

# Discrete Optimization

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## 1 Introduction

This file will contain the table of contents of the class web site.

The web site is divided into weekly folders. Each folder will include the lecture notes, the weekly assignments, some additional information and a folder called supplements.

In it you can find examples, some additional explanations, or proofs.

A more detailed description of each file and folder follows below.

## 2 Content

1. Syllabus.pdf
2. Journal.pdf General information.
3. **Week-1**
  - a. Lecture-1: What is optimization? Discrete Optimization?
  - b. Lecture-2: Examples: The assignment problem and the Traveling salesman Problem (TSP)
  - c. DOassign1: assignment
  - d. Prep-2: A sample  $6 \times 6$  assignment sample.
  - e. Prep-3: Reductions.
  - f. Chinn and Flink folder. Contains implementations of the Hungarian method.
4. **Week-2**
  - a. Lecture-3: the Hungarian method.
  - b. Prep-4: Graph preparation.

5. **Week-3**

- a. Lecture 4: Graph theory, basic concepts.
- b. Lecture-5: Graphs, basic concepts (continued).
- c. DOassign2: Second assignment.
- d. Supplements folder: contains 17 files showing some graphs, isomorphism demonstrations, graph representations. prep-5 is an isomorphism drill, perp-6 is a shortest path drill and prep-7 a MCST drill.

6. **Week-4**

- a. Lecture-6: Graph traversals. BFS,
- b. DOassignt: assignment # 3.

7. **Week-5**

- a. Lecture-7: Minimum Cost Spanning Tree, Shortest Path algorithms.
- b. DO-journal-5: Information.
- c. assignment-4.
- d. density: a brief discussion of graph density.
- e. Folder: Supplements
  - 1. GraphsGeneration folder: A java program to generate various graph samples.
  - 2. prep-9: Garbage collection preparation.
  - 3. Java Applet demonstrating MCST, Shortest Path algorithms.
  - 4. graph1: an adjacency list of a graph.
  - 5. garbage, Garbage 1. A sample of the Chinese postman problem.
  - 6. floyd: A demonstration of an output of Floyd's algorithm.
  - 7. Dijkstra: A sample graph to demonstrate Dijkstra's algorithm.
  - 8. Kruskal: A proof of the correctness of Kruskal MCST algorithm.
  - 9. aimms\_tutorial\_beginner: a tutorial. How to use our AIMMS software.

8. **Week-6**

- a. Lecture-8: Eulerian cycles, matchings, alternating paths, matchings in bipartite graphs (König's Theorem)
- b. assignment-5.
- c. DO-journal-6: information.
- d. Folder Supplements:
  - 1. xe-dap: A PERT instance (longest path application)
  - 2. prep-10: A LP problem.
  - 3. mining: data for an AIMMS project.

4. LP: A brief review of LP and the simplex method.
5. Exercises: A set of review questions.

9. **Week-7**

- a. lecture-8: Matchings (continued) Systems of Distinct Representatives.
- b. DOassign6.
- c. Folder Supplements:
  1. Proof of König's Theorem.
  2. Graph Study
  3. Demonstration of augmenting paths.

10. **Week-8**

- a. lecture-9: Hall's theorem, Euclidean TSP, Algorithm with performance guarantee.
- b. DO-journal-8: Information about this week and the coming midterm.
- c. DOassign7:
- d. Folder Supplements with Herschel's graph needed for the assignment.

11. **Week-9**

- a. lecture-10.pdf The traveling salesman problem, approximation algorithms.
- b. lecture-11.pdf The stable marriage problem.
- c. DO-journal-9.pdf Instructions, preparation for midterm.
- d Supplements folder:
  1. ships.pdf An instance of ships maintenance schedule.
  2. My TSP instance.pdf An instance of a Euclidean TSP instance.
  3. My MCST.pdf A minimum cost spanning tree and a tour for the TSP instance.
  4. Drill-8.pdf A drill for the tutorial.

12. **Week-10**

1. Midterm-2011.pdf: the mid term.
2. Assign-8
  - floyd.pdf: a sample of execution of Floyd's all pairs shortest path algorithm.
3. Supplements folder:
  - a. Ships.pdf: shipping problem
  - b. mining.pdf: First installment of the mining project.

13. **Week-11**

1. Lecture -13.pdf: Flows in Networks.
2. DO-journal-9.pdf: this weeks information.
3. Assign-9.pdf
4. Supplements folder:
  - a. Prep-11.pdf: A sample problem for preparation for the next topic.
  - b. Six examples of network flows.
  - c. danger.pdf: finding max flow can take a very long time.
  - d. back-flow.pdf; an example where we have to reverse a flow along an edge.

14. **Week-12**

1. lecture-14.pdf: Vertex and edge coloring of graphs. Complexity of 3-coloring.
2. Assign-10.pdf
4. Supplements folder:
  - a. Prep-12.pdf: preparation for graph coloring.

15. **Week-13**

1. lecture-15: Edge coloring, Vizing's theorem and its algorithmic aspect.
2. assignment-11.1.docx:
4. Supplements folder:
  - a. Vizing's demo.pdf: A proof of Vizing's theorem.

16. **Week-14**

1. lecture-16.pdf: Computational complexity, NP-complete examples.
2. Assignment-12.pdf
- 3.
4. Supplements folder:
  - a.
  - b.

17. **Week-15**

1. Project: Final class project
2. ProjectInfo.pdf: further information about the project.
- 3.
4. Supplements folder:
  - a.
  - b.