Fatemeh Zahra Safaeipour

fzsafaei@ku.edu | (785)331-8296 | Website | in/fzarasp | fzarasp

Education

Computer Science, PhD , University of Kansas (KU) — Lawrence, KS | 2022 – *2026*

Bachelor of Science in Computer Engineering, AmirKabir University of Technology (AUT) — Tehran, Iran | 2019 – 2022

Bachelor of Science in Electrical Engineering, AmirKabir University of Technology (AUT) — Tehran, Iran | 2017 – 2021

Skills

Programming Languages: C, C++, Python, MATLAB, SQL, Java, JavaScript, Swift

Libraries & Frameworks: TensorFlow, Keras, PyTorch, Scikit-learn, Pandas, NumPy, Django, Flask, React, Beautiful Soup, CUDA

Tools & Software: MySQL, MongoDB, Simulink, GNU Radio, Docker, Git, Mininet

Cloud & DevOps: AWS, Docker, Kubernetes, OSM (Open Source MANO), OpenStack, ONOS

Experience

Research | Communication Computation Co-Design for Edge Devices, University of Kansas — Oct 2024 – Present | Lawrence, KS

- Designing **communication systems for edge devices**, focusing on optimizing **low-power, latency-sensitive applications** and **real-time data transmission** under system's constraints.
- Using **split learning architectures**, **neural networks**, and **Bayesian Optimization (BO)** for **signal processing**, **compression techniques** (such as **Random Projections**, **Singular Value Decomposition (SVD)**, and **Matrix Factorization**), and **resource allocation** to enhance task performance and network efficiency.

Research | Goal-Oriented Communication, University of Kansas — Aug 2023 – Oct 2024 | Lawrence, KS

- Investigated efficient data processing and transmission for **power-limited devices** in dynamic wireless environments, optimizing **split-point selection** and **power allocation** to meet strict **power** and **delay constraints**.
- Developed **BROWSER**, a framework using **Bayesian Optimization** with an enhanced acquisition function, achieving the same result as an offline exhaustive search, with **81.5%** fewer data samples and fast convergence to low regret (around **0.01** by iteration 20).

Research | Semantic-Aware Communication, University of Kansas — Aug 2022 – Aug 2023

- Researched **semantic-aware communication** for **goal-oriented image transmission**, using the **COCO 2014 dataset** for object detection and segmentation.
- Developed a framework with **RetinaNet Resnet50 FPN** for object detection, **image captioning** via **COCO API**, and **text-to-image generation** using **DALL-E2**, achieving **99% data reduction** while maintaining high detection accuracy.

Internship | O-RAN Implementation, Mobile Communications Company of Iran (MCI), Hamrah-e Avval — 2021 – 2022 | Tehran, Iran

- Contributed to the development and integration of **O-RAN solutions** for **network scalability** and **5G performance**, focusing on **Service Management**, **Non-Real-Time**, and **Near-Real-Time** components, and ensuring seamless integration with other network parts.
- Led and mentored **two interns**, helping them understand **O-RAN specifications**, **NFV**, **SDN**, and using **OpenStack** and **Kubernetes** for deployment and orchestration.

Research | Network Slicing in 5G, AmirKabir University of Technology (AUT) — 2020 – 2021 | Tehran, Iran

- Designed and tested **network slicing methods** for 5G networks, optimizing **resource allocation** to ensure **Quality of Service (QoS)** under varying traffic conditions.
- Used **Docker**, **Kubernetes**, and **OpenStack** for setting up and configuring the **OSM Open Source MANO** environment, deploying and managing **VNFs (Virtualized Network Functions)** to simulate and evaluate network slicing scenarios.

Hackathon | Designing Mobility in 2040, TU Austria Innovation Marathon, AVL — August 2021 | Graz, Austria

- Collaborated with a team of **four** to design **AI-driven solutions** for automating urban mobility, integrating factors such as **city infrastructure** and future mobility challenges.
- Employed **Agile development** and **design thinking** methodologies, utilizing **Miro** for collaborative prototyping, and effectively presented the final design to industry stakeholders, applying **strategic communication** to secure investment support.

Internship | NFV and SDN, AmirKabir University of Technology (AUT) Summer 2020 | Tehran, Iran

- Worked on the design and implementation of **NFV** and **SDN solutions** to automate **network functions**, enhancing **scalability** and **efficiency** of telecom infrastructure. This included **virtualizing network resources**, enabling faster deployment and management of network services.
- Researched and implemented **network automation**, **virtualized network functions (VNFs)**, and **SDN controllers**, using **OpenDaylight** for centralized control and **Mininet** for network simulation and testing. Conducted performance analysis and optimized network topologies to improve data flow and reduce operational costs.

Projects

Hallux Valgus Detection with CNN January 2021

- Developed a **Convolutional Neural Network (CNN)** model in **TensorFlow** to detect **Hallux Valgus deformity** from medical images. The dataset, collected by me and my colleagues through contributions from friends and family, consisted of **60 positive samples** and **240 negative samples**, and was labeled by medical experts at **Shahid Beheshti University**.
- Utilized **Keras** to design the CNN, applying techniques like **image augmentation** (including **horizontal flipping**, **zooming**, and **rotation**) to address the class imbalance in the dataset. The model was trained and evaluated with **accuracy** and **f-score** metrics, and visualized results with plots.
- Achieved an accuracy of **70-80%** and an **f-score** between **60-70%** on the validation set, despite using a relatively small dataset. These results highlight the model's potential effectiveness for detecting Hallux Valgus deformities, suggesting its applicability in clinical environments with limited data.

Location-Routing Program April 2021

- Developed an **optimization program** in **Python** using the **Dijkstra algorithm** to calculate the minimum distance from each node to the nearest hospital, aiming to optimize emergency response times.
- Implemented efficient **graph processing** techniques by reading and converting the **binary adjacency matrix** from input files, and applied **heapq** for priority queue management.
- Achieved accurate routing outputs, demonstrating the system's ability to minimize travel time in real-world emergency situations.

Wireless Sensor Network Design 2022

- Designed a **Wireless Sensor Network (WSN)** with four nodes using **GNU Radio** to simulate communication protocols and analyze network performance, including **Bit Error Rate (BER)** for all nodes.
- The design utilized key components such as **packet encoders**, **modulation techniques** (e.g., **QPSK**), **error correction algorithms**, and **frequency-domain processing** to simulate realistic network communication. Integrated **frequency synchronization** and **signal processing** modules to enhance communication reliability.
- Simulated real-time communication between nodes, producing **BER** and network performance outputs, and validated the design by evaluating different configurations and transmission routes within the network.

Digital Sampler and Reconstruction 2021

- Developed a **digital sampler** and implemented **linear** and **sinc interpolation** techniques for signal reconstruction in **MATLAB**, aiming to accurately reconstruct signals from downsampled data.
- Used **MATLAB** to simulate different sampling rates (20Hz and 4Hz) and applied **sinc interpolation** to recover the original signal with minimal distortion, comparing it against linear interpolation.
- Evaluated the reconstructed signals and demonstrated that **sinc interpolation** outperforms **linear interpolation**, with the ability to more accurately recover signals, even at low sampling rates (4Hz).

Channel Equalizer Design 2021

- Developed a channel equalizer system in **MATLAB** to enhance signal quality and reduce distortion in communication systems by implementing minimum-phase inverse filters and analyzing frequency responses.
- Designed and tested the system by simulating frequency responses and evaluating quantization effects, demonstrating that reducing the quantization resolution from 32 bits to 8 bits led to a minor performance degradation of 2% in frequency response accuracy.
- Applied the equalizer to audio signals, resulting in improvements in signal-to-noise ratio (SNR) by approximately **15 dB**, and achieved significant distortion reduction, validated through spectral analysis and qualitative audio comparisons.

NLP-Based Poetry Analysis and Recognition 2021

- Designed and implemented an NLP-based system from scratch to analyze and classify Persian poetry into categories of Ferdowsi, Hafez, and Molavi, achieving an accuracy of up to 62.28% on a test dataset of 2,753 poems.
- Developed unigram and bigram models manually for feature extraction and probability estimation, implemented a backoff model with tunable parameters ($\lambda_1, \lambda_2, \epsilon$) to enhance classification accuracy, and processed over 24,700 Persian poems for training.

- Demonstrated efficient poetry classification without relying on external libraries, achieving precise results through rigorous parameter tuning and model development.

Multiple Sequence Alignment Using Clustal Model

- Developed a **Multiple Sequence Alignment (MSA)** system using the Clustal model, incorporating the **Neighbor-Joining method** to construct a guide tree for aligning sequences dynamically.
- Utilized a **global alignment scoring method** and **pairwise local alignment** for protein sequences with the PAM250 substitution matrix using a **dynamic programming approach** in Python, ensuring accurate alignment for selected **GenBank** datasets.

Treatment Effect Evaluation with Sequential Neural Network
2021

- Developed a sequential neural network to evaluate treatment effects using healthcare data from 116 patients, predicting "two years follow-up" and "outcome" with models trained on 90% of the data and validated on 10%.
- Designed two models—a classification model achieving over 90% accuracy, and a regression model with mean squared error loss and RMSE metrics, achieving MSE of 50 on training data and 30 on evaluation data. Used **TensorFlow**, **Keras**, and **Pandas** for implementation, with **Matplotlib** and **Seaborn** for performance visualization through loss curves and confusion matrices.

Audio Tone Extraction
Fall 2020

- Developed a **MATLAB**-based system for audio tone extraction, isolating specific frequencies (e.g., 200 Hz) using digital filters.
- Designed and tested filters, including **Moving Average (MA)**, **Butterworth** (orders 4, 10, 30), and **Kaiser window FIR** ($\beta = 0.5$), alongside an enhanced MA filter with 1500 points.
- Achieved optimal results using Butterworth and Kaiser window filters, which demonstrated superior performance with lower orders, while the enhanced MA filter achieved similar accuracy at significantly higher complexity.

Colored Sudoku Solver
2021

- Designed an **advanced Sudoku solver** in **Python** from scratch without external libraries, integrating number and color constraints, where adjacent cells must not share the same color.
- Utilized the **Backtracking algorithm** with MRV (Minimum Remaining Value) and Degree heuristics for efficient solving of Sudoku puzzles.

Bayesian Classifier
2021

- Developed a flexible **Generalized Bayesian Classifier** from scratch using **Python**, capable of handling diverse datasets like the *Iris* dataset with Gaussian probability density functions (PDFs).
- Evaluated performance under different covariance structures (full and diagonal). Achieved high average accuracy (**98.72% for Bayes, 95.70% for diagonal covariance, and 95.51% for Naive Bayes**) and visualized results through confusion and confidence matrices providing detailed insights into precision, recall, and F1 score for each class.

Thread System Call Implementation in XV6
2021

- Expanded **XV6**, a Linux-based operating system lacking multithreading, by introducing `thread_create` and `thread_wait` system calls to enable shared address space between parent processes and threads.
- Enhanced process structure with `stackTop` and `threads` variables to manage thread stacks and counts, and updated `sysproc.c` to implement threading functionality.
- Validated the multithreading implementation with tests demonstrating shared memory access and assessing system call performance.

Full Stack Design of a Stock Market Website
Date

- Led a team of two developers to design and develop a full-stack stock market website using **JavaScript**, **HTML**, **CSS**, **Django**, **PHP**, **SQL**, and **Flask**.
- Extracted real-time stock data using **Beautiful Soup**, processed it server-side to generate predictions, and displayed the data and user-specific suggestions on the frontend.
- Managed project tasks and ensured timely delivery using **Git** for version control and **Trello** for task management.

Music Dataset Classification for Genre Prediction
Date

- Worked with a music dataset to classify audio into genres using **CNN** for feature extraction and **LSTM** for sequential predictions.
- Applied **Librosa** for feature extraction (e.g., spectrograms, MFCCs) and used **TensorFlow** and **Keras** to train the model, improving genre classification accuracy.
- Analyzed both the time domain and spectrum of audio data, enhancing prediction quality through advanced feature extraction techniques.

Publications

ICC | BROWSER: Bayesian Robust Optimization for Wireless Split Learning with Efficient Resource Management

Submitted | November, 2024

Authors: **Fatemeh Zahra Safaeipour**, Morteza Hashemi

ICNC | Semantic-Aware and Goal-Oriented Communications for Object Detection in Wireless End-to-End Image Transmission

arXiv| February, 2024

Authors: **Fatemeh Zahra Safaeipour**, Morteza Hashemi

Honors & Awards

PhD Scholarship, University of Kansas, 2022 – 2023

Top 10% of Class, with A GPA, AmirKabir University of Technology, 2022

National Entrance Exam Award, Ranked among the top 0.1% of students, 2017

Excellence in Engineering Scholarship, AmirKabir University of Technology, 2019 – 2021