

# OeGOR Summer-School for PhD-candidates and Post-Docs



The Austrian Society for Operations Research (OeGOR) organizes for the third time a summer-school for PhD-candidates and Post-Docs.

## **Invited Speakers:**

**Timo Gschwind** (RPTU Kaiserslautern):

*Introduction to Column-Generation Theory and Application*

**Maximilian Schiffer** (TU München):

*Combinatorial optimization augmented machine learning for contextual multi-stage problems*

**Date: 22.07.2024 – 26.07.2024**

**Place:** University for Continuing Education (Donau Uni) Krems

Participation in the school is free of charge, if your institution or supervisor are members of OeGOR or of an OR-Society in a neighboring country. However, lunch will be organized centrally, thus requiring a meal contribution of ca. € 60.- (nonrefundable) to be paid until 21.06.2024. All other food, travel and hotel arrangements must be organized and covered by the participants.

**Registration:** send an e-mail **until May 24, 2024** to [raimund.kovacevic@donau-uni.ac.at](mailto:raimund.kovacevic@donau-uni.ac.at)

Each invited speaker will give a two-day program. The participants are also invited to give a presentation of their work. Take the chance to create a bond with fellow students and with OeGOR!

## **22.7.-23.7. Timo Gschwind:**

### **Introduction to Column-Generation Theory and Application**

Column Generation (CG)-based methods are (among) the leading exact solution techniques for many important combinatorial optimization problems including problems in routing, scheduling, cutting and packing, and network design to name a few. CG itself is an iterative procedure that can tackle Linear Programs (LPs) containing a huge number of variables. At each iteration, it solves a restricted version of the LP containing only a subset of the variables and one or several pricing problems to generate missing variables. When solving integer problems, CG is embedded in an overall strategy (e.g., Branch-and-Bound) to guarantee integer solutions, resulting in an integer CG approach (e.g., Branch-and-Price, B&P). However, (integer) CG approaches are not out-of-the-box solution methods. Many important building blocks are often problem specific and a textbook implementation of basic CG is typically not competitive.

This course begins with a practice-oriented introduction to CG and B&P. It then covers the basic theory of (integer) CG and discusses more advanced techniques such as pricing strategies, cutting, strategies to obtain integer solutions, stabilization, variable fixing, or CG-based heuristics. Overall, the course aims at providing a balance between theoretical foundations and ready-to-apply knowledge for designing and implementing CG approaches. The course also includes practical implementation sessions.

### **24.7.: Short presentations by the participants**

## **25.7.-26.7. Maximilian Schiffer: Combinatorial optimization augmented machine learning for contextual multi-stage problems**

Combinatorial optimization augmented machine learning (COAML) is a novel field that combines methods from machine learning and operations research to tackle contextual data-driven problems that involve both uncertainty and combinatorics. These problems arise frequently in industrial processes, where firms seek to leverage large and noisy data sets to optimize their operations. COAML typically involves embedding combinatorial optimization layers into neural networks and training them with decision-aware learning techniques.

In this summer school, we will learn i) how such algorithmic pipelines work and ii) how they can be designed depending on the planning problem faced. We will then iii) focus on the difference between pipelines that are based on structured learning and pipelines that are based on reinforcement learning. Finally, we will focus iv) on a hands-on coding exercise to build a respective algorithmic pipeline on our own to reflect the theory studied.

The participants are invited to attend the course with their own laptops, having super-user access on their computers for installing the required resources, and with wifi-internet access (Eduroam or 4G/5G).