Assignment #03 - DCSP

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Problem Modeling

N-queens on NxN chessboard
The N-queens problem is formalized as a $DCSP\langle P, D, C, Q\rangle$

Agents

$\{Q_1, Q_2, \cdots, Q_N\} \to Q_k$ where $k \in [1, N]$

Variables

$\{P_1, P_2, \cdots, P_N\} \to P_k$ where $k \in [1, N], P_k \in D_k$
k^{th} queen is in position (k, j)

Domain

$\{(0,0), (0,1), \cdots, (1,0), (1,1) \cdots, (N-1, N-1)\}$
$|D| = N \times N$
$D_k \in \{(k,0), (k,1), \cdots, (k, N-1)\} \to |D_k| = N$

Constraints

Queens should not attack each other
For queens Q_A, Q_B where $P_A = (i_A, j_A), P_B = (i_B, j_B)$

$$\neg(i_A == i_B)$$
$$\neg(j_A == j_B)$$
$$\neg(|i_A - i_B| == |j_A - j_B|)$$

For our problem, it is guaranteed by definition that $i_A \neq i_B$

Algorithm

The classic ABT algorithm is customized to fit our problem.

Priorities are defined at the beginning of the algorithm.
Agent at row 0 has highest priority.
Agent at row $n-1$ has lowest priority.

$$\left[0 \uparrow^{priority} \cdots n-1 \downarrow_{priority}\right]$$

An agent only checks for consistency with his ancestors.
Ok? messages are sent from higher priority agents, to lower priority ones.
noGoods are sent from lower priority agents, to higher priority ones.

The version of the algorithm described by J. M. Vidal prescribes to remove from the local view of the child, the neighbor to which one is backtracking. This is not being done, and it is required to be handled in this way for deterministic termination detection.

The end of the search is being determined by a traverse from lowest priority agent, to highest priority one, and back again.

The sequence is as follows:
1. When lowest priority agent is successful in his move (no **backtrack()**), he sends a message to his parent to check for his consistency.

2. This same check happens between each child and parent, until reaching highest level priority agent. It will only reach there, if each child is consistent and doesn't need to make a move.

3. After reaching the highest priority agent, a new sequence of messages start, to check if the value in the view of each child is up to date with his parent's. Consistency is checked again, but now from top to bottom.

4. If this is ok for each parent-child pair until reaching the lowest priority agent again, then he sends to all the parents that a solution is found and that each of them holds the solution value for the variable it is accountable for.