# Anwoy Chatterjee

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## Education

- **Indian Institute of Technology, Delhi** — New Delhi, India
  ***Doctor of Philosophy** in **Electrical Engineering**; GPA: 10/10* — *July 2023 - Present*
  - **Areas of specialization**: Natural Language Processing, Large Language Models
  - **Prospective thesis**: *"Towards Robust and Explainable Mixed-context Learning in LLMs"*
  - Supported by **Google PhD Fellowship**
  - **Courses Credited**: Deep Learning for NLP, Cloud Computing

- **Indian Institute of Technology, Delhi** — New Delhi, India
  ***Master of Technology** in **Machine Intelligence and Data Science**; GPA: 8.808/10* — *Aug 2022 - June 2023*
  - Transitioned to PhD
  - **Ranked $1^{st}$ in the program on the basis of GPA**
  - **Courses Credited**: Artificial Intelligence, Machine Learning, Data Mining, Mathematical Foundations of AI, Computer Vision, Stochastic Control and Reinforcement Learning, AI for Earth Observation, Ethical Considerations in AI

- **Indian Institute of Technology (BHU), Varanasi** — Varanasi, India
  ***Bachelor of Technology** in **Computer Science and Engineering**; GPA: 9.72/10* — *Aug 2018 - May 2022*
  - B.Tech Thesis: "Trajectory prediction of dynamic agents around an autonomous vehicle using GNNs"
  - **Ranked $2^{nd}$ (among 75 graduates) in the department on the basis of GPA**

## Skills Summary

- **Programming Languages**: Python, C++, C, Java, SQL, Unix scripting
- **Libraries & Frameworks**: PyTorch, PyTorch Geometric, TensorFlow, Keras, Scikit-Learn, Numpy, Pandas, OpenCV
- **Tools**: Springboot, Git, MySQL

## Publications

*: Equal contribution

**[C2]** **Anwoy Chatterjee***, H S V N S Kowndinya Renduchintala*, Sumit Bhatia, Tanmoy Chakraborty,"*POSIX: A Prompt Sensitivity Index For Large Language Models*", **EMNLP 2024 (Findings)**, arXiv:2410.02185, September 2024.

**[C1]** **Anwoy Chatterjee***, Eshaan Tanwar*, Subhabrata Dutta, Tanmoy Chakraborty,"*Language Models can Exploit Cross-Task In-context Learning for Data-Scarce Novel Tasks*", **ACL 2024 (Main)**, arXiv:2405.10548, May 2024.

## Experience

- **Research Intern** — Adobe Inc.
  *Media and Data Science Research Lab, Adobe India;* ***Mentor** - Dr. Sumit Bhatia* — *May 2024 - Aug 2024*
  - Worked on analyzing and quantifying the sensitivity of LLMs to alterations in the input prompt.
  - Also looked into the possibility of utilizing the aspect of prompt sensitivity index as an augmented loss during pre-training of LLMs.
  - **A part of the work done during the internship is now published at EMNLP'24**.

## Selected Research Projects

- **Understanding the changes within LLMs on instruction tuning** — IIT Delhi
  *Ongoing PhD Project;* ***Supervisor** - Prof. Tanmoy Chakraborty* — *July 2024 - Present*
  - LLMs are observed to perform significantly well in generating coherent outputs on instruction tuning. Though certain abilities, like instruction following, are expected to be enhanced on instruction tuning, we observe certain outputs and behaviours that are not very intuitive but appear as a *by-product* of instruction tuning.
  - In this project, I am trying to investigate what kind of changes the LLMs undergo in the instruction tuning procedure. The aim is to demystify the alterations in the LLMs' components and understand the origin of the LLMs' enhanced abilities. Through our studies, we aspire to make the instruction tuning procedure more robust.

- **Investigating and quantifying the sensitivity of LLMs towards prompt perturbations** — Adobe & IIT Delhi
  *Ongoing PhD Project;* ***Supervisors** - Prof. Tanmoy Chakraborty and Dr. Sumit Bhatia* — *Jan 2024 - Present*
  - LLMs are observed to generate varied outputs on slightly changing the input prompt. This is often concerning for end users, as finding the optimal prompt is non-trivial for naive users.
  - We are currently looking into the internal activations of LLMs to get an idea of the role of neurons and attention heads in different layers towards the sensitivity to different kinds of prompt perturbations.

- **Cross-task in-context learning in LLMs to solve data-scarce novel tasks** — IIT Delhi
  *Ongoing PhD Project;* ***Supervisor** - Prof. Tanmoy Chakraborty* — *Aug 2023 - Present*
  - We are currently performing an in-depth analysis of what facilitates cross-task ICL, from a **mechanistic perspective**. We have identified certain **neural circuitries aiding the phenomena** and are currently analysing the contribution of different model components.

## Selected Course Projects

- **Self-supervised segmentation of hyper-spectral images**: Proposed three novel pretext tasks for self-supervised segmentation of Hyper-spectral images (HSIs) to harness the rich spectral information often overlooked by existing pretext tasks designed for normal images. The tasks involved shuffling channels/bands and reconstructing original HSIs to learn valuable spectral insights. Trained a feature-extractor model on these pretext tasks and conducted experiments on various datasets, achieving comparable performance with supervised classification for two of the three proposed tasks. Currently, conducting further extensive experimentation and collecting additional HSI data due to limited open-source datasets in this domain. Future plans include submitting our work for publication. All implementations were carried out in *PyTorch*. ***[IIT Delhi ; April '23]***
- **Prediction of traffic at road junctions using graph neural networks**: The project involved development of two GNN-based models - one for prediction of traffic at a node for a timestep by looking at the traffics at its neighbouring nodes for the previous timestep. The other model was to predict the traffic at a node for future $f$ timesteps by looking at the traffic at its neighbouring nodes for the past $p$ timesteps. Got the exposure in working with *PyTorch Geometric and NetworkX.* ***[IIT Delhi ; Nov '22]***
- **Game playing AI agent for Connect4 game**: Designed an AI agent for playing a two-player game by modelling the game's actions as an Adversarial Search Problem. Adversarial search-based agents were implemented using algorithms like Minimax, Alpha-beta Pruning and Expectimax. More specifically, the agent was designed based on *Iterative Deepening Minimax Algorithm with Alpha-Beta Pruning*, and we used a specially tailored heuristic function to evaluate the nodes based on the game's rules. ***[IIT Delhi ; Oct '22]***
- **Departmental store management website (WebApp)**: Designed a website for management of sales, customer and staff records, suppliers, stocks etc. of a Departmental Store. *Spring MVC* framework in *Java* was used for this project. I also used third normal form (3NF) to reduce redundancy in the database. Got the exposure in working with *MySQL, Spring MVC, Java, HTML, CSS and JavaScript.* ***[IIT (BHU), Varanasi ; Nov '20]***
- **Document mining and understanding**: Prepared our own annotated dataset of images. First, for each image, it was tested if it is of a document (using background analysis of the image). Then, for images of documents, the topic of the document was detected. *We prepared a model for Document Classification using Keras (on TensorFlow). We derived our own word embeddings from our dataset for preparing the model.* ***[IIT (BHU), Varanasi ; Sept '20]***
- **Smart attendance monitor (WebApp)**: Designed a *geo-location based attendance registering website secured by face recognition* using *Django framework in Python*. Also got exposure to working with MySQL, HTML, CSS, JavaScript, Ajax and OpenCV. ***[IIT (BHU), Varanasi ; Nov '19]***

## Services

Served as a **Graduate Teaching Assistant** for the following courses:

- *ELL881/AIL821 (Large Language Models: Introduction and Recent Advances)* course in Sem-I of 2024-25 at *IIT Delhi*. Responsibilities involve designing course content, assignments, and quizzes, as well as mentoring the students in their course projects.
- *ELL101 (Introduction to Electrical Engineering)* course in Sem-II of 2023-24 at *IIT Delhi*. Served as the Head TA, coordinating 10 other TAs in the course. Designed assignments and quizzes, as well as helped students in their lab experiments.
- *ELL880 (Social Network Analysis)* course in Sem-I of 2023-24 at *IIT Delhi*. Responsibilities involved designing and evaluating assignments and quizzes.
- *MTL101 (Linear Algebra and Differential Equations)* course in Sem-II of 2022-23 at *IIT Delhi*.

## Honors and Awards

- Awarded with the **Google PhD Fellowship**, 2024 in the area of **Natural Language Processing**
- Selected to attend the *Google Research Week*, 2024
- Ranked $2^{nd}$ in the Department of Computer Science and Engineering, IIT (BHU), among the graduating batch of 2022
- Qualified among the top 2% of the students (about 160,000) appearing for *JEE-Advanced*, 2018
- Ranked overall $4^{th}$ in the state of West Bengal ($3^{rd}$ in Science stream) in *Higher Secondary Examination*, 2018
- Selected for the prestigious *KVPY Fellowship* by Government of India (while studying in Class 11) in 2016
- Ranked $9^{th}$ in West Bengal in *NTSE (National Talent Search Examination)*, 2015