Species Scholarship 2026: Lancaster University Leipzig

Short CV: John Alasdair Warwicker (j.warwicker@lancaster.ac.uk)

Dr. John Alasdair Warwicker in an Assistant Professor (Lecturer) in Computer Science at Lancaster University Leipzig. His research centres on the intersection between optimisation approaches and machine learning. In particular, he is interested in understand why common machine learning approaches are so successful, and how to design them such that they are efficient, robust and transparent.

Education

PhD in Theoretical Computer Science (2015 - 2018)
Institution: The University of Sheffield, UK
Supervisor: Prof. Pietro S. Oliveto
Thesis Title: On The Runtime Analysis of Selection Hyper-heuristics for Pseudo-Boolean Optimisation Problems
MMath Mathematics Degree (2011 - 2015)
Institution: Loughborough University, UK
Grade: First Class Honours

Academic Positions

Assistant Professor (Lecturer) in Computer Science (2025 - Present)
Institution: Lancaster University Leipzig, Germany
Adjunct Lecturer (2023 - 2025)
Institution: Reutlingen University, Germany
Postdoctoral Research Associate (2019 - 2025)
Institution: Karlsruhe Institute of Technology, Germany
Research Assistant (2018 - 2019)
Institution: The University of Sheffield, UK

Teaching and Supervision Experience

Lecturer
Fundamentals of Computer Science (Undergraduate), Optimisation and Heuristics, Intelligent Systems and Processes (Master)
Seminar Leader
Energy and Power Systems Optimisation, Trending Topics in Optimisation and Machine Learning, Stochastic Optimisation (Bachelor/Master)
Supervision
PhD Co-supervision (Topic: Theoretical and Empirical Analyses of Matheuristics for Vehicle Routing Problems)
Master Thesis Supervision x6, Bachelor Thesis Supervision x4, Working Student x2

Research Group

The research will take place within the research group of Dr. John Alasdair Warwicker, in the School of Computing and Communications at Lancaster University Leipzig.

Research Focus

Our primary research interests lie on the intersection of Computer Science, Optimisation and Machine Learning (ML). In particular, we are interested in understanding how and why complex systems solve problems, and exploiting this understanding in order to provide advancements in terms of efficiency, performance and explainability. To this end, we are interested in exploring how optimisation approaches can be used to enhance our understanding of state-of-the-art ML approaches. Particular topics of interest include:

- Performance analysis of hyper-heuristics and evolutionary algorithms, including neuroevolutionary approaches;
- Modelling and formulations for piecewise linear functions;
- Optimisation approaches for machine learning, with a focus on neural networks;
- Matheuristics, combining mathematical programming with heuristics.

Ongoing Collaborations

We have ongoing collaborations with researchers at the following institutions, among others:

- Lancaster University, UK;
- Karlsruhe Institute of Technology, Germany;
- École Polytechnique, France;
- Université Sorbonne Paris Nord, France;
- Technical University of Denmark, Denmark;
- Southern University of Science and Technology, China;
- University of Adelaide, Australia.

Selected Publications

John Alasdair Warwicker, Samuel Roths, and Steffen Rebennack. *A Mixed-Integer Linear Programming Framework for the Adversarial Training of Neural Networks.* 2026. Under Review.

Paul Fischer, Carsten Witt, and **John Alasdair Warwicker**. *A Runtime Analysis of Bias-invariant Neuroevolution and Dynamic Fitness Evaluation for Binary Classification Problems.* 2026. Under Review.

Benjamin Doerr, Pietro S. Oliveto, and **John Alasdair Warwicker**; *Selection Hyper-heuristics Can Automatically Adjust the Learning Period to Optimally Solve Pseudo-Boolean Problems.* Artificial Intelligence, 2026. To Appear.

John Alasdair Warwicker and Steffen Rebennack. *Efficient continuous piecewise linear regression for linearising univariate non-linear functions.* IISE Transactions, 57(3):231–245, 2025.

John Alasdair Warwicker and Steffen Rebennack. *A Unified Framework for Bivariate Clustering and Regression Problems via Mixed-Integer Linear Programming.* Discrete Applied Mathematics, 336:15–36, 2023.

Research Topic: Analysing Evolutionary Local Branching Matheuristics for Combinatorial Optimisation Problems

Matheuristics (MAs) concern the interoperation of Mathematical Programming (MP) and Metaheuristics (MHs), in which one of the techniques is used to design or enhance existing models from the other. For example, consider mixed-integer programs, whose solution methods often take advantage of the solutions of a series of auxiliary linear programs (LPs). Heuristic solvers can be used to solve such LPs, using MH approaches such as local search or evolutionary algorithms.

In particular, local branching is a technique for solving MP problems (Fischetti and Lodi 2003). In this technique, branches are formed in the search space, of which one constitutes a local search in a given neighbourhood. The size of the neighbourhood should be sufficiently large to ensure the existence of an improved solution, but not too large to be computationally expensive. In order to ensure fast solutions to the neighbourhood search, heuristics, such as evolutionary algorithms, should be utilized.

The goal of this project is to analyse the effectiveness of different evolutionary-based approaches in augmenting the local branching algorithm. While the performance of evolutionary approaches to combinatorial optimization is well understood, hybridising them within a MP framework is yet to be thoroughly studied (Rothberg 2007).

Alongside initial studies on benchmark functions from evolutionary computation, an analysis on real-world combinatorial optimisation problems from the transport industry, such as vehicle routing and scheduling where MAs have been shown to be effective (Archetti and Speranza 2014), would showcase the effectiveness of evolutionary MA methods.

Research Questions

This project answers the following questions:

- How can evolutionary algorithms (EAs) enhance the performance of the local branching heuristic?
- Based on the problem structure, which EAs work well in this MA approach, and which do not?
- How can the insights from the previous questions extend to real-world vehicle routing problems?

Student's Profile

This project can be approached from a theoretical or empirical perspective, or both. Familiarity with evolutionary algorithms and mathematical programming is beneficial.

References

Archetti, C. and Speranza, M. G. (2014). A survey on matheuristics for routing problems. *EURO Journal on Computational Optimization*, 2(4):223–246.

Fischetti, M. and Lodi, A. (2003). Local branching. *Mathematical programming*, 98(1):23–47.

Rothberg, E. (2007). An evolutionary algorithm for polishing mixed integer programming solutions. *INFORMS Journal on Computing*, 19(4):534–541.

The Institution: Lancaster University Leipzig

Lancaster University Leipzig is a European branch campus of Lancaster University (UK). Lancaster is a research-intensive university, with 35% of our research classed as world-leading and 48% classed as internationally excellent in the UK Government's most recent independent review, the Research Excellence Framework (REF).

The Leipzig campus was established in 2020, becoming the first public British university to open a campus in Germany. In that time, it has grown to host over 500 students from across the world. It is situated inside the pedestrianised city centre of Leipzig and next to the city's historic icon 'Nikolaikirche'/St. Nicholas Church—the place of origin of the Peaceful Revolution in 1989—it is an unparalleled location to support a dynamic and exciting student experience. Visits to Berlin, Prague and various nearby cities are possible from Leipzig within a direct train connection.

Further details about the campus and the university can be found at `www.lancasterleipzig.de`