Homework 2

CS 5233 – Fall 2007 assigned September 5, 2007
Tom Bylander, Instructor due September 12, 2007

1. Define a heuristic for the Tower of Hanoi problem as follows. Assume Disk 1 is the smallest disk and Disk n is the largest disk. Let Disk i be the largest disk that is not on the goal peg. Let j be the number of disks on top of Disk i plus the number of disks on the goal peg that are smaller than Disk i, i.e., j is the number of disks you have to get out of the way in order to move Disk i to the goal peg. Then the heuristic gives the estimate $i + j$.

   (a) (25 pts.) Prove that the heuristic never overestimates the number of moves to the goal state.

   (b) (25 pts.) Let $n = 3$. Show the order in which A* search would visit the states. You may break ties in any way you wish.

   (c) (25 pts.) Let $n = 3$. Show the order in which IDA* search would visit the states.

   (d) (100 pts., shared extra credit) Define a heuristic function that determines the exact distance between any two states. This heuristic should be efficient and should work for any two states and any number of disks. Hint: Define a recursive function that reduces the problem from n disks to $n - 1$ disks, i.e., move disks 1 through $n - 1$ out of the way of disk n, move disk n, and move disks 1 though $n - 1$ to their destinations.

2. (25 pts.) Do one of the following two questions:

   (a) The analysis of A*-search assumes that there is exactly one goal state. Suppose that there are ten goal states that are distance d away from the initial state. What will be the result of a modified analysis? Justify your answer.

   (b) The analysis of A*-search assumes that there is exactly one (simple) path to the goal state. Suppose that there are ten paths with length d from the initial state to the goal state. What will be the result of a modified analysis? Justify your answer.