

## Combinatorial Optimization I (DM208) — Ugeseddel 1

### Welcome to the course Combinatorial Optimization I!

#### Litterature

- Main text: PS= Papadimitriou and Steiglitz, Combinatorial Optimization – Algorithms and complexity, Dover 1998. Available in the bookstore.
- SCH = Schrijver: A course in Combinatorial Optimization, Lecture Notes CWI 2009. Available for download from the course page.
- KHU = Khuller : Design and Analysis of algorithms, course notes University of Maryland. Available for download from the course page.
- BJG = Bang-Jensen and Gutin, Digraphs: Theory, Algorithms and Applications, Springer Verlag 2001. Available for download from the course page.

**Evaluation** "Take home" exam. Graded after the Danish 7 point scale with external examination. This will consist of a number of problems to solve. They will be posed toward the end of the course and must be handed in again by the end of week 44 (we will discuss the exact period for the project during the course).

**Schedule and location of classes** NB!!!! The schedule may still change so check again on August 26!!

- Tuesday 14-16 in various rooms:
  - 28/8 U145
  - 4/9 U144
  - 25/9 U26
  - 11/9, 18/9, 2/10, 9/10 all in U66
- Wednesday 10-14 in IMADAs seminarroom.

**Format:** We will spend part of the wednesday 4 hours for exercises, except for week 35. Of course there will be a lunch break and I propose that we start with 10.15-11.45 without a break and then start again at 12.15 with two normal lectures (with a break at 13.00). We may discuss other ways of using the time at the first lecture.

You will see from the weekly note what the program for the next week will be.

In the first week we start with lectures to give you some new material to work on. Generally I will expect you to have read (most of) the material to be covered at the lecture before showing up. That way we can concentrate more on the difficult parts.

**Lecture August 28, 2012:** I will give an overview of the course and also recapitulate topics such as linear programming and flows in networks. A sample of the problems we will be looking at in the course is:

- Minimum spanning trees, edge disjoint spanning trees, min-min cost edge-disjoint spanning trees, min-sum edge-disjoint spanning trees.
- Flows, min cost flows, shortest paths
- Matchings and vertex covers
- Linear programming, duality and primal dual algorithms.

- Integer Programming and modelling.
- Connectivity, Menger's theorem, Gomory Hu Trees, Maximum adjacency orderings.
- Matroids, greedy algorithm, matroid intersection and union
- Minimum cost branchings.

To prepare yourself for the first lecture (and the course) you may read the following:

- PS chapter 1.1-1.2, 2.1-2.2 and 3.1-3.2 (only so that you recall what a linear programming problem and its dual is)
- SCH pages 5-9
- Any material you have on minimum spanning trees and shortest paths, so that you are well aware how to solve these problems and remember the algorithms by Dijkstra and Kruskal.
- BJG Chapter 3.1-3.5 (mostly 3.1 and 3.5).

**Lecture August 29, 2012:**

- Matroids, spanning trees and the greedy algorithm. PS 12.1-12.4 and SCH 10.1.
- Matchings in bipartite graphs, vertex and edge covers and connectivity of (di)graphs (Menger's theorem). The relevant material is
  - SCH sections 3.1-3.4, 4.1
  - PS 10.1-10.3
  - BJG 3.11.1, 7.3