CS440/ECE448 Worksheet 1

Name and NetID:_____

Week of 2/1/2021

Question 1

In the tree search formulation, why do we restrict step costs to be non-negative?

> **Solution:** If the cost around any loop is negative, then the lowest-cost path is to take that loop an infinite number of times.

Question 2

What is the distinction between a world state and a search tree node?

> **Solution:** A world state contains enough information to know (1) whether or not you've reached the goal, (2) what actions can be performed, (3) what will be the result of each action. A search tree node contains a pointer to the world state, plus a pointer to the parent node.

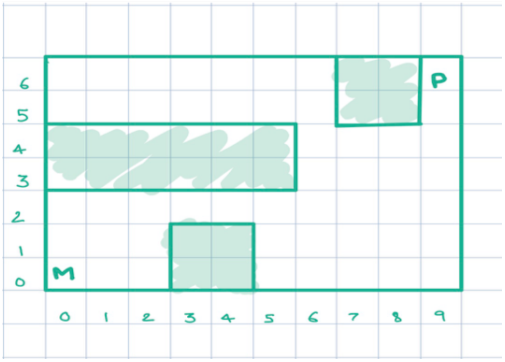
Question 3

How do we avoid repeated states during tree search?

> **Solution:** By keeping a set of "explored states." If expanding a search node results in a state that has already been explored, we don't add it to the frontier.

Question 4

Refer to the maze shown below. Here, M represents Mario, P represents Peach, and the goal of the game is to get Mario and Peach to find each other. In each move, both Mario and Peach take turns. For example, one move would consist of Peach moving a block to the bottom from her current position, and Mario moving one block to the left from his current position. Standing still is also an option.



(a) Describe state and action representations for this problem.

Solution:

- State = (x_M, y_M) position of Mario, (x_P, y_P) position of Peach.
- Action = Mario moves up,down,left,right, or stationary,
  Peach moves up,down,left,right, or stationary.

(b) What is the size of the state space?

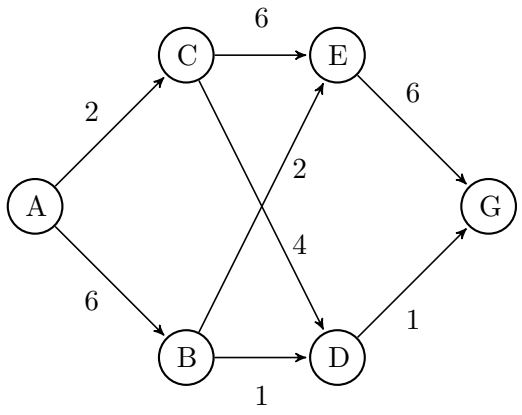
Solution: There are 50 possible locations for both Mario and Peach (if we assume that they can occupy the same square), for a total state space of 2500.

(c) Describe an admissible heuristic for this problem.

Solution: The heuristic $h(n) = 0$ is always admissible, but would receive at most a little bit of partial credit, because it's trivial. A more useful heuristic would measure the distance between Mario and Peach, e.g., $0.5 * (|x_M - x_P| + |y_M - y_P|)$.

Question 5

Consider the following search graph.



Ties are resolved in alphabetical order, e.g., if node B and node C both have an equal score, then node B is evaluated first. Node G is the goal state.

(a) What nodes are evaluated during BFS? What is the chosen path?

Solution: Evaluated: A,B,C,D,E,G, Chosen: ABDG.

(b) What nodes are evaluated during UCS? What is the chosen path?

Solution: Evaluated: A,C,B,D,G, Chosen: ACDG

(c) Suppose that the heuristic is $h(G) = 0$, $h(D) = h(E) = 1$, $h(B) = h(C) = 2$, $h(A) = 3$. What nodes are evaluated during **A*** search? What is the chosen path?

Solution: Evaluated: A,C,D,G, Chosen: ACDG