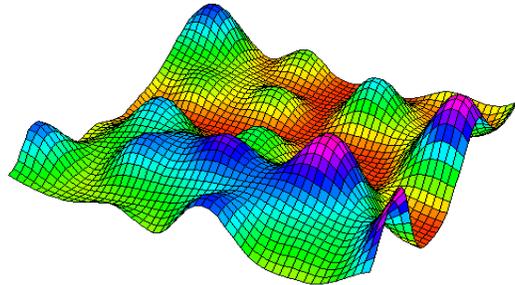


# Nonlinear (Global and Local) Optimization

## Models, Algorithms, Software, and Applications



Presented by

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### Summary

Global optimization (GO) is aimed at finding the best solution of nonlinear decision models, in the possible or verified presence of multiple optima. For illustration, please see the figure above that shows a multimodal function. Traditional (local scope) nonlinear optimization methods will often fail to find the global minimum or maximum of such functions. GO is an emerging area of research, with significant existing and potential applications.

In a practically focused series of lectures, first we review the basic concepts and methods of traditional nonlinear programming (NLP). Next, we discuss the relevance of global optimization in real-world applications and formulate a canonical GO model. We then review the key GO model types, and the most prominent exact and heuristic algorithmic solution approaches. A more detailed discussion is devoted to several key exact deterministic and stochastic solution strategies.

Next, we present a review of modeling environments and software for solving NLP and GO problems. We introduce and demonstrate (as time allows) several professional software implementations, available for compiler platforms, spreadsheets, optimization modeling languages, and integrated technical computing systems. The model examples presented include standard test problems from model libraries and some well-known optimization challenges. We will also review several advanced applications and case studies.

The lecture series is offered in an interactive atmosphere, and in a flexibly adaptable manner. The subjects presented can be chosen based on the course attendees' knowledge, specific interests, and needs. Questions, comments, test challenges and real-world GO applications are welcome.

The presentation slides, and a selection of articles / book chapters written by the course presenter and his co-authors will be made available to course attendees.

## Topics Covered

- Introduction and Discussion of Course Objectives
- Operations Research, Optimization Models, and Solution Techniques
- The Relevance of Nonlinear and Global Optimization
- Local Nonlinear Optimization: A Review of the Key Concepts
- The Global Optimization Model and Several Important Special Cases
- Exact and Heuristic Algorithms for Global Optimization
- Modeling Environments and Solver Engines
- Global and Local Nonlinear Optimization Software Implementations
- Software Demonstrations
- Modeling Tips and Solver Tuning for Better Performance
- Numerical Tests and Benchmarking of Optimization Software
- A Review of Existing and Prospective GO Applications
- Illustrative Case Studies
- References and Further Information Sources

## Software Demonstrations

Several of the following software products will be optionally demonstrated as part of the course.

LGO stand-alone solver engine (for C/C++/C# and FORTRAN compilers, and for other compiler-based links): [www.pinterconsulting.com](http://www.pinterconsulting.com)

AIMMS/LGO solver engine: <http://www.aimms.com/aimms/solvers/lgo/>

AMPL/LGO solver engine: [www.pinterconsulting.com](http://www.pinterconsulting.com) and [www.ampl.com](http://www.ampl.com)

Excel-LGO solver engine [www.pinterconsulting.com](http://www.pinterconsulting.com)

GAMS/LGO solver engine: [www.gams.com/solvers/solvers.htm#LGO](http://www.gams.com/solvers/solvers.htm#LGO)

Global Optimization Toolbox for Maple (with reference to the Toolbox version that has been available from Maple releases 10 to 16): [www.pinterconsulting.com](http://www.pinterconsulting.com)

MathOptimizer Professional (with LGO solver engine) for Mathematica:

[www.pinterconsulting.com](http://www.pinterconsulting.com) and [www.wolfram.com/products/applications/mathoptpro](http://www.wolfram.com/products/applications/mathoptpro)

MathOptimizer for Mathematica: [www.pinterconsulting.com](http://www.pinterconsulting.com) and

[www.wolfram.com/products/applications/mathoptimizer](http://www.wolfram.com/products/applications/mathoptimizer)

MPL/LGO solver engine: <http://www.maximalsoftware.com/solvers/lgo.html>

LGO for MATLAB: [www.pinterconsulting.com](http://www.pinterconsulting.com)

TOMLAB/LGO: [www.tomopt.com/tomlab/products/lgo](http://www.tomopt.com/tomlab/products/lgo)

## Illustrative References

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## About the Lecturer



János D. Pintér (M.Sc., Budapest; Ph.D., Moscow; D.Sc., Hungarian Academy of Sciences) is a researcher and practitioner with more than four decades of experience. Dr. Pintér runs Pintér Consulting Services (incorporated in Canada) since 1994.

His main area of expertise is nonlinear systems modeling and optimization, including algorithm and software development, and a broad range of applications. He is the author or editor of several books. He also wrote more than 200 articles, book chapters, encyclopedia and proceedings entries, technical reports and other professional publications.

Dr. Pintér is a past or present member of the Canadian and Hungarian Operations Research Societies, INFORMS, the Mathematical Programming Society, and SIAM. He serves/served on the editorial board of the *Journal of Global Optimization* (since 1991), the *Journal of Applied Mathematics and Decision Sciences* (from 2004 to 2009), *Algorithmic Operations Research* (from 2005 to 2011), the *International Journal of Modeling, Identification, and Control* (from 2005 to 2009), and of the web forums *GAMS Global World* and *GAMS Performance World* (since 2003). From 2002 to 2004 he served as Global Optimization Vice-Chair of the INFORMS Optimization Society. Between 2009 and 2014, he served/serves as a member and chairman of the Managing Board of EUROPT (within EURO, the organization of the European Operations Research Societies).

Dr. Pintér received the 2000 INFORMS Computing Society Prize for his monograph titled *Global Optimization in Action*. He also has received numerous awards, grants and fellowships in Australia, Austria, Canada, Germany, Hungary, Italy, the Netherlands, the United States, and elsewhere. He is an INFORMS Speaker and a CORS Traveling Speaker, and he has presented lectures, tutorials, and workshops in some 40 countries of the world. Recently (from 2008 to 2011) he also worked as a visiting professor at Bilkent University and Özyeğin University in Turkey.

Dr. Pintér is the principal developer of the LGO, AIMMS/LGO, AMPL/LGO, Excel/LGO, GAMS/LGO, Global Optimization Toolbox for Maple, MPL/LGO, MathOptimizer, MathOptimizer Professional, MATLAB/LGO, and TOMLAB/LGO optimization solver engines, and other modeling and optimization related software products. These products – developed and supported with partners – are in use by businesses, government institutes, and academic organizations around the world.

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