hw1

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1 Question 1

1.1 a

It is false because DFS can sometimes beat A* by luck when all the successors are on one side of track, which makes A* slower because it contains the factor of heuristic which drags the speed because it expands through other branches.

1.2 b

True because there is no other estimated distance can be higher than the distance of 0, which means that it is a admissible heuristic.

1.3 c

True because searching can be continuous and the robotics process eventually outputs a series of results.

1.4 d

It is true. "Breadth-first search is complete whenever the branching factor is finite." Therefore, even if the step cost is zero step, which is allowed.

1.5 e

False because the cost of a move can be more than a move, therefore the Manhattan distance can be more than true cost of move.

2 Question 2

It happens in a case where all nodes has a single successor, and there is a single goal at depth n. Then DFS will find the goal in n steps, but IDS will take $1 + 2 + 3 + \ldots + n = O(n2)$ steps.

3 Question 3

3.1 a

UCS can proceed BFS when the cost of steps are equal which means g(n) consists for depth(n).

3.2 b

Like the statement proved above: BFS is BFS when $f(n) = depth(n)$.

3.3 c

UCS is A* Search when $h(n) = 0$.

4 Quesiton 4

First, a heuristic is consistent if and only if: $h(n) \leq c(n, a, n') + h(n')$.

Base case: when n' is the goal state and n is the previous node of n'. Then $h(n') = 0$,$h(n) \leq c(n, a, n')$, which also means that $c(n, a, n') = h * (n)$.By $h(n) \leq c(n, a, n') + h(n')$, we can get $h(n) \leq h * (n)$.

Inductive step: Assume that n' is k steps away from the goal node, n is k+1 steps away from the goal node and n' is admissible. If we can inductively prove n is admissible, then we can prove that consistency leads to admissibility.

By consistency, we know $h(n) <= c(n, a, n') + h(n')$. Assume n' is admissible, $h(n') \leq h * (n')$. Thus, $h(n) \leq c(n, a, n') + h(n') \leq c(n, a, n') + h * (n')$. Since c(n,a,n') is the true cost from n to n' and h*(n') is true cost from n' to goal node, $c(n, a, n') + h * (n')$is the true cost from n to goal node. Connecting these two inequations, we find that $h(n) \leq c(n, a, n')+h(n') \leq c(n, a, n')+h*(n') = h*(n)$. This leads to $h(n) \leq h * (n')$. Now we have proved n is admissible assuming n' is admissible.

By induction, if a heuristic is consistent, it must be admissible.