

Prof. Dr. Knut Reinert,  
Prof. Dr. Alexander Bockmayr,  
Annika Röhl

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# Optimization

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## Exercise 6

### 1. Bin Packing

Consider the following variant of the *bin packing* problem:

- Pack  $n$  items of size  $g_i, i = 1, \dots, n$ , into (at most)  $n$  bins, each of capacity  $c$ .
  - Put the first  $m$  items into different bins.
  - Find the minimal number of bins necessary.
- i) Model the problem in constraint programming (hint: cumulative constraint).
- ii) Model the problem in integer linear programming.

### 2. Investments

Suppose that you are interested in choosing a set of investments  $\{1, \dots, 7\}$ . Model the following constraints:

- (a) You cannot invest in all of them.
- (b) You must choose at least one of them.
- (c) Investment 1 cannot be chosen if investment 3 is chosen.
- (d) Investment 4 can be chosen only if investment 2 is also chosen.
- (e) You must choose either both investments 1 and 5 or neither.
- (f) You must choose either at least one of the investments 1, 2, 3 or at least two investments from 2, 4, 5, 6.
- i) Choose a set of investments  $\{1, \dots, 7\}$  using 0–1 variables. Model the constraints as IP formulations.
- ii) Choose again a set of investments  $\{1, \dots, 7\}$ . Model now the constraints as CP formulations.