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Research Areas

Applied Machine Learning • Classification • Clustering • Computer Security • Computational Criminology • Decision Support Systems

Current position

2023– *Associate Professor (Docent)*, Department of Computer Science, Blekinge Institute of Technology (BTH)

Education

2014 PH. D. in Computer Science, BTH Sweden
2012 LIC. TECH. in Computer Science, BTH, Sweden
2009 B. Sc. in Computer Science, BTH Sweden

Ph.D. Dissertation

2014 *On Descriptive and Predictive Models for Serial Crime Analysis* [\[PDF\]](#) [\[HTML\]](#)
The thesis first investigates predictive and descriptive machine learning methods, with a focus on data structuring, comparison, and evaluation of methods. The knowledge is then applied to the domain of crime scene analysis, with a focus on detecting serial residential burglaries. The thesis also investigates impact and relationship between crime scene characteristics and how to evaluate the descriptive model results.

Research Summary

I am currently involved in projects investigating how CCTV cameras can be placed for crime investigation and prevention (together with MAU and Swedish Law enforcement), if utilization forecasting in private clouds can be used to reduce energy consumption (together with Ericsson and Cleura), and production planning (together with NKT).

I defended my thesis in late 2014. The thesis mainly concerned how machine learning can be used to analyze residential burglaries. The research was conducted in cooperation with Swedish law enforcement and the Swedish National Forensic Center. I have since been involved in multiple projects in collaboration with public and private organisations.

Work experience

- 2023– *Associate Professor (Docent)*, Department of Computer Science, BTH.
- 2018–2023 *Senior Lecturer*, Department of Computer Science, BTH. Main research focus has been on anomaly detection, applied machine learning, and document analysis (including NLP).
- 2017–2018 *Associate Senior Lecturer*
Department of Computer Science, BTH. Main research focus has been on anomaly detection and document analysis (including NLP).
- 2015–2017 *Post-doc*
Employed at the department of Computer Science and Engineering, BTH. Main focus has been on research in the domains of clustering and computation criminology (both towards analyzing serial crime).
- 2009–2014 *Ph.D. Student*
Ph.D. student at the department of Computer Science and Engineering, BTH. Main focus was on research involving machine learning for use in the domains of computer security (spam and spyware detection) and computational criminology (link detection between residential burglaries). Part of the position involved teaching students at bachelor and masters level.
- 2008 *Software developer*
Employed by Blekinge Business Incubator as a C++ Developer to develop a proof-of-concept for a Reputation System for malicious software in a two man team. Project lasted over the summer, during my bachelor studies.
- 2007 *Software developer*
Employed by Blekinge Business Incubator as a C#/C++ Developer to develop a proof-of-concept for a Reputation System for malicious software in a two man team. Project lasted over the summer, during my bachelor studies.

Academic Leadership

- 2024– Team-leader for the Computer and Systems group (COSY) within the department of Computer Science, BTH
- 2021 Dec– Deputy Head of Department at the department of Computer Science, BTH.
- 2021 Jan–Nov Acting Head of Department at the department of Computer Science, BTH.
- 2020 Oct–Dec Deputy Head of Department at the department of Computer Science, BTH.

Educational Leadership

- 2017–2022 Program-manager for the Master of science in engineering in IT-Security.
- 2017–2022 Lead developer and program-manager for the Bachelor of science in engineering in IT-Security.
- 2015–2018 Program-manager for the bachelor program in IT-Security.

Community Service

- 2022 External evaluator for the bachelor program in software development at Högskolan Kristianstad.
- 2019 External evaluator for the bachelor program in digital forensics at Högskolan Halmstad.
- 2018 General Chair European Intelligence and Security Informatics Conference (EISIC) 2018
- 2015–2020 Board member of [Swedish AI Society \(SAIS\)](#)
- 2010–2012 Elected Chairman of the Doctoral Candidate Council at BTH in 2011–2012. Member of the board 2010–2012.
- 2010–2012 Board member of the Faculty board and the Teachers Appointment board at BTH as a doctoral candidate representative, 2010–2011.
- 2007–2008 Secretary in Program Association for students of the bachelor program for computer security.

Programming Skills

Scientific computing (R, Python, MySQL).
Scripting languages (PHP, Python, shell script).
Development languages (c++, Java, Python).
Markup languages (HTML, CSS).
Revision control (Git, Subversion).
Digital typesetting (\LaTeX).

Languages

Swedish (Native Speaker)
English (professional proficiency)

Press

- 2018 [Så manipuleras du på nätet](#), Sydöstran (Swedish)
[Så blir vi manipulerade på nätet](#), Sveriges Radio (Swedish)
- 2017 [Elektroniska val är framtiden](#), Sveriges Radio (Swedish)
- 2016 [Polisens nya grepp mot inbrott](#), Skydd & Säkerhet (Swedish)
[Nytt system kartlägger tjuvar](#), TT (Swedish)
[Polis får hjälp av forskare](#), SVT (Swedish)
- 2012 [BTH vill hjälpa polisen, locka studenter och spara pengar åt Ericsson](#), Sydöstran (Swedish)
- 2009 [Forskning ska säkra e-posten](#), Computer Sweden (Swedish)

Projects

- 2024 *NPTelligent*
Research project for NKT HV Cables investigating decision support for production planning. Project leader.
- 2023-2025 *Green Clouds*
KKS-Hög project focusing on load prediction in order to optimize energy consumption in private clouds. Funding provided by KKS, 5.2MSEK. Co-applicant with Håkan Grahn and Lars Lundberg.
- 2023 – 2025 *Data-driven analys av polisens kamerabevakning - Effekter på brott, brottsupplärning och otrygghet*
Joint project with Malmö University and University of New Haven. The main focus of the project is to investigate law enforcement usage of surveillance cameras and their effect on crimes. BTH is investigating data driven methods for optimizing camera placement. Funding granted by Vetenskapsrådet (4.7MSEK). Co-applicant. Manne Gerell was main applicant.
- 2022–2024 *Automatiserad analys & klassificering av förseningsorsaker i järnvägssystemet*
The focus of the project is to investigate the use of machine learning in fault classification for delays in the national railway system. Funding is provided by Trafikverket, (1.6MSEK). Co-applicant. Johanna Törnqvist Krasemann was main applicant.
- 2021–2023 *Law Enforcement Support System using Intelligent Models*
The project is a joint project together with the department of criminology at Malmö University and Swedish Law Enforcement. BTHs part in the project is focused on applying computer science methods to provide tools to improve camera surveillance systems and their use in solving and reducing crimes. Funding provided by Länsförsäkringar, 5MSEK (Already funded). Manne Gerell was main applicant.
- 2018-2022 *Rekrytering17, Lektor i datavetenskap*
The project is a KKS recruitment project which overlaps with the project *Scalable resource-efficient systems for big data analytics* (grant 20170236) (Already funded). Håkan Grahn was lead applicant.
- 2020 *Automatic Analysis of Patient complaints using Intelligent Models*
The project focused on using machine learning models to extract knowledge from patient complaints in order to assist complaint personnel handling the complaints. Automatic complaint categorization and comparison with similar types of errands to support when deciding how to handle each complaint. Funding provided by Region Blekinge, 300K. Lisa Skär was main applicant.
- 2017–2020 *Scalable resource-efficient systems for big data analytics*
Project that focus on combining machine learning, data mining, and computer engineering to create new knowledge in the area of scalable resource-efficient systems for big data analytics. In this project I have been involved in a subproject involving machine learning for decision support systems in large-scale systems. Funding was granted by the Knowledge Foundation for 2014–2020 (already funded). I was involved during 2017. Håkan Grahn was main applicant.
- 2016 *Efficient collection and analysis of crime scene information regarding volume crimes*
Second continuation project in collaboration with Swedish police and Swedish National Forensic Center. The goal of the project was investigating prototypes for use by law enforcement, as well as methods for qualitative feedback. In this project I conducted research in how supervised and unsupervised machine learning can be used to assist solving volume crimes. Funding was granted by Vinnova (1.2 MSEK from funding agency), co-applicant. Martin Boldt was main applicant.

- 2015 *National center for IT-based law enforcement methodology research*
Continuation project in collaboration with Swedish police and Swedish National Forensic Center. The project focused on extending the previous research into other types of crime, to establish an academic center for computational criminology, and to investigate possible collaboration with other parts of society. Funding was granted by Region Blekinge, 2 MSEK (1 MSEK from funding agency), co-applicant. Martin Boldt was main applicant.
- 2012–2014 *Computer-based support for increased knowledge concerning crimes with series characteristics*
Project in collaboration with local law enforcement and Swedish National Forensic Center. The purpose of the project was investigating systematic residential burglary incident reporting and computer-based analysis. In this project I conducted research in how primarily unsupervised machine learning, but also supervised techniques, can be used to assist solving volume crimes. Funding granted by ERUF, 5.6 MSEK (already funded). Niklas Lavesson was main applicant.
- 2009–2012 *Reliable e-mail communication*
Project with .SE, the Swedish internet registrar, with the purpose of investigating decision support for detecting malicious software. In this project I assisted in developing simulation models for reputation based decision support, a tool that uses machine learning to analyze license agreements and worked with several studies investigating these approaches. Funding granted by .SE, 1.85 MSEK (already funded). Bengt Carlsson was main applicant.

Supervision Experience

PH.D. SUPERVISION

I completed the Ph.D. Supervision course at BTH during spring 2020.

- 2022– Kenneth Lewenhagen, supervisor. Main supervisor is Martin Boldt.
 2022– Christoffer Åleskog, supervisor. Main supervisor is Håkan Grahn.
 2022– Jim Ahlstrand, supervisor. Main supervisor is Martin Boldt.
 2022– Aleksandr Silonov, supervisor. Main supervisor is Emiliano Casalicchio.
 2020– Mahwish Anwar, supervisor. Main supervisor is Lars Lundberg.

GRADUATE THESIS SUPERVISION

- 2022 Alexander Ljungberg, Simon Smedberg, "Discovering and masking environmental features in modern sandboxes"
 2019 Henning Råberg, Viktor Uppströmer, "Detecting Lateral Movement in Microsoft Active Directory Log Files: A supervised machine learning approach"
 2019 Albert Fiati-Kumasenu, "Extracting Customer Sentiments from Email Support Tickets: A case for email support ticket prioritisation"
 2019 Martin Lundblad, Robin Roth, "An Evaluation of Machine Learning Approaches for Hierarchical Malware Classification"
 2018 Oliver Rosander, Jim Ahlstrand, "Email Classification with Machine Learning and Word Embeddings for Improved Customer Support"
 2018 Leonce Hauvigman, "Conformal Anomaly Detection of household energy consumption"
 2018 Kenneth Lewenhagen, Andreas Arnesson, "Comparison and Prediction of Temporal hotspots"
 2016 Johan Eliasson, "Linkage Detection using Crime Route Analysis and Modus Operandi Similarity"

2015 Kim Hansson, Erik Hörlin, "Active learning via Transduction in Regression Forests"

UNDERGRADUATE THESIS SUPERVISION

2019 Vincent Teowolde, "Comparison of authentication options for MQTT communication in an IoT based smart grid solution"

2014 Erik Johansson, Christoffer Gåhlin, "Crime hotspots: An evaluation of the KDE spatial mapping technique: Spatial analysis"

2013 Sebastian Norling, "En säkerhetsgranskning av Secure Application Framework"

2012 Pawel Mynarski, Oscar Carlsson, "Identification and analysis of botnets with the help of active security systems" (Swedish)

Reviewer

JOURNAL REVIEWER

[Machine Learning](#)

[International Journal of Computational Science and Engineering,](#)

[International Journal of Advanced Intelligence Paradigms,](#)

[Expert Systems with Applications,](#)

[Applied Geography,](#)

[ISPRS International Journal of Geo-Information,](#)

[Security Journal](#)

[Journal of Machine Learning](#)

[Neural Computing and Applications](#)

CONFERENCE REVIEWER

European Intelligence and Security Informatics Conference (EISIC): 2016;

Swedish Artificial Intelligence Society (SAIS): 2016, 2017; 2019;

European Network Intelligence Conference (ENIC): 2016, 2017;

The International Conference on Machine Learning, Optimization, and Data Science (LOD): 2015; 2018, 2019, 2020, 2021, 2022, 2023, 2024

The International Conference on Complex Networks and their Applications (COMPLEX NETWORKS): 2021, 2022;

International Special Session on Data Mining and Machine Learning Applications for Cyber Security (DMMLACS): 2022

Scandinavian Conference on AI (SCAI): 2024

CONFERENCE ORGANIZING COMMITTEES

European Intelligence and Security Informatics Conference (EISIC) 2018;

The 35th Swedish Artificial Intelligence Society (SAIS'23) annual workshop;

Publications

PEER-REVIEWED JOURNALS

- J1: **Anton Borg**, Per Lingvall, and Martin Svensson. "Hierarchical Delay Attribution Classification Using Unstructured Text in Train Management Systems." ArXiv, (2024).
- J2: Lars Lundberg, Martin Boldt, **Anton Borg**, and Håkan Grahn, "Bibliometric Mining of Research Trends in Machine Learning", *AI*, vol 5, no 1, pages 208-236 (2024), [doi]
- J3: Mahwish Anwar, Lars Lundberg, **Anton Borg**, "Improving anomaly detection in SCADA network communication with attribute extension." *Energy Inform*, 5, 69 (2022). [doi]
- J4: Christoffer Åleskog, Håkan Grahn, **Anton Borg**, "Recent Developments in Low-Power AI Accelerators: A Survey." *Algorithms*, vol 15, no. 11 (2022), 419. [doi]
- J5: **Anton Borg**, Martin Svensson, "All Burglaries Are Not the Same: Predicting Near-Repeat Burglaries in Cities Using Modus Operandi", Special Issue "Geographic Crime Analysis", *International Journal of Geo-Information*, Vol. 11, no 3, article 160 (2022) [doi]
- J6: Martin Boldt, Selim Ickin, **Anton Borg**, Valentin Kulyk, Jörgen Gustafsson, "Alarm prediction in cellular base stations using data-driven methods", *IEEE Transactions on Network and Service Management*, Vol. 18, no 2, pages 1925-1933 (2021)
- J7: **Anton Borg**, Martin Boldt, "Using VADER sentiment and SVM for predicting customer response sentiment", *Expert Systems with Applications*, (2020)
- J8: **Anton Borg**, Martin Boldt, Oliver Rosander, Jim Ahlstrand, "E-mail classification with machine learning and word embeddings for improved customer support", *Neural Computing and Applications*, pages 1-22 (2021)
- J9: Martin Boldt, **Anton Borg**, Selim Ickin, Jörgen Gustafsson, "Anomaly detection of event sequences using multiple temporal resolutions and Markov chains", *Knowledge and Information Systems*, pages 1-18 (2019) [doi]
- J10: Martin Boldt, **Anton Borg**, Martin Svensson, Jonas Hildeby, "Using predictive models on crime scene data to estimate burglars' risk exposure and level of pre-crime preparation", *Intelligent Data Analysis*, Vol. 22, no. 1, Pages 167-190 (2018) [doi]
- J11: Martin Boldt, **Anton Borg**, "Evaluating temporal analysis methods using residential burglary data", *International Journal of Geo-Information* 5(9), 148; (2016) [doi]
- J12: Fredrik Erlandsson, Piotr Bródka, **Anton Borg**, Henric Johnson, "Finding Influential Users in Social Media Using Association Rule Learning." *Entropy* 18, no. 5: 164. (2016) [doi]
- J13: **Anton Borg**, Martin Boldt, "Clustering Residential Burglaries Using Modus Operandi and Spatiotemporal Information", *International Journal of Information Technology & Decision Making* 15, 23 (2016). [doi]
- J14: **Anton Borg**, Martin Boldt, Niklas Lavesson, Veselka Boeva, Ulf Melander, "Detecting Serial Residential Burglaries using Clustering," *Expert Systems With Applications*, Volume 41, Issue 11, 1 September 2014, Pages 5252-5266, Elsevier. [doi]

PEER-REVIEWED CONFERENCES

- C1: Jim Ahlstrand, Martin Boldt, **Anton Borg**, Håkan Grahn, "Preliminary Results on the use of Artificial Intelligence for Managing Customer Life Cycles", Swedish Artificial Intelligence Society, 2023, 68-76, [doi]
- C2: Mahwish Anwar, **Anton Borg**, Lars Lundberg, "A Comparison of Unsupervised Learning Algorithms for Intrusion Detection in IEC 104 SCADA Protocol," *2021 International Conference on Machine Learning and Cybernetics (ICMLC)*, Adelaide, Australia, 2021, pp. 1-8, [doi]
- C3: **Anton Borg**, Jim Ahlstrand, "Detecting Non-routine Customer Support E-Mails", *Proceedings of the 23rd International Conference on Enterprise Information Systems (ICEIS 2021)*, Vol. 1, pages 387-394, 2021. [doi]
- C4: **Anton Borg**, Jim Ahlstrand, Martin Boldt, "Improving Corporate Support by Predicting Customer e-Mail Response Time: Experimental Evaluation and a Practical Use Case", In: Filipe J., Śmialek M., Brodsky A., Hammoudi S. (eds) *Enterprise Information Systems. ICEIS 2020.*, Lecture Notes in Business Information Processing, vol 417. Springer, Cham. [doi].
- C5: **Anton Borg**, Jim Ahlstrand, Martin Boldt, "Predicting E-Mail Response Time in Corporate Customer Support," *Proceedings of the 22nd International Conference on Enterprise Information Systems (ICEIS)*, 2020.
- C6: **Anton Borg**, Martin Boldt, Johan Svensson, "Using Conformal Prediction for Multi-label Document Classification in e-Mail Support Systems," *International Conference on Industrial, Engineering and Other Applications of Applied Intelligent Systems*, 2019.
- C7: Martin Boldt, Veselka Boeva, **Anton Borg**, "Multi-Expert Estimations of Burglars' Risk Exposure and Level of Pre-Crime Preparation Using Coded Crime Scene Data: Work in Progress", *2018 European Intelligence and Security Informatics Conference (EISIC)*, 77-80.
- C8: Martin Boldt, **Anton Borg**, "A statistical method for detecting significant temporal hotspots using LISA statistics", in proceedings of *the 8th European Intelligence and Security Informatics Conference (EISIC)*, 2017. [PDF]
- C9: **Anton Borg**, Martin Boldt and Johan Eliasson, "Detecting crime series based on route estimations and behavioral similarity", in proceedings of *the 8th European Intelligence and Security Informatics Conference (EISIC)*, 2017. [PDF]
- C10: Fredrik Erlandsson, Piotr Bródka, **Anton Borg**, "Seed Selection for Information Cascade in Multilayer Networks", *International Conference on Complex Networks and their Applications*, 2017. [doi] *
- C11: Fredrik Erlandsson, **Anton Borg**, Piotr Bródka, Henric Johnson, "Predicting User Participation in Social Media", *Advances in Network Science*, 126-135, 2016. [doi]
- C12: Erik Johansson, Christoffer Gåhlin and **Anton Borg**, "Crime Hotspots: An Evaluation of the KDE Spatial Mapping Technique," *Intelligence and Security Informatics Conference (EISIC)*, 2015 European, Manchester, 2015, pp. 69-74. [doi]
- C13: Martin Boldt, **Anton Borg**, "En ny metod för registrering och automatisk analys av mängdbrott", *proceedings of The 5th Biennial Nordic Police Research Seminar*, 2014.
- C14: **Anton Borg**, Niklas Lavesson, Veselka Boeva, "Comparison of Clustering Approaches for Gene Expression Data," *Twelfth Scandinavian Conference on Artificial Intelligence: SCAI 2013*, Vol. 257, 2013, IOS Press. [doi]

- C15: **Anton Borg**, Niklas Lavesson, "E-mail Classification using Social Network Information," pp. 168-173, 2012 *International Conference on Availability, Reliability and Security*, IEEE. [\[doi\]](#)
- C16: **Anton Borg**, Martin Boldt, Niklas Lavesson, "Informed software installation through License Agreement Categorization," *Information Security South Africa*, 2011, pp.1-8., IEEE. [\[doi\]](#)
- C17: **Anton Borg**, Martin Boldt, Bengt Carlsson, "Simulating Malicious Users in a Software Reputation System", *Secure and Trust Computing, Data Management and Applications*, 2011, Communications in Computer and Information Science, Volume 186, Part 1, 147-156, Springer. [\[doi\]](#)
- C18: Martin Boldt, **Anton Borg**, Bengt Carlsson, "On the Simulation of a Software Reputation System," pp.333-340, 2010 *International Conference on Availability, Reliability and Security*, IEEE. [\[doi\]](#)

PEER-REVIEWED WORKSHOPS

- W1: Kenneth Lewenhagen, Martin Boldt, **Anton Borg**, Manne Gerell, Johan Dahlén, "An Interdisciplinary Web-based Framework for Data-driven Placement Analysis of CCTV Cameras", *2021 Swedish Workshop on Data Science (SweDS)*, 1-6, 2021.
- W2: Martin Boldt, Veselka Boeva, **Anton Borg**, "Multi-expert estimations of burglars' risk exposure and level of pre-crime preparation based on crime scene data", *30th Annual Workshop of the Swedish Artificial Intelligence Society (SAIS2017)*, 2017.

REPORTS

- R1: Manne Gerell, Carolina Ellberg, Kenneth Lewenhagen, **Anton Borg**, Martin Boldt, "Kamerabevakning i polisens brottsutredande arbete", *Report, MAU* (2021)