AI ASSIGNMENT # 02

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ANSWER NO. 1.

(i).

```
          +1   +1   +1
      A(1) B(6) C(5) D(7)      0   F
    + E(0) B(6) C(5) B(0)      1   A
    ------------------------
    A F(0) G(3) A(1) G(3)      2
                               3   G
                               4
                               5   C
                               6   B
                               7   D
                               8   E
                               9

          +1                   0   0
    , W(9) I(7) R(6) E(2)      1   M
    + M(1) O(0) R(6) E(2)      2   E
    ------------------------
    M O(0) N(8) E(2) Y(4)      3
                               4   Y
                               5
                               6
                               7
                               8   N
                               9
```

(ii).

ANSWER NO. II.

Q_1	x	x	x		Q_1	x	x	x
x	x			→	x	x	Q_2	x
x		x			x	x	x	x
x			x		x	x	x	x

Backtrack & replace Q_2

Q_1	x	x	x		Q_1	x	x	x
x	x	x	Q_2	→	x	x	x	Q_2
x		x	x		x	Q_3	x	x
x	x		x		x	x	x	x

Backtrack to Q_1

x	Q_1	x	x		x	Q_1	x	x
x	x	x		→	x	x	x	Q_2
	x	x	x			x	x	x
	x					x		x

x	Q_1	x	x		x	Q_1	x	x
x	x	x	Q_2	→	x	x	x	Q_2
Q_3	x	x	x			x	x	x
x	x		x			x		Q_4

ANSWER NO. 2.

a)

$f(x_1) = (6+5)+(4+1)+(3+5)-(3+2) = 9$

$f(x_2) = (8+7)-(1+2)+(6+6)-(0-1) = 23$

$f(x_3) = (2+3)-(9+2)+(1+2)-(8+5) = -16$

$f(x_4) = (4+1)-(8+5)+(2+0)-(9+4) = -19$

$\rightarrow x_2, x_1, x_3, x_4$

b) One point crossover on x_2 and x_1

$x_2 = 8712|6601 \Rightarrow O_1 = 87123532$

$x_1 = 6541|3532 \quad O_2 = 6541660$

Two point crossover on x_1 and x_3

$x_1 = 65|4135|32 \Rightarrow O_3 = 65921232$

$x_2 = 23|9212|85 \quad O_4 = 23413585$

Uniform crossover (random exchanges)

$x_2 = \underline{8}7\underline{1}2\underline{6}\underline{6}01 \Rightarrow O_5\ 27126201$

$x_3 = \underline{2}39\underline{2}\underline{1}\underline{2}85 \quad O_6\ 83921685$

c). New population:

$O_1 = 87123532$ $O_4 = 23413585$

$O_2 = 65416601$ $O_5 = 27126201$

$O_3 = 65921232$ $O_6 = 83921685$

Applying fitness function:

$f(O_1) = 15$ $f(O_4) = -3$

$f(O_2) = 17$ $f(O_5) = 13$

$f(O_3) = -2$ $f(O_6) = -6$

Overall fitness has improved.

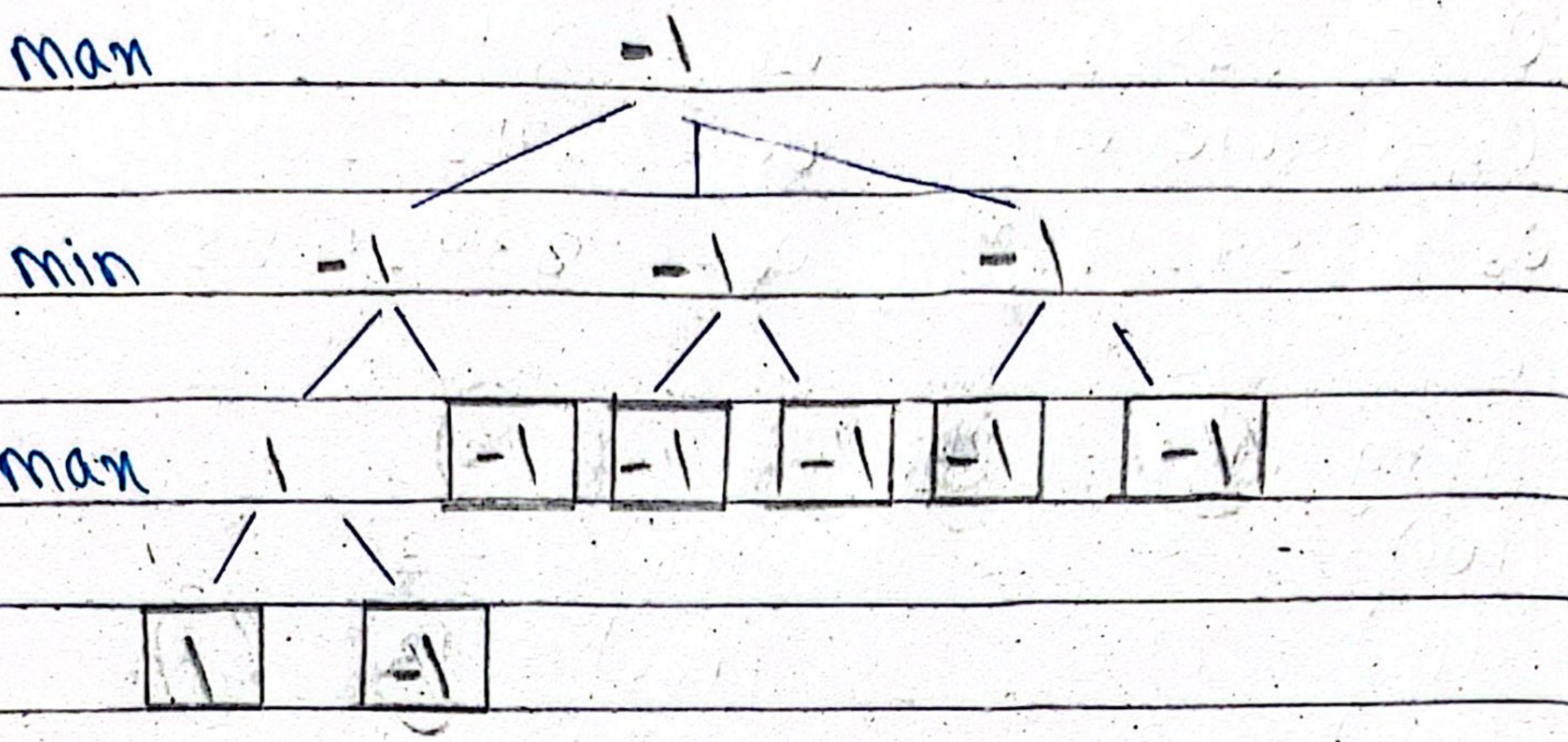
d).

No, the algorithm will never reach the optimal solution without mutation. The optimal solution is $x_{optimal} = 99009900$. If mutation does not occur, then the only way to change genes is by applying the crossover operator.

This means that the first gene in the chromosomes of children can only be either 6, 8, 2 or 4 (i.e. first genes of x_1, x_2, x_3 & x_4) and because none of the individual in the initial population begins with gene 9, the crossover operator alone will never be able to produce an offspring with gene 9 in the beginning.

ANSWER NO. 3.

(i). miniman solution



Player max will lose

(ii). miniman solution with alpha-beta pruning.