

Madhurima Nath

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Multi-cloud certified data scientist and engineer with 8+ years of experience in algorithm development and computational modeling, recognized for immense business, leadership and management skills.

EDUCATION

Ph.D., Physics, Virginia Tech, Blacksburg, VA Dec 2018

Dissertation: *Application of Network Reliability to Analyze Diffusive Processes on Graph Dynamical Systems*

This work explores the effects of the structural properties of an interacting system on the outcomes of a diffusive process on realistic socio-technical systems using an efficient and generalized probabilistic measure based on Monte-Carlo simulations and graph theory techniques.

US Patent (US20210286859A1): *System, method and computer readable medium for sensitivity of dynamical systems to interaction network topology*

M.S., Physics, Virginia Tech, Blacksburg, VA May 2017

M.Sc., Physics, Indian Institute of Technology Delhi, New Delhi, India May 2012

Thesis: *Study of Cold Atomic Condensates by Atomic Photon Interactions*

Award: *Best Master of Science Thesis 2011-2012*

B.Sc. (Hons.), Physics, University of Calcutta, Kolkata, India May 2010

Minors: *Mathematics and Chemistry*

SKILLS

Programming: Python, SQL, PySpark, R || **CI/CD**¹: Git/GitHub/Azure DevOps/BitBucket

Certifications: Azure Data Scientist Associate, Databricks Lakehouse Data Engineer Associate, GCP³ Associate Cloud Engineer, AWS² Cloud Practitioner, Domino Data Lab Data Science Practitioner, Tableau Desktop Specialist, Matillion Associate

Others: Data Modeling, Gap Analysis, Technical and Data Architecture Diagrams, Data Flows, Agile Delivery

Awards: Slalom Mogul Award recognizing outstanding client service and delivery excellence, Q1 2023, Q2 2022, Q4 2020.

INDUSTRY EXPERIENCE

Senior Data Scientist, Data & Analytics, Slalom Consulting, New York, NY Jan 2020 – Present

Technical Experience

- Designed and implemented a prototype interactive knowledge-based tool to assist sales representatives to service customer inquiries in an efficient and concise manner, using AWS² services and large language models, as the first digital innovation project for one of the largest equipment rental clients.
- Co-led the development and deployment of a text classification model using NLP⁴ techniques and XGBoost in Azure to categorize product data into multiple groups defined by a standardized template. This accelerated the data foundation launch roadmap by over a year and provided a comprehensive view of \$35B global procurement spend for a consumer packaged goods client.
- Led the development and deployment of sentiment analysis and topic modeling NLP⁴ pipelines in Azure Databricks to uncover safety-related themes from auto-refreshed free-form data. The resulting PowerBI dashboard enabled the executive safety committee of a large Midwest utility provider to identify risky practices and improve the policies to safeguard their employees.
- Co-led the design and development of fuzzy matching rules and data engineering pipelines to integrate syndicated retail data from multiple vendors - including Nielson, IRI and Skupos - into a centralized platform on Azure, replacing existing manual processes and improving efficiency for product comparison by ~28% for a consumer packaged goods client.
- Created a segmentation model using historical customer viewership of sports events to implement better reporting, personalized marketing strategies and data governance for a media and television client.

¹CI/CD: Continuous Integration & Continuous Development, ²AWS: Amazon Web Services, ³GCP: Google Cloud Platform, ⁴NLP: Natural Language Processing

Consulting Experience

- Built a reputation for proactively taking on new projects and shepherding them to success, i.e., showcasing potential machine learning solutions to senior-level executives and contributing to proposals for potential client.
- Coached and mentored summer interns, served as go-to resource on advanced analytics solutions and computational modeling.
- Co-led multiple solution accelerators initiatives on Azure Databricks, including data ingestion pipelines using medallion structure, data quality frameworks, NLP⁴ solution to implement semantic search, to jumpstart product delivery for clients.
- Performed gap analysis, gathered business requirements and analyzed customer engagement from historical data in Snowflake to define key performance metrics of a new product launch for a media and television client.

RESEARCH EXPERIENCE

Post-graduate Research Assistant, Virginia Tech, VA

Mar 2019 – Dec 2019

- Developed an algorithm using Monte-Carlo simulations and perturbative methods to efficiently estimate the solution of a NP-hard problem with sufficiently good precision for all practical purposes.
- Applied aforementioned algorithm to food networks data from United Nations Comtrade database to detect significant communities important to prevent global distribution of pestilence, this method outperforms the well-known heuristic solution by $\sim 12\%$ on average.

Graduate Research Assistant, Virginia Tech, VA

May 2014 – Dec 2018

- Developed an algorithm to efficiently approximate real-world scenarios for epidemic outbreaks as a function of interactions and infection rate. Policymakers can be equipped with better and more accurate estimates, instead of using existing methods which overestimate the number of infections by $\sim 50\%$.
- Identified vulnerabilities in international food trade networks and estimated effects of mitigating contagion conditions with 96% accuracy to guide informed decision-making.
- Developed an algorithm using concepts of Moore–Shannon network reliability to estimate the energy states of an interacting magnetic system, reducing the time complexity from $O(n^2)$ to $O(n)$.

Instructor of Record, Department of Physics, Virginia Tech, VA

Aug 2018 – Dec 2018

- Ranked as one of the most effective physics instructors by students who fosters an atmosphere of mutual respect.
- Designed and facilitated weekly lectures, one-on-one sessions and recitation sessions for a 3-credit introductory physics course curriculum for ~ 120 undergraduate engineering students.
- Supervised physics laboratory sessions and office hours for both engineering and non-engineering students, which improved the grades of $\sim 15\%$ of the students.

PUBLICATIONS

- Eubank, S., **Nath, M.**, Mishra, R., and Adiga, A. (2023). Communities in directed weighted food networks using Moore-Shannon network reliability. (submitted Applied Network Science).
- Mishra, R., Eubank, S., **Nath, M.**, Amundsen, M., and Adiga, A. (2022, November). Community Detection Using Moore-Shannon Network Reliability: Application to Food Networks, In International Conference on Complex Networks and Their Applications (pp. 271-282). Cham: Springer International Publishing.
- Eubank, S., **Nath, M.**, Ren, Y., and Adiga, A. (2022). Perturbative methods for mostly monotonic probabilistic satisfiability problems. arXiv preprint arXiv:2206.03550.
- **Nath, M.**, et. al. (2019). Using network reliability to understand international food trade dynamics. In Complex Networks and Their Applications VII: Volume 1 Proceedings The 7th International Conference on Complex Networks and Their Applications COMPLEX NETWORKS 2018 7 (pp. 524-535). Springer International Publishing.

- **Nath, M.**, Ren Y., and Eubank, S. (2019). An approach to structural analysis using Moore-Shannon network reliability. In Complex Networks and Their Applications VII: Volume 1 Proceedings The 7th International Conference on Complex Networks and Their Applications COMPLEX NETWORKS 2018 7 (pp. 537-549). Springer International Publishing.
- **Nath, M.**, Ren, Y., Khorramzadeh, Y., and Eubank, S. (2018). Determining whether a class of random graphs is consistent with an observed contact network. *Journal of theoretical biology*. 440, 121-132.
- **Nath, M.**, and Eubank, S. (2018). Model selection for sequential designs in discrete finite systems using Bernstein kernels. arXiv preprint arXiv:1807.06661.
- Ren, Y., Eubank, S., and **Nath, M.**. (2016). From network reliability to the Ising model: A parallel scheme for estimating the joint density of states. *Physical Review E*, 94(4), 042125.
- **M. Nath**, et. al. (2015). A two-parameter method to characterize the network reliability for diffusive processes. In Complex Networks VI: Proceedings of the 6th Workshop on Complex Networks CompleNet 2015 (pp. 139-148). Springer International Publishing.
- Agarwala, A., **Nath, M.**, Lugani, J., Thyagarajan, K., and Ghosh, G. (2012). Fock-space exploration by angle resolved transmission through a quantum diffraction grating of cold atoms in an optical lattice. *Physical Review A*, 85(6), 063606. (*equal contribution as first author*).

CONFERENCE PRESENTATIONS

- **Invited Talk:** Network reliability: a generic tool to explore diffusive processes on interacting systems, NASA PCE3 (Prebiotic Chemistry and Early Earth Environments) Virtual Workshop 2022 Nano- to Cosmic- Studies of Complex Systems, University of Wisconsin Madison, Madison, WI, Oct. 20, 2022.
- **Talk:** Perturbative methods for estimating relative contributions to network reliability, SIAM (Society for Industrial and Applied Mathematics) Workshop on Network Science, Virtual Workshop, Sep 13-15, 2022.
- **Talk:** Statistical mechanical applications of graph dynamical systems, Condensed Matter Seminar, Department of Physics, Virginia Tech, Blacksburg, VA, Oct. 30, 2017.
- **Talk:** Determining whether a particular contact network is consistent with a network model, 1st North American Social Networks Conference of the International Network for Social Network Analysis, Washington DC, Jul. 26-30, 2017.
- **Talk:** Network reliability: A novel measure to study the effects of network topology on the diffusive dynamics, Symposium for the Society of Young Network Scientists, NetSci 2017, Indianapolis, IN, Jun. 19-23, 2017.
- **Poster:** Network reliability: A measure to study diffusive dynamics on networks, Center for Soft Matter and Biological Physics Symposium 2017, Virginia Tech, Blacksburg, VA, May 17-18, 2017.
- **Talk:** Effects of network structure on propagation of infectious diseases, 33rd Annual Graduate Student Assembly Symposium and Exposition, Virginia Tech, Blacksburg, VA, Mar. 29, 2017.
- **Talk:** Renormalization group approaches for dynamics on irregular networks, APS (American Physical Society) March Meeting 2017, New Orleans, LA, Mar. 13-17, 2017.
- **Poster:** Diffusive dynamics on a network, SESAPS (Southeastern Section of the American Physical Society) Conference 2016, Charlottesville, VA, Nov. 9-12, 2016.
- **Poster:** Effects of network structure on epidemic modeling, Biocomplexity Institute Symposium 2016, Virginia Tech, Blacksburg, VA, Nov. 1, 2016.
- **Talk:** A two-parameter method to characterize the network reliability for diffusive processes, CompleNet 2015, New York City, NY, Mar. 25-27, 2015.
- **Poster:** Four-parameter characterization of network reliability and analysis of critical point phenomenology, APS (American Physical Society) March Meeting 2015, San Antonio, TX, Mar. 2-6, 2015.

OUTREACH

- Reviewer - Synergy of Scientific and Machine Learning Modeling, 2023 International Conference on Machine Learning.
- Reviewer - Machine Learning and the Physical Sciences, NeurIPS2022 - Conference on Neural Information Processing Systems.
- Reviewer - Journal - Physical Review E. 2022 – Present
- Industry Ambassador, Women in Network Science Society. Sep 2022 – Present
- Invited Speaker at Women in Machine Learning and Data Science, Bay area chapter. Aug 2023
- Speaker at Women Who Code Data Science and San Francisco Backend chapters. Apr – Jul 2021
- Invited Speaker and Panelist at Women Who Code Statistics in Data Science Workshop Series Feb – Mar 2021
- Organizer of Women in Network Science Networks 2021 Conference Jun – Jul 2021
- Invited student speaker of APS Conference for Undergraduate Women in Physics, 2017. Jan 2017