CS 5100 – PS2

Yijing Xiao

Problem 1: In what order does A* expand the nodes for the graph?

Frontier	Path cost	Heuristic	f = g + h	CurrNode
S	0	5	5	
b	1	3	4	S
a	1	4	5	
c	3	1	4	b
d	3	1	4	
a	1	4	5	
g	5	0	5	
d	3	1	4	c
a	1	4	5	
g	5	0	5	
g	4	0	4	d
a	1	4	5	
a	1	4	5	g

Extra explanation: the frontier is a priority queue in alphabetical order and after popping out a node, it will check the f value and sort queue from smallest to largest so that is why the node a behind node g in the penultimate row. In the last step, since we've already reached out to node g, we don't need to explore even though the frontier is not empty.

Problem 2: Which of the following are true and which are false? Explain your answers.

a) **Depth-first search always expands at least as many nodes as A* search with an admissible heuristic.**
False. Depth-first search always expands node as deep as possible; it might only expand some nodes to reach out the goal. However, A* may check other more nodes to make sure the path is optimal.

b) **h(s) = 0 is an admissible heuristic for the 8-puzzle.**
True. An admissible heuristic must have $0 \leq h(s) \leq h^*(s)$. The $h^*(s)$ is always positive and $h(s) = 0$, thus it satisfied all conditions.

c) **An admissible heuristic must be consistent.**
False. In the lecture we have an example of admissible but inconsistent heuristic (Informed

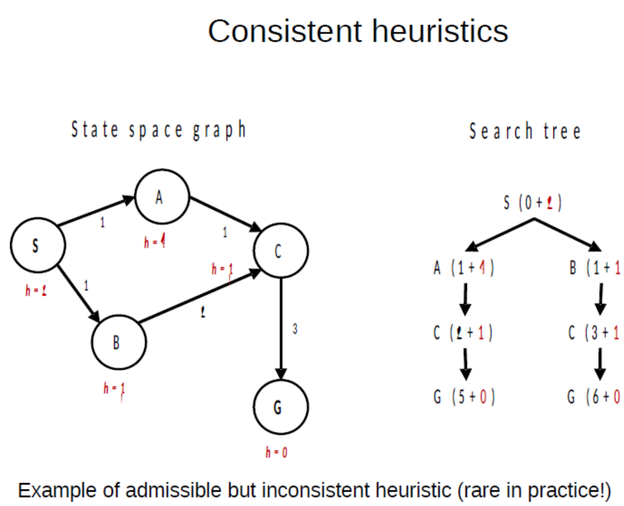

Figure 1 problem 2 (c)

search, PowerPoint page 79, showed on above). Therefor this statement is false.

d) **A* with an admissible heuristic is always the best choice for finding a reasonably short path quickly (in terms of computation time), because it is optimal.**
False. A* is optimal if heuristic is admissible only in tree search. For graph search, A* is optimal if heuristic is consistent.

e) **Assume that a rook can move on a chessboard any number of squares in a straight line, vertically or horizontally, but cannot jump over other pieces. Manhattan distance is an admissible heuristic for the problem of moving the rook from square A to square B in the smallest number of moves.**
False. According to the AIMA book, there are three relaxed problems: If a rook can move from square A to square B if A is adjacent to B, we can derive Manhattan distance. If A rook can move from square A to square B if B is blank, we can derive Gaschnig heuristic. If A rook can move from square A to square B, we can derive misplaced titles. Hence, the cost of an optimal solution to a relaxed problem is an admissible heuristic for the original problem.

Problem 3 Extra Credit: Explain why Gaschnig's heuristic is at least as accurate as the number-of-misplaced-tiles heuristic.
Since the misplaced-titles heuristic is for a tile can move from square A to square B which is a relaxation of the condition for a tile can move from square A to square B if B is blank. Thus, the number-of-misplaced-tiles heuristic cannot bigger than Gaschnig's heuristic. Since both are also admissible (because the cost of an optimal solution to a relaxed problem is an admissible heuristic for the original problem), then we have $0 \leq \text{the number of misplaced tiles} \leq \text{Gaschnig's heuristic} \leq$ h*. Therefore, why Gaschnig's heuristic is at least as accurate as the number-of-misplaced-tiles heuristic.