

Akshar Varma

PhD Candidate, Khoury College of Computer Sciences, Northeastern University
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Research interests

- **Theoretical Computer Science**
Theoretical aspects of Machine Learning and deep learning in particular;
Graph algorithms and hardness: specifically sublinear and FPT algorithms.
- **Other**
Computational Science: High Performance Computing; Complex Networks

Education

- **PhD. in Computer Science** GPA: 3.98/4
Northeastern University, Boston, USA. (2017– *expected* 2024)
Advisor: Dr. Ravi Sundaram
Thesis focus: Graph parameters; approximation, sublinear, FPT algorithms; machine learning
- **B.Tech. (Hons.) in Information and Communication Technology** GPA: 8.9/10
Minor: Computational Science
DA-IICT, Gandhinagar, India. (2013–2017)
Bachelor's Thesis: Reachability Problems and Space Bounds
Advisor: Dr. Nutan Limaye, IIT Bombay

Papers and posters

- **Toward remote and secure authentication: Disambiguation of magnetic microwire signatures using neural networks**
Akshar Varma, Xiaoyu Zhang, Brian Lejeune, Laura Cebada Almagro, Rafael P del Real, Pilar Marin, Ogheneyunume Fitchorova, Laura H Lewis, Ravi Sundaram.
MRS Communications, <https://doi.org/10.1557/s43579-022-00302-5>
Preliminary work was presented as a poster at MRS 2022 Spring Meeting.
- **Realization Problems on Reachability Sequences**
Matthew Dippel, Ravi Sundaram, Akshar Varma.
Theoretical Computer Science 866: 1-13 (2021). Preliminary version appeared in *COCOON (2020)*, <https://aksharvarma.org/TCS-Realization-problems-on-reachability-sequences.pdf>
- **Let's HPC: A web-based platform to aid parallel, distributed and high performance computing education**
Bhaskar Chaudhury, Akshar Varma, Yashwant Keswani, Yashodhan Bhatnagar, Samarth Parikh.
Journal of Parallel and Distributed Computing (2018), <https://doi.org/10.1016/j.jpdc.2018.03.001>.
- **Parallelizing Union-Find for shared-memory architectures**
Joint work with Yashwant Keswani, under the guidance of Prof. Bhaskar Chaudhury.
Poster presented @ IEEE International Conference on High Performance Computing, Data, & Analytics, 2016

Workshops

- Short talk at the Theoretical Basis of Machine Learning discussion meeting at ICTS Bangalore, December 2018.
- *Attended:* Statistical Physics and Machine Learning at ICTS, Bangalore, January 2020; Theory of Deep Learning: Where next? at IAS, Princeton, October 2019; Non-convex optimization and deep learning at MIT, Boston, 2019; The NMI workshop on Complexity Theory at IIT Gandhinagar, November 2016; Forum for Information Retrieval Evaluation at DA-IICT, Gandhinagar, December 2015.

Internships

- **Automated Time Series Forecasting and Anomaly Detection** *(Oracle, Summer 2020)*
Mentor: Rajagopalan Govindarajan and Vikas Agrawal, Oracle
Worked on a fully automated time series forecasting and anomaly detection proof-of-concept project in the Oracle Cloud Analytics team. Developed and implemented algorithms to detect seasonality and trend in time series data as well as to automatically determine SARIMAX model parameters. Combined with causality

detection on exogenous variables, this resulted in an end-to-end method for solving forecasting and anomaly detection problems on stationary time series data.

- **Latent Space Embeddings for Query Reformulation**

Mentor: Raju Matta, Amazon and Ravi Sundaram, NEU

(Amazon, May-December 2018)

Worked on the problem of generating latent space embeddings of product search queries for the task of reformulating infrequent queries using popular queries. Implemented novel Attention based Deep Neural Networks trained on query-query similarity graph. Also developed a novel quantitative metric for evaluation of the models. We further did analysis of theoretical aspects of the models and a paper is under submission.

- **Cryptanalysis of Classical Ciphers using Markov Chain Monte Carlo methods**

Mentor: Prof. Anish Mathuria

(Summer 2016)

Studied the effectiveness of using Markov Chain Monte Carlo (MCMC) methods for the purpose of cryptanalysis of classical ciphers. Focused on the cryptanalysis of the Vigenere cipher and showed that MCMC methods are a poor cryptanalysis choice, by comparing against classical cryptanalysis methods, using Python implementations.

- **Existence of k-ary Trees: Subtree Sizes, Heights and Depths**

Mentors: Prof. Rahul Muthu, Prof. Srikrishnan Divakaran

(Summer 2015)

Obtained several results on the complexity of determining the existence of k-ary trees when a sequence of attributes like subtree sizes, heights or depths (or a combination of these) are given as input.

arXiv preprint: <https://arxiv.org/abs/1510.00958v2>.

Graduate Coursework

Theoretical Topics in Machine Learning, Advanced Algorithms, Topics in Streaming Algorithms, Theory of Computation, Cryptography, Probabilistic Methods, Machine Learning, HPC and GPU programming, Compilers.

Selected course projects

- **Estimating the Last Vertex of Random Walks on Graphs in the Streaming Model**

Mentor: Prof. Huy L. Nguyen.

Spring 2019

Looked at the problem of outputting the last vertex in a t -step random walk on graphs in the one-pass streaming model. Showed a lower bound of $\Omega(n \log n)$ for this problem in the case of both directed and undirected graphs where n is the number of vertices in the graph.

- **Who let the tweets out: Author identification of very short texts**

Mentor: Prof. Rose Yu. Team Size - 2.

Fall 2018

Studied the problem of author attribution for very short texts, focusing on the feature extraction aspect. Implemented latent space embeddings methods and evaluated their performance against bag of words based approaches on Twitter data. Github: <https://github.com/aksharvarma/who-let-the-tweets-out>.

- **GPUs for HPC: Future directions and challenges**

Mentor: Prof. Gene Cooperman.

Fall 2017

Surveyed the use of GPUs for HPC applications, focusing on the challenges in using GPUs for HPC in the cloud, in embedded systems and incorporating them using heterogeneous computing techniques.

Programming skills

- Python (PyTorch; Scientific computing: Numpy, Scipy, Matplotlib, Pandas, etc.)
- Basic experience: Haskell, Elisp, Standard ML.
- C/C++ (Linux/GCC development environment; OpenMP, MPI parallelization libraries; CUDA)

Teaching

- Head Teaching Assistant for *CS5800: Algorithms* offered to Master's students (Sep – Dec 2019, 2020, 2021, 2022) and *CS3000: Algorithms* offered to Undergraduate students (Jan – Apr 2021).
- Teaching Assistant for *CS4800: Algorithms and Data* offered to undergraduates (Sep – Dec 2017).
- Teaching Assistant for the High Performance Computing course offered to junior year students (Jul – Nov 2016).

Positions of responsibility

- One of the founding members and head of the student Research Club at DA-IICT (Jan 2017 – Apr 2017).
- Chief Editor of the College e-magazine in DA-IICT (Jan 2017 – Apr 2017) and Member of Editorial Board (Apr 2015 – Apr 2017).