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:** Computer Vision (CV), Natural Language Processing (NLP), 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, no-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**
*Knowledge-Guided Machine Learning Lab, Virginia Tech* *Blacksburg, Virginia*

- **Tree** conditioned **Stable Diffusion,** to accelerate scientific discovery in evolutionary biology for animal species (**ECCV'24**)
- Training **Bio-Diffusion** a **foundational diffusion model** for predicting evolution of animalia due to environmental changes
- Benchmarked Vision Language Models (**VLMs**) including **GPT-4o**, LLaVa on **multimodal scientific data** (**NeurIPS'24**)
- Building **VLM4Bio** using Retrieval-augmented generation (**RAG**) to provide species-specific trait information from images.

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

- Designed and built a **Trading Platform (OMS)** handling over **$10 Million** in Indian stock markets. Mentoring **2 interns**.
- Achieved a **15x increase** in volume to support **1,500 securities** by implementing **Kafka** for real-time stock data streaming.
- 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's** target marketing leveraging methods like **Random Forest** and **XGBoost**.
- Big data processing **10,000+ variables & 2M rows**, reducing dimensionality by **97%** using **PCA,** variable binning & **clustering**.
- Developed models for maximum likelihood estimation, achieved an F1 score of **77%**, a **10% increase** from previous 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 and mitigating positional biases & adversarial vulnerabilities in VLMs on MCQA tasks.
- Proposed **Visual Latent Smoothing** enhancing robustness of LLaVa & BLIP VLMs against adversarial attacks by **9% & 4%** resp

**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 headlines.
- Fine-tuned **Llama-2** using **LoRA**, **T5**-large, XLM-Roberta to first accurately generate numeral values and then the headline.

## PROFESSIONAL ACTIVITIES

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

## ACHIEVEMENTS

- **Taekwondo:** State level **Gold medalist**, India. **Basketball: (Gold Medal** at AAHVAAN'17, **Silver medal** at SPORTECH'17)
- **Music:** Certified **Grade 2** drummer, 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)*
- M. Maruf, Arka Daw, Kazi S. Mehrab, Harish. B. Manogaran, Abhilash Neog, Medha Sawhney, **Mridul Khurana**, …, Anuj Karpatne. "*VLM4Bio: A Benchmark Dataset to Evaluate Pretrained Vision-Language Models for Trait Discovery from Biological Images*". Accepted to ***NeurIPS 2024*** *(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".* (*arXiv*) *(Paper)*

### PEER-REVIEWED WORKSHOPS

- **Mridul Khurana**, Arka Daw, M. Maruf, …, Anuj Karpatne. *"Conditioning Diffusion Models Using the Knowledge of Phylogeny for Understanding Species Evolution".* In *Imageomics workshop 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)*