

**Combinatorial Optimization at Work**  
A course at TU Berlin  
in cooperation with MATHEON and the Berlin Mathematical School  
offered by Prof. Martin Grötschel

**Outline of the Course**

Dates of the course:	September 21 – October 9, 2009
Course language:	English
Location:	Zuse Institute Berlin
Application deadline:	June 1, 2009
Participation fee:	none
URL (info/application):	<a href="http://co-at-work.zib.de">http://co-at-work.zib.de</a>
Preparatory material available:	End of June 2009
Intended audience:	late master and PhD students, Post-docs
Contact:	coaw@zib.de

**Contents**

Monday, September 21

**Welcome and Introduction to CO@W**

Linear and integer programming: an introduction, basics of polyhedral theory, the Travelling Salesman Problem and its applications

Tuesday, September 22

**Introduction to the ZIB Optimization Suite**

Data, modelling, and solvers, including Zimpl, Soplex, SCIP, PORTA, Polymake (application cases, e.g., sequencing welding robots)

Wednesday, September 23

**Theory of combinatorial auctions and auction practice** (algorithmic game theory)

Thursday, September 24

**Advanced Linear Programming**, Solving LPs in Practice  
(Lectures by Bob Bixby)

Friday, September 25

**Advanced Mixed Integer Programming**, Solving MIPs in Practice  
(Lectures by Bob Bixby)

Saturday, September 26 (optional)

Learning/Refreshing C programming in one day

Sunday, September 27

No scientific program

Monday, September 28

**Programming in SCIP:** how to implement components of a B&C Solver  
(application cases, e.g., solving routing problems)

Tuesday, September 29

**Programming in SCIP:** how to implement constraint handlers  
(application cases, e.g., solving chip verification problems)

Wednesday, September 30

**Public Transportation:** several cases from practice, including vehicle routing, driver assignment. How to implement a column generation procedure in SCIP

Thursday, October 01

Excursion to a company (various options)

Friday, October 02

**Logistics:** several cases from practice, including elevator sequencing, control of stacker cranes, online planning of service vehicles

Saturday, October 03

**Telecommunication:** several cases from practice, including survivable network design, multilayer network design, Internet routing, frequency assignment for GSM mobile phone systems, capacity and coverage planning for the UMTS radio interface

Sunday, October 04

No scientific program

Monday, October 05

Canada Day (applications of combinatorial optimization at MITACS),  
several cases from practice including **health care operations research**

Tuesday, October 06

Australia Day (applications of combinatorial optimization at MASCOS)  
Several cases from practice including **mining operations**

Wednesday, October 07

Written examination, visit of 3D graphics studio DaVinci, visit of Technikmuseum

Thursday, October 08

**Modelling stochastic and nonlinear mixed integer programming problems,**  
e.g. designing and operating gas-networks

Friday, October 09

Summary of the course, future perspectives (research and practice), results of the examination

Please note that there may be changes in the sequence of the topics.

## Daily Plan

Each day will consist of a mixture of lectures and exercises with the following schedule:

09:00 – 10:30 lecture  
11:00 – 12:30 lecture or exercises  
12:30 – 14:00 lunch (at the FU Mensa)  
14:00 – 15:30 lecture  
16.00 – 17:30 lecture or exercises

The program will be adapted to the daily needs. For all lectures, slides will be made available.

## Remarks

1. In addition to the main lecturer (Martin Grötschel), several international colleagues (including Bob Bixby from Rice University, Houston, and Martin Puterman from UBC, Vancouver) and colleagues from Berlin (including Ralf Borndörfer and Thorsten Koch) will present exciting real world applications of combinatorial optimization and integer programming.
2. This block course targets master students (in their final year), PhD students, and Post-docs interested in the use of combinatorial optimization and mathematical programming techniques in concrete applications from practice.
3. Students are expected to be familiar with the basics of linear, integer, mixed integer and combinatorial optimization. Preparatory material covering these basics and various lectures to be given will be distributed in June 2009.
4. Students are expected to bring (if possible) a laptop along. We will make first class optimization and other software available and will teach the use of this software using real world data from practical problem instances.
5. The number of participants is limited.
6. There will be a test with a certificate of successful participation in the course and the exercises. For German students, this is equivalent to a “Schein zur erfolgreichen Teilnahme an einer vierstündigen Vorlesung und zweistündigen Übungen”.
7. For participants from outside Berlin, we are prepared to offer low-priced accommodation.