Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

PhD Course

Matheuristics

block course:

15.05.2020	4:00-8:00 pm
16.05.2020	9:00 am- 4:00 pm
22.05.2020	4:00-8:00 pm
23.05.2020	9:00 am- 4:00 pm
26.06.2020	4:00-8:00 pm (presentations)
27.06.2020	9:00 am- 4:00 pm (presentations)

Course Instructors: Prof. Dr. Stefan Voß

Course Value: 3 SWS or 6 LP

Course Overview:

Introduction

Heuristics

Local Search and Metaheuristics

Foundation (Complexity, Maths, Dantzig-Wolfe etc.)

Matheuristics: Hybridizing Metaheuristics and Mathematical Programming

Various Approaches (POPMUSIC, Feasibility Pump etc.)

Applications

Conclusions

In between: Interludes /

How to compare numerical results?

Student Presentations

Course Contents:

After World War 2 the main application area for optimization shifted from the military to the industry. Industrial activities, and related functions, yield a cornucopia of applications for optimization algorithms, often backed by substantial money for finding good solutions. Unsurprisingly therefore, we have records of several decades of efforts dedicated to the solution of the induced problems. And unfortunately almost all of them are NP-hard.

How do we deal with NP-hardness, when a good solution is needed with limited computational resources? By means of heuristics. So we have several decades of research on heuristic algorithms to exploit. As the limit on the available computational resources has been increasingly lifted, the set of utilizable methodologies progressively widened. First heuristics were very simple, constructive and local search, then we had metaheuristics. Now, we are moving forward, and one of the pursued paths leads to including mathematical programming techniques into the solution framework, giving rise to matheuristic algorithms.

The course will feature some hands-on experience on these progressively complex approaches to the solution of some (one? two? many?) combinatorial optimization problems, arising in an industrial context, presumably logistics, unless the attendants wish otherwise. Given the no free lunch theorem, and the deriving relevance of the instance source, we will utilize or generate real world (-like) instances to work upon. Simple heuristics and metaheuristics for the problem will be sketched and the corresponding code will be applied to the instance of concern.

Then, some matheuristic approaches will be introduced, with reference to the example problem. As matheuristics methods are deeply rooted into mathematics, we will agree whether to delve into the maths and justify few approaches, or to be shallow and present more approaches.

Matheuristcs of interest include decomposition methods, for example Lagrangian or Dantzig-Wolfe / column generation, MIP constraining, for example local branching or the corridor method, kernel problem identification, very large neighborhood search, POPMUSIC and possibly others. For some of these, the implemented code will be shown and validated.

Student evaluation:

Participation in the course, written term paper.

How to register:

Please register here https://www.mincommsy.uni-hamburg.de/room/11791190
until April 20, 2020 using the code: Math2020.