



Solving Multilevel/Multistage Mixed Integer Linear Optimization

Motivation

Many real-world applications have:

- **Discrete/indivisible** decisions
- **Multiple** objectives
- **Multiple** decision-makers
- **Multiple** time periods

But hardly any research work addresses this **generic** class of problems

Application Areas

- Airline pricing and capacity allocation
- Chemical process optimization
- Natural gas shipping
- Gene-deletion strategy development
- Road network construction
- Attacker-defender type problems
- Toll revenue maximization
- Electricity demand management
- **Many more...**

Methodology

- Developed an abstract framework for generalizing **Benders' technique** for **reformulation** that encompasses non-traditional problem classes
- Specified an algorithmic procedure employing **PVIs**
- Applied this procedure to solve **mixed integer bilevel linear optimization problems**
- Developed **an open-source solver in C++** for this algorithm

Warm-starting Mixed Integer Linear Optimization

Motivation

Many applications require **re-solving** an optimization problem:

- **Thousands** of times per minute
- **Closely-related** problems with **minor** variation in the input data

But usually, these re-solves are done **independently** by discarding most of the **useful** historical information

Application Areas

Online optimization	Optimization problem classes	Algorithms
• Routing	• Bilevel optimization	• Decomposition
• Stochastic matching	• Multi-criteria optimization	• Lagrangian relaxation
• Resource allocation	• Stochastic optimization	

Methodology

- **Solving** an optimization problem
- **Gathering** certain information primarily based on the **theory of duality** for mixed integer linear optimization
- **Reusing** the information via **PVIs** while solving a related problem
- Implementation in **SYMPHONY**, an open-source solver written in **C/C++**