Research Summary

I am currently a Ph.D. student at Georgia State University, Atlanta, GA, USA. My current advisor is Dr. Murray Patterson [1]. My main area of research interest is in Machine Learning, Adversarial Attacks, Bioinformatics, and Deep Learning. Recently, I published many papers in machine learning venues like ACML and ICONIP, etc.

I completed my MS in Computer Science from Lahore University of Management Sciences (LUMS), Lahore Pakistan, in 2018. After that, I worked as a **Research Associate** with my advisor, Dr. Imdadullah Khan [2] in Data Science Lab at LUMS university. In this Lab, we work on problems related to data analytics, data mining, big data, machine learning, artificial intelligence, smart grid, and graph algorithms. In my MS thesis, I worked to design a prediction system, which uses machine learning models to predict missing attributes values (and exploit security) in large graphs (social network graphs, bibliography networks, etc). The title of this research work is "Predicting Attributes of Nodes Using Network Structure". This research paper is already accepted in "ACM Transactions on Intelligent Systems and Technology (ACM TIST)" [3]. I have worked on several other research projects during my MS in the fields related to *Optimization* (Fair allocation based soft load shedding), *Network Security* (Detecting DDoS Attack on SDN Due to Vulnerabilities in OpenFlow), *Big Data* (Detecting Overlapping Clusters In Attributed Graph), *Image Processing* (Tone Mapping Algorithms in High Dynamic Range imaging and their comparisons), *Machine Learning* ("Soft Load Shedding" an approach to manage electricity demand and generation gap), *Artificial Intelligence* (Short Term Electricity Load Forecasting), and *Algorithms* (Search Engine for Source Code). One of my research paper "*Combinatorial Trace Method for Network Immunization*" got published at the Journal of *Information Science*. In this paper, we worked on the problem of finding a subset of nodes whose immunization results in the least vulnerability of the network [4].

I am also Collaborating in the field of Combinatorial Optimization with Professor Pablo Moscato [5] from the University of Newcastle, NSW, Australia. In the combinatorial optimization field, I am working to solve the Hamiltonian cycle problem, Traveling Salesman Problem, and Vertex Cover Problem efficiently using the Lin-Kernighan heuristic and Memetic Algorithm. My complete list of research papers (published/under review) can be found online [6].

I have also served as external reviewer for different conferences and Journals related to data mining, artificial intelligence, and machine learning. These include AusDM, NeurIPS, ICML, AAAI, AECT, and TIST. To get an idea of what type and quality of work I have already done, you can check my research papers on my google scholar profile using the following URL: https://scholar.google.com/citations?user=9dtXSoAAAAJ&hl=en.

During my Ph.D., I am focusing on developing fast and efficient embedding methods to classify/cluster the biological sequences. One of such paper, called Spike2Vec, got published at IEEE Big Data [7]. I also worked in the area of adversarial attacks in biological sequences, where we introduced error in the protein sequences in a biologically meaningful way and then evaluating the robustness of machine learning models using different embedding methods. The research paper is available online [8]. Recently, I am using Hashing and kernel matrix based methods to improve the predictive performance along with the computational runtime and space complexity (in case of kernel matrices) for classification of protein sequences. I also worked in the area of federated learning to improve the performance of sequence classification.

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[1] https://scholar.google.ca/citations?user=49aQ7scAAAAJ&hl=en
[2] https://www.researchgate.net/profile/Imdadullah_Khan2
[3] https://dl.acm.org/doi/abs/10.1145/3442390
[4] https://www.sciencedirect.com/science/article/pii/S0020025520300396
[5] https://scholar.google.com.au/citations?user=cc3Ym4gAAAAJ&hl=en
[6] https://drive.google.com/file/d/10rqTHzyQZR0KL2qXEI0r7qzVb_xRWV4M/view?usp=sharing
[7] https://ieeexplore.ieee.org/abstract/document/9671848
[8] https://arxiv.org/abs/2207.08898