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Discrete Mathematics WS 07/08

Homework 8 (due 21/12)

Exercise 1:
Consider the region R given in exercise 2 of homework 7. Solve the corresponding CSP formulated as in question *b*) using the backtracking search algorithm with forward checking and the most-constrained-variable heuristic.

Exercise 2:
In some cases the application of arc-consistency is too costly. This is the case when the domains of the variables are large sets of integers. In such cases, *bounds-consistency* appears to be highly cost-effective. A constraint is *bounds-consistent* if, for each of its variables, say x, there is an assignment for the other variables that is compatible with $\min(D_x)$ and another assignment that is compatible with $\max(D_x)$, where D_x is the domain of x.

Consider the constraint problem with variables $x_1, \ldots, x_6$, each with domains $1, \ldots, 6$, and constraints

$$\begin{aligned} C_1 &: \; x_4 \geq x_1 + 3, \\ C_2 &: \; x_4 \geq x_2 + 3, \\ C_3 &: \; x_5 \geq x_3 + 3, \\ C_4 &: \; x_5 \geq x_4 + 1. \end{aligned}$$

a) Show a constraint that is not bounds-consistent,

b) Apply bounds-consistency to reduce the domains of the variables.

c) Is the resulting problem already arc-consistent?

Exercise 3:
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

a) Integer linear programming

b) Constraint programming (hint: cumulative constraint)

and compare the two models.