



UNIVERSITY OF
LEICESTER

High-level search methodologies for problem solving in industrial applications

Supervisor: Dr. John H. Drake (Associate Professor)

Short CV

Dr. John H. Drake is an Associate Professor in the School of Informatics at the University of Leicester and a Visiting Research Fellow at BT (British Telecom). He previously held faculty positions at Queen Mary University of London and the University of Nottingham, working extensively within the partnerships of these two organisations in China. He holds a BSc, MSc and PhD in Computer Science and is a professional member of the ACM and IEEE. His research interests lie at the interface between Computer Science, Artificial Intelligence and Operational Research, focusing on metaheuristic and evolutionary computation methods for real-world scheduling problems. Previous research has centred on maintenance scheduling for real-world infrastructure networks in the context of railways and telecommunications, in partnership with Banedanmark and BT respectively, developing intelligent decision support systems to facilitate efficient allocation of resources for such problems. He has published over 30 papers in SCI-indexed leading conferences and journals in the fields of Computer Science and Operational Research, including *European Journal of Operational Research* (Elsevier), *Computers & Operations Research* (Elsevier) and *Evolutionary Computation* (MIT Press). Two recent papers were nominated for best paper awards at EvoApplications 2018 and EuroGP 2019. He is currently a co-investigator on OR-MASTER (EP/M020258/1), a £2.3M EPSRC programme grant project focused on reducing congestion at airports.

Applied Algorithm and AI Group (AAAI)

The AAAI research area encompasses a range of data-driven applied and foundational research in the School, with a strong algorithmic flavour, and with a focus on empirical methods for evaluation. A sub-area is knowledge discovery for robotics, remote sensing and medical image analysis. Other areas of interest include pure and applied aspects of machine learning, automated reasoning, data mining and Internet of Things. A distinctive applied research focus is the development of novel optimisation technologies with applications for timetabling, flight scheduling and physical- and cyber-security. The group currently consists of 10 full-time faculty members, including 7 full-professors. This scholarship will be hosted in the **Optimisation** sub-area, where we develop novel methods and tools for mathematical programming, global and local search and decision-making in real-world optimisation problems. Applications of the research include: communication networks, planning of transportation, resource allocation, routing and scheduling of data flows.

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Optimisation problems often explore a search space which is too large to enumerate and exhaustively search for an optimal solution. Various heuristics and metaheuristics have been applied successfully to problems of this nature. One drawback of such approaches is the necessity to manually adapt the method used to solve different problem domains or classes of problem. Hyper-heuristics are a class of high-level search techniques which aim to raise the level of generality at which search methods operate. Unlike traditional techniques, a hyper-heuristic operates on a search space of heuristics rather than directly on the search space of solutions. The last decade or so has seen sustained research effort directed at hyper-heuristic methods, much of which is a result of pioneering work done by researchers at Leicester. This project will apply hyper-heuristic methods to real-world combinatorial optimisation problems, seeking to automate the heuristic design process, reducing the time required to develop such methods and the burden on the human involved in the development cycle. The project will focus specifically on solving real-world problems of relevance to industry with one of our collaborating partners, providing a balance between cutting-edge pure 'blue skies' research and practical applications. The domain can be tailored to suit the interests of the individual, possible projects include optimisation in network design, airline scheduling and assembly-line balancing in industrial manufacturing.

Other information

The University of Leicester is a leading UK university committed to international excellence through the creation of world changing research and high quality, inspirational teaching. The University now has a student population of around 23,000 and an annual turnover in excess of £260m. The University employs around 3,300 people, making us the third largest employer in Leicester. We are known for the high quality of our research, with strengths in a number of academic areas. Some of Leicester's best-known achievements include the invention of genetic fingerprinting and, more recently, the discovery of the remains of Richard III in a Leicester car park. Leicester is consistently one of the most socially inclusive of the UK's leading universities with a long-standing commitment to providing fairer and equal access to higher education. Getting to Leicester and to the rest of the UK is made easy by the city's excellent rail and road connections. Leicester is centrally located within the UK and only 65 minutes from central London. As a true student city, Leicester has a huge variety of bars and clubs offering student nights and discounts. We have everything from cocktail bars to real ale pubs to dessert parlours, coffee shops and award-winning restaurants. Leicester's cultural diversity is reflected in the stunning range of cuisine available, with restaurants representing all corners of the globe.

Please e-mail john.drake@leicester.ac.uk for further information about this project.