CSE 415 Assignment 4, Lo Hung, 1926128

1.(a) DFS: 21, BFS: 13, IDDFS: 13

1.(b) DFS: O(N), BFS: O(N), IDDFS: O(N)

1.(c) DFS: O(N), BFS: O(N), IDDFS: O(N)

1.(d) DFS: O(log N), BFS: O(N), IDDFS: O(N)

1.(e) BFS & IDDFS can remember whole routes of solutions, so they can promise the optimal solution. on the other hand, DFS just remember recent visited path, so it might not be optimal answer.

1.(f) Heuristic function can provide value of estimating goal state and current state. If it is not worst case and heuristic function is admissable, A* search will reduce the extending states.

1.(g) In best case, heuristic function can avoid expanding states not in the optimal path; In worst case, because it is admissable heuristic, it will $\leq h^*(s)$ and the time complexity will $\leq$ UCS search.

2.(a) [0, 0, 0] → [0, -1, 1] → [1, -2, 1] → [2, -3, 1] → [3, 3, 0]

total cost = 17 = 6 + 3 + 3 + 5 ※

2.(b) 33 states

2.(c) the distance func is : $|x_1 - x_2| + 2|y_1 - y_2| + 4|z_1 - z_2|$

if $h(s) = \min(|x - x_g|, |y - y_g|, |z - z_g|)$

the true cost to goal state $= \sum_{n=0}^{goal} d((x_n, y_n, z_n), (x_{(n+1)}, y_{(n+1)}, z_{(n+1)}))$

@ any state, cost to goal : $\sum_{n=cur}^{goal} d((x_n, y_n, z_n), (x_{(n+1)}, y_{(y+1)}, z_{(n+1)}))$

$$> \sum_{n=cur}^{goal} |x_n - x_{n+1}| + |y_n - y_{n+1}| + |z_n - z_{n+1}|$$

$$\geq |x_n - x_{goal}| + |y_n - y_{goal}| + |z_n - z_{goal}|$$

$$\geq \min(|x_n - x_{goal}|, |y_n - y_{goal}|, |z_n - z_{goal}|)$$

$$\geq h(s) ※$$

↓

if $h^*(s) \geq h(s)$

h(s) is admissable ※

2.(d) 29 states , $[0,0,0] \rightarrow [0,+,1,2] \Rightarrow [\,?\,] \Rightarrow [\,?\,] \rightarrow [\,?\,]$

2.(e) because the distance function is $|x_1-x_2|+2|y_1-y_2|+4|z_1-z_2|$

the $h(s)$ is $\min(|x-x_g|, |y-y_g|, |z-z_g|)$

① UCS: the priority $= d(x', y', z')$

② Astar: the priority $= d(x', y', z') + h(s)$, by definition of $(h(s))$

the more closer to goal state, the higher priority for state.

Therefore, search can deal with the case that has same $d(x', y', z')$ but $h(s)$ is different. Besides, the $h(s)$ is admissable, so the search can first extend the higher priority states which might not be expanded in UCS,

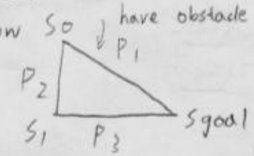
2.(f) ① My $h(s)$ is the number of obstacle ≠ obstacle direction on the goal state

For instance: state $(2,-1,-1)$ have obstacle on $(1,-1,0)$ & $(1,0,-1)$

My $h(s) = |x| + |-1| \times 2 + |x| + |-1| \times 4 = 8$ ※

② When obstacles on the goal states direction, it will be useful

Because by math we know



P_2+P_3 , $P_1 < P_2+P_3$

So the true cost $h^*(n) \geq My\,h(s)$, on the other hand if obstacle is not on the way of going to goal state, $My\,h(s)$ might not be useful

2.(g) 32. states expanded #

3.(a)&(b)

$s \in S$	$a \in A$	$s' \in S$	$T(s,a,s')$	$R(s,a,s')$
F	U	A	1	-0.2
A	U	B	0.7	-0.2
A	U	F	0.3	0.1
A	D	B	0.3	-0.2
A	D	F	0.7	0.1
B	D	A	0.7	0.1
B	D	C	0.3	0.1
B	G	C	0.7	0.1
B	G	A	0.3	0.1
C	U	B	0.7	-0.5
C	U	E	0.3	0.1
C	D	B	0.3	-0.5
C	D	E	0.7	0.1
E	D	F	0.7	10
E	D	C	0.3	-0.5
E	U	F	0.3	10
E	U	C	0.7	-0.5

3.(c) $Q(s,a) = \Sigma R(s,a,s') * T(s,a,s')$

$Q(F,U) = 1 * -0.2 = -0.2$

$Q(A,U) = -0.14 + 0.03 = -0.11$

$Q(A,D) = -0.06 + 0.07 = 0.01$

$Q(B,D) = 0.07 + 0.03 = 0.1$

$Q(B,G) = 0.07 + 0.03 = 0.1$

$Q(C,U) = -0.35 + 0.03 = -0.32$

$Q(C,D) = -0.15 + 0.07 = -0.08$

$Q(E,D) = 7 - 0.15 = 6.85$

$Q(E,U) = 3 - 0.35 = 2.65$

3.(d) $= R(A,D,F) + R(F,U,A) + R(A,U,B) + R(B,D,A) + R(A,U,B) + R(B,G,C) + R(C,D,B) + R(B,G,C) + R(C,D,E) + R(E,D,C) + R(C,D,E) + R(E,U,F) + R(F,U,A)$

$= 0.1 + -0.2 + -0.2 + 0.1 + -0.2 + 0.1 + -0.5 + 0.1 + 0.1 + -0.5 + 0.1 - 0.2 + 10$

$= 8.8$ #