CSCI/PHIL 4550/6550 Artificial Intelligence

Problem Set Number 2: Due 9/17/2009 **(in class)**

1. **[10 points]** Solve problem 4.2 page 134 in Russell and Norvig.

2. **[20 points]** Suppose you have just solved a state space search problem using the A* algorithm with a heuristic function h(n) and found a solution that you thought was optimal with cost $f^*_{apparent}$. Suppose you then discovered that the heuristic function you had used (h(n)) was not admissible, but rather it was $\epsilon - admissible$ meaning that it could over estimate the cost of getting to the nearest goal state by at most ϵ.

   (a) What is the relation between the cost of the solution you found $f^*_{apparent}$ to the true optimal solution cost f^*? Briefly justify your answer.

   (b) How would you modify the A* algorithm to be able to use an $\epsilon - admissible$ heuristic function and still find the true optimal solution in the most efficient way?

3. **[10 points]** Solve problem 5.6 page 159 in Russell and Norvig.

4. **[20 points] Sorting** The sorting problem is stated as follows. Given a set of n real numbers $X = x_1, x_2, \ldots, x_n$. Find a permutation (reordering) $P = p_1, p_2, \ldots, p_n$ of the set X such that $p_1 \leq p_2 \leq \ldots \leq p_n$.

   (a) Formulate the sorting problem as a Constraint Satisfaction Problem (CSP); you should include an informal description of the following:

   - The set of variables.
   - The domain of values for each variable.
   - The collection of constraints on the variables.
   - For each constraint, an indication the *arity* of the constraint: (unary, binary, n-ary or global).

   Hint: you may assume that the elements of the set X are unique.

   (b) Solve the CSP you have formulated for the case $X = 5, 3, 7, 1, 9$. Show the solution tree using backtracking with forward checking.

5. **For CSCI/PHIL 6550 students only [10 points]** Solve problem 4.7 page 135 in Russell and Norvig.