

Curriculum for (42113) Networks and Integer Programming, Fall 2010

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Teaching Material:

- L.A. Wolsey (IP): “Integer Programming”, John Wiley, 1998
- J. Larsen and J. Clausen (LC): “Supplementary Notes to Networks and Integer Programming” (based on the second version named “supplnotes020209.pdf”), February 2009.
- Used overheads (available on the homepage of the course).

Curriculum:

- IP:
 - Chapters 1, 2, 3 (excl. sec. 3.6), 5, 6, 7, 8 (excl sec. 8.7.3 and 8.8), 9 (excl. 9.2.3, 9.4), 10 (excl. “subgradient algorithm”, 10.5), 12.
- LC:
 - Chapters 1, 2, 3, 4 (excl. sec. 4.5), 6 and 7
- Used overheads (available on the homepage of the course)

Networks and Integer Programming, Spring 2010.

Exam questions and og guide for the oral examination.

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The oral exam consists of an examination taking approx. 25 minutes, to which each student has a preparation time of approx. 30 minutes. Roughly the initial 15 minutes of the examination is at the disposal of the student, who presents a particular aspect of his/her question. The question is drawn by the student. In the following 10 minutes supplementary questions are asked by the examiner – the topic range for these questions is the complete curriculum.

In connection with the methods it is expected that the student can argue for the correctness, i.e. indicate why these produce the results claimed. A stringent mathematical proof is not expected, but of course it is permitted to give such a proof.

Below, the exam questions are stated. For each question, a number of keywords are given. These may form the basis for the presentation, however, the student is perfectly free to choose another approach for the presentation.

1. Bounds in Integer Programming

- Bounds as tools in solving problems
- The concepts of primal and dual bounds
- relaxation vs. duality
- Examples of primal bounds
- Examples of dual bounds

2. Minimum Spanning Trees in Networks.

- Basic graph concepts and problem formulation
- Kruskal's algorithm or Prim's algorithm
- Correctness argument
- Complexity of the algorithm

3. "Single Source" Shortest Paths in Networks

- Basic digraph concepts and problem formulation
- Ford-Bellman's or Dijkstra's algorithm
- Correctness argument
- Complexity of the algorithm

4. Max Flow: Concepts and methods

- Basic concepts and problem formulation
- The flow augmenting path or the Preflow-Push - algorithm
- The Max Flow - Min Cut - theorem
- Correctness argument

5. Min Cost Flow

- Basic concepts and problem formulation
- Augmenting circuit method
- Description of the transshipment-algorithm and relation to LP
- Example of an iteration

6. Dynamic programming

- Basic idea
- Dynamic Programming for 0-1 knapsack problems
- Dynamic Programming for Uncapacitated Lot Sizing
- Finding the optimal solution

7. LP-based Branch-and-Bound.

- Basic components of Branch and Bound
- 0-1 integer programming
- Example

8. Branch-and-Bound for STSP.

- Basic components of Branch-and-Bound
- TSP as a graph problem and as an 0-1 integer programming problem.
- The 1-tree bound and its correctness
- Description of a possible branching strategy

9. Cutting Planes

- The idea of cutting planes
- Examples of “ad hoc” cuts
- Derivation of the basic Gomory cut
- Example

10. Lagrangean Relaxation (LR).

- The relaxation idea
- LP-relaxation for integer programming problems
- Lagrange-relaxation
- Pros and cons when using LR for calculation of dual bounds in Branch-and-Bound.