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Problem Set 2 | Search
Group Submission
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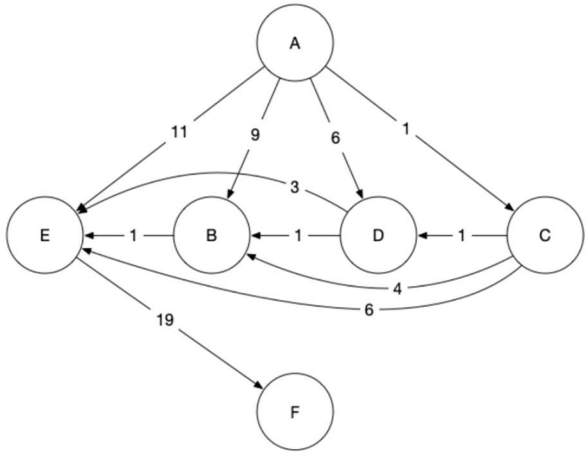
Use the graph given in figure 1 for the next few questions. Nodes are labeled with their names, edges with their weights. The starting state is A" and the goal state is F". When describing actions, use the notation A->C" to refer to moving from state A to state C", which in this graph has a cost of 6. Use alphabetical order in the case of ties.

1. Find a path from the start (A) to the goal (F) using the Depth First Search version of the Generic Search Algorithm discussed in class, making sure to
(a) Show the status of the open and closed data structures for each iteration.
(b) Show the final search tree after the goal state is reached.
(c) Show the final result (path).

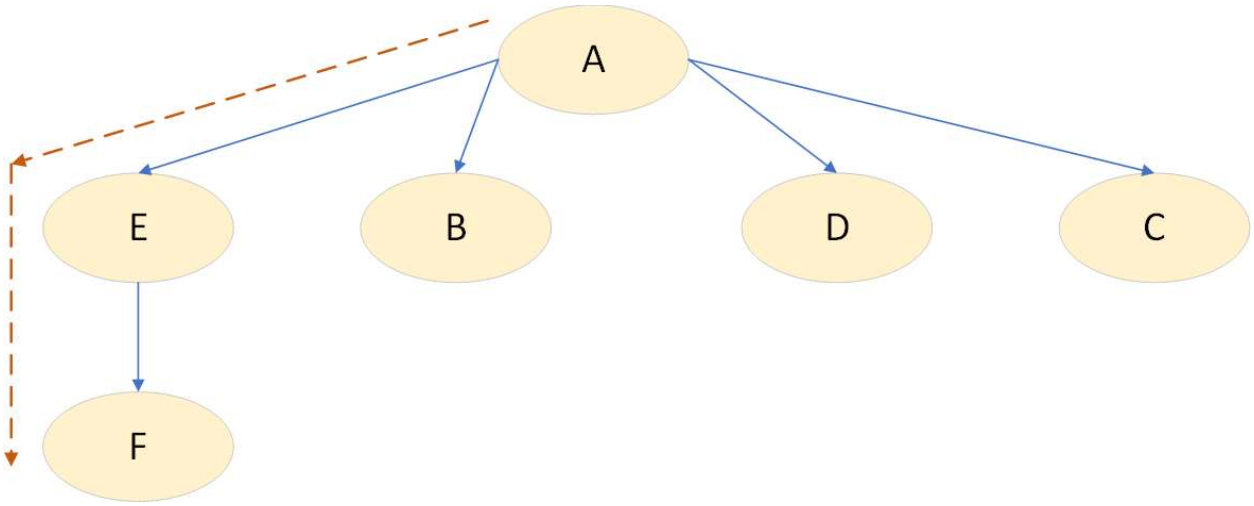


(a)

Level 0	A	A	A	A	A	A	A
Level 1	E	B	D	D	C	C	C
Level 2	F	E	B	E	E	D	B
Level 3		F	E	F	F	B	E
Level 4			F			E	F
Level 5						F	

STATE	Open	Closed
Start	A	[]
A->E	E	A
E->F	F	A, E

b)



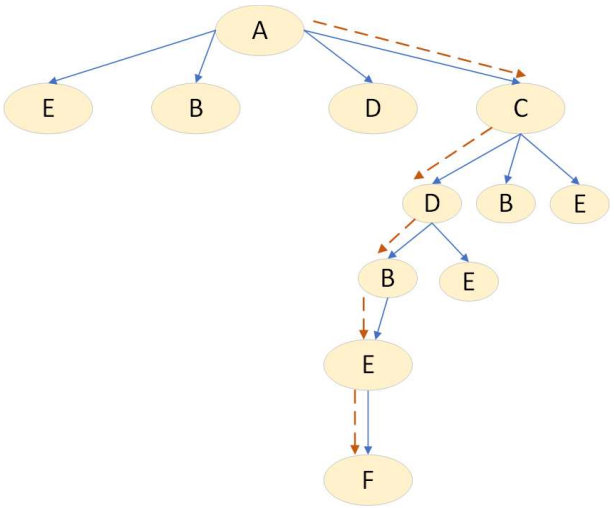
c) A->E->F

2. Answer the same three questions for the Uniform Cost Search version.

a) Show the status of the open and closed data structures for each iteration.

STATE	Options	PATH	OPEN	CLOSED	COST (g(n))
Start	-	A			0
A->C	A->E cost 11 A->B cost 9 A->D cost 6 A->C Cost 1	A->C	C	A	1
C->D	C->D cost 1 C->B cost 4 C->E cost 6	A->C->D	D	A, C	1+1=2
D->B	D->B cost 1 D->E cost 3	A->C->D->B	B	A, C, D	1+1+1=3
B->E	-	A->C->D ->B->E	E	A, C, D, B	1+1+1+1=4
E->F	-	A->C->D ->B->E->F	F	A, C, D, B, E	1+1+1+1+19=23
Goal	-	-	-	A, C, D, B, E, F	

b)



c) A->C->D ->B->E->F

3. Answer the same three questions for A* search using the following heuristic:
State h(State)

State	h(State)
A	23
B	3
C	13
D	7
E	0
F	0

Start

node	G(n)	h(n)	F(n)	prev
A	0	23	23	None
B	9	3	12	A
C	1	13	14	A
D	6	7	13	A
E	11	0	11	A
F	19	0		None

Visited list

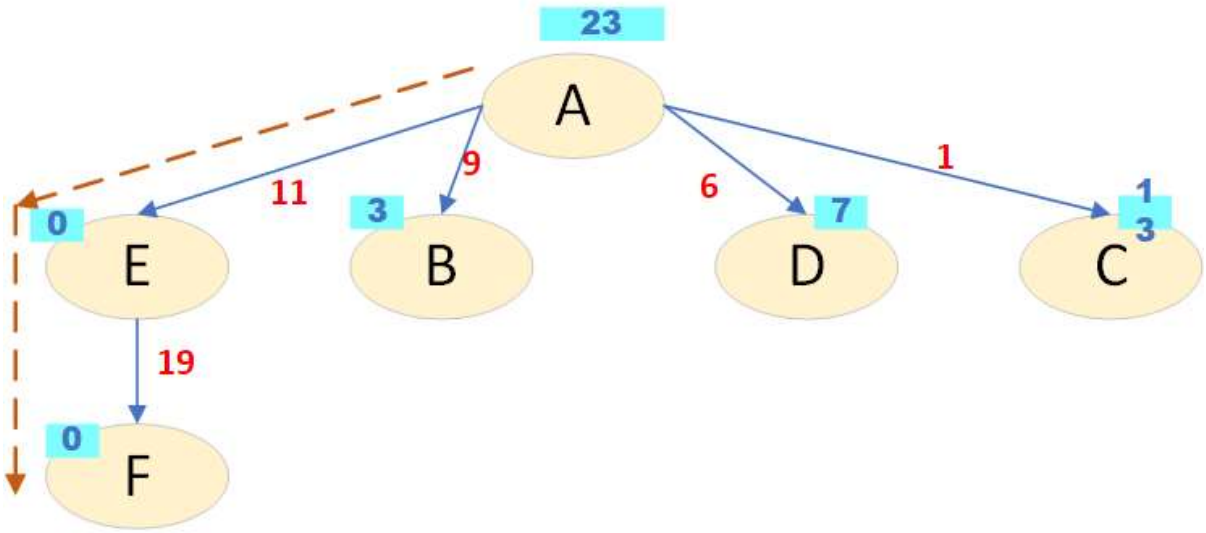
node	Path	G(n)	h(n)	F(n)	prev
A	A	0	23	23	None
E	A->E	11	0	11	A

Unvisited list

node	G(n)	h(n)	F(n)	prev
B	9	3	12	A
C	1	13	14	A
D	6	7	13	A
F	19	0		None

At point E, only option is to go to F

node	Path	G(n)	h(n)	F(n)	prev
A	A	0	23	23	None
E	A->E	0+11=11	0	11	A
F	A->E->F	0+11+19=30	0	30	E



4. Is this heuristic admissible? Explain why or why not.

Path	Cost(h*(n)	H(n)	Admissible ? (H(n) < H*(n)
A->F	30/23 (in 2 different path)	23	Yes
B->F	20	3	Yes
C->F (C->B->D->E->F)	22	13	Yes
D->F(D->B-E-F)	21	7	Yes
E-F	19	0	Yes

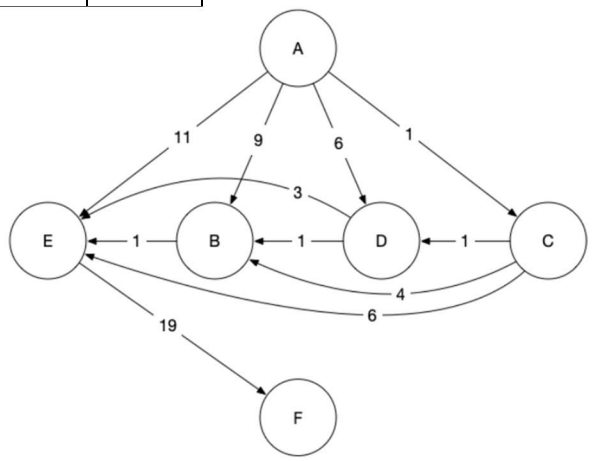
Its admissible.

5. This graph is part of a family of similar graphs known as Martelli's family that is specifically designed to illustrate why consistency is important for a heuristic. Replace the heuristic function from question

3 with one that is consistent and re-do the search. How was the search different?

Consistent if $h(n) \leq c(n,a,n') + h(n')$

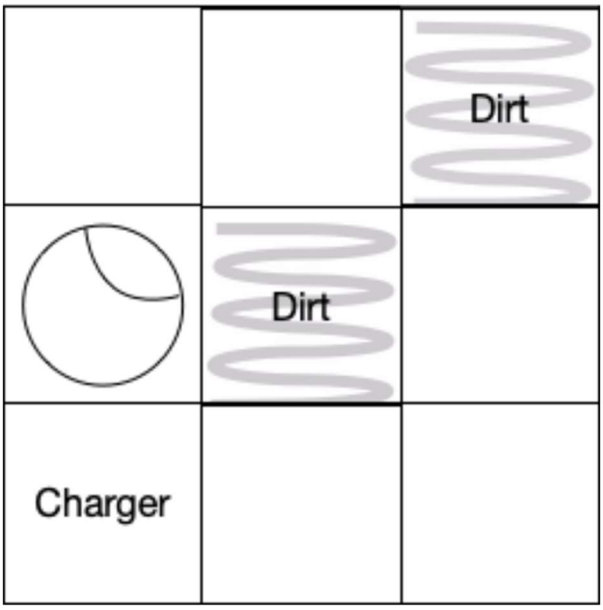
State	h(State)
A	23
B	3
C	13
D	7
E	0
F	0



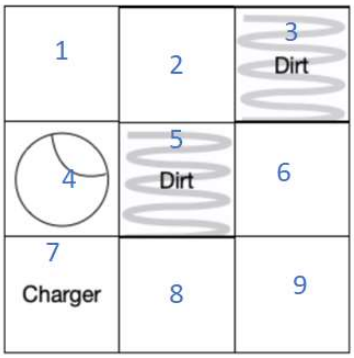
Path	h(n)	C(n,a,n')	h{n')	C(n,a,n') + h(n')	$h(n) \leq c(n,a,n') + h(n')$
A->B	23	9	3	12	No
A->C	23	1	13	14	No
A->D	23	6	7	13	No
A->E	23	11	0	11	No
C->D	13	1	7	8	No
C->B	13	4	3	7	No
B->E	3	1	0	1	No
C->E	13	6	0	6	No
D->B	7	1	3	4	No
D->E	7	1	0	1	No
E->F	0	19	0	19	Yes

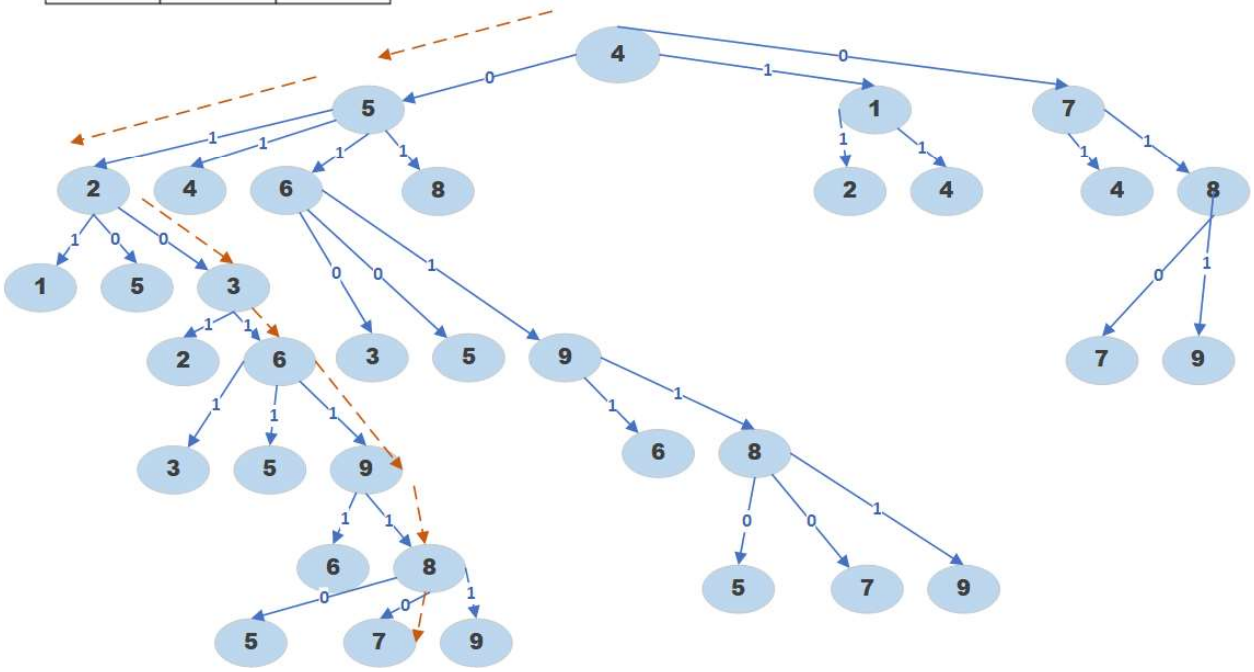
So, its not consistent

6. Our friendly vacuum robot needs to clean the room illustrated in Figure 2. For the purposes of this example, the vacuum is running the entire time, so the only actions are to move between adjacent cells. The robot's goal is to visit each of the spaces with dirt, and return to its charger afterwards. Define this task as a search problem and give all the components necessary to solve it using either uninformed or informed search.



Start : (4)
State :
Action : Move Left, Right, Up, Down, must cover dirt before going to charger
Path Cost : 1 for any move to clean , 0 for dirt or charger
Goal : Charger (7)
We do a Uniform Cost search.

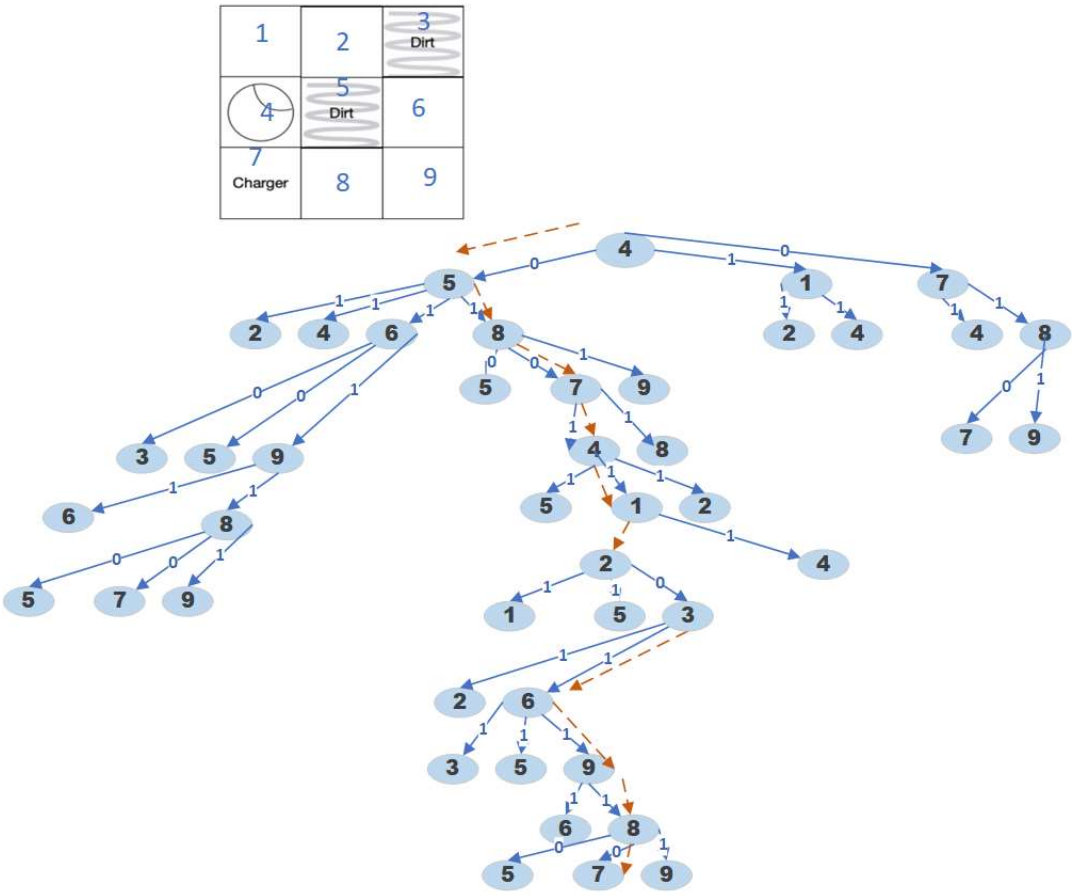




Optimum path is 4->5->2->3->6->9->8->7, total cost : 4

7. Given your problem definition, which technique would you use? What would change if the robot had to recharge after cleaning a dirty cell? Describe in words how this would change your problem definition.

I would use lowest cost search , ie Uniform cost search.
The goal will be changed to go 7 cell after 5 and 3.


1
2
3
Dirt
4
5
Dirt
6
7
Charger
8
9