ILOG Constraint Programming

Sophisticated scheduling and routing solutions

Finding optimized solutions when math programming won't do

Constraint programming solves the complex scheduling and routing problems beyond the capabilities of the best math programming (MP) engines. ILOG knows because it also makes ILOG CPLEX, the leading MP engine. Some problems are just too challenging:

- How can hundreds of auditors best be assigned to thousands of client jobs?
- What is the most efficient way for a plant to load thousands of orders into hundreds of trucks and rail cars each week?
- How does a cable company reschedule installation and repair technicians with last-minute appointment cancellations and unexpected absences?

Fortunately, while good scheduling applications can be difficult to develop, they are worth the effort. They allow organizations to achieve the greatest possible return on assets while meeting customer service goals and other obligations. And if you have never used constraint programming technology, ILOG's Professional Services organization can help you build a state-of-the-art scheduling or routing application based on ILOG CP.

Satisfy thousands of operational constraints

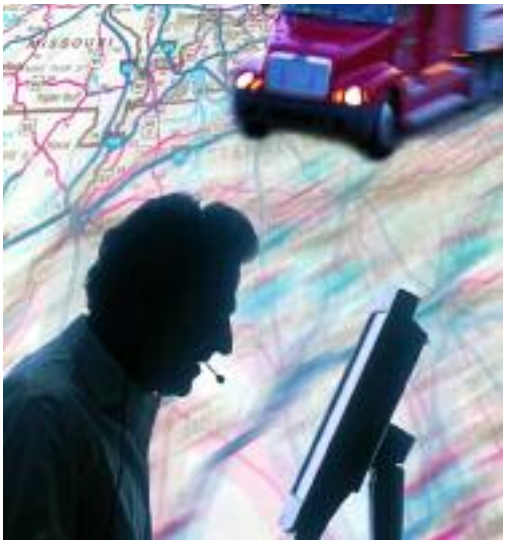
ILOG Constraint Programming (ILOG CP) performs the work needed to quickly find feasible solutions to difficult constraint satisfaction problems. Some scheduling problems can have thousands of individual operating constraints. Consider the complexities that arise from equipment set-up, cleaning and maintenance requirements in a multiproduct fresh dairy plant, or truck capacity, weather conditions, customer delivery windows and work rules in transportation routing. And workforce scheduling becomes more complex each year as employers try to retain employees by accommodating their individual needs. In short, finding a good schedule often requires specialized optimization software.

- **Generate feasible schedules for complex operations**
- **Balance conflicting business goals**
- **Model any type of constraint or business rule**
- **View schedules using state-of-the-art visualization**

ILOG®

Changing the rules of business™

ILOG Constraint Programming



Finding the right answers

ILOG CP is both a modeling language and a solving engine. A developer models a business problem in a declarative fashion using decision variables, constraints and objectives. ILOG CP then applies domain reduction algorithms to systematically reduce the search space until a good solution is found, and then it fine-tunes the solution into the best possible schedule or set of routes. You can stop the process whenever you think the solution is good enough.

ILOG CP modules

ILOG CP is composed of three modules that can be used to build models that solve almost any scheduling or routing problem:

■ **ILOG Solver – ILOG's core constraint-programming engine**

The Solver module provides powerful optimization technology for solving complex scheduling, sequencing, timetabling, routing and dispatching problems with large numbers of irregular constraints. It uses discrete variables to represent the primary decisions in a problem, and high-level constraints to represent the relationships between the variables. The constraints are combined to match the complex relationships in combinatorial problems. Solver also uses interval arithmetic algorithms to represent floating-point decision variables in linear and nonlinear expressions to more accurately model real-world problems.

■ **ILOG Scheduler – Extensions for scheduling challenges**

The Scheduler module offers extensions for solving scheduling problems commonly found in manufacturing, truck loading, warehousing and workforce planning. Its modeling objects allow you to define a wide range of resources and activities, as well as constraints that enforce timing, sequence and capacity restrictions. Resources vary greatly. Tanks, for example, consume capacity and can be scheduled for replenishment. Similarly, some activities can be interrupted while others cannot, and some must be done in sequence, while others are independent without precedence constraints. State-of-the-art algorithms rapidly and accurately compute schedules with precise start and stop times that minimize resources used while satisfying constraints and maximizing business objectives.

■ **ILOG Dispatcher – Extensions for vehicle routing**

The Dispatcher module provides extensions for vehicle and personnel routing aimed at minimizing travel time and distance to meet service goals. Dispatcher determines the most efficient routes, working with routing objects such as vehicles, locations and visits. It can also model common complexities such as regulations, vehicle compartments and dock time windows. Costs can be considered for vehicles and drivers, and include fixed costs, costs per quantity, and costs for distance or time. Revenue per stop can also be optimized. Dispatcher's object model distinguishes between travel, waiting and loading/unloading times, and supports driver breaks and other work rules.

> "The WorldCLASS Planner and Scheduler – using ILOG Solver and ILOG Scheduler – has dramatically cut the planning cycle, allowing McDougalls Foods to operate with 75% less stock, and as a result, this APS delivers a world-class stock turn combined with an impeccable level of customer service."
>
> – Martin Hollingworth
> Operations Planning Manager
> McDougalls Foods Ltd.

ILOG's supply chain planning and scheduling applications

ILOG CP technology is at the core of ILOG's innovative planning and scheduling applications for manufacturing and transportation operations:

- **ILOG Plant PowerOps – Integrated production planning and detailed scheduling for process manufacturing**
  ILOG Plant PowerOps (ILOG PPO) is an application that delivers interactive production planning and scheduling based on an integrated set of fine-grained MP and CP models that capture the full complexity of process manufacturing operations. Its scenario management interface lets supply chain executives and plant managers create and compare plans and schedules across key manufacturing metrics, allowing them to make the best trade-offs between conflicting goals when supply or demand changes unexpectedly. Bridging the gap between planning and execution, ILOG PPO improves the flexibility and agility of process manufacturing.

- **ILOG Fab PowerOps – Real-time scheduling for wafer processing in the semiconductor industry**
  ILOG Fab PowerOps (ILOG FPO) is a real-time, detailed scheduling application for semiconductor manufacturing. It creates optimal forward-looking production schedules for all the tools in each fab process area. Combining detailed operational models with optimization-based operations research techniques and continuous event monitoring, ILOG FPO shortens cycle time, increases tool utilization and enables fabs to respond more effectively to interruptions, recipe qualifications and hot lots.

- **ILOG Transport PowerOps – Route planning and detailed scheduling for truck freight delivery**
  ILOG Transport PowerOps (ILOG TPO) provides the performance, precision and interaction needed to make deliveries on time, every time. Its transportation planning balances the trade-offs between costs and on-time service, while respecting operational constraints and exploiting opportunities. Users can plan across multiple business units or facilities to create round trips, leverage multiple pickup points per route, dynamically route through multiple cross docks to take advantage of changing shipment volumes, level the workload at facilities across shifts to reduce congestion, and interactively create scenarios to explore new business opportunities or respond to changing market conditions.

> "With thousands of people and operations to schedule, we couldn't afford to skimp on a scheduling system. ILOG leads in optimization, and we are seeing improvements around here daily that are directly attributable to better resource allocation."
>
> – Hwa-Young Lee
> Project Manager
> Samho Heavy Industries

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Control your business by balancing multiple goals

In addition to satisfying your operational constraints, a good scheduling solution must also provide you with the ability to balance multiple goals and compare different solutions. ILOG CP's engines not only help you find optimized solutions, they also help you make decisions based on the KPIs that matter to you, whether they measure profitability, level of service or throughput. With ILOG CP, you can make informed decisions that give you greater control over your business.

Business benefits

Users of ILOG CP enjoy a wide range of benefits:

- Better schedules that balance conflicting goals
- Lower operating costs
- Easier rescheduling in response to changes in supply or demand
- Improved customer satisfaction
- Improved ROA through better utilization of resources
- Greater accommodation of employee preferences

Typical KPIs for scheduling and routing applications

- Overall operational efficiency
- Equipment, vehicle and resource utilization
- Fuel consumption
- Number of routes
- WIP and finished goods inventory levels
- Revenue per day or week
- Number of met workforce preferences
- Overtime costs
- Level of service

> "Our ability to deliver high-performance, cutting-edge applications that give our customers a significant competitive advantage is the key to our success. These requirements mean that we must seek out the best technology partners. We have enjoyed a long association with ILOG for the high quality of its products and because of the company's acknowledged leadership in supply chain and manufacturing optimization solutions."
>
> – Hiroshi Namie
> Group Leader
> NS Solutions Corporation
> (Nippon Steel)

ABOUT ILOG'S OPTIMIZATION PRODUCTS

More than 1,000 commercial customers, including 160 members of the Global 500, use ILOG optimization tools and engines to solve the world's most challenging planning and scheduling problems. ILOG optimization products are also used by a majority of the leading supply chain management software vendors, as well as in research programs at over 1,000 universities around the world, making the products the "gold standard" for performance and solution quality in the operations research community. For more information and a complete list of customer references, please visit http://optimization.ilog.com.

ABOUT ILOG

ILOG delivers software and services that empower customers to make better decisions faster and manage change and complexity. Over 2,500 global corporations and more than 465 leading software vendors rely on ILOG's market-leading business rule management system (BRMS), optimization and visualization software components, to achieve dramatic returns on investment, create market-defining products and services, and sharpen their competitive edge. The BRMS market share leader, ILOG was founded in 1987 and employs more than 700 people worldwide.

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