Assignment ②
CSE422

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Ans1: (1) Creating an initial population of 4 different chromosomes
Maximum Weight = 20

	A	B	C	D	E	F	G	Weight
C1:	1	1	1	1	0	0	0	19
C2:	0	0	1	1	1	1	0	20
C3:	1	1	0	1	1	0	0	18
C4:	0	1	1	1	0	1	0	17

(2) Fitness function is calculated by the summation of profits corresponding to the selected objects.

First, the objects are selected within the maximum weight threshold and then their corresponding profit is added for each chromosome to account for the fitness value.

Here, higher the profit value, more fit is the chromosome.

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(3) Fitness function Calculation

F(c1) = A + B + C + D = 7 + 3 + 12 + 5 = 27

F(C2) = C + D + E + F = 12 + 5 + 4 + 16 = 37

F(C3) = A + B + D + E = 7 + 3 + 5 + 4 = 19

F(C4) = B + C + D + F = 3 + 12 + 5 + 16 = 36

(4) Chromosomes C2 and C4 are selected as they are the most fit ones.

	A	B	C	D	E	F	G
C2:	0	0	1	1	1	1	0
C4:	0	1	1	1	0	1	0

(5) Crossover performed on C_4 and C_2

0	0	1	1	1	1	0
0	1	1	1	0	1	0

A	B	C	D	E	F	G
0	0	1	1	0	1	0

Offspring 1

0	1	1	1	1	1	0

Offspring 2

(6) Performing mutation

	A	B	C	D	E	F	G
P_1':	1	0	1	0	0	1	1
P_2':	0	1	1	0	1	1	0

Fitness of P_1' : $A + C + F + G = 7 + 12 + 16 + 20 = 55$

Weight of P_1' : $3 + 6 + 1 + 4 = 14$

Fitness of P_2' : $B + C + E + F = 3 + 12 + 4 + 16 = 35$

Weight of P_2' : $2 + 6 + 5 + 1 = 14$

The final offspring is P_1':

A	B	C	D	E	F	G
1	0	1	0	0	1	1

We have reached an optimal solution as the final offspring P_1' gives a fitness value of 55 which is much larger than those of the chromosomes of the parents selected. Also, the weight for P_1' is much smaller than those of its parents chromosomes.

Ans 2: (1)

$A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F$	C1	13
$F \rightarrow E \rightarrow D \rightarrow C \rightarrow A \rightarrow B$	C2	14
$A \rightarrow B \rightarrow C \rightarrow E \rightarrow D \rightarrow F$	C3	18

(2) $A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F$

(i) Gene: A, B, C, D, E, F

(ii) Chromosome: $A \rightarrow B \rightarrow C \rightarrow D \rightarrow E \rightarrow F$

(3) Fitness function is calculated by the summation of the distance/edges between the nodes, keeping in mind to navigate through a minimum distance approach.
The fitness value is weighted here as the lowest value indicating more fitness as we are concerned with the minimum cost of the distance.

(4) C1 : $A+B+C+D+E+F$

$\cancel{=2+5}$ $= 2+3+3+1+4$ $\therefore F(C1) = 13$

$= 13$ (selected) ✓

C2: $F+E+D+C+A+B$

$= 4+1+3+4+2$ $\therefore F(C2) = 24$

$= 14$ (selected) ✓

C3: $A+B+C+E+D+F$

$= 2+3+6+1+6$ $\therefore F(C3) = 18$

$= 18$

Selecting chromosomes C1 and C2 based on the fitness function.

(5)

$A \to B \to C \to D \to E \to F$ → $A \to B \to C \to C \to A \to B$

$F \to E \to D \to C \to A \to B$ → $F \to E \to D \to D \to E \to F$

After crossover, the offspring chromosomes have visited the same city more than once and also not all the cities are visited. Hence, for this problem it is not ideal to perform crossover in this specific way.

(6) ~~AB~~ $A \to B \to C \to C \to A \to B$

$\downarrow$ mutate

$A \to B \to C \to D \to E \to F$

Mutation is randomized but for this specific problem it does not bring random diversity into the genetic code of the chromosome and hence no optimal final offspring. Therefore, mutation performed in this way is not ideal for this problem.

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