Aman Sinha

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EDUCATION

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

[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

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

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

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

Skills

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.: LaTeX, 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

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

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. Kripabandhu Ghosh
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