Constraint Satisfaction Problems

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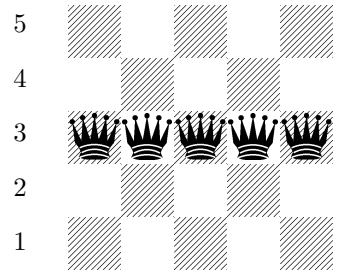
Exercise Sheet 8

Due: 12.1.2015

Exercise 8.1 (2+2 points)

We consider a variant of stochastic local search (SLS) on the 5-queens problem.
For the formalization, assume five variables $V = (q_1, \ldots, q_5)$ representing the queens, which take their row as value. The cost of an assignment is defined as the number of queen pairs that attack each other.
For the SLS search we proceed as follows: Assume that the initial state is given by $a = (3, 3, 3, 3, 3)$, i.e., the following figure:



$\texttt{cost}(a) = 10$

We use 1-exchange neighborhoods selecting a neighbor that minimizes the cost among all possible choices (break ties randomly), unlimited tries, no random walk steps.

(a) Show the steps of your search (you can stop the search once a solution or local minimum has been found). For each state also provide its cost.

(b) Discuss whether it makes sense to consider 2-exchange neighborhoods in this example.

Exercise 8.2 (3 points)

Let $V = (v_1, \ldots, v_5)$ be variables with corresponding domains
$D = (\{0\}, \{0, 3\}, \{1, 3, 4\}, \{1, 2\}, \{0, 2, 4\})$.
Establish generalized arc consistency for the $\texttt{alldifferent}(v_1, \ldots, v_5)$ constraint. For this use the graph-based algorithm presented in the lecture and provide the value graph, the strongly connected components, and the used edges.

Exercise 8.3 (3 points)

Let $V = (v_1, \ldots, v_n)$ be variables with the corresponding domains D_i, $i \in \{1, \ldots, n\}$ and G the corresponding value graph.

Show that the constraint $\texttt{alldifferent}(v_1, \ldots, v_n)$ is generalized arc-consistent if and only if every edge in G belongs to a matching in G that covers V.