Ravi Ghadia

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Skills: Large Language Models | GPU Architecture | Machine Learning | Combinatorial Optimization | Statistics | Distributed Systems | Reinforcement Learning

Education

The University of Texas at Austin **Aug'24 – Present**
Masters of Science in Electrical and Computer Engineering
Focus: Computer Architecture, Computer Systems and Embedded Systems

Indian Institute of Technology, Kharagpur **July'17 – June'21**
Bachelor of Technology in Electronics and Electrical Comms. Engg, CGPA: 9.35/10
Minor in Computer Science and Engineering

Industry Experience

Applied ML Architect, NVIDIA **July'21 - Jul'24**
Manager: Sivakumar Anandan | Machine Learning, GPU Architecture, Statistical Analysis
- Developed high-fidelity statistical Debug system at unit level to understand GPU inefficiencies
- Built predictive ML models to project performance for compute workloads: HPC, LLMs, Recommender Systems
- Designed statistical Monte-Carlo simulation environments for DGX-class systems to enable management/marketing with product road-map decisions on datacenter systems
- Improved the runtime & resource complexity of highly intensive algorithms: MaxQ (using RL) and Bin-Optimization (using CNNs), enabling rapid turn-around for data requests

Architecture Intern, NVIDIA **April'20 – July'20**
Mentor: Sivakumar Anandan | Reinforcement Learning, GPU Architecture
- Used Reinforcement Learning to solve combinatorial optimization of the most energy-efficient GPU configuration
- Developed proof-of-concept promising massive runtime benefits compared to the traditional brute-force solution
- Follow-up work accepted as an Oral presentation at NTECH 2023, NVIDIA's internal Global Tech Conference

Research Experience

Graduate Research Assistant, The University of Texas at Austin **Aug'24 – Present**
Advisor : Prof. Poulami Das | Large Language Models, GPU Architecture, Machine Learning
- Optimizing **inter-token generation latency** during LLM inferencing by tuning **KV cache** size in real-time
- Used distributional ML models to identify **eligible candidates for KV cache**, reducing the overall cache size

Research Assistant, H2Lab, University of Washington **Nov'22 – Aug'24**
Advisor : Prof. Prithviraj Ammanabrolu | Large Language Models, Reinforcement Learning
- Used **freeform linguistic feedback** to train large language models via **reward function learned on the feedback**
- Designed **vectorized policy framework** with localized rewards for incorporating multi-faceted feedback
- Experimental runs showed better alignment with the feedback: **improved Alignscore** on Question-Answering

Undergraduate Research Assistant, CNeRG CSE, IIT Kharagpur **Sept'20 – Jun'21**
Advisor : Prof. Pawan Goyal | Large Language Models, Reinforcement Learning, Statistics
- Critically analyzed the **shortcomings of Cross-Entropy** Loss for training **generative dialog models**
- Hypothesized the **model artifact theory**: For different inputs, model generates the same output response (which has almost no semantic relation to the input)
- Proposed **ranking based reward function** to train LLMs in an RL setting - mitigates the shortcomings of CE-Loss

Publications and Preprints

MaxQ Optimization using Reinforcement Learning
Ravi Ghadia, Vamsi Krishna, Karthik Prakash, Sivakumar Anandan, Raghavendra Bhat
Accepted for Oral Presentation at NTECH US 2023 (NVIDIA-Internal Global Conference, acceptance 18%)
- Implemented RL based solution achieving the MaxQ configuration of a GPU (optimal configuration with best Performance per Watt)
- Delivered ∼**2000x** runtime and resource benefits as compared to the conventional brute force approach

CORAL: Contextual Response Retrievability Loss Function for Training Dialog Generation Models
Bishal Santra, Ravi Ghadia, Manish Gupta, Pawan Goyal
Bachelor's Thesis — Arxiv[preprint]
- Proposed retriever based loss function that considers context to assign loss for the generated output
- Achieved state-of-the-art on relevance metrics like MauDe/DeB against several strong pretrained baselines

Perf Activity Driven Instantaneous Power Projection
Ravi Ghadia, Sivakumar Anandan, Raghavendra Bhat
Accepted to NTECH India 2022 (NVIDIA-Internal Conference, acceptance rate 22%)
- Built a framework that allowed high precision energy analysis and helped isolate inefficient regions in the graphics pipeline

Teaching Experience

Teaching Assistant: Advanced Machine Learning **Aug'24 – Present**
Instructor : Prof. Joydeep Ghosh, McCombs School of Business, UT Austin
- Advanced course on ML covering Predictive modeling for practical business applications scaling on big data
- Facilitated interactive teaching sessions for a class with a highly diverse set of students from different backgrounds

Certified Instructor — NVIDIA Deep Learning Institute **Dec'21 – Jul'24**
- Served as an instructor for courses on **Transformer based NLP applications** and **LLM Inference Optimizations**
- Conducted sessions during NVIDIA GTC and assisted other instructors as TA during related courses

Technical Strengths

- **Programming Languages:** Python, C/C++, MATLAB, HTML, Javascript
- **Frameworks:** Pytorch, Tensorflow, Django, Streamlit
- **Libraries:** HuggingFace, OpenAI Gym, RL4LMs, stable-baselines
- **Profilers:** NVIDIA Nsight, Radeon Graphics Profiler
- **Utilities:** Perforce, Git, Bash, Linux

Selected Academic Projects / Competitions

Maverick 2.0 Hackathon — AB InBev **April'21 - May'21**
National Finalists (top 8 out of 750+ teams Pan India) | Machine Learning
- Developed an application to recommend customized discounts basis product data across various sectors
- Implemented pipelining for real-time request processing — Applauded by the panelists for outstanding design

Secure Authentication via user-behaviour **Aug'20 - Nov'20**
Advisor : Dr. Sudipta Mukhopadhyay | Machine Learning, Statistics
- Authenticated users based on their usage profile for mouse activity — click-time, pause-time, cursor-velocity etc.
- Used self-organizing maps for feature-extraction — Prevented unauthorised access with an 83% recall

Optimal Power Distribution **Nov'18 - Dec'18**
Advisor : Dr. Arijit De | Optimization, Statistics
- Determined network stability from its transfer function with variation in inductive and capacitive components
- Developed Monte-Carlo simulation environment for optimal transfer function providing maximal power efficiency

Extracurricular Activities

- **Volunteered as a Mentor** at Mentor Together, a Non-Profit Organization aiming to assist underprivileged young-minds in their student-to-professional transition
- Served as the Hall Alumni Committee head, orchestrating alumni funds to initiate annual donation drive for Ambassadors Children Home, an orphanage near the IIT Kharagpur campus
- Performed a lead role representing the Rajkot District team in **National Science Dramatics Competition 2014**