MRIDUL KHURANA

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EDUCATION

Virginia Tech **Aug 2022 – May 2024**
Master of Science (M.S.), Computer Engineering | GPA 4.0 *Blacksburg, Virginia, US*
Courses: Natural Language Processing, Computer Vision, Advanced Machine Learning, Deep Reinforcement Learning

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

PUBLICATIONS

PEER-REVIEWED CONFERENCES

- 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 published + Oral)*

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)***
- 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 (**CVPR**) Workshop - CV4Animals **2023 (Oral)** (Poster published + Oral)*

PROFESSIONAL EXPERIENCE

Graduate Research Assistant (Advisor: Dr. Anuj Karpatne) **Sep 2022 – Present**
Dept. of Computer Science, Virginia Tech *Blacksburg, USA*

- Working on multimodal vision and Generative AI using **Stable Diffusion**, **GANs**, autoencoders (**VAEs**) and **transformers**.
- Introducing **Tree & Graph**-based conditioning for **Diffusion models**.
- Using **GPT-4V** and other Vision Language Models (**VLM**) like LLaVA-1.5, CogVLM, BLIP for multiple species trait detection.

Software Engineer (Quantitative Trading) **May 2020 - July 2022**
Theremin.ai *Mumbai, India*

- Designed and built a **Trading Platform** to handling more than **$10 Million** in the Indian stock markets.
- **10x** volume increase to **1000** securities using **Kafka** for streaming real-time price data from the stock exchange.
- Designed APIs to integrate the **ETL** pipeline & built Framework based on **event-driven architecture**, deployed on AWS.

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

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

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

- Worked on **unsupervised depth estimation** and scene parsing using stereo and **monocular images** using Tensorflow
- Depth for indoor scenes was predicted using Fully Convolutional Residual Networks (**FCRN**) on the NYU-Depth v2 dataset
- Outdoor monocular depth estimation using **CNNs** (ResNet-50) and fovea transformations - Cartesian Variable Resolution.
- The absolute and squared relative errors were reduced by 0.7% and 2% resp on the KITTI stereo test dataset

ACADEMIC PROJECTS

Numeral-Aware 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.

Decision Transformers in Near Real-World GitHub Feb 2023 - May 2023

- Implemented **Decision Transformers** (DT) and evaluated their efficacy on near real-world **Reinforcement Learning** tasks.
- Evaluated DT on various offline-RL datasets like D4RL and NeoRL on tasks which mimic near real-world tasks such as Androit (robotoic hand), Finance RL, CityLearn, Industrial Benchmark, Walker2d, Hopper and Half-Cheetah

Sequential Emotion Recognition in Conversations GitHub Sep 2022 - Dec 2022

- Implemented a **BERT**-based model (RoBERTa) along with conditional random fields (CRFs) to capture emotions.
- Benchmarked the model across various datasets - MELD, IEMOCAP, DailyDialog, and EmoryNLP achieving weighted F1 scores of 66.02%, 62.41%, 55.58%, and 39.11% respectively, in line with SOTA.

Remote Sensing - Image Change Detection GitHub Sep 2022 - Dec 2022

- Built a Siamese network using **UNet** and co-attention module and added a segmentation layer to capture pixel-level changes between two images. Also tested the model's robustness to different affine transformations.
- Achieved a cross-entropy loss of 0.826 and Dice coeff. of 0.894.

Visual Question Answering Sep 2018 - Dec 2018

- Image embeddings from VGG-19 were accompanied by each text vector obtained from **GloVe** representation and given as an input to a single layer **LSTM** followed by a CNN layer. Got 52% accuracy on the COCO-VQA dataset.

Human Activity Recognition Feb 2018 - May 2018

- Used VGG-19 to encode visual representation of each frame followed by RNN for the sequential processing of these observations. At each timestep, model outputs the start & end time of action and predicts the action probability.

PROFESSIONAL DUTIES

- Reviewer for **NeurIPS** 2023 Workshops:
  - Generative AI and Biology (GenBio)
  - Machine Learning and Physical Sciences (ML4PS)
- Reviewer for **AAAI** 2024 Workshops:
  - Responsible Language Models (ReLM)
  - Imageomics : Discovering Biological Knowledge from Images using AI

TECHNICAL SKILLS

- **Programming Languages:** Python, C++, Shell Scripting, SQL
- **Technologies:** PyTorch, TensorFlow, OpenCV, Kafka, AWS, EC2, RDS, EBS, PostgreSQL, MongoDB, OOPs, Git, WandB, Jira

ACHIEVEMENTS

- National-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**.