CS 188 Spring 2021 | Introduction to Artificial Intelligence | MT Review: Search

Q1. Search

(a) Consider a graph search problem where for every action, the cost is at least ϵ, with $\epsilon > 0$. Assume the used heuristic is consistent.

(i) [*true* or *false*] Depth-first graph search is guaranteed to return an optimal solution.

(ii) [*true* or *false*] Breadth-first graph search is guaranteed to return an optimal solution.

(iii) [*true* or *false*] Uniform-cost graph search is guaranteed to return an optimal solution.

(iv) [*true* or *false*] Greedy graph search is guaranteed to return an optimal solution.

(v) [*true* or *false*] A* graph search is guaranteed to return an optimal solution.

(vi) [*true* or *false*] A* graph search is guaranteed to expand no more nodes than depth-first graph search.

(vii) [*true* or *false*] A* graph search is guaranteed to expand no more nodes than uniform-cost graph search.

(b) Let $h_1(s)$ be an admissible A* heuristic. Let $h_2(s) = 2h_1(s)$. Then:

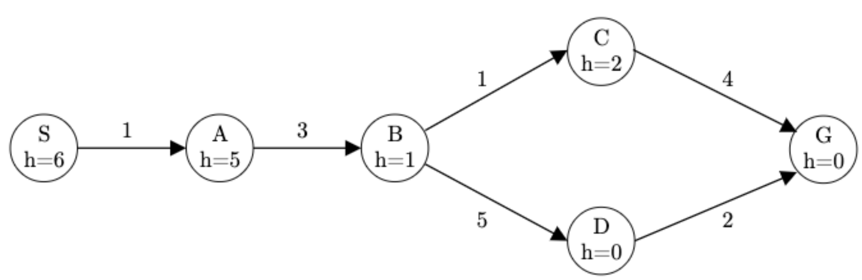
(i) [*true* or *false*] The solution found by A* tree search with h_2 is guaranteed to be an optimal solution.

(ii) [*true* or *false*] The solution found by A* tree search with h_2 is guaranteed to have a cost at most twice as much as the optimal path.

(iii) [*true* or *false*] The solution found by A* graph search with h_2 is guaranteed to be an optimal solution.

(c) The heuristic values for the graph below are not correct. For which single state (S, A, B, C, D, or G) could you change the heuristic value to make everything admissible and consistent? What range of values are possible to make this correction?

State: ______ Range: ______



Q2. Power Pellets

Consider a Pacman game where Pacman can eat 3 types of pellets:

- Normal pellets (n-pellets), which are worth one point.
- Decaying pellets (d-pellets), which are worth $max(0, 5 - t)$ points, where t is time.
- Growing pellets (g-pellets), which are worth t points, where t is time.

The pellet's point value stops changing once eaten. For example, if Pacman eats one g-pellet at $t = 1$ and one d-pellet at $t = 2$, Pacman will have won $1 + 3 = 4$ points.

Pacman needs to find a path to win at least 10 points but he wants to minimize distance travelled. The cost between states is equal to distance travelled.

(a) Which of the following must be including for a minimum, sufficient state space?

☐ Pacman's location
☐ Location and type of each pellet
☐ How far Pacman has travelled
☐ Current time
☐ How many pellets Pacman has eaten and the point value of each eaten pellet
☐ Total points Pacman has won
☐ Which pellets Pacman has eaten

(b) Which of the following are admissible heuristics? Let x be the number of points won so far.

☐ Distance to closest pellet, except if in the goal state, in which case the heuristic value is 0.
☐ Distance needed to win $10 - x$ points, determining the value of all pellets as if they were n-pellets.
☐ Distance needed to win $10 - x$ points, determining the value of all pellets as if they were g-pellets (i.e. all pellet values will be t.)
☐ Distance needed to win $10 - x$ points, determining the value of all pellets as if they were d-pellets (i.e. all pellet values will be $max(0, 5 - t)$.
☐ Distance needed to win $10 - x$ points assuming all pellets maintain current point value (g-pellets stop increasing in value and d-pellets stop decreasing in value)
☐ None of the above

(c) Instead of finding a path which minimizes distance, Pacman would like to find a path which minimizes the following:

$$C_{new} = a * t + b * d$$

where t is the amount of time elapsed, d is the distance travelled, and a and b are non-negative constants such that $a + b = 1$. Pacman knows an admissible heuristic when he is trying to minimize time (i.e. when $a = 1, b = 0$), h_t, and when he is trying to minimize distance, h_d (i.e. when $a = 0, b = 1$).
Which of the following heuristics is guaranteed to be admissible when minimizing C_{new}?

☐ $mean(h_t, h_d)$ ☐ $min(h_t, h_d)$ ☐ $max(h_t, h_d)$ ☐ $a * h_t + b * h_d$
☐ None of the above