

# Alexander Soen

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## Summary

I have a wide range of interests within machine learning, with a primary interest in utilizing information geometric tools and loss function theory. My current research focus involves exploring bounds for domain adaptation and exploring novel perspectives for learning with rejection / model cascades. I also have a strong interest in fairness and boosting algorithms, which I have explored earlier in my PhD. Previously, I have worked on topics including theorem provers, visualisation of academic influence, universal approximation theorems, and point process models.

## Education

### Doctor of Philosophy in Computer Science

THE AUSTRALIAN NATIONAL UNIVERSITY; CANBERRA, AUSTRALIA

*Anticipated Submission 2026 March*

*2021 – Pres.*

### Bachelor of Advanced Computing (R&D) (First Class Honours, University Medal)

THE AUSTRALIAN NATIONAL UNIVERSITY; CANBERRA, AUSTRALIA

*GPA: 7.0/7.0*

*2016 – 2019*

### Secondary School

RADFORD COLLEGE; CANBERRA, AUSTRALIA

*ATAR: 98.75*

*2014 – 2015*

## Publications

### Published

- [1] **Soen A**, “A Connection Between Learning to Reject and Bhattacharyya Divergences” GSI 2025
- [2] Koc O, **Soen A**, Chiang CK, Sugiyama M, “Domain Adaptation and Entanglement: an Optimal Transport Perspective” AISTATS 2025
- [3] Calderon P, **Soen A**, Rizoiu MA, “Linking Across Data Granularity: Fitting Multivariate Hawkes Processes to Partially Interval-Censored Data” IEEE TCSS 2024
- [4] **Soen A**, Husain H, Schulz P, Nguyen V, “Rejection via Learning Density Ratios” NeurIPS 2024
- [5] **Soen A**, Sun K, “Tradeoffs of Diagonal Fisher Information Matrix Estimators” NeurIPS 2024
- [6] Nock R, Amid E, Nielsen F, **Soen A**, Warmuth MK, “Hyperbolic Embeddings of Supervised Models” NeurIPS 2024
- [7] Zhu H, **Soen A**, Cheung YK, Xie L, “Online Learning in Betting Markets: Profit versus Prediction” ICML 2024
- [8] Wang EX, et al., “3D NLTE Lithium abundances for late-type stars in GALAH DR3” MNRAS 2024/3
- [9] **Soen A**, Husain H, Nock R, “Fair Densities via Boosting the Sufficient Statistics of Exponential Families” ICML 2023
- [10] **Soen A**, Alabdulmohsin I, Koyejo S, Mansour Y, Moorosi N, Nock R, Sun K, Xie L, “Fair Wrapping for Black-box Predictions” NeurIPS 2022
- [11] Rizoiu MA, **Soen A**, Li S, Calderon P, Dong L, Menon AK, Xie L, “Interval-censored Hawkes processes” JMLR 2022
- [12] **Soen A**, Sun K, “On the Variance of the Fisher Information for Deep Learning” NeurIPS 2021
- [13] **Soen A**, Mathews A, Grixti-Cheng D, Xie L, “UNIPoint: Universally Approximating Point Processes Intensities” AAAI 2021
- [14] Shin M, **Soen A**, Readshaw BT, Blackburn SM, Whitelaw M, Xie L, “Influence flowers of academic entities” IEEE VAST 2019

### Preprints (arXiv)

- [15] **Soen A**, Nielsen F, “pyBregMan: A Python library for Bregman Manifolds” 2408.04175
- [16] Li S, Walder C, **Soen A**, Xie L, Liu M, “Sampled transformer for point sets” 2302.14346

## Work Experience and Projects

### PhD Student

AUSTRALIAN NATIONAL UNIVERSITY

*Canberra, Australia*

*2021 – 2026*

- In collaboration with the interdisciplinary Humanising Machine Intelligence group at the Australian National University.
- Developing novel algorithms using tools from theoretical machine learning and information geometry, with applications in algorithmic fairness.

### Student Researcher

GOOGLE

*Sydney, Australia*

*2025*

- 6 month internship at Google Sydney in the efficiency team.
- Worked on research in machine learning efficiency, including, topics such as speculative decoding and working on JAX code.

### Student Trainee

RIKEN

*Remote + Tokyo, Japan*

*2023 – 2025*

- 6 month internship at the RIKEN Imperfect Information Learning Team.
- Machine learning research on generalized exponential families, importance weighting, and PAC-Bayesian generalization bounds.
- Coauthored a paper on unsupervised domain adaptation [2].

<b>PyBregMan - Co-creator</b>	Remote + Tokyo, Japan
AUSTRALIAN NATIONAL UNIVERSITY / RIKEN	2023 – 2024
<ul style="list-style-type: none"> <li>An open source Python library for geometric computing on BREGman MANifolds with applications. Available on <a href="#">GitHub</a> and <a href="#">PyPi</a>.</li> <li>Tutorial “Data Representations on the Bregman Manifold” accepted at ICML’24 GRaM workshop with <a href="#">Google Colab</a>.</li> <li>Website at: <a href="https://franknielsen.github.io/pyBregMan/index.html">https://franknielsen.github.io/pyBregMan/index.html</a>. Reference documentation for software [15].</li> </ul>	
<b>Applied Scientist Intern</b>	Canberra, Australia
AMAZON	2023
<ul style="list-style-type: none"> <li>6 month internship at the Amazon Australian Machine Learning team.</li> <li>Machine learning research on causal inference, uncertainty quantification, and learning with rejection. Paper published [4].</li> <li>Working on business projects in the retail product space.</li> <li>Analysing data, building models, and using Amazon’s tool-kits (AWS, Python, Tensorflow).</li> </ul>	
<b>Interval-Censored Point Processes – Research Assistant</b>	Sydney, Australia
UNIVERSITY OF TECHNOLOGY SYDNEY	2020
<ul style="list-style-type: none"> <li>Worked in a Facebook funded project which involves the collaboration of computer scientists and social scientists to study hate speech.</li> <li>Built and deployed various web-crawlers from scratch in Python using numerous APIs.</li> <li>Developed new algorithms to fit interval-censored data to Hawkes Process; which resulted in publications [11, 3].</li> </ul>	
<b>Knowledge Graphs – Research Assistant</b>	Canberra, Australia
AUSTRALIAN NATIONAL UNIVERSITY	2020
<ul style="list-style-type: none"> <li>Collaborated with departments of the Australian Government to integrate different data sources for analysis.</li> <li>Created a software pipeline to create knowledge graphs using various technologies (RDF, SPARQL, external APIs).</li> </ul>	
<b>Point Processes and Neural Networks – Summer Research + Research Student</b>	Canberra, Australia
AUSTRALIAN NATIONAL UNIVERSITY + AUSTRALIAN SIGNALS DIRECTORATE	2018 – 2019
<ul style="list-style-type: none"> <li>Collaborated with the Australian Signals Directorate in linking different types of Hawkes process models.</li> <li>Proposed a novel architecture for incorporating universal approximation of neural networks for Hawkes process models.</li> <li>The work resulted in publication [13].</li> </ul>	
<b>Visualisation of Academic Influence – Research Assistant</b>	Canberra, Australia
AUSTRALIAN NATIONAL UNIVERSITY	2017 – 2019
<ul style="list-style-type: none"> <li>Maintained and developed the InfluenceMap website (<a href="https://influencemap.cmlab.dev">https://influencemap.cmlab.dev</a>): a visualisation tool for examining citation and publication based influence patterns in research.</li> <li>Worked with Microsoft Academic API to gather the data used for visualisation.</li> <li>Presented and demoed the project at the 2018 ACM Multimedia Conference business meeting in Seoul, South Korea.</li> <li>The insights and tools developed resulted in publication [14].</li> </ul>	
<b>Theorem Provers – Summer Research</b>	Canberra, Australia
AUSTRALIAN NATIONAL UNIVERSITY	2016
<ul style="list-style-type: none"> <li>Investigated translating formal semantics defined in HOL4 to executable code in CakeML.</li> <li>Presented a talk with a poster at the Fifth Data61 Software Systems Summer School.</li> </ul>	
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<b>Other Experience</b>	
<b>Teaching Assistant</b>	Canberra, Australia
AUSTRALIAN NATIONAL UNIVERSITY (VARIOUS COURSES)	2017, 2020 – 2024
<ul style="list-style-type: none"> <li>Taught courses ranging in topics from machine learning (primarily), data management, to logic with various conveners.</li> <li>Helped design and release course material, including, original assignments and lecture plans.</li> <li>Taking a head tutor role in 2022 and part of 2023 for a machine learning course of 250+ students, which includes overseeing course design and day-to-day logistics. I have advised in the material and topics taught in the course; and have been strongly involved in developing and creating all course content including examination material.</li> </ul>	
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<b>Honors &amp; Awards</b>	
<ul style="list-style-type: none"> <li>○ Australian National University Vice-Chancellor’s HDR Travel Grants (\$1500) 2024</li> <li>○ NeurIPS Scholar Award (Registration + Accommodation Cover) 2022, 2024</li> <li>○ Australian Government Research Training Program 2021</li> <li>○ Australian National University: University Medal [Top 2 First Class Honours Graduates] 2019</li> <li>○ Ian Ross Honours Scholarship [High-performing Honours Student] (\$5000) 2019</li> <li>○ Honours Scholarship with the Australian Signal Directorate (\$8000) 2019</li> <li>○ Summer Scholarship with the Australian National University (\$5000) × 3 2016 – 2018</li> </ul>	