CS-GY 6613 HW2

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Q1 (a) False

(b) False

(c) False

(d) True.

Q2 (a) False

(b) False

(c) True

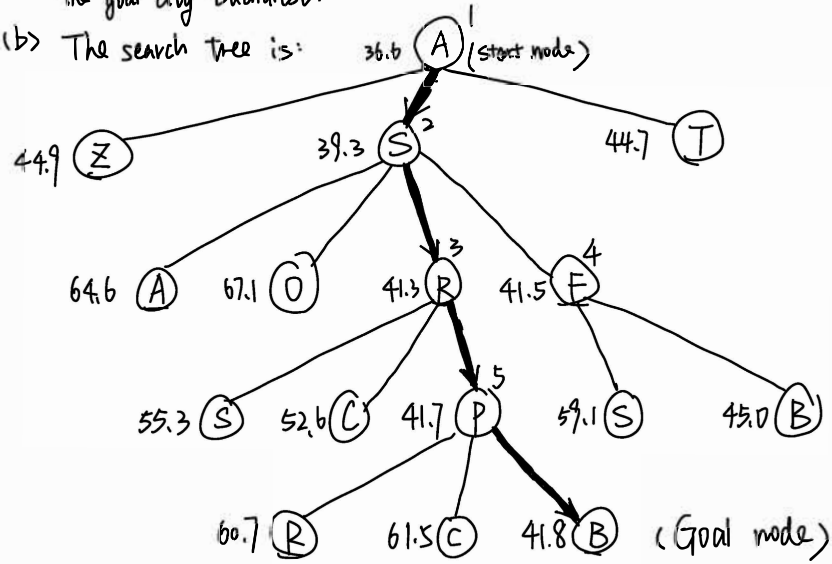
(d) True

(e) True

(f) True

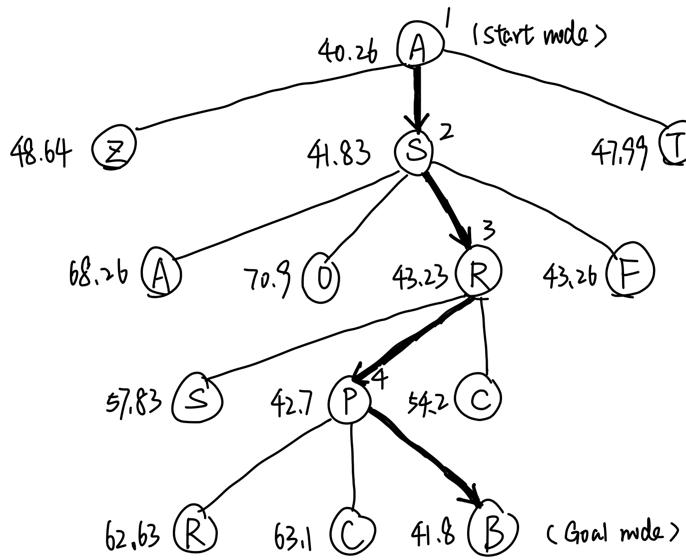
Q3 (a) The heuristic function h is the estimated straight cost from each city to the goal city Bucharest.

(b) The search tree is:



Q4 $f(n) = g(n) + W \times h(n)$. $W = 1.1$

(a) The search tree is:



(b) No, because $W \times h(\text{Pitesti}) = 110$, but $h^*(\text{Pitesti})$ is 101, which is the cost of the optimal path from Pitesti to Bucharest (goal city).

i.e. $W \times h(\text{Pitesti}) > h^*(\text{Pitesti})$.

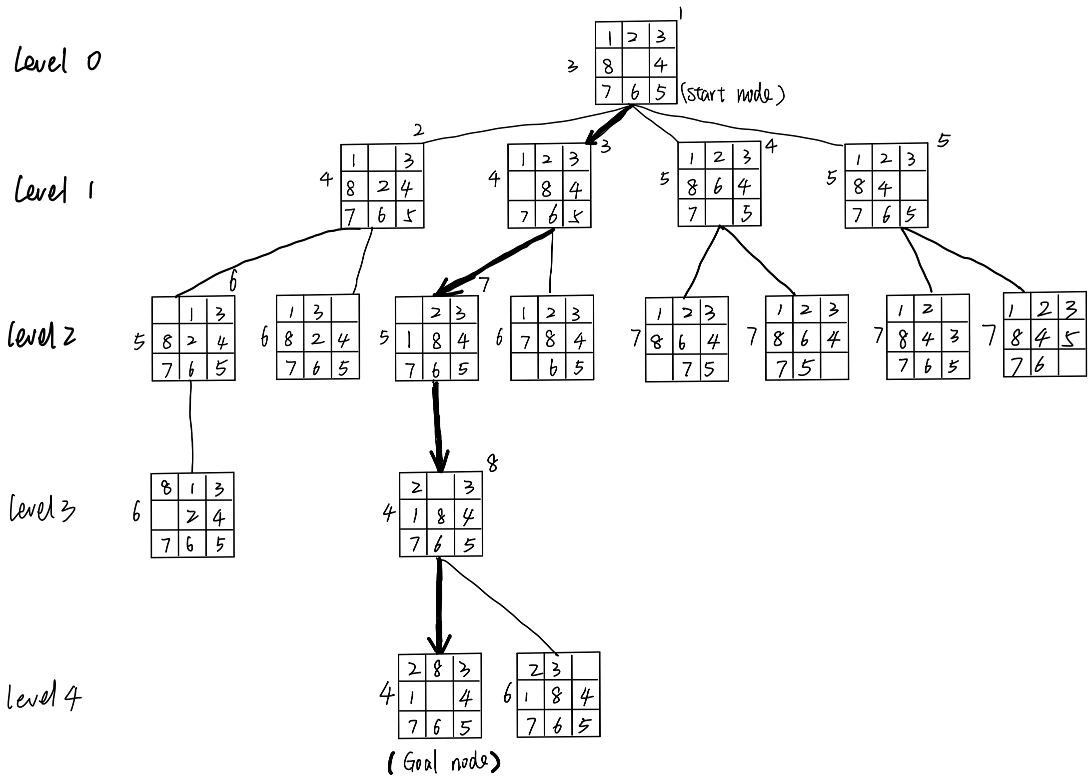
So $W \times h(n)$ with $W = 1.1$ isn't an admissible heuristic function in this problem.

(c) Yes. The path is same as Problem 3, which is the optimal path.

(d) Yes, Compared with Problem 3, weighted A* algorithm in this problem generates few nodes.

Q5

(a) Let g(n) be the depth level in the problem, and the level of start node is 0.
The search tree is:



(b) 17 entries are in the table reached.

Q6

Pf: Consider the optimal path from node n to the optimal goal node G. and let the sequence of nodes along this path be denoted as $n, n_1, n_2, \cdots, n_k, G$. where n is the start node, and G is the goal node.

Using the concept of consistent heuristic, we can get

$$h(n) \le c(n, a_1, n_1) + h(n_1)$$
$$h(n_1) \le c(n_1, a_2, n_2) + h(n_2)$$
$$h(n_2) \le c(n_2, a_3, n_3) + h(n_3)$$
$$\cdots$$
$$h(n_{k-1}) \le c(n_{k-1}, a_k, n_k) + h(n_k)$$
$$h(n_k) \le c(n_k, a_{k+1}, G) + h(G) \qquad (h(G) = 0)$$

Add all the inequalities together:

$$h(n) + h(n_1) + h(n_2) + \cdots + h(n_{k-1}) + h(n_k)$$
$$\le c(n, a_1, n_1) + c(n_1, a_2, n_2) + \cdots + c(n_{k-1}, a_k, n_k) + c(n_k, a_{k+1}, G)$$
$$+ h(n_1) + h(n_2) + \cdots + h(n_k) + h(G)$$

$$h(n) \le c(n, a_1, n_1) + c(n_1, a_2, n_2) + \cdots + c(n_{k-1}, a_k, n_k) + c(n_k, a_{k+1}, G)$$

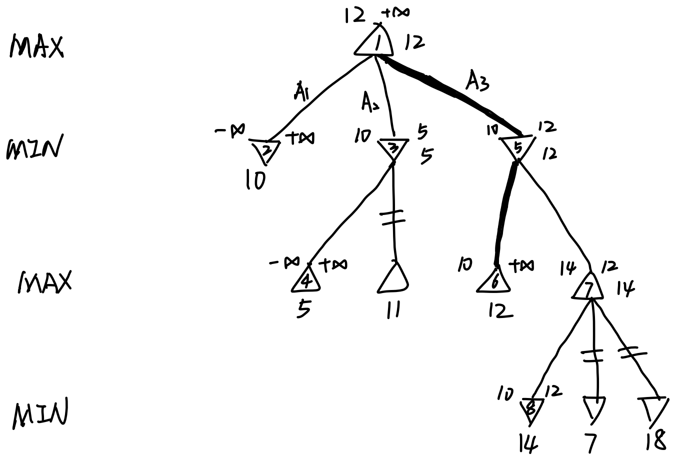
Let $h^*(n)$ be the cost of the optimal path from n to goal, so we can find.

$$h^*(n) = c(n, a_1, n_1) + c(n_1, a_2, n_2) + \cdots + c(n_{k-1}, a_k, n_k) + c(n_k, a_{k+1}, G)$$

As a result, we can get $h(n) \le h^*(n)$, which means the heuristic function $h(n)$ never overestimates the cost to reach the goal.

Thus, in A^* search, if a heuristic function $h(n)$ is consistent, it must be admissible.

Q7.



The best action returned by the Alpha-beta search algorithm is A3.