Heuristic Search Review

Artificial Intelligence

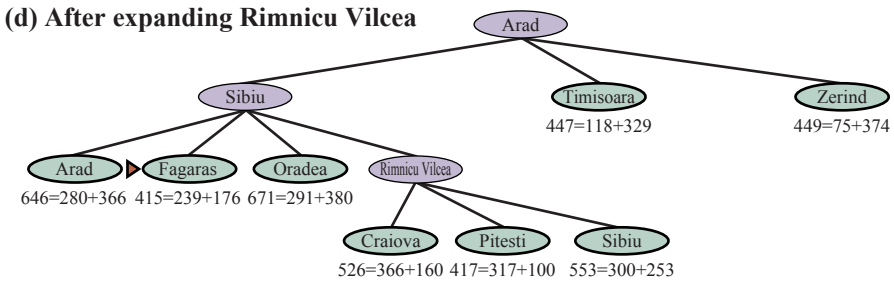
1. What is a heuristic function?

> **Solution:** A heuristic function, $h(n)$, gives an estimated cost of the cheapest path from the state at node n to a goal state.

2. How do you use Best-First Search to implement A^* search?

> **Solution:** Remember that Best-First Search uses a priority queue to choose the next node for consideration, where the ordering of nodes in the priority queue is determined by the value of a function $f(n)$. If the path cost from the initial state to a node n is given by $g(n)$, then $f(n) = g(n) + h(n)$ is an estimate of the complete path cost from the initial state to a goal state tghrough node n. A^* search uses $f(n) = g(n) + h(n)$ to order the nodes in the priority queue.

3. In this diagram, nodes are marked with their A^* heuristic values, $f(n) = g(n) + h(n)$. Which node will be the next node expanded by A^*?



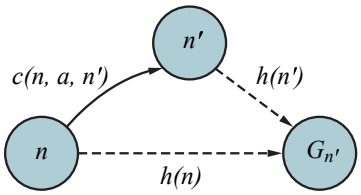
> **Solution:** Faragas, because it has the least $f(n)$ value of all the unexpanded nodes.

4. Define admissible heuristic.

> **Solution:** An admissible heuristic never overestimates the cost of the path from a node a goal

5. Define consistent heuristic.

Solution: A heuristic $h(n)$ is consistent if, for every node n and every successor n' of n generated by an action a, we have $h(n) \leq c(n, a, n') + h(n')$



6. Which important property does an admissible heuristic give A^*?

Solution:

7. How does using a consistent heuristc improve A^* compared to using an admissible, but not consistent heuristic?

Solution:

8. Describe three approaches to designing a heuristic function.

Solution:

9. Use one of the three approaches from the previous question to design an admissible heuristic for the Three Pitchers problem. In the Three Pitchers problem thre are three unmarked pitchers – an 8 L pitcher full of water, an empty 5 L pitcher, and an empty 3 L pitcher – and an agent must reallocate the water so that one of the pitchers contains exactly 4 L of water.

Solution: