Sajal Saha

Assistant Professor
Department of Computer Science
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Research Interest

- Internet Traffic Analysis (focus: traffic prediction, traffic classification).
- Cyber-attack Detection (focus: anomaly detection, forecasting based attack detection, blockchain, mobile cyber-physical system)
- Data Mining (focus: association rules mining, formal concept analysis)

Teaching Interest

Computer Programming, Data Structure and Algorithm, Operating Systems, Computer Networking, Information Security, Software Engineering, Data Mining, Applied Machine Learning.

Education

2020-2023 : **Ph.D. in Computer Science** ***(Nominee for the Governor General's Gold Medal)***
Western University, Canada.
Thesis : *Toward building an intelligent and secure network: A Traffic Forecasting Perspective*
Supervisor : Dr. Anwar Haque
Synopsis : contributed to efficient traffic forecasting by developing techniques and tools for *(i)* handling outliers in real-world traffic *(ii)* dealing with data scarcity to make robust traffic prediction model and *(iii)* increasing generalization capability for out-of-distribution samples.

2018-2020 : **M.Sc. in Computer Science** ***(With Distinction)***
Brock University, Canada.
Thesis : *Data mining using L-fuzzy concept analysis*
Supervisor : Dr. Michale Winter
Synopsis : contributed to propose a relational theory for generating attribute implications from many-valued contexts.

2013-2014 : **M.Sc. in Information Technology,** Jahangirnagar University, Bangladesh.

2008-2012 : **B.Sc. in Computer Science and Engineering** ***(Recipient of the Chancellor's Gold Award and Prime Minister's Gold Award)***
Patuakhali Science. and Technology University, Bangladesh.

Research and Teaching Experience

08/23 - now : **Assistant Professor**, *University of Northern British Columbia, Canada.*

- **Supervising** MSc thesis students and undergraduate research students.
- **Collaborating** with universities (UNBC, Western University, Brock University, University of Memphis, Utah Valley University, and Brandon University) and industry partners (Tejas Networks Limited and Bamboo Innovation) on research projects in Internet traffic forecasting and anomaly detection.
- **Teaching** graduate and undergraduate courses, including CPSC 100 - Programming Language I, CPSC 321 - Operating Systems, and CPSC 499/699 - Applied Machine Learning.

01/23 - 08/23 : **Professor**, Seneca College, Canada.

- **Taught** courses: DSA555 (Data Structure and Algorithm using C++) and MAP524 (Mobile Application Development: Android) and duty include course design, prepare lecture material, and student evaluation.

09/20 - 08/23 : **Teaching and Research Assistant**, *Western University, Canada.*

- **Conducted** research on various projects, including traffic forecasting, cyber-attack forecasting, cyber-attack detection, generative adversarial attack generation, and malware detection.
- **Assisted in teaching** several undergraduate computer science courses including CS3305, CS1032, and CS4417.
- **Assisted** in designing course materials as WSSI intern.

09/18 - 09/20 : **Teaching and Research Assistant,** *Brock University, Canada.*

- **Conducted** research on L-fuzzy formal concept analysis and developed a simulation tool using Java for mining association rules using formal concept analysis.
- **Assisted in teaching** in undergraduate computer science teaching including COSC 4F00, COSC 3P97, COSC 3P93, COSC 2P13, COSC 2P12, COSC 2P95, COSC 1P02.

08/15-08/18 : **Lecturer,** *Patuakhali Science and Technology University, Bangladesh.*

- **Taught** undergraduate courses including Structured programming language (C), Object-oriented programming language (Java), Data Structure and Algorithm, Computer Networks, Numerical Methods, and Software Development.
- **Supervised** final year student thesis/project.

Industry Experience

09/20 - 08/23 : **Mitacs Accelerate Research Fellow,** *Juniper Networks, Canada*

- **Developed** short and long-term traffic prediction framework using real-world internet traffic data.

03/13 - 02/15 : **Software Engineer,** *Samsung R&D Institute Ltd., Dhaka.*

- **Resolved** technical issues on Android commercialization projects.
- **Designed** and **developed** different R&D projects on augmented reality, automated testing, and smart device integration.

Research Funding and Grant

2023-2028 : **Start-Up Grant *(Secured)* –** University of Northern British Columbia *Provided by UNBC to support the establishment of the INFORM Lab and early-stage research on cybersecurity and anomaly detection.*

2024 : **University Research Experience (URE) Award *(Secured)*** – UNBC *Awarded for supervising undergraduate summer thesis research on adaptive models for network traffic prediction*

2024 : **NSERC Undergraduate Student Research Award (USRA) *(Secured)* – $4500** UNBC *Supported undergraduate research on improving semantic information transmission in computer networks.*

2024-2026 **NSERC Early Career Researcher (ECR) Voucher *(Secured)* – $10,000** *Awarded to support research in privacy-preserving intelligent vehicular environments.*

2024-2029 **NSERC Discovery Grant *(Under Review)* –** *Proposed research on integrating LLMs with Internet traffic forecasting and cybersecurity frameworks.*

2024 **NSERC Alliance Advantage Grant *(In Preparation)-*** *Collaboration with Bamboo Innovation on privacy-preserving intelligent vehicular environments.*

2025 **Canada Summer Jobs Program *(Under Review)-*** *Application for funding undergraduate students on machine learning-based anomaly detection projects.*

Awards and Honors

08/23 : **Nominee for the Governor's Gold Medal Award,** *Western University.*

08/21 : **Distinguished Graduate Student Award**, *Brock University.*

04/21 : **Western Summer Student Internship (WSSI)**, *Western University,* ***Value $7,500****.*

09/20 - 12/22 : **Mitacs Accelerate Research Fellowship**, Western University**,** ***Value $20,000/year****.*

09/20 - 08/23 : **Western Graduate Research Scholarship (WGRS),** *Western University,* ***Value $5,000/year****.*

05/19 - 08/19 : **Provost's Brock University International Scholarship**, *Brock University,* ***Value $1,635****.*

05/19 - 08/19 : **DGS Spring 2019 Research Fellowship**, *Brock University,* ***Value $4,000****.*

09/18 - 08/20 : **Graduate Fellowship,** *Brock University,* ***Value $7,500/year****.*

09/18 - 08/20 : **Research Fellowship,** *Brock University,* ***Value $6,000/year****.*

01/16 : **Prime Minister Gold Award,** *Patuakhali Science & Technology University.*

08/12 : **Chancellor Gold Award,** *Patuakhali Science & Technology University.*

01/08 - 12/12 : **Dean's Award,** *Patuakhali Science & Technology University.*

Publications

J1 : **Sajal Saha**, and Anwar Haque," Overcoming Data Scarcity Challenges: Predicting Internet Traffic in Small ISP Networks with Transfer Learning and Data Augmentation", ***Submitted Revision to Elsevier Computer Communication.***

J2 Wumian Wang, **Sajal Saha**, Anwar Haque, Greg Sidebottom, "Intelligent Routing Algorithm over SDN: Reusable Reinforcement Learning Approach", ***Submitted to Elsevier Computer Network.***

J3 : **Sajal Saha**, Saikat Das, and Glaucio H.S.Carvalho, "Adversarially Robust Internet Traffic Prediction with ConvLSTMTransNet", **Submitted to Elsevier Journal of IoT.**

J4 : Sudipto Baral, **Sajal Saha**, and Anwar Haque, "Domain-Specific Fine-Tuning of Open Source LLMs for Cyberattack Mitigation", **Submitted to IEEE TNSM**.

J5 : Anik Islam, **Sajal Saha**, and Hadis Karimpouri, "PRAG: A Privacy Preserving Agent Architecture for Securing Sensitive Data in Cross Silo LLM Applications", **Submitted to ICML 2025.**

J6 : Samia, Nusrat, **Sajal Saha**, and Anwar Haque, "Predicting and mitigating cyber threats through data mining and machine learning." Computer Communications 228 (2024): 107949***. Impact Factor 4.3***

J7 : Sayem, Ibrahim Mohammed, Moinul Islam Sayed, **Sajal Saha**, and Anwar Haque. "ENIDS: A Deep Learning-Based Ensemble Framework for Network Intrusion Detection Systems." *IEEE Transactions on Network and Service Management* (2024).

J8 : Saha, S.; Haque, A.; Sidebottom, G. Multi-Step Internet Traffic Forecasting Models with Variable Forecast Horizons for Proactive Network Management. Sensors 2024, 24, 1871. https://doi.org/10.3390/s24061871 *).* **Impact Factor 3.847**

J9 : **Saha, Sajal**, Anwar Haque, and Greg Sidebottom. "Analyzing the Impact of Outlier Data Points on Multi-Step Internet Traffic Prediction using Deep Sequence Models." *IEEE Transactions on Network and Service Management (2023).* **Impact Factor 4.68**

J10 : Addison, George, Anahita Izadpanahi, **Sajal Saha**, and Michael Winter. "L-fuzzy concept analysis using fuzzy categories." *Elsevier Fuzzy Sets and Systems 460 (2023): 72-102.* **Impact Factor 4.46**

J11 : Islam, Rejwana, Moinul Islam Sayed, **Sajal Saha**, Mohammad Jamal Hossain, and Md Abdul Masud. "Android malware classification using optimum feature selection and ensemble machine learning." *Internet of Things and Cyber-Physical Systems (2023): 100-111.*

J12 : **Saha, Sajal**, Annita Tahsin Priyoti, Aakriti Sharma, and Anwar Haque. "Towards an Optimized Ensemble Feature Selection for DDoS Detection Using Both Supervised and Unsupervised Method." *Sensors 22, no. 23 (2022): 9144.* **Impact Factor 3.847**

J13 : Sayed, Moinul Islam, **Sajal Saha**, Ibrahim Mohammed Sayem, and Sarna Majumder. "A Comparative Study on Load Balancing Techniques in Software Defined Networks." *International Journal of Advanced Networking and Applications* 13, no. 4 (2022): 5016-5023.

J14 : Das, Saikat, **Sajal Saha**, Annita Tahsin Priyoti, Etee Kawna Roy, Frederick T. Sheldon, Anwar Haque, and Sajjan Shiva. "Network intrusion detection and comparative analysis using ensemble machine learning and feature selection." *IEEE Transactions on Network and Service Management (2021).* **Impact Factor 4.68.**

C1 : **Chandrika Saha, Sajal Saha**, and Anwar Haque. "Modeling and Prediction of Network Failures: A Machine Learning Approach". ***Submitted to IEEE ICC 2025.***

C2 : Sudipto Baral, Sajal Saha, and Anwar Haque, "Autonomous Cyber Incident Response Using Reasoning and Action", **Submitted to IEEE IWCMC 2025.**

C3 : **Sajal Saha**, Moinul Islam, Md Motiur Rahman, Miad Faezipour, Smrity Bhatt, "Resilient Federated Learning for DDoS Detection with Multi-Krum Aggregation and Anomaly Detection", **Submitted to IEEE SmartNet 2025.**

C4 : **Sajal Saha,** Saikat Das, and Glaucio H.S. Carvalho "ConvLSTMTransNet: A Hybrid Deep Learning Approach for Internet Traffic Telemetry". ***Accepted to IEEE VCC 2024.***

C5 : **Sajal Saha**, Sudipto Baral, and Anwar Haque. "An Adaptive End-To-End IoT Security Framework Using Explainable AI and LLMs." *Accepted to IEEE WF-IoT 2024.*

C6 : Samia, Nusrat, **Sajal Saha**, and Anwar Haque. "Advancing Network Resilience Through Data Mining and Machine Learning in Cybersecurity." In 2024 20th International Conference on the Design of Reliable Communication Networks (DRCN), pp. 100-106. IEEE, 2024.

C7 : **Saha, Sajal,** Sudipto Baral, and Anwar Haque. "Optimizing Internet Traffic Predictions with a Novel Deep Learning EMD-KNN Framework." In 2024 International Wireless Communications and Mobile Computing (IWCMC), pp. 1382-1387. IEEE, 2024.

C8 : R. I. Nekvi, **S. Saha,** Y. A. Mtawa and A. Haque, "Examining Generative Adversarial Network for Smart Home DDoS Traffic Generation," 2023 International Symposium on Networks, Computers and Communications (ISNCC), Doha, Qatar, 2023, pp. 1-6, doi: 10.1109/ISNCC58260.2023.10323616.

C9 : **Sajal Saha**, Moinul Islam Sayed, and Anwar Haque, "Empirical Mode Decomposition and Stationary Wavelet Transformation in Internet Traffic Prediction" IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS), Hoboken, NJ, USA, 2023, pp. 1-6, doi: 10.1109/INFOCOMWKSHPS57453.2023.10226162. **Acceptance Rate ~33%**

C10 : **S. Saha** and A. Haque, "Wavelet-Based Hybrid Machine Learning Model for Out-of-distribution Internet Traffic Prediction," NOMS 2023-2023 IEEE/IFIP Network Operations and Management Symposium, Miami, FL, USA, 2023, pp. 1-8, doi: 10.1109/NOMS56928.2023.10154337, **Acceptance Rate 25%**

C11 : M. I. Sayed, **Sajal Saha** and A. Haque, "Deep Learning Based Malapps Detection in Android Powered Mobile Cyber-Physical System," 2023 International Conference on Computing, Networking and Communications (ICNC), Honolulu, HI, USA, 2023, pp. 443-449, doi: 10.1109/ICNC57223.2023.10074208. **Acceptance Rate 25%**

C12 : **Saha, Sajal**, Anwar Haque, and Greg Sidebottom. "Transfer learning based efficient traffic prediction with limited training data." *In 2023 IEEE 20th Consumer Communications & Networking Conference (CCNC), pp. 477-480. IEEE, 2023.* **Acceptance Rate 34%**

C13 : **Saha, Sajal**, Moinul Islam Sayed, and Rejwana Islam. "Detecting DNS over HTTPS Traffic Using Ensemble Feature-based Machine Learning." *In Applied Intelligence for Industry 4.0, pp. 118-131. Chapman and Hall/CRC, 2023.*

C14 : **S. Saha** and A. Haque, "Out-of-Distribution Internet Traffic Prediction Generalization Using Deep Sequence Model," ICC 2023 - IEEE International Conference on Communications, Rome, Italy, 2023, pp. 3830-3835, doi: 10.1109/ICC45041.2023.10279740. **Acceptance Rate 39%**

C15 : Sayed, Moinul Islam, Ibrahim Mohammed Sayem, **Sajal Saha**, and Anwar Haque. "A Multi-Classifier for DDoS Attacks Using Stacking Ensemble Deep Neural Network." *In 2022 International Wireless Communications and Mobile Computing (IWCMC), pp. 1125-1130. IEEE, 2022.* **Acceptance Rate 37%=**

C16 : **Saha, Sajal,** Anwar Haque, and Greg Sidebottom. "Towards an Ensemble Regressor Model for ISP Traffic Prediction with Anomaly Detection and Mitigation." *In 2022 International Symposium on Networks, Computers and Communications (ISNCC), pp. 1-6. IEEE, 2022.* **Acceptance Rate 37%**

C17 : **Saha, Sajal**, Anwar Haque, and Greg Sidebottom. "An empirical study on internet traffic prediction using statistical rolling model." *In 2022 International Wireless Communications and Mobile Computing (IWCMC), pp. 1058-1063. IEEE, 2022.* **Acceptance Rate 37%**

C18 : Sayed, Moinul Islam, Ibrahim Mohammed Sayem, **Sajal Saha**, and Anwar Haque. "A Multi-Classifier for DDoS Attacks Using Stacking Ensemble Deep Neural Network." *In 2022 International Wireless Communications and Mobile Computing (IWCMC), pp. 1125-1130. IEEE, 2022.* **Acceptance Rate 37%**

C19 : **Saha, Sajal**, Anwar Haque, and Greg Sidebottom. "Deep sequence modeling for anomalous isp traffic prediction." *In ICC 2022-IEEE International Conference on Communications, pp. 5439-5444. IEEE, 2022.* **Acceptance Rate 39%**

C20 : **Saha, Sajal**, Annita Tahsin Priyoti, Aakriti Sharma, and Anwar Haque. "Towards an Optimal Feature Selection Method for AI-Based DDoS Detection System." *In 2022 IEEE 19th Annual Consumer Communications & Networking Conference (CCNC), pp. 425-428. IEEE, 2022.* **Acceptance Rate 34%**

C21 : **Saha, Sajal**, Golam Md Muradul Bashir, Md Raihan Talukder, Joy Karmaker, and Md Saiful Islam. "Which Programming Language and Platform Developers Prefer for the Development? A Study Using Stack Overflow." *In 2018 International Conference on Innovations in Science, Engineering and Technology (ICISET), pp. 305-310. IEEE, 2018.*

C22 : **Saha, Sajal**, Rakibul Hasan Rajib, and Sumaiya Kabir. "IoT based automated fish farm aquaculture monitoring system." *In 2018 International Conference on Innovations in Science, Engineering and Technology (ICISET), pp. 201-206. IEEE, 2018.*

Student Advising

2024 **:** **NSERC USRA by Rohan Soares "**Machine Learning for Improved Semantic Information Transmission in Computer Networks**", University of Northern British Columbia**

2024 **:** **Undergraduate Summer Research by Rohan Soares** "A Comparative Performance Analysis of Machine Learning Models for Detecting Spoofing Attacks", University of Northern British Columbia.

2024 **:** **Undergraduate Summer Research by Nihal Gaurav Jani** "Adaptive Models for Network Traffic Prediction: Bridging Gaps with Transfer Learning and GANs", University of Northern British Columbia.

2024 **:** **Undergraduate Summer Research by Ben Dempsey** "SafeConnect: Integrating Federated Learning for Robust IoT Security", University of Northern British Columbia.

2022 **:** **Master's thesis (Mentoring with Dr. Anwar Haque) by Nusrat Samia,** "Real-Time Cyber-Attack Prediction Using Machine Learning", Western University.

2022 : **Master's thesis (Mentoring with Dr. Anwar Haque) by Ibrahim Mohammod Sayem,** "ENIDS: A Multi-Classifier for an AI-Based Ensemble Approach for Network Intrusion Detection", Western University.

2023 : **Master's project (Mentoring with Dr. Anwar Haque) by Venkata Harshavardhan Arepalli,** "Generation of Network Failure Dataset", Western University.

2018 : **Bachelor thesis by Rakibul Hasan Rajib,** "IoT based automated fish farm aquaculture monitoring system", Patuakhali Science and Technology University.

2018 : **Bachelor thesis by Md Raihan Talukder,** " Which Programming Language and Platform Developers Prefer for the Development? A Study Using Stack Overflow", Patuakhali Science and Technology University.

2016 : **Bachelor thesis by Mushfica Jannat Mohona, "**Fall Detection and Monitoring System Using Tri-Axial Acceleration Sensor in the Elderly", Patuakhali Science and Technology University.

2016 : **Bachelor thesis by Pradip Das, "**SIG: A Gossip Based Energy Efficient Routing Protocol for WSN", Patuakhali Science and Technology University.

Invited Talks & Presentation

2024 : **Invited talk on "Empowering Women Through Cybersecurity: Building Resilience Against Digital Threats",** Workshop on Developing a Women's Cyber Self-Defence Toolkit, University of Northern British Columbia.

2023 : **Invited talk on "Towards building an intelligent and proactive network: A Traffic Forecasting Perspective",** Computer Science Colloquium Series, Western University.

2023 : **Invited talk on "AI-Assisted Traffic Forecasting",** Juniper Network's Machine Learning Forum.

2023 : **"Empirical Mode Decomposition and Stationary Wavelet Transformation in Internet Traffic Prediction",** paper presenter, IEEE Conf. on INFOCOM.

2023 : **"Out-of-distribution Internet Traffic Prediction Generalization Using Deep Sequence Model",** paper presenter, IEEE Conf. on ICC.

2023 : **"Wavelet-Based Hybrid Machine Learning Model for Out-of-distribution Internet Traffic Prediction",** paper presenter, IEEE/IFIP Conf. on NOMS.

2023 : **"Transfer Learning Based Efficient Traffic Prediction with Limited Training Data",** paper presenter, IEEE Conf. on CCNC.

2022 : **"Towards an Ensemble Regressor Model for ISP Traffic Prediction with Anomaly Detection and Mitigation",** paper presenter, IEEE Conf. on ISNCC.

2022 : **"An Empirical Study on Internet Traffic Prediction Using Statistical Rolling Model",** paper presenter, IEEE Conf. on IWCMC.

2022 : **"Deep Sequence Modeling for Anomalous ISP Traffic Prediction",** paper presenter, IEEE Conf. on ICC.

2022 : **"Towards an Optimal Feature Selection Method for AI-Based DDoS Detection System"** paper presenter, IEEE Conf. on CCNC, 2022

2021 : **"A Study of Extracting an Optimum Feature Set Using Ensemble Technique",** research presenter, Conf. on UWORCS, London, Canada.

Activities and Services

Member	:	Program Committee, 24th ACM/IFIP International Middleware Conference, 2023
Reviewer	:	*IEEE Transactions on Network and Service Management*, IEEE Internet of Things, Elsevier Computer Networks, Elsevier Vehicular Communication, IEEE ICC, IEEE CNSM.
Member	:	Institute of Electrical and Electronics Engineers (IEEE)
Member	:	Public Service Alliance of Canada (PSAC), Western University.
Member	:	Publication Secretary, Patuakhali Science and Technology University Teachers Association.
Member	:	Student Resident Supervisor, Patuakhali Science and Technology University.

Professional Skills

Programming	:	Python, C, C++, C#, Java, JavaScript, Matlab.
ML	:	Scikit-learn, Seaborn, Tensorflow, Keras, Pytorch
Database	:	Oracle and SQL
Web	:	PHP, HTML5, CSS, React, Nodejs, MEAN.
Cloud	:	Docker, AWS.
Tools/IDE	:	VS Code, NetBeans, Eclipse, Android Studio, Notebook, Colab.
Simulation	:	Mininet, WEKA.
VCS		GitHub, Perforce.
OS	:	Unix/Linux, Mac, and Windows.

References

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