ESOBE Masterclass 2025
Neural Methods for Amortised Inference

Abstract: This workshop is an introduction to the new, fledging, field of neural amortised statistical inference. The one-day event is a mix of methodology and practice. The methodological component covers the fundamentals of neural networks, their role in facilitating point estimation, and the provision of full posterior distributions within a decision-theoretic framework. The practical component involves implementing neural networks for regression, for point estimation, and for sampling from posterior distributions. Participants will become familiar with the software packages NeuralEstimators and BayesFlow, which enable the application of these methods to various data types and models. The workshop concludes with advanced topics on handling missing or irregularly spaced data and an overview of the current state of the field.

Bio: Andrew Zammit-Mangion is Associate Professor with the School of Mathematics and Applied Statistics at the University of Wollongong, Australia. His research focusses on spatio-temporal models, the approximate inferential tools that enable them, and their application to studies of climate and environment. Andrew was awarded the Cozzarelli Prize Class III by the National Academy of Sciences of the US in 2013; the Abdel El-Shaarawi Young Researcher's Award by The International Environmetrics Society (TIES) in 2020; the Early Investigator Award by the Section of Statistics and the Environment of the American Statistical Association (ASA) in 2022; and, together with co-authors, three international awards from the ASA and the International Society for Bayesian Analysis (ISBA) for his work on carbon dioxide flux inversion from remote sensing data in 2023. Andrew is an ISI elected member and member of NASA's Orbiting Carbon Observatory Science Team. In 2019 he published a co-authored book with Christopher Wikle and Noel Cressie on spatio-temporal modelling with R.

List of topics:
- Introduction to neural networks in a regression or classification context.
- Introduction to decision theory and its connection to amortised inference.
- Neural Bayes estimation
- Neural posterior inference
- Dealing with missing and irregularly spaced data

Schedule:

09:00-09:45:	Presentation:	Introduction to neural networks for classification and regression
09:45-10:30:	Lab:	Implementing a simple neural network for regression
10:30-11:00:	Break	
11:00-11:45:	Presentation:	Decision theory, amortisation, and neural Bayes estimation
11:45-12:30:	Lab:	Implementing a neural Bayes estimator from scratch for a simple model
12:30-13:30:	Lunch	
13:30-14:15:	Presentation:	Amortised Bayesian inference
14:15-15:00:	Lab:	Using BayesFlow to obtain full posterior distributions
15:00-15:30:	Break	
15:30-16:15:	Presentation:	Dealing with missing or irregularly spaced data
16:15-17:00:	Lab:	Using NeuralEstimators for a spatial missing data problem
17:00-17:10:	Conclusion	

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