CS 771 Artificial Intelligence
Spring 2019 Homework 2 (60 points)

Assigned: Wednesday, February 13, 2019
Due: Wednesday, February 20, 2019

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1. (10 points) Consider the best-first search algorithm in which evaluation function is given by

$$f(n) = wg(n) + (8 - w)h(n)$$

where w is any positive number in between 0 and 2. Recall that $g(n)$ is the cost to reach to state n starting from start state and $h(n)$ is the heuristic that provides the best guess for the cost to reach to the goal stat starting from state n. Now answer the following.

   (a) what kind of search does this perform for $w = 8$? Explain.

   (b) what kind of search does this perform for $w = 0$? Explain.

   (c) what kind of search does this perform for $w = 4$? Explain.

   (d) Assume that h is admissible. Find the range of values of w for which this search is optimal. Recall that for any positive scalar c and any admissible heuristic $\tilde{h}$ if an algorithm uses the evaluation function $f(n) = c\left(g(n) + \tilde{h}(n)\right)$, then the search is optimal.

2. (25 points) For the Figure shown below, trace the operation of A* search applied to the problem of getting to Bucharest from Timisoara using the straight-line heuristic as shown in the bottom part of the figure. For each step, show the nodes which are already explored and the nodes which are currently in frontier along with associated f, g and h score for each node. You can represent each node that denotes a city by using the first letter of the city. For each step, please use search tree representation. In addition, use a circle to indicate a node currently in frontier and a shaded circle to indicated an explored node.

3. Answer the following.

   (a) (5 points) Suppose in case of simulated annealing, the temperature T is set to $T = \infty$ all the time. Explain what kind of local search this corresponds to.

   (b) (5 points) Suppose in case of simulated annealing, the temperature T is set to $T = 0$ all the time. Explain what kind of local search this corresponds to.

4. Explain and answer the following.

   (a) (3 points) Is it possible for an optimal search algorithm to be incomplete?

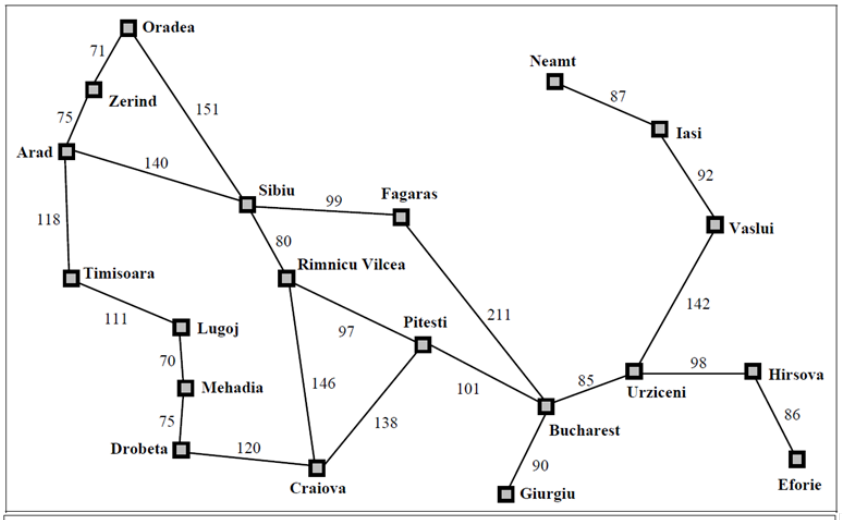
   (b) (3 points) Is it possible for a complete search algorithm to be non-optimal?

   (c) (3 points) Is uniform cost-search and greedy best first searches are special cases of A* search.

5. Answer the following.

   (a) (3 points) Suppose in a search algorithm all step costs are 1. Let $depth(n)$ denotes the depth of any node/state from the start node/state. If you use uniform cost search with with $f(n) = depth(n)$ what does this search correspond to?

   (b) (3 points) Suppose in a search algorithm all step costs are 1. Let $depth(n)$ denotes the depth of any node/state from the start node/state. If you use uniform cost search with with $f(n) = -depth(n)$ what does this search correspond to?



Arad	366	**Mehadia**	241
Bucharest	0	**Neamt**	234
Craiova	160	**Oradea**	380
Drobeta	242	**Pitesti**	100
Eforie	161	**Rimnicu Vilcea**	193
Fagaras	176	**Sibiu**	253
Giurgiu	77	**Timisoara**	329
Hirsova	151	**Urziceni**	80
Iasi	226	**Vaslui**	199
Lugoj	244	**Zerind**	374

Figure 1: Romania map and straight line distance chart to Bucharest