

ICS 271
Fall 2017
Instructor : Kalev Kask
Homework Assignment 2
Due Thursday 10/19

1. (10 points) Suppose that we run a greedy search algorithm with the following heuristic functions,
 - (a) $h(n) = -g(n)$. What sort of search will the greedy search emulate?
 - (b) $h(n) = g(n)$. What sort of search will the greedy search emulate?
2. (10 points) Trace the operation of graph-search A^* applied to the problem of getting from Oradea to Bucharest using the straight-line distance heuristic. That is, show the frontier at each step, nodes that the algorithm will expand and the f , g and h value for each node.
3. (50 points) A heuristic function is consistent if for every node n and its child node nt , $h(n) \leq c(n, nt) + h(nt)$. Prove the following properties of algorithm A^* .
 - (a) (10) The f -values of the nodes expanded by Best-First-Search form a non-decreasing sequence.
 - (b) (10) Prove that if h_1 and h_2 are both consistent, so also is $h = \max(h_1, h_2)$.
 - (c) (10) 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) (10) Prove that if the heuristic function is consistent then A^* graph search will never re-open any nodes.
 - (e) (10) 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 .
4. (30) This question is about weighted heuristic evaluation functions. The **heuristic path algorithm** (Pohl, 1977) is a best-first search in

which the evaluation function is $f(n) = (2 - w)g(n) + wh(n)$. In the following, assume you are executing graph-search with re-opening of closed nodes, guided by f defined as above.

- (a) For what values of w is this complete?
 - (b) For what values is it optimal, assuming that h is admissible?
 - (c) What kind of search does this perform for $w = 0, w = 1$ and $w = 2$?
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 (that is, a goal node is generated and added to the frontier) 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. (Note, you are not told anything about the nature/properties of h here).