

Sifat Afroj Moon

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SUMMARY

I am an applied research scientist and an ex-software engineer with a decade of experience in research and development. My background ranges from machine learning, network science, scalable data mining, and predictive modeling. I have pioneered several novel computational tools to model and analyze graph-based spreading processes. In my Ph.D. and postdoc, I became an expert in developing end-to-end solutions leveraging real-world data.

EDUCATION

Ph.D. in Computer Engineering

Kansas State University, Manhattan, KS, US 2016 – 2021
Dissertation: Modeling and analysis of spreading processes over large networks from limited data.

Courses: Scalability for data science, multivariate statistical methods, network theory, machine learning and pattern recognition, analysis of algorithms, agent-based game theory, applied probability theory, and random process.

CGPA: 3.82 / 4.00

M.Sc. in Electrical and Computer Engineering

Kansas State University, Manhattan, KS, USA 2016 – 2018
CGPA: 3.89 / 4.00

B.Sc. in Electrical and Electronic Engineering

Bangladesh University of Engineering and Technology (BUET), BD 2008 – 2013
CGPA: 3.70 / 4.00

EXPERIENCE

Computational Sciences and Engineering Division, Oak Ridge National Laboratory, Tennessee, USA

Research Scientist for HPC and AI Feb 2024 – Current

- Develop methodologies for generative agent-based models.
 - Assist computational models using graph-related AI and large language models (LLMs).
- Research on the uncertainty quantification efforts of computational models.
 - A Parallel Sequential Monte Carlo method for utilizing a scalable system.
- Design trustworthy agent-based methods using graph neural network explainability.
 - Mentored a SULI student intern for this initiative during Fall 2024.

Network Systems Science and Advanced Computing division, Biocomplexity Institute, University of Virginia, Charlottesville, VA, USA

Postdoctoral Researcher July 2021– Jan 2024

- Led a project with an interdisciplinary team of three members to deliver bi-weekly updates on a detailed knowledge graph project to find the economic impact of under-vaccinated spatiotemporal clusters.
 - 3TB high-dimensional APCD (All-Payer Claims database), data mining, foundation model, graph neural network.

- Developed an abductive agent-based surveillance tool to understand the political opinion on a social contact network with millions of nodes in a distributed environment.
 - HPC (High-Performance Computing) system, pattern recognition, support vector machines, XGboost.
- Built a graph neural network-based machine learning surrogate model for the agent-based simulation.
- Guided two junior scientists and more than four grad students.

Network Science and Engineering group, Kansas State University, Manhattan, KS, USA

Graduate Research Assistant

Aug 2016 – May 2021

- Designed a computationally efficient stochastic Monte Carlo simulation tool to understand the time-series local dynamics of the Markov spreading processes over large networks.
- Modified and implemented approximate Bayesian computation based on sequential Monte Carlo (ABC SMC) sampling method for a stochastic individual-level multi-layer network system.
- Directed a project to estimate a movement network from NASS data using a maximum entropy reinforcement learning method to support data privacy.

Samsung R&D Institute, Samsung Electronics, Samsung, Dhaka, BD

Software Engineer

Aug 2013 – Aug 2016

- Optimized watercolor brush algorithm and pattern fill tools for the s-pen drawing bitmap engine of Galaxy Note5.
- Developed and deployed Allshare play/Samsung Link software for Windows Phone 8.1 and an initial version of quick-connect (a convergence app of Samsung).
- Led a group of one software engineer and two interns for four months.

TEACHING

Electrical and Computer Engineering, KSU, USA

Aug 2016 - May, 2019

- Teaching assistant, ECE525 Electronics 1
- Visiting lecturer, ECE 841 Network Theory

Industrial and Manufacturing Systems Engineering, KSU, USA, 2021.

- Visiting lecturer, IMSE 802 Advanced Topics in Industrial Engineering

RELEVANT

CERTIFICATION

- AWS certified machine learning MLS-CO1, 2023.

Verify: cp.certmetrics.com/amazon/en/public/verify/credential/J0EE0RBCVNQ41XWG

- Machine learning specialization from DeepLearning.ai and Stanford University via Coursera, 2021.

Verify: www.coursera.org/account/accomplishments/specialization/certificate/WWA7XCTBML5

- Certificate of Advanced Level Programmer from Samsung Electronics, 2016.

- Certificate of Completion - CCNA Exploration 4.0 from Cisco Networking Academy, 2013.

PATENT

Mozumder MS, **Moon SA**, Nandy J, Mondol MA, Islam SU, inventors; Samsung Electronics Co Ltd, assignee. Collaborative drawing method and electronic device therefor. United States A1 patent US20210026531A1. 2021 Jan 28..

PUBLICATION

- **Moon SA**, Chen J, Espinoza B, Lewis B, Marathe M, Outten J, Venkatramanan S, Vullikanti A, Warren A. Agent-Based Simulation Framework for Multi-Variant Surveillance. In 2024 Winter Simulation Conference (WSC) 2024 Dec 15 (pp. 276-287). IEEE.
- Espinoza B, Adiga A, Venkatramanan S, Warren AS, Chen J, Lewis BL, Vullikanti A, Swarup S, **Moon SA**, Barrett CL, Athreya S. Coupled models of genomic surveillance and evolving pandemics with applications for timely public health interventions. Proceedings of the National Academy of Sciences. 2023 Nov 28;120(48):e2305227120.
- Wu N, **Moon SA**, Falk A, Marathe A, Vullikanti A. Estimating the maximum risk of measles outbreaks due to heterogeneous fall in immunization rates. medRxiv. 2023 Oct 25:2023-10.
- **Moon SA**, Marathe A, Vullikanti A. Are all underimmunized measles clusters equally critical?. Royal Society Open Science. 2023 Aug 16;10(8):230873.
- **Moon SA**, Datta R, Ferdousi T, Baek H, Adiga A, Marathe A, Vullikanti A. A Graph Based Deep Learning Framework for Predicting Spatio-Temporal Vaccine Hesitancy. medRxiv. 2023:2023-10.
- **Moon SA**, Scoglio CM. Contact tracing evaluation for COVID-19 transmission in the different movement levels of a rural college town in the USA. Scientific reports. 2021 Mar 1;11(1):4891.
- **Moon SA**. Modeling and analysis of epidemic processes over large networks from limited data. Kansas State University; 2021.
- **Moon SA**, Sahneh FD, Scoglio C. Group-based general epidemic modeling for spreading processes on networks: GroupGEM. IEEE Transactions on Network Science and Engineering. 2020 Nov 23;8(1):434-46.
- Ferdousi T, **Moon SA**, Self A, Scoglio C. Generation of swine movement network and analysis of efficient mitigation strategies for African swine fever virus. PloS one. 2019 Dec 5;14(12):e0225785.
- **Moon SA**, Ferdousi T, Self A, Scoglio CM. Estimation of swine movement network at farm level in the US from the Census of Agriculture data. Scientific reports. 2019 Apr 17;9(1):6237.
- **Moon SA**, Cohnstaedt LW, McVey DS, Scoglio CM. A spatio-temporal individual-based network framework for West Nile virus in the USA: Spreading pattern of West Nile virus. PLoS computational biology. 2019 Mar 13;15(3):e1006875.
- Zhang X, Sellens KA, **Moon SA**, Culbertson CT, Osta MA, Scoglio C, Michel K. Protease networks control and integrate mosquito immune reactions. In Entomology 2018 2018 Nov 14. ESA.

SELECTED TALK

Agent-Based Simulation Framework for Multi-Variant Surveillance, Winter Simulation Conference, 2024.

A combination of graph neural network and recurrent neural network for spatio-temporal forecasting, Julia for ORNL Science Workshop, 2024.

A graph-based deep learning framework for understanding spatio-temporal hesitancy, UVA Postdoc Symposium, 2023.

Impact of spatial clustering of under-immunization on the risk of measles outbreaks, BI-Research Meeting NSSAC Postdocs, 2022.

Emerging variant detection as a function of dispersal, timing, and immune escape; GPCE Expeditions 2-year review, 2022

Risk analysis in a social contact network by developing a high-performance agent-based computational framework, MIDAS annual meeting, Bethesda, Maryland, 2022.

Error and attack tolerance of complex networks, Expedition Project Meeting, Charlottesville, Virginia, 2022.

Network estimation and validation from population distribution and google data, Industrial and Manufacturing Systems Engineering, Kansas State University, Manhattan, Kansas, 2022.

Estimation of a movement network to preserve the data privacy, iREDEFINE ECEDHA conference, Arizona, 2019.

SERVICE

Journal Reviewer:

- IEEE Transactions on Network Science and Engineering
- IEEE Networking Letters
- PLOS Computational Biology
- PLOS One
- Journal of Theoretical Biology
- Nature Scientific Reports
- Frontiers in Veterinary Science
- Journal of the Royal Society Interface

Conference Reviewer:

- Association for the Advancement of Artificial Intelligence (AAAI), 2023
- Annual Modeling and Simulation Conference (ANNSIM), 2023
- University of Virginia Engineering Research Symposium (UVERS) judge, 2023
- International Conference on Complex Networks & Their Applications, 2023
- MIDAS Network Annual Meeting, 2022
- International Conference on Complex Networks & Their Applications, 2022

RECOGNITION

National Science Foundation travel grant under Expeditions grant, 2022.

KSU Electrical and Computer Engineering Fellowship, 2016 - 2019.

National Science Foundation: iREDEFINE ECE professional development award from ECEDHA annual conference, Arizona, 2019.

Certificate for Advanced Level in software capability test from Samsung R&D Institute, 2016.

Perfect score in the quantitative section of the Graduate Record Examination, 2016.

Iconic team award from Samsung R&D Institute, 2016.

Certificate for Excellence in innovation from Samsung R&D Institute, 2015.

PROFESSIONAL ORGANIZATION

IEEE member

Society for Modeling & Simulation International

MEDIA COVERAGE

Researchers work across disciplines to end COVID-19 pandemic, Seek, KSU, Spring 2021. <https://www.k-state.edu/research/about/seek/spring-2021/researchers-work-across-disciplines-to-end-pandemic.html>