

Algorithm design

Assignment 1: approximation algorithms

Instructions

- The assignment is worth 6% of the final grade.
- The deadline is Sunday, November 21 at 23.59.
- Hand in a report in pdf (this may be a scan of a handwritten document) and your code as a zip-file (you can use the programming language of your choice).
- The assignment can be made in groups of at most two students.

Exercise 1

Consider the Knapsack problem where 10 instances are provided on Canvas. The formatting of the files is as follows:

- the first line contains the number of items and knapsack capacity,
- the second line contains the values of the items, and
- the third line contains the weights of the items.

Solve or approximate each instance by:

- a. using a commercial solver like Cplex or Gurobi by considering the problem as a binary linear programming problem,
- b. using the $O(nb)$ dynamic programming algorithm (see slides Dynamic programming), and
- c. using the FPTAS using $\varepsilon \in \{10, 1, 0.1, 0\}$ (see slides Approximation algorithms).

Make a concise report that should contain the following aspects:

- Report the optimal objective value of each instance.
- Report the Cplex or Gurobi version and the programming language used.
- For each of the methods, report the average running time and the standard deviation (in milliseconds) over all instances.
- For each ε used in the FPTAS report the average optimality gap.
- Describe what you observe, in particular, the behavior of the FPTAS. Moreover, describe the advantages and disadvantages of the different methods used.