Written Homework

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CS-380

1. **What is the branching factor *b* in this state space?**

The branching factor is 4 for this state space. This is because you can move in 4 different directions: up, down, left, and right.

2. **How many distinct states are there at depth *k* (for *k* larger than 0).**

There are 4^k distinct states for depth k (k > 0).

3. **What is the maximum number of nodes expanded by breadth-first tree search?**

The maximum number of nodes that can be expanded in a breadth-first tree search would be infinite considering that the 2D graph is unbounded.

4. **What is the maximum number of nodes expanded by breadth-first graph search?**

The maximum number of nodes expanded by breadth-first graph search would also be infinite for the same reason that the 2D graph is unbounded.

5. **Is $h = |u - x| + |v - y|$ an admissible heuristic for a state at (u,v)? Explain.**

Yes, this is an admissible heuristic. This heuristic represents the Manhattan distance. This heuristic will never overestimate the actual cost because it calculates the shortest possible path, and since you can not move diagonally in this state space, it will never overestimate. This heuristic represents the minimum number of moves needed to reach the goal.

6. **How many nodes are expanded by A* graph search using h?**

A* will only expand the nodes that are on the shortest path from the starting position to the end goals. It will also expand nodes with equal total cost.

7. **Does *h* remain admissible if some links are removed?**

Yes, *h* will remain admissible if links are removed. The Manhattan distance would still be the lower bound of the actual path cost. Removing links would only increase the path length, not make the path shorter.

8. **Does *h* remain admissible if some links are added between nonadjacent states?**

No, *h* does not remain admissible. This distance calculates the distance between two points by taking the absolute differences representing movement along the grid lines. This does not account for diagonal movement meaning that *h* potentially could over estimate the distance to the goal.