CS1571
Fall 2019
9/18 Homework

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Read Russell & Norvig, Chapter 3.6.

Then, answer the following questions. They are both to test your understanding of the reading and to review what we have covered in class so far.

1. (4 pts) The following are two heuristics for the N-puzzle problem (see p. 103).
   a. h_1 = the number of misplaced tiles
   b. h_2 = the Manhattan distance

   Which of the following options are true about the heuristics. Check all that apply.

   _____ h_1 and h_2 are considered to be admissible, because they never underestimate the cost to reach the goal.

   __X___ h_1 and h_2 are both consistent.

   ___X__ h_1 and h_2 represent optimal solutions to relaxed versions of the N-puzzle problem.

   _____ h_1 dominates h_2.

2. (3 pts) Assume you are running a bidirectional search, where you run a BFS from the initial state, and idDFS from the goal state. What is the time and space complexity? Only one response is correct.

   __X___ The time complexity is $O(2b^{d/2})$, while the space complexity is $O(b^{d/2} + bd)$.

   _____ Both the time and space complexity are $O(bd)$.

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   _____ The time complexity is $O(b^{d/2})$ while the space complexity is $O(bd)$.

3. (3 pts) The following problem description is taken from this library of constraint satisfaction problems: www.csplib.org.

Consider a four way traffic junction with eight traffic lights. Four of the traffic lights are for the vehicles and can be represented by the variables V_1 to V_4 with domains {r,ry,g,y} (for red, red-yellow, green and yellow). The other four traffic lights are for the pedestrians and can be represented by the variables P_1 to P_4 with domains {r,g}. The constraints on these variables can be modelled by quaternary constraints on (V_i, P_i, V_j, P_j) for $1 \leq i \leq 4$, $j = (1 + i)$ *mod* 4 which allow just the tuples {(r,r,g,g), (ry,r,y,r), (g,g,r,r), (y,r,ry,r)}.

Your task is to modify this description to represent a Pittsburgh intersection such as Fifth Ave. and Craig St. This junction is a four-way junction with eight traffic lights, but:
- There is no red-yellow light.
- All vehicle lights must be red for the pedestrian lights to be green, and when a vehicle light is green or yellow, the pedestrian light will be red.
- The pedestrian lights also have a "yellow" mode which warns pedestrians when the light will turn red (the flashing hand with the number countdown).

Given this new scenario, outline the following properties of the CSP:

Variables:

Vehicle: {V1, V2, V3, V4}
Pedestrian: {P1, P2, P3, P4}

Domain:

Vehicle lights: {red, green, yellow}
Pedestrian lights: {red, yellow, green}

Constraints:

For 1<=i<=4, j=(1+i) mod 3