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1. a) Let fitness value be number of 1^x in the binary string.

$\therefore$ evaluation values fitness value:-

Chromosome 1: 1000000101 ------→ 3

Chromosome 2: 0111100010 ------→ 5

chromosome 3: 0010101 0100 ------→ 4

Chromosome 4: 0000000000 ------→ 0

1st generation.

x	f(x)
1) 1000000101	→ 3
2) 0111100010	→ 5
3) 0010101 0100	→ 4
4) 0000000000	→ 0

selected pop → (0111100010 , 0010101 0100)

crossover →

crossover prob @ P_c = 0.8

assume rand() generates 0.5 ⇒ crossover occurs.

0111.100010 ────→ 0111101 0100

0010101 0100 ────→ 0010100010

crossover site

$\therefore$ new population.

10000000101

001

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P_m = 0.002

rand () = 0.1

no. mutation.

5.1
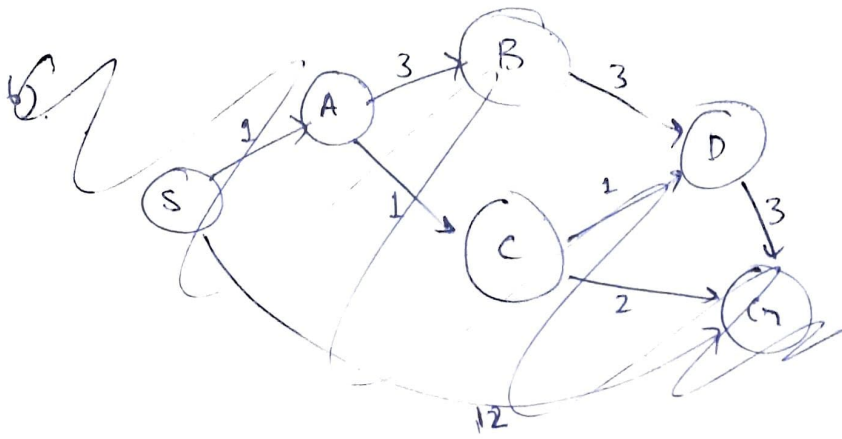
New population

new population :→

$1000000101 \rightarrow 3$

$0111100010 \rightarrow 5$

$0010101010 0 \rightarrow 4$

X $0000000000 \rightarrow 0 \longrightarrow$ deleted

$01111 0101000 \rightarrow 6$

X $0010100010 \rightarrow 3 \rightarrow$ deleted

2nd gen
⇓

$f(x)$	X	$f(x)$

$1000000101 \rightarrow 3$

$0111100010 \rightarrow 5$

$0010101010 0 \rightarrow 4$

$01111 0101000 \rightarrow 6$

selected pop → (0111100010 , $0111101010 0$)

rand() → 0.33 ∴ crossover occurs

base no.

0111100010 ⟶ $0111101010 0 \rightarrow 7$

$0111101010 0$ ⟶ $0111100010 \rightarrow 5$

rand() → 0.001 ∴ mutation occurs

$0.0111010100 \rightarrow 8$

mutated bit

new population →

X	$f(x)$

1000000101

0111100010

$0010101010 0$

$0111101010 0 \xrightarrow{mutation} 0011101010 0$

$0111100010 \xrightarrow{''} 1111100010$

∴ new pop :-

✗ 1 0 0 0 0 0 0 0 . 1 0 1 → 3 ⟶ deleted

0 1 1 1 1 0 0 0 1 0 → 5

✗ 0 0 1 0 1 0 1 0 1 0 0 → 4 ⟶ delete

0 1 1 1 1 0 1 0 1 0 0 → 6

0 0 1 1 1 0 1 0 1 0 0 → 5

1 1 1 1 0 0 0 1 0 → 6

⇓

new $\underline{X}$ $\underline{f(x)}$

0 1 1 1 1 0 0 0 1 0 → 5

~~0 0 1 0 1 0 1 0 1 0 0~~

0 1 1 1 1 0 1 0 1 0 0 → 6

0 0 1 1 1 0 1 0 1 0 0 → 5

1 1 1 1 1 0 0 0 1 0 → 6

6).
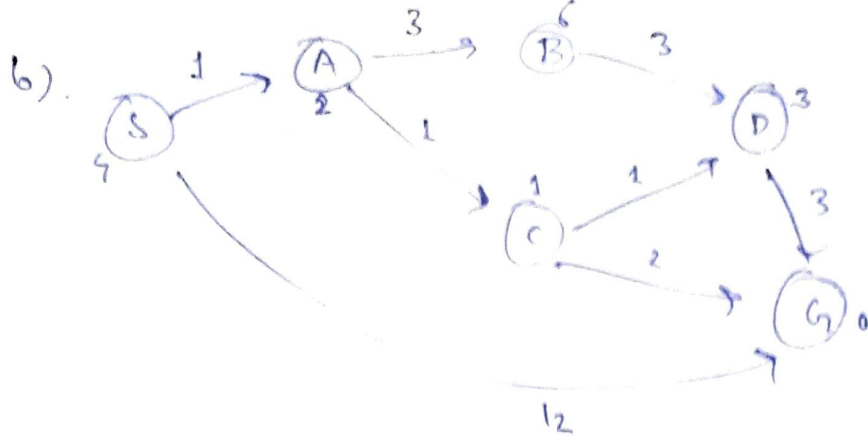
iteration	OPEN set.	CLOSE set
0	S (0 + 4)	—
1	A(1+2), G(12 + 0)	S (0 + 4)
2	G(12+0), B(4+6), C(2+1)	S (0+4), & A(1+2)
3	B(4+6), D(3+3), G(4+0)	S(0+4), A(1+2), C(2+1)
4	B(4+6), D (3+3)	S(0+4), A(1+2), C(2+1), G(4+0)

↓

goal
reached.

∴ path ⇒ {S →, A, C, G}

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