HUMAYRA TASNIM

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RESEARCH INTERESTS

My research aims to develop advanced computational techniques for analyzing complex biological systems and biomedical imaging, to boost understanding, facilitate discovery, and improve prognosis capabilities. To date, my research focuses on modeling and simulation of intricate biological phenomena, developing information theory frameworks for spatial-temporal relationships in complex systems, and employing visual computation and advanced image analysis to extract meaningful insights from biological datasets. A key future direction involves integrating explainable AI and machine learning to enhance data-driven insights and predictions and support pertinent biological system modeling. My research lies at the nexus of biological modeling and biomedical image analysis using artificial intelligence, machine learning, and information theory-based tools

EDUCATION

Doctor of Philosophy in Computer Science   *July 2024*
University of New Mexico, Albuquerque, NM
  - Dissertation: Insight Into Complexity: Novel Information Theoretic Analysis of Spatiotemporal Interactions
  - Advisor: Melanie E. Moses

Master of Science in Computer Science   *December 2021*
University of New Mexico, Albuquerque, NM

Master of Science in Computer Science & Engineering   *2014 - 2015*
University of Dhaka, Dhaka, Bangladesh
  - Dissertation: An Efficient Approach to Minimize a Boolean Function and Its Application to Reversible Logic Circuit Design. Advisor: Lafifa Jamal

Bachelor of Science in Computer Science & Engineering   *2009 - 2013*
University of Dhaka, Dhaka, Bangladesh
  - Dissertation: RNA Pseduknot Prediction Inlcuding Intramolecular Kissing Hairpin Using Dotknot and Its Visualization. Advisor: Saifuddin Md Tareeq

SELECTED PUBLICATIONS

- Tasnim, Humayra. "Insight Into Complexity: Novel Information Theoretic Analysis of Spatiotemporal Interactions." (2024). https://digitalrepository.unm.edu/cs_etds/127
- **Tasnim, H.**, Dutta, S., Moses, M., 2023. Dynamic spatio-temporal summarization using information-based fusion. arXiv:2310.01617. submitted to Image and Vision Computing, Elsevier (under review)
- **H. Tasnim**, S. Dutta, T. L. Turton, D. Rogers, and M. E. Moses, (2022) "Information-theoretic Exploration of Multivariate Time-Varying Image Databases", *Computing in Science & Engineering*
- Soumya Dutta, **Humayra Tasnim**, Terece L. Turton, and James Ahrens, "In Situ Adaptive Spatio-Temporal Data Summarization", IEEE International Conference on Big Data (IEEEBigdata) 2021, pp. 315-321.
- Moses, M.E., Hofmeyr, S., Cannon, J.L., Andrews, A., Gridley, R., Hinga, M., Leyba, K., Pribisova, A., Surdidijaja, V., **Tasnim, H**. and Forrest, S.,"Spatially distributed infection increases viral load in a computational model of SARS-CoV-2 lung infection", PLoS Computational Biology.2021;17(12):e1009735.
- Judy L Cannon, Melanie E Moses, Janie R Byrum, Paulus Mrass, G Matthew Fricke, **Humayra Tasnim**. "Modeling T Cell Motion in Tissues During Immune Responses." *Biophysical Journal 116 (3), 322a, Elsevier, 2019*
- **Humayra Tasnim**, G. Matthew Fricke, Janie R. Byrum, Justyna O. Tafoya, Judy L. Cannon, Melanie E. Moses. "Quantitative Measurement of Naive T cell Association with Dendritic Cells, FRC, and Blood Vessels in Lymph Nodes." *Frontiers in Immunology, section Microbial Immunology, 2018*, Front.Immunol.9:1571.doi: 10.3389/fimmu.2018.01571
- Sadia Nowrin, Lafifa Jamal, **Humayra Tasnim**, "An Efficient Approach To Design A Reversible Signed Multiplier," in *TENCON 2014 - 2014 IEEE Region 10 Conference*, vol., no., pp.1-6, 22-25 Oct. 2014

Google Scholar: https://scholar.google.com/citations?hl=en&user=Q-vo1KQAAAAJ

EMPLOYMENT HISTORY

Instructional Post Doctoral Fellow *August 2024 - Present*
Department of Computer Science, University of New Mexico *Albuquerque, New Mexico*
- Instructor for courses: Introduction to Programming using Python, Data Structure and Algorithms

Post Doctoral Research Fellow *July 2024 - Present*
Office of the Vice President for Research (OVPR), University of New Mexico *Albuquerque, New Mexico*
- Project: Semi-automate or automate processes in the OVPR units to improve customer service using AI and Large Language Models.

Research Assistant, *Moses Biological Computational Lab* *June 2017 - May 2024*
Department of Computer Science, Univerity of New Mexico *Albuquerque, New Mexico*
- Use computer modeling, statistical tools, and simulations to analyze and comprehend complex biological systems scenarios such as spatial association, cell motility, signaling, search behaviors, and localization.
- Develop information theory-based frameworks that enable the analysis and identification of spatial and temporal relationships within large-scale image datasets.

Summer Research Intern *June 2023 - August 2023*
Lawrence Berkeley National Laboratory *Berkeley, California*
- Intern at Computer Languages and Systems Software Group.
- Project: Analyzing T-Cell Behavior for Immune Response in SARS-CoV-2 Patients using CT Scans and SIMCoV Model

Summer Research Intern *June 2022 - August 2022*
Lawrence Berkeley National Laboratory *Berkeley, California*
- Internship funded by Sustainable Research Pathways for High-Performance Computing program.
- Project: Analyzing Spatial Features of SARS-CoV-2 Infection Spread in Human Lung using CT Scans Compared to SIMCoV Model.

Summer Research Fellow *June 2020 - August 2020*
Los Alamos National Laboratory *Los Alamos, New Mexico*
- Research fellowship at Data Science at Scale Summer School Program.
- Developed an information-theoretic analysis framework that works on multivariate time-varying Cinema databases (image database developed at LANL) and performs automatic identification of salient regions.
- The technique serves as an interactive customized tool for the existing Cinema viewer presenting pre-analyzed results for further research.

Teaching Assistant *August 2016 - May 2017*
Department of Computer Science, University of New Mexico *Albuquerque, New Mexico*
- Courses: Data Structure and Algorithm I and Data Structure and Algorithm II

Lecturer in Computer Science & Engineering *2014 - 2016*
Eastern University *Dhaka, Bangladesh*
- Courses: Structured and Object-Oriented Programming, Theory of Computation, Software Engineering

SELECTED RESEARCH PROJECTS

- **Quantitative Measurement of Spatial Association in Biological Systems**
  - Developed and applied **Normalized Mutual Information (NMI)** to quantitatively measure the spatial association of naive T cells with other cell types in lymph nodes in mice.
  - This analysis is important for T cell activation and motility to understand the rapid response of the immune system to novel infections.
- **Information-Theoretic Feature Analysis in Multivariate Time-Varying Image Databases**
  - Developed an information-theoretic framework for automatic salient feature exploration in image databases.
  - Developed a feature-based temporal data summarizing technique for large-scale time-varying data using information-based fusion technique.
- **Spatial Features Analysis of SARS-CoV-2 in Lung CT scans**
  - Propose a computational model to identify and track the progression of SARS-CoV-2 infection from Computed Tomography (CT) scans.

– This model will explain the growth rates of lung lesions observed in sequential CT scans using SimCoV (computer-simulated agent-based model) developed in the Moses lab to study SARS-CoV-2 infection by analyzing the spatial distribution of infected cells and immune response in patients.

APPLICATION BASED PROJECTS

- **Technical Lead - Swarmathon : The Next Generation** *2020 - 2022*
  - Taught a course (Spring 2022) and organized a workshop (Spring 2021) sponsored by Google exploreCSR outreach program to encourage women undergrad students to pursue research careers, focusing on AI and machine learning. Link: `https://swarmathon-tng.cs.unm.edu/`
  - The Workshop provided basic ideas to use machine learning framework, TensorFlow, to train neural network models. As an application, object detection features were integrated into the swarm robots for autonomous detection and collection of objects.
- **Graduate Student Advisor: UNM Chili House - NASA MINDS Challenge** *Spring 2021*
  - Part of the winning team *UNM Chili House* at NASA MINDS Challenge that proposed the use of robots to autonomously water and grow plants (New Mexico Chiles) on Mars and Moon to provide fresh food for astronauts. Link: `https://news.unm.edu/news/could-plants-control-robots-on-mars`
  - I worked on the approach to implementing the autonomous path-planning procedure of the robots and mentored undergraduate students.
- **Finalist: Team Swarmathon - NASA Space Robotics Challenge Phase 2** *Spring 2021*
  - Competition to develop software to increase the autonomy of mobile robots during space travel.
  - In the qualification round, as a part of the team, my work focused on resource detection and localization of the robots on the simulated environment.

SELECTED POSTERS AND TALKS

- ECP Annual Meeting, 2023, Poster: "Spatial Spread of SARS-CoV-2 in Lung CT Scans."
- 16th UNM CS Conference, Talk:"Information-theoretic Exploration of Multivariate Time-Varying Image Databases."
- CRA-W Grad Cohort 2019, Poster: "Quantitative Measurement of Spatial Association in Biological Systems."
- UNM STEM Research Symposium 2019, Talk: "Quantitative Measurement of Naive T cell Association with Dendritic Cells, FRC, and Blood Vessels in Lymph Nodes."
- UNM ESS–organized CS showcase event 2019, Poster: "Swarmathon: The Next Generation Workshop."

LEADERSHIP, AWARDS AND HONORS

Awardee, to attend Rising Stars in Computational and Data Sciences Event, UT Austin	*2024*
Reviewer & Program Committee, Visualization in Environmental Sciences Workshop, EuroVis	*2024*
Recipient, UNM School of Engineering Outstanding Graduate Student Award from CS Department	*2023*
Recipient, Student Scholarship recipient to attend 2022 Grace Hopper Celebration	*2022*
Recipient and Student Lead , Google exploreCSR Award (2 consecutive Years)	*20-21, 21-22*
Graduate Student Advisor, UNM Chili House Team, NASA MINDS Challenge	*2021*
Participant, Team Swarmathon, NASA Space Robotics Challenge Phase Two	*2021*
Recipient, NSF scholarship recipient to attend 2020 ACM Richard Tapia Conference	*2020*
Co-Organizer, Student -Faculty Panel, 16th and 17th UNM CS Student Conference	*2021-2022*
Recipient, CRA-W Grad Cohort Workshop Participation Grant	*2019*
Recipient, UNM GPSA Professional Development Grant (Spring)	*2019*
Mentor, Summer intern project for a high school student.	*2019*
President, Computer Science Graduate Student Association at UNM	*2018-19*
Lead Organizer, 15th UNM CS Student Conference and effectively secured exemplary external funding	*2019*
Representative, Woman in Computing chapter at UNM in 2018 Grace Hopper Celebration	*2018*
Recipient, Student Conference Award Program to attend 2018 Grace Hopper Celebration	*2018*
Organizer, 14th UNM Computer Science Student Conference	*2018*
General Secretary, Computer Science Graduate Student Association at UNM	*2017-18*
Treasurer, Woman in Computing (WinC) Chapter at UNM	*2017-18*
Reviewer, IEEE Symposium on Artificial Life (ALIFE)	*2017*
Volunteer, 13th UNM Computer Science Student Conference	*2017*
Ministry of ICT Fellowship from Bangladesh Government for MS thesis	*2014-15*
7th place in National Collegiate Programming Contest (Women), Bangladesh	*2011*