Prof. Dr. Alexander Bockmayr,
Prof. Dr. Knut Reinert,
Sandro Andreotti

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Discrete Mathematics for Bioinformatics (P1)

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Exercises 8

1. **Task Scheduling**

   Suppose we have a set of activities, each with a specified duration. There are precedence constraints between the activities, such that if task A precedes task B, then task B cannot start before task A ends.

Task	Duration	Precedes
A	3	B,C
B	2	D
C	4	D
D	2	

   (a) Model the problem as a constraint satisfaction problem.

   (b) Add two artificial tasks *Start* and *End* to model the beginning and the end of the project.

   (c) Apply arc consistency to reduce the domains of the variables.

   (d) What further reduction can be obtained by fixing the end of the project to the minimum possible value?

2. **Bin Packing**

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

   - Pack n items of size $g_i, i = 1, \ldots, n$, into (at most) n bins, each of capacity c.
   - Put the first m items into different bins.
   - Find the minimal number of bins necessary.

   Model the problem in

   - integer linear programming
   - constraint programming (hint: cumulative constraint)

   and compare the two models.

3. **SAT Problem**

   The Pigeon hole principle: If there are n + 1 pigeons and n pigeon holes, then there must result at least one pigeon hole with more than one pigeon.

   (a) Model the Pigeon hole principle as as SAT problem.