and Optimization
- Probability and Statistics
- Natural Language Processing
- Optimization Techniques
- Stat Techniques in AI & Data Mining
- Time Series Analysis
- Applied Stochastic Process

Mathematics:

- Linear & Abstract Algebra
- Topics in Topology
- Graph Theory
- Real & Complex Analysis
- Partial Differential Equations
- Several Variables Calculus

Other Relevant Courses:

- Introduction to Programming
- Introduction to Electronics
- Introduction to Cognitive Science
- Data Structures and Algorithms
- Theory of Computation
- Continuum Mechanics

Online Courses:

- Machine Learning (Dr. Andrew Ng)
- NLP (Dr. Dan Jurafsky)
- Cryptography (Dr. Dan Boneh)
- Deep Learning (Dr. Freitas)

Technical Skills

Programming: C, C++, Python, R, Octave
Web Development: HTML, PHP, JavaScript, Yii, Node.js
Other Tools: Bash, Matlab, Git, LaTeX, Android SDK, Adobe Photoshop
Operating Systems: Windows, Linux(Ubuntu), Mac OS

Extra-Curricular Activities

- Participated in various Intra and Inter-college Quizzes as a part of Quiz Club.
- An Active Member of Special Interest Group on Machine Learning(SIGML).
- Amongst the Top 10 Best Coded Applications in the country for Hitch-a-ride, a taxi-pooling Windows phone app in Microsoft Code.fun.do.
- First Runner-up in Internet of Things competition for building a smart-mirror, at the 4th Inter-IIT Technical meet.
- Participated in Winter Hackathon'14 with Pulkit Aggarwal to develop Infexious, a spatially local Social Network, working on Android devices employing Bluethooh-LE.
- Co-ordinator, Crypto (Techkriti): Formulated questions for the online cryptographic treasure hunt, which witnessed participation from more than 1000 people.

References   Available on request.