SUBANGKAR KARMAKER SHANTO

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RESEARCH INTEREST

Systems and Network Security - Privacy - Machine Learning & Data Mining - Ubiquitous Computing

EDUCATION

Purdue University, West Lafayette, Indiana, US — Aug 2024 - Present
Ph.D. in Computer Science (Ongoing)
Advisor: Dr. Elisa Bertino, Samuel D. Conte Professor of Computer Science
CGPA: 4 out of 4

Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh — 2016 - 2021
BSc. in Computer Science and Engineering
Thesis: Atrial Fibrillation Detection from Noisy Photoplethysmography Signals
CGPA: 3.88 out of 4 (*Ranked 8^{th} in a class of 143 students*)

WORK EXPERIENCE

Graduate Research Assistant — Aug 2024 - Present
Department of CS, Purdue University — *Indiana, US*
- Cyber2slab of Dr. Elisa Bertino

Lecturer — Feb 2021 - July 2024
Dept. of CSE, United International University (UIU) — *Madani Ave, Dhaka, Bangladesh*
- **Courses Conducted**: Structured Programming theory and lab, Object Oriented Programming theory and lab, Artificial Intelligence theory and lab, Bioinformatics, Algorithms, Computer Networks lab, Human Computer Interaction and Society, Technology & Engineering Ethics

Lecturer (Part-time) — Jan 2022 - April 2022
Dept. of CSE, Bangladesh University of Engineering and Technology (BUET — *Dhaka, Bangladesh*
- **Courses Conducted**: Structured Programming Language Laboratory, Programming Lab (C, C++)

Research Assistant (Part-time) — Mar 2021 - Dec 2021
Datalab, Dept. of CSE, Bangladesh University of Engineering and Technology (BUET)
- Worked as a graduate research assistant under supervision of Dr. Atif Hasan Rahman and Dr. Mohammed Eunus Ali. Multiple research projects in this lab are funded by the government of Bangladesh.

PUBLICATIONS

BayesBeat: Reliable Atrial Fibrillation Detection from Noisy Photoplethysmography Data
Published in: [UbiComp 2022] Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies, 6, 1, Article 8 (March 29, 2022) [URL] [arXiv]
Authors: Sarkar Snigdha Sarathi Das, **Subangkar Karmaker Shanto**, Masum Rahman, Md. Saiful Islam, Atif Rahman, Mohammad Mehedy Masud, Mohammed Eunus Ali

ACHIEVEMENTS AND AWARDS

Themes Category Winner, Blockchain Olympiad Bangladesh	February, 2021
Winner, National Hackathon on Frontier Technologies	February, 2020
Merit Award Winner, International Blockchain Olympiad	June, 2020
University Merit Scholarship, Bangladesh University of Engineering and Technology	2017, 2018, 2019
Dean's List Scholarship, Bangladesh University of Engineering and Technology	2016, 2017, 2018

RESEARCH EXPERIENCE

Security Analysis of 5G Control Plane Protocols
Focused on analyzing and finding security flaws in the 5G control plane protocols. Implemented a testbed using radio drivers by modifying open source suites deployed on mini base stations. With testbed we can asynchronously send protocol messages to smartphones via the 5G network to find out the vendor specific deviations from the 3GPP standards and potentials security implications.
Programming Language: Java, **Frameworks**: Open5GS core, SRSRAN project, OpenAirInterface

BayesBeat: Reliable Atrial Fibrillation Detection from Noisy Photoplethysmography Data
Focused on reliable prediction on Photoplethysmography (PPG) signals that noisy due to motion artifacts. Implemented a Bayesian Deep Learning Model in Python using PyTorch framework to provide an uncertainty estimate along with the prediction. Our Model beat the state of the art work both on the largest publicly available dataset by 7-25% and on the MIMIC-III dataset by 10-14%. It was the first application of Bayesian Deep Learning in this domain. This work was accepted in UbiComp 2022, Published in IMWUT [Publication Link]
Programming Language: Python, **Deep Learning Framework**: PyTorch; [GitHub Repo]

Contrastive Learning Based Approach for Patient Similarity

Experimented with contrastive learning to learn patient similarity from physiological signals, particularly Photoplethysmography (PPG) signals. Designed a new contrastive loss function for this use case. Due to limited availability of dataset, conducted a case study on Atrial Fibrillation Detection from PPG signals. It was the first application of Contrastive Similarity Learning in this domain. [arXiv Link]
Programming Language: Python, **Deep Learning Framework**: PyTorch; [GitHub Repo]

Privacy risk of Machine Learning Models

Experimented on vulnerabilities/privacy risk of Trained Classification Models introduced particularly from Model Explainability. Explored potential applications of various model explanation techniques like LIME, SHAP, Counterfactual Explanation etc. for implementing model inversion attacks. Experimented with Adult, Census19, GSS, FTE dataset.
Programming Language: Python, **ML Framework**: Scikit-Learn;

ACTIVITIES & SERVICES

Supervised the Gold Winner team of International Blockchain Olympiad 2023 Final
Hosted in Amsterdam, The Netherlands, EU from 15th to 17th of November 2023 [Certificates]

Problem setter of UIU Intra University Deep Learning Sprint Fall 2022
Prepared Dataset to Distinguish between Relevant/Irrelevant Image Captions using Deep Learning [Kaggle Contest Link]

TECHNICAL SKILLS

Programming & Scripting Languages: C, C++, Python, Java, Bash Scripting, Assembly (iAPX 86), MATLAB
Markup Languages: HTML, LaTeX, Markdown
Machine Learning Frameworks & Libraries: PyTorch, Keras, Scikit-Learn, Numpy, Pandas, SciPy
Development Tools & Frameworks: Django, Django REST Framework, Postgres, MySQL, JavaFX (Java GUI)
Project Management Tools: Git, Github, Slack, Docker, Docker Hub
Design Tools: Proteus circuit simulator, Logisim circuit simulator and CISCO packet tracer
Hardware Tools: Atmega32 Microcontroller
Miscellaneous: MS Word, Powerpoint, Excel

SELECTED PROJECTS

FoodSquare
Developed a web app using Django and Postgres for an online restaurant hub on the perspective of Dhaka City of Bangladesh. This system provides restaurant owners a platform to manage their own restaurants and put their products on display. On the other hand, food-lovers get the opportunity to browse food items as per their taste and budget from hundreds of restaurants. Deliveryman also have access to this system to pickup orders submitted by the customers. A dockerized version is uploaded into the docker hub [Docker Hub Repo]
Programming Language: Python, **Web Framework**: Django, **Backend Database**: Postgres; [Github Repo]

Image Captioning
Experimented with several deep learning models to generate single line caption given an image. The deep learning models include Resnet-101 & LSTM with Attention Mechanism and trained on Flickr8k Image dataset.
Programming Language: Python, **Deep Learning Framework**: PyTorch; [Github Repo]

Samsung Gear Fit 2 Pro PPG Logger
A tizen native UI app and native background service to collect raw sensor data from a tizen OS based smartwatch device. The logger service activates sensor periodically using timers. The recorded data are saved into a single CSV file for that segment with device id as part of the filename for identifying individuals uniquely. After each recording, the logger service checks for Wi-Fi availability and tries to upload all the csv files present locally to a remote server via Wi-Fi or to a paired smartphone via bluetooth. Successfully uploaded files are deleted from watch storage.
Programming Language: C, **SDK**: Tizen 2.3.1, **Device**: Samsung Gear Fit 2 Pro Smartwatch; [Github Repo]

ICMP Ping Spoofing
A project to demonstrate security exploitation by sending ping with spoofed IP. Victim's source IP is spoofed to send a ping to server from Attacker. As the source IP is spoofed server takes is as a original IP and hence ping reply is sent to victim instead of attacker who send the actual ping request. Also a sniffer using pcap is built to sniff ICMP packets for verification.
Programming Language: Python, **Libraries**: libpcap; [Github Repo]

C Compiler
A simple subset of C Compiler(Lexical Analyzer, Syntax Analyzer, Semantic Analyzer & Intermediate Code Generator) was implemented as an assignment of compiler LAB course in undergraduate studies.
Programming Language: C++, **Libraries**: Flex, Yacc-Bison; [Github Repo]

University Hall Management System
Database Sessional Project focussing on Raw SQL to manage several activies for academic dormitory of students in a university. Frontend developed as a desktop app in JavaFX
Programming Language: Java, **Framework**: JavaFX, **Backend Database**: Oracle; [Github Repo]

Real-Time Audio to Frequency Spectrum Transformation on Atmega32 Microcontroller
A hardware project to demonstrate frequency spectrum visualization from real time audio via time domain to frequency domain conversion on Atmega32 microcontroller using 32-Point Integer Discrete Fourier Transform (DFT). Amplitude plotted on two Dot Matrices consist of uniformly distributed 16 frequency bins over 0-4kHz. Each bin has amplitude height of 8. Lower amplitude frequencies cause dot matrix to have green bars on corresponding bin columns while red is for the higher

amplitudes.
Programming Language: C, **Microcontroller**: Atmega32, **Output Device**: LCD, Dot Matrix; [Github Repo]

REFERENCES

Dr. Elisa Bertino
Samuel D. Conte Professor, Department of Computer Science
Purdue University
E-mail: bertino@purdue.edu

Dr. Imtiaz Karim
Postdoctoral Researcher, Department of Computer Science
Purdue University
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Dr. Atif Hasan Rahman
Associate Professor, Department of Computer Science and Engineering
Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh
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