2 - A momentum-based linearized augmented Lagrangian method for nonconvex constrained stochastic optimization
Xiao Wang
Nonconvex constrained stochastic optimization has emerged in many important application areas. Subject to general functional constraints it minimizes the sum of an expectation function and a nonsmooth regularizer. Main challenges arise due to the stochasticity in the random integrand and the possibly nonconvex functional constraints. To address these issues we propose a momentum-based linearized augmented Lagrangian method (MLALM). MLALM adopts a single-loop framework and incorporates a recursive momentum scheme to compute the stochastic gradient, which enables the construction of a stochastic approximation to the augmented Lagrangian function. We provide an analysis of global convergence of MLALM. Under mild conditions and with unbounded penalty parameters, we show that the sequences of average stationarity measure and constraint violations are convergent in expectation. Under a constraint qualification assumption the sequences of average constraint violation and complementary slackness measure converge to zero in expectation. We also explore properties of those related metrics when penalty parameters are bounded. Furthermore, we investigate oracle complexities of MLALM in terms of total number of stochastic gradient evaluations to find an $epsilon$-stationary point and an $epsilon$-KKT point when assuming the constraint qualification. Numerical experiments on two types of test problems reveal promising performances of the proposed algorithm.

3 - Primal-Dual Algorithms for Saddle Point Problems—Convergence Analysis and Equilibrium Properties
Deren Han
The saddle point problem is a significant class of issues in the fields of optimization and game theory, where both theoretical and applied research have consistently garnered widespread attention. Among the core algorithms to address this problem are those based on primal-dual methods. This report presents a convergence analysis for some fundamental saddle point problems and introduces a novel algorithm that considers the equilibrium between primal and dual aspects.

4 - A Block Coordinate Descent enhanced metaheuristic for the Euclidean Traveling Salesman Problem with Polygonal Neighborhoods
Ernesto G. Birgin, Paula C. R. Ertel
The Traveling Salesman Problem with Neighborhoods (TSPN) is a generalization of the well-known Traveling Salesman Problem. In the TSPN, given a finite set of regions of the Euclidean space, the goal is to find an order of these regions and a visit point in each region so that the length of a tour that visits them only once and returns to the starting point is minimized. Most of the literature on the TSPN focuses on the case where the regions are disks. In this work, we focus on the case where the regions are given by arbitrary (nonconvex) polygons. Considering the Euclidean distance, the problem can be modeled as a mixed-integer quadratically constrained programming problem. We propose an Iterated Local Search (ILS) metaheuristic to find solutions to large instances of the problem. The proposed ILS combines a block coordinate descent method to determine the visit points with different neighborhood structures widely used in the TSP literature to generate the permutations. Numerical experiments illustrate the performance of the proposed method.

■ MC-38
Monday, 12:30-14:00 - Room: Michael Sadler LG19

Automating the Design, Generation and Control of Optimization Algorithms 2

Stream: Data Science meets Optimization
Invited session
Chair: *Ender Özcan*
Chair: *Andrew J. Parkes*

1 - Genetic programming based algorithm for managing of rescue teams in crisis situations
Adam Górski, Maciej Ogorzałek

Crisis situations like traffic accidents, tsunamis, fires, etc. demands coordinated cooperation of many rescue teams. Such teams can be: emergences, fire brigades, police, divers, etc. In crisis situations time is critical. Rescue teams need to help people unless it is too late. Therefore an appropriate management of the teams including choosing the number and type of rescue teams and the assignment of given tasks is very important. We present a genetic programming based algorithm which is able to optimize the cost of rescue action by choosing the number and type of rescue teams and assignment of the tasks. the algorithm starts from initial population which is consistent of randomly created genotypes. Each genotype is a tree. In the nodes of the tree are decisions about sending a new rescue team or assigning the tasks to the teams. The next generations of individual are created using standard genetic operators: selection, mutation and crossover. We believe that proposed methodology is able to make the rescue action more effective, faster and cheaper.

2 - Designing branching strategies with genetic programming
Simon Renard, Bernard Fortz, Quentin Louveaux

Branching strategies play a crucial role in the efficiency of branch-and-bound algorithms for solving combinatorial optimization problems. Traditional heuristics rely on handcrafted rules that remain fixed across different problem instances, while recent advances have used machine learning to learn problem-specific branching strategies.

In this work, we propose a novel approach to designing branching strategies using genetic programming. Our method simulates an evolutionary process in which individuals represent scoring functions that define branching decisions. This approach not only enables the discovery of new strategies without relying on existing heuristics but also provides interpretable strategies in the form of simple mathematical expressions.

3 - Using Genetic Programming to generate Dispatching Rules for a Large-Scale Project Scheduling Problem
Nuno Marques, Gonçalo Figueira, Luís Guardão, Luis Guimarães

Scheduling in real-world settings is becoming increasingly challenging due to more complex products, pressures from customers and competitors, continuous adjustment to new technologies, and frequent unexpected events such as breakdowns, illness and supply chain disruptions. A sector in which scheduling is deeply affected by uncertainty is the aircraft maintenance and repair operations (MRO) business. Optimizing scheduling in MRO is important to reduce costs, plane unavailability and promote safety. There are three main types of aircraft MRO: Line, Light and Heavy. Due to its complexity, this work focuses on heavy maintenance, as it encompasses thousands of tasks and can ground a plane for over two months. Moreover, uncertainty is constantly present in three main dimensions: planes' arrival dates, task durations, and a large amount of unplanned work. Lastly, aircraft MRO scheduling encompasses several subproblems: task scheduling, staff allocation and work centre allocation. When facing such a complex, large and uncertain problem, one needs reactive solution methods such as dispatching rules (DRs) that can schedule tasks on the fly. Manually updating schedules or using approaches based on exact and meta-heuristics methods is not feasible as they would take too long. Therefore, in this work, Genetic Programming was used to generate new DRs for the aircraft MRO scheduling problem. These novel AI-generated DRs outperform existing DRs while maintaining a compact form.