Rahul Nandakumar

Austin, Texas

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Education

M.S. in Operations Research and Industrial Engineering (Thesis) *Aug. 2022 - May. 2024*
The University of Texas at Austin

- Relevant Coursework: Statistical Modeling I, Linear and Integer Programming, Applied Stochastic Processes, Production and Inventory Control, Decision Analysis
- Advisor: Dr. Deepayan Chakrabarti.

B.Tech. in Chemical Engineering (Thesis) *Aug. 2018 - May. 2022*
National Institute of Technology, Andhra Pradesh, India

- Relevant Coursework: Industrial Engineering and Management, Optimization and Soft Computing Techniques
- Advisor: Dr. P Dinesh Sankar Reddy.

Research Experience

Graduate Research Assistant, *Aug. 2023 – Present*
McCombs School of Business, University of Texas at Austin

- Developed a novel Machine Learning algorithm for manufacturing complex features in binary classification tasks on high-dimensional, multi-cluster datasets.
- Implemented highly efficient, parallelizable code to optimize algorithm performance on both GPU and CPU architectures.
- Rigorously evaluated the performance of the developed algorithm using synthetic test data, varying the initial algorithm parameters and default values for data generation. This provided a deep understanding of the algorithm's behavior across a range of input conditions.
- Conducted comprehensive performance assessments to compare the algorithm against competitors such as Random Forests, Gradient Boosting, Linear SVC and Multilayer Perceptron architectures. Achieved ~ 16 % increase in AUC on simulated test data.
- Expanded the scope of the Machine Learning algorithm by adapting it for multiclass classification tasks.
- Currently engaged in testing the algorithm's performance using benchmark datasets, including CIFAR-10 and CIFAR-100. Link to writing sample.

Research Intern, *Sept. 2021 – Mar. 2022*
Advanced Manufacturing Technology Development Center – Indian Institute of Technology, Madras

- Selected, and received funding from the Ministry of Heavy Industries – Govt. of India to contribute to an autonomous robotic beach plastic waste removal project.
- Employed cutting-edge technology, using Computer Vision with a state-of-the-art 3D camera for precise object detection. Utilized a LiDAR to accurately determine the range of detected objects.
- Spearheaded the effort to collect and meticulously annotate a substantial dataset comprising over 1000 images using the Roboflow platform. Leveraged Transfer Learning techniques within TensorFlow 2, utilizing pre-trained models such as SSD MobileNet, Faster R-CNN, and Mask R-CNN to assess their relative performance in the context of the project's objectives.
- Demonstrated strong teamwork by collaborating effectively with interdisciplinary teams to develop a sophisticated Digital Twin for the robotic system. This Digital Twin, created using Unity3D and ROS (Robot Operating System), enabled comprehensive testing of autonomous navigation strategies. Additionally, successfully integrated an ESP32 Module onto the robot, facilitating real-time data analytics and enhancing the robot's capabilities for data-driven decision-making.
- Co – authored a manuscript with collaborators from the Digital Twin and Autonomous Guidance teams, documenting the results. The manuscript comprehensively documented the project's methodologies, findings, and outcomes, contributing valuable insights to the field of autonomous robotics and environmental conservation. Link to manuscript.

Undergraduate Research Assistant, *Apr. 2021 – Feb. 2022*
National Institute of Technology, Andhra Pradesh

- Demonstrated ability to critically analyze and synthesize existing research, contributing to a deeper understanding of Deep Eutectic Solvents (DES) -based electrochemical processes.
- Collaborated as a co – author on a manuscript, which delves into the intricate details of DES utilization in electrochemical processes, specifically focusing on electrodeposition and electropolishing of metals. This work signifies active engagement and potential impact in the field of electrochemistry.

Publications, Presentations and Invited Talks

Research Papers

- **Rahul Nandakumar**., Deepayan Chakrabarti., *'Manufacturing complex interpretable features from high dimensional data'.* (In Preparation).

Conference Presentations

- **Rahul Nandakumar**., PK Baranwal., *'A Review on Electrochemical Applications of Deep Eutectic Solvents in the Electrodeposition of Metals'.* presented at the International Conference on Advances in Chemical and Materials Sciences, 'ACMS – 2022'. Link to Paper, Presentation

Invited Talks

- Featured as a panel speaker at *'Career Insight Series - NIT Andhra Pradesh'* to inspire career growth opportunities for undergraduate students, September 2023. Link to Talk

Teaching Experience

Graduate Teaching Assistant, *Jun. 2023 – Aug. 2023*
Data Science Programming

- Mentored and provided one-on-one assistance to students/working professionals, clarifying complex coding challenges and fostering a supportive learning environment.
- Demonstrated practical applications of data science libraries and frameworks in Python through live coding sessions, encouraging students hands-on experimentation and critical thinking.
- Supported the grading and evaluation process, maintaining accurate grade records and communicating feedback to students to promote continuous improvement.
- Course Evaluation Average: 4.58.

Teaching Assistant, *Jun. 2023 - Jul. 2023*
Data Science For Business Applications

- Helped the instructor create and deliver lectures on data science methodologies and their real-world business applications using R. Helped students comprehend and use machine learning and statistical ideas to address business problems in the real world.
- Provided feedback to students to improve the efficiency, readability, and maintainability of their HW assigmnemts.
- Hosted office hours and responded promptly to students queries, cultivating an approachable and accessible resource for academic assistance.
- Course Evaluation Average: 4.73.

Professional Experience

Data Science Intern: AI Team, *Apr. 2022 – Jul. 2022*
Twimbit

- Installed and managed a holistic data pipeline (Algolia, Heap, Matomo, Segment) for tracking website user interactions, and facilitating data-driven decisions.
- Leveraged A/B test insights and ad-hoc analysis to reduce product friction and boost daily user numbers by $\sim$ 5%.
- Parsed raw HTML data from 700+ webpages on the website using Beautiful Soup to train a Decision Tree model for automated classification of future records into distinct categories. This reduced engineering hours and manual classification.

Projects

Multi-Modal Content Generation and Alignment with Efficient Optimization (Work in progress)

- Motivation: The primary objective of this project is to develop a versatile AI pipeline to generate coherent, high-quality content in both the 2D and 3D domains based on textual descriptions.
- Seamlessly merged a Stable Diffusion based text to image model with AlignProp (a backpropagtion based approach to align diffusion models with downstream reward functions) and DreamGaussian (a 3D Gaussian Splatting model with mesh extraction and texture refinement).
- Demonstrated the superiority of DreamGaussian in generating high-quality textured meshes, achieving a remarkable 10-fold acceleration compared to existing methods, with the ability to produce content from a single-view image in just 2 minutes.

A graph-based big data optimization approach using Hidden Markov Model and Constraint Satisfaction Problem. *(Supervised by Dr. Abhra Sarkar, Assistant Professor - Department of Statistics and Data Sciences, UT Austin)*

- Implemented a novel framework to seamlessly integrate a Constraint Satisfaction Problem (CSP) into a Hidden Markov Model (HMM) for the purpose of optimizing state space in financial time series analysis.
- Leveraged Twitter sentiment analysis data spanning from January 20, 2017, to January 20, 2020, to introduce unique constraints into the model. This approach distinguished itself from conventional non-CSP methods.
- Successfully applied the developed framework to predict Dow Jones Industrial Average closing prices. Achieved a remarkable reduction in Mean Absolute Percentage Error (MAPE) by 0.59%, elevating the predictive accuracy to an impressive 90%. Additionally, streamlined computational efficiency by reducing computational time by 0.02 seconds. [Link to Paper](#)

Deep Learning integrated with modeling a medical waste gasification-power production plant. *(Supervised by Dr. P Dinesh Sankar Reddy, NIT Andhra Pradesh)*

- Conducted an extensive literature review to delve into the intricate aspects of medical waste generation. This comprehensive survey encompassed a meticulous examination of sources, types, and the environmental repercussions associated with medical waste.
- Spearheaded the design and implementation of a sophisticated Deep Learning model, leveraging the PyTorch framework. The primary objective of this model was to simulate thermodynamic equilibrium within a downdraft gasifier, focusing specifically on the conversion of medicinal biomass into energy.
- This highlighted the potential of data-driven simulation techniques as a viable alternative to conventional and time-consuming design simulation softwares like Aspen Plus.
- Achieved a remarkable 77% accuracy rate of output energy on the evaluation dataset with 1000 datapoints and 11 features. [Link to Thesis](#)

Optimizing material flow in a multi - echelon, multi - mode, multi - product Supply Chain Network.

- Carried out literature surveys on inventory transportation Problems, transportation problems considering stakeholder behavioural tendencies, and integrating lean, sustainable development and logistics into a lean sustainable logistics model.
- Implemented a heuristic algorithm for optimizing material flow based on the research paper by Raju Rajkanth., G. Srinivasan., Mohan Gopalakrishnan., 'Material flow optimisation in a multi – echelon and multi – product supply chain'.
- This algorithm based on the TOPCM method involved optimizing the distribution costs and the vehicle transportation costs over the multi – period, multi – mode network and yielded solutions within 5% of the LP relaxation solution.

Supply Chain Management Strategy for Medical Technologies Corporation.

- Successfully managed a complex network of companies in a real-life scenario to counter a 10% profit reduction due to medical device taxes.
- Formulated cost-saving solutions in Logistics, Operations, Planning, and Sourcing as key strategies
- Implemented a supply chain redesign that removed third-party logistics firms and integrated Oracle and SAP ERP systems.
- Conducted demand forecasting to optimize inventory management.
- Performed a Make vs. Buy Analysis for off-site sterilization processes, resulting in significant cost savings.

Extra – Curricular Activities and Awards

- Best Project with Spirit Award at the AI and Energy Hackathon organized by UT PGE — *Jan. 2023*
- Webmaster, Social Events Chair at INFORMS Student Chapter, UT Austin. — *Aug. 2022 – Present*
- Chief Editor at ABSORB, The ChE Magazine, NIT AP. — *Aug. 2020 – May. 2022*
- Secretary at the ChE Association, NIT AP. — *Sept. 2019 – May. 2022*
- Core Technical Team Member at the Developer Student Club, NIT AP. — *Sept. 2018 – Sept. 2020*
- Joint Secretary at the Entrepreneurship and Innovation Cell, NIT AP. — *Aug. 2018 – Aug. 2020*
- Operations Team Co – ordinator at the Task Force, NIT AP. — *Oct. 2019 – Aug. 2021*
- Volunteer, Swachh Bharat Mission – Swachhata Pakhwada 2020. — *Jan. 2020 – Feb. 2020*
- Regional Topper, Informatics Practices – Class XII, CBSE examinations awarded by TVS Motor Limited. — *Aug. 2017*
- Secured 94.4% in Class XII, CBSE and a Cumulative GPA of 10.0/10.0 in Class X, CBSE. — *2017*
- International Science and Mathematics Olympiad Gold, Bronze Medal winner, organized by Science Olympiad Foundation. — *2015*