

Foundations of Constraint Programming

Prof. Steffen Hölldobler, Sebastian Haufe

International Master Program in Computational Logic — winter term 2010/2011

Date of exercise: 29.10.2010

Exercise 1.1

Consider the task of assigning to each node of a finite graph a color in such a way that no two adjacent nodes have the same color. Such an assignment is called a coloring of the graph. A coloring of the graph involving the minimal number of colors is called the chromatic number of the graph.

Formulate the problem of finding the chromatic number of a graph as a constrained optimization problem.

Exercise 1.2

Formulate the following problem as a constrained optimization problem: Place a minimum number of queens on the chess board so that each unoccupied field comes under attack.

Hint:

For each chess board cell $(i, j) \in \{1, \dots, 8\} \times \{1, \dots, 8\}$, use a variable $x_{i,j}$ with domain $\{0, 1\}$.

Exercise 1.3

Download and install the open source Prolog version Eclipse-Prolog. It can be found together with detailed documentation at the url <http://www.eclipseclp.org/>. After installation you can start Eclipse-Prolog using the command `eclipse` and load a file `filename.pl` via `compile(filename)`.

- a) Write a program in Eclipse-Prolog that solves the N Queens problem (see Slide 12 in Chapter 1). Use the hybrid integer/real interval arithmetic constraint solving library `ic` (load it with `:- lib(ic)`). Use the built-in constraint propagation so that your program is able to find all solutions of an 8-queens problem almost instantaneously.
- b) Compare the run time of your program to the time needed to find one solution of the 8-queens problem using a brute force strategy without constraint propagation.

Hints:

- Constraints are given using the `#` operator, so for example, `N1 #\= N2` implies that number `N1` is unequal to number `N2`.
- Have a look at the predicate `#::/2` for assigning integer intervals to a list of variables.
- Additionally the predicates `labeling/1` and `findall/3` might be useful.