

Md Mushfiqur Rahman

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PROFILE

- 4th year PhD student with a Master's degree in Computer Science (Machine Learning concentration) and a strong background in Mathematics. Specializes in NLP and its applications in health. Experienced in building and managing industry-standard ML pipelines.
- Published 8 peer-reviewed papers, including 2 in Q1 Journals and 2 at ACL workshops.
- Collaborated with the US Naval Research Laboratory to build a GAN-based image denoiser that is actively being used in the Hinode spacecraft.

CORE EXPERTISE

ML Pipelines AI Chatbots Cross-lingual Transfer	Generative AI Cloud Image Denoising	Backend & Database User Study Game Development	NLP in Health Continual Learning Text Simplification
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TECHNICAL SKILLS AND CERTIFICATIONS

Languages:	Python, Java, C#, C++, Octave, TypeScript (Angular), JavaScript (React)
ML Tools:	PyTorch, TensorFlow, Scikit-learn, GANs, RAG, Reinforcement Learning (RL and RLHF), Code2Vec
NLP & Vision:	Hugging Face, LangChain, On-device LLM, Fine-tuning, GPT, OpenCV Visualization: Matplotlib, Seaborn
Cloud:	AWS (Lambda, EC2, S3), Google Cloud Platform (GCP), Firebase, Azure Platforms: Web, Windows, Linux
Backend:	REST, JUnit, FastAPI, Docker Database: SQL, MongoDB, MySQL, NoSQL, SQLite, PL/SQL
Tools:	Cloud console, GitHub Enterprise, CI/CD, Postman, AI Evaluation, HCI, Developer Productivity Tools
Certifications:	"Deep Learning Specialization" (5 courses by Deeplearning.AI), "Machine Learning" (by Stanford University through Coursera), "Front-end JS Framework: Angular" (by HKUST through Coursera)

EXPERIENCE

George Mason University <i>Graduate Research Assistant</i>	Fairfax, VA Aug. 2021 – Present
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- Research on NLP with a focus on improving information accessibility in the healthcare domain. Published **5 research papers**.
- Investigating how tone and dialect variations impact the performance and robustness of LLMs, with the goal of developing models that can effectively address these challenges
- Studying LLM performance in key tasks such as conversational agents, information retrieval, and question-answering systems

US Naval Research Laboratory <i>Machine Learning Software Developer (Intern)</i>	SW Washington, DC May 2024 – Aug. 2024
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- Designed a **Retrieval-Augmented Generation** pipeline, processing 100K+ technical documents to achieve real-time response rates.
- Engineered the embedding and retrieval framework using **MiniLMEmbedder** and **WindowRetriever**, reducing the memory footprint and computational load by 20%.
- Integrated Llama-3.1-70B as the generative model for a seamless interaction with the RAG system.

Machine Learning Software Developer (Intern)	May 2023 – Aug. 2023
- Built a GAN (Generative Adversarial Network)-based image denoiser for the EIS (Extreme-ultraviolet Image Spectrometer) machine hosted in the Hinode spacecraft. - The ML model is actively being used in the Hinode spacecraft and removes 93% noise from the EIS-generated images. It achieves 0.48 average test error which is significantly better than the previous best (0.72).	

Military Institute of Science and Technology <i>Faculty (Lecturer)</i>	Dhaka, Bangladesh Mar 2021 – Aug. 2021
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- Courses: "Introduction to Artificial Intelligence" and "Algorithms I"
- Co-supervised **3 undergraduate thesis projects** related to machine learning.

Samsung R&D Institute Bangladesh <i>ML Research Intern</i>	Dhaka, Bangladesh Nov. 2019 Jan. 2020
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- Developed a deep learning model that generates **3D objects from equirectangular (box-map) images**.
- The GAN-like model (adjusted for spherical images) achieved **0.21 RMS error** for the 3-D vertices

M-World <i>Game Development (Team Lead)</i>	Dhaka, Bangladesh Feb. 2019 Sept. 2019
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- Led a cross-functional team of 2 developers, a designer, and a QA tester to develop a **hyper-casual mobile game** (for Android).
- Managed the complete **software development lifecycle**, from concept and design to deployment and post-launch support.
- Utilized **Agile methodologies**, leading daily stand-ups and sprint planning meetings to ensure project milestones were met on schedule.

EDUCATION

George Mason University <i>PhD in Computer Science</i> (CGPA: 3.90)	Fairfax, VA Aug. 2021 – May 2026
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- Master's (MSc) in Computer Science (with Machine Learning concentration) (Degree received on May 2024)

Islamic University of Technology <i>Bachelor's (BSc) in Computer Science and Engineering</i> (CGPA: 3.79)	Gazipur, Bangladesh Jan. 2017 – Feb. 2021
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PROJECTS

Spectral Reconstruction of EIS Images with Conditional GAN

- Compared 4 image reconstruction/denoising algorithms (GAN, cGAN, WGAN, and Autoencoder) for EIS images.
- The cGAN **removes 93% noise** and improves image denoising capabilities of the EIS hosted in Hinode.

Health Information Simplification and Summarization [\[Code\]](#) [\[Paper\]](#)

- Created a parallel text dataset for **health-text simplification** in collaboration with nurse practitioners and patient-communication experts.
- Fine-tuned **GPT4** and **Llama2** (with **PPO** and **Reinforcement Learning**) on this dataset to get SOTA results in the domain.
- Trained Llama-2 with a 16-bit quantized Q-LoRA (minimizing computational resource requirement by **60% for GPU usage and 90% for time**). Reduced data requirements significantly by introducing a novel **Supervised Fine-tuning (SFT)**+RLHF model (with a novel reward).

Modes in Cross-lingual Transfer (tokenization vs non-tokenization) [\[Code\]](#) [\[Paper\]](#)

- Compared tokenization-based models (BERT, mBERT) with tokenization-free models (PIXEL, CANINE). Proposed a decision aid for text-representation based on **19 source and 133 target languages** for **3 common NLP tasks**.
- The analysis underscores the **importance of non-tokenization models** for specific tasks.

Mitigating Catastrophic Forgetting in Continual Learning

- Developed an algorithm to mitigate catastrophic forgetting enabling ML models to retain high performance on previously learned tasks.
- The algorithm uses **A-GEM** as its base but equates all higher-degree polynomials in the second derivative of the Taylor series as zero.

COVID Misinformation Detection

- Built a BERT-based model for identifying misinformation across diverse datasets. **Accuracy:** 97% on Constraint2021 and 93% on CoAID
- Extensively analyzed the effectiveness of **LLMs (GPT3) in zero-shot and few-shot settings** for this task.

Intent Detection and Slot Filling for Home Assistants [\[Code\]](#) [\[Paper\]](#)

- Built the **first ever intent detection and slot filling dataset** for Bangla and Sylheti.
- GPT-3.5 model achieves **0.94 (intent detection) and 0.51 (slot filling)** F1 score for Bangla.

Analyzing the Effect of Attentions in Video Captioning [\[Code\]](#) [\[Paper\]](#)

- Compared different attention mechanisms and for video captioning. Created a **video captioning model** with stacked attention that achieved **state-of-the-art performance on MSVD**.
- A **detailed ablation study of each component** of the model showed the contribution of the stacked attention in retaining semantic information.

Image In-painting and Reconstruction with GAN [\[Code\]](#)

- Proposed a **novel loss function** for image in-painting that utilizes the structural information and edge-map from images.
- Our method, **StructGAN**, enhances image restoration by using the structure loss, achieving 16% higher SSIM scores than SOTA.

AWARDS AND SCHOLARSHIPS

- **Distinguished Academic Achievement Award**, from George Mason University (2024)
- **Runner-up of Inter-University App Development Contest**, IUT ICT Fest (2019)
- **Champion of ICT4D** at 4th AUW ICT Fest (2018)
- **National Topper** in Mathematics in IAS (International Assessment for Schools) by UNSW (x2) (2008, 2014)
- **National Mathematical Olympiads Medals** (x4) (2009, 2012, 2013, 2014)

SELECTED PUBLICATIONS

- [1] [\[Q1 Journal\]](#) **Md Mushfiqur Rahman**[†], Mohammad Sabik Irbaz[†], Kai North, Michelle S. Williams, Marcos Zampieri, and Kevin Lybarger. 2024. Health text simplification: An annotated corpus for digestive cancer education and novel strategies for reinforcement learning. *Journal of Biomedical Informatics*, 158:104727
- [2] **Md Mushfiqur Rahman**, Fardin Ahsan Sakib, Fahim Faisal, and Antonios Anastasopoulos. 2023. To token or not to token: A comparative study of text representations for cross-lingual transfer. In *Workshop on Multi-lingual Representation Learning (MRL)*. Association for Computational Linguistics
- [3] Fardin Ahsan Sakib[†], A H M Rezaul Karim[†], Saadat Hasan Khan[†], and **Md Mushfiqur Rahman**[†]. 2023. Intent detection and slot filling for home assistants: Dataset and analysis for Bangla and Sylheti. In *Workshop on Bangla Language Processing (BLP)*. Association for Computational Linguistics
- [4] Bin Han[†], Haotian Zhu[†], Sitong Zhou[†], Sofia Ahmed, **Md Mushfiqur Rahman**, Fei Xia, and Kevin Lybarger. 2023. Huskyscribe at medqa-sum 2023: Summarizing clinical dialogues with transformers. Thessaloniki, Greece. CLEF
- [5] Refaat Mohammad Alamgir, Ali Abir Shuvro, Mueeze Al Mushabbir, Mohammed Ashfaq Raiyan, Nusrat Jahan Rani, **Md Mushfiqur Rahman**, Md. Hasanul Kabir, and Sabbir Ahmed. 2022. Performance analysis of yolo-based architectures for vehicle detection from traffic images in bangladesh. In *25th International Conference on Computer and Information Technology (ICCIT)*
- [6] [\[Q1 Journal\]](#) **Md Mushfiqur Rahman**[†], Thasin Abedin[†], Khondokar SS Prottoy, Ayana Moshruha, and Fazlul Hasan Siddiqui. 2021. Video captioning with stacked attention and semantic hard pull. *PeerJ Computer Science*
- [7] **Md Mushfiqur Rahman**, Sabah Binte Noor, and Fazlul Hasan Siddiqui. 2020. Automated large-scale class scheduling in minizinc. In *International Conference on Sustainable Technologies for Industry 4.0 (STI)*

INVITED TALKS

- May 2024, Naval Research Laboratory: “Leveraging Generative AI for Advanced Scientific Research: Breakthroughs and Barriers”
- Equally contributing authors marked with †.