Homework 2 – Computational Intelligence – Particle Swarm Optimization

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- Assigned Optimization Problem:

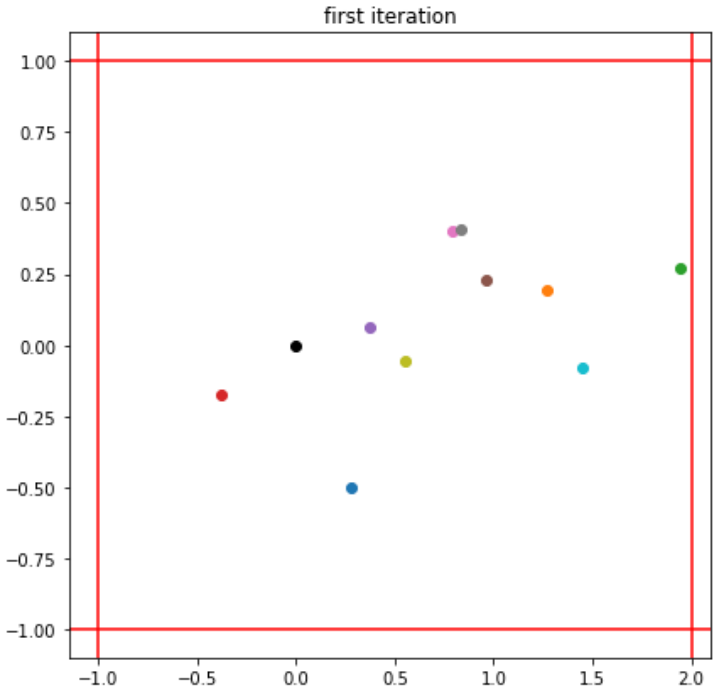
Problem 4

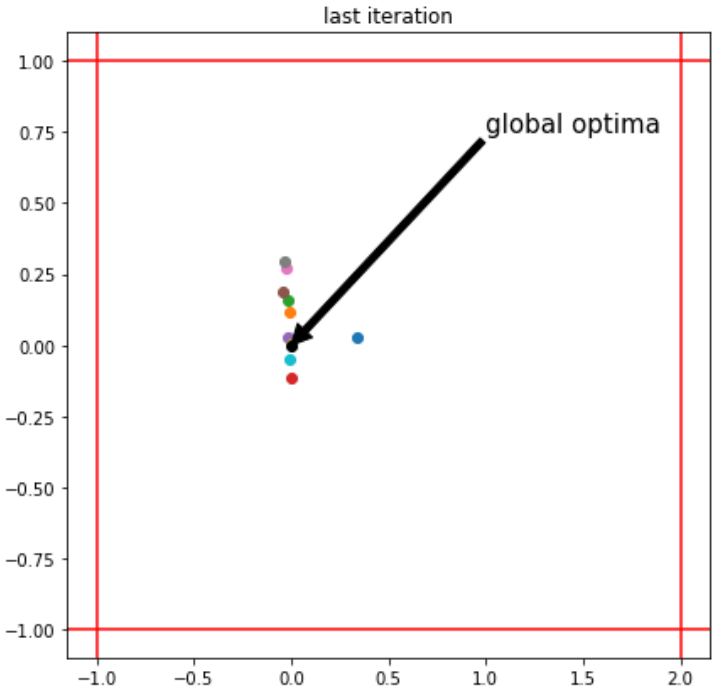
Maximize $f(x,y) = 8 - \frac{\sin^2(\sqrt{(x^2+y^2)})}{(1+0.001*(x^2-y^2))^8}$ $-1 \leqq x \leqq 2;\ -1 \leqq y \leqq 1;\ x+y \geqq -1$

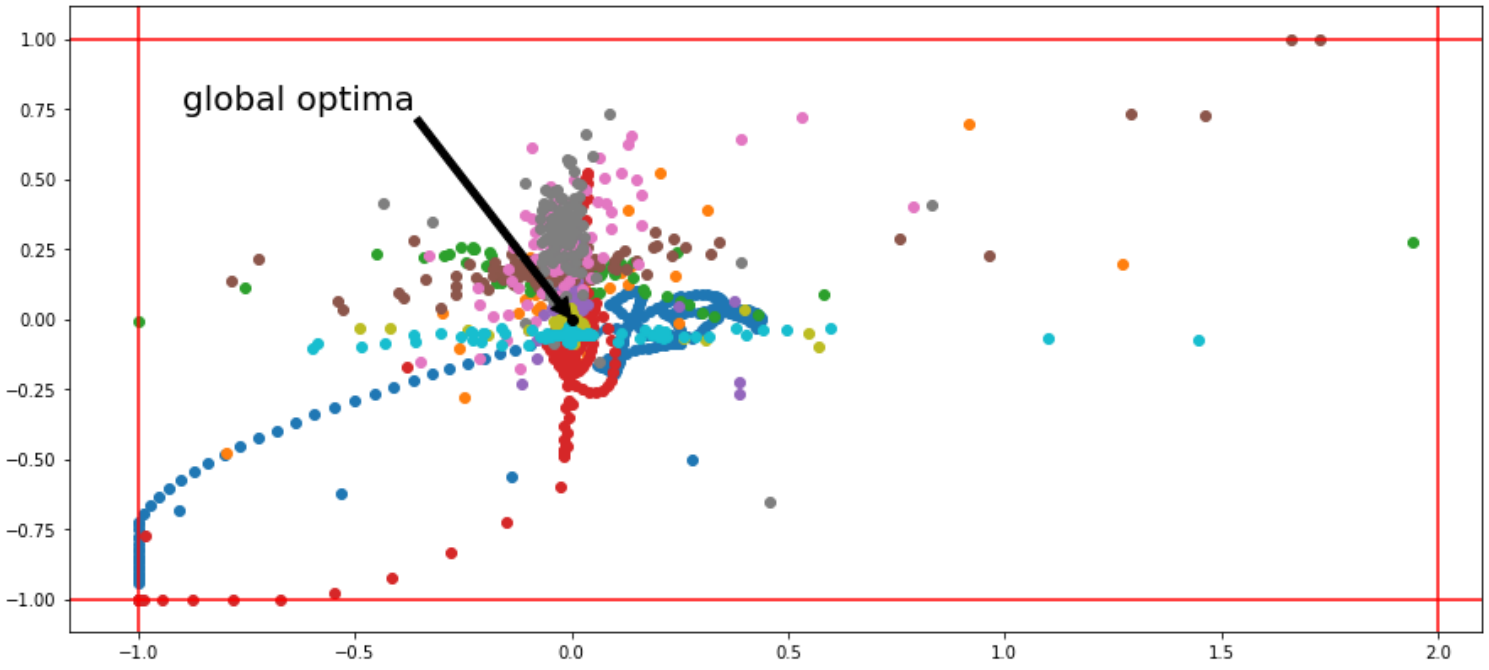
Maximum=8 at (x,y)=(0,0)

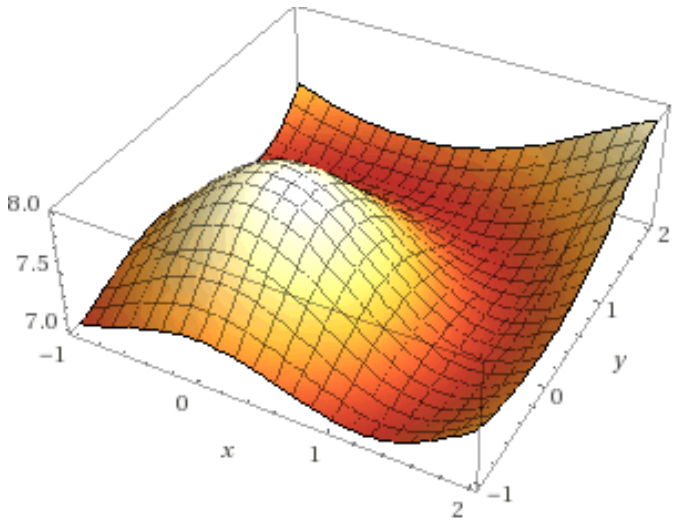
- With the precision of 10^{-3}
- X is around range (-1, 2) and Y around range (-1, 1). This time, I use **200 iterations, with 10 population**. The number can be easily changed as I use it as a global variable.
- There are several parameters that I use. The first one is the inertia weight (w). **Inertia weight that I use are different** each iteration where the **weight will be lessen each iteration** passed so the flock can reach global optima without moving too much nearing end iteration.
- The second one is r1 and r2, this two-random number is distributed around the range 0 and 1. The **random value of r1 and r2 I use have the same value** each individual.
- The third parameter is c1 and c2. c1 and c2 as a parameter act as an individual psychological behavior factor, where bigger c1 result in bigger cognitive confidence (where the individual is sure that he is the most right one between the flock), and c2 acting as the social factor where bigger c2 will result in the individual always following his/her flock movement. Imitating human psychology where each individual social and cognitive behavior is different, I decided to make **c1 and c2 random** for each individual
- Constraint that I use on the velocity is the **Damping Limit**, with value Vmax = 0.5. More than the value Vmax will result in the dampening which limit the speed to 0.5. This Vmax value can be easily changed from the code as I use it as global variable.
- Boundary Violation Handling that I use is **Boundary Adhering**. When the individual location update exceeds the range x (-1,2) or y (-1,1), the individual will adhere to the boundary wall.
- I introduce the flock to the **craziness** parameter too for maintaining diversity, avoiding the flock to be stuck in the local optima. **Craziness rate I use is very small, only 0.05** because the boundary of this particular problem is too small for the individual to go crazy too often.
- The fittest gen that I get from the PSO code is 7.999, with its XY coordinate at (-0.002, 0.005). It is pretty much the same as answer that the problem seeks (XY coordinate (0,0) with value f(x) = 8)

8	-0.002132	0.005481	-0.003670	0.060927	0.614	0.614	0.928	1.510	7.999965	7.999998	7.999998









(3D Plot created from Wolfram Alpha Graph Plotter)