# Aditya **Sinha**


**M.S. in C.S. student, University of Illinois at Urbana-Champaign**

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## Education

**Present** | **University of Illinois at Urbana-Champaign** — **Illinois, USA**
**Aug 2022** | M.S. in Computer Science (thesis track)

**Aug 2020** | **Birla Institute of Technology and Science, Pilani** — **Goa, India**
**Aug 2015** | B.E. (Honors) Computer Science; M.Sc.(Hons.) Economics

## Experience

**July 2022** | **Google Research | Machine Learning and Optimization** [🌐] — **Bangalore, India**
**June 2021** | *Research Engineer (Contract)* | *Primary Advisors: Dr. Prateek Jain, Dr. Gaurav Aggarwal*
*Collaborators: Dr. Abhradeep Guha Thakurta , Dr. Praneeth Netrapalli , Dr. Sujoy Paul*
Projects: Differentially Private Graph Neural Networks (DP-GNN), Scalable Self-Supervised Graph Representation Learning ($S^3$GC), Efficient Representations for Adaptive Deployment (MRL), Automatic Hyperparameter Tuning (AHPT)

**June 2021** | **Microsoft Research | Machine Learning and Optimization** [🌐] — **Bangalore, India**
**Aug 2020** | *Research Fellow* | *Primary Advisor: Dr. Prateek Jain*
*Collaborators: Prof. Purushottam Kar, Dr. Sundararajan Sellamanickam, Dr. Ayush Choure*
Projects: Efficient and Scalable Graph Convolutional Networks, Position Click Bias Estimation in Search

**June 2020** | **Microsoft Research | Machine Learning and Optimization** [🌐] — **Bangalore, India**
**Jul 2019** | *Research Intern (Bachelor Thesis)* | *Advisors: Dr. Prateek Jain, Dr. Ayush Choure*
Projects: Scalable Algorithms for Learning Embeddings from Social Network Graphs

**May 2019** | **Birla Institute of Technology and Science, Pilani** [🌐] — **Goa, India**
**Aug 2018** | *Undergraduate Research* | *Advisor: Prof. Ashwin Srinivasan*
Projects: Task Based Conversational Agent for Library (Talking Head), Memory Networks based Conversational Agent

**Aug 2018** | **Indian Institute of Science | Statistical Signal Processing Lab, ECE Dept.** [🌐] — **Bangalore, India**
**May 2018** | *Summer Research Intern* | *Advisor: Prof. K.V.S. Hari*
Project: Object Detection in Road Traffic using YOLO and R-CNN

## Publications

C=Conference, S=In Submission, A=Permanently ArXived, *=Equal Contribution

**[C.1]** **IGLU: Efficient GCN Training via Lazy Updates** [PDF]
S. Deepak Narayanan*, Aditya Sinha*, Prateek Jain, Purushottam, Kar, Sundararajan Sellamanickam
*[International Conference on Learning Representations (Poster)]* [**ICLR '22**]

**[S.1]** **Node-Level Differentially Private Graph Neural Networks** [PDF]
Ameya Daigavane, Gagan Madan, Aditya Sinha, Abhradeep Guha Thakurta, Gaurav Aggarwal, Prateek Jain
*[Oral at PAIR$^2$Struct, ICLR '22, longer version under review at TMLR]* [**PAIR$^2$Struct, ICLR '22**]

**[S.2]** **$S^3$GC - Scalable Self Supervised Graph Clustering**
Devvrit, Aditya Sinha, Inderjit Dhillon, Prateek Jain
*[Under Review at NeurIPS '22]*

**[S.3]** **Matryoshka Representations for Adaptive Deployment** [PDF]
Aditya Kusupati, Gantavya Bhatt, Aniket Rege, Matthew Wallingford, Aditya Sinha, Vivek Ramanujan, William Howard-Snyder, Kaifeng Chen, Sham M. Kakade, Prateek Jain, Ali Farhadi
*[Under Review at NeurIPS '22]*

**[A.1]** **Rich-Item Recommendations for Rich-Users: Exploiting Dynamic and Static Side Information** [PDF]
Amar Budhiraja*, Gaurush Hiranandani*, Darshak Chhatbar, Aditya Sinha, Navya Yarrabelly, Ayush Choure, Oluwasanmi Koyejo, Prateek Jain
*ArXiv:2001.10495, [cs.LG], '20*

## Select Research Projects

**Differentially Private Graph Neural Networks (DP-GNN)** June '21 - Feb '22

*Advisors: Dr. Prateek Jain, Dr. Gaurav Aggarwal, Dr. Abhradeep Guha Thakurta*

- Develop the first novel Differentially Private GNN learning algorithm with Node-level Differential Privacy as compared to the easier problem of edge-level Differential Privacy in prior works. One of the four papers selected for **Oral** presentation at the **PAIR$^2$Struct** workshop at **ICLR '22**. [**Longer version currently under review at TMLR.**]
- Formally define the problem of learning 1-layer GNN's with node-level differential privacy, provide an algorithmic solution by a non-trivial extension of the privacy amplification-by-subsampling technique with a strong node level differential privacy guarantee. Empirically demonstrate that our solution learns accurate privacy preserving GNN's that outperform non-private non-graph based methods.

**Scalable Self-Supervised Graph Representation Learning (S$^3$GC)** Oct '21 - July '22

*Advisors: Dr. Prateek Jain, Dr. Inderjit Dhillon*

- Worked on developing an efficient and scalable method for Graph Clustering using self-supervised learning. Proposed a method using contrastive loss formulation and Graph Neural Networks for learning clusterable features, robust to noise in the graph information or node features.
- The proposed method scales to very large graphs of the order 100M nodes with significant gains in the clustering metrics (NMI) as compared to the other state-of-the-art methods. [**Paper under review at NeurIPS '22.**]

**Matryoshka Representations for Adaptive Deployment (MRL)** March '22 - July '22

*Advisors: Dr. Prateek Jain*

- Worked on the ideation and experimentation for Matryoshka Representation Learning in the Pre-Training and Retrieval/Ranking scenario using Large Language Models such as BERT, demonstrating significantly more efficient lower-dimensional representations for deployment with minimal loss in accuracy. [**Paper under review at NeurIPS '22.**]

**Automatic Hyperparameter Tuning (AHPT)** Feb '22 - July '22

*Advisors: Dr. Gaurav Aggarwal, Dr. Praneeth Netrapalli , Dr. Sujoy Paul*

- Explored the development of a generic framework for dynamically tuning hyper-parameters in the training runs. Worked on analyzing previously proposed metrics, as well as proposing new metrics for an informative characterization of the training state space, such as approximations of the loss landscape curvature, gradient noise across batches, etc.
- The generated training history can be utilized by a reinforcement-learning based setup such as policy optimization to adjust hyper-parameters.

**EffIcient Training of Graph Convolutional Networks via Lazy Updates (IGLU)** Aug'20 - June '21

*Advisors: Dr. Prateek Jain, Prof. Purushottam Kar, Dr. Sundararajan Sellamanickam*

- Develop an Efficient and Scalable method for training Graph Convolutional Networks (GCN's) by caching intermediate representations and performing lazy updates to the representations and parameters. [**ICLR '22 (Poster)**]
- Strong theoretical guarantees for a bounded bias and provable convergence to a first order saddle point under standard assumptions.
- Empirically, IGLU offers significant speedups (upto **88%**) and performance improvements (upto **1.2%**) in training time on real world graphs in large benchmark datasets.

**Positional Click Bias Estimation in Search** Dec'20 - June '21

*Advisor: Dr. Ayush Choure*

- Joint work with the Applied Science and Engineering Group **(ASE)** and Microsoft Teams team, IDC Bangalore.
- Explored Regression based-EM algorithms for estimating position bias in search logs and de-biasing data using Inverse Propensity Weighting.
- Improvement in unbiased metric MCRC and NDCG after training of the unbiased search ranker in **Microsoft Teams** production system.

**Scalable learning algorithms for Social Network Graphs in Recommendation Systems** July '19 - July '20

*Advisors: Dr. Prateek Jain, Dr. Ayush Choure*

- Bachelor's Thesis as a joint work between the Machine Learning and Optimisation **(MLO)** Group and Applied Science and Engineering **(ASE)** Group. Worked on developing scalable Graph Convolutional Networks for learning more robust Social Network Graph Embeddings from interaction information.
- Learnt user embeddings are used as side information for better Recommendations in Microsoft Enterprise Softwares. Learnt embeddings using the developed method: Adjacency Learnt - GCN (**AL-GCN**) showed significant improvements in NDCG@K, Precision@K and Micro-AUC-Rel@K as compared to deployed baseline models for recommendations.

## Academic Service

**Reviewer** NeurIPS '21, ICML '22, NeurIPS '22
**Volunteer** NeurIPS '20, NeurIPS '21

## Honours and Awards

**Western Digital Scholarship for STEM, 2019** Recipient of the Western Digital Scholarship for STEM in the amount of USD 2000 Awarded for excellent overall and academic performance in university. Awarded globally to 100 students.

**BITS Summer Internship Assistance Fellowship, 2018** Summer Internship Assistance Fellowship awarded by the university to only 4 students yearly for dedicated and promising contributions to fields of research.

**Kishore Vaigyanik Protsahan Yojana Scholar, 2013** Conferred by the Indian Institute of Science(IISc) to the top 0.004 percent of scholars in a pool of over 1,05,000 applicants.

## Teaching and Leadership

**ECON F314 - Introduction to Macroeconomics** *Teaching Assistant* Jan '19 - May '19

› Conducted quizzes and assisted, mentored and graded 45 students in Macroeconomics.

**CS F111 - Introduction to Programming** *Teaching Assistant* Jan '17 - May '17

› Assisted, mentored and graded 150 students in Bash and C programming in the lab sessions.

**Department of Photography, BITS Goa** *Photography Head* Aug '17 - May '18

› Managed a team of 100+ Photography and Videography enthusiasts and ensuring and facilitating event coverages during fests.

**Nirmaan Organisation, Goa Chapter** *Volunteer* Aug '16 - May '17

› Volunteered with Nirmaan for teaching underpriviliged kids aged 10-14 in Goa.

**ML Reading Group, Google Research, Bangalore, India** *Participant* Jun '21 - Present

› Active participant in our weekly reading group where I regularly present research papers and engage in discussions.

**ML Reading Group, Microsoft Research, Bangalore, India** *Participant* July '19 - Jun '21

› Active participant in the weekly reading group where I regularly presented research papers and engaged in discussions.

## Professional Experience

**Software Development Intern** May '19 - July '19
*Tesco Bengaluru*

› Worked on Development of an Android App using Kotlin as a PoC for the Loading and Unloading process.

› Used MVVM for the app architecture. Dagger2 for dependency inversion, Retrofit for Network interfacing, RxJava for Scheduling and Node.js express server for the backend

**Software Development Intern** May '17 - July '17
*Q.A. Infotech, Noida*

› Development of a Chrome Extension for Data Analytics in Learning Management Systems. Also worked on the mechanism for the collection, processing and Visualisation of Data.

› It involved the use of JavaScript, Sensor API, Caliper Analytics and ElasticSearch.

## Skills

**Languages** Python, C++, Java, HTML, Bash, JavaScript
**Frameworks** Tensorflow, Numpy, Keras
**Relevant Coursework** Machine Learning, Data Mining, Neural Networks and Deep Learning, Probability and Statistics, Discrete Computer Science, Object Oriented Programming, Data Structures and Algorithms, Database Systems, Design and Analysis of Algorithms, Introduction to Programming, Linear Algebra, Mathematical and Statistical Methods, Applied Econometrics, Game Theory