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.