

Reek Majumder, Ph.D.

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Summary — I am a versatile professional with a Ph.D. in Civil Engineering (Transportation Cyber-Physical Systems, May 2025) and an M.S. in Computer Science, reflecting my ability to adapt seamlessly to diverse domains. My academic journey bridges computational expertise and practical problem-solving, showcased by three years of industry experience in Java and web-based software development and a strong portfolio of AI/ML research in autonomous vehicles and Unmanned Aerial Vehicles (UAVs). I excel in developing advanced solutions like hybrid quantum-classical models for traffic sign classification, adversarial learning, and graph-based ML systems for intrusion detection, leveraging my deep technical acumen to address real-world challenges. My expertise spans software development, data science, machine learning, quantum machine learning (QML), and cloud computing, enabling me to design innovative, scalable solutions across interdisciplinary domains.

Projects

- QML for Autonomous Vehicle Traffic Sign Classification** | *Pytorch, PennyLane, Optuna* | [Github](#) Jan 2021 - Nov. 2023
– Leveraged PennyLane for QML in traffic sign detection, rigorously testing against adversarial attacks. Incorporated QML using transfer learning on image data and integrating gate-based quantum computers, achieving a performance boost of 85% for hybrid classical-quantum models.
- Graph-based Machine Learning for Intrusion Detection** | *Python, Pytorch-Geometric* | [Github](#) Jan 2024 - Aug. 2024
– Designed and validated graph-based machine learning models for protocol-independent intrusion detection system in drones, delivering a 3% to 35% performance boost across diverse Denial of Service (DoS) attacks, such as flooding, fuzzy, and replay attacks, outperforming baseline Long Short-Term Memory (LSTM) models.
- Generative AI models for CIFAR-10 Dataset** | *Python, Pytorch* | [Github](#) Aug 2021 - Dec 2021
– Executed a Generative Adversarial Network (GAN), training a discriminator/generator pair on the CIFAR10 dataset with techniques from DCGAN, Wasserstein GANs, WGAN-GP, and ACGAN.
- Gated Recurrent Unit (GRU) for Automated Video Captioning** | *Python, Pytorch* | [Github](#) Aug 2021 - Dec 2021
– Assembled a Video Caption Generation system using S2VT, creating a Sequence to Sequence – Video to Text model with GRU. Trained the model using provided video and caption files, evaluating its performance with a BLEU Score (best model BLEU score = 0.705).
- Neuroimaging-Based Autism Group Classification** | *Python, Scikit-learn, Nilearn* | [Github](#) Jan 2020 - May 2020
– We used the Autism Brain Imaging Data Exchange (ABIDE) Dataset to extract subject-specific time-series data to construct functional connectomes and predict autism groups using ridge and support vector classifiers, with an accuracy of 83%.
- Ensemble Learning Models for Methane Detection** | *AutoGluon, Python* | [Github](#) Aug 2021 - June 2024
– Designed an ensemble learning model for real-time methane detection and intensity prediction, using a pipeline that combines classification and regression ensembles, leveraging distributed meteorological data for efficient large-scale monitoring and achieving improved R^2 values of up to 85%.
- Soccer Data Visualization** | *D3.js, Python* | [Github](#) Aug 2020 - Dec 2020
– Analyzed team rankings in the English Premier League and La Liga during the 2017-2018 season, creating interactive visualizations to illustrate score performance trends throughout the tournament and achieved a Net Promoter Score (NPS) of 72% from the instructor and classmates for the quality and clarity of the visualizations.
- Multi-Task Learning Framework for Segmentation and Depth Estimation** | *Pytorch, CreStereo* | [Github](#) Oct 2024 - Dec 2024
– Multi-task learning (MTL) framework integrating semantic segmentation and depth estimation using the Cityscapes dataset.
– Designed a compact architecture with a MobileNetV3-Small encoder, shared generators, and GAN-based discriminators, utilizing a combination of loss functions including cross-entropy, dice, scale-invariant, perceptual, and adversarial losses to ensure accurate and perceptually consistent results. ([Project Website](#))
- Flask Web Application for Real-Time Traffic Sign Classification** | *HTML, Javascript, CSS* | [Github](#) Oct 2023 - Dec 2023
– Develop a flask application to capture real-time video feed from the camera, process frames using a pre-trained classical and quantum AI model for traffic sign classification, and render the annotated frames back to the user interface in real-time.
- Traffic Sign Classification Under Varying Luminous Conditions Using YOLOv8** | *Pytorch* | [Github](#) Aug 2024 - Dec 2024
– This project develops an AI model using YOLOv8 as a pretrained backbone to classify traffic signs under varying luminous conditions, such as glare and low light, leveraging the Traffic Glare dataset. The model addresses challenges like glare-induced occlusions through robust training and data augmentation, enabling accurate real-time classification for improved reliability in automated driving systems.
- Quantum Restricted Boltzmann Machine for Intrusion Detection** | *D-Wave, Python* Aug 2023 - Dec 2023
– Achieved 98.3% detection accuracy by implementing a hybrid quantum-classical framework using Restricted Boltzmann Machines for intrusion detection in automotive Controller Area Network systems.
- Reinforcement Learning-Based Collision Avoidance System for Drones** | *Unreal Engine, Airsim* Aug 2023 - Dec 2024
– Implemented a collision avoidance system for UAVs using AirSim simulation, applying reinforcement learning algorithms to enable autonomous navigation and real-time obstacle avoidance in dynamic environments.
- Cloud-Powered Autonomous Mobility Enhancement** | *Python, Amazon AWS services, Synchro* Aug 2022 - Dec 2022
– Utilized Amazon AWS services (DynamoDB, Kinesis, Lambda) to develop a cloud-based speed advisory system for autonomous vehicles, integrating data from Synchro micro traffic flow simulation software to calculate advisable speeds and deliver real-time feedback for optimal vehicle performance.

Professional Experience

Clemson University | Center for Connected Multimodal Mobility | Transportation Cybersecurity and Resiliency
Graduate Researcher
Jan 2021 – Present

- Accomplished innovative research on autonomous vehicles and drones by applying advanced computational techniques, including graph-based machine learning, deep learning, quantum computing, and cloud computing, which led to real-world solutions for cyber-physical transportation challenges.
- Conducted vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication research using DSRC and C-V2X technologies, enabling seamless communication for transportation systems. This improved the efficiency of vehicle communication frameworks based on Federal Aviation Administration (FAA) standards.
- Coordinated and led student demonstrations for diverse audiences, including federal agencies, high schools, and industry representatives, showcasing innovations such as vision-based collision alerts, IoT-based pedestrian warning systems, and cybersecurity solutions like adversarial attack detection in traffic sign classification, while also mentoring high school students on enhancing autonomous vehicle perception systems using deep learning techniques; *IEEE/IAVVC, 2023*.

Cognizant Technology Solutions
Associate Engineer-1
Jan 2016 – Jun 2019

- Accomplished a 7% improvement in test-case generation efficiency by developing the Activity Diagram-based Path Analysis and Regression Testing (ADPART) tool using Eclipse Rich Client Platform and Java.
- Designed a reverse engineering workflow to generate activity diagrams directly from textual test cases in Excel, which increased team productivity by 70% within six months.
- Implemented Quality Insight Bots and an interactive dashboard using HTML, jQuery, CSS3, and Java, improving client issue allocation to teams by 30%. This allowed for efficient resolution by identifying similar previously solved issues.

Education

Clemson University
M.S in Computer Science
Specialization: Data Science and Information Systems
Aug 2021
Ph.D. in Civil Engineering
Specialization: Transportation Cyber-Physical Systems, Machine Learning, Cloud Computing
Dissertation: Integrating AI for Environmental and Cybersecurity Challenges: Methane Detection and Secure Autonomous Systems
May 2025

Kalinga Institute of Industrial Technology
B.Tech in Computer Science
Specialization: Software Development
Jun 2015

Skills

- **Languages:** Python, C/C++ , Java, JavaScript, R-language, HTML/CSS, PHP, LaTeX
- **Libraries:** Pytorch, PennyLane, Qiskit, OpenAI-Gym, Adversarial Robustness Toolbox(ART), AdverTorch
- **Database:** MySQL, MongoDB, DynamoDB
- **Tools:** Git/GitHub, VS Code, Tableau, Orange Civil3D, ArcGIS,
- **Amazon AWS:** Kinesis, Lambda, DynamoDB, Sagemaker, API Gateway
- **Intelligent Transportation Systems (ITS) Framework:** ARC-IT, RAD-IT, and SET-IT
- **Communication:**Dedicated Short-Range Communications (DSRC), and Cellular Vehicle-to-Everything (C-V2X)

Publications

- **Majumdar, R.**, Comert, G., Werth, D., Gale, A., Chowdhury, M. and Sabbir Salek, M., 2024. Graph-Powered Defense: Controller Area Network Intrusion Detection for Unmanned Aerial Vehicles. arXiv e-prints, pp.arXiv-2412. (*Under Review: TRR, 2025*)
- Enan, A., Salek, M. S., Chowdhury, M., Comert, G., Khan, S. M., & **Majumder, R.** (2024). Optimal Traffic Flow in Quantum Annealing-Supported Virtual Traffic Lights. arXiv preprint arXiv:2412.18776. (*Under Review: IEEE IOT Journal 2025*)
- Puspa, S.N., Enan, A., **Majumder, R.**, Sabbir Salek, M., Comert, G. and Chowdhury, M., 2024. An AI-Enabled Side Channel Power Analysis Based Hardware Trojan Detection Method for Securing the Integrated Circuits in Cyber-Physical Systems. arXiv e-prints, pp.arXiv-2411. (*Under Review: ACM Transactions on Cyber-Physical Systems 2025*)
- **Majumder, R.**, Pollard, J., Salek, M.S., Werth, D., Comert, G., Gale, A., Khan, S.M., Darko, S. and Chowdhury, M., 2024. Development and Evaluation of Ensemble Learning-based Environmental Methane Detection and Intensity Prediction Models. Environmental Health Insights, 18, p.11786302241227307.
- Khan, Z., Tine, J.M., Khan, S.M., **Majumdar, R.**, Comert, A.T., Rice, D., Comert, G., Michalaka, D., Mwakalonge, J. and Chowdhury, M., 2023, June. Hybrid quantum-classical neural network for incident detection. In 2023 26th International Conference on Information Fusion (FUSION) (pp. 1-8). IEEE.
- Tine, JM, Puspa, SN, **Majumdar, R.**, Comert, G, Chowdhury, M, and Lao, Y., 2023, October. Threats of Trojan Incursion in Transportation Hardware. In 2023 IEEE International Automated Vehicle Validation Conference (IAVVC) (pp. 1-7). IEEE.

- Azim, O.A., Baker, L., **Majumdar, R.**, Enan, A., Khan, S.M. and Chowdhury, M.A., 2023, October. Data-Driven Defenses Against Adversarial Attacks for Autonomous Vehicles. In 2023 IEEE International Automated Vehicle Validation Conference (IAVVC) (pp. 1-5). IEEE.
- **Majumder, R.**, Chowdhury, M., Khan, S.M., Khan, Z., Ahmed, F., Ngeni, F., Comert, G., Mwakalonge, J. and Michalaka, D., 2023. Adversarial Attack-Resilient Perception Module for Traffic Sign Classification.
- Baral, B., **Majumdar, R.**, Bhalgamiya, B. and Roy, T.D., 2023, September. Evaluating Quantum Machine Learning Approaches for Histopathological Cancer Detection: Classical, Hybrid Simulation, and IBM Quantum Computing. In 2023 IEEE International Conference on Quantum Computing and Engineering (QCE) (Vol. 2, pp. 238-239). IEEE.
- Majumdar, R., Bakilapadavu, G., **Majumder, R.**, Chen, A.M.R., Flanagan, B. and Ogata, H., 2020, November. Learning analytics of critical reading activity: Reading Hayavadana during lockdown. In 28th International Conference on Computers in Education Conference Proceedings (Vol. 1, pp. 127-136). Asia-Pacific Society for Computers in Education (APSCE).

Presentations

- Poster presentation at **104th Annual Transportation Research Board (TRB)** on Graph-based Machine Learning for Intrusion Detection on Unmanned Aerial Vehicles (Jan, 2025).
- Poster presentation at **Transportation Cybersecurity and Resiliency (TraCR)** on Secured Surveillance: Drones Detecting Methane, Fortified Against Cyber Threats (May, 2024).
- Poster presentation at **2024 National Environmental Justice (NEJ) Conference**, on Detecting Spatial Changes in Fugitive Methane in Urban Communities (Apr, 2024).
- Panel Discussion at **23rd IEEE International Automated Vehicle Validation Conference (IAVVC)** on Quantum Machine Learning for Incident Detection in Smart City Infrastructure (Oct, 2023).
- Panel discussion at **26th International Conference on Information Fusion** on Quantum Machine Learning for Incident Detection in Smart City Infrastructure (Jun, 2023).
- Panel discussion at **Minority Serving Institution Partnership Program (MSIPP)** on Edge-Centric Cloud Based Distributed Surveillance for Environmental Detection Surveys (Aug, 2022).
- Poster presentation at **5th Annual C²M² Virtual Fall Conference** on Quantum Machine Learning for Autonomous vehicle Security (Oct, 2021).
- Poster presentation at **100th Annual Transportation Research Board (TRB)** on Quantum machine learning for autonomous vehicles against adversarial attacks (Jan, 2021).

Certifications

- **DroneDeploy's Oil and Gas Analyst** Credential ID: pw65xh9a6k2g
- **Udemy's Time Series Analysis and Forecasting using Python** Credential ID: UC-a2796f99-88ef-4458-8caf-cd02b9e69938
- **Coursera's Exploratory Data Analysis** Credential ID: 9EALXLNMHFY9
- **Clemson University's Geographic Information System (GIS) Fundamentals**
- **Coursera's R Programming** Credential ID: J4TK4JWYXL87
- **Udemy's Reinforcement Learning Mastery** - [In-progress](#)
- **AWS Certified Solution Architect Associate** - [In-progress](#)

Technical Demonstrations

Demonstration of transportation cyber-physical system applications includes examples like quantum computing-supported traffic sign detection and mitigation techniques against real-time cyberattacks, Lossy video-compression-based pedestrian detection with IoT-based pedestrian warning at crosswalk, Vision and CV2-X based collision alerts. We presented it to

- USDOT Future of Transportation Summit, USDOT headquarters, Washington DC (Aug, 2024).
- TraCR Annual Conference 2024 at CU-ICAR, Greenville, SC (May, 2024).
- 7th Annual UTC Conference for the Southeastern Region, at Florida Atlantic University, Boca Raton, FL (Mar, 2023).
- SC Department of Transportation (SCDOT) officials visit to Clemson University, Clemson, SC (Mar, 2023).
- C²M² 6th Annual Conference, Clemson University, Clemson, SC (Nov, 2022).
- C²M² 5th Annual Conference, Clemson University, Clemson, SC (Aug, 2021).

Leadership and Community Service

- Vice-president, IEEE ITSS Clemson University Student Chapter (2023-2024).
- Secretary, IEEE ITSS Clemson University Student Chapter (2022-2023).
- Coordinator, South Asian Food on International Food Festival (Spring 2022).
- Treasurer, ITE Clemson University Student Chapter (2022-2023).
- Volunteer, Campus clean-up service as a part of IEEE ITSS Clemson University Student Chapter (Fall 2021).
- Volunteer, Sauer Magnolia plantation drive on Arbor Day Tree Plantation Ceremony (Fall 2021).
- Co-founder, Head of Logistics, The TiffinWala (2014-2015).
- Co-founder, Sales, Plebians Marketing (2014-2015).
- Co-founder, Chief Technical Officer, Luminate Pvt Ltd (2024-present)