

When OPL ? When AMPL or AMPL plus ?

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1. Introduction

As general purpose modeling languages supporting math programming, there are several products which are specifically targeted towards the mathematical programming problems, such as AMPL, GAMS, MPL, AIMMS, etc, and also the recent new product ILOG OPL Studio, which offers the same capabilities of those products, plus offers constraint programming and scheduling support, as well as C++ code generation.

This paper gives a comparison study of ILOG-offered modeling systems, that is, OPL Studio, AMPL and AMPL Plus, and recommendations are given at the end of the paper.

2. ILOG OPL Studio

ILOG OPL Studio delivers the capabilities you need to quickly and easily create advanced business optimization solutions. Its interactive graphical environment lets you develop high-level optimization applications without a detailed knowledge of computer programming. Simple and powerful, the OPL language represents optimization problems in a natural, intuitive way. ILOG OPL Studio lets you rapidly create models of optimization problems, then modify and update them with unmatched ease and accuracy. The studio's graphical user interface helps you structure problems and choose solution strategies. Once you have developed a model for your problem, ILOG OPL Studio's code generation feature produces C++ code that can be directly linked with ILOG Optimization Suite components for application deployment. The code generation feature lets you couple OPL models with external data sources to create complete, powerful, highly flexible applications.

Detailed features can be summarized as:

- A single, unique modeling language for applying linear and integer programming, constraint programming, and scheduling
- First modeling language combining linear and integer programming with constraint programming and scheduling
- First modeling language to support search strategies of constraint programming
- Easy to learn and use
- Powerful declarative language, defining an intuitive language format for models
- Ability to define problems, write search strategies, and solve problems without the need for C++

- programming
- Model and data are separated to facilitate model reusability
- Graphical interactive environment for quick and easy development
- Dynamic visualization of solutions and search strategy progression
- Supports constraint programming as well as linear and integer programming, allowing easier evaluation of alternative solution techniques
- Database access, allowing the import of external data into an optimization model, and the export of solutions
- OPLScript, a scripting language allowing sequences of models to be solved, as well as allowing the output of one model to become the input of another model
- C++ code generation for ILOG Optimization Suite application development.

ILOG OPL Studio makes the resources of the ILOG Optimization Suite available to non-programmers, which lets you harness the power of the world's most advanced optimization tools to improve your enterprise's efficiency and do it faster.

3. AMPL and AMPL plus

AMPL (A Mathematical Programming Language, or A Modeling Language for Mathematical Programming) is a well-known and popular language supporting mathematical programming developed by Lucent Technologies Bell Laboratories. AMPL supports linear and mixed-integer programming, as well as quadratic programming and non-linear programming.

AMPL lets you use common notation and familiar concepts to formulate optimization models and examine solutions, while the computer manages communication with an appropriate solver.

AMPL's flexibility and convenience render it ideal for rapid prototyping and model development, while its speed and control options make it an especially efficient choice for repeated production runs.

AMPL Plus provides an extended environment for the use of AMPL. It provides a graphical interface to AMPL under Microsoft Windows, and access to a wide variety of databases through drivers for the ODBC standard.

Detailed features can be summarized as:

- Excellent math programming modeling tool-- Expressive, flexible & powerful syntax
- Established user community--many existing users
- Nonlinear solver support--MINOS solver available from ILOG for non-linear problems
- Ongoing development-- Frequent syntax enhancements and bug fixes
- Open solver interface--Most available solvers supported
- A full-featured GUI is provided by the AMPL Plus

4. Detailed Comparison

The following table illustrates the differences between OPL Studio 2.1, AMPL and AMPL Plus:

	ILOG OPL Studio 2.1	AMPL	AMPL Plus
GUI	O		O
GUI for Unix platforms	O		
GUI for Microsoft Windows platforms	O		O
Database Connections	O		O
Support for generalized nonlinear solvers		O	O
Full support for LP and MIP	O	O	O
Modern, flexible, easy to read modeling constructs	O	O	O
Support for quadratic programming		O	O
Support for piece-wise linear objective functions and constraints	O	O	O
Solves sequences of related problems via programming/command constructs	O	O	O
Efficient sparsity handling in models	O		
Performance: interface with CPLEX	O (in-core)	O (files)	O (files)
Support of constraint programming	O		
Support of scheduling in language constructs	O		
Facilitates transition from modeling to production/deployment via code generation	O		

5. Conclusion and Recommendations:

In most cases, OPL Studio should be the recommended modeling system, because:

- It supports LP/MIP, constraint programming, and scheduling, and users can benefit from the ability to evaluate alternative methodologies and also to blend methodologies
- It provides a smooth migration path from prototyping/modeling to application development and deployment
- It is the only modeling tool supporting CP and LP, with full ILOG support and future R&D enhancement

AMPL could be recommend in the following cases:

- If you know AMPL already, prefers it, and specifically requests it
- If you have a quadratic programming or general non-linear problem
- If you already own the CPLEX Callable Library and simply wants a modeling system to supplement that

6. Reference

- [1] ILOG Optimization Technology White Paper, ILOG, Inc. 1997. (<http://www.ilog.co.jp/>)
- [2] ILOG OPL, User Manual, version 2.1, May, 1999
- [3] Pascal Van Hentenryck, The OPL Optimization Programming Language, MIT Press, 1999
- [4] Robert Fourer, David M. Gay, and Brian W. Kernighan, AMPL: A Modeling Language for Mathematical Programming, Duxbury Press, 1993