Website: mridulk97.github.io LinkedIn: mridulk97

MRIDUL KHURANA

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EDUCATION

Virginia Tech **Aug 2022 – May 2027**
PhD. in Computer Science, *Advisor: Dr. Anuj Karpatne* GPA 4.0/4.0 *Blacksburg, Virginia*
Courses: Natural Language Processing (NLP), Computer Vision, Deep Reinforcement Learning (RL), Adv Machine Learning

Delhi Technological University **Aug 2015 - May 2019**
Bachelor of Technology (B.Tech.), Electrical Engineering *New Delhi, India*

TECHNICAL SKILLS

- **Programming Languages:** Python, C++, Shell Scripting, SQL, Git, MATLAB
- **Technologies:** PyTorch, HuggingFace, Tensorflow, AWS, Docker, OpenCV, Scikit-learn, WandB, Kafka, MongoDB

PROFESSIONAL EXPERIENCE

Graduate Research Assistant (Advisor: Dr. Anuj Karpatne) **Sep 2022 – Present**
Science-Guided Machine Learning Lab, Virginia Tech *Blacksburg, Virginia*

- Hierarchical Conditioning of **Stable Diffusion** with **Trees** to accelerate scientific discovery in evolutionary biology (**ECCV'24**)
- Building **VLM4Bio** using Retrieval-augmented generation (**RAG**) to provide species-specific trait information from images.
- Benchmarked Vision Language Models (**VLMs**) including **GPT-4o**, LLaVa on **multimodal scientific data** (in review **NeurIPS'24**)
- Working on **GenAI**, building memory and compute efficient **image-to-image** Schrödinger bridge models.

Software Engineer **May 2020 - July 2022**
Theremin.ai *Mumbai, India*

- Designed and built a **Trading Platform (OMS)** handling more than **$10 Million** in Indian stock markets. Mentored **2 interns**.
- **15x** volume increase to **1500** securities using **Kafka** for streaming real-time price data from the stock exchange.
- Deployed the **event-driven architecture** framework on **AWS**, and integrated **ETL** pipelines with database using custom **APIs**

Software Engineer **June 2019 - Apr 2020**
Fractal Analytics *Mumbai, India*

- Built multiple ML models for **Comcast** target marketing leveraging ensemble methods like **Random Forest** and **XGBoost**.
- Big data processing with **10,000+ variables** using feature engineering like **PCA,** variable binning and **clustering**.
- Developed models for maximum likelihood estimation, achieved an F1 score of **77%**, improving the existing client models.

ML Research Intern (Advisor: Dr. R. Venkatesh Babu) **May 2018 - July 2018**
Vision and AI Lab, IISc Bangalore *Bangalore, India*

- Developed **monocular depth estimation** models using **CNNs** (ResNet-50) & fovea transformations for outdoor scenes.
- The absolute & squared relative errors were reduced by 0.7% and 2% resp on the KITTI stereo dataset (at par with SOTA).
- Employed Fully Convolutional Residual Networks (**FCRN**) using **unsupervised learning** for indoor scenes in Tensorflow.

PROJECTS

Mitigating Simple and Adversarial Attacks on Vision Language Models (VLMs) GitHub Feb 2024 - May 2024

- Jailbreaking positional biases & adversarial vulnerabilities in VLMs on MCQA tasks, proposing effective mitigation techniques
- Designed **Visual Latent Smoothing** to enhance VLM robustness against adversarial attacks on LLaVa and BLIP VLMs.

Numeral-Aware Large Language Models (LLMs) GitHub Sep 2023 – Dec 2023

- **Prompt tuning** (zero-shot, one-shot and few-shot) for generating Numeral Aware news headline.
- Fine-tuned **Llama-2** using **LoRA**, **T5**-large, XLM-Roberta to first accurately generate numeral values and then the headline.

PROFESSIONAL DUTIES

- Reviewer for **NeurIPS 2023** Workshops: Generative AI & Biology (GenBio) & Machine Learning and Physical Sciences (ML4PS)
- Reviewer for **AAAI 2024** Workshops: Responsible Language Models (ReLM) & Imageomics

ACHIEVEMENTS

- State level **Gold medalist** in Taekwondo, India. Basketball **- (Gold Medal** at AAHVAAN'17, **Silver medalist** at SPORTECH'17 and UDGHOSH'17)
- Certified **Grade 2** drummer by Rockschool, **Trinity College of London**.

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PUBLICATIONS

PEER-REVIEWED CONFERENCES

- **Mridul Khurana,** Arka Daw, M. Maruf, …, Anuj Karpatne. "*Hierarchical Conditioning of Diffusion Models Using Tree-of-Life for Studying Species Evolution*". Accepted to ***ECCV 2024*** *(Paper)*
- Mohannad Elhamod, **Mridul Khurana**, Harish Babu Manogaran, …, Anuj Karpatne. *"Discovering Novel Biological Traits from Images using Phylogeny-guided Neural Networks".* In *Proceedings of the 29th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (**KDD**) **2023 (Oral)** (Paper)*
- Kazi S. Mehrab, M. Maruf, Arka Daw, Harish. B. Manogaran, Abhilash Neog, **Mridul Khurana**, …, Anuj Karpatne *"Fish-Vista: A Multi-Purpose Dataset for Understanding & Identification of Traits from Images".* (in review **NeurIPS 2024**) *(Paper)*
- M. Maruf, Arka Daw, Kazi S. Mehrab, Harish. B. Manogaran, Abhilash Neog, Medha Sawhney, **Mridul Khurana**, …, Anuj Karpatne. "*On the Zero-Shot Effectiveness of Pre-trained Vison Language Models (VLMs) for Understanding Scientific Images: A Case Study in Organismal Biology*". (in review **NeurIPS 2024**)

PEER-REVIEWED WORKSHOPS

- **Mridul Khurana**, Arka Daw, M. Maruf, …, Anuj Karpatne. *"Conditioning Diffusion Models Using the Knowledge of Phylogeny for Understanding Species Evolution".* In *first workshop of Imageomics at Association for the Advancement of Artificial Intelligence **(AAAI) 2024 (Oral)** (Poster)*
- Mohannad Elhamod, **Mridul Khurana**, Harish Babu Manogaran, …, Anuj Karpatne. *"Discovering Novel Biological Traits from Images using Phylogeny-guided Neural Networks".* In *Computer Vision and Pattern Recognition Workshop - CV4Animals (**CVPR**) **2023 (Oral)** (Poster)*