Anton Borg

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Research Areas

Machine Learning • Classification • Clustering • Computer Security • Computational Criminology

Current position

2015–2017 *Post-doc*, Department of Computer Science and Engineering, Blekinge Institute of Technology (BTH)

Education

2014 Ph. D. in Computer Science, BTH Sweden
2012 Lic. Sc. in Computer Science, BTH, Sweden
2009 B. Sc. in Computer Science with emphasis on Computer Security, 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.

Work experience

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.

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.

Miscellaneous

2015–present 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, JavaScript).
Development languages (c++, Java, C#).
Markup languages (HTML, CSS).
Revision control (Git, Subversion).
Digital typesetting (LaTeX).

Languages

Swedish (Native Speaker)
English (professional proficiency)

Press

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

2017– *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, I became involved 2017.

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 with Martin Boldt et al.

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 together with Martin Boldt et al.

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)

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)

Publications

Journals

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", journal manuscript accepted for publication to Intelligent Data Analysis, 2018.

Martin Boldt, **Anton Borg**, "Evaluating temporal analysis methods using residential burglary data", *International Journal of Geo-Information* 5(9), 148; (2016) [DOI]

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]

Anton Borg, Martin Boldt, "Clustering Residential Burglaries Using Modus Operandi and Spatiotemporal Information", *International Journal of Information Technology & Decision Making* 15, 23 (2016). [DOI]

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]

Conferences

Martin Boldt, Veselka Boeva, **Anton Borg**, "Multi-expert estimations of burglars' risk exposure and level of pre-crime preparation based on crime scene data", Accepted for publication at *30th Annual Workshop of the Swedish Artificial Intelligence Society (SAIS2017)*, 2017.

Fredrik Erlandsson, **Anton Borg**, Piotr Bródka, Henric Johnson, "Predicting User Participation in Social Media", *Advances in Network Science*, 126-135, 2016 [DOI]

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]

Martin Boldt, **Anton Borg**, "En ny metod för registrering och automatisk analys av mängdbrott", *proceedings of The 5th Biennial Nordic Police Research Seminar*, 2014.

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]

Anton Borg, Niklas Lavesson, "E-mail Classification using Social Network Information," pp. 168-173, 2012 *International Conference on Availability, Reliability and Security*, IEEE. [DOI]

Anton Borg, Martin Boldt, Niklas Lavesson, "Informed software installation through License Agreement Categorization," *Information Security South Africa*, 2011, pp.1-8., IEEE. [DOI]

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]

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]

Manuscripts

Anton Borg, Martin Svensson, "Estimating near-repeats using Modus operandi". Journal manuscript, 2017.

Martin Boldt, **Anton Borg**, "A statistical method for detecting significant temporal hotspots using LISA statistics", Conference manuscript submitted for publication, 2017

Anton Borg, "Linking Residential Burglaries using Modus Operandi", journal manuscript submitted for publication 2017.

Anton Borg, Martin Boldt, Johan Eliasson, "Detecting Crime Series Based on Route Estimation and Behavioral Similarity", Conference manuscript submitted for publication, 2017

Fredrik Erlandsson, Piotr Bródka, **Anton Borg**, "Finding influential users for information spreading in multilayer networks", journal manuscript, 2017

Anton Borg, "Predicting Offender Profile using Modus Operandi", Journal manuscript

Teaching

2017–present Responsible for the civil engineering (masters of science in engineering) program in computer security at BTH.

2015–present Responsible for the Bachelor program in Computer Security at BTH.

2012–present Supervisor for bachelor- and masters students in computer science.

Examples of courses where I have been involved in development, teaching, reviewing, or examinations: *Introduction to Computer Security* (7.5 ECTS); *Software Security* (7.5 ECTS); *Databases* (7.5 ECTS); *Introduction to C++* (7.5 ECTS); *Object-oriented Programming* (7.5 ECTS); *Programming, Data-structures, and Algorithms* (22.5 ECTS); *Computer Security for parents* (7.5 ECTS); *Security in Digital Ecosystems* (7.5 ECTS); *Machine Learning* (7.5 ECTS); *Masters thesis in Computer Science* (30 ECTS); *Degree Project in Master of Science in Engineering* (30 ECTS); *Bachelor Thesis in Computer Science* (15 ECTS); *Project in Security with emphasis Software Development* (8 ECTS); *Introduction to Computer Security* (5.5 ECTS); *Research orientation, computer security* (2 ECTS)

Masters- & Bachelor thesis Supervision

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”

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: International Journal of Computational Science and Engineering; International Journal of Advanced Intelligence Paradigms, Expert Systems with Applications

Conference Reviewer and Program Committees: European Intelligence and Security Informatics Conference (EISIC) 2016; Swedish Artificial Intelligence Society (SAIS 2016); Swedish Artificial Intelligence Society (SAIS 2017); MOD 2015 - The First International Workshop on Machine Learning, Optimization and Big Data; European Network Intelligence Conference (ENIC 2016); European Network Intelligence Conference (ENIC 2017)