

# Aman Sinha

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## EDUCATION

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### University of Utah

Salt Lake City, Utah, USA

*PhD in Computing | Artificial Intelligence track*

*Aug 2023 – Current*

### Indian Institute of Science Education and Research (IISER) Kolkata

Kolkata, India

*5-Year BS-MS Dual Degree | Physics (Major), Computational & Data Science (Minor)*

*2018 – 2023*

- CGPA: 8.18/10.0
- 4-point GPA (Scholaro): 3.46/4.0

## PUBLICATIONS

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- [1] **Aman Sinha**, Priyanshu Raj Mall, Dwaipayan Roy. *Exploring the Nexus Between Retrievability and Query Generation Strategies*. In: ECIR '24: The 46th European Conference on Information Retrieval, Glasgow, Scotland: March 24 - 28, 2024.  
[\[paper\]](#) [\[code\]](#)
- [2] **Aman Sinha**, Priyanshu Raj Mall, Dwaipayan Roy, Kripabandhu Ghosh. *A Comparative Analysis of Retrievability and PageRank Measures*. In: FIRE '23: The 15th meeting of Forum for Information Retrieval Evaluation 2023. Goa University, Panjim, India: December 15-18, 2023.  
[\[paper\]](#) [\[arXiv\]](#) [\[slides\]](#)
- [3] **Aman Sinha**, Priyanshu Raj Mall, Dwaipayan Roy. *Findability: A Novel Measure of Information Accessibility*. In: CIKM '23: The 32nd ACM International Conference on Information and Knowledge Management. Birmingham, United Kingdom: October 21 - 25, 2023.  
[\[paper\]](#) [\[arXiv\]](#) [\[code\]](#) [\[poster\]](#)

## RESEARCH EXPERIENCE

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### Retrievability bias in IR and model effectiveness

Aug 2022 – Jun 2023

*Guide: Dr. Dwaipayan Roy, IISER Kolkata.*

- In my Master's Thesis, I researched algorithmic bias in retrieval models towards certain documents in a collection and their impact on model performance.
- Developed an improved method to generate artificial search queries which were more realistic queries.
- Evaluated Retrievability bias of baseline IR models and found BM25 to induce least bias.
- Discovered bias in the pool of documents in TREC relevance judgement.
- Correlated relevance feedback with greater bias in search results.
- Found *Fairness hypothesis* that the model effectiveness will be inversely correlated with retrievability bias, to not hold for BM25+RM3.
- Computed PageRank of all Wikipedia articles by processing 100GB+ data

### Retrievability Analysis of Neural IR Models

Aug – Dec 2022

*Guide: Dr. Kripabandhu Ghosh, IISER Kolkata*

- In this Independent study, I investigated biases in Doc2vec and SBERT by performing retrievability analysis.
- Worked on TREC 678 news collection along with 580k artificial queries
- Performed a large scale retrieval simulation for SBERT on the institute's Supercomputer

## Query Expansion and Relevance Feedback

Jun – July 2022

Guide: Dr. Dwaipayan Roy, IISER Kolkata

- In this Summer project, I tested True Relevance Feedback (TRF) and Pseudo Relevance Feedback (PRF) for Rocchio and RM3 query expansion.
- Implemented Rocchio and RM3 query expansion algorithms in Python.
- Studied the impact of negative feedback for true relevance and pseudo relevance feedback.
- Explored the integration of negative feedback part from Rocchio into RM3 to boost performance.

## PROJECTS

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### Hopfield Neural Networks

May 2022

Guide: Dr. Bhavtosh Bansal, IISER Kolkata

- Associative memory and efficient memory retrieval are often overlooked ingredients to machine intelligence. In this project, I studied Ising spin glass model inspired Hopfield Recurrent Neural Network.
- Studied the emergence of content addressable memory from Hebbian-learning-based update-rule and Hamiltonian of the network.
- Experimented with Hopfield net to perform image reconstruction from partial cues and dealt with mixed states problem

### Pattern Classification and Network analysis on Colonoscopy data

Apr 2022

Guide: Dr. Koel Das, IISER Kolkata

- In this project, I worked with Gastrointestinal Lesions in Regular Colonoscopy Dataset and LSVT Voice Rehabilitation Dataset.
- Applied Extra Trees Classifier to classify different types of lesions which outperformed the baseline by 11.5%.
- Performed network analysis approach to cluster the classes using gini feature importance scores from the classifier.

### Nonlinear Dynamical Analysis of Rumor Spreading

Nov 2021

Guide: Prof. Pradeep Kumar Mohanty, IISER Kolkata

- Motivated by the similarities between the spread of rumors and the spread of infectious diseases, I studied and simulated a rumor spreading model by Tingting Li & Youming Guo (2021).
- Simulated and studied the influence of different control parameters on the rumor propagation process.
- Compared the outcomes with models with no control parameters.

### Quantum Circuit for solving Linear Differential Equations

Dec 2018 – Jan 2019

Guide: Prof. Prasanta K. Panigrahi, IISER Kolkata

- Studied a novel Quantum algorithm for solving a system of LDEs by Tao Xin, et al.
- Developed a quantum circuit based on the algorithm to solve 4 x 4 LDE on IBM Quantum

## RELEVANT COURSEWORK

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|---|-----------------------------------|--|
| ○ Information Retrieval and Web Search  | ○ Probability I                   | ○ Programming and Data Structures I and II |
| ○ Natural Language Processing           | ○ Mathematical Methods of Physics | ○ Introduction to Computation              |
| ○ Machine Learning and Network Analysis | ○ Computational Physics           | ○ Introduction to Computer Programming     |
| ○ Statistics I                          | ○ Nonlinear Dynamics              |  |

## SKILLS

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**Programming Languages:** Python (advanced), Java, Shell script (intermediate), C (basic), HTML, CSS, JS (basic).

**Libraries:** PyTorch, Tensorflow, Keras, PyLucene, Pyserini, Gensim, NumPy, SciPy, Pandas, Matplotlib

**Software:** MATLAB, Origin, GnuPlot, ImageJ

**Misc.:** L<sup>A</sup>T<sub>E</sub>X, Git, GitHub, Supercomputing, Cluster MPI

**Mathematics:** Probability and Statistics, Tensor algebra, Nonlinear dynamics, PDE and ODE, Linear Algebra, Network analysis

**Foreign Language:** English | TOEFL iBT score: 107/120 (R:30 L:27 W:28 S:22)

## TEACHING ASSISTANTSHIPS

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### **CS4201: Information Retrieval and Web Search**

Spring 2022

*Instructor: Dr. Dwaipayan Roy*

*IISER Kolkata*

- TA to a class of more than 40 master's students

### **CS1101: Introduction to Computer Programming**

Autumn 2022

*Instructor: Prof. Supratim Sengupta, Prof. Swastika Chatterjee*

*IISER Kolkata*

- Cleared doubts in lab sessions, Graded assignments, invigilated exams

### **CS1101: Introduction to Computer Programming**

Autumn 2021

*Instructor: Prof. Supratim Sengupta, Prof. Dwaipayan Roy*

*IISER Kolkata*

- Held one-to-one tutorial sessions, Cleared doubts in lab sessions, Graded assignments

## TRAINING & CONFERENCES

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IBM Qiskit Global Summer School 2021 on Quantum Machine Learning

Jul 2021

- Classical ML, Quantum Approximate Optimization Algorithm, Variational Algorithms, Quantum Kernels and Quantum SVMs, Quantum Boltzmann Machines, Quantum GANs

IBM Qiskit Global Summer School 2020 Quantum Computing and Quantum Hardware

Jul 2020

- Quantum Circuits, Quantum measurements, Quantum Fourier Transform, Shor's Algorithm, Quantum Error Correction using Repetition Codes, Superconducting Qubits

International Conference on Quantum Information and Quantum Technology

Jun – Jul 2019

- QIQT-2019 Conference at IISER Kolkata

Asia Pacific Conference and Workshop on Quantum Information Science

Dec 2018

- APCWQIS-2018 Conference at IISER Kolkata

## REFERENCES

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### **Dr. Dwaipayan Roy**

*Assistant Professor, Department of Computational and Data Sciences*

*Indian Institute of Science Education and Research Kolkata, India*

*Email: dwaipayan.roy[at]iiserkol.ac.in*

### **Dr. Kripabandhu Ghosh**

*Assistant Professor, Department of Computational and Data Sciences*

*Indian Institute of Science Education and Research Kolkata, India*

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