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Evolutionary Algorithm; Assignment no-3

Problems: Using GA find Maximum value of $f(x) = x^2 - 5x + 10$ over $\{0, 1, \dots, 15\}$. Consider population size 4, 1 one point crossover and 50% mutation.

Ans:

1. We have to generate initial population at random. They are chromosomes or Genotype -

(15) 01111, (14) 01110, (13) 01101, (12) 01100

2. Evaluate fitness:

Calculate fitness with $f(x) = x^2 - 5x + 10$;

3. Select parent based upon their fitness

$$P_i = \frac{F_i}{\sum_{j=1}^n F_j}$$

F_i = Fitness for string i in population

P_i = Probability of string i being selected.

n = Number of individuals.

$n \times P_i$ = Expected count

$$P_i = \frac{f(x_i)}{\text{sum}}$$

(P.T.O)

Selection table:

String no	Initial population	x value	Fitness $f(x) = x^2 \times 5x + 10$	Probability P_i	Expected count $n \times P_i$
1	01111	15	160	0.318	1.272
2	01110	14	136	0.2698	1.0792
3	01101	13	114	0.2262	0.9048
4	01100	12	94	0.1864	0.744
Sum			504		4
Avg			126		1
Max			160		1.272

$$P_1 = \frac{f(x_1)}{\text{Sum}} = \frac{160}{504} = 0.318$$

$$P_2 = \frac{f(x_2)}{\text{Sum}} = \frac{136}{504} = 0.269$$

$$P_3 = \frac{f(x_3)}{\text{Sum}} = \frac{114}{504} = 0.226$$

$$P_4 = \frac{f(x_4)}{\text{Sum}} = \frac{94}{504} = 0.186$$

4/ 1 point Crossover

String 1 = 01/111

String 2 = 01/110

offspring 1 = 01110

offspring 2 = 01111

(3)

Crossover table:

String No	Mating pool	Crossover point	Offspring after Crossover	x Value	Fitness $f(x) = x^2 - 5x + 10$
1	01/111	2	01110	14	136
2	01/110	2	01111	15	160
1	011/11	3	01101	13	114
3	011/01	3	01111	15	160
Sum	-	-	-	-	570
Avg	-	-	-	-	143
Max	-	-	-	-	160

Mutation 50% :-

String No	Offspring after x-over	Offspring after Mutation	x Value	Fitness $f(x) = x^2 - 5x + 10$
1	01110	01101	13	114
2	01111	01110	14	136
3	01111	01111	15	160
4	01100	01100	12	94
Sum	-	-	-	504
Avg	-	-	-	126
Max	-	-	-	160