Colin Bellinger

Curriculum Vitae

53 Hazel Street
Ottawa, Ontario
(613) 700-4295

Data Science for Complex Systems
Digital Technologies Research Centre
National Research Council of Canada
Ottawa, Canada

Fields of Interest

Artificial Intelligence: Machine learning, deep learning, autoencoders, reinforcement learning, learning from limited data, class imbalance, multi-label and multi-class classification, one-class classification
Data analysis: Data properties and how they impact the complexity of the learning task.
Data mining: Geo-spatial and stream mining.
Applications: Environmental and health sciences, medical informatics and decision support, AI for materials design, machine failure prediction, and security

Education

PhD Computer Science *2016*
University of Ottawa, Ottawa, Canada
Thesis Title: Beyond the boundaries of smote: A framework for manifold-based synthetic oversampling
Advisors: Dr. N. Japkowicz, Dr. C. Drummond

MSc Computer Science - with distinction *2010*
Carleton University, Ottawa, Canada
Thesis Title: Modelling and classifying stochastically episodic events
Advisor: Dr. J. Oommen

BCS, minor in mathematics *2006*
Carleton University, Ottawa, Canada

Awards and Honors

- *2015*: Best paper award: Synthetic Oversampling for Advanced Radioactive Threat Detection (ICMLA 2015)
- *2012*: Best paper award: Clustering Based One-class Classification for Compliance Verification of the Comprehensive Nuclear-test-ban Treaty (CAI 2012)

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2. mailto:colin.bellinger@gmail.com
3. https://web.cs.dal.ca/~bellinger
4. https://scholar.google.ca/citations?user=ZTBEngEAAAAJ&hl=en

Academic Positions Held

Digital Technologies Research Centre, National Research Council of Canada,
Ottawa, Canada
Assistant Research Officer *October 2018 – present*

Faculty of Computer Science, Dalhousie University,
Halifax, Canada
Adjunct Professor *May 2019 – present*

Faculty of Computing Science
Dalhousie University, Halifax, Canada
Donald Hill Postdoctoral Fellow *July 2018 – October 2018*

Alberta Machine Intelligence Institute (AMII), Computing Science
University of Alberta, Edmonton, Canada
Postdoctoral Fellow *June 2016 – July 2018*

School of Electrical Engineering and Computer Science
University of Ottawa, Ottawa, Canada
Research Fellow *April 2016 – June 2016*

Teaching

Institute for Environmental and Interdisciplinary Science
Carleton University, Ottawa, Canada
ISAP 3001: Introduction to data science *Autumn 2021*

Research Funding

- *2017-2018*: WCB-Alberta grant co-recipient ($32,213)
- *2012-2015*: Ontario Graduate Scholarship ($45,000)
- *2012-2012*: Canada-Brazil Joint Research initiative (6 months $10,200)
- *2010-2014*: Research Assistant, University of Ottawa ($36,000)
- *2010-2014*: Admission Scholarship, PhD program, University of Ottawa ($36,000)
- *2009-2010*: Research Assistance, Carleton University ($12,000)
- *2008-2010*: Admission scholarship and Teaching Assistant, MCS program, Carleton University ($12,000)

Publications (in reverse chronological order**)**

Articles Under Review

[1] **Bellinger, C**. and Corizzo, R. and Japkowicz, N. "Remix: Calibrated resampling for class imbalance in deep learning" Submitted to *Discovery Science*, (May 2021.)

[2] Ghosh, K. and **Bellinger, C**. and Corizzo, R. and Krawczyk, B and Japkowicz, N. " On the combined effect of class imbalance and concept complexity in deep learning" Submitted to *IEEE International Conference on Data Science and Advanced Analytics*, (May 2021.)

Articles Accepted in Refereed Journals

[1] Koziarski, M and **Bellinger, C**. and Woźniak, M., "RB-CCR: Radial-Based Combined Cleaning and Resampling algorithm for imbalanced data classification." In *Machine Learning*, 2021.

[2] Gross, D. P. and Steenstra, I. A. and Harrell, F. E. and **Bellinger, C**. and Zaïane, O., "Machine Learning for Work Disability Prevention: Introduction to the Special Series.." *Journal of occupational rehabilitation*, 2020.

[3] Tarawneh, A. S. and Hassanat, A.B.A. and Almohammadi, K. and Chetverikov, D. and **Bellinger, C**., "Smotefuna: Synthetic minority over-sampling technique based on furthest neighbour algorithm." *IEEE Access*, 2020.

[4] **Bellinger, C**. and Sharma, S. and Japkowicz, N. and Zaïane, O., "Framework for Extreme Imbalance Classification - SWIM: Sampling WIth the Majority Class." *Knowledge and Information Systems (KAIS)*, (Accepted July, 2019.)

[5] Gross, P.D. and Steenstra, A.I. and Shaw, W. and Yousefi, P. and **Bellinger, C**. and Zaiane, O. "Validity of the Work Assessment Triage Tool for Selecting Rehabilitation Interventions for Workers' Compensation Claimants with Musculoskeletal Conditions" *Journal of Occupational Rehabilitation*, (Accepted July 2019.)

[6] Serrano-Lomelin, J. and Nielsen, C. and Jabbar, S.M. and Wine, O. and **Bellinger, C**. and Villeneuve, P.J. and Stieb, D. and Aelicks, N. and Aziz, K. and Buka, I. and Chandra, S. and Crawford, S. and Demers, P. and Erickson, A.C. and Hystad, P. and Kumar, M. and Phipps, E. and Shah, P.S. and Yuan, Y. and Zaiane, O.R. and Osornio-Vargas, A.R. "Interdisciplinary-driven hypotheses on spatial associations of mixtures of industrial air pollutants with adverse birth outcomes." *Environmental International*, (Accepted June 2019.)

[7] Vu, K. and Clark, R. and **Bellinger, C**. and Erickson, G. Zaiane, O. and Osornio-Vargas, A. and Yuan, Y., "Lift and its Relationship to Relative Risk and Odds Ratio - Bridging the Terminology Gap Between Data Mining and Health Research" Submitted to *BMC Public Health*, (Accepted June, 2019.)

[8] Aldana, D. and Salgueiro, Y. and **Bellinger, C**. and Rivera, M. and Astudillo, C. "Data for resistance and inductance estimation within a voltage source inverter." *Data in Brief* (Accepted May 2019.)

[9] **Bellinger, C**. and Sharma, S. and Japkowicz, N., "One-Class Classification - From Theory to Practice: A case-study in radioactive threat detection." *Expert Systems with Applications*, (Submitted 29 Aug 2017, accepted 9 May 2018.)

[10] **Bellinger, C**. and Jabbar, M.S.M. and Zaïane, O. and Osornio-Vargas, A., "A Systematic Review of Data Mining and Machine Learning for Air Pollution Epidemiology." *BMC Public Health*, (Accepted Nov., 2017.)

[11] Jabbar, M.S.M. and **Bellinger, C**. and Zaiane, O. and Osornio-Vargas, A., "Discovering Co-location Patterns with Aggregated Spatial Transactions and Dependency Rules." *International Journal of Data Science and Analytics*, (Accepted Oct., 2017.)

[12] **Bellinger, C**. and Drummond, C. and Japkowicz, N., "Manifold-Based Synthetic Oversampling with Manifold Conformance Estimation." *Machine Learning*, (Accepted Sept., 2017.)

[13] **Bellinger, C**, and Oommen, B. J., "On the Pattern Recognition and Classification of Stochastically Episodic Events." *Transactions on Computational Collective Intelligence VI*, vol. 6, 2012.

Chapters in Edited Books

[1] **Bellinger, C**. and Jabbar, M.S.M. and Wine, O. and Nielsen, C. Lomelin, J.S. and Osornio-Vargas, A. and Zaiane, O., "AI Applied to Air Pollution and Environmental Health: A Case Study on Hypothesis Generation." In *Humanity Driven AI*, (Chen, F. and Zhou, J., ed.), Springer Nature Switzerland AG, 2021

[2] Oommen, B. J., and **Bellinger, C**., "Emerging Trends in Machine Learning: Classification of Stochastically Episodic Events." In *Emerging Paradigms in Machine Learning* (Ramanna, S. and Jain, L. C. and Howlett, R. J., ed.), Springer Berlin Heidelberg, pp. 161–195, 2013.

Articles Accepted in Refereed Conferences

[1] **Bellinger, C**. and Coles, R., and Crowley, M., and Tamblyn, I. "Active Measure Reinforcement Learning for Observation Cost Minimization." In *Proceedings of the Canadian Conference on Advances in Artificial Intelligence*, 2021.

[2] **Bellinger, C**. and Coles, R., and Crowley, M., and Tamblyn, I. "Reinforcement Learning in a Physics-Inspired Semi-Markov Environment." In *Proceedings of the Canadian Conference on Advances in Artificial Intelligence*, 2020.

[3] **Bellinger, C**. and Branco, P. and Torgo, L., "The CURE for Class Imbalance." In *Proceedings of the International Conference on Discovery Science*, 2019.

[4] Sharma, S. and **Bellinger, C**. and Krawczyk, B. and Japkowicz, N. and Zaïane, O., "Synthetic oversampling with the majority class: A new perspective on handling extreme imbalance." In *Proceedings of the 2018 IEEE International Conference on Data Mining*, 2018.

[5] Aldana, D. and Salgueiro, Y. and **Bellinger, C**. and Rivera, M. and Astudillo, C. "Performance Assessment of Classification Methods for the Inductance within a VSI." In *Proceedings of the 2018 IEEE International Conference on Automation*, 2018.

[6] Ahmed, F. and Samorani, M. and **Bellinger, C**. and Zaïane, O., "Advantage of integration in big data: Feature generation in multi-relational databases for imbalanced learning." In *Proceedings of the 2016 IEEE International Conference on Big Data*, pp. 532–539, 2016.

[7] **Bellinger, C**. and Drummond, C. and Japkowicz, N., "Beyond the Boundaries of SMOTE: Manifold-Based Synthetic Oversampling." In *Proceedings of the Machine Learning and Knowledge Discovery in Databases: European Conference*, pp. 248–263, 2016.

[8] V. Barnabé-Lortie, V. and **Bellinger, C**. and Japkowicz, N., "Active Learning for One-Class Classification." In *Proceedings of the 2015 IEEE 14th International Conference on Machine Learning and Applications*, pp. 390–395, 2015.

[9] **Bellinger, C**. and Amid, A. and Japkowicz, N. and Victor, H., "Multi-label Classification of Anemia Patients." In *Proceedings of the 2015 IEEE 14th International Conference on Machine Learning and Applications*, pp. 825–830, 2015.

[10] **Bellinger, C**. and Japkowicz, N. and Drummond, C., "Synthetic Oversampling for Advanced Radioactive Threat Detection." In *Proceedings of the 2015 IEEE 14th International Conference on Machine Learning and Applications*, pp. 825–830, 2015. *Best Paper Award*

[11] Barnabé-Lortie, V. and **Bellinger, C**. and Japkowicz, N., "Smoothing Gamma Ray Spectra to Improve Outlier Detection." In *Proceedings of the 2014 Seventh IEEE Symposium on Computational Intelligence for Security and Defense Applications*, pp. 1–8, 2014.

[12] **Bellinger, C**. and Sharma, S. and Japkowicz, N., "One-Class versus Binary Classification: Which and When?" In *Proceedings of the 2012 11th International Conference on Machine Learning and Applications*, pp. 102–106, 2012.

[13] Sharma, S. and **Bellinger, C**. and Japkowicz, N. and Berg, R. and Ungar, K., "Anomaly detection in gamma ray spectra: A machine learning perspective." In *Proceedings of the 2012 IEEE Symposium on Computational Intelligence for Security and Defence Applications*, pp. 1–8, 2012.

[14] Sharma, S. and **Bellinger, C**. and Japkowicz, N., "Clustering Based One-class Classification for Compliance Verification of the Comprehensive Nuclear-test-ban Treaty." In *Proceedings of the 2012 25th Canadian Conference on Advances in Artificial Intelligence*, pp. 181–193, 2012. *Best Paper Award*

[15] **Bellinger, C**. and Japkowicz, N., "Motivating the inclusion of meteorological indicators in the CTBT feature-space." In *Proceedings of the 2011 IEEE Symposium on Computational Intelligence for Security and Defense Applications*, pp. 2329–6267, 2011.

[16] **Bellinger, C**. and Oommen, B. J., "A new frontier in novelty detection: Pattern recognition of stochastically episodic events." In *Proceedings of the 2011 Asian Conference on Intelligent Information and Database Systems*, pp. 435–444, 2011.

[17] **Bellinger, C**. and Oommen, B. J., "On Simulating Episodic Events Against a Background of Noise-like Non-episodic Events." In *Proceedings of the 2010 Summer Computer Simulation Conference*, pp. 452–460, 2010.

Articles Accepted in Refereed Workshops

[1] **Bellinger, C** and Sharma, S. and Zaiane, O. and Japkowicz, N., "Sampling a Longer Life: Binary versus One-class classification Revisited." In *Proceedings of the 1st International Workshop on Learning with Imbalanced Domains: Theory and Application at ECML*, 2017.

[2] **Bellinger, C**. and others, "An Evaluation of the Value Added by Informative Metrics." In *Proceedings of the 4th workshop on Evaluation Methods for Machine Learning at ICML*, 2009.

Abstracts Accepted in Refereed Conferences

[1] Gross, D.P. and Steenstra, A.I. and Shaw, W.S. and Yousefi, P. and **Bellinger, C.** and Zaïane, O., "Validation of the Work Assessment Triage Tool for Selecting Rehabilitation Interventions for Injured Workers." *Work Disability Prevention and Integration Conference*, 2018.

[2] Nielsen, C. and Serrano Lomelin, J. Jabbar, MSM. Wine, O. and Zaïane, O. and Osornio Vargas, AR. and **Bellinger, C**. and the DoMiNo Team, "An Integrative and Collaborative Approach to Associating Adverse Birth Outcomes and Industrial Air Pollution." *Canadian National Perinatal Research Meeting*, 2018.

[3] **Bellinger, C**. and Jabbar, M.S.M. and Hojjati, S. and Zaïane, O. and Osornio Vargas, AR. and the DoMiNo Team, "VizAR: A Software Tool for Epidemiological Hypothesis Generation with Geo-Spatial Data Mining." *Canadian National Perinatal Research Meeting*, 2018.

Professional Duties

Program Chair:

- *2017*: 30th Canadian Conference on Artificial Intelligence Graduate Student Symposium (GSS)
- *2019*: 32th Canadian Conference on Artificial Intelligence Graduate Student Symposium (GSS)

Program Committees:

- *2021*: Conference on Knowledge Discovery and Data Mining (KDD 2021)
- *2021*: Conference on Artificial Intelligence (AAAI-21)
- *2021*: International Joint Conference on Artificial Intelligence (IJCAI 2021)
- *2021*: European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML PKDD 2021)
- *2020*: Neural Information Processing Systems (NeurIPS 2020)
- *2020*: International Joint Conference on Artificial Intelligence (IJCAI 2020)
- *2019*: Canadian Conference on Artificial Intelligence (AI 2019)
- *2018*: Canadian Conference on Artificial Intelligence (AI 2018)
- *2018*: Cost-Sensitive Learning Workshop (co-located with SDM 2018)
- *2018*: International Symposium on Methodologies for Intelligent Systems (ISMIS 2018)
- *2018*: Workshop on Learning with Imbalanced Domains: Theory and Applications (LIDTA)
- *2018*: Association for the Advancement of Artificial Intelligence (AAAI)
- *2018*: International Joint Conference on Artificial Intelligence (IJCAI)
- *2017*: Association for the Advancement of Artificial Intelligence (AAAI)
- *2017*: Canadian Conference on Advances in Artificial Intelligence (CAI)
- *2017*: Data Mining for Cyber Security (co-located with IEEE ICDM 2017)
- *2017*: Workshop on Learning with Imbalanced Domains: Theory and Applications (LIDTA)
- *2016*: IEEE Symposium on Computational Intelligence for Security and Defense Applications (CISDA)
- *2015*: Discovery Science (DS)

Refereeing:

Grants:

- *2019*: NSERC College and Community Innovation – Innovation Enhancement Grant, Canada
- *2018*: National Fund for Scientific and Technological Development (FONDECYT), Chile

Journals: Journal of Machine Learning Research & Expert Systems with Applications & IEEE Intelligent Systems & Machine Learning Journal & Neurocomputing & Transactions on Knowledge and Data Engineering & IEEE Transactions on Neural Networks and Learning Systems & IEEE Transactions on Pattern Analysis and Machine Intelligence & Pattern Recognition Letters & Technology & Information Sciences &BMC Medical Informatics and Decision Making & Environmental Science & Health and Technology & Environmental Research

Organizer:

- *May 2021*: ICLR 2021 S2D-OLAD Workshop
- *Weekly 2016 – 2018*: University of Alberta, Weekly AI Seminars
- *February 2018*: Carleton University, Canada, Workshop on Epidemiological Hypothesis Generation with the VizAR Software

Other Contributions:

- *2019*: IBM AI XPRIZE For Social Good – Red Judge
- *2019*: GovLab 100 Questions Initiative on Air Quality – Contributor

Other Events

- *June 2019*: The 36th Annual Quality and Productivity Research Conference, Workshop on Applied Data Mining, (Invited speaker).
- *February 2018*: Carleton University, Canada, Workshop on Epidemiological Hypothesis Generation with the VizAR Software, (lecturer and tutorial instructor).
- *August 2016*: University of Alberta, Canada, AI Seminar, (invited speaker).
- *May 2014*: Universidad de Talca, Chile, visiting Cesar Astudillo, (invited speaker).
- *February 2014*: University of Ottawa, Canada, The Text Analysis and Machine Learning Group. (invited speaker).

Other Relevant Employment

University of Ottawa, School of Electrical Engineering and Computer Science, Ottawa, Canada
Teaching Assistant / Lab Instructor *September 2010 - December 2015*

University of Ottawa, School of Electrical Engineering and Computer Science, Ottawa, Canada
Programming tutor *January 2010 - December 2014*

Carleton University, School of Computer Science, Ottawa, Canada
Teaching Assistant / Lab Instructor *September 2008 - May 2010*

Carleton University, School of Computer Science, Ottawa, Canada
Programming Tutor *January 2010 - May 2010*

Carleton University, School of Computer Science, Ottawa, Canada
Computer Science Peer Counselor *September 2006 - December 2006*

Citizen of

Canada

Languages:

First language: English
Beginner level: French and Spanish.