# Majid Farhadloo


**Contact Information**

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**Research Interest**

Machine Learning, Data Mining, Graph Neural Networks, Computer Vision, Natural Language Processing, Spatial Data Mining, Bioinformatics, Computational Biology, Spatial-Enabled AI

**Education**

**University of Minnesota, Twin Cities** (UMN) — Aug. 2019 - Expected May 2025
*Ph.D. Candidate in Computer Science*
*Advised by Prof. Shashi Shekhar*

**University of Minnesota, Twin Cities** (UMN) — Aug. 2019 - May 2022
*MS in Computer Science*
*Advised by Prof. Shashi Shekhar*

**California State University, Fresno** (Cal State Fresno) — Aug. 2017 - May 2019
*BS in Computer Science*

**Appointments**

**Graduate Research Assistant** — Jan. 2021 - Present
*Department of Computer Science and Engineering, UMN*

**Graduate Teaching Assistant** — Aug. 2019 - May 2021
*Department of Computer Science and Engineering, UMN*

**Technical Skills**

- **Languages:** Python, Java, C++, R, SQL, Android.
- **Machine Learning:** PyTorch, OpenCV, Matlab Deep Learning Tools, Google Colab.
- **Big Data:** Apache Spark, Hadoop, Hive, HDFS, PySpark.
- **DevOps:** Git, Agile Methodologies, WordPress.

**Research & Work Experience**

**Graduate Research Assistant, UMN, Twin Cities** — Jan 2021 - Present

***Towards Spatially-Lucid AI Approach in Non-Euclidean Space***

- Faced with spatial variability limiting tumor classification. Developed spatial ensemble deep learning; boosted accuracy 15%. Validated on real-world oncology MxIF data.
- Developed a spatial domain adaptation sub-network to address insufficient learning samples and inherent heterogeneity across spatial domains in oncology.
- Mayo Clinic oncologists found spatial patterns identified by this work effective, by highlighting cellular interactions ranging from location-independent to location-specific.

***Towards Spatially-Explainable AI Classification for Biomedical Data***

- Developed a novel spatially-explainable DNN architecture for classifying cellular maps (e.g., MxIF), yielding substantial accuracy compared to SOTA methods.
- Developed a dynamic attention-based prioritization network to learn the most discriminative features in high-order spatial relationships effectively.
- Mayo Clinic oncologists found spatial patterns identified by proposed approach biologically interpretable and linked to tumor progression.

***Contrasting Spatial Co-location Pattern Mining***

- Developed novel contrasting spatial co-location pattern discovery framework to identify patterns differing significantly across domains.
- Introduced participation index distribution difference (PIDD) metric quantifying prevalence differences of patterns between domains.
- Proposed early-stop binary search algorithm exploiting anti-monotonicity of PIDD; yielded substantial computational time savings.

***Understanding COVID-19 Effects on Mobility Patterns***

- Faced with need to understand COVID-19 mobility effects. Investigated impact on travel patterns and time at home; discovered hangout hotspots. Enabled data-driven policy decisions during pandemic.
- Tasked with supporting complex spatial queries. Collaborated on database schema design and architecture. Enabled efficient analytics on mobility data like long-duration visits.
- Presented with need for community-engaged platform. Co-designed interactive decision support system with end users. Provided custom analytics to inform policymakers on COVID-19 impact.

**Undergraduate Thesis Research, Cal State Fresno** Jan. 2019 - May 2019
***Machine Vision for Grape Detection in Vineyard***

- Improve crop production monitoring and optimization by tackling the challenges of image segmentation in viticulture.
- Investigated the efficacy of 11 pre-trained deep neural network architectures in retraining a new classifier for grape detection.
- Evaluated the extent to which data augmentation impacts the performance of a DNN architecture.
- Investigated the impact of the input feature space (e.g., color images, histograms of the colors) using Transfer Learning.

## Publications

**SAMCNet: Towards a Spatially Explainable AI Approach for Classifying MxIF Oncology Data. Farhadloo, M.**, Molnar, C., Luo, G., Li, Y., Shekhar, S., Maus L. R., Markovic, S., Moore, R., and Leontovich A. In Proceedings of KDD '2022: The 28th ACM SIGKDD International Conference on Knowledge Discovery Data Mining (SIGKDD 2022).

**Contrasting Spatial Co-location Discovery: A Case Study for Analyzing MxIF Oncology Imagery.** Li, Y., *, **Farhadloo, M.,***, Krishnan. S., Xie, Y., Frankel, T.L., Shekhar, S., and Rao, A. 2022. In Proceedings of the (BigSpatial '22): 10th ACM SIGSPATIAL International Workshop on Analytics for Big Geospatial Data (***equal contribution**) **(Best Paper Award)**

**SRNet: A spatial-relationship aware point-set classification method for multiplexed pathology images.** Li, Y., **Farhadloo, M.**, Krishnan, S., Frankel, T. L., Shekhar, S., and Rao, A. In Proceedings of the (DeepSpatial '21): 2nd ACM SIGKDD Workshop on Deep Learning for Spatiotemporal Data, Applications, and Systems. Vol. 10. 2021.

**Eco-PiNN: A Physics-informed Neural Network for Eco-toll Estimation.** Li, Y., Yang, M., Eagon, M., **Farhadloo, M.**, Xie, Y., Northrop, W., and Shekhar, S. SIAM International Conference on Data Mining (SDM'23), 2023.

**Understanding COVID-19 Effects on Mobility: A Community-Engaged Approach.** Sharma, A., **Farhadloo, M.**, Li, Y., Kulkarni., A., Gupta., Y., and Shekhar S. AGILE GIScience 2022.

**An Introduction to Spatial Data Mining.** Golmohammadi, J., Xie, Y., Gupta, J., **Farhadloo, M.**, Li, Y., Cai, Y., Detor, S., Roh, A., & Shekhar, S. The Geographic Information Science & Technology Body of Knowledge. 2020.

**Grape detection with Convolutional Neural Networks.** Cecotti, H., Rivera, A., **Farhadloo, M.** , and Villarreal, M. Expert Systems with Applications., 113588., 2020.

**A Relational Database for the National Turfgrass Evaluation Program.** Xie, Y., **Farhadloo, M.** Guo, N., Shekhar, S., Watkins, E., Kne, L., Bao, H., Patton, A., and Morris, K. International Turfgrass Society Research Journal 14.1 (2022): 316-332.

## Ongoing Works

**Spatial Computing Opportunities in Biomedical Decision Support: The Atlas-EHR Vision. Farhadloo, M.**, Sharma, A., Markovic, S., and Shekhar, S. ACM Transactions on Spatial Algorithms and Systems (Under review).
**SAMCNet: Towards A Spatially-Explainable AI Classification. Farhadloo, M.**, Shekhar, S., Rao, A., Moore, R., Leontovich A., and Markovic, S. ACM Transactions on Intelligent Systems and Technology (Under review).
**Towards Spatially Lucid AI Classification in Non-Euclidean Space: An Application for MxIF Oncology Data.**
**Farhadloo, M.**, Gupta, J., Leontovich, A., Markovic, S., and Shekhar, S. SIAM International Conference on Data Mining (SDM 2024) (Under review).

## Teaching Experience

**CSCI 8715 Spatial Data Science Research** **Spring 2022**
**CSCI 4041 Data Structures and Algorithms** **Spring 2021**
**CSCI 5715 Spatial Data Science** **Fall 2020**
**CSCI 5708 Advanced Database Systems** **Spring 2020**
**CSCI 2011 Discrete Structure** **Fall 2019**
*Graduate Teaching Assistant*

- Guest Lecturer on topics: Physical Database Design, Trends in Spatial Data Mining
- Designed homework, labs, and exams for classes of over 110+ students.
- Instructed and proctored weekly recitation sessions with over 40+ students.
- Held office hours and answered questions via effective remote and in-person sessions with 4.5 student satisfaction.

## Leadership / Volunteership

**Spatial Computing Research Group, Mentorship** | *UMN,* Aug. 2021 - Present
- Mentored grad and undergrad students in research fundamentals, instilling analytical skills that led to prestigious job, grad school, and undergrad placements.
- Guided high school students in research thinking, enabling advancement to JSHS and International Science Fair.

**International Ambassador (IA)** | *Cal State Fresno,* Aug. 2018 - May 2019
- Assisted in facilitating the adjustment of new international students to the U.S. culture and life at Fresno State.
- Organized monthly fun and informative events for international students with over 50-150 students at each event.

**Chevron STEM Zone Instructor** | *Chevron, Fresno* Oct. 2018
- Assisted in organizing an interactive space for students, teachers, and parents to learn how STEM relate to sports and everyday life.

## Services and Leadership

**Session Chair**
SIAM International Conference on Data Mining, 2023.
**Program Committee/Reviewer**
SIAM DM, SIGSPATIAL, SIGKDD, SSTD, Fragile Earth: Data Science for a Sustainable Planet, Journal of Data & Knowledge Engineering, Journal of IEEE Transactions on Big Data, Geoinformatica.

## Awards & Scholarships

**Scholarships:**
- **Dean Scholarship,** August 2018
  *College of Science and Mathematics, Cal State Fresno*
- **International Ambassador Scholarship,** August 2018 & January 2018
  *International Office, Cal State Fresno*
- **Ronald McDonald House Charities,** June 2016

**NSF Travel Award**: SIAM DM 2023, SIGSPATIAL 2019