



Artificial intelligence

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<https://youtu.be/udN28wPqaZI>

Genetic Algorithm

Maximize the
Function

$$f(x) = x^2$$

Solved
Example



#1

Genetic Algorithm Solved Example

- Consider the function of maximizing the function

$$f(x) = x^2$$

- where x is permitted to vary between 0 to 31

Genetic Algorithm Solved Example - Select Encoding Technique

- Select Encoding Technique
- 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.

Genetic Algorithm Solved Example – Select Initial Population

Select Initial Population

- To start with, select initial population are random.
- Here initial population of size 4 is chosen, but any number of populations can be selected based on the requirement and application.
- Table shows an initial population randomly selected.

Genetic Algorithm Solved Example – Calculate Fitness Value

“The initial binary or decimal values may be provided as fixed in the question.”

String No.	Initial Population (Randomly Selected)	X Value	Fitness $f(x) = x^2$	Prob	% Prob	Expected Count	Actual Count
1	01100	12	144				
2	11001	25	625				
3	00101	5	25				
4	10011	19	181				
Sum			1155				
Average			288.75				
Maximum			625				



Genetic Algorithm Solved Example – Calculate Fitness Value

This is also called the Fitness Ratio:

$$Prob = \frac{f(x)}{\sum f(x)}$$



Genetic Algorithm Solved Example – Calculate Fitness Value

String No.	Initial Population (Randomly Selected)	X Value	Fitness $f(x) = x^2$	Prob	% Prob 	Expected Count 	Actual Count
1	01100	12	144	0.1247	12.47		
2	11001	25	625	0.5411	54.11		
3	00101	5	25	0.0216	2.16		
4	10011	19	181	0.3126	31.26		
Sum			1155	1.0	100		
Average			288.75	0.25	25		
Maximum			625	0.5411	54.11		

Genetic Algorithm Solved Example – Calculate Fitness Value

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



Genetic Algorithm Solved Example – Calculate Fitness Value

String No.	Initial Population (Randomly Selected)	X Value	Fitness $f(x) = x^2$	Prob	% Prob	Expected Count	Actual Count
1	01100	12	144	0.1247	12.47	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
Average			288.75	0.25	25	1	1
Maximum			625	0.5411	54.11	2.1645	2

Genetic Algorithm Solved Example – Calculate Fitness Value

String No.	Initial Population (Randomly Selected)	X Value	Fitness $f(x) = x^2$	Prob	% Prob	Expected Count	Actual Count
1	01100 ✓	12	144	0.1247	12.47	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
Average			288.75	0.25	25	1	1
Maximum			625	0.5411	54.11	2.1645	2

Genetic Algorithm Solved Example – Crossover

String No.	Mating Pool	Crossover Point	Offspring after crossover	X Value	Fitness $f(x) = x^2$
1	01100	4	01101		
2	11001		11000		
3	11001	2	11011		
4	10011		10001		
Sum					
Average					
Maximum					

Genetic Algorithm Solved Example – Calculate Fitness Value

String No.	Mating Pool	Crossover Point	Offspring after crossover	X Value	Fitness $f(x) = x^2$
1	01100	4	01101	13	169
2	11001		11000	24	576
3	11001	2	11011	27	729
4	10011		10001	17	289
Sum					1763
Average					440.75
Maximum					729

Genetic Algorithm Solved Example – Calculate Fitness Value

String No.	Mating Pool	Crossover Point	Offspring after crossover	X Value	Fitness $f(x) = x^2$
1	01100	4	01101	13	169 ✓
2	11001		11000	24	576 ✓
3	11001	2	11011	27	729 ✓
4	10011		10001	17	289 ✓
Sum					<u>1763</u>
Average					440.75
Maximum					<u>729</u>

625

Genetic Algorithm Solved Example – Mutation

String No.	Offspring after crossover	Mutation Chromosome for flipping	Offspring after mutation	X Value	Fitness $f(x) = x^2$
1	01101	10000	11101	29	841
2	11000	00000	11000	24	576
3	11011	00000	11011	27	729
4	10001	00101	10100	20	400
Sum					2546
Average					636.5
Maximum					841

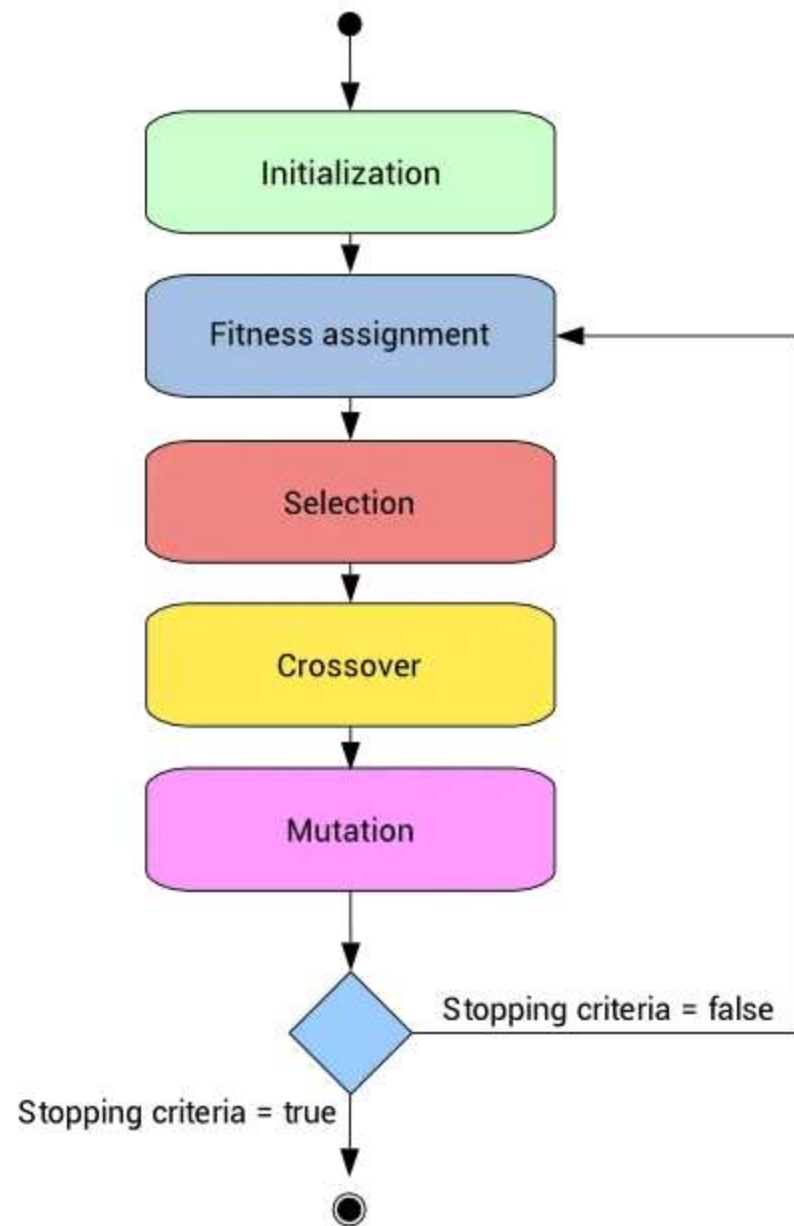
Genetic Algorithm Solved Example – Mutation

String No.	Offspring after crossover	Mutation Chromosome for flipping	Offspring after mutation	X Value	Fitness $f(x) = x^2$
1	01101	10000	11101	29	841 ✓
2	11000	00000	11000	24	576 ✓
3	11011	00000	11011	27	729 ✓
4	10001	00101	10100	20	400 ✓
Sum					2546
Average					636.5
Maximum					841

625

729

841



Flowchart for Genetic Algorithm

