Homework #1
CS 405, Total 54 Points
Due Tuesday, September 22, Midnight

1. (4 pts) If a computer can pass the Turing Test do you think the system is intelligent? Argue why or why not.

2. (5 pts) Give an example of a problem for which Breadth-First Search would work better than depth-first search. Give an example of a problem for which depth-first search would work better than breadth-first search.

3. (10 pts) Consider the 8-puzzle sliding block tile game. You can slide an adjacent tile into the empty square and your goal is to arrange the tiles as follows:

1	2	3
8		4
7	6	5

Given the start state of:

1	4	2
8	6	3
7		5

Denote each state as a small table, e.g.

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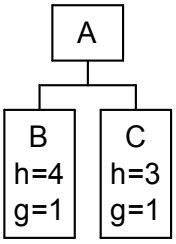
1 4 2
8 6 3
7   5
```

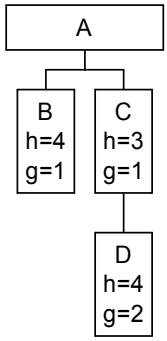
would be the start state. If you want to type it as text, it is acceptable to represent this state as [142 863 7b5].

Using A*, run through the algorithm until 5 states have been removed from the OPEN list. Be sure to show the states and heuristic value of each state on the OPEN list for each step. The actual cost to move a tile is always 1. Use the sum of the Manhattan Distance (number of horizontal plus vertical tiles to goal location) of each tile as the heuristic function. You can skip the blank tile in calculating the heuristic.

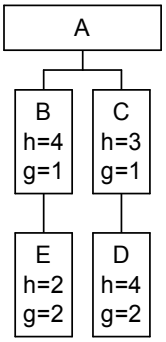
4. (6 pts) Suppose that the first step of the operation of Best-First-Search results in the following tree where we just examined A:



The second step examines C and results in:



The third step examines B and results in:



(a) What node will be expanded at the next step?

(b) Can we guarantee that the best solution will be found? Is it likely that the heuristic is admissible?

5. (8 pts) Here are three 8-puzzle heuristics:

H1: Number of tiles out of place (not including the blank)
H2: Sum of Manhattan distances of tiles out of places (not including the blank)
H3: The number of direct tile reversals multiplied by 2 (a direct tile reversal is when two adjacent tiles must be swapped to match the goal order).

Consider a fourth heuristic:

H4: H2 + H3 + 2

a) For each heuristic, is it admissible? Give an argument why the heuristic is admissible or give a counter-example if you believe it is not.

b) How informed is each heuristic? In other words, how good is the heuristic at effectively pruning the state space?

6. (6 pts). Give the name of the algorithm that results from each of the following special cases:
   a) Local beam search with k = 1
   b) Local beam search with k = ∞
   c) Simulated annealing with T = 0 at all times

7. (15 pts) 8 Puzzle Programming

Write a program using the programming language of your choice that generates random 8 puzzle boards. You don't need a fancy GUI, it is fine to simply output the board in ASCII. Use the following order as your goal state:

1	2	3
4	5	6
7	8	

To generate the random board, start with the goal state and then make 20 random moves. Next, implement A* using the heuristic of your choice. Your program should be able to solve the 8 puzzle and output what move to make along with a depiction of the board after each move is made until the goal state is reached.

Run the program where the heuristic always returns 0, and comment on the resulting behavior.