Faria Binta Awal

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Lecturer, Department of CSE, BRAC University

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Research Interest

My primary research interest lies in leveraging computational methods to advance the fields of life science, spatial biology and biomedical data science. Specifically, my domains of interests include:

- **Machine Learning for analyzing Spatial Transcriptomics and Multi-Modal Integration**
- **Computer Vision for Biomedical Image Analysis**
- **Graph-Based Models for Biological Networks and Structured Data**
- **Retrieval and Representation Learning for Complex Data**
- **Deep Learning for Structural Biology and Biomedicine**

Education

Bangladesh University of Engineering and Technology *Feb 2020 – March 2025*

B.Sc. in Computer Science and Engineering

CGPA: 3.97 / 4.00 | **Major: 3.98 / 4.00** | **Rank: 10 / 120**

Publications and Workshops

- **Supervised Factorization to Associate Spatial Transcriptomics with Complementary Molecular Readouts**

  bioRxiv, 2025

  ***Faria Binta Awal**, Robia G. Pautler, Md. Abul Hassan Samee, M Saifur Rahman*

  - *DOI:* bioRxiv Preprint
  - *Code Repository:* SuNSTAMP (GitHub)
  - *Status:* Manuscript under review at Genome Research

- **The Festival of Genomics and Biodata Boston 2025**

  - Contributed to the design and development of a spatial transcriptomics tutorial demonstrating analysis pipelines for MERFISH and Visium 2.1.0 datasets using the **spatialdata** toolkit.
  - The tutorial aimed to establish reproducible workflows in spatial transcriptomics analysis for the bioinformatics research community.
  - The pipeline was utilized during live demonstrations at a *workshop* titled ***Workshop: Mastering Spatial Data Analysis: From Basics to Cutting-Edge Innovations***, part of the Festival of Genomics and Biodata Boston 2025.
  - *Code Repository:* spatialomics-toolkit

Research Experience

- **Undergraduate Thesis Student**, CSE, BUET *Feb 2024 – March 2025*

  Supervisor: Dr. Mohammad Saifur Rahman (Professor, CSE, BUET)
  Collaborator: Dr. Md Abul Hassan Samee (Associate Professor, Baylor College of Medicine)

  - ***SuNSTAMP*: Supervised Factorization to Associate Spatial Transcriptomics with Complementary Molecular Readouts**
    - We propose a supervised Non-negative Matrix Factorization (NMF) framework designed to integrate spatial transcriptomics with complementary molecular or imaging modalities.
    - The project addresses a key gap in spatial omics by enabling joint modeling of gene expression and pathology-derived molecular features.
    - Demonstrated strong predictive performance (AUC $\geq$ 0.90) in Alzheimer's disease and high correlation with myocardial injury markers, revealing biologically interpretable spatial gene modules.

- **Remote Research Engineer (Machine Learning)** *May 2025 - September 2025*

  Supervised by Dr. Md Abul Hassan Samee

  - ***spatialomics-toolkit*: Spatial Transcriptomics Data Analysis Pipeline**
    - Worked with Dr. Md. Abul Hassan Samee on literature review and development of a unified spatial transcriptomics pipeline using **spatialdata**.
    - Addressed the challenge of standardizing workflows across heterogeneous technologies.
    - The pipeline was later utilized in a **Festival of Genomics and Biodata Boston 2025 workshop** (see above).

Ongoing Research Projects

- **Cell–Cell Communication Network Using Spatial Ligand–Receptor Correlation**
  Aug 2025 – Ongoing

  - Working with *Dr. Md. Abul Hassan Samee* to model spatially resolved cell–cell communication networks in *axolotl* regeneration datasets.
  - Designed neighborhood-based matrices and heuristic strategies to efficiently infer multi-step ligand–receptor signaling cascades.
  - Identified spatially coherent signaling chains and candidate hubs which offers insights into regeneration-associated pathways.

- **Time-Varying Mixture Models for Enhanced Phylogenetic Inference** *June 2025 – Ongoing*

  - Working with *Dr. Md. Shamsuzzoha Bayzid* to propose time-varying mixture models to capture dynamic molecular evolution along phylogenetic branches.
  - This approach addresses the limitations in current tools' handling of temporal heterogeneity.
  - Temporal parameters regulate transitions between evolutionary regimes at speciation events and along branch lengths.

- **Graph-Based Contrastive Recommendation System** *December 2024 – Ongoing*
  Targeted Venue: *NeurIPS Workshop*

  - Working with *Dr. Mohammad Saifur Rahman* to develop an advanced recommendation framework by enhancing Neural Graph Collaborative Filtering (NGCF) with neighborhood-based contrastive learning and graph attention mechanisms.
  - Evaluated on Gowalla and Amazon Books datasets, achieving improved performance in Normalized Discounted Cumulative Gain (NDCG@k) and Recall@k metrics.

- **PatchRecall: Patch-Driven Retrieval for Automated Program Repair** *June 2025 – Ongoing*
  Targeted Venue: *ICSE (International Conference on Software Engineering)*

  - In collaboration with *Dr. Anindya Iqbal*, we developed *PatchRecall* to improve file retrieval in Automated Program Repair (APR) by balancing high recall with minimal noise from irrelevant files.
  - *PatchRecall* is a hybrid retrieval approach combining codebase-based matching with history-based candidate selection, followed by merging and reranking.
  - Experiments on SWE-Bench demonstrate higher recall without increasing retrieved file count, enabling more efficient and accurate APR.

National Awards

National Girls' Programming Contest (NGPC) 2022
Rank: Champion
Team Name: BUET_Pirates

- Highlighted on the University Website: *CSE BUET News*
- Featured in a leading national newspaper: *Prothom Alo*

Research Awards

Research and Innovation Centre for Science and Engineering (RISE) Research Grant 2024

- Awarded a full research grant of BDT 100,000 from the Research and Innovation Centre for Science and Engineering (RISE), BUET, in support of my undergraduate thesis project.

Academic Awards

- **Dean's List Award (2020 - 2025)**
  Awarded for consistent academic excellence throughout all four years of undergraduate studies.
- **University Merit Scholarship**
  Competitive scholarship awarded 5 times for exceptional academic achievement.
- **Talent Pool Scholarship (SSC & HSC, Dhaka Board)**
  Awarded by the Government of Bangladesh for outstanding performance in national SSC and HSC examinations. Ranked 8^{th} in Dhaka Board (HSC).
- **Golden Certificate 2019 for 100% Attendance**
  Awarded by Holy Cross College in recognition of maintaining perfect attendance throughout the entire academic tenure.

- **Dhaka Divisional Champion, Creativity Talent Hunt 2017**
  Awarded for outstanding performance in Mathematics and Computer Science. Received the prize from the Honourable Education Minister in the presence of the Prime Minister of Bangladesh.

Programming Contest and Hackathon Achievements

- **ICPC Asia Dhaka Regional Contest 2024**
  Rank - 23
  Team Name - BUET_Harmonica
- **Samsung Research and Development (SRBD) Coding Contest 2024**
  Rank - Selected for the Second Round
  Participated individually (no team)
- **ICPC Asia Dhaka Regional Contest 2023**
  Rank - Selected in Preliminary Contest
  Team Name - BUET _Code _Chronicles
- **BUET Inter University Programming Contest 2023**
  Rank - 15
  Team Name - BUET_Trumpet
- **Ada Lovelace National Girls' Programming Contest 2022**
  Rank - 14
  Team Name - BUET_error_404
- **NASA Space Apps Challenge 2021**
  Rank - 2nd Runner Up, Dhaka Division
  Team Name - Luminal Caliber | *Project Page*

Teaching Experience

- **Adjunct Lecturer** *Apr 2025 – Present*
  Department of Computer Science and Engineering
  Bangladesh University of Engineering and Technology (BUET)
- **Lecturer** *Aug 2025 – Present*
  Department of Computer Science and Engineering
  School of Data and Sciences, BRAC University

Technical Skills

- **Languages:** C, C++, x86 Assembly, Bison/Flex, Python, Java, JavaScript, Bash, MySQL
- **Frameworks:** PyTorch, NS3, xv6, Sveltekit, NodeJS, Git, Oracle DBMS, LaTeX
- **Libraries:** Scikit-learn, Numpy, Anndata, Pandas, Matplotlib, Seaborn