Hamidreza Lotfalizadeh, Ph.D.

Mountain View, CA | (424)434-8454 | HamidLA.AP@gmail.com | linkedin.com/in/hessamla | hessamla.github.io

RESEARCH INTERESTS: Graph machine learning with focus on **force-directed embedding methodologies**, **diffusion models on dynamic graphs**, and **graph neural networks**. Research interests include developing **theoretically-grounded, computationally-efficient algorithms** for large-scale graph analysis with applications in **temporal network dynamics**, **disease propagation modeling**, and **knowledge graph systems**.

EDUCATION

Purdue University - Main Campus - Ph.D. in Computer Engineering — Dec 2024
Dissertation: "Kinematics-Based Force-Directed Graph Embedding" | *Advisor*: Dr. Mohammad Al Hasan

Amirkabir University of Technology - M.Sc. in Computer Engineering — Feb 2011
Thesis: Quantum computer scheduling for ion-trap architectures

Azad University - B.S. in Computer Engineering — Jul 2008

RESEARCH EXPERIENCE

Postdoctoral Researcher | Indiana University, Indianapolis, IN — Apr 2025 - Present
Advisor: Dr. Mohammad Al Hasan | ***Research Focus***: Diffusion models on dynamic graphs for temporal network analysis

- Developing **graph diffusion models** for simulating **disease propagation** on dynamic network structures
- Investigating **diffusion-based approaches for graph alignment tasks**
- Extending **force-directed embedding methodology** to temporal graph settings with structural changes
- Advancing **theoretical foundations for diffusion processes** on time-evolving graphs

PhD Research: Force-Directed Graph Embedding | Purdue University, West Lafayette, IN — Oct 2022 - Dec 2024
Advisor: Dr. Mohammad Al Hasan | ***Skills***: PyTorch, PyTorch-Geometric, CUDA, Multi-GPU, SLURM, MLFlow

- Innovated **kinematic-based force-directed methodology** for unsupervised graph embedding, providing **rigorous mathematical proof of convergence** using Brouwer's fixed point theorem
- Engineered **highly scalable framework** achieving **9x speedup** through algorithmic complexity optimization ($O(n^2)$ → $O(n \log n)$)
- Implemented **GPU-accelerated algorithm** using PyTorch and CUDA with **distributed multi-GPU execution** via SLURM on HPC clusters
- Demonstrated **6% improvement in link prediction and node classification** metrics compared to state-of-the-art embedding methods (Node2Vec, DeepWalk, GraphSAGE)
- Developed **memory optimization library** using wrapper design pattern via Python decorators
- Implemented **comprehensive experiment tracking system** using MLFlow

DDoS Attack Detection in Software-Defined Networks | Purdue University, West Lafayette, IN — Sep 2017 - Aug 2022
Advisor: Dr. Mohammad Al Hasan | ***Skills***: Entropy Analysis, Time Series, RNN, CRNN, Network Security, C++

- Designed **real-time detection and mitigation system** using entropy-based time series analysis
- Developed **recurrent neural network models** (RNN, CRNN) for traffic classification and attack detection
- Proposed **novel traffic partitioning scheme** based on flow characteristics for improved detection accuracy
- Analyzed **temporal patterns in network traffic** using group testing methodologies

IoT Data Analysis for Building Safety Systems | Purdue University (FireEvac Group), West Lafayette, IN — Dec 2019 - Apr 2022
Skills: Python, MQTT, IoT sensors, Time Series Analysis, Anomaly Detection

- Developed **time series prediction models** for early incident detection in urban buildings using environmental sensor data
- Engineered **end-to-end data pipeline** integrating real-time IoT sensor streams via MQTT protocol
- Applied **multivariate time series analysis** techniques for anomaly detection and predictive modeling
- Compiled sensor data into structured time series supporting classification and prediction procedures

Quantum Computing Scheduler Design (Master's Thesis) | Amirkabir University of Technology (QDA Group) 2009 - 2011

Skills: C++, OOP design, Graph algorithms, Maze routing, Scheduling optimization

- Designed **scheduling algorithm for ion-trap quantum computers** using graph-based routing approaches
- Applied **Lee's maze routing algorithm** to quantum gate scheduling problem
- Achieved **50% reduction in scheduling latency** through algorithmic optimization
- Implemented **object-oriented design in C++** for quantum computer simulation

INDUSTRY RESEARCH EXPERIENCE

Research Intern | Eli Lilly and Company, Indianapolis, IN May 2024 - Aug 2024

Group: Advanced Analytics and Data Science (AADS) | ***Project***: LLM-Enhanced Knowledge Graph Exploration

- Investigated **machine learning and large language model methods** for scalable knowledge graph analysis and query-based exploration
- Developed **hybrid RAG-graph traversal architecture** combining retrieval-augmented generation with intelligent subgraph extraction
- Optimized algorithms to handle **enterprise knowledge graphs exceeding 1M nodes** with real-time query performance
- Researched **fusion approaches combining semantic search (RAG)** with structural graph algorithms
- Collaborated with **cross-functional research teams** spanning chemistry, pharmaceutical sciences, and data science
- Implemented **web-based interface for interactive knowledge graph exploration**

Software Developer | Purdue University (TASI Group), West Lafayette, IN May 2018 - Aug 2020

- Developed **network communication infrastructure** between server and simulated client nodes
- Implemented **socket programming in Python** for distributed system communication
- Designed and deployed **web server using Django framework**

System Software Engineer | Parsian e-Commerce Co. Sep 2013 - Aug 2016

- Maintained **Linux-based Point-of-Sale (POS) embedded systems**
- Designed and implemented **USSD connection protocols** for secure transaction processing
- Developed **embedded applications for LAN and dial-up connectivity**
- Created **reconfigurable embedded printer system** with modular architecture
- Engineered **communication interfaces between POS devices** and web/desktop applications

Digital Design Engineer | Rahnama Systems May 2012 - Sep 2013

- Implemented **digital signal processing (DSP) algorithms** on Virtex4 FPGA development boards
- Developed **hardware-accelerated signal processing solutions**

PUBLICATIONS

[1] Hamidreza Lotfalizadeh and Mohammad Al Hasan. "Kinematic-Based Force-Directed Graph Embedding." *International Conference on Complex Networks and Their Applications (ComplexNetworks)*, 2024. Springer Nature Switzerland.

[2] Hamidreza Lotfalizadeh and Mohammad Al Hasan. "Force-directed graph embedding with hops distance." *IEEE International Conference on Big Data (BigData)*, 2023.

[3] Hamidreza Lotfalizadeh, et al. "Investigating real-time entropy features of DDoS attack based on categorized partial-flows." *International Conference on Ubiquitous Information Management and Communication (IMCOM)*, 2020. IEEE.

[4] Hamidreza Lotfalizadeh, et al. "Toward network-based DDoS detection in software-defined networks." *IMCOM*, 2018.

Google Scholar Profile

TECHNICAL RESEARCH SKILLS

ML Frameworks:	PyTorch, TensorFlow, PyTorch Geometric, Hugging Face Transformers, Node2Vec, GNN, GCN, GraphSAGE, NumPy, SciPy, Scikit-learn, Pandas, MATLAB
HPC & GPU:	CUDA programming, Multi-GPU optimization, Memory management, SLURM cluster management, Parallel algorithm design, Algorithmic complexity reduction

NLP & LLMs:	Fine-tuning, PEFT, RAG architectures, Prompt engineering, LangChain, LangGraph, Claude API, LLaMA, Transformer architectures
Programming:	Python (Expert), C/C++ (Expert), MATLAB, Rust, Java, JavaScript, TypeScript, C#, VHDL, OOP, Functional programming, Concurrent/parallel programming
Statistical Analysis:	Time series analysis, Entropy analysis, Multivariate statistics, Design of experiments (DOE), Hypothesis testing, Statistical modeling, Predictive analytics
Development Tools:	Git, CI/CD, Docker, Podman, Kubernetes, AWS, REST APIs, SQL, Graph databases, MLFlow, MQTT

TEACHING EXPERIENCE

Graduate Teaching Assistant | Purdue University, West Lafayette, IN 2017 - 2024

- **Courses Taught (with laboratory sections):** Computer Architecture, C Programming, Python Programming, Unix Programming, Logic Circuits Design
- **Courses Taught (lecture):** Theory of Machines and Languages, Software Engineering, Calculus
- Designed and delivered **lectures, laboratory exercises, and programming assignments**
- Mentored students in **debugging, algorithm design, and systems programming**
- Held regular **office hours** providing individualized academic support
- Developed **course materials and assessment instruments**

PROFESSIONAL DEVELOPMENT

Machine Learning Specialization
Stanford University (Coursera), 2023 Verification: https://coursera.org/verify/specialization/HMWE8SJ5U82M

Deep Learning Specialization
Stanford University (Coursera), 2023 Verification: https://coursera.org/share/8472b6c042e27a28374512f169eb175a

MLOps Specialization
Duke University (Coursera), 2023 Verification: https://coursera.org/verify/specialization/ENSE7V7CKMU7