1. (10 points) Suppose that we run a greedy search algorithm with the following heuristic functions,
   - (5) $h(n) = -g(n)$. What sort of search will the greedy search emulate?
   - (5) $h(n) = g(n)$. What sort of search will the greedy search emulate?

2. (10 points) Trace the operation of $A^*$ search applied to the problem of getting to Bucharest from Oradea using the straight-line distance heuristic. That is, show the sequence of nodes that the algorithm will consider and the $f$, $g$ and $h$ value for each node.

3. (25 points) A heuristic function is consistent if for every node $n$ and its child node $n'$, $h(n) \leq c(n, n') + h(n')$. Prove the following properties of algorithm $A^*$.
   - (a) (5) The $f$-values of the nodes expanded by BFS form a non-decreasing sequence.
   - (b) (5) Prove that if $h_1$ and $h_2$ are both consistent, so also is $h = \max(h_1, h_2)$.
   - (c) (5) Prove that if $h$ is consistent then it is also admissible (hint, you can prove this by induction moving from the goal node backwards).
   - (d) (5) Prove that if the heuristic function is consistent then $A^*$ graph search will never re-open any nodes.
   - (e) (5) Prove or give a counter example: if for every node $n$, $h_1(n) \geq h_2(n)$, and for some nodes $h_1(n) > h_2(n)$ then $A^*$ with $h_1$ always expands less nodes than $A^*$ with $h_2$. 

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4. (10 points) Let’s assume that you are using A* graph search with a consistent heuristic. Further, let’s suppose you are given a solution (a path from start to goal) $U$, with its cost $f_U$. Note that you don’t know if this solution is optimal. Can you use this fact (solution $U$ and its cost) to improve the efficiency of your A*? If yes, how?

5. (10 points) Algorithm $A^*$ does not terminate until a goal node is selected for expansion. However, a path to a goal node might be reached (generated) long before that node is selected for expansion. Why not terminate as soon as a goal node has been found? Illustrate your answer with an example.