



Universität Innsbruck - Institut für Informatik  
Prof. Clemens Ballarin, Robert Binna, Friedrich Neurauter, Fran-  
cois Scharffe and Sarah Winkler

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Proseminar Algorithmen und Datenstrukturen

## Exercise Sheet 13

### Exercise 1 (Knapsack problem)

Consider the knapsack problem as explained in the lecture: Given  $K \in \mathbb{N}$  the capacity of a knapsack and  $n$  objects  $1, \dots, n$ . Each object has a weight of size  $k_i \in \mathbb{N}$ . Determine a subset of these objects that the sum of the weights of this subset is exactly the same as the capacity of the knapsack.

- a) Implement an algorithm in C that solves the knapsack problem as described above.
  
- b) In the US, the president is elected by so-called electors which are representatives of a state citizens (check the following URL for more details: [http://en.wikipedia.org/wiki/U.S.\\_Electoral\\_College](http://en.wikipedia.org/wiki/U.S._Electoral_College)). The electors are nominated according to the votes of the citizens in a winner takes it all fashion. By this reason all electors of one state are for one candidate or the other one. So each state has a weight in the presidential elections equal to the number of electors. The question is: Can a draw occur as an outcome of the voting process? Give the formalization of this problem in terms of the Knapsack problem and use it to answer.

### Exercise 2 (Graph algorithms)

Give three examples of problems that can be represented using graphs, and formalize them in terms of graphs. The model of graphs presented in the lecture may be extended by attaching information to nodes and edges, if necessary.

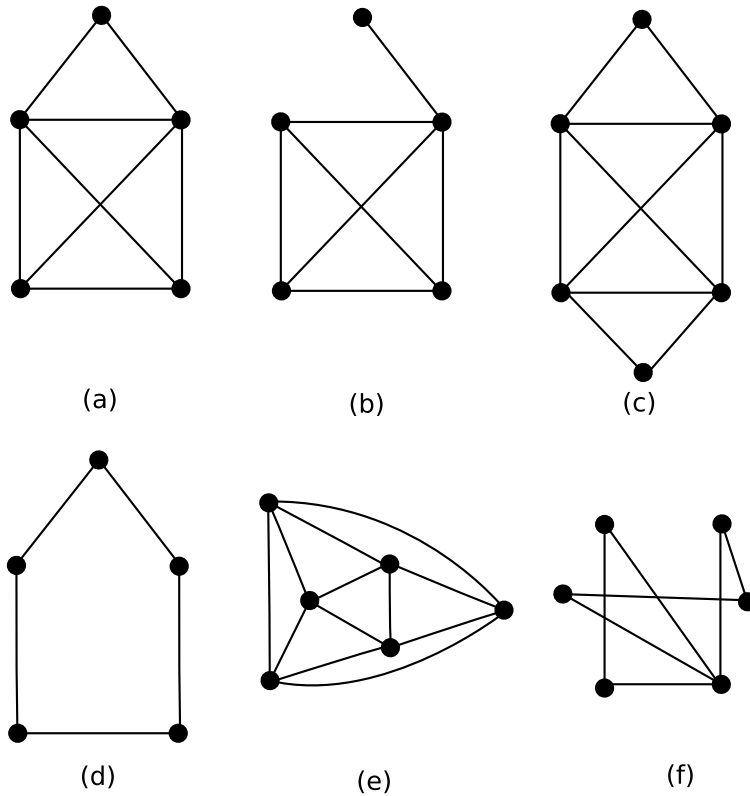


Abbildung 1: Are these graphs Eulerians ?

### Exercise 3 (Euler Graphs)

Consider the graphs Figure 1. For each of them:

- Is there an Eulerian path ?
- Is there an Eulerian circuit ?

### Exercise 4 (Knapsack problem variant)

Solve the following variant of the knapsack problem: given  $n$  items  $1 \dots n$  where item  $i$  is of size  $k_i$  and a knapsack of size  $K$ . Determine a subset of items such that the sum of their sizes is maximal but less than or equal  $K$ .

- Design a dynamic programming algorithm to solve the problem in  $O(nK)$ . Outline your algorithm and show that the computed solution is optimal.
- Give pseudo code for your algorithm.