

Contemporary Intelligent Information Technology (CIIT)***Function Minimization***

09/17/2018

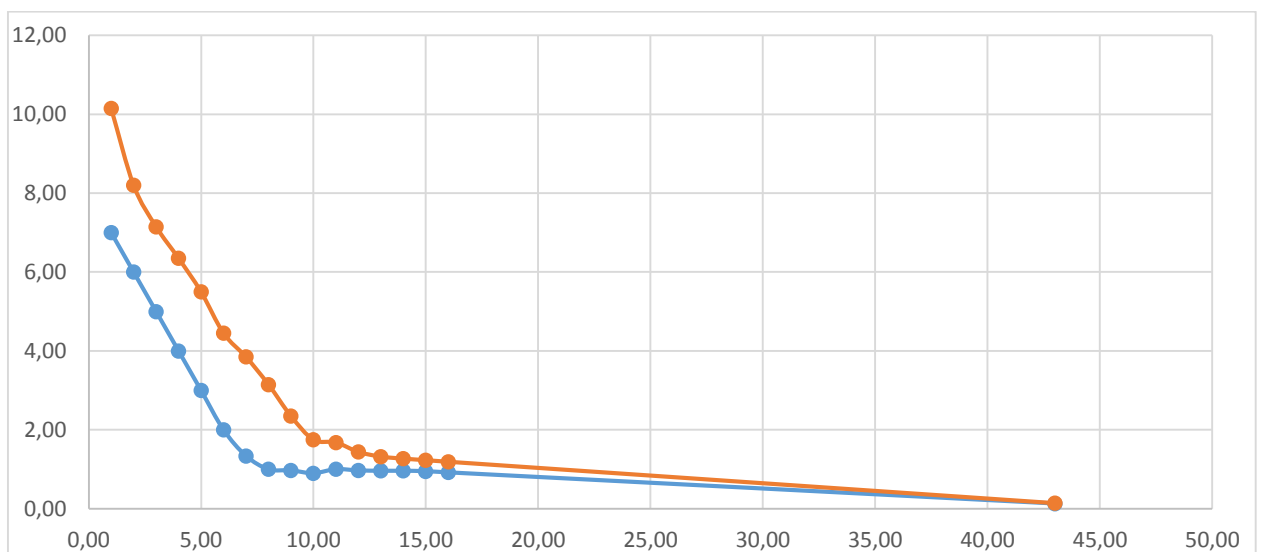
Task 1.

Minimize the function with 20 parameters ($x_1, x_2, \dots, x_{20}$) using two approaches:

$$y = (x_1)^2 + (x_2)^2 + (x_3)^2 + (x_4)^2 + \dots + (x_{20})^2 \quad [-1.1]$$

The 1st approach (GA without mutation):

Iteration number	The best fitness in generation	Average fitness
1,00	7,00	10,15
2,00	6,00	8,20
3,00	5,00	7,15
4,00	4,00	6,35
5,00	3,00	5,50
6,00	2,00	4,45
7,00	1,34	3,85
8,00	1,00	3,15
9,00	0,97	2,35
10,00	0,90	1,75
11,00	1,00	1,68
12,00	0,97	1,44
13,00	0,96	1,32
14,00	0,96	1,27
15,00	0,95	1,23
16,00	0,92	1,19
...	...	...
43,00	0,13	0,14



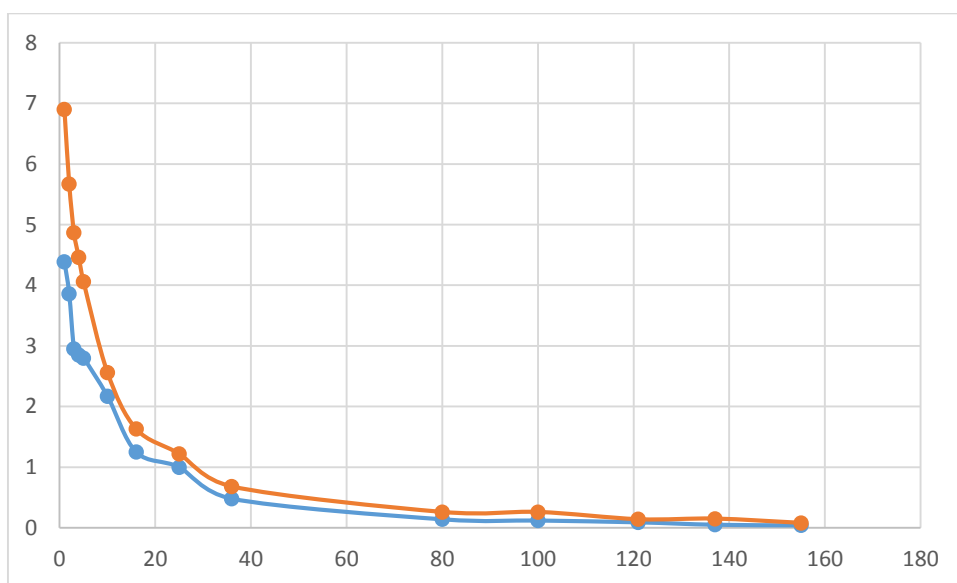
The **X** axis describes generation number, the **Y** axis describes fitness.

Blue line – the best fitness in generation

Orange line – average fitness

The 2nd approach (GA with mutation):

Iteration number	The best fitness in generation	Average fitness
1	4,39	6,9
2	3,86	5,67
3	2,95	4,87
4	2,85	4,46
5	2,8	4,06
...	...	...
10	2,17	2,56
...	...	...
16	1,25	1,63
...	...	...
25	1	1,22
...	...	...
36	0,48	0,68
...	...	...
80	0,14	0,26
...	...	...
100	0,12	0,26
...	...	...
121	0,09	0,14
...	...	...
137	0,05	0,15
...	...	...
155	0,04	0,08



The **X** axis describes generation number, the **Y** axis describes fitness.

Blue line – the best fitness in generation

Orange line – average fitness

The method with mutation gave more accurate result for fewer iteration number.

Task 2.

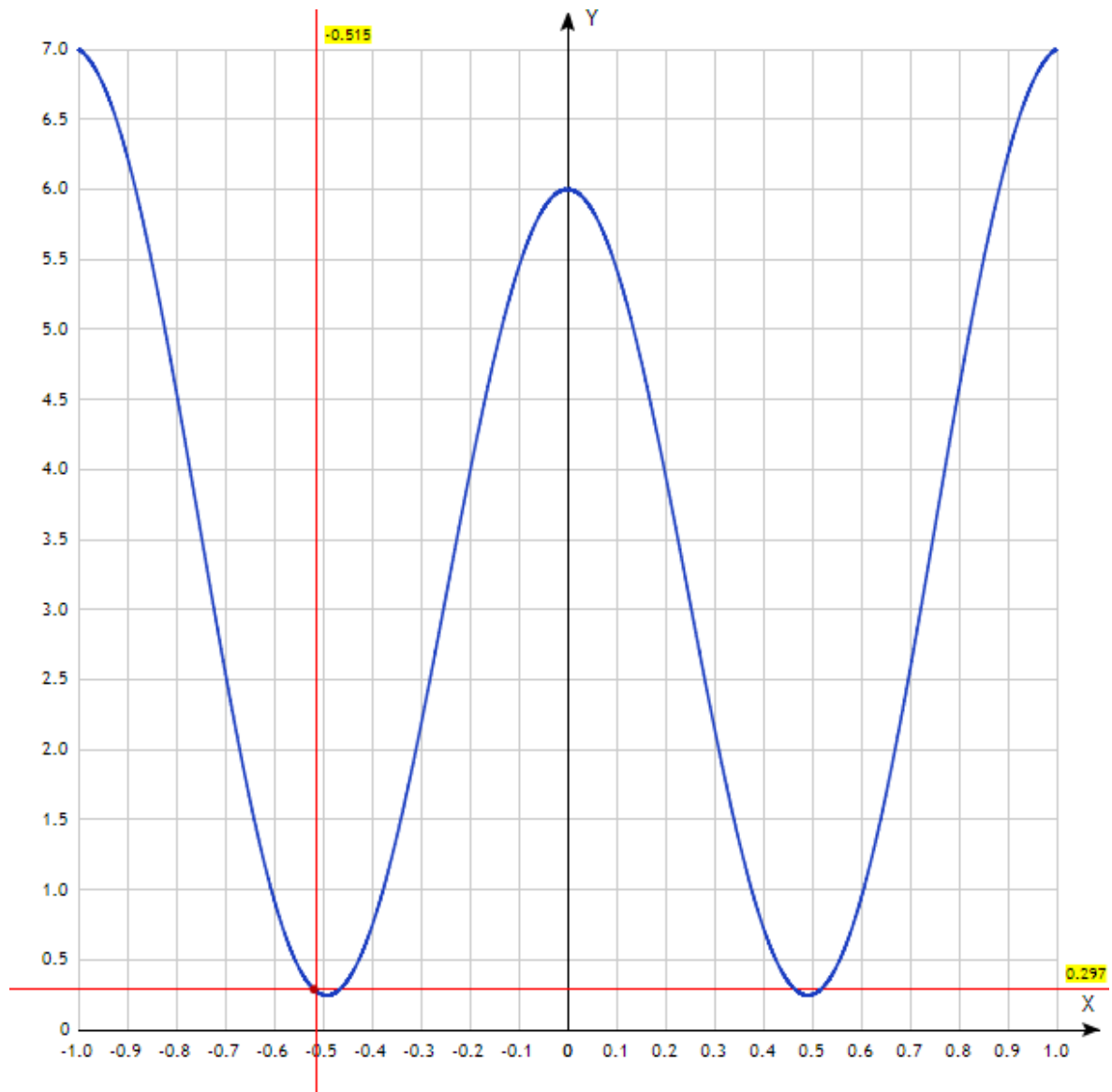
Minimize the 2D function using two approaches:

$$y = 3 + x^2 + 3 \cdot \cos(2 \cdot \pi \cdot x) \quad [-1, 1]$$

The 1st approach (GA without mutation):

Iteration number: 1

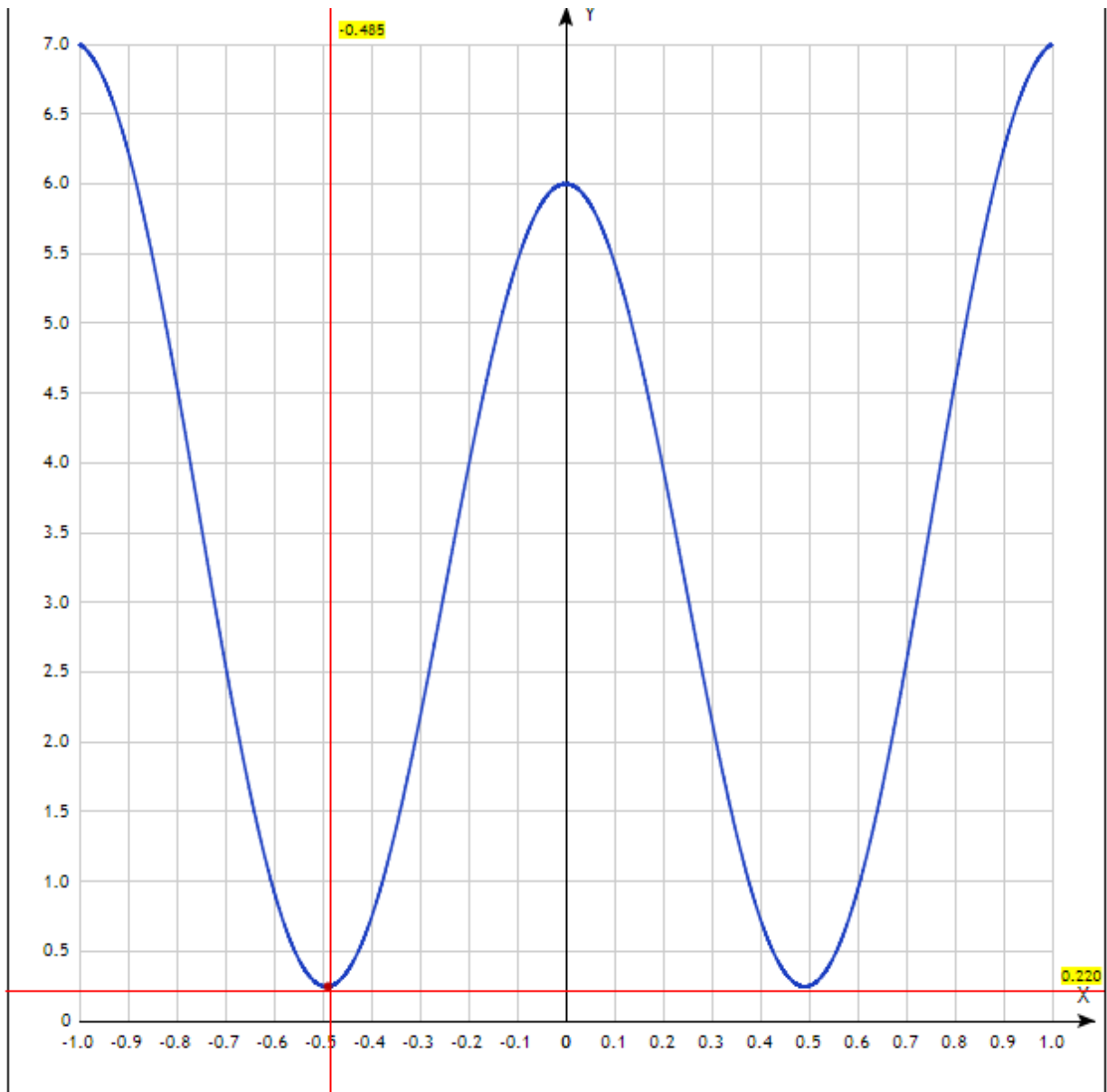
```
00001101010 Integer value is -0.5180840664711632; Fitness of gene: 0.287756418183994
00100101100 Integer value is -1.466275659824047; Fitness of gene: 2.217062735215999
00011111000 Integer value is -1.2121212121212122; Fitness of gene: 5.176514639402479
00111111011 Integer value is -2.4780058651026393; Fitness of gene: 6.169113559063012
00111101111 Integer value is -2.4193548387096775; Fitness of gene: 6.230237987154183
10010111010 Integer value is 0.9090909090909092; Fitness of gene: 6.350206879485279
10011000100 Integer value is 0.9579667644183774; Fitness of gene: 6.813681764152066
10110000100 Integer value is 1.8963831867057674; Fitness of gene: 8.982624498026665
10110111110 Integer value is 2.179863147605083; Fitness of gene: 9.031474842560348
10110010000 Integer value is 1.9550342130987293; Fitness of gene: 9.703219686695459
01011001101 Integer value is -3.5043988269794726; Fitness of gene: 12.28195690764506
01011100100 Integer value is -3.6168132942326494; Fitness of gene: 13.853754261116697
11100001001 Integer value is 3.7976539589442817; Fitness of gene: 18.30706992092464
01100001011 Integer value is -3.8074291300097753; Fitness of gene: 18.55569137669367
11110001000 Integer value is 4.418377321603128; Fitness of gene: 19.90800978509085
01110001100 Integer value is -4.437927663734115; Fitness of gene: 19.920488445919318
11100011001 Integer value is 3.875855327468231; Fitness of gene: 20.154944533868093
01100100100 Integer value is -3.929618768328446; Fitness of gene: 21.15331736698637
01101011001 Integer value is -4.188660801564027; Fitness of gene: 21.672684218451394
11100110101 Integer value is 4.012707722385142; Fitness of gene: 22.092265514690496
Average fitness of generation: 12.443103767066303
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Iteration number: 5

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00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
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00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
00001101000 Integer value is -0.5083088954056696; Fitness of gene: 0.26246525595330406
00001101010 Integer value is -0.5180840664711632; Fitness of gene: 0.287756418183994
00001101010 Integer value is -0.5180840664711632; Fitness of gene: 0.287756418183994
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00001101010 Integer value is -0.5180840664711632; Fitness of gene: 0.287756418183994
00001101100 Integer value is -0.5278592375366569; Fitness of gene: 0.32447913593718836
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00001101100 Integer value is -0.5278592375366569; Fitness of gene: 0.32447913593718836
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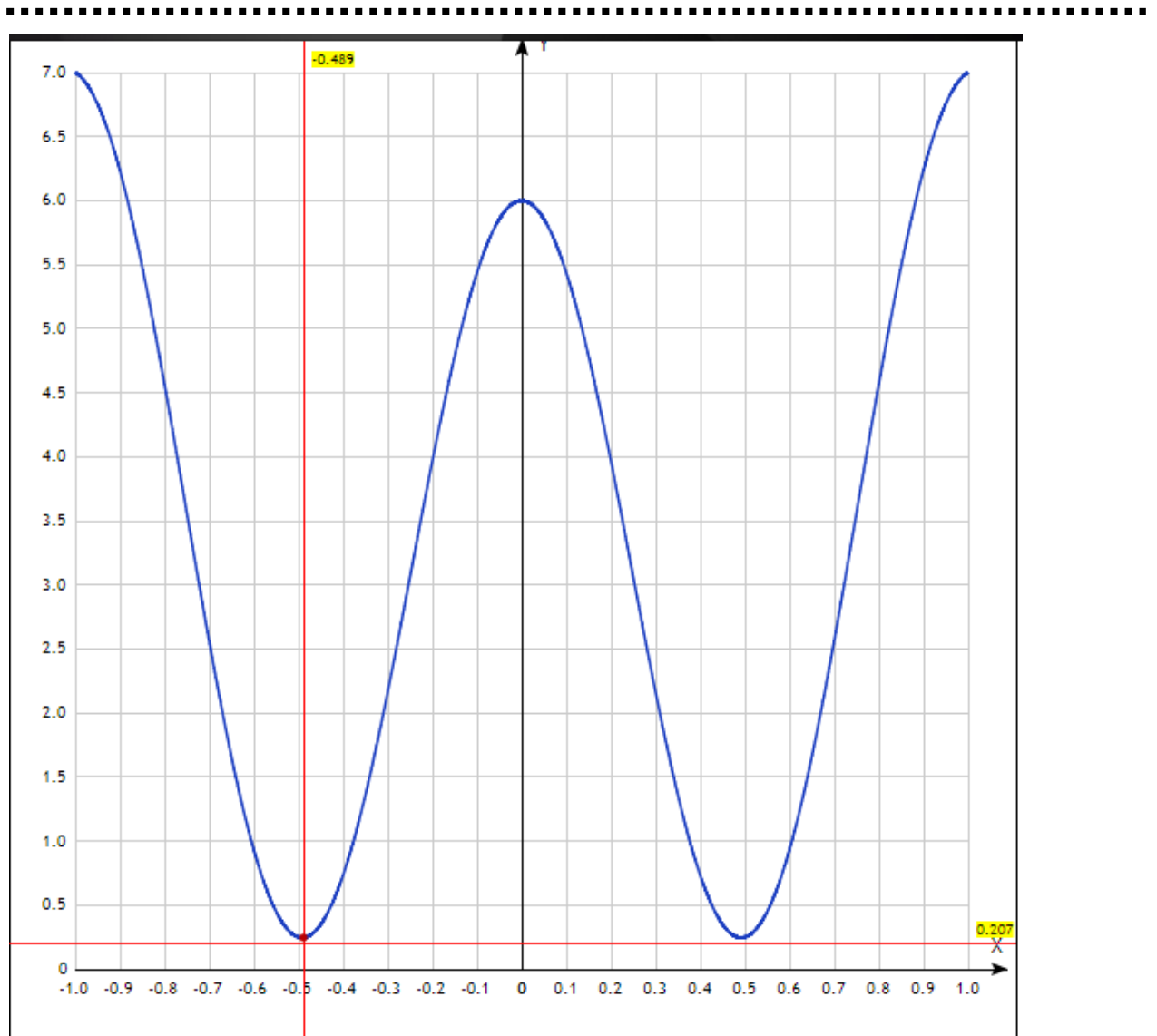
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00001101100 Integer value is -0.5278592375366569; Fitness of gene: 0.32447913593718836
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00001101100 Integer value is -0.5278592375366569; Fitness of gene: 0.32447913593718836
00001101110 Integer value is -0.5376344086021505; Fitness of gene: 0.3725334800390123
Average fitness of generation: 0.2911662844053324
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Iteration number: 13 (last)

[illegible]

00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
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00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
00001100100 Integer value is -0.4887585532746823; Fitness of gene: 0.24636515160567374
Average fitness of generation: 0.24636515160567374

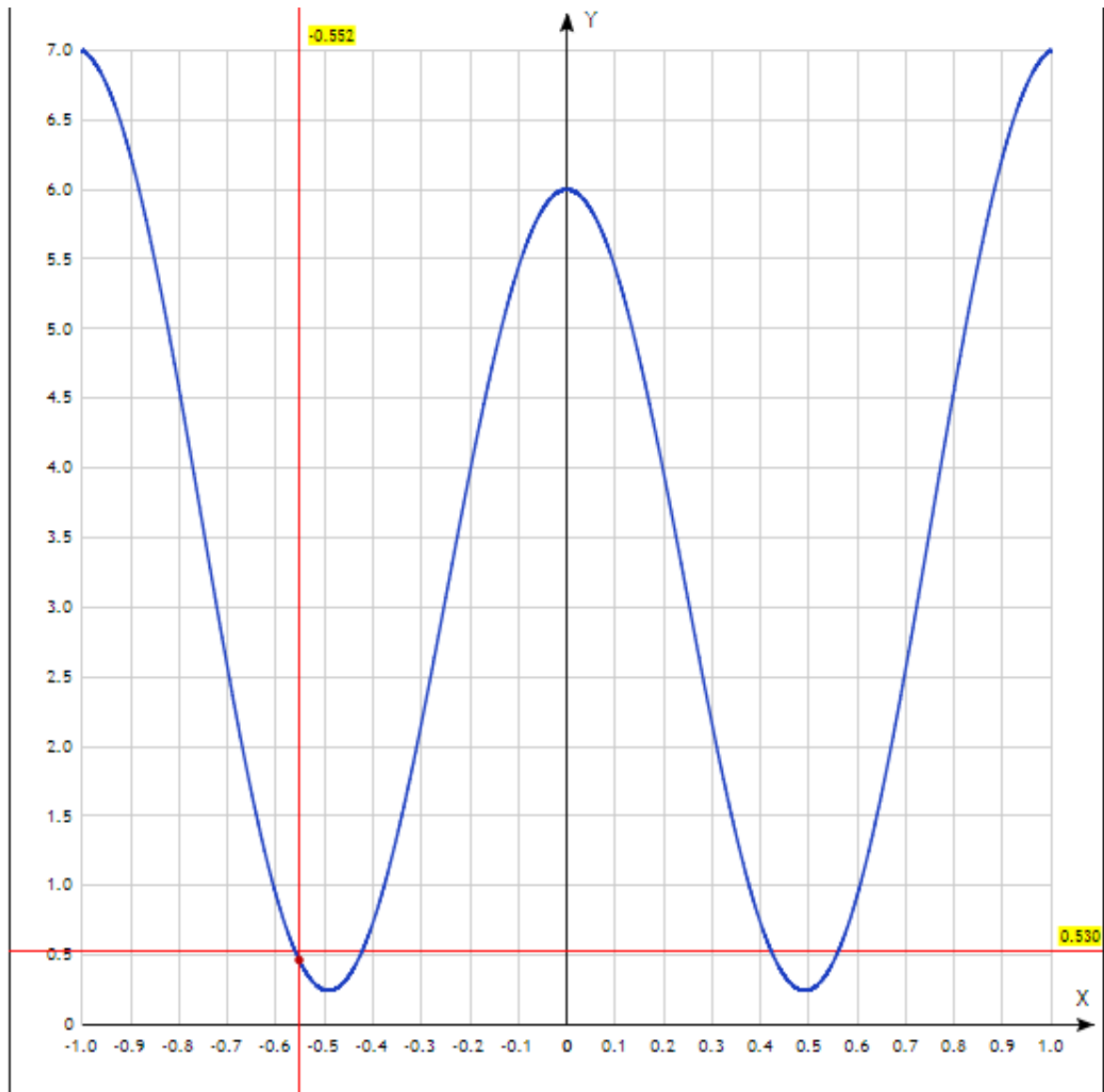


The 2nd approach (GA with mutation):

Iteration number: 1 (the first)

00001110001	Integer value is	-0.552297165200391;	Fitness of gene:	0.46553993918368564
10001010100	Integer value is	0.4105571847507331;	Fitness of gene:	0.6299613392804857
00001001100	Integer value is	-0.37145650048875856;	Fitness of gene:	1.064411501086001
00000111011	Integer value is	-0.2883675464320625;	Fitness of gene:	2.366929199473328
10000111001	Integer value is	0.2785923753665689;	Fitness of gene:	2.5415545392762984
10000000111	Integer value is	0.03421309872922776;	Fitness of gene:	5.932120685438607
10011011100	Integer value is	1.075268817204301;	Fitness of gene:	6.826918381676992
00011010001	Integer value is	-1.021505376344086;	Fitness of gene:	7.016127838374588
00110000111	Integer value is	-1.911045943304008;	Fitness of gene:	9.195589728167958
01010111101	Integer value is	-3.4261974584555226;	Fitness of gene:	12.055637931865709
11010011011	Integer value is	3.2600195503421308;	Fitness of gene:	13.438988123360515
01010011010	Integer value is	-3.255131964809384;	Fitness of gene:	13.499165613132993
11001100011	Integer value is	2.986314760508309;	Fitness of gene:	14.906992061233245
01110001100	Integer value is	-4.437927663734115;	Fitness of gene:	19.920488445919318
01101100010	Integer value is	-4.232649071358749;	Fitness of gene:	21.241727990923575
01100101011	Integer value is	-3.9638318670576735;	Fitness of gene:	21.63483129151666
11100110111	Integer value is	4.022482893450635;	Fitness of gene:	22.150485017819626
01101000101	Integer value is	-4.090909090909091;	Fitness of gene:	22.25929778857619
11110111110	Integer value is	4.682306940371456;	Fitness of gene:	23.68613944015874
1111010000	Integer value is	4.7702834799608995;	Fitness of gene:	26.13690491715221

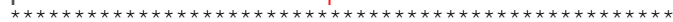
Average fitness of generation: 12.348490588680836



Iteration number: 11

00001100101	Integer value is	-0.49364613880742914;	Fitness of gene:	0.24607690033657148
00001100100	Integer value is	-0.4887585532746823;	Fitness of gene:	0.24636515160567374

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000001100101 Integer value is 0.40364613880742014; Fitness of gene: 0.24607600033657148
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10001100101 Integer value is 0.49364613880742914; Fitness of gene: 0.24607690033657148
10001100101 Integer value is 0.49364613880742914; Fitness of gene: 0.24607690033657148
10001100101 Integer value is 0.49364613880742914; Fitness of gene: 0.24607690033657148
10001100101 Integer value is 0.49364613880742914; Fitness of gene: 0.24607690033657148
10001100101 Integer value is 0.49364613880742914; Fitness of gene: 0.24607690033657148
10001100100 Integer value is 0.4887585532746823; Fitness of gene: 0.24636515160567374
Average fitness of generation: 0.24609131290002667

