Curriculumn Vitae/Resume
Md. Rownok Zahan Ratul

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Research Interests

My research interests are **Computational Genomics, Single-cell Genomics, Developing Algorithms for Next Generation Sequencing (NGS)** and **Machine Learning for Bioinformatics**. I am motivated to leverage computational methods to unravel complex biological processes at the single cell resolution.

Education

Bangladesh University of Engineering and Technology (BUET) July 2019 ∼ July 2024
Bachelon of Science in Computer Science and Engineering *CGPA: 3.94/4.0*

 University Merit Scholarship, Dean's List (for academic excellence in all semesters)

Preprint

1. Ratul MRZ, Karim MR, Samee MAH, Rahman A. Reference-free Analysis of scRNA-seq Data Reveals Elevated rRNA and mtRNA Transcription during Neurogenesis in Axolotl. (2024). *Submitted to Nature Genetics.* [doi]

Publications

1. Hakim SA, Ratul MRZ, Bayzid MS. wQFM-DISCO: DISCO-enabled wQFM improves phylogenomic analyses despite the presence of paralogs. (2024). *Bioinformatics Advances.* [doi]

2. Shahgir HAZ*, Ratul MRZ*, Tahmid MT, Sayeed KS, Rahman A. RNA-DCGen: Dual Constrained RNA Sequence Generation with LLM-Attack.(2024). *Accepted to NeurIPS 2024 Workshop on Machine Learning for Structural Biology.* [doi]

Work Experience

Research Assistant, BUET x Samsung Research Bangladesh Dhaka, Bangladesh
Applied Machine Learningg Laboratory, Comp. Scie. & Engg., BUET *February '24 ∼ Present*

Teaching Experience

Guest Lecturer, CSE, BUET Dhaka, Bangladesh
Course: Information System Design, CSE325 *September '24 ∼ October '24*

Research Experience

 Undergraduate Research Assistant Dhaka, Bangladesh
Computational Genomics Laboratory, Comp. Sci. & Engg., BUET. *July '23 ∼ July '24*

- **Reference-free Method for single-cell RNA-seq**
- Supervisor: *Dr. Atif Rahman, Dr. Md. Abul Hasan Samee*
- Collaborated with Baylor College of Medicine, TX to develop a method, scKAR, for detecting non-reference differentially expressed transcriptomic events (intron-retention, lncRNA & micro-RNA regulation) in scRNA-seq. scKAR addresses the drawbacks of traditional pipeline where quantification of expression is based on aligning reads to reference transcriptome for downstream analysis. This can be highly preferred for sequence analysis of non-model organisms and atypical splicing for cancer or highly stressed conditions where reference transcriptome is scant.

- **Phylogenomic Analyses Despite the Presence of Paralogs**
- Supervisor: *Dr. Md Shamsuzzoha Bayzid*
- Co-developed a new method wQFM-DISCO for species tree construction in the presence of paralogs. Formulated DISCO-R, a method for decomposing gene trees for duplication removal that retrieves speciation-driven quartets (SQs) that are missing in traditional decomposition method.

 Research Assistant Dhaka, Bangladesh
NLP_Bio Laboratory, Comp. Sci. & Engg., BUET *June '24 ∼ October '24*

- **Generation of Multi-constrained RNA-seq with Adversarial Gradient Guided Search**
- Supervisor: *Dr. Atif Rahman*

- Collaborating with University of California, Riverside and developed, [RNA-DCGen](), a method for generating RNA sequences with specified structural and functional properties. Applying adversarial gradient guided search techniques capable of imposing dual-constraints on pre-trained RNA language models. Currently working to generalize this approach for protein and DNA sequences, facilitating the in-silico generation of physically realizable sequences.

🧑‍🔬 Research Assistant, Samsung Research Bangladesh   Dhaka, Bangladesh
Applied Machine Learning Laboratory, Comp. Sci. & Engg., BUET   *February '24 ~ Present*

- ⛓ **Machine Learning Based Automatic Test Case Generation and Execution**
- Supervisor: *Dr. Anindya Iqbal*
- Developing a multi-modal language model to automate android ent-to-end app testing. Developed a model-based exploration to generate a finite-state (FS) representation of application under test in black-box setting. Applied a dynamic analysis on generated FS in graph-theoretic settings to optimize state-explosion using vision based decision. The model is capable of generating test objectives and contextual mappings of corresponding expected results to verify the correctness of each test case.

PROJECTS

🖥 **Ray-Tracing** | *C++* [github]   December 2023
- **Features:** Real-time ray tracing for convex polygons in 3D world in C++. Implementation of shadows, reflection, lighting, texture-mapping, object modeling using Phong and Gauraud models.
- **Learning Outcome:** Computational geometry, OpenGL, fractals and Bézier curves.

🖥 **xv6 Memory Management, Scheduler, IPC** | *C++, QEMU* [github]   July 2023
- **Features:** Implementation of weighted round-robin scheduler for xv6, thread management, inter-process communication, paging and swapping, copy-on-write.
- **Learning Outcome:** System level implementation of programs and drivers, parallelization in OS and managing memory scarcity.

🖥 **C_compiler** | *Flex, Yacc, 8086-assembly* [github]   January 2023
- **Features:** Through lexical analyzer, syntax analyzer, intermediate code-generator, a given C code can be transformed to a 8086-assembly. Generated code finally goes through an optimization.
- **Learning Outcome:** The working principles of programming languages, semantics and automata theory.

🖥 **MIPS Architecture from scratch** | *H/W logic gates*   January 2023
- **Features:** Built a 16-bit MIPS computer incrementally with RAM, ROM, CPU, ALU with basic logic gates.
- **Learning Outcome:** Von Neumann architecture of computers, hardware logic design, instruction set design.

SKILLS

Programming Languages: C/C++, Python, R, Bash, Assembly, Java, JavaScript
Frameworks & Libraries: PyTorch, Seurat, SCANPY, React, NodeJS
Volunteer Activities:

- Coordinator, Disaster Management Club, Dhaka College, Dhaka. Participated in several flood management in Sunamganj, Bangladesh.
- Voluntary Coordinator, "Education for Everybody" – community campaign for underrepresented rural students.
- Represented my institution in the Fabrication Laboratory Student Chapter, Department of Electrical and Electronic Engineering, University of Dhaka.

REFERENCES

📇 **Dr. Atif Hasan Rahman**
Associate Professor, Comp. Sci. & Engg., Bangladesh University of Engg. & Tech.
PhD, University of California Berkeley
Palashi, Dhaka, Bangladesh
Email: atif@cse.buet.ac.bd

📇 **Dr. Md. Abul Hasan Samee**
Assistant Professor, Molecular Physiology & Biophys, Baylor College of Medicine
PhD, University of Illinois Urbana-Champaign
Houston, Texas, United States
Email: Md.AbulHassan.Samee@bcm.edu