Assignment Problems

- Assigning values to variables subject to constraints
- Examples
  - Eight-Queens problem
  - Crossword puzzles

Eight-Queens Problem

No queen can be placed so that it can capture any of the others, according to the rules of chess.

An obvious data structure is 8-by-8 array containing queen(1) or empty(0).
Eight-Queens Problem (cont’d)

- We can solve constraint-satisfaction problems by graph-search methods
  - Constructive method
  - Repair approach
  - Function optimization

Constructive Method

- Begin with no assignments
- Each operator adds a queen to the array in such a way that the resulting array satisfies constraints among its queens
- Constraint propagation technique helps markedly in reducing the size of the search space

Constraint Propagation (four-queens problem)

- Each variable constrains all of the others, so all of the nodes have arcs to all other nodes
- A directed constraint arc(i,j), variable labeling i is constrained by the value of the variable labeling j

Constraint Propagation (cont’d)

- Circle: Values eliminated by first making arc(q_j,q_i) consistent
- Box: Values eliminated by next making arc(q_j,q_k) consistent
Heuristic Repair

- Starts with a proposed solution, which most probably does not satisfy the constraints
- The operators change a data structure so that it violates fewer constraints

Function Optimization

- Hill-climbing
  - Traversing by moving from one point to that “adjacent” point having the highest elevation
  - To solve local maxima problem
    - Several separate hill-climbing, starting at different locations (choose the highest of these)
    - Simulated annealing (choose by probability distribution)

Solving the Two-Color Problem (Hill Climbing)

1. Set the current node, $n$, to a randomly selected node, $n_0$.
2. Generate the successors of $n$.
3. If $F(n) < V(n)$, exit with $n$ as the best node found so far.
4. Otherwise, set $n$ to $n_0$, and go to step 2.