Aref Afzali

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Summary — Results-driven Computer Science graduate student and AI specialist with expertise spanning machine learning, neuroscience, and complex networks. Innovative problem solver with proven ability to design advanced algorithms and architect scalable systems for real-world challenges. Combines theoretical depth with practical leadership experience, effectively translating complex concepts into collaborative technical solutions across diverse domains.

Education

Concordia University **Sep 2024 - Now**
Master of Science in Computer Science
Supervisor: Prof. Hovhannes Harutyunyan

University of Tehran **Sep 2017 - Jul 2022**
Bachelor of Science in Engineering Science (Software Engineering Branch) (GPA: 16.20/20)
B.Sc. Thesis on an Application of Basket Analysis Using Data Mining Approaches
Minors: Computer Science *Sep 2019 - Jul 2022*

Publications

- Afzali A., Bashizade M., Akbarein H. (2023). **The Application of Spiking Neural Network in Schizophrenia.** *1st International Congress of Artificial Intelligence in Medical Sciences (AIMS 2023)*. (A Poster Presentation)
- Shayegh B., Afzali A., MohammadHashemi S., MohammadTaheri K., Mohammadi S. (2021). **Discrete Mathematics: An Introduction with an Academic Approach.** *GitHub (to be accessible to the public)* (A Book)

Experience

Software Team Lead | **RomaParvaz Travel Agency** **Mar 2022 – Mar 2023**
- Led the end-to-end development of a scalable airline ticketing platform, driving the project from design to deployment using the Scrum methodology.
- Architected a robust microservices-based system with NestJS (backend), React (frontend), and PostgreSQL, MongoDB, and Redis (databases) to ensure high availability and performance.
- Successfully integrated multiple Global Distribution Systems (GDS) like Amadeus, Gabriel, and TravelPort, enabling seamless access to airline inventory and enhancing booking efficiency.

Data Specialist | **Carriot Company** **Jul 2020 – Apr 2021**
- Developed a **Vehicle Routing Problem (VRP) API** using metaheuristic approaches with Google OR-Tools and custom algorithms, optimizing fleet logistics with advanced features like Pickup & Delivery with Time Windows, Open Depots, and Multi-Depot support.
- Built a **Persian Address Geocoding API** using Sent2Vec-based clustering, improving address resolution accuracy for logistics applications.
- Created a **geographic heat map visualization**, providing actionable insights for fleet movement and demand distribution.
- Engineered **acceleration axis calibration** and **car stop type detection** by analyzing speed, acceleration, and geospatial data, enabling more precise vehicle behavior monitoring. coordinates data

Teaching

Concordia University **Sep 2024 – Now**

Numerical Methods
- Tutor and Marker, *Instructor: Assis. Prof. Victor Kalvin*

Combinatorics
- Tutor and Marker, *Instructor: Prof. Hovhannes Harutyunyan*

Introduction to Theoretical Computer Science
- Tutor and Marker, *Instructor: Assis. Prof. Denis Pankratov*

Salam High School **Sep 2023 – Mar 2024**

CPP Programming
- Lecturer and Tutor

University of Tehran **Feb 2019 – Feb 2022**

Engineering Probability and Statistics
- Chief TA, *Instructor: Assis. Prof. Behnam Bahrak*
  Introduction to Computer and Programming
- Tutor and Marker, *Instructor: Assis. Prof. Ali Kamandi*
  Numerical Computation
- Tutor and Marker, *Instructor: Assis. Prof. Ali Fahim*
  Introduction to Computer and Programming
- Tutor and Marker, *Instructor: Assoc. Prof. Manouchehr MoradiSabzevar*
  Digital Logic Circuits
- Tutor, *Instructor: Dr. Noushin Karimian*

Projects

Natural Language Processing & Information Retrieval

- Startup Recommendation System
  - Developed a **RAG-based recommendation system** using LlamaIndex and Qdrant DB to match companies with similar startups from YCombinator and TechStars, integrating **Exa Search API** for real-time company data retrieval.
- Web Form Analysis System
  - Engineered a **multi-approach form extraction system** combining HTML analysis, **multimodal agents** (Browser-Use), and **LLM-powered processing** (HyperBrowser). Designed a custom query engine using LlamaIndex to aggregate and analyze extraction results efficiently.

Complex Networks

- Multimodal Graph-Based Recommendation System
  - Implemented MGCLTransformer, integrating **Graph Transformers** with **Multimodal Graph Contrastive Learning (MGCL)** to process user-item interactions based on item images and titles. Achieved 21.4% improvement in Hit Ratio and 44.1% in NDCG over baseline models. Used PyTorch, PyTorch Geometric, SentenceTransformer, and ResNet-50 for implementation.
- Graph Analysis & Community Detection
  - Analyzed **centrality measures** (Eigenvector Centrality, Betweenness Centrality, etc.) across multiple datasets.
  - Applied **community detection algorithms** (Spectral Clustering, K-Means) and **dimensionality reduction** (PCA, Laplacian Eigenmaps).
  - Developed **fuzzy community detection models** using C-means and **Non-negative Matrix Factorization** (NMF).
  - Utilized **Graph Convolutional Networks** (GCNs) for image classification, demonstrating the effectiveness of graph-based deep learning.

Business Intelligence

- Basket Recommender Application (B.Sc. Thesis)
  - Developed a recommendation system using **Association Rules algorithms** to suggest products and target customers based on purchase history. Built with Flask-RESTful (backend), VueJS (frontend), and PostgreSQL (database). Achieved **2nd place** among B.Sc. theses selected by the faculty.

Computational Neuroscience

- Neural Network Models of Schizophrenia
  - Conducted an extensive literature review on schizophrenia symptoms and neural network-based modeling approaches, analyzing all relevant studies up to 2020. *(Supervisor: Assoc. Prof. Mohammad Ganjtabesh)*
- Deep Learning Models of ADHD
  - Reviewed deep learning models for ADHD in a Cognitive Neuroscience Competition (2019) project.
- Spiking Neural Network (SNN) Framework
  - Implemented a custom SNN framework with various neuron models (LIF, ELIF, AELIF), connectivity structures (fully connected, random), and encoding methods (Time-to-First-Spike, Positional, Poisson encoding). Integrated unsupervised (STDP, Flat-STDP) and reinforcement learning (RSTDP) rules for adaptive learning.
- Deep Spiking Neural Networks for Image Classification
  - Applied **NengoDL SNNs** for classifying the MNIST dataset, demonstrating neuromorphic computing for vision tasks.

Machine Learning & Artificial Intelligence

- Music Genre Classification
  - Worked on Neuromatch Academy (2022) project for classifying music genres using machine learning on spectral and temporal audio features.
- Optimized CNN for Efficient Computation

  - Designed a CNN model with CUDA, leveraging float16 precision for improved efficiency on the MNIST dataset.
- Image Classification with Deep Learning
  - Developed deep neural networks for image classification tasks, including Fashion-MNIST (PyTorch-based DNN) and other datasets.
- Text Classification & Decoding Optimization
  - Built a news classification system using Bayesian Networks for probabilistic inference.
  - Developed a genetic algorithm-based replacement decoding method to optimize text reconstruction.
- Applied ML Techniques with SciKit-Learn
  - Conducted multiple classification tasks using standard ML algorithms, evaluating performance across datasets.

Skills

ML Frameworks Pytorch, Llama-Index
Data Manip. Python (Pandas, Numpy, Networkx, Matplotlib, Statistics, Folium, . . .), R, Matlab
DBMS PostgreSQL, MySQL, MongoDB
Version Control Git, DVC
Parallel Prog. POSIX, OpenMP, CUDA
Back-end Dev. Django, C++, NestJS, Java
Others LaTex, Verilog

Familiar with (used in at least one project):
scripting Shell
Big Data Spark, Hadoop
DBMS Neo4j, Elasticsearch, Casandra
Func. Prog. Scala
CI/C Docker, Kubernetes
Game Designing C#, Unity
Front-end Dev. HTML, CSS, VueJS
Others Arduino, SEO, Go

Honors & Achievements

- Ranked in **top 1%** of National University Entrance Examination, earning **full tuition waiver** for B.Sc. studies; achieved **2nd rank** for undergraduate thesis and 5th rank overall in program.
- Successfully participated in prestigious AI research programs including **Neuromatch Academy Deep Learning** and **ANITI's Reinforcement Learning Virtual School**.
- Served as **Chief Teaching Assistant** for Engineering Probability and Statistics at University of Tehran; provided instructional support across multiple technical courses at **Concordia University** and **University of Tehran** including Numerical Methods, Combinatorics, Theoretical Computer Science, and more.
- Qualified for first stage of both National Mathematics and Computer Olympiads; completed competitive phases of multiple Cognitive Neuroscience Competitions

Hobbies & Interests

- Active member of Scientific Student Association of Engineering Science Department; volunteer judge for University of Tehran's national Mechatronics Student Competition.
- Designed and delivered CPP Programming curriculum at Salam High School; enjoy mentoring students in computer science and mathematics.
- 4th-dan black belt in Kyokushin Karate with Instructor and Judge certifications; medal winner in multiple national competitions (1st place 2016, 3rd place 2018, 3rd place 2021).
- Dedicated guitar player, developing creative expression alongside technical pursuits.

Languages

- Persian (Native)
- English (Advance)
- French (Elementary)
- German (Elementary)