CSE 422

Assignment 01

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Section :- 06

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Ans to the ques no :- A

1

Here, the maximum weight capacity = 12

However, we should carry object 'H' always. 'H' has weight = 2. So, the remaining weight is 12 - 2 = 10. Therefore, we should fillup the bag with maximum weight 10, achieving ~~maxi~~ maximum reward at the same time.

There are in total 8 objects. Excluding object 'H', there are 7 objects. So, our chromosome length will be 7. However, the weight must not exceed 10.

Keeping all of these in mind, the initial population of 4 chromosomes may be,

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Chromosome 1 :

0	1	2	3	4	5	6
1	1	1	0	0	0	0

Chromosome 2 :

0	1	2	3	4	5	6
0	0	0	0	0	1	1

Chromosome 3 :

0	1	2	3	4	5	6
0	1	0	1	0	0	0

Chromosome 4 :

0	1	2	3	4	5	6
0	1	1	0	0	0	1

$\boxed{2}$

An appropriate evaluation function for the problem will be the Reward for each chromosome. So, we will have a maximizing evaluation function,

Evaluation function = Reward of that chromosome (Total)

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Using the fitness function, the fitness values for the initial population :

Chromosome 1 : 35

Chromosome 2 : 29

Chromosome 3 : 45

Chromosome 4 : 19

Therefore, the 2 fittest chromosomes are:-

Chromosome 1 : 35

Chromosome 3 : 45

$\boxed{3}$

Crossover point $= \lfloor$ Length of chromosomes $/ 2 \rceil$

$= \lfloor 7/2 \rceil$

$= 3$

Chromosome 1 :-	1	1	1	0	0	0	0
Chromosome 3 :-	0	1	0	1	0	0	0
	0	1	2	3	4	5	6

Therefore,

Offspring 1 :	1	1	1	1	0	0	0
	0	1	2	3	4	5	6

Offspring 2 :	0	1	0	0	0	0	0
	0	1	2	3	4	5	6

$\boxed{4}$

Let some mutation threshold was set and both the offsprings exceeded that threshold. So, both of them will be mutated.

After mutation :-

Offspring 1 :	1	1	0	1	0	0	0
	0	1	2	3	4	5	6

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Offspring 2 :

0	1	0	1	0	0	0
0	1	2	3	4	5	6

Here, the total weight of offspring 1 is 11, which makes it an invalid offspring.

Similarly, the total weight for offspring2 is 10. It is a valid offspring. The fitness value of offspring 2 is 45.

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Ans to the problem no:- B

$\boxed{1}$

Here the following conditions needs to be considered:

1. There is no fixed start point. We need to start from a city and cover every city.

2. We must go to one city exactly once. So, we can not come back to any city if required. Therefore, the sequence of travelling will matter here.

3. When travelling to the next city, there must be a direct edge to the next city.

4. As there are 7 cities, the length of the chromosomes will be 7. Each index will contain one city. The order of

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travelling the cities will be stored sequencially in the chromosome.

Taking care of these conditions, the initial population of 4 different chromosomes may be :-

Chromosome 1 :

A	F	B	C	D	G	E
0	1	2	3	4	5	6

Chromosome 2 :

C	D	G	E	B	F	A
0	1	2	3	4	5	6

Chromosome 3 :

F	C	G	D	A	B	E
0	1	2	3	4	5	6

Chromosome 4 :

D	E	G	C	A	B	F
0	1	2	3	4	5	6

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Here, the goal is to take minimum distance possible to cover every city.

∴ Fitness function = Total path cost of a chromosome.

Here the fitness function will be a minimizing function.

Using this fitness function, the fitness values of the initial population :-

Chromosome 1 :- 49

Chromosome 2 :- 52

Chromosome 3 :- 44

Chromosome 4 :- 67.

So, the fittest 2 chromosomes are :-

Chromosome 1 : 49

Chromosome 3 : 44

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$\boxed{3}$

	0	1	2	3	4	5	6
Chromosome 1 :	A	F	B	C	D	G	E
Chromosome 3 :	F	C	G	D	A	B	E

After crossover :-

	0	1	2	3	4	5	6
offspring 1 :-	A	F	B	D	A	B	E
Off spring 2 :	F	C	G	C	D	G	E

These offsprings are not eligible as a solution. Because it violates the conditions:

1. Every city should be visited. Cities C, G are missing from offspring 1 and cities A, B, are missing from offspring 2.

2. There is no direct path from B to D in offspring 1. ~~Sim~~ offspring 2 does not

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violate this condition.

3. No city should be visited more than once. City A and B are visited twice in offspring 1 and city C, G are visited twice in offspring 2.

Since the offsprings violate the conditions for the problem, they are not eligible solutions.

$\boxed{4}$

The usual method of mutation will not work here. Because :-

1. The randomly changed city might already be present in the chromosome.

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2. There might not be any direct path from the previous or to the next ~~node~~ city in the chromosome.

3. All of the cities might not be covered.

So, the usual method of mutation will not work here. We need to follow some special approach for mutation.

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Ans to the problem no:- C

Applying A^* search :- (Considering source = A)

A_{10}^{A}	

$f(A) = 0 + 10$

A_{10}^{A}

B_{14}^{AB}	F_{9}^{AF}

$f(B) = 6 + 8$

$f(F) = 3 + 6$

F_{9}^{AF}

B_{14}^{AB}	G_{9}^{AFG}	H_{13}^{AFH}

$f(G) = (3+1) + 5$

$f(H) = (3+7) + 3$

G_{9}^{AFG}

B_{14}^{AB}	H_{13}^{AFH}	I_{8}^{AFGI}

$f(I) = (3+1+3) + 1$

I_{8}^{AFGI}

B_{14}^{AB}	H_{13}^{AFH}	E_{15}^{AFGIE}	J_{10}^{AFGIJ}	H_{12}^{AFGIH}

$f(E) = (3+1+3+5)+3$

$f(J) = (3+1+3+3)+0$

$f(H) = (3+1+3+2)+3$

J_{10}^{AFGIJ}

B_{14}^{AB}	H_{13}^{AFH}	E_{15}^{AFGIE}	~~J_{10}^{AFGIJ}~~	H_{12}^{AFGIH}	E_{18}^{AFGIJE}

$f(E) = (3+1+3+3+5)+3$

$\therefore$ Optimal path : $A \to F \to G \to I \to J$

Cost of the path = 10

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Applying Greedy Best First search :- (Considering source = A)

	A_{10}				
A_{10}	B_8	F_6			
F_6	B_8	G_5	H_3		
H_3	B_8	G_5	I_1		
I_1	B_8	G_5	G_5	E_3	J_0
J_0	B_8	G_5	G_5	E_3	E_3

$\therefore$ Optimal path : $A \rightarrow F \rightarrow H \rightarrow I \rightarrow J$

Cost of the path = 15

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Ans to the problem no: D

Applying A* Search :- (Considering source = S)

	S_7^{S}				$f(S) = 0 + 7$
S_7^{S}	A_{12}^{SA}	D_7^{SD}			$f(A) = 3 + 9$ $f(D) = 2 + 5$
D_7^{SD}	A_{12}^{SA}	B_7^{SDB}	E_9^{SDE}		$f(B) = (2+1) + 4$ $f(E) = (2+4) + 3$
B_7^{SDB}	A_{12}^{SA}	E_9^{SDE}	C_7^{SDBC}	E_7^{SDBE}	$f(C) = (2+1+2) + 2$ $f(E) = (2+1+1) + 3$
C_7^{SDBC}	A_{12}^{SA}	E_9^{SDE}	E_7^{SDBE}	G_9^{SDBCG}	$f(G) = (2+1+2+4) + 0$
E_7^{SDBE}	A_{12}^{AB}	E_9^{SDE}	G_9^{SDBCG}	G_7^{SDBEG}	$f(G) = (2+1+1+3) + 0$
G_7^{SDBEG}	A_{12}^{AB}	E_9^{SDE}	G_9^{SDBCG}		

∴ Optimal path :- S → D → B → E → G

Cost of the path = 7

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Applying Greedy Best First Search :- (considering source = S)

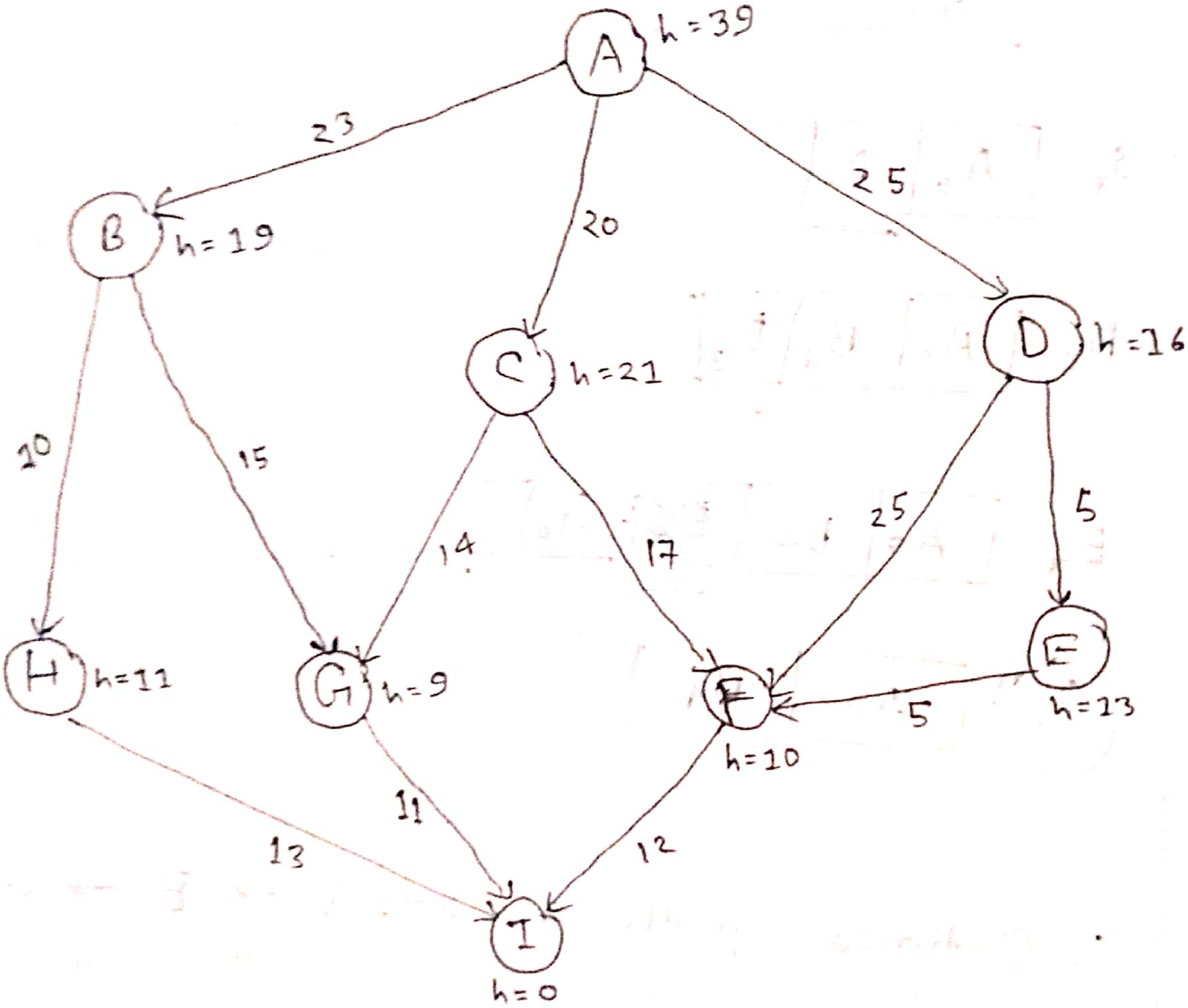
	S_7		
S_7	A_9	D_5	
D_5	A_9	B_4	E_3
E_3	A_9	B_4	G_0
G_0	A_9	B_4	

$\therefore$ Optimal path := $S \rightarrow D \rightarrow E \rightarrow G$

$\therefore$ Cost of the path = 9

Ans to the problem no :- E

$\boxed{1}$



~~State (n)~~	~~Heuristic value (h(n))~~
~~A~~	
~~B~~	
~~C~~	
~~D~~	
~~E~~	
~~F~~	
~~G~~	
~~H~~	
~~I~~	

State (n)	Heuristic value (h(n))
A	39
B	19
C	21
D	16
E	13
F	10
G	9
H	11
I	0

$\boxed{2}$

If heuristic values are consistent, then the values are also admissible.

Therefore, the values will be same as the heuristic values of subproblem 1.

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3

If we just change the heuristic value of C in subproblem 1 to 15, then $h(A) \leq h^*(A, C) + h(C)$ does not hold true. So, the heuristic does not remain consistent, but remains admissible (As every node has a heuristic value underestimating the actual cheapest cost).

The new values will be:-

State (n)	Heuristic value (h(n))
A	39
B	19
C	15
D	16
E	13
F	10
G	9
H	11
I	0

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