Exercise # 7

Consider the Ackley function defined as

f (x, y) = −20e^(−0.2 √0.5(x2+y2)) − e^(0.5[cos(2πx)+cos(2πy)]) + e + 20

where the global optimum point is f (0, 0) = 0. Use particle swarm optimization algorithm to find the global minimizer of f with w = 1, c_1 = 1.47, c_2 = 1.62 and maximum iteration of 500.

1. **Give the graph of the particles after N − 500 together with the graph of the *f(gbest)* as iteration goes to 500.**

   Using Python, we produced the following graphs below

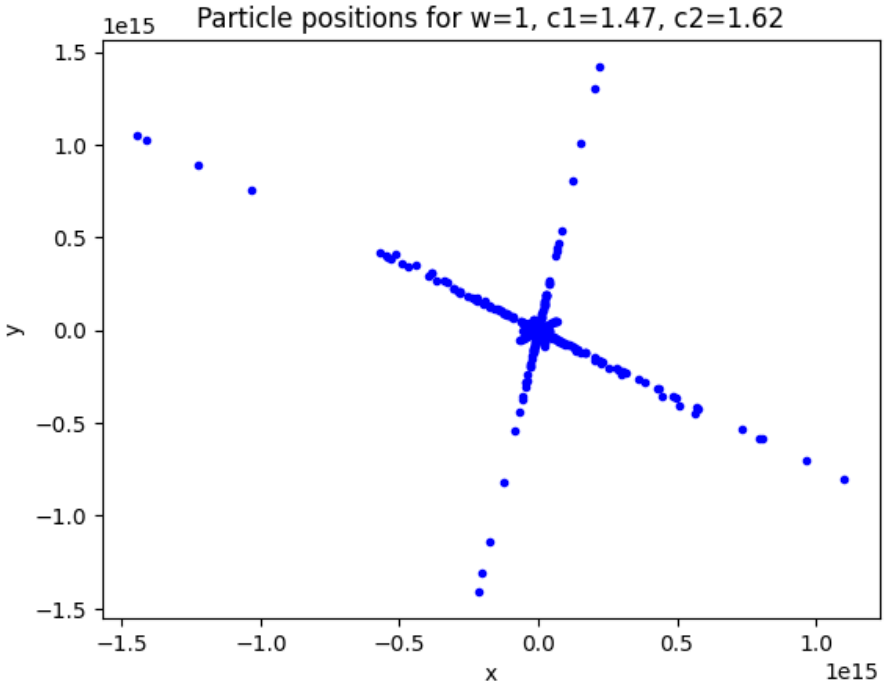

Figure 1. Graph of the particles

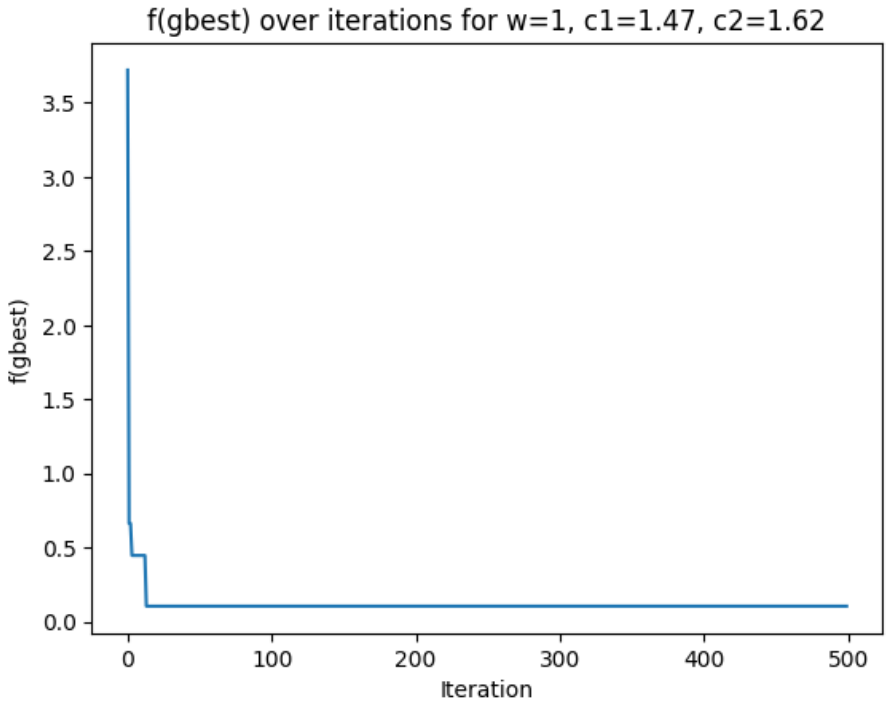

Figure 2. The trend of *f(gbest)* up to 500 iterations.

2. **Specify another two set of values for w, c_1, and c_2. What happens to the particles and the *f(gbest)* as the iteration goes? What are the noticeable changes that you have noticed?**

Experimenting with different values of w, c_1, c_2 values we set w_values = [1, 0.5, 1.5], c1_values = [1.47, 1.5, 1.8], c2_values = [1.62, 1.3, 1.9] in the Python code. We let the code pick among these values and we got the two graphs for the particles with the values w = 0.5, c_1 = 1.5, c_2 = 1.3, and w = 1.5, c_1 = 1.8, c_2 = 1.9. Their graphs are shown below.

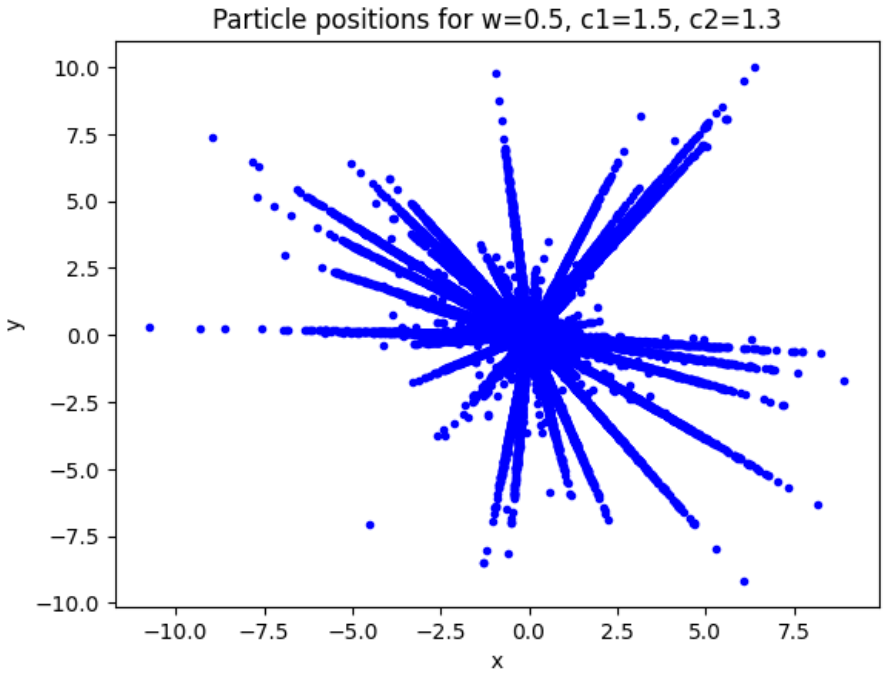

Figure 3. Graph of the particles with values w = 0.5, c_1 = 1.5, c_2 = 1.3.

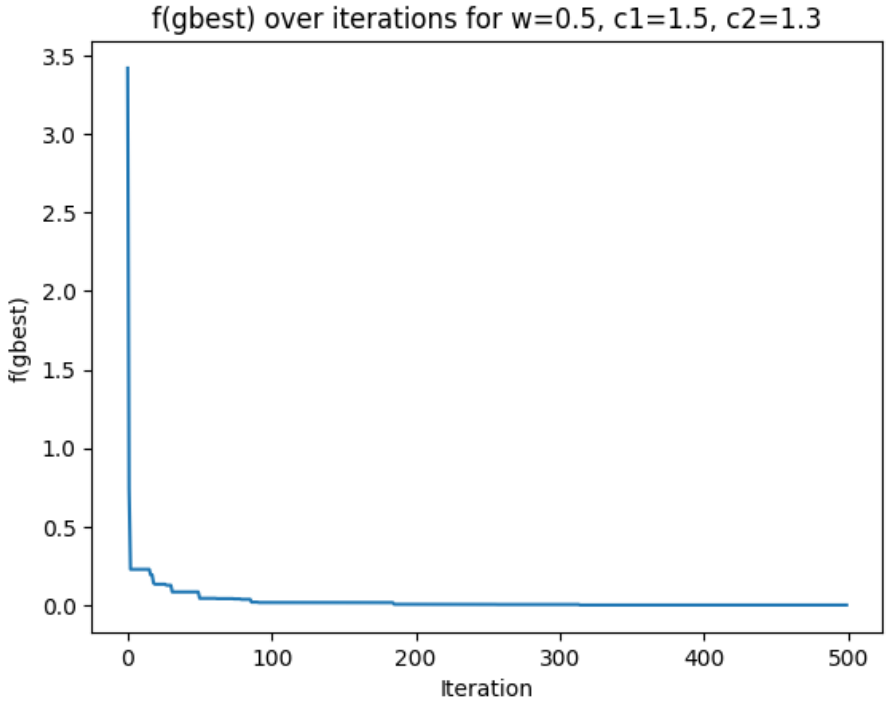

Figure 4. The trend of *f(gbest)* up to 500 iterations with values w = 0.5, c_1 = 1.5, c_2 = 1.3.

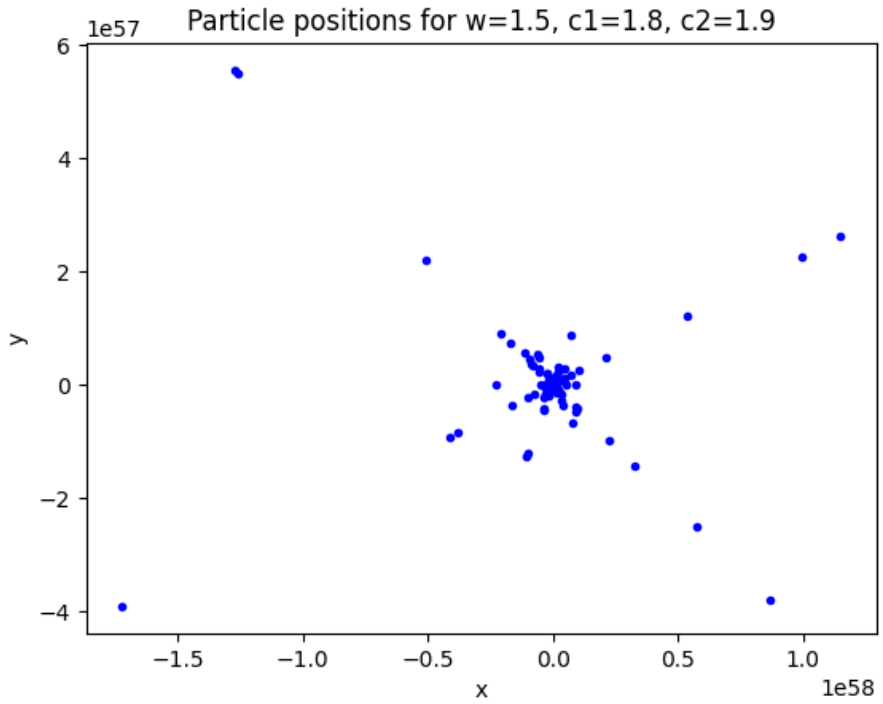

Figure 5. Graph of the particles with values w = 1.5, c_1 = 1.8, c_2 = 1.9.

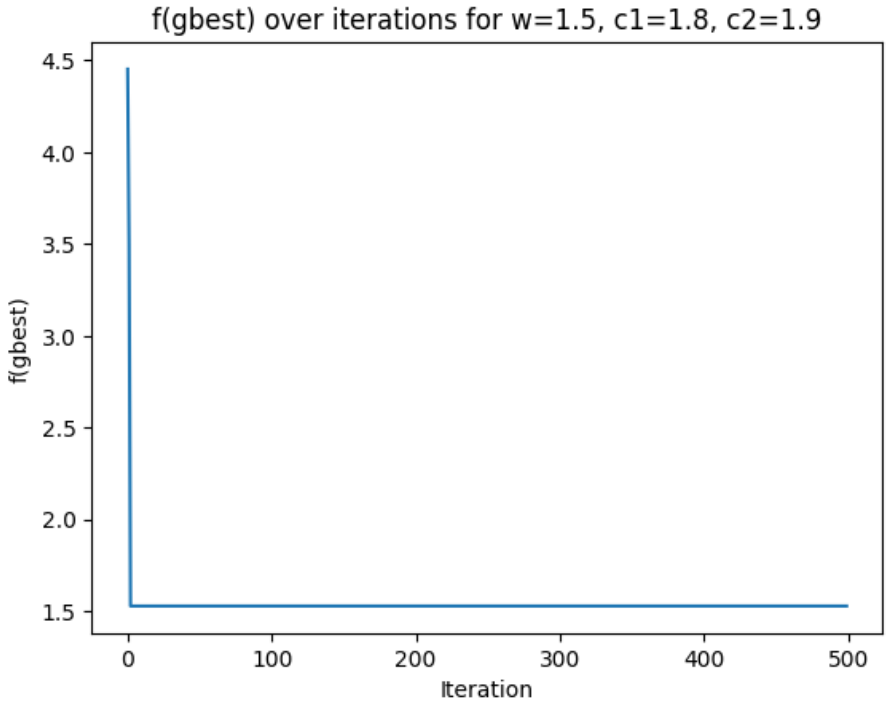

Figure 6. The trend of *f(gbest)* up to 500 iterations with values w = 1.5, c_1 = 1.8, c_2 = 1.9.

We can see above that the particles converge to the point (0,0) at the center of figures 3 and 5 and the f(gbest) is approaching the value 0 at figures 4 and 6. From the

graphs, the noticeable changes are when the c_2 is higher the particles converge faster to the global optimum point. Also, when w is low, the movement of the particles is slower.