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Subject = Evolutionary Algorithm (MCE-662)

Assignment NO-03.

Q Using GA find Maximum value of $f(x) = x^2 - 5x + 10$
Over $\{0, 1, \dots, 15\}$. Consider population size 4, 1-Point
Crossovers and 50% mutation.

Solution: 1. Generate initial population at random. They
are Chromosomes or Genotype:

01111 (15), 01100 (12), 01000 (8)

01110 (14)

2. Calculate fitness / Evaluate fitness:

a) Evaluate fitness, $f(x) = x^2 - 5x + 10$;

3. Select parents (n individuals) based on their fitness
is P_i :

$$P_i = F_i / \left(\sum_{j=1}^n F_j \right)$$

F_i = fitness for string i in population.

P_i = Prob of string i being selected.

n = no. of individuals.

$n \times P_i$ = expected count.

Selection

String No	Initial Population	x Value	Fitness $f(x) = 2^x - 5x + 10$	Prob i	Expected Count or Probability
1	01111	15	160	0.38	1.52
2	01100	12	94	0.22	0.88
3	01000	8	34	0.08	0.32
4	01110	14	136	0.32	1.28
Sum			424	1.00	4
Avg			106	0.25	1
Max			160	0.38	1.52

$$\begin{aligned}
 \text{Prob i} &= \frac{f(x_1)}{\text{Sum}} = \frac{160}{424} = 0.38 \\
 &= \frac{f(x_2)}{\text{Sum}} = \frac{94}{424} = 0.22 \\
 &= \frac{f(x_3)}{\text{Sum}} = \frac{34}{424} = 0.08 \\
 &= \frac{f(x_4)}{\text{Sum}} = \frac{136}{424} = 0.32
 \end{aligned}$$

4. Crossover: 1 point Crossover.

Chromosome 1 = 01111

Chromosome 2 = 01100

Offspring 1 = 01100

Offspring 2 = 01111

String No.	Mating Pool	Crossover Point	offspring after crossover	x value	Fitness $f(x) = x^2 - 5x + 10$
1	0 1 1 1 1	3	0 1 1 0 0	12	94
2	0 1 1 0 0	3	0 1 1 1 1	15	160
1	0 1 1 1 1	2	0 1 1 1 0	14	136
4	0 1 1 1 0	2	0 1 1 1 1	15	160
Sum					550
Avg					138
Max					160

5. Mutation: 50%

String No.	offspring after crossover	offspring after Mutation	x value	Fitness $f(x) = x^2 - 5x + 10$
1	0 1 1 0 0	0 1 1 1 0	14	136
2	0 1 1 1 1	0 1 1 1 1	15	160
3	0 1 1 1 0	0 1 1 1 1	15	160
4	0 1 1 1 1	0 1 1 1 1	15	160
Sum				616
Avg				154
Max				160