Applied Discrete Optimization

Contents

1. Review of Linear Programming
   (a) Simplex algorithm
   (b) Basics of Polyhedral theory
2. Public transport Optimization (Vehicle & crew scheduling)
   (a) Minimum Cost Flow problem
   (b) Shortest Path problem (with and without resource constraints): solved using Dynamic Proramming
   (c) Directed Acyclic Graphs
3. Column generation and Dantzig Wolfe decomposition
   (a) Integer Knapsack problem (NP-hard)
   (b) Cutting Stock problem (NP-hard)
      i. Kantorovich formulation
      ii. Gilmore-Gomory formulation
   (c) Vertex coloring problem
      i. Stable set
   (d) Multi-commodity flow problem
4. Combinatorial auctions
   (a) 0-1 Knapsack problem
5. Resource-constrained project scheduling
6. Bender's decomposition
   (a) Capacitated facility location problem
7. Branch & Bound, Branch & Cut
   (a) LP based B&B
8. Lagrangian relaxation
   (a) Uncapacitated facility location problem
   (b) Geoffrion's theorem
   (c) Subgradient method (Polyak theorem)
9. Kidney exchange networks
   (a) Price Collecting Traveling Salesman problem
   (b) Ford-Fulkerson algorithm
   (c) Max-flow min-cut theorem

(d) Cutting Plane algorithms

10. Branch-and-Price-and-Cut
11. Traffic paradoxes and route guidance
    (a) Nonatomic Selfish Routing
    (b) Pigou example
12. Routing of Automated Guided Vehicles (AGVs)
    (a) Primal Heuristics
    (b) Static Routing approach
    (c) Dynamic Routing approach
    (d) Kiel's Canal Ship Traffic Control problem
    (e) Heuristic approach
13. Graph Theory
    (a) Eulerian Paths and Cycles
        i. Fleury's algorithm
        ii. Hierholzer's algorithm
    (b) Directed graphs
    (c) Matchings
    (d) Chinese Postman problem