Kazi Sajeed **Mehrab**

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Research Interests

Knowledge-guided machine learning, Fine-grained computer vision, Multimodal learning, Vision-language models, Graph machine learning, Natural language processing

Education

Virginia Tech — *Blacksburg, Virginia*

Ph.D. in Computer Science. Advisor: Dr. Anuj Karpatne — Grade: 4.00/4.00 — *August 2022 - Present*

Bangladesh University of Engineering and Technology — *Dhaka, Bangladesh*

B.Sc. in Computer Science and Engineering — Grade: 3.69/4.00 — *February 2016 - February 2021*

Experience

Knowledge Guided Machine Learning Lab, Virginia Tech — *Blacksburg, Virginia*

Graduate Research Assistant, supervised by Dr. Anuj Karpatne — *Aug 2022 - Present*

- Created and benchmarked *Fish-Vista*, a **multi-purpose dataset** containing **60k images spanning 1900 aquatic species**. The dataset includes **fine-grained annotations** on **rigorously preprocessed** images for **fine-grained image classification**, **attribute identification** and **semantic segmentation** (Paper under review at NeurIPS 2024. Preprint available on Arxiv)
- Proposed a **graph neural network** approach for **fine-grained visual attribute identification**. The method incorporates **scientific knowledge** available in the form of phylogeny **graphs**, and **improves rare attribute identification by ≈10%** (short paper accepted at **AAAI 2024** Workshop)
- Benchmarked **vision language models (VLMs)** for identifying and localizing visual attributes through **prompting** and **in-context learning** (Paper under review at NeurIPS 2024. Preprint available on Arxiv)
- Collaborated on a project that developed a **hierarchical prototype network** to discover evolutionary attributes from images as prototypes (Paper under review at NeurIPS 2024. Preprint available on Arxiv)
- Analyzed **data imabalance techniques** and **transformer-based interpretability techniques** on fine-grained image datasets
- Exploring the use of **VLMs** and **multimodal learning** for **grounding language descriptions** to fine-grained image attributes

Computer Vision Lab, Virginia Tech — *Blacksburg, Virginia*

Graduate Student Researcher, supervised by Dr. Chris Thomas — *Sep 2022 - May 2023*

- Worked on identifying entities and relationships within textual claims that are entailed by **multiple multimodal documents**
- Implemented a **hiearchical multimodal transformer** for encoding text and images, and a **graph neural network** head for fine-grained entailment predictions. Proposed method achieves improved performance vs baselines like **MiniGPT-v2** and **LlaVa** (Under review at EMNLP 2024)

Virginia Tech — *Blacksburg, Virginia*

Graduate Teaching Assistant — *Aug 2022 - May 2023, Jan 2024 - Present*

- **CS 5805 Machine Learning** *(Spring 2024, Fall 2024)*: Prepared introductory lectures on **pytorch, RNN, transformers and foundation models**
- **CS 3114 Data Structures and Algorithms** *(Fall 2022)* and **CS 5764 Information Visualization** *(Spring 2023)*

United International University & Eastern University — *Dhaka, Bangladesh*

Instructor, Department of Computer Science and Engineering — *Feb 2021 - Aug 2022*

- Instructed key courses, including Artifical Intelligence, Discrete Mathematics and Object Oriented Programming
- Designed and judged AI Contests on Kaggle

Natural Language Processing Lab, Bangladesh University of Engineering and Technology — *Dhaka, Bangladesh*

Undergraduate Research Assistant — *Feb 2020 - Feb 2021*

- Worked on several projects at the intersection of **natural language processing (NLP)** and **programming language (PL)**
- Implemented a pipeline that **generates android apps from natural language (NL) descriptions**. The pipeline utilizes **a novel intermediate language** between NL and PL, along with **a transformer encoder-decoder architecture** (RoBERTa, Code-BERT). (Paper accepted at NLP for Programming Workshop at **ACL 2021**)
- Created **CoDesc: a large source code vs. natural language dataset**. Pretraining and finetuning on the dataset improved code retrieval by 22% and code summarization by 2%, **achieving new state-of-the-art** (Co-authored paper accepted at **ACL 2021**)

Skills

Programming	Python, Java, C/C++, SQL, R
Libraries and Frameworks	PyTorch, torchvision, NumPy, Pandas, HuggingFace, Matplotlib, sklearn, skimage, Keras
Tools and Software	Linux, Git, Conda, Jupyter Notebook, VS Code, LaTeX
Miscellaneous	Tableau, D3 by Observable, AWS, HTML, CSS, Django

Honors & Awards

2021 **Richard E. Merwin Scholarship,** IEEE Computer Society *(Awarded based on academic achievements, ECAs)*

2020 **ICT Innovation Fund,** Government of Bangladesh *(Research grant for undergraduate thesis)*

Academic Services and Volunteering

- Reviewer, IEEE Transactions on Neural Networks and Learning Systems (**TNNLS 2023**) and Imageomics Workshop at **AAAI 2024**
- Student Volunteer, Association of Computational Linguistics (**ACL 2021**)
- International Ambassador, IEEE Computer Society (2021)

Publications

Accepted in Peer Reviewed Conference/Workshop

- Phylo-GNN: Phylogeny-guided Graph Neural Network Approach for Fine-Grained Image Trait Identification. ***Kazi Sajeed Mehrab****, Arka Daw, M. Maruf, Wasila M Dahdul, Paula Mabee, Yasin Bakis, Henry Bart, Anuj Karpatne*, in the Imageomics Workshop at **AAAI 2024**
- CoDesc: A Large Code-Description Parallel Dataset. *Masum Hasan, Tanveer Muttaqueen, Abdullah Al Ishtiaq,* ***Kazi Sajeed Mehrab****, Md. Mahim Anjum Haque, Tahmid Hasan, Wasi Uddin Ahmad, Anindya Iqbal, Rifat Shahriyar*, in the Findings of the Association of Computational Linguistics, **ACL 2021**
- Text2App: A Framework for Creating Android Apps from Text Descriptions. *Masum Hasan*,* ***Kazi Sajeed Mehrab****, Wasi Ahmad, Rifat Shahriyar*, in the NLP for Programming Workshop at **ACL 2021**

Under review/Preprints on Arxiv

- Fish-Vista: A Multi-Purpose Dataset for Understanding & Identification of Traits from Images. ***Kazi Sajeed Mehrab****, M. Maruf, Arka Daw ... Anuj Karpatne*, under review at **NeurIPS Datasets and Benchmarks 2024**
- VLM4Bio: A Benchmark Dataset to Evaluate Pretrained Vision-Language Models for Trait Discovery from Biological Images. *M. Maruf, Arka Daw,* ***Kazi Sajeed Mehrab*** *... Anuj Karpatne*, under review at **NeurIPS Datsets and Benchmarks 2024**
- Let There Be Order: Rethinking Ordering in Autoregressive Graph Generation. Jie Bu, **Kazi Sajeed Mehrab**, Anuj Karpatne, **2023**
- Bert2code: Can pretrained language models be leveraged for code search?. *Abdullah Al Ishtiaq, Masum Hasan, Md Mahim Anjum Haque,* ***Kazi Sajeed Mehrab****, Tanveer Muttaqueen, Tahmid Hasan, Anindya Iqbal, Rifat Shahriyar*, **2021**