

Advisors

Dr Alexander Brownlee is a Senior Lecturer (Associate Professor) in the Division of Computing Science & Mathematics at the University of Stirling, and a Visiting Fellow in Building Performance Engineering at Loughborough University. He holds a PhD and BSc (hons) in Computer Science and has worked in academia, industry, and the civil service. His research is in explainable optimisation, machine learning and decision support systems, and he has extensive experience of industrial collaboration with names such as British Telecom, KLM, and Manchester Airport. He has published in leading journals such as IEEE Transactions on Evolutionary Computation, Transportation Research Part C, and Building & Environment, on the topics of metaheuristics, machine learning, large-scale and multi-objective optimisation, search-based software engineering, and decision support. His research has found applications in aviation, civil & building engineering, scheduling, logistics, software engineering, and healthcare. He has chaired and organised multiple workshops and tutorials, including the *Evolutionary Computation and Explainable AI* workshop and *Genetic Improvement of Software* tutorial at GECCO 2022-3. He has hosted several short-term projects by students and researchers of different experience levels, from undergraduate to postdoctoral level, many of which have led to publications.

Dr Sarah Thomson is a Lecturer (Assistant Professor) at UoS, and an early-career expert in fitness landscapes and visualisation. She has extensive experience building models for algorithm performance prediction, regularly published in leading venues including journals such as Evolutionary Computation (ECJ) and Natural Computing. Her papers were twice included in the EvoStar conference's "outstanding students", and received a best paper nomination with invited fast-track journal extension.

Dr Jason Adair is a Lecturer (Assistant Professor) at UoS. His research experience includes data analytics, machine learning, and optimisation. He has experience in applying optimisation techniques to machine learning models to enhance their accuracy and reduce hardware requirements. He has also been involved with predictive analytics using sensors in agricultural settings to detect the most important environmental parameters for optimal animal growth, developing decision support tools for financial services companies, creating rule-based systems for smart healthcare systems, and AI-developed personalised rehabilitation schedules. He has multiple publications in leading conferences on these topics and was co-author on a best paper on transfer learning for deep neuroevolution at EvoStar 2023.

Research Group

The Data Science and Intelligent Systems (DAIS) Research Group <https://cs.stir.ac.uk/research/dais/index.html#about>, in Computing Science & Mathematics, is led by Dr Brownlee. The group, consisting of 8 faculty staff, 2 postdoc RAs, and several PhD students, develops techniques in operational research, heuristic optimisation, statistics, and machine learning, and conducts both fundamental and applied research. Application areas include finance, industrial scheduling, healthcare, biological, environmental, sports and clinical sciences, software engineering and civil engineering. The group works with industry, public sector and charitable organisations to put its research into practice, and has held funding from EPSRC, Leverhulme Trust, Innovate UK, the Data Lab, and the Carnegie Trust.

Project

The project will investigate the emerging topic of explainability of Evolutionary Algorithms. As automated decision making approaches find more applications in the real world, it is becoming crucial to explain their decision making processes. Explainability for machine learning is already established as an active research topic but only recently have researchers started to explore how to explain the processes of stochastic optimisation methods like metaheuristics. The advisors have

developed proof-of-concept approaches in this area, able to answer questions like which decision variables are crucial to driving the optimisation process, which characteristics of a solution are critical to its optimality, and when the search discovered particular components of the optima. These approaches largely draw on mining of surrogate fitness models, and exploration of local optima networks. This project will investigate new aspects of explainability for EAs, and can be tailored to the interested candidate. We might explore how to extend or adapt the existing approaches for new representations, such as permutations or GP trees, or develop new visualisations or natural language generation techniques. The techniques could be applied to real-world optimisation problems such as aircraft routing, building energy performance, or medicine.

About the University and City

Since our founding in 1967, the University of Stirling has always been driven by transformative thinking and a spirit of innovation. Our multi-disciplinary researchers challenge assumptions, innovate thinking and find solutions, from feeding the world to using psychology to catch criminals. We are set in one of the most beautiful campuses in the UK, surrounded by Scottish mountains, glens, and lochs. Stirling is a beautiful, historic city with easy access to wild landscapes and outdoor activities. We also enjoy fast transport links to the busy cities of Glasgow and Edinburgh. Discounted accommodation is available for visitors to the University.