

Arun Sharma

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EDUCATION

UNIVERSITY OF MINNESOTA, TWIN CITIES

Doctor of Philosophy (Ph.D.) in Computer Science

Minneapolis, MN

Expected June 2025

Advisor: [Prof. Shashi Shekhar](#) | [Spatial Computing Research Group, UMN](#)

Thesis Committee: [Prof. Vipin Kumar](#), [Prof. Ravi Janardan](#), and [Prof. Ying Song](#)

STATE UNIVERSITY OF NEW YORK AT BUFFALO

Master in Science (M.S.) in Computer Science

Buffalo, NY

August 2016 - June 2018

Advisor: [Prof. Varun Chandola](#)

WORK EXPERIENCE

ESRI - ENVIRONMENTAL SYSTEMS RESEARCH INSTITUTE

Redlands, CA

Research Intern - Ph.D.

June 2023 – August 2023

- Designed and implemented a scalable Graph-based Traffic Representation and Association (GTRA) framework for maritime route optimization, leveraging PySpark and GeoAnalytics APIs, reducing query latency by 40%.
- Developed an anomaly detection pipeline integrating Transformer-based models, Evidential Deep Learning (EDL), and AWS SageMaker, improving real-time anomaly classification accuracy from 54.76% to 73.02%.
- Developed an automated model training pipeline and optimized inference for GIS-based AI models on a large-scale maritime dataset by leveraging AWS services (Lambda, ECS, SageMaker Pipelines, Multi-Model Endpoints (MME), Step Functions, SQS, CloudWatch) and implementing model quantization, reducing model retraining time by 35% and API latency by 30%.

UNIVERSITY OF MINNESOTA, TWIN CITIES

Minneapolis, MN

Graduate Research Assistant

January 2020 – Present

- Led a project analyzing data distortion using physics-aware methods, improving anomaly detection accuracy by ~25% and identifying complex mobility patterns (e.g., clandestine rendezvous) with a 30% reduction in false positives.
- Designed and implemented scalable detection algorithms, cutting processing time by 40% while boosting precision by 20%.
- Proposed state-of-the-art generative models for climate downscaling, achieving a 35% reduction in error for abnormal sea-level rise predictions, and enhanced physics-informed trajectory generation by augmenting realistic simulations across various scenarios, leading to a 25% improvement in trajectory fidelity.

STATE UNIVERSITY OF NEW YORK AT BUFFALO

Buffalo, NY

Graduate Project Assistant

June 2017 – August 2017

- Developed an end-to-end framework on Apache Spark and Hadoop to analyze climate change impacts using NetCDF data, integrating a Gaussian process-based algorithm for detecting extreme temperature events (e.g., excessive heat, winter storms).
- Proposed and scaled an efficient GP regression on Apache Spark, reducing complexity from $O(N^3)$ to $O(N^2)$ via matrix factorization, with geo visualizations, intuitive UX/UI, and reproducible Jupyter Notebooks.

TECHNICAL SKILLS

Languages: Python, Java, R, SQL, Scala, C/C++, Julia, Rust, Go, Shell (Bash), MATLAB, JavaScript (Node.js), TypeScript.

Machine Learning: MLflow, XGBoost, MLlib, LLMs (fine-tuning & inference), RAG, LangChain, VectorDB (FAISS, Chroma, Pinecone), Hugging Face Transformers, LoRA, PEFT, RLHF, OpenAI API, Triton Inference Server, ONNX.

Big Data & Distributed Systems: PySpark, Hadoop, Flink, Presto, Trino, Hive, Kafka, Delta Lake, Docker, Kubernetes.

ML Frameworks & Deployments: PyTorch, TensorFlow, JAX, ONNX, SageMaker, Lambda, ECS, Bedrock.

HONORS AND ACHIEVEMENTS

DOCTORAL DISSERTATION FELLOWSHIP

2022 - 2023

University of Minnesota, Twin Cities

REVIEWER

NeurIPS, ICML, ICLR, CVPR, ECCV, AAAI, IJCAI, SIGKDD, CIKM, ICDM, SDM, MLSys, SIGSPATIAL, TKDE, JMLR

SELECTED PUBLICATIONS

- [1] Towards Physics-informed Diffusion for Anomaly Detection in Trajectories: A Summary of Results
31st SIGKDD Conference on Knowledge Discovery and Data Mining - Research Track 2025 (Under Review).
Arun Sharma, Subhankar Ghosh, Mingzhou Yang, Majid Farhadloo, Jayant Gupta, Bharat Jayaprakash, and Shashi Shekhar
- [2] Geo-lucid Conditional Diffusion Models for High Physical Fidelity Trajectory Generation
31st SIGKDD Conference on Knowledge Discovery and Data Mining - Research Track 2025 (Under Review).
Mingzhou Yang, **Arun Sharma**, Majid Farhadloo, Bharat Jayaprakash, and Shashi Shekhar
- [3] Spatially-Delineated Domain-Adapted AI Classification: An Application for Oncology Data
SIAM International Conference on Data Mining, 2025 (Accepted).
M Farhadloo, **Arun Sharma**, A. Leontovich, S N. Markovic, and Shashi Shekhar
- [4] Towards Spatially-Lucid AI Classification in Non-Euclidean Space: An Application for MxIF Oncology Data
SIAM International Conference on Data Mining, 2024.
M Farhadloo, **Arun Sharma**, J. Gupta, A. Leontovich, S N. Markovic, and Shashi Shekhar
- [5] Spatial Computing Opportunities in Biomedical Decision Support: The Atlas-EHR Vision
ACM Transactions on Spatial Algorithms and Systems, 2024
M Farhadloo, **Arun Sharma**, A. Leontovich, S N. Markovic, and Shashi Shekhar
- [6] Towards Kriging-informed Conditional Diffusion for Regional Sea-Level Data Downscaling: A Summary of Results
32nd International Conference on Advances in Geographic Information Systems, 2024
Authors: S Ghosh*, **Arun Sharma***, J. Gupta, A. Subramanian and Shashi Shekhar
(*Both authors contributed equally to this paper)
- [7] Towards Pareto-optimality with Multi-level Bi-objective Routing: A Summary of Results."
17th ACM SIGSPATIAL International Workshop on Computational Transportation Science GenAI and Smart Mobility Session
Mingzhou Yang, Ruolei Zeng, **Arun Sharma**, Shunichi Sawamura, William F. Northrop, and Shashi Shekhar
- [8] Physics-based Abnormal Trajectory-Gap Detection
ACM Transactions in Intelligent Systems and Technology, 2024.
Arun Sharma, Subhankar Ghosh, and Shashi Shekhar
- [9] Analyzing Trajectory Gaps for Possible Rendezvous Regions
ACM Transactions in Intelligent Systems and Technology, 2022
Arun Sharma and Shashi Shekhar
- [10] Towards a Tighter Bound on Possible-Rendezvous Areas: Preliminary Results
30th International Conference on Advances in Geographic Information Systems, 2022
Arun Sharma, Jayant Gupta, Subhankar Ghosh, and Shashi Shekhar
- [11] Mining taxonomy-aware colocations: A Summary of Results
30th International Conference on Advances in Geographic Information Systems, 2022
Jayant Gupta, **Arun Sharma**, and Shashi Shekhar
- [12] Spatiotemporal Data Mining: A Survey
Handbook of Spatial Analysis for the Social Sciences, Edward Elgar, 2022
Arun Sharma, Zhe Jiang, and Shashi Shekhar
- [13] Analyzing Trajectory Gaps for Possible Rendezvous Regions: A Summary of Results
11th International Conference on Geographic Information Science (GIScience), 2021
Arun Sharma, Xun Tang, Jayant Gupta, Majid Farhadloo, and Shashi Shekhar
- [14] WebGlobe: A cloud-based framework for interacting with climate data
International Workshop on Analytics for Big Geospatial Data (SIGSPATIAL) 2018
Arun Sharma, SM Arshad Zaidi, Varun Chandola, Melissa R Dumas, Budhendra L Bhaduri

TEACHING EXPERIENCE

SPATIAL DATA SCIENCE RESEARCH

Spring 2024

- Guest lectures on scientific methodology, fostering research skills, and effectively communicating research ideas.
- Supervised diverse projects and mentored multiple graduate and undergraduate students from interdisciplinary fields.

SPATIAL DATA SCIENCE

Fall 2019

- Responsible for handling class lectures, queries, homework assignments, labs, exams, lecture slides, etc.
- Guest lecture topics: Spatial Indexing, Networks, and Data Mining.

ADVANCED DATABASE SYSTEMS

Spring 2019

- Responsible for handling class lectures, queries, homework assignments, labs, exams, lecture slides, etc.
- Guest lecture topics: Concurrency Control, Database Security, and Data Mining.

DATA STRUCTURES AND ALGORITHMS

Fall 2018

- Instructed weekly recitation sessions with over 40+ students and grading of 400+ students.

SERVICES AND LEADERSHIP

SUST 4096 SUSTAINABILITY INTERNSHIP, UNIVERSITY OF MINNESOTA, MN

Spring 2024

- Supervised an undergraduate student on a course project based on KGML for Sustainable and Precision Agriculture.
- Presented a lightning talk and a poster at the Annual AI-CLIMATE Review Meeting in UMN Saint Paul Campus, MN¹.

HONORS MENTORS CONNECTION, WAYZATA HIGH SCHOOL, MN

Fall 2023 - Spring 2024

- Advised a high school student to analyze a real-world case study of signal spoofing behavior in the maritime domain.
- The student helped analyze circular patterns, enabling us to create a taxonomy of spoofing behavior in open waters.

MINNESOTA DEPARTMENT OF MANAGEMENT AND BUDGET, MN

May 2020 - June 2022

- Reported county-level mobility traffic to epidemiologists, analysts, and policymakers for informed decision-making.²
- Advised multiple high school and undergraduate students who are considering a research career.

INVITED PRESENTATIONS AND POSTERS

Poster: Spatial Distribution-Shift Aware Knowledge-Guided Machine Learning

2025

AAAI Bridge on Knowledge-Guided ML: Bridging Scientific Knowledge and AI, 2025.

Authors: **Arun Sharma**, Majid Farhadloo, Mingzhou Yang, Subhankar Ghosh, Shashi Shekhar

Blue Sky Ideas: Towards Physics-Guided Foundation Models

2025

AAAI Bridge on Knowledge-guided ML Bridging Scientific Knowledge and AI, 2025

Authors: Majid Farhadloo*, **Arun Sharma***, Mingzhou Yang, Bharat Jayaprakash, William Northrop, and Shashi Shekhar

(*Both authors contributed equally to this paper)

From KGML-AG to KGML Precision-Ag: A Spatial Variability Approach

2024

AI-CLIMATE Annual Review Meeting, 2025

Presenters: Ruolei Zheng* and **Arun Sharma***

(*Both authors contributed equally)

Addressing Data Distortion: A Physics-based Approach

2023

MIDAS Future Leaders Summit: University of Michigan, Ann Arbor

Presenter: Arun Sharma

Rendezvous Pattern Detection From AIS Ship Trajectories

2020

Center of Geospatial Information Science: University of Maryland, College Park

Presenter: Arun Sharma

¹ <https://cse.umn.edu/aiclimat/news/2024-ai-climate-annual-review-meeting>

² Sharma, Arun, Majid Farhadloo, Yan Li, Jayant Gupta, Aditya Kulkarni, and Shashi Shekhar. "Understanding covid-19 effects on mobility: A community-engaged approach." *AGILE: GIScience Series* 3 (2022): 14.