Neel Mishra

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Education

International Institute of Information Technology — Hyderabad, Telangana
Master of Science by Research, Computer Science, 9.00/10 — *Aug. 2020 – Present*
Courses: *Topics in Applied Optimization, Advanced Optimization, Digital Image Processing, Data Analytics I, Statistical Methods in AI*

Gujarat Technological University — Ahmedabad, Gujarat
Bachelor of Engineering, Computer Science, 9.11/10.0 — *June 2016 – May 2020*
Courses: *Data Structures and Algorithms, Object Oriented Programming, Operating Systems, Computer Networks, Artificial Intelligence, Theory of Computation, Computer Organization*

Publications

Angle based dynamic learning rate for gradient descent, *Neel Mishra, Pawan Kumar, International Joint Conference on Neural Networks (IJCNN) 2023* link

A Gauss-Newton Approach for Min-Max Optimization in GANs, *Neel Mishra, Pawan Kumar, Bamdev Mishra, Pratik Jawanapuria, Submitted in WACV 2023*

Academic Experience

IIIT Hyderabad — Hyderabad, India
Thesis - Numerical Optimization, Advisor: Prof. Pawan Kumar — *Aug 2020 - Present*

- Developed and validated custom PyTorch solvers for Conjugate Gradient and BI-Conjugate Gradient Stabilized methods, and made them GPU compatible, resulting in a remarkable over 96% reduction in runtime for million-entry Hessian matrices, surpassing the standard implementation with numpy.
- Conducted GAN research on architectural modifications, label smoothing and preconditioning, verified through comprehensive experimentation.
- Designed a novel optimization technique for image classification tasks that guarantees convergence and satisfies Armijo's condition under certain assumptions, outperforming current state-of-the-art first-order optimizers.
- Formulated a first-order approximated Gauss-Newton solver for GANs, which outperformed existing second-order optimizers, with theoretical convergence guarantees and verified through experimentation.

Microsoft Academic Partnership Grant — *Aug 2021 - March 2023*

- Collaborated with a team of data scientists and researchers to develop and improve machine learning models, and presented research findings and technical solutions to both technical and non-technical audiences
- Developed and implemented top conference papers from scratch using PyTorch, incorporating various optimization algorithms such as CGD, Numerics of GANs, Follow The Ridge, LEAD, ICR, Angulargrad, diffGrad, NADAM, NAG, and AdaMax to validate results.
- Designed and tested various GAN optimizers and explored novel optimization strategies on toy examples, analyzing the associated trajectories and eigenvalue spectrum to improve the current state-of-the-art GAN models.

iHub-Data — *Sept 2022 - March2023*

- Led a team of students to plan and execute a comprehensive research project. Developed a detailed roadmap for the study and discussed the overall framework to ensure feasibility.
- Utilized Generative Adversarial Networks (GANs) for data augmentation on medical data, specifically a brain tumor dataset. Generated high-quality synthetic images to expand and diversify the dataset. Presented the research findings to a committee of experts

Graduate Teaching Assistant — *Aug. 2021 – Oct. 2022*

- Topics in Applied Optimization (Aug.2022 – Oct. 2022)
- Probability and Statistics (Aug. 2021 – Dec. 2021 and Aug.2022 – Oct. 2022)

SOCET Software Development Team — Ahmedabad, Gujarat
Team Lead — *Sept 2017 - March 2020*

- Led and coordinated a software development team at SOCET, demonstrating strong leadership and project management skills. Successfully delivered software development projects within the allocated budget and timeline.

- Represented Silver Oak as a delegate at the IEEE Sampark 2017 event in DDIT Nadiad, showcasing the progress of the IEEE Silver Oak Student Branch and its initiatives. Received the Best Rising Branch 2018 award in recognition of the contributions made.

Industry Experience

Tekion Bangalore, India

Data Scientist *Jul 2023 - Present*

Data-Driven Analysis of Customer Preferences and Inventory Management *July 10, 2023 - July 18, 2023*

- Led data pre-processing, including categorization, filtering, joins, and timestamp handling.
- Conducted EDA on global and state-specific datasets, revealing demand trends, customer preferences, inventory size, and selling price segmentation.
- Key insights: Observed post-2020 vehicle age trends, analyzed age distribution relative to global averages, and identified changing customer budget patterns from 2017 to 2023.

Data-Driven Analysis for Personalized FNI and Accessory Solutions in Vehicle Sales *July 19, 2023 - July 27, 2023*

- Conducted data pre-processing involving merging, deduplication, and standardization.
- Performed insightful EDA to determine vehicle sales trends based on types and popular FNI products.
- Key insights: Identified popular FNI trends, analyzed cost variations between used and new cars for specific FNIs.

Analyzing Internal RO and Evaluating MPVI Performance *July 28, 2023 - August 5, 2023*

- Addressed data scarcity by leveraging non-migrated data and employing strategic joins.
- Performed comprehensive EDA to assess recommendation effectiveness and calculate approved job percentages for MPVI and non-MPVI cases.
- Key insights: Identified differences in the effectiveness of recommendations and observed varying job approval trends across dealerships, particularly for critical recommendations.

Acquiring Marketing Features and Comparisons for Make Model Year (MMY) *August 6, 2023 - August 11, 2023*

- Scraped extensive data, including lists of alternate/similar vehicles, key features, pros and cons, reviews, in-depth tabular comparisons, and vehicular cards for over 800 cars from online sources.
- Identified issues with the use of the search engine LLM tool and recommended utilizing structured URL-based data sources for more efficient data retrieval.
- Explored online sources for pre-transformed data matching project needs, eliminating Large Language Model (LLM) usage and resulting in cost saving.
- Performed comprehensive data cleaning and ensured proper data storage formats.

Vehicular Marketing Question and Answering Chatbot Development *August 12, 2023 - September 10, 2023*

- Identified key use cases and initiated chatbot architecture development using Langchain. Enhanced and presented a successful demo.
- Addressed issues and edge cases from the initial version, significantly improving the retrieval system.
- Incorporated advanced intent analysis, standalone question generation, and additional intents for fallback and greetings.
- Thoroughly documented project elements, including architecture, performance evaluations (e.g., intent analyzer, retrievers, standalone question generator), and comprehensive flow use cases. Maintained regular communication with superiors, ensuring timely reporting and updates.
- POC Outcomes: Achieved high robustness, passing the majority of test cases. Completed the entire Proof of Concept (POC) under one month, presenting a successful demo to senior stakeholders, including the Machine Learning Director.

Data Cleaning: Next Email Prediction *August 12, 2023 - September 10, 2023*

- Developed an efficient pipeline that categorizes emails into templated and non-templated types and organizes data into multiple buckets. Implemented multithreading to reduce execution time from 6 hours to 30 minutes.
- Cleaned and normalized a 16,000-data point dataset, rectifying non-displayable Unicode characters, incomplete emails, footer content, and text elements to enhance data quality substantially.
- Developed an efficient pipeline that categorizes emails into templated and non-templated types and organizes data into multiple buckets. Implemented multithreading to reduce execution time from 6 hours to 30 minutes.
- Used clustering, and semantic similarities to filter out the templated, and non-templated emails. I also used the timestamp in the email to assign a bracket to each data point.

Ground Truth Generation: Next Email Prediction *September 10, 2023 - September 15, 2023*

- Applied prompt engineering to craft precise, constraint-driven reverse-engineered prompts, enabling control over prompt length, and validated them for varying word counts (20, 30, 40, 50, and 60 words).
- Hand crafted few shot examples across 8 categories that enhanced the prompt generation.
- Generated set of keywords from the context and pruned them using fuzzy clustering logic, and used these keywords to mask the data.
- Created multi prompt approach to tackle the over generalization of the prompt generation.

Finetuned LLM: Worked on finetuning *September 15, 2023 - December 9, 2023*

- Finetuned the opensource models tinyLlama, Llama2 3b, Llama2 7b, Zephyr 7b-alpha, Zephy 7b-beta.
- Used automated validation using cosine similarity, as well as performed a manual level validation

Sales ChatBot using RASA *December 9, 2023 - Present*

- Fetched, cleaned, and annotated data across multiple datasets
- Used the data, and RASA to train an intent classifier

Academic Projects

Motion Deblurring Using Transparency

- Implemented the MAP approach for motion deblurring based on the paper "Single Image Motion Deblurring Using Transparency."
- Led a team of four to recover motion blur filters, dividing the task into three modules: object extraction, deblurring with known filters, and blur filter estimation.
- Utilized traditional gradient descent to estimate blur filters on patches and stitched deblurred patches to form complete object images.

Implemented Machine Learning Algorithms From Scratch

- Implemented Optimal Bayes, Naive Bayes, Ridge, and Lasso regression, visualizing decision boundaries and optimization trajectories.
- Executed PCA for 95% variance-preserving compression of a human face dataset.
- Implemented Linear Discriminant Analysis (LDA) for multi-class classification on the IRIS dataset, comparing dimensionality reduction with PCA.

Implementation of Recommender System Using Latent Factor Model

- Developed a recommendation system using matrix factorization and a custom loss formulation for latent factor estimation in the rating matrix.
- Applied L2 regularization to counter overfitting due to many latent vector columns.

Clustering Analysis

- Implemented K-means, Hierarchical clustering, and DBSCAN from scratch.
- Conducted data preprocessing, noise removal, and visualized data using 3D plots.

Technical Skills

Languages and tools: Python, Git, Linux, VS Code
Libraries and Frameworks: PyTorch, TensorFlow, langchain, llama-index, scikit-learn, pandas, numpy