

# Ravi Ghadia

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**Skills:** Large Language Models | GPU Architecture | Deep 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, CGPA: 4.0/4.0*

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

### GPU 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
- Leveraging Sparse attention to identify key tokens of importance to manage KV cache more economically

### 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

### Dialogue Without Limits: Constant-Sized KV Caches for Extended Responses in LLMs

Ravi Ghadia, Avinash Kumar, Gaurav Jain, Prashant Nair, Poulami Das

Accepted to ICML 2025 | Arxiv [preprint]

- Implemented MorphKV: a dynamic token selection algorithm with constant KV cache usage for LLM inference
- Our approach saves **53% more memory** while improving accuracy by 18% on avg. compared to SOTA methods

### 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**

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### **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**

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- **Programming Languages:** Python, C/C++, MATLAB, LC-3b
- **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**

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### **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**

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- **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