

University of Tunis, Doctoral School

Combinatorial optimization

The course emphasizes the strengthening techniques of linear formulations to NP-hard problems. The corresponding approach aims to add supplementary valid inequalities that cut off the feasible region containing only fractional solutions without eliminating the integer ones enhancing, thereby, the effectiveness of the solution algorithms.

Pre-requisites

Students must be familiar with the basics of linear and integer programming, and the branch and bound method.

Content:

Day 1:

- General concepts about decision problems in presence of integer variables,
- Complexity associated with mixed integer programs (P, NP, NP-complete and NP-hard problems)
- Geometrical interpretation of the complexity and the ideal polyhedron,
- Cutting planes approach: fractional Gomory cuts, cover cuts, zero-half cuts, rounding cuts.

Day 2:

- Constraint-generation in case of complicating constraints
- Benders decomposition
- Application of Benders decomposition to network design problems,
- Application of Benders decomposition to traveling salesman and vehicle routing problems

Day 3

- Projections and constraint-generation
- Application of projections to traveling salesman and vehicle routing problems

Day 4:

- Strengthening formulations with the lifting technique,
- Sequential lifting,
- Simultaneous lifting
- Lifting in the context of traveling salesman and vehicle routing problems

Day 5:

- Strengthening formulations with the Reformulation-Linearization Technique (RLT),
- RLT with special structures
- Applications to traveling salesman and vehicle routing problems