

# Madhurima Nath

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Multi-cloud certified machine learning scientist with 10+ years of experience in algorithm development and computational modeling, recognized for immense business, leadership and project management skills.

## SKILLS

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

**Certifications:** Azure Data Scientist Associate, Databricks Machine Learning Associate, Databricks Data Engineer Associate, AWS<sup>2</sup> Cloud Practitioner, GCP<sup>3</sup> Associate Cloud Engineer, Salesforce AI Associate, Domino Data Lab Data Science Practitioner

**Others:** Data Modeling, Gap Analysis, Technical, Conceptual & Data Architecture Diagrams, Data Flows, Agile Delivery

## INDUSTRY EXPERIENCE

### Senior Data Scientist, Data & Analytics, Slalom, Inc., New York, NY

Jan 2020 – Present

- Developed an interactive Q&A chatbot powered by Anthropic Claude model on AWS<sup>2</sup> Bedrock, delivering hypotheses and insights from biopharmaceutical and medtech datasets to users within a healthcare technology startup. Improved application interface, boosting customer satisfaction by enhancing usability and accessibility across diverse user groups.
- Engineered and deployed an interactive knowledge-based application chatbot utilizing the RAG<sup>4</sup> approach to assist sales representatives at a leading equipment rental firm, reducing customer inquiry response times by ~22% and streamlining document search processes, enhancing overall efficiency. Leveraged OpenAI LLM<sup>5</sup> model and LangChain in development, marking the client's inaugural digital innovation initiative.
- Spearheaded the design and development of an NLP<sup>6</sup> based architecture on AWS<sup>2</sup> SageMaker to evaluate document relevance in e-discovery, overseeing the ingestion of millions of documents and implementing batch updates with human-reviewed data. This initiative yielded notable efficiency gains, saving numerous hours of manual review time and thousands of dollars in expenses for a legal services client.
- Collaboratively led the implementation of a Delta Lakehouse solution on Azure Databricks and developed NLP<sup>6</sup> pipelines with MLOps best practices for future scalability. This accelerated the data foundation roadmap by over a year, delivering improved visibility, uniformity, and consistency, and resulting in significant efficiency gains and millions of dollars in savings for one of the world's largest consumer packaged goods companies.
- Directed the implementation of NLP<sup>6</sup> pipelines in Azure Databricks for sentiment analysis and topic modeling to extract safety-related themes. Empowered the executive safety committee of a large Midwest utility client to refine policies, ensuring employee safety and reducing incident frequency and severity.
- Designed and developed fuzzy matching rules and data engineering pipelines to consolidate syndicated retail data from various vendors (such as Nielsen, IRI, and Skupos) into a centralized platform using Azure Databricks. Replaced manual processes, resulting in a ~38% efficiency improvement in product comparison for a consumer packaged goods client.
- Played a pivotal role in formulating proposals for potential clients, leading to a ~\$1.2M revenue boost in the New York market. Proven track record of driving revenue growth through proactive proposal development, resulting in a substantial increase in pipeline revenue from 2023 to 2025.
- Managed and provided hands-on guidance and mentorship to summer interns, imparting expertise in advanced analytics, AI/ML<sup>6</sup> solutions, and serving as a trusted resource for technical insights and professional growth.

## RESEARCH EXPERIENCE

### Post-doctoral Research Assistant, Virginia Tech, VA

Feb 2019 – Dec 2019

- Formulated an innovative algorithm combining Monte Carlo simulations and perturbative methods to accurately solve NP-hard problems. Applied this method to analyze food network data from the UN Comtrade database, achieving a ~10% improvement over heuristic solutions in identifying crucial communities for preventing global pestilence distribution.

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

Aug 2018 – Dec 2018

- Recognized as a top-performing physics instructor for creating a respectful learning environment and delivering engaging lectures, recitations, and one-on-one sessions.
- Facilitated supervised laboratory sessions, held office hours, and offered tailored support, resulting in a ~15% increase in student grades by improving comprehension of course materials.

### Graduate Research Assistant, Virginia Tech, VA

May 2014 – Dec 2018

- Developed an algorithm employing Monte Carlo simulations to effectively simulate real-world epidemic outbreak scenarios, providing policymakers with improved estimates compared to existing methods which overestimate infections by ~50%.
- Identified vulnerabilities within global food trade networks and accurately forecasted the impact of mitigating contagion conditions with ~96% precision to understand and mitigate the spread of pests, guiding strategic decision-making processes.

<sup>1</sup>CI/CD: Continuous Integration & Continuous Development, <sup>2</sup>AWS: Amazon Web Services, <sup>3</sup>GCP: Google Cloud Platform, <sup>4</sup>RAG: Retrieval-Augmented Generation, <sup>5</sup>LLM: Large Language Model, <sup>6</sup>NLP: Natural Language Processing, <sup>7</sup>AI/ML: Artificial Intelligence/ Machine Learning

## EDUCATION

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- 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*

## PUBLICATIONS

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- 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

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- Invited Speaker:** 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.
- 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.
- 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.
- Renormalization group approaches for dynamics on irregular networks, APS (American Physical Society) March Meeting 2017, New Orleans, LA, Mar. 13-17, 2017.

## OUTREACH

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- 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