

# The Comet Hybrid Optimization System

## Introduction

This tutorial gives an in-depth overview of Comet, a hybrid optimization platform featuring constraint programming, constraint-based local search, and mathematical programming. Comet is a full object-oriented programming with sophisticated modeling and search abstractions. The tutorial reviews each of these paradigms and illustrate them in Comet on applications in sequencing, scheduling, routing, resource allocation, and rostering. It will both cover how to model with Comet and the underlying technology.

## Outline of the tutorial

- Goals: Give an introduction to Comet and to its underlying technologies. Comet is an award-winning system that integrates three main approaches to optimization problems: constraint programming, constraint-based local search, and mathematical programming. It has been used to solved complex industrial problems in logistics, manufacturing, rostering., and engineering. The tutorial will give attendees an overview of using Comet to solve complex applications.
- Content:
  - Motivation
  - Getting started in Comet
  - Constraint Programming
  - Constraint-Based Local Search
  - Mathematical Programming
  - Hybrid optimization in Comet
  - Practical Applications: Video tracking, Disaster Management, Hot Strip Mill SequencingThe goals of the tutorials will be achieved by demonstrating how Comet programs can exploit the various solvers to solve simple and more complex applications. Demonstrations of real applications will also be shown.
- Language: English

## Background

Earlier experience with the paradigm is not necessary.

## Presenters

- *Ivan Dotu*. Brown University, RI (USA). Ivan Dotu is a post-doctoral researcher at Brown University under the supervision of Professor Pascal Van Hentenryck. During the past 5 years he has been working closely with Pascal Van Hentenryck in a number of scheduling problems that had help shape part of the underlying algorithms inside Comet. He has also worked on practical applications using Comet such as video tracking and protein structure. Ivan was member of the program committee of AAAI-08 and he is a reviewer of several international conferences such as CP and SAT and journals such as Constraints, Journal of Mathematical Biology and Transactions on Computational Biology and Bioinformatics. He has also been a professor of Algorithms and Operations Research at Universidad Europea in Madrid.
- *Pascal Van Hentenryck*. Brown University, RI (USA). Pascal Van Hentenryck is a professor of computer science at Brown University and the director of the optimization laboratory. During the past 20 years, he developed a number of influential systems, including the pioneering CHIP system which is the foundation of all modern constraint programming systems, the Numerica system for global optimization, the optimization programming language OPL, and the programming language Comet which supports constraint-based local search, constraint programming, and mathematical programming. Most of these systems, and their foundations, are described in books published by the MIT Press and have been licensed to industry. His current research in online stochastic optimization integrates techniques from artificial intelligence, stochastic optimization, and combinatorial optimization to tackle complex decision-making applications under uncertainty. Van Hentenryck is the recipient of an 1993 NSF National Young Investigator (NYI) award, the 2002 INFORMS ICS Award for research excellence at the interface between computer science and operations research, the 2006 ACP Award for Research Excellence in Constraint Programming, best paper awards at CP'03, CP'04, and IJCAI'07, and an IBM Faculty Award in 2004. Pascal has given invited talks at many premier conferences in artificial intelligence, operations research, and programming languages, including IJCAI'97, CP'97, UAI'06, CP'AI'OR'08, SIOP'08, ECAI'08, and NIPS'08.
- *Miguel A. Patricia*. Universidad Carlos III de Madrid (Spain) He received his BSc in Computer

Science from the Universidad Politécnica de Madrid in 1991, his MSc in Computer Science in 1995 and his PhD degree in Artificial Intelligence from the same university in 2002. He has held an administrative position at the Computer Science Department of the Universidad Politécnica de Madrid since 1993. He is currently Associate Professor at the Escuela Politécnica Superior of the Universidad Carlos III de Madrid and research fellow of the Applied Artificial Intelligence Group (GIAA). His current research focuses on the application of soft computing techniques (NN, Evolutionary Computation, Fuzzy Logic and Multiagent Systems) to computer vision and video processing. He is author of several international journals and conference papers. He has carried out a number of research projects, patents and consulting activities in the areas of automatic visual inspection systems, texture recognition, neural networks and industrial applications.