Kenneth Brezinski

Post Doctoral Fellow

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Education

08/18–08/24 **Doctor of Philosophy,** *University of Manitoba*, Winnipeg, MB.
Electrical and Computer Engineering
Dissertation: Complexity-Based Graph Attention Network for Metamorphic Malware Detection

01/16-09/18 **Master of Science,** *University of Manitoba*, Winnipeg, MB.
Civil Engineering
Dissertation: High Performance Chromatography as a Natural Organic Matter Property Indicator in Ion-Exchange Applications

08/10-08/15 **Bachelor of Science,** *University of Winnipeg*, Winnipeg, MB.
Chemistry
Dissertation: Monitoring the Natural Organic Matter Composition throughout Manitoba Water Treatment Plants using Solid Phase Extraction

Journal and Book Publications

Machine Learning, Deep Learning, Security, Complexity, Malware

Graph-Ensemble Methods for Detecting Metamorphic Malware, Brezinski, K., Ferens, K., 2023. *Cybersecurity: Cyber Defense, Privacy and Cyber Warfare*. De Gruyter (book); invited, in progress

Metamorphic Malware and Obfuscation - A Survey of Techniques, Variants and Generation Kits, Brezinski, K., Ferens, K., 2023. *Security and Communications* (journal); DOI: 10.1155/2023/8227751

Incorporating Topological Complexity into a Multilayer Perceptron, Brezinski, K., Ferens, K., 2022. *Transactions on Computational Science & Computational Intelligence*. Springer Nature (book); accepted, in press

Classifying SARS-CoV-2 and Common Co-infections from Genome Assemblies, Mohaimen Rahman**,** Brezinski, K., Ferens, K., 2022. *Transactions on Computational Science & Computational Intelligence*. Springer Nature (book); accepted, in press

Transformers – Malware in Disguise, Brezinski, K., Ferens, K., 2021. *Advances in Security, Networks, and Internet of Things*, In book: *Transactions on Computational Science & Computational Intelligence Chapter*. Springer Nature (book); accepted, in press

Sandy Toolbox: A Framework for Dynamic Malware Analysis and Model Development, Brezinski, K, Ferens, K., 2021. *Security & Management (SAM'21) Advances in Security, Networks, and Internet of Things.* Springer Nature (book); accepted, in press

An Adaptive Tribal Topology for Particle Swarm Optimization, Brezinski, K, Ferens, K., 2020. *Advances in Artificial Intelligence and Applied Cognitive Computing*. Springer Nature (book); DOI: 10.4018/IJSSCI.2020040105

Population Based Equilibrium in Hybrid SA/PSO for Combinatorial Optimization, Brezinski, K, Ferens, K., 2020*. International Journal of Software Science and Computational Intelligence* (journal); DOI: 10.4018/IJSSCI.2020040105

Cognitive Hybrid PSO/SA Combinatorial Optimization, Brezinski, K, Ferens, K., 2020. *Advances in Security, Networks, and Internet of Things*. Springer Nature (book); DOI: 10.1109/ICCICC46617.2019.9146062

Environmental Engineering, Chemistry

Ozonation of natural organic matter and aquatic humic substances: the effects of ozone on the structural characteristics and subsequent trihalomethane formation potential, Mehrnaz Sadrnourmohamadi**,** Ken Brezinski, Beata Gorczyca, 2020. *Water Quality Research Journal of Canada* (journal); DOI: https://doi.org/10.2166/wqrj.2020.011

Multi-spectral characterization of natural organic matter (NOM) from Manitoba surface waters using high performance size exclusion chromatography (HPSEC), Ken Brezinski, Beata Gorczyca, 2019. *Chemosphere* (journal); DOI: https://doi.org/10.1016/j.chemosphere.2019.02.176

An overview of the uses of high-performance size exclusion chromatography (HPSEC) in the characterization of natural organic matter (NOM) in potable water, and ion-exchange applications, Ken Brezinski, Beata Gorczyca, 2018. *Chemosphere* (journal); DOI: https://doi.org/10.1016/j.chemosphere.2018.10.028

Ion-Exchange for Trihalomethane control in potable water treatment – A municipal water treatment case study in Rainy River, Ontario, Canada, Ken Brezinski, Mehrnaz Sadrnourmohamadi, Beata Gorczyca, 2018. *Water Quality Research Journal of Canada* (journal); DOI: https://doi.org/10.2166/wqrj.2018.134

Effect of total organic carbon and aquatic humic substances on the occurrence of lead at the tap, Lisa Winning, Beata Gorczyca, Ken Brezinski, 2017. *Water Quality Research Journal of Canada* (journal); DOI: 10.2166/wqrjc.2017.028

Conference Publications

Graph-Oriented Modelling of Process Event Activity for the Detection of Malware, Brezinski, K., Ferens, K., 2023. *7th International Conference on Applied Cognitive Computing* (proceedings); IEEE. DOI: 10.1109/CSCE60160.2023.00085

Complexity-Based Lambda Layer for Time Series Prediction, Brezinski, K., Ferens, K., 2021. *IEEE Congress on Evolutionary Computation* (proceedings); IEEE. DOI: 10.1109/CEC45853.2021.9504995

Complexity-Based Convolutional Neural Network for Malware Classification, Brezinski, K, Ferens, K., 2020. *International Conference on Computational Science and Computational Intelligence* (proceedings); IEEE. DOI: 10.1109/CSCI51800.2020.00008

Professional Experience

Since 09/24 **Post Doctoral Fellow,** *University of Manitoba, Winnipeg, Canada*

- Carry out research on the application of Chaos Theory and Fractal Complexity analysis towards improving machine learning and deep learning frameworks.
- Improve host-based intrusion detection systems for an industry partner, Canadian Tire Corp.

Since 05/23 **Systems Designer, Water & Wastewater,** *WSP Canada, Winnipeg, Canada*

- Carrying out water and wastewater treatment plant assessments, investigations, and process design & system optimization, including SCADA and PLC designs.
- Develop OT networking architecture, perform cyber security audits; configure and install firewall, switches, routers, and intrusion detection systems.

09/22-12/22 **Visiting Researcher**, *National Institute for Informatics*, Tokyo, Japan

- Develop a graph autoencoder to detect network anomalies from backbone network traffic connecting Japanese Academic institutions to North America.
- Automate firewall rule generation using node embeddings, GNNExplainer and explainable AI and scale the application to billions of network packets daily.

05/22-08/22 **Data Scientist Intern**, *Microsoft*, Redmond, WA

- Worked with the Windows Defender for Endpoint Team on developing detectors to alert customers in the early stages of an exfiltration or ransomware attack.
- Leveraged PySpark and cross-product telemetry to improve the signal-noise-ratio of the detector to 80% and to scale to billions of live customer events.
- Coordinate with Security Engineers and Threat Researchers on identifying the most important precursors to malicious network connections.

05/21-08/21 **Applied Research Scientist II Intern**, *Amazon Web Services*, New York, NY

- Worked with the Amazon GuardDuty threat detection research team on developing novel semi-supervised techniques to apply weak labelling to Linux binaries.
- Established a working group of Security Engineers and SWE to coordinate and consult on the ongoing project.

10/19-10/22 **Research Intern Lead**, *Canadian Tire Corp.,* Winnipeg, MB

- First-authored six publications in close collaboration with an industry collaboration with Canadian Tire executives with a focus on Malware detection of enterprise security threats.

Teaching Experience

09/16 -05/22 **Teacher's Assistant,** *University of Manitoba, Winnipeg, Canada*

Worked as a Teacher Assistant for the following courses over 20+ appointments:

CHEM 1300 – Chemistry
CHEM 1122 – Introduction to Chemistry Techniques for Engineering 1
CHEM 1126 - Introduction to Chemistry Techniques for Engineering 2
ENG 3000 - Engineering Economics
ECE 3740 - Systems Engineering Principles 1
CIVL 3700 - Environmental Engineering Design
MECH 4860 - Engineering Design
CIVL 3690 - Environmental Engineering Analysis
CIVL 4100 - Engineering Management and the Environment
ENG 2040 - Engineering Communication: Strategies, Practice and Design
ENG 2030 - Engineering Communication: Strategies for the Profession

08/17-04/18 **Engineering Graduate Student Tutor,** *University of Manitoba, Winnipeg, Canada*

- Proofread manuscripts, thesis dissertations, award applications and course deliverables for graduate students in the department of Biosystems, Civil, Electrical and Computer Engineering.

Professional Memberships

ISA **Member,** Industrial Society for Automation

EngGeoMB **Engineer In-Training (EIT)**, Engineers Geoscientists Manitoba

CTTAM **Certified Technician (C.Tech.)**, Certified Technicians & Technologists Association of Manitoba

PMI **Project Management Professional (PMP)**, Project Management Institute

ACPA **Chemist in Training (C.I.T.)**, Association of the Chemical Profession of Alberta

WCW **Member,** Western Canada Water

WEF **Member,** Water Environment Foundation

Fellowships and Awards

2023 **Research Completion Scholarship**
2022 **Emily and Lynette Hain Graduate Engineering Scholarship**
2021-2022 **University of Manitoba Graduate Fellowship**
2021-2022 **Edward R. Toporeck Graduate Fellowship in Engineering**
2021 **Mitacs Globalink - JSPS**
2020 **A. Keith Dixon Graduate Scholarship in Engineering**
2021-2022 **Philip and Marjorie Eckman Scholarship in Engineering**
2019-2022 **Mitacs Accelerate – Ph. D**
2019 **NSERC – CGS M**
2016 **Mitacs Accelerate – M.Sc.**

Students Supervised

Undergrad **Michael Guevarra,** University of Manitoba, 2019

Academic and Volunteer Service

since 05/20 **Reviewer**, International Journal of Software Science and Computational Engineering

11/17 – 01/21 **Reviewer**, Journal of Desalination and Water Treatment

04/17 – 01/21 **Reviewer**, Journal of Water Science and Technology

09/18 – 05/21 **Student Peer Mentor**, University of Manitoba Students' Union

01/19 – 01/21 **Language Partner Volunteer**, English Language Center

09/19 – 09/20 **Faculty of Science Mentor**, Faculty of Science

04/19-12/19 **Language Exchange Program Volunteer**, International Center

06/19 – 01/21 **President and Founder,** University of Manitoba Engineering Masters (UMEM)

06/20 – 06/23 **Personal Disaster Response Volunteer,** Canadian Red Cross

11/16-11/17 **Vice-President,** University of Manitoba Water and Environmental Foundation (UMWEF)