SANJEDA AKTER

+1(917)245-7004
github.com/Sanjeeda-Jeba
sanjeeda.jeba@gmail.com
linkedin.com/in/sanjeeda-akter/
scholar.google.com/suaj_dAAAAAJ

EDUCATION

Iowa State University — **January 2025 – December 2026 (Expected)**
Master of Science in Artificial Intelligence — *Ames, Iowa*

BRAC University — **January 2019 – January 2023**
Bachelor of Science in Computer Science and Engineering — *CGPA: 3.81/4.00, Highest Distinction*

RESEARCH INTEREST

- **Agentic and Reflective AI Systems:** Autonomous planning and self-critique loops, supervisor–executor architectures, reflective reasoning, and memory-driven adaptation for complex tasks.
- **Trustworthy and Certifiable Machine Learning:** PAC-Bayesian generalization and risk certification, counterfactual sensitivity for faithful reasoning, black-box evaluation of large language models.
- **Efficient Deep and Reinforcement Learning:** Model pruning and optimization for state-space architectures (Mamba), cache-efficient posterior sampling, scalable learning under sparse rewards.
- **Retrieval-Augmented and Reasoning-Centric LLMs:** Hybrid RAG systems (LangGraph + Qdrant), interpretable knowledge retrieval, and reasoning-grounded generation for domain-specific AI.
- **Applied and Resource-Constrained AI:** Deployable agentic pipelines for agriculture, transportation, and sustainability; offline and edge-based inference for low-connectivity environments.

RESEARCH EXPERIENCE

AgAdvisor: Agentic AI for Agricultural Query Resolution | *Master's Research Project* — **June 2025 – Present**

- Architecting an **agentic AI pipeline** using **LangGraph** to parse natural language queries into structured API calls, dynamically plan and replan actions via a *supervisor–executor–checker* loop, and return verifiable, log-rich results.
- Developing a **query parsing module** combining rule-based (spaCy Matcher, PhraseMatcher) and semantic (KeyBERT, RapidFuzz) techniques for hybrid keyword extraction and API operation matching.
- Integrating **CDMS pesticide label APIs** via automated OpenAPI/Swagger enumeration and a resilient client layer with standardized retries, exponential backoff, and authentication handling; extending existing integrations (OpenWeatherMap, USDA SDA, APSIM).
- Implementing a **Reflection-style self-critique cycle** (*plan → act → evaluate → reflect → replan*) to enable autonomous self-repair and dynamic strategy revision during complex multi-step reasoning tasks.
- Expanding **RAG-based retrieval** using hybrid vector–keyword techniques (**LangGraph + Qdrant**) to provide grounded agricultural and regulatory knowledge synthesis.
- Building an **evaluation harness** for reproducibility, trajectory-based performance scoring, and cost analysis; presented architecture and live demo to faculty, outlining extensions to Agrian and EPA PPLS datasets.

Efficient Deep Learning & Reinforcement Learning Systems — **Jan 2025 – Present**

- Co-authored multiple works on optimization of LLMs and reinforcement learning, accepted at **ECAI 2025** and **EMNLP 2025**
- Proposed **HMAE**, a self-supervised few-shot framework for modeling quantum spin systems, improving data efficiency in physics-informed ML (Published in **ECAI 25**)
- Developed **pruning strategies** for Mamba State-Space Models to improve efficiency in edge and resource-limited environments (Published in **EMNLP 25**)
- Introduced cache-efficient posterior sampling with LLM-derived priors, enabling scalable RL across discrete and continuous domains (Published in **EMNLP 25**)
- Conducted large-scale empirical analysis of **reward hacking** in RL agents, and explored theoretical foundations of sparse-reward learning . (Under review in **ICML 26**)
- Advanced research on hallucinations detection using information theory and certifications (under review at **ICML 2026** and **ACL 2026**)
- Advanced research on counterfactual sensitivity, differentiable entropy regularization, and PAC-Bayesian certification for LLM outputs (Multiple papers under review at **ICML 2026** and **ACL 2026**)

LLMs for Computer Vision & Transportation Systems — **Jan 2025 – Present**

- First-author surveys exploring integration of **Large Language Models (LLMs)** into computer vision and transportation: crash detection, video understanding, and image segmentation (under review at **IEEE ITS Transactions**)
- Proposed hybrid approaches combining **LLM reasoning** with visual segmentation pipelines for ITS

- Designed HybridMamba framework for sub-second temporal localization in traffic incident detection (under review at **IEEE ITS Transactions**)

NLP: Banglish Sentiment Analysis | *Undergraduate Thesis* **September 2021 – December 2022**

- Engineered a comprehensive data acquisition pipeline to collect and process 10,000+ code-mixed Bengali-English text samples through advanced web scraping techniques
- Architected and implemented a hybrid CNN-GRU deep learning model that achieved 88% classification accuracy on sentiment analysis tasks for resource-constrained Banglish language
- Developed sophisticated NLP preprocessing methodologies to address the unique challenges of code-mixed language standardization and tokenization
- Presented research findings to a faculty committee, receiving a 95% evaluation for methodological rigor and innovative approach to computational linguistics

PUBLICATIONS

Published and Accepted:

- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "HMAE: Self-Supervised Few-Shot Learning for Quantum Spin Systems." *arXiv preprint arXiv:2505.03140* (Accepted to **ECAI 2025**)
- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "Efficient Unstructured Pruning of Mamba State–Space Models for Resource-Constrained Environments." *arXiv preprint arXiv:2505.08299*, 2025. (Accepted to **EMNLP 2025**)
- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "Cache-Efficient Posterior Sampling for Reinforcement Learning with LLM-Derived Priors Across Discrete and Continuous Domains." *arXiv preprint arXiv:2505.07274*, 2025. (Accepted to **EMNLP 2025**)

Under Review:

- **Sanjeda Akter**, Ibne Farabi Shihab, and Anuj Sharma. "Image Segmentation with Large Language Models: A Survey with Perspectives for Intelligent Transportation Systems." *arXiv preprint arXiv:2506.14096*, 2025.(Submitted to **IEEE ITS Transaction**)
- **Sanjeda Akter**, Ibne Farabi Shihab, and A. Sharma. "Large Language Models for Crash Detection in Video: A Survey of Methods, Datasets, and Challenges" *arXiv preprint arXiv:2507.02074*, 2025. (Submitted to **IEE ITS Transaction**)
- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "Detecting and Mitigating Reward Hacking in Reinforcement Learning Systems: A Comprehensive Empirical Study." *arXiv preprint arXiv:2507.05619* , 2025. (Submitted to **ACL 2026**)
- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "What Fundamental Structure in Reward Functions Enables Efficient Sparse-Reward Learning?." *arXiv preprint arXiv:2509.03790*, 2025.(Submitted to **ICML 2026**)
- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "Differentiable Entropy Regularization for Geometry and Neural Networks." *arXiv preprint arXiv:2509.03733*, 2025.(Submitted to **ICML 2026**)
- **Sanjeda Akter**, Ibne Farabi Shihab, and Anuj Sharma. "Counterfactual Sensitivity for Faithful Reasoning in Language Models." *arXiv preprint arXiv:2509.01544*, 2025.(Submitted to **ICML 2026**)
- **Sanjeda Akter**, Ibne Farabi Shihab, and Anuj Sharma. "Selective Risk Certification for LLM Outputs via Information-Lift Statistics: PAC-Bayes, Robustness, and Skeleton Design." *arXiv preprint arXiv:2509.12527*, 2025.(Submitted to **ICML 2026**)
- Ibne Farabi Shihab, **Sanjeda Akter**, and Anuj Sharma. "Enhancing Traffic Incident Response through Sub-Second Temporal Localization with HybridMamba." *arXiv preprint arXiv:2504.03235*, 2025.(Submitted to **IEE ITS Transaction**)
- **Sanjeda Akter**, Ibne Farabi Shihab, and Anuj Sharma. "Valid Stopping for LLM Generation via Empirical Dynamic Formal Lift" *arXiv preprint arXiv:2510.06478*, 2025.(Submitted to **ACL 2026**)
- Ibne Farabi Shihab, Weiheng Chai, Jiyang Wang, **Sanjeda Akter**, Senem Velipasalar Gursoy, and Anuj Sharma. "Calibrated and Resource-Aware Super-Resolution for Reliable Driver Behavior Analysis" *arXiv preprint arXiv:2509.23535*, 2025.(Submitted to **IEE ITS Transaction**)

ACADEMIC SERVICE

Reviewer **2026**

IEEE Transactions on Intelligent Transportation Systems

Registered Reviewer **2026**

International Conference on Machine Learning (ICML)

TEACHING EXPERIENCE

Radiant International School **January 2023 – December 2024**
Assistant Teacher, Mathematics and Science Department *Dhaka, Bangladesh*

- Designed and delivered comprehensive mathematics and science curriculum to 160 students across multiple sections, incorporating innovative teaching methodologies to enhance student engagement
- Developed and implemented data-driven assessment strategies, resulting in a 15% improvement in average class performance metrics
- Established an effective academic intervention program for struggling students, utilizing targeted instructional approaches based on individual learning needs
- Led cross-functional teams in organizing annual STEM competitions and educational events, demonstrating project management and leadership capabilities
- Implemented a structured communication framework with parents and administrators to ensure transparent reporting of academic progress and developmental milestones

BRAC University, Department of Mathematics and Natural Sciences **January 2022 – January 2023**
Teaching Assistant, Advanced Pre-Calculus, Calculus I, Calculus II (MAT092, MAT110, MAT120) *Dhaka, Bangladesh*

- Delivered comprehensive instructional support to 150+ undergraduate students per semester, focusing on advanced mathematical concepts and problem-solving methodologies
- Formulated and administered assessment materials, providing detailed analytical feedback to facilitate deeper conceptual understanding and application
- Conducted targeted intervention sessions for students requiring specialized support, resulting in significant performance improvements
- Collaborated with faculty members on examination administration, grade management, and curriculum enhancement initiatives

TECHNICAL EXPERTISE

Programming Languages: Python, Java, C, JavaScript, HTML/CSS, SQL
Machine Learning and Data Science: Pandas, NumPy, Scikit-learn, TensorFlow, Keras, PyTorch, OpenCV
Web Development: Express.js, React.js, Node.js, RESTful APIs
Database Technologies: MySQL, MongoDB, Database Design
Development Tools: Git, Linux, Bash/Zsh, LaTeX, Version Control
Certifications and Assessments: GRE 306 (Verbal: 151, Quantitative: 155), IELTS 7.5

SOFTWARE DEVELOPMENT PROJECTS

Full-Stack Music Streaming Platform | *MERN Stack* |

- Engineered scalable RESTful API architecture utilizing Express.js and Node.js, implementing comprehensive endpoints for user authentication, content management, and media streaming capabilities
- Designed and optimized MongoDB database schemas for efficient storage and retrieval of user profiles, media metadata, and personalized content relationships

Visitor Management System | *MySQL, PHP* |

- Architected a robust relational database system utilizing normalized schema design principles to effectively track visitor data, appointment scheduling, and security clearance protocols
- Developed an intuitive administrative interface with advanced querying capabilities, enabling real-time visitor monitoring and comprehensive reporting functionality

Text Classification System uisng ML Techniques | *Python, Scikit-learn* |

- Implemented an end-to-end machine learning pipeline for text classification achieving 96% accuracy through strategic feature engineering and model optimization
- Conducted comparative analysis of multiple classification algorithms, identifying optimal performance parameters through cross-validation and hyperparameter tuning

Medical Image (Brain Tumor) Analysis | *Tensorflow, Keras, OpenCV* |

- Developed a convolutional neural network architecture for accurate brain tumor classification from MRI images
- Implemented advanced image preprocessing techniques including normalization, augmentation, and segmentation to enhance model generalization and diagnostic accuracy

ACADEMIC DISTINCTIONS

ISSO Global Scholars Award for Retention **Fall 2025**
Iowa State University

Merit-Based Academic Scholarship **Fall 2019 – Fall 2022**
BRAC University *Awarded for Excellence in Academic Performance*

LEADERSHIP & PROFESSIONAL ACTIVITIES

BRAC University Computer Club **May 2019 – December 2022**
Marketing Department Specialist

- Spearheaded strategic digital marketing initiatives for high-profile technical events, resulting in increased participation and engagement metrics
- Collaborated with cross-functional teams to organize programming competitions and technical workshops, enhancing the academic community's technical capabilities

Bangladesh National Cadet Corps **2016 – 2018**
Cadet Officer

- Participated in advanced leadership development programs focusing on strategic planning, team management, and disciplinary protocols
- Led the organization and execution of community-focused athletic events, developing project management and interpersonal communication skills