GOR

Gesellschaft für Operations Research e.V.

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85th Meeting of the GOR Working Group

Practice of the Mathematical Optimization

Modeling Languages in Mathematical Optimization
– Overview, Opportunities & Challenges in Application Development –

18–29 November, 2010
Physikzentrum, Bad Honnef, Germany
(www.pbh.de)

Organisation

Josef Kallrath & Alexander Lavrov
GOR AG „Praxis der mathematischen Optimierung“

Modeling Languages in Mathematical Optimization
– Overview, Opportunities & Challenges in Application Development –

This symposium deals in a unique combination with the aspects of model-building and solving real world-optimization problems. It treats in a systematic way all major modeling languages and model language software used to solve mathematical optimization problems.

Speakers of all major modeling language providers will be present and will give deep insight into their motivations and conceptual design features of the software, highlight their advantages but also discuss critically their limits.

Roughly speaking, a modeling language is a means of describing problems to a computer system in the same way that people describe those problems to each other. Of course in reality it is not exactly in the same way, but the resemblance has to be close enough to spare the user any significant translation. Of course, in this symposium we focus on modeling languages used in mathematical optimization. As an example, when practitioner or researchers describe large-scale linear programs to each other, they use summations and subscripting. To give a negative definition first: Probably one would not consider a language lacking in these features to be a modeling language for large-scale LP. This can be turned into a positive definition: A modeling language in mathematical optimization needs to support the expressions and symbols used in the mathematical optimization community. Therefore, it is naturally an algebraic modeling language supporting the concepts of data, variables, constraints and objective function. Those entities are connected by algebraic operations (+,-,x) but also nonlinear functions.

The earliest algebraic modeling languages appeared in the late 1970s and early 1980s. They were already very useful supporting analysts to feed their problems to solvers. In the midst 1980s, when, for instance, AMPL or XPress-MP appeared, the software developers were already trying to improve on previous designs, by taking advantage of faster computers and better computing environments.

By showing the strengths and characteristic features we hope to give novices and practitioners in mathematical optimization, supply chain management, finance industry and other areas of industry a useful overview of these different software packages and support decision makers when they have to decide which way to go.

This two-days event will give an overview of the current state of the art including new topics such as grid computing, stochastic optimization, and hybrid methods. A special focus is on application layers above the algebraic modeling languages. Such structures we find, for instance, in the energy, supply chain and refinery sectors. Please contact Alexander Lavrov or myself if you are interested to contribute a talk or a presentation.

In regular talks, each approx. 30-45 minutes, and 60 minutes blocks (including several small contributions) by the modelling language providers experts from practice, research institutions or software companies, will present selected problems and the corresponding solutions. Confirmations for their talks have been obtained from the following speakers:

Dr. Oliver Bastert, Dr. Yves Colombani & Dr. Susanne Heipcke
The Xpress-Mosel Environment (Xpress Team, FICO, München & Marseille, FR)

Dr. Bert Beisiegel (B2 Software-Technik GmbH, Mülheim/Ruhr, Germany)
Modeling Languages: What I liked in the Past and what I hope for in the Future

Dr. Wolfgang Britz (Institute for Food And Resource Economics, University Bonn, Germany)
GAMS Models in Agricultural Economics

Prof. Dr. Robert Fourer & Dr. David M. Gay (AMPL Optimization LLC, Albuquerque, NM, US)
Recent Developments in Model and Solver Support in the AMPL Modeling Language

Jan-H. Jagla (GAMS Software GmbH, Köln, Germany)
GAMS - Features you might not know about

Dr. Ferenc Katai (IBM ILOG SWG AIM, Valbonne, France)
IBM ILOG Optimization Programming Language (OPL): Powerful Combinations of Different Modeling Worlds

Dr. Thorsten Koch (Zuse Institute Berlin, Berlin, Germany)
The ZIB Optimization Suite

Prof. Dr. Josef Kallrath (GOR „Real World Optimization“, Germany)
Polylithic Modeling and Solution Approaches

Bjarni Kristjansson (Maximal Software, UK)
Current Developments for the MPL Modeling System and Optimax Component Library

Alexander Meeraus (GAMS Development Corporation, Washington, D.C., US)
GAMS Past - Present - Future

Arnold Neumaier, Peter Schodl & Kevin Kofler (University of Vienna, Vienna, Austria)
FMathL -- Formal Mathematical Language

Dr. Olaf Syben (ProCom GmbH, Luisenstr. 41, 52070 Aachen, Germany)
BoFiT, a Graphical Modeling Framework for Mixed Integer Programs

In particular, the following thematic fields will be addressed:

- Algebraic modeling languages
- Data interfacing
- Graphical modelling frameworks
- Practioners' views

We expect an interesting overview on the current status of modeling languages, reflecting modern requirements, possibilities, and limitations. Part of the official program is a visit and a guided tour through the private house of the German chancellor, Konrad Adenauer.

GOR Gesellschaft für Operations Research e.V.

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85. Sitzung der GOR Arbeitsgruppe
Praxis der Mathematischen Optimierung

Modeling Languages in Mathematical Optimization
– Overview, Opportunities & Challenges in Application Development –

Physikzentrum, Bad Honnef, November 18 & 19, 2010

Thursday, Nov. 18 - 2010 : 09:30 – 23:00

09:30-09:40 **Opening and Welcome Session** (J. Kallrath & A. Lavrov)

09:40-10:15 **Bert Beisiegel** B2 Software-Technik GmbH, Mülheim/Ruhr, Germany
Modeling Languages: What I liked in the Past and what I hope for in the Future

10:15-10:30 **Alexander Meeraus** GAMS Development Corp., Washington, D.C., US
GAMS Past - Present - Future

10:30-10:50 ----------------------------- Coffee Break --------------------------------

10:50-11:35 **Jan-H. Jagla** GAMS Software GmbH, Cologne, Germany
GAMS - Features you might not know about

11:35-13:00 -------------------------- Lunch Break ---------------------------------

13:00-13:40 **Arnold Neumaier, Peter Schodl & Kevin Kofler** (University of Vienna, Vienna, Austria)
FMathL -- Formal Mathematical Language

13:40-14:20 **Thorsten Koch** (Zuse Institute Berlin, Berlin, Germany)
The ZIB Optimization Suite

14:20-14:45 ----------------------------- Coffee Break --------------------------------
14:45-16:45 ----- Visit & Guided Tour: Stiftung Bundeskanzler-Adenauer-Haus --------

16:45-17:30 **Josef Kallrath** GOR Arbeitsgruppe, Weisenheim am Berg, Germany
Polylithic Modeling and Solution Approaches

17:30-18:30 **Olaf Syben** (ProCom GmbH, Aachen, Germany)
BoFiT, a Graphical Modeling Framework for Mixed Integer Programs

18:35-18:45 **Internal Meeting** of the Working Group
19:00 - **Conference Dinner** – Buffet; get-together in the wine-cellar
Celebrating the 85th Meeting of our GOR Working Group

GOR Gesellschaft für Operations Research e.V.

Friday, Nov. 19 - 2010 : 09:15 – 16:30

09:15-10:15 **Robert Fourer & David M. Gay** (AMPL Optimization LLC, Albuquerque)
Recent Developments in Model and Solver Support in the AMPL Modeling Language

10:15-10:45 ------------------------- Coffee Break ---------------------------------

10:45-11:45 **Bjarni Kristjansson** (Maximal Software, London, UK)
Current Developments for the MPL Modeling System and Optimax Component Library

11:45-12:30 **Wolfgang Britz** Inst. for Food And Resource Economics, Univ. Bonn
GAMS Models in Agricultural Economics

12:30-14:00 ------------------------------------- Lunch Break ----------------------

14:00-15:00 **Oliver Bastert, Yves Colombani & Susanne Heipcke**
The Xpress-Mosel Environment (Xpress Team, FICO, München & Marseille)

15:00-15:20 ------------------------- Coffee Break ---------------------------------

15:20-16:20 **Ferenc Katai** (IBM ILOG SWG AIM, Valbonne, France)
IBM ILOG Optimization Programming Language (OPL): Powerful Combinations of Different Modeling Worlds

16:20-16:30 **Final Discussion – End of the Workshop**

The Speakers

Oliver Bastert is product manager for the FICO Xpress Optimization suite. Before joining FICO in 2008, he has worked for almost a decade as a software developer and consultant at Dash Optimization. He has published several scientific papers and delivers university lectures and presentations on optimization periodically. Oliver Bastert holds a diploma in mathematics and computer science from the University of Cologne, Germany, and a doctorate degree in applied mathematics from the Munich University of Technology, Germany.

Bert Beisiegel runs a tiny company for more than twenty years; see the abstract of his talk for more information. He has studied mathematics (and physics) at the Johannes Gutenberg University at Mainz; his thesis (from 1975) has dealt with finite simple groups, an algebraic topic, certainly remote from "algebraic" modeling languages. More can be found at www.b2st.de/1_1_ich.html.

Wolfgang Britz, senior researcher and lecturer at the Institute for Food and Resource Economics, University Bonn, focuses since two decades on economic simulation models for impact assessment of agricultural policies. Besides methodological work, project management and applications for policy support, he his also involved in IT implementation and GUI development of large-scale economic modeling systems.

Michael R. Bussieck is a Senior Research Analyst at GAMS Software GmbH. From 1999 to 2004 he worked at the GAMS Development headquarters in Washington DC, USA. He received his Ph.D. from Technical University Braunschweig, Germany.

Yves Colombani is a computer scientist from Marseille (France). For his PhD, awarded in 1997, he worked on scheduling problems and implemented a constraint solver on intervals of integers. He then joined Dash Optimization (now: FICO). Yves has entirely designed and implemented Mosel and continues the development of its core functionality.

Robert Fourer is a partner of AMPL Optimization LLC and has been a member of the faculty of the Industrial Engineering and Management Sciences Department at Northwestern University for over 30 years. His involvement in the creation of the AMPL modeling languages dates to a sabbatical visit to Bell Laboratories in 1985-86. He received a Ph.D. from Stanford University in 1980.

David M. Gay is a partner of AMPL Optimization LLC and a research professor at the University of New Mexico. Previously he worked for over six years at Sandia National Labs in Albuquerque, New Mexico, and for nearly 20 years at Bell Labs in Murray Hill, New Jersey, where he helped create the AMPL modeling language. He received a Ph.D. from Cornell University in 1975.

Susanne Heipcke worked for BASF-AG (Germany) before joining Dash Optimization in 1998. Her Ph.D. research (awarded in 1999 by the University of Buckingham) focused on the solution of large-scale industrial problems by a combination of constraint programming and mixed integer programming. More recently she has worked on various aspects of modeling, including the development of teaching material for Mosel (including the book "Applications of optimization with Xpress-MP" published in September 2002), and interfaces to different types of solvers and solution methods. Her responsibilities at FICO comprise the model builder library Xpress-BCL, coordination of the development of the constraint programming software Xpress-Kalis, consulting projects in various business sectors, training courses and the organization of specialist training events.

Jan-H. Jagla studied mathematical economics at the Technical University Braunschweig, Germany and the University of Zaragoza, Spain. Since 2006 he is an optimization analyst at GAMS Software GmbH.

Ferenc Katai received his Theoretical Mathematician diploma in Hungary/Szeged in 1987 and then went on to do research in a Hungarian Academy affiliated Reserch Institute to solve chemical industry related problems ranging from reactor modeling/reactor sizing with efficient start-ups - including writing LP/MIP and NLP solvers -, and to conduct research on chemical process scheduling. In 1992 he received a scholarship to pursue his Ph.D. in the Research Laboratory of Resource Utilization of Tokyo Institut of Technology/Japan on Stochastic Learning in Genetic Algorithms applied for checmical scheduling processes. After he got his Ph.D. he spent two years as an Assistant Processor in the same University but in different laboratory building simulation architectures for chemical plants. In 1998 he joined ILOG Japan as a senior consultant of optimization and then became the Director of Consulting for ILOG Japan office. He had first hand experience how to model/solve large size problems in different industries in logistics/manufacturing/manpower related/etc. Since 2007 he has been product manager of the product called IBM ILOG CPLEX Optimization Studio(formerly called ILOG OPL Studio). He published over 20 papers during his research years - and some after that as well -, and participated in many conferences on optimization/scheduling.

Thorsten Koch is a member of the research staff of the Discrete Methods Division at the Zuse Institute Berlin (ZIB) since 1998. He has worked in several areas, especially Telecommunication, Chip Verification, Mathematical Education and Integer Programming. In 2001 he became a member of the DFG research center *Matheon* and is now head of the project B20 Optimization of Gas Networks. He received his Ph.D in 2004 from TU Berlin for his thesis on *Rapid Mathematical Programming*. Since 2009 he is director of the Scientific Information department at ZIB and also head of the Linear and Non-linear Integer Programming Group.

Gertjan de Lange joined Paragon Decision Technology in 1995. Paragon is the developer of AIMMS, an optimization platform that enables organizations to incorporate Operations Research to support complex decision making in a straightforward manner (www.aimms.com). Currently, he is responsible for the Product Strategy of AIMMS. In 2006, Gertjan started the US office of Paragon in Kirkland, WA from which he returned early 2010. He has an MSc in Applied Operations Research from University of Twente (NL).

Annette Mura is working in the products department of ProCom and is responsible for the specification of requirements of BoFiT. During her studies of mathematics at the TU Berlin she specialized on optimization methods and modeling of mixed integer problems using different modeling languages. Starting as consultant for optimization problems in different areas at ProCom in 2007 she is now responsible for the mathematical design of the optimization components in BoFiT.

Alexander Meeraus is president of GAMS Development Corporation (GDC). For 17 years he worked in research at the World Bank heading Analytic Support. 1987 he founded GDC to turn GAMS, the research product, into a viable commercial system.

Arnold Neumaier is since 1994 full professor for computational mathematics at the University of Vienna. He has very broad interests, with long term activities in many fields of pure and applied mathematics, computer science, and physics, including software development and analysis of algorithms in optimization, numerical analysis, and statistics, and uncertainty modeling in high dimensions. Successful software packages include the VCE covariance estimation software; MCS, the only global optimization code in the huge NAG library; and SNOBFIT, a user-friendly package for expensive parallel noisy optimization. He is also the author of several books and extensive survey articles, in particular on topics from numerical analysis and optimization. His extensive web site at `http://www.mat.univie.ac.at/~neum/` is one of the most visible ones in mathematics and adjacent areas, among those owned and maintained by a single person who is also responsible for the contents.

Dr. Olaf Syben is heading the products department of ProCom and is thereby responsible for the development of BoFiT. After his Ph.D. in the field of elementary particle physics he has been working in IT projects for more than 12 years. His main subjects have been the specification of requirements and the translation of customer requirements and needs to IT solutions.

Lutz Westermann is an Optimization Analyst at GAMS Software GmbH since 2006. He graduated as Dipl.-Math. oec. at the Technical University Braunschweig, Germany.

The Xpress-Mosel Environment

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April 2010

1. *Introduction to the Mosel language and the associated tools*
   The first talk gives an overview of the Mosel language, presenting its use as a mathematical modelling language and equally its programming functionality that makes it possible to implement complete optimization applications in a single environment. Development and analysis of optimization models is aided by the graphical environment Xpress-IVE, and tools such as the Mosel debugger and profiler, and the Xpress-Tuner. The Mosel libraries provide the neccessary functionality for a tight integration into existing (C/Java/.net) applications for model deployment.

2. *Decomposition schemes in Mosel*
   This talk presents possibilities for problem decomposition and concurrent solving from a modelling point of view (that is, excluding "parallel MIP" and other solver-internal options). We provide examples of problem classes suitable for the different approaches and hint at their implementation with Xpress-Mosel, using Mosel's capacity of handling multiple models, multiple problems within a model, and as a new feature, distributed computation using multiple processors. Some remarks on the "doability" for less expert modellers close the discussion.

3. *Application demos*
   By design, Mosel has an open, modular architecture. Besides various solver modules and data connectors, the Mosel distribution also includes the module Xpress-XAD for the development of graphical user interfaces to optimization models. In this talk we show various examples of applications from different industry sector developed with XAD, that is simply just another add-on module to the Mosel language, with a dedicated a drag-and-drop editor in IVE.

Modeling Languages: What I liked in the past and what I hope for in the future

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B2ST implements tailor made application software for steel works including various types of charge design and alloy calculations and static metallurgical models for vessels such as AOD, VAD and VOD. All these calculations have to solve LP- (and slightly NLP-) problems.

For many years, we have used our own solvers (written in FORTRAN and C). In 2003 we have finally abandoned those and moved on to use commercial solvers and a modeling language. I will comment on why we made this move and how we selected a specific modeling language.

I consider a modeling language quite beneficial not only for OR experts, but for users. too. Unfortunately, users are rarely aware of the benefits of the modeling language; in most cases they are not aware of the modeling language at all. I will present some suggestions on how "the community" could change this.

I will conclude with some of my wishes for additional and/or enhanced features of modeling languages.

GAMS Models in Agricultural Economics

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Economic simulation models in agricultural economics are applied at quite different scales from single farms to globe and for quite different purposes such as policy impact assessment or farm level planning. The paper aims to summarize pros and cons of using GAMS for agricultural simulation models, drawing mostly on experiences gathered by a team in Bonn and by contacts with other agricultural economists.

The major advantages of GAMS can be summarized as follows. A notation close to equations in a scientific paper eases documentation and training. Its set driven concept based on elements wise operations in multi-dimensional matrices avoids explicit loops and if statements and leads to compact code, and supports separation of data and code. It comprises transparent links to high-performance solvers for LP, NLP, MIP, CNS, and MCP. In combination, these features lead to its relatively wide spread use in agricultural economic simulation models and a vivid user community.

There are some clear restrictions. GAMS declares all symbols as global and does (basically) not feature the concept of a function and sub-routine. That decreases learning costs, but hinders a modular design. Moreover, GAMS supports only a few types of objects: double precision multi-dimensional arrays (including scalars) indexed with string collections the so-called sets -, sets, and the objects around a model. It does not allow handling of other data types/objects, and does not comprise in-built functions for even basic statistics. All matrix operations must be programmed element wise. I/O is restricted to the proprietary GDX format or plain text/CSV. However, GDX interfacing tools and an API for the GDX format are available.

Summarizing, the relatively simple language structure of GAMS allows economists even without IT training to set-up and apply relatively quickly an even large-scale simulation model. Its future market share could depend on two issues. Firstly, how far will GAMS benefit from parallel execution to answer the growing demand for stochastic simulations and large-scale sensitivity analysis? Secondly, will it be possible for GAMS, without losing its appealing simplicity, to support a more modular design to ease application in large-scale projects and exchange of libraries.

Recent Developments in Model and Solver Support in the AMPL Modeling Language

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We describe extensions that enable the AMPL modeling language to more naturally express certain discrete and stochastic optimization problems. Only a modest number of straightforward changes to the language are necessitated by these extensions. However we have also faced a range of challenges in conveying these extensions from models to problem instances to varied solvers, in such a way that each solver can take best advantage of the problem structure. To explain these challenges we describe several AMPL-solver links that have been implemented in the past year.

GAMS - Features you might not know about

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In the last decade the General Algebraic Modeling System (GAMS) has been improved in various ways. Improvements like the availability of new solvers are visible and known to most of the users. Other enhancements are more hidden and the user might not know that these exist. In this talk we give an overview of features which were added in the recent and not so recent past.

Polylithic Modeling and Solution Approaches

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Based on the Greek *term monolithos* (stone consisting of one single block) Kallrath (2009) introduced the corresponding term *polylithic* for modeling and solution approaches in which mixed integer or non-convex nonlinear optimization problems are solved by a tailor-made methods involving several models and/or algorithmic components. A *monolithic model* is just one model with data, a set of variables and a set of constraints and one solve statement calling a solver, *e.g.*, `CPLEX`, `Gurobi`, or `Xpress`. In contrast, a *polylithic model* contains a set of models which are somehow connected in their data flow of input and output data, *i.e.*, the solution of one model is input to another one. This can be exploited to initialize certain variables, or to provide bounds on them. Examples of polylithic models are decomposition approaches, column generation as in Gilmore & Gomory (1961)] and Branch&Price [see, for instance, Barnhart et al. (1998)] or hybrid techniques [see, for instance, Pochet and Wolsey (2006)] in which constructive heuristics and local search improvement methods are coupled with exact MIP algorithms to produce feasible points and tight lower and upper bounds. Thus, we observe that the sub-models of polylithic models are often connected in such a way that they represent a tailor-made algorithm.

Tailor-made polylithic solution approaches with thousands or millions of solve statement to be executed put an extreme challenge on algebraic modeling languages. Hot-start techniques avoiding that the whole matrix is re-generated become essential.

In this talk we present illustrative examples from the paper and metals industries, scheduling in the process industry, and planning of hydro-thermal plants in the energy industry. Lexicographic goal programming, a useful approach in multi-criteria planning problems, is another example of a polylithic modeling.

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IBM ILOG Optimization Programming Language (OPL): Powerful Combinations of Different Modeling Worlds

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Linear/integer/quadratic programming models along with combinatorial optimization models arise in a variety of application areas, which include planning, scheduling, sequencing, resource allocation, design, and configuration to name a few. Usually modelers choose the technology - the underlying solving engine - first, and then they use a language in which they can write their models and then access their choice of solving engine. The IBM ILOG Optimization Language (OPL) does not close all the doors for model developers since thru the OPL language they can access mathematical programming - for linear and mixed integer models - (MP), constraint programming and constraint-based scheduling - for combinatorial models - (CP and CP-based scheduling) models thru the same language/language environment. Then the modeler can try out different techniques/models which suits the best to problem at hand. In addition OPL would like to make modelers lives easy simplifying the modeling and the model development process itself. The presentation consists of three parts. First a description of OPL as a language - along with the utility tools built in/on the language - is given focusing on the three possible techniques (MP/CP/CP-based scheduling). Then the second part discusses how CP-based scheduling-based models can outperform/out-scale MP-based models on scheduling problems. In the same section how a combination of (MP and CP) model chaining can be achieved using ILOG Scripting language will outlined. In fact OPL itself is not limited by the underlying solving engines, it provides APIs for embedding into virtually any code base (Java/C++/.Net). Or the modeler could write her own external algorithms in Java and connect to the OPL model. This will be shown in the third part. At the last part some of the applications where OPL is used are highlighted and conclusions are drawn.

Keywords: Mathematical programming, integer programming, constraint programming, constraint-based scheduling, optimization modeling language, IDE, solving engine,

The ZIB Optimization Suite

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We present the ZIB Optimization Suite, a toolset for mathematical programming, which is freely available for academic use including complete source code. It consists of the algebraic modeling language ZIMPL, the (non)linear mixed integer programming solver SCIP, and the LP solver SoPlex. Using these tools it is possible to model, solve, and analyze large mathematical programming instances in the classroom (and on the students Laptops) and can therefore enhance the teaching of problem solving issues. Using some examples, the ZIMPL modeling language will be introduced and the main features of the SCIP solver.

GAMS Past - Present - Future

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From the beginning in the 1970 at the World Bank till today, GAMS, the General Algebraic Modeling System, has evolved continuously in response to user requirements, changes in computing environments and advances in the theory and practice of mathematical programing. These changes and improvements where guided by a few basic principles: Platform independence, open architecture with interfaces to other systems, balanced mix of declarative and procedural elements and the separation of interface, data, model and solver. These fundamental concepts will also be constants during future development.

FMathL – Formal Mathematical Language

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FMathL is the working title for a modeling and documentation language for mathematics, suited to the habits of mathematicians, to be developed in a project at the University of Vienna.

The goal of the FMathL project is to combine the universality of the common mathematical language to describe completely arbitrary problems and the user-friendliness of mathematical modeling systems such as AMPL or GAMS for the flexible definition of large-scale optimization problems. Formal models are specified close to how they would be communicated informally when describing them in a lecture or paper, except that no relevant details are suppressed.

FMathL enables users to express arbitrary mathematics in a form that is translated into a semantically faithful internal representation. Application modules can therefore be fed by algorithms that extract from this description the relevant information.

FMathL allows to specify problems in their natural mathematical form, with functions, sets, operators, measures, quantifiers, tables, cases rather than loops, indices, diagrams, etc.. It will also allow to define high-level strategies for combining algorithms with well-defined input output behavior to solve problems of a given category.

At present we have a fragment of FMathL designed to encode, analyze, and translate into AMPL code the problem classes described in the OR-Library. We already successfully encoded about 1/3 of the problem classes described there. It is planned to develop this fragment into a comfortable front end for conventional modeling languages.

BoFiT, a Graphical Modeling Framework for Mixed Integer Programs

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BoFiT is a standard optimization product for applications in the energy sector delivered by the ProCom GmbH. The solution covers the complete process starting with the modeling of mixed integer programs and ending with the automized integration of optimization runs and results in the business processes of the customers. The supported business processes range from intraday and day ahead calculations up to long term scenarios for fuel planning or investment decisions. BoFiT is able to cover problems containing e.g. thermal production, power exchange, fuel contracts, storages, emission trading or district heat distribution. The modelling of the optimization problems is based on a graphical approach in terms of a material flow problem. A large number of pre-defined modelling components as contracts, turbines or balance nodes is combined to a model. Each component represents a given subset of mathematical equations while the connections between the components represent additional restrictions on the variables. By introducing constraints to the different variables the mathematical problem is completed and solved by commercially available standard solvers. In the actual BoFiT release the graphical editor is developed in a way that it derives its modelling capabilities from a configuration file. The file contains the component definitions, their modeling behaviour (connections) and their internal parameters. Thus the exchange of the configuration file would lead to a graphical editor with new modelling capabilities. This leads to new applications of BoFiT in different sectors where a graphical modelling language can help the users to express their needs in terms of optimization problems. The newest invention within BoFiT is a general component where the mathematical equations can be defined using a standard modelling language. With help of that component BoFiT opens a link between the mathematical modelling languages to the graphical modelling and combines the advantages of the two approaches: graphical models are easy to read and to understand but have a given library of equations while programming languages are hard to read but free in the modelling capabilities.