

# Algorithms for decisions making M

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## Course Syllabus

- Notation, Linear Programming, standard and canonical form (equivalence), Integer Linear Programming (ILP);
- Duality: Lagrangean relaxation, Dual problem, weak duality, strong duality, the diet problem and pill maker problem: primal and dual interpretation;
- Complexity theory: complexity of an algorithm, complexity of a problem: P, NP, NP-complete. Ideal formulations for problems in P and NP;
- LP relaxation, Branch-and-Bound algorithm for ILP;
- Uncapacitated Facility Location problem, formulation;
- Set Covering, Packing and Partitioning problems, formulations;
- Capacitated Facility Location problem, Bin Packing: descriptive formulation, set covering formulation, Cutting Stock problem, Gilmore-Gomory formulation (exponential size);
- Fixed Charge, big M constraints;
- Stable Set problem: edge constraints, clique constraints formulations; Stable Set and Set Packing.
- Vertex Coloring problem: descriptive formulation, set covering formulation;
- Traveling Salesman problem: formulation, subtour elimination constraints;
- Models with exponentially-many constraints: separation; example: asymmetric Traveling Salesman problem;
- Models with exponentially-many variables: column generation; examples: Bin Packing problem, Vertex Coloring, Cutting Stock problem;
- Vehicle Routing Problem. Two and three index formulations, separation. Set Partitioning formulation, column generation;
- Cutting and Packing problems; 2D-Knapsack problem: geometric formulation. Guillotine cutting; exponential-size formulation (Gilmore-Gomory), column generation.
- AMPL: basic functions, use. Column generation in AMPL (Bin Packing example).