Rachna Ramesh

rachna-r.github.io Github: Rachna-R
rachna.x.ramesh@gmail.com linkedin.com/in/rachnaramesh/

Education

Master's, Data Science & Artificial Intelligence **2023 – 2025***
Eindhoven University of Technology (TU/e) *Eindhoven, The Netherlands*
***Thesis**: Neural Simulation of Spatiotemporal Dynamics in Rising Bubbles Using Spherical Harmonics**

Bachelor's, Computer Science & Engineering **2014 – 2018**
University of Kerala *Trivandrum, India*
***Thesis**: Handwritten Mathematical Expression Recognition and Evaluation*

Research

Neural Simulation of Spatiotemporal Dynamics in Rising Bubbles Using Spherical Harmonics*
Nov 2024 – Present*
Mentor: Dr. Vlado Menkovski, Data Mining Cluster, TU/e

- Exploring Flow Matching and normalizing flows to model continuous-time differential dynamics in high-dimensional spaces, capturing interactions of 32 bubbles with symmetry constraints for precise position, velocity, and shape representation.
- Implemented an autoregressive E(n) Equivariant Graph Neural Network (EGNN) with a graph structure, where nodes represent bubble states and edges capture the relative interactions between the bubbles.
- Utilizing spherical harmonic coefficients to represent bubble shape deformations, aiming to computational efficiency while ensuring precision in modeling bubble behaviors as part of thesis research.

Analysis of Deep Learning Approaches for Graph Drawing
Apr 2024 – Aug 2024
Mentor: Dr. Alessio Arleo, Visual Analytics Cluster, TU/e

- Performed an extensive literature review of state-of-the-art deep learning methodologies for graph drawing, focusing on advancements in representation learning and layout optimization.
- Proposed a taxonomy of graph drawing approaches, categorizing them into direct and indirect methods, as well as supervised, unsupervised, and criteria-based optimization frameworks, based on learning paradigms and objectives.
- Analyzed the reproducibility and scalability of these techniques by evaluating publicly available implementations, datasets, and training pipelines for practical applicability and fine-tuning.

Experience

Machine Learning Engineer **Aug 2019 – July 2023**
Emerging Technologies, R.R Donnelley (RRD) *Chennai, India*

- *Enhanced Document Layout Automation*: Increased automation of manual remediation from 50% to over 80% by developing a production-grade deep learning tool, deployed organization-wide. Utilized transformer-based models and PyTorch to streamline document processing workflows.

- *Multimodal Document Analysis*: Developed and implemented a deep learning solution for multimodal analysis of tagged PDFs, utilizing advanced techniques to accurately classify and identify document elements based on a large-scale dataset.
- *Automated Entity Recognition & Document Retrieval*: Created a LLM-powered chatbot with entity linking and retrieval-augmented generation (RAG) for financial document analysis, leveraging pretrained transformers and fine-tuned retrieval architectures.
- Led ML model deployment utilizing Docker and AWS, ensuring scalability and fault tolerance.

Machine Learning and Data Analytics Intern **Dec 2018 – May 2019**
QuEST Global *Trivandrum, India*

- Performed time-series forecasting and anomaly detection for energy consumption analysis, applying exploratory data analysis (EDA) and feature engineering to extract valuable insights and enhance predictive modeling.
- Researched and implemented regression algorithms, recurrent neural networks (RNNs), and long short-term memory (LSTMs) to predict electricity bills and optimize system efficiencies.

Skills

Languages: Python, C++

Deep Learning Frameworks: PyTorch, TensorFlow, Keras

Machine Learning Techniques: GNNs, Transformers, Equivariant Neural Networks, Self-Supervised Learning

Tools: Docker, Podman, Jupyter, Git, Postman

Relevant Coursework

Deep Learning, Machine Learning Engineering, Reinforcement Learning, Research Topics in Data Mining, Neural Networks, Big Data Management

Achievements

- Recognized by RRD Leadership for High Performance in AI-driven Product Development, contributing to a new revenue stream (July 2022).
- Selected as **Employee of the Quarter** for **Delivery Excellence** (Q2 2021) from over 1500 employees by RRD.
- Received a **National Level Merit Scholarship** from the All India Council for Technical Education (AICTE) in 2015.