Block course

Combinatorial Optimization at Work

Lectures	Prof. Dr. Martin Grötschel (MG)
Guest lectures	Prof. Dr. Robert Bixby (BB)
Exercises	Dr. Thorsten Koch (TK)
Date	October, 4-15, 9:00-17:00
Place	Zuse Institute Berlin, Takustr. 7, Lecture hall 2005
Language	English

The course will focus on the utilization of combinatorial optimization in practice. The program is a daily alternating combination of lectures, mathematical modeling exercises, problem solving, computer work with software that is specially made available for the course, etc. Approximately ten real applications will be taught. Every new case study will start with an oral presentation of the real problem and its mathematical modeling, then the theory behind will be explained. Finally the development of the solution algorithms will be described and the successes of the problem solution in practice demonstrated.

An info for foreign participants: Monday, October 3, 2005 is a public holiday in Germany. Note that all shops, offices (including ZIB and TU) are closed.

Tuesday, Oct. 4		
09:00-10:30	MG	LP / IP basics
11:00-12:30	MG	Polyhedra, an introduction
13:30-15:00	TK	Using ZIMPL and LP / IP solvers
15:30-17:00	TK	Exercises
Wednesday, Oct. 5		
08:00-18:00		Excursion to Volkswagen, Wolfsburg Visit of "VW Konzernlogistik" and more
Thursday, Oct. 6		
09:00-10:30	MG	In-plant logistics (stacker cranes,
11:00-12:30	MG	elevators, welding robots, etc.)
13:30-15:00	MG	Modeling the TSP
15:30-17:00	TK	Exercises
Friday, Oct. 7		
09:00-10:30	MG	Chip design
11:00-12:30	MG	Printed circuit board production and related issues
13:30-15:00	BB	Production-line scheduling in front-end wafer fabs
15:30-17:00	TK	Exercises
Saturday, Oct. 8		
09:00-10:30	BB	Simplex algorithms: The legacy of George Dantzig (Algorithmic framework for the primal and dual, ratio test, degeneracy, pricing, solving large-scale problems)
11:00-12:30	BB	MIP: Then and now
13:30-15:00	BB	Exercises
15:30-17:00	TK	Exercises

Monday, Oct. 10		
09:00-10:30	MG	Telecommunication access network planning
11:00-12:30	MG	(selecting locations, survivability, etc.)
13:30-15:00	TK	Exercises
15:30-17:00	TK	Exercises
Tuesday, Oct. 11		
09:00-10:30	MG	Mobile phone radio interface planning
11:00-12:30	MG	(frequency assignment in GSM,
		capacity and coverage planning in UMTS)
13:30-15:00	MG	Site selection in UMTS
15:30-17:00	TK	Exercises
Wednesday, Oct. 12		
09:00-10:30	MG	Service vehicle scheduling (“Yellow Angels”
11:00-12:30	MG	of ADAC) and online optimization
13:30-15:00	TK	Exercises
15:30-17:00	TK	Exercises
Thursday, Oct. 13		
09:00-10:30	MG	Vehicle circulation
11:00-12:30	MG	and routing
13:30-15:00	TK	Exercises
15:30-17:00	TK	Exercises
Friday, Oct. 14		
09:00-10:30	MG	Crew scheduling in
11:00-12:30	MG	public transport, airlines, . . .
13:30-15:00	TK	Exercises
15:30-17:00	TK	Exercises
Saturday, Oct. 15		
09:00-10:30	MG	Optimizing container terminals
11:00-12:30	MG	and related topics
13:30-15:00	TK	Exercises

MG = Martin Grötschel (groetschel@zib.de), `www.zib.de/groetschel`
BB = Robert Bixby, Creator of CPLEX and Chief Science Officer, ILOG
TK = Thorsten Koch (koch@zib.de), `www.zib.de/koch`

In the second week, there will be one evening lecture by Eran Davidson, President & CEO of HassoPlattnerVentures (http://www.hp-ventures.com/), Potsdam on entrepreneurship. HassoPlattnerVentures is an ”incubator” and is now searching for ”young top persons with the best ideas from the sciences who have a great entrepreneurial spirit and ideas for IT products and services providing particular user benefits - to target global markets”.

We would like all participants to register at

`http://co-at-work.zib.de/register.php`

For students registered before September, 4 the excursion to Wolfsburg will be free of charge. Participants registering after that date have to organize the journey to Wolfsburg themselves.

This block course is equivalent to a 4 hour lecture, 2 hour exercise per week course.

An info for all participants: We would like all participants who have the possibility to bring a laptop pc to the course to do so.

Please send any questions to kasse@zib.de.

Literature:

There is no book that covers the contents of the block course. In fact, the material of the block course (and more) will be turned into a series of chapters that will comprise a book (hopefully ready at the end of 2006). For those who want to refresh their knowledge or would like to screen some books on integer programming and combinatorial optimization here are some hints to good literature: The following book

Christelle Gueret, Christian Prins & Marc Sevaux,
(translated and revised by Susanne Heipcke):
Applications of optimization with Xpress-MP,
published by Dash Optimization Ltd,
(last update June 6, 2005) is available for download, free of charge, at
`http://www.dashoptimization.com/home/downloads/book/booka4.pdf` and is a book that is concerned with mathematical modeling. The book is, of course, biased towards implementation with *Xpress-Mosel*, but the 60 or so examples of applications of linear and integer programs can also be used with other modeling software. For an overview, see
`http://www.dashoptimization.com/home/services/publications/applications_book_ov.html`

Another book that deals with the formulation of practical problems as linear or integer programs and gives some modeling advice is:

Josef Kallrath,
Gemischt-ganzzahlige Optimierung: Modellierung in der Praxis
Mit Fallstudien aus Chemie, Energiewirtschaft, Metallgewerbe, Produktion und Logistik.
Vieweg, Braunschweig, 2002. ISBN: 3-528-03141-7

The following books are good introductions to integer programming and combinatorial optimization:

Bernhard Korte, Jens Vygen,
Combinatorial optimization: Theory and algorithms (2nd ed.), Springer, Berlin, 2002.

Alexander Schrijver,
Combinatorial optimization: Polyhedra and efficiency (3 volumes), Springer, Berlin, 2003 (also available on CD-ROM).

Laurence A. Wolsey,
Integer programming.
Wiley-Interscience Series in Discrete Mathematics and Optimization, Chichester, 1998.

Those who would like to refresh their knowledge on linear programming should consult one of the following books:

Vasek Chvátal,
Linear programming.
Freeman, New York, 1983.

Manfred Padberg,
Linear optimization and extensions (2nd ed.)
Springer, Berlin, 1999, ISBN: 3-540-65833-5.

Alexander Schrijver,
Theory of linear and integer programming (Reprint). Wiley, Chichester, 1998, 484 p.,
ISBN: 0-471-98232-6

Vanderbei, Robert J.
Linear programming, Foundations and extensions (2nd ed.),
International Series in Operations Research & Management Science, Vol. 37, Kluwer, Dordrecht, 2001, ISBN: 0-7923-7342-1

Stephen J. Wright,
Primal-dual interior-point methods.
SIAM, Philadelphia, 1997.