Zahidur Talukder

Rigorous Design Lab
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RESEARCH INTERESTS

My research centers on privacy-preserving machine learning, with a strong emphasis on data privacy, security, fairness, and AI sustainability. As a 2024 Machine Learning and Systems Rising Star, I am dedicated to advancing secure and ethically driven AI solutions. My work involves developing innovative methods for federated learning, including self-regulating mechanisms for client data integrity and cutting-edge aggregation techniques for servers. My ultimate goal is to leverage privacy-preserving machine learning to build trustworthy online ecosystems that contribute to the social good.

EDUCATION

The University of Texas at Arlington, Texas

Ph.D. Candidate in Computer Science and Engineering — Aug 2019 – Present

- Lab: *Rigorous Design Lab, UTA*
- Advisor: Mohammad Atiqul Islam

Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

B.S. in Electrical and Electronic Engineering — May 2014 – Oct 2018

PROFESSIONAL EMPLOYMENT

Graduate Research Assistant

Computer Science and Engineering, The University of Texas at Arlington
Lab: Rigorous Design Lab (RiDL) — Aug 2019 – Current

Graduate Teaching Assistant

Computer Science and Engineering, The University of Texas at Arlington
Notable Courses: Algorithm & Data Structure, Computer Architecture, Professional Practices etc — Aug 2019 – Current

RESEARCH EXPERIENCE

Graduate Research Assistant

Rigorous Design Lab (RiDL), UTA — Aug 2019 – Current

- **Reducing Water Footprint for LLM based Training**- NSF Funded
  - Proposed algorithms ensure dynamic resource allocation for reducing water footprint
  - Strategic data center selection
  - Incorporate dynamic learning rate to reduce temporal water footprint
  - Proposed model is evaluated using 60 different data centers located in different cities in USA
- **Fair Federated Learning with Heterogeneous Devices**
  - Proposed algorithms ensure fairness for heterogeneous devices with respect to model architecture for federated learning
  - Remove local computational power bottlenecks among participating clients in federated learning
  - Incorporate Q-fairness among clients to minimize the variance of accuracy among clients
  - Proposed the theoretical analysis of convergence guarantee of fair FL with heterogeneous devices
- **Self Regulating Clients for Federated Learning**
  - The designed algorithm enables self-regulating clients who can actively take decisions regarding participation in federated learning
  - Self-regulating clients can save local computation costs by stopping them from doing local computation

- Self-regulating clients can save uplink communication costs by not sending the model update to the global server
- Proposed algorithm can be incorporated in the backend with any existing federated learning techniques
- Proposed the theoretical analysis of convergence guarantee of fair FL with heterogeneous devices

■ **Auto-Weighted Aggregation for Heterogeneous Federated Learning**

- The proposed lightweight auto-weighted aggregation techniques can handle the heterogeneity of federated learning by minimizing the weight of unfavorable model updates
- The proposed algorithm is lightweight and adds no additional computation to the global server
- The proposed algorithm is scalable and robust without adding additional computation
- The worst-case performance of the proposed algorithm is like the popular federated averaging techniques

■ **Server-Level Power Monitoring in Data Centers Using Single-Point Voltage Measurement**- NSF Funded

- The proposed power monitoring approach extracts power consumption information of all servers by utilizing the conducted electromagnetic interference of server power supplies
- This is a low-cost approach and needs only one sensor
- Designed the prototype to get the voltage information
- Real-time power monitoring is possible using the side channel information

PUBLICATIONS

Refereed Journal Papers

■ **Zahidur Talukder**, Mohammad A. Islam, "Remote Access Attack for Active Sensors in Autonomous Vehicles", [In Submission]

■ **Zahidur Talukder**, Bingqian Lu, Shaolei Ren, Mohammad A. Islam, "Fair Federated Learning with Heterogeneous Devices", [**ACM TOMPECS24**]

■ Sai Puppala, Ismail Hossain, Md Jahangir Alam, Sajedul Talukder,**Zahidur Talukder**, Sayed Bahauddin, "SCALE: Self-regulated Clustered federAted LEarning in a Homogeneous Environment", Journal of Data Analytics and Engineering Decision Making. (**JDAEDM**), 2024

■ Sajedul Talukder, Md. Iftekharul Islam Sakib, **Zahidur Talukder**, "Giving Up Privacy For Security: A Survey On Privacy Trade-off During Pandemic Emergency", International Journal on Cryptography and Information Security (**IJCIS)**, Jul 2020.

■ Sajedul Talukder and **Zahidur Talukder**, "A Survey on Malware Detection and Analysis Tools", International Journal of Network Security & Its Applications (**IJNSA**), Vol. 12, No. 2, Mar 2020.

■ **Zahidur Talukder**, "A comparative study of various methods of Phasor Measurement Unit (PMUs)", Bangladesh University of Engineering and Technology (BUET), 2018.

Refereed Conference Papers

■ **Zahidur Talukder**, Pranjol Gupta, Shaolei Ren, Mohammad A. Islam, "Reducing Water Footprint for Data Centers", [In Submission] [**Asplos24**]

■ **Zahidur Talukder**, Mohammad Rana, Keaton Hamm, Mohammad A. Islam, "Client Side Federated Learning Ensuring Data Quality", [In Submission] [**AAAI24**]

■ Ismail Hossain, Sai Puppala, Md Jahangir Alam, Sajedul Talukder,**Zahidur Talukder**, "A Visual Approach to Tracking Emotional Sentiment Dynamics in Social Network Commentaries", Proceedings of the Eighteenth International AAAI Conference on Web and Social Media. (**AAAI WSM**), 2024

■ P. Gupta, M. Hossen, P. Li, S. Ren, and M. Islam, **Zahidur Talukder**, "A dataset for research on water sustainability," Open Science Framework (OSF), https://osf.io/g3zvd/?view_only=63e9c2f0cdf547d792bdd8e93045f89e. (**e-Energy**), 2024

■ Pranjol Gupta, **Zahidur Talukder**, Tasnim Abir, Phuc Nguyen, Mohammad A. Islam, "Enabling Low-Cost Server Level Power Monitoring in Data Centers Using Conducted EMI", 21st ACM Conference on Embedded Networked Sensor Systems (**SenSys**), 2023.

■ Paul Agbaje, Afia Anjum, **Zahidur Talukder**, Mohammad Islam, Ebelechukwu Nwafor and Habeeb Olufowobi, "FedCime: An Efficient Federated Learning Approach For Clients in Mobile Edge Computing", IEEE International Conference on Edge Computing Communications (**IEEE EDGE**), 2023.

- **Zahidur Talukder**, Mohammad A. Islam, "FedSRC: Efficient Federated Learning with Self-Regulating Clients", ACM International Conference on Measurement and Modeling of Computer Systems (**SIGMETRICS**), 2022.
- **Zahidur Talukder**, Mohammad A. Islam, "Computationally Efficient Auto-Weighted Aggregation for Heterogeneous Federated Learning", IEEE International Conference on Edge Computing Communications (**IEEE EDGE**), 2022.
- **Zahidur Talukder**, Kazi Nishat, Md Shamim Reza, "A Comparative Study of Various Methods of Phasor Measurement Unit Algorithms", 1st International Conference on Advances in Science, Engineering and Robotics Technology (**ICASERT**), 2019.
- Sajedul Talukder, Md. Iftekharul Islam Sakib, Md. Faruk Hossen, **Zahidur Talukder** and Md. Shohrab Hossain, "Attacks and Defenses in Mobile IP: Modeling with Stochastic Game Petri Net", In Proceedings of the IEEE International Conference on Current Trends in Computer, Electrical, Electronics and Communication (**IEEE ICCTCEEC**), Sep 2017.
- Sajedul Talukder, Md. Iftekharul Islam Sakib, **Zahidur Talukder**, Upoma Das, Arnob Saha and Nur Sultan Nazar Bayev, "USenSewer: Ultrasonic Sensor and GSM-Arduino Based Automated Sewerage Management", In Proceedings of the IEEE International Conference on Current Trends in Computer, Electrical, Electronics and Communication (**IEEE ICCTCEEC**), Sep 2017.

Workshops and Posters

- Pranjol Gupta, **Zahidur Talukder**, Mohammad A. Islam, Phuc Nguyen, "Towards Server-Level Power Monitoring in Data Centers Using Single-Point Voltage Measurement", 20th ACM Conference on Embedded Networked Sensor Systems (**SenSys**), 2022.
- **Zahidur Talukder**, Mohammad A. Islam, "FedSRC: Efficient Federated Learning with Self-Regulating Clients", ACM International Conference on Measurement and Modeling of Computer Systems (**SIGMETRICS**), 2022 (Poster).
- **Zahidur Talukder**, Mohammad A. Islam, "FedASL: Auto Weighted Aggregation Techniques for Federated Learning", SCRF@UTA 2022, **Best Poster Award Honorable Mention**.

WORK IN PROGRESS

- **Zahidur Talukder**, Bingqian Lu, Mohammad A. Islam, Shaolei Ren, "Fair Federated Learning with Heterogeneous Devices", In preparation.
- **Zahidur Talukder**, Mohammad A. Islam, "Self Regulating clients for Federated Learning", In preparation.

TEACHING EXPERIENCE

Graduate Teaching Assistant

Department of Computer Science and Engineering, UTA — Aug 2019 – Present

- *CSE-4323-001-QUANTITATIVE COMPUTER ARCH*
  - Designed weekly quizzes, graded quizzes, and lab reports, and tracked the students' progress using Gradescope and Canvas
  - Provided students with one-on-one tutoring and regular out-of-class assistance
  - Tutored students with special needs, including those with learning disabilities or who had language disadvantages
- *CSE-3318-001-ALGORITHMS DATA STRUCTURES*
  - Assisted professor with classroom instruction materials, exams, assignments, and record keeping
  - Collaborated with the professor at the weekly meetings and actively contributed new ideas on teaching
  - Improved student participation in the classroom through integration of creative role-playing exercises and peer review sessions
- *CSE-4314-001-PROFESSIONAL PRACTICES*
  - Prepared and presented lectures using multimedia technologies such as Zoom, PowerPoint, video clips, and Canvas course website
  - Developed and graded exams and quizzes that assess student mastery of subject matter
- *CSE-5392-001-TOPICS IN COMPUTER SCIENCE*
  - Prepared lesson plans, and assignments and conducted the labs

- Evaluated homeworks, tests, and quizzes and held office hours to ensure students understood course concepts
- Consistently received positive teacher evaluations from students

■ *CSE-1105-001-INTRO COMPUTER SCI ENGR*

- Conducted labs and graded student lab reports and quizzes using Canvas
- Held office hours to ensure students understood the labs and successfully balanced student work-load with teaching work-load

MENTORING EXPERIENCE

I-Engage Graduate Mentor 2023, 2024

■ *Federated Learning for Undergraduate Student*

- Mentor an undergraduate student about the current federated learning techniques
- Provide him hardware and software facilities to build his project
- **Mentee**
  - Edward Alkire- Summer 2024
  - Areeb Khan- Summer 2023

OurCS@DFW Team Presentation Mentor

■ *[Security-H] Stealing Secret Data from Computers Without a Network* **(Best OurCS@DFW Team Presentation Awards)**

- Conduct the workshop in computer science in the Dallas, Fort Worth area with more than 20 undergraduate students
- Provided students hardware and software facilities to build their own project

UTA LSAMP - Summer Research Academy Mentor

■ *Social Impact of Machine learning and AI*

- Mentor an undergraduate student who is both Black and a woman, guiding her to understand the social impact of Machine Learning and AI
- Help her to explore the potential privacy and security aspects of AI in our society
- **Mentee**
  - Angela Taylor- Summer 2022

Summer High School Student Mentor

■ *Introduction to Machine learning and AI*

- Mentor a high school student to learn about Machine learning and AI
- Provided all the materials to a high-level understanding of the concept of machine learning and AI
- Teach a few machine learning algorithms, like clustering, PCA, ICA, and tree

HONORS AND AWARDS

■ **Machine Learning and Systems Rising Stars 2024** - MLCommons 2024

■ **Best Poster Award Honorable Mention**- SCRF@UTA, 2022, 2023

■ Dean's Merit List Award from Bangladesh University of Engineering and Technology (BUET), 2017 & 2018

■ Honorable Mention in Undergraduate Thesis Poster Competition, Department of EEE, BUET, 2018

■ Bangladesh Government Merit Scholarship, Secondary and Higher Secondary public exams (Top 1% among 2 million students), 2011 & 2013

GRANTS

- Travel grants- **Machine Learning and Systems Rising Stars 2024** - MLCommons 2024. $1,600
- **I-Engage Graduate Mentor Scholarship**- Summer 2024. $2,000
- **I-Engage Graduate Mentor Scholarship**- Summer 2023. $2,000
- Travel grants- **SC** 2022. $1,800
- Travel grants- **IEEE Edge** 2022. $1,100

ACADEMIC SERVICES

Volunteering Experience

- Student volunteer at SC22, Dallas, Tx, USA
- Organizer OURCS@UTA workshops 2022, 2023, 2024
- Judge UTA Innovation Day 2023

Conference Reviewer

- Reviewer for The 38th Annual Conference on Neural Information Processing Systems (NeurIPS) in 2024
- Reviewer for The ACM Performance Evaluation in 2024
- Reviewer for The 8th Workshop on Online Abuse and Harms (WOAH) in 2024
- Reviewer for The 4th Workshop on Online Abuse and Harms (WOAH) in 2020

INVITED TALKS

- MLCommon talk- "Addressing Water Footprint for Growing AI " at Nvidia Headquarters, Santa Clara in 2024
- Invited talk- "Computationally Efficient Auto-Weighted Aggregation for Heterogeneous Federated Learning" at Massachusetts General Hospital and Harvard Medical School in 2022
- Ph.D. Lightening Talk- "Ensuring Data Quality and Hardware Sensitive Fairness in Heterogeneous Federated Learning" at UTA 2023

REFERENCES

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