Consider the function of maximizing $f(x) = x^2$ (1)

where $x$ is Permitted to vary between 0 to 31

The minimum Value is 0 and maximum Value is 31.

Using a five-bit binary integer, numbers between 0 (00000) and 31 (11111) can be obtained..

The objective function here is $f(x) = x^2$, which is to be maximized.

Select Initial Population

To start with select initial population in random

Initial population of size 4 is chooseen, but any number of populations can be selected based on requirement.

~~How~~ ~~To~~ To select the solutions from these chromosomes.

we will calculate the probability

$$\text{Prob} = \frac{f(x)}{\Sigma f(x)}$$

$$\text{Expected Count} = \frac{f(x)}{\text{Avg}(\Sigma f(x))}$$

Chromosome with ~~the~~ actual count with '0' will not be selected for next generations.

| String No | Initial Population | X value | fitness $f(x) = x^2$ | Prob | % Prob | Expected count | Actual count |
|---|---|---|---|---|---|---|---|
| 1 | 01100 | 12 | 144 | $144/1155 = 0.1247$ | 12.47 | $144/288.75 = 0.4987$ | 1 |
| 2 | 11001 | 25 | 625 | 0.5411 | 54.11 | 2.1645 | 2 |
| 3 | 00101 | 5 | 25 | 0.0216 | 2.16 | 0.0866 | 0 |
| 4 | 10011 | 19 | 181 | 0.3126 | 31.26 | 1.2502 | 1 |
| Sum | | | 1155 | 1.0 | 100 | 4 | 4 |
| Avg | | | 288.75 | 0.25 | 25 | 1 | 1 |
| Max | | | 625 | 0.5411 | 54.11 | 2.1645 | 2 |

Based on actual count the first chromosome will be selected for once, 2 will be selected for 2 times and chromosome 4 will be selected for 1 time.

| String NO | Mating Pool | Crossover Point | Offspring after crossover | X value | Fitness $f(x)=x^2$ |
|---|---|---|---|---|---|
| 1 | 011 0\|0 | 4 | 01101 | 13 | 169 |
|  |  |  | 11000 | 24 | 576 |
| 2 | 11 00\|1 |  |  | 27 | 729 |
| 3 | 11\|001 | 2 | 11011 | 17 | 289 |
| 4 | 1\|0\|011 |  | 10001 |  |  |
| Sum |  |  |  |  | 1763 |
| Average |  |  |  |  | 440.75 |
| Maximum |  |  |  |  | 729 |

4) Mutation

| SNO | ~~Mutat~~ Offspring after crossover | ~~Mutation chromosome for flipping~~ | Offspring after mutation | X value | fitness $f(x)=x^2$ |
|---|---|---|---|---|---|
| 1 | 01101 | 11101 | 11101 | 29 | 841 |
| 2 | 11000 | 11000 | 11000 | 24 | 576 |
| 3 | 11011 | 11011 | 11011 | 27 | 729 |
| 4 | 10001 | 00001 | 10001 | 21 | 441 |
| Sum |  |  |  |  | 2587 |
| Avg |  |  |  |  | 646.75 |
| Maximum |  |  |  |  | 841 |

(w)

4) Mutation

| SNO | offspring after cross over: | offspring after Mutation | x value | |
|---|---|---|---|---|
| 1 | 01101 | 01001 | 9 | 81 |
| 2 | 11000 | 10100 | 28 | 784 |
| 3 | 11011 | 11111 | 31 | 961 |
| 4 | 10001 | 10101 | 21 | 441 |
| | | | | 2267 |

Avg $\frac{2267}{4} = 566.75$

Maximum 961 ✓

01001
10100
11111
10101

9
28
31
21

81
784
961
441
2267

Maximize the value of the function

$$f(x) = -x^2+2x.$$

over the range of real numbers from 0 to 2.

with initial population 11010, 00111, 10110, 00101

with random number 0.4, 0.15, 0.7, 0.9.

Select the crossover point between the first and fifth digits?

Select the Encoding Technique. min = 0, max = 2.

As a part of problem statement definition encoding technique is already given, 11010, 00111, 10110, 00101

The initial population is already given.

Convert the initial population in to a real number.

1) $11010 = 0 + \frac{(2-0)}{(2^5-1)} \times (26) = \frac{2}{30} \times 26 = 1.677$

2) $00111 = 0 + \frac{(2-0)}{(2^5-1)} \times 7 = \frac{2}{30} \times 7 = 0.451$

3) $10110 = 0 + \frac{(2-0)}{(2^5-1)} \times 22 = \frac{44}{31} = 1.419$

4) $00101 \rightarrow 0 + \frac{(2-0)}{(2^5-1)} \times 5 = \frac{10}{31} = 0.322$

| SNO | Initial Population | x value | Fitness $f(x) = -x^2+2x$ | Prob | Cumulative | Intervals RN |
|---|---|---|---|---|---|---|
| 1 | 11010 | 1.677 | 0.541 | 0.21 | 0.21 | 0 to 0.21 |
| 2 | 00111 | 0.451 | 0.699 | 0.27 | 0.48 | 0.22 - 0.48 |
| 3 | 10110 | 1.419 | 0.824 | 0.32 | 0.8 | 0.49 - 0.8 |
| 4 | 00101 | 0.322 | 0.541 | 0.2 | 1 | 0.81 - 1 |
| Sum | | | 2.6086 | | | |
| Avg | | | 0.6514 | | | |
| Maximum | | | 0.824 | | | |

| | | |
|---|---|---|
| 0.4 | 0.22 - 0.48 | 00111 |
| 0.15 | 0 - 0.21 | 11010 |
| 0.7 | 0.49 - 0.8 | 10110 |
| 0.9 | 0.81 - 1 | 00101 |

The first 2 pairs

$\cancel{0|0\,11|1}$ $\cancel{1|10\,1|0}$

0 0 1 1 1 $\rightarrow$ 0 | 0 1 1 | 1 = 0 1 0 1 1

1 1 0 1 0 $\rightarrow$ 1 | 1 0 1 | 0 = 1 0 1 1 0

Second pair

1 0 1 1 0 , 0 0 1 0 1

1|0 1 1|0 $\rightarrow$ 1 0 1 0 0

0|0 1 0|1 $\rightarrow$ 0 0 1 1 1

$0\,1011 = 0 + \frac{(2-0)}{30} \times 11 = 0.709$

$10\,110 = 0 + \frac{2}{30} \times 22 = 1.419$

$10\,100 = 0 + \frac{2}{30} \times 20 = \frac{40}{31} = 1.29$

$0\,0\,11\,1 = 0 + \frac{2}{30} \times 7 = 0.451$

| x value | $f(x) = -x^2 + 2x$ |
|---|---|
| 0.709 | 0.915 |
| 1.419 | 0.824 |
| 1.29 | 0.915 |
| 0.451 | 0.699 |

~~Avg~~ Sum 3.354

Avg 0.8387

max 0.915