Students and Professors meet in the forests around Bielefeld, Germany, to discuss Data Science and Combinatorial Optimisation: *EWG/DSO EURO PhD School*

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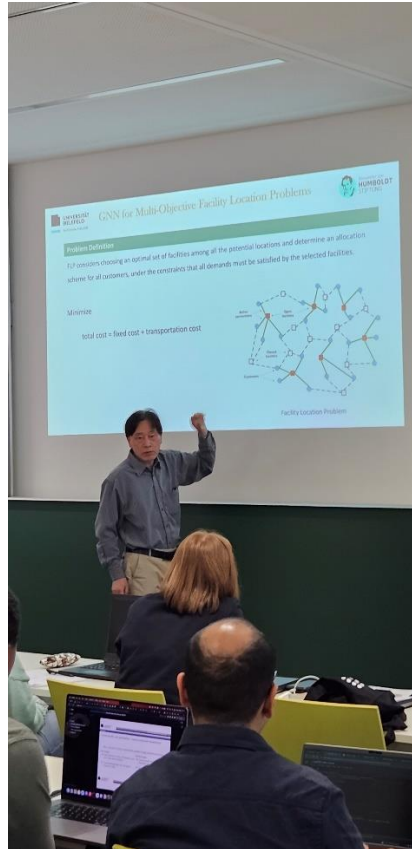
September 4-8 2023, Bielefeld

From September 4th to 8th 2023, Bielefeld University hosted the first *EURO Summer School on "Data Science Meets Combinatorial Optimisation"*. It took place at the campus of the university and offered deepening into five subjects all embodying specific interaction between the two domains (see https://decision-analytics.github.io/PhD-School-DSO-2023/).

Each of the five days of the PhD school, one or two renowned professors would introduce a specific state-of-the art topic taken from her or his recent work, hereby often assisted by a post-doc and providing both theory and hands-on training as well as exercises in two or three sessions after which PhD students were prompted to present and discuss on their own, related, work. This already rich program of the summer school was taken to an even higher level in an invited talk by the *Alexander von Humboldt Professor Yachou Jin*. As essential as this scientific enrichment, joint meals and social activities were organized and there was plenty of room for socializing and networking. Given the great weather throughout the whole PhD school week, many participants opted for a daily hike from the campus through the beautiful *Teutoburg Forest* to the hotel in which all participants and lecturers stayed. the joint dinners at the hotel were held outside with a view on the city of Bielefeld and the medieval *Sparrenburg Castle*.
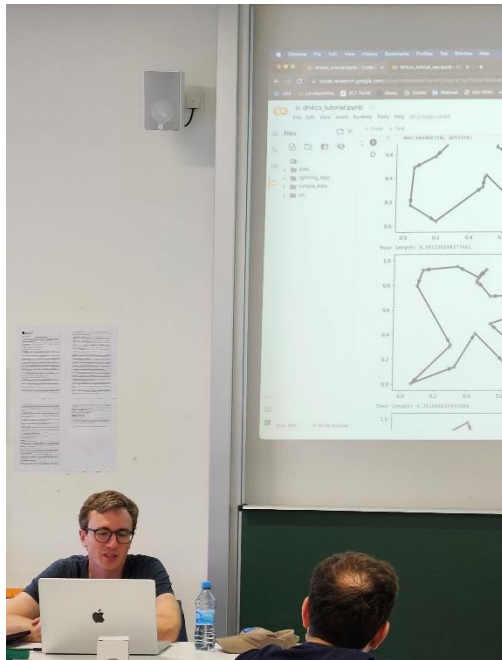

EWG/DSO EURO PhD School:
enjoy outside; Young people discuss with *Prof. Kate Smith-Miles* (left, front).

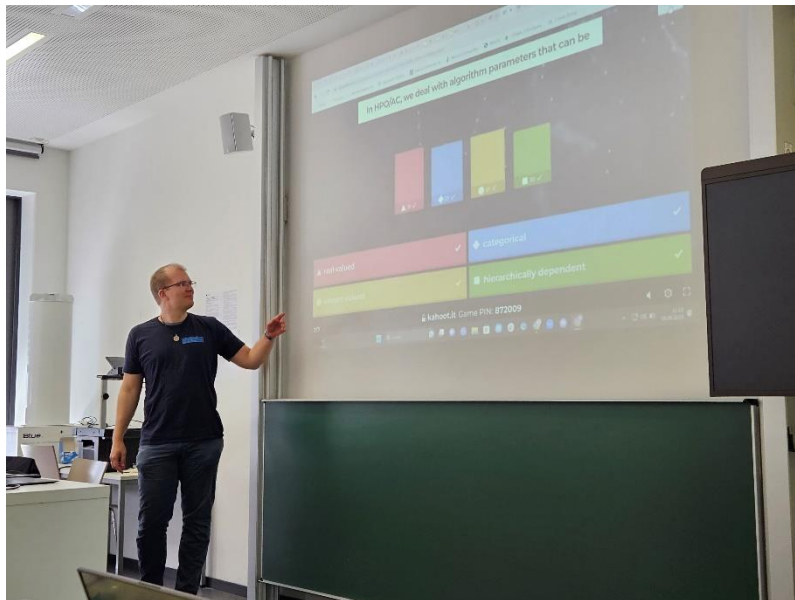*EWG/DSO EURO PhD School*: the lecture by *Prof. Yachou Jin*.

The aim of the *PhD School* was to study features of algorithms for combinatorial optimization and feature aspects related to data science. The NP-hardness of most combinatorial optimization problems reflects itself in complicated and large solution spaces. The relation to real-world problems and the inherent complexity of the resulting context impacts the set of instances likely to ask for a solution and this influences the applicability as well as the configuration of specific algorithms. Specific algorithms may allow fast solutions for specific classes of instances while performing much worse on other classes. A landscape of instances is the result in which algorithms need to be positioned. Study of this enlarged problem setting increases understanding on the problem and on the applicability of specific algorithms.

The first day was devoted to *'Deep Reinforcement Learning for Vehicle Routing Problems'* and was led by *Professor Kevin Tierney* of Bielefeld University. This was also the day of the keynote by *Professor Yachou Jin* on *"Graph Neural Networks for Combinatorial Optimization"*.

EWG/DSO EURO PhD School: the lecture by *Prof. Kevin Tierney*.

On the second day, the subject was *"Efficient algorithm design via automated algorithm selection and configuration"* by *Professor Marius Lindauer* and his assistant *Alexander Tornede*, both from University of HannHover, Germany. In the afternoon, the first session of student presentations took place with four students discussing their work.

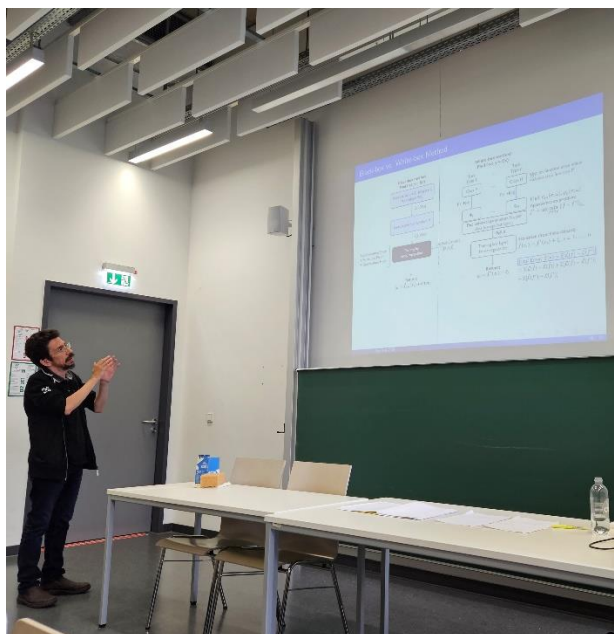*EWG/DSO EURO PhD School*: the lecture by *Prof. Marius Lindauer*.

The third day was led by *Professor Yingqian Zhang* from Eindhoven University of Technology and *Professor Sicco Verwer* from TU Delft both in the Netherlands. Again, in the afternoon, five students presented and discussed on their projects.

EWG/DSO EURO PhD School:
program led by *Prof. Yingqian Zhang* and *Prof. Sicco Verwer* (left to right).

The fourth day was on *"Instance Space Analysis"* by *Professor Kate Smith-Miles* from The University of Melbourne in Australia. In the afternoon, a guided city-walk, and a social dinner in the *Sparrenburg Castle* offered plenty of opportunities for interaction.

The school closed on the fifth day with a scope-enlarging session on *"A third dimension for characterizing algorithms: spatial properties"* by *Professor Dimitri Papadimitriou* of University of Antwerp in Belgium.

EWG/DSO EURO PhD School: the lecture by *Prof. Dimitri Papadimitriou*.

Group photo of celebrated *EWG/DSO EURO PhD School 2023*.

The enthusiasm of the lecturers stimulated a highly motivated audience of 30 PhD students from 22 universities all over Europe. These young scientists had the invaluable opportunity of interacting closely with renowned professors from all over the world, and these contacts may play a role in their future career. The diversity in scientific interest, educational luggage as well as cultural background proved once more the importance of this kind of interactions. As the organizers know from their own experience, the week has created memories for life. Lasting

acquaintances between participants and some long-term collaborative endeavors are bound to emerge.

EWG/DSO EURO PhD School: the Social Dinner.

Profs. Michael Römer, Sicco Verwer and *Yingqian Zhang* and PhD student *Mohsen Nafar* enjoying the weather (left to right).

List of participants funded by Euro:

No	Name	First Name	University	Country
1	Abouelrous	Abdo	Technical University Eindhoven	Netherlands
2	Leloup	Emeline	HEC Liège	Belgium
3	Rajaei	Ali	Delft University of Technology	Netherlands
4	Boveroux	Laurie	University of Liège	Belgium
5	Dobos	Teodora	Technical University of Munich	Germany
6	Evers	Justine	University of Liège	Belgium
7	Hildebrandt	Sophie	Pforzheim University of Appl.Sciences	Germany
8	Mohammadi	Mostafa	Sapienza University of Rome	Italy
9	Rahmanifar	Golman	Sapienza University of Rome	Italy
10	Mencaroni	Andrea	Ghent University	Belgium
11	Kutabi	Abdül Hadi	TU Dortmund	Germany
12	Disselnmeyer	Max	TU Dortmund	Germany
13	Fakhredin	Fatemeh	Kühne Logistics University	Germany
14	Montaruli	Antonio	University of Twente	Netherlands
15	Dileep	Anandhu	University of Bergen	Norway
16	Gasparin	Andrea	University of Trieste	Italy
17	Hurovich	Gustavo	Erasmus University Rotterdam	Netherlands
18	Camerota Verdù	Federico	University of Trieste	Italy
19	Cargan	Tim	University of Nottingham	England
20	Kroner	Frederic	TU Braunschweig	Germany
21	Schmidl	Christoph	Radboud University Nijmegen	Netherlands
22	Liu	Chang	KU Leuven	Belgium
23	Manondo	Marshall	University of Cape Town	South Africa
24	Aktas Dejaegere	Dilay	KU Leuven	Belgium
25	Gül	Yağmur	University of Hamburg	Germany
26	Merten	Sebastian	University of Passau	Germany
27	Rienks	Simon	University of Hamburg	Germany
28	Sauerbier	Fiona	University of Hamburg	Germany
29	Tamburini	Alberto	DTU Copenhagen	Denmark
30	Song	Ya	Eindhoven University of Technology	Netherlands