SCT Experiment No: 7

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Dept: FY M Tech DSA(2022-24)

Aim:

Demonstrate particle swarm optimization technique.

Introduction:

Particle Swarm Optimization was proposed by Kennedy and Eberhart in 1995. As mentioned in the original paper, sociobiologists believe a school of fish or a flock of birds that moves in a group "can profit from the experience of all other members". In other words, while a bird flying and searching randomly for food, for instance, all birds in the flock can share their discovery and help the entire flock get the best hunt.

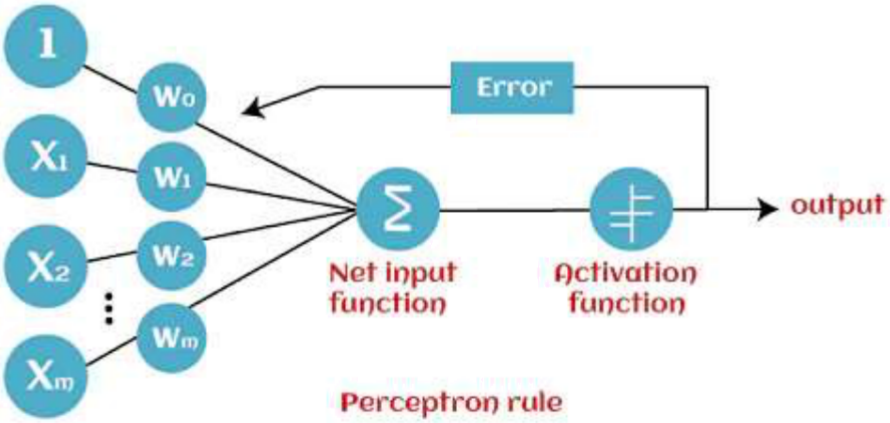
Example:

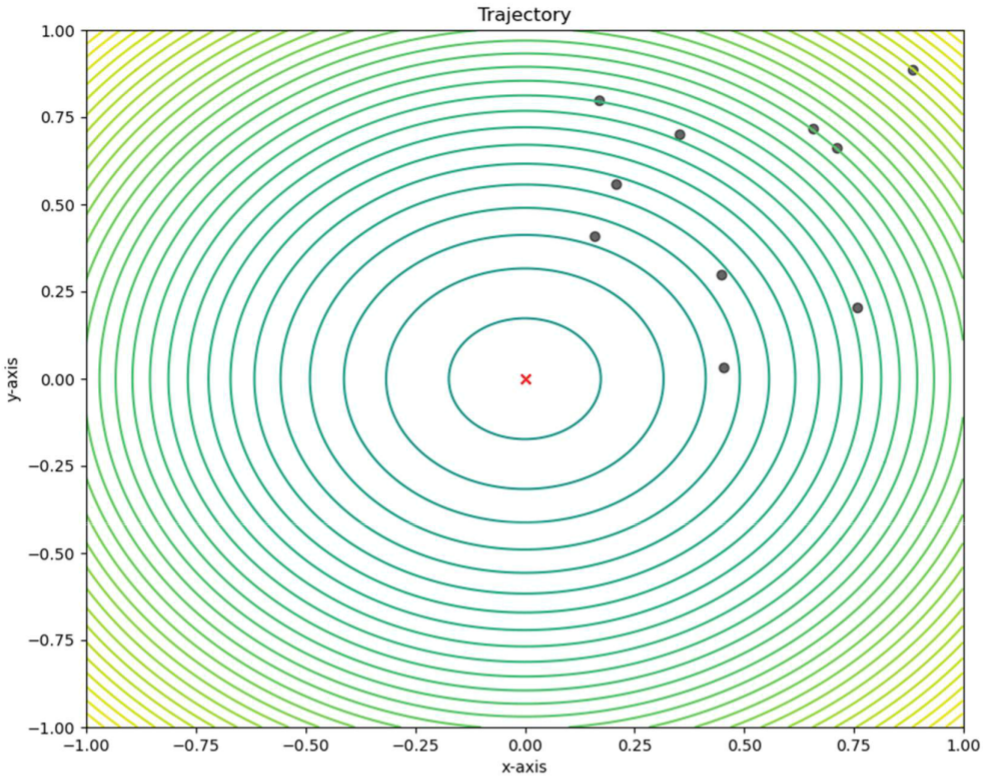
Suppose there is a swarm (a group of birds). Now, all the birds are hungry and are searching for food. These hungry birds can be correlated with the tasks in a computation system which are hungry for resources. Now, in the locality of these birds, there is only one food particle. This food particle can be correlated with a resource. As we know, tasks are many, resources are limited. So this has become a similar condition as in a certain computation environment. Now, the birds don't know where the food particle is hidden or located. In such a scenario, how the algorithm to find the food particle should be designed. If every bird will try to find the food on its own, it may cause havoc and may consume a large amount of time. Thus on careful observation of this swarm, it was realized that though the birds don't know where the food particle is located, they do know their distance from it. Thus the best approach to finding that food particle is to follow the birds which are nearest to the food particle. This behavior of birds is simulated in the computation environment and the algorithm so designed is termed as Particle Swarm Optimization Algorithm.

Example problem and solution using Genetic Algorithms:

Given a target string, the goal is to produce target string starting from a random string of the same length. In the following implementation, following analogies are made –

Characters A-Z, a-z, 0-9, and other special symbols are considered as genes
A string generated by these characters is considered as chromosome/solution/Individual


1
Wo
X1
W1
X2
W2
Xm
Wm
Error
output
Net input function
Activation function
Perceptron rule

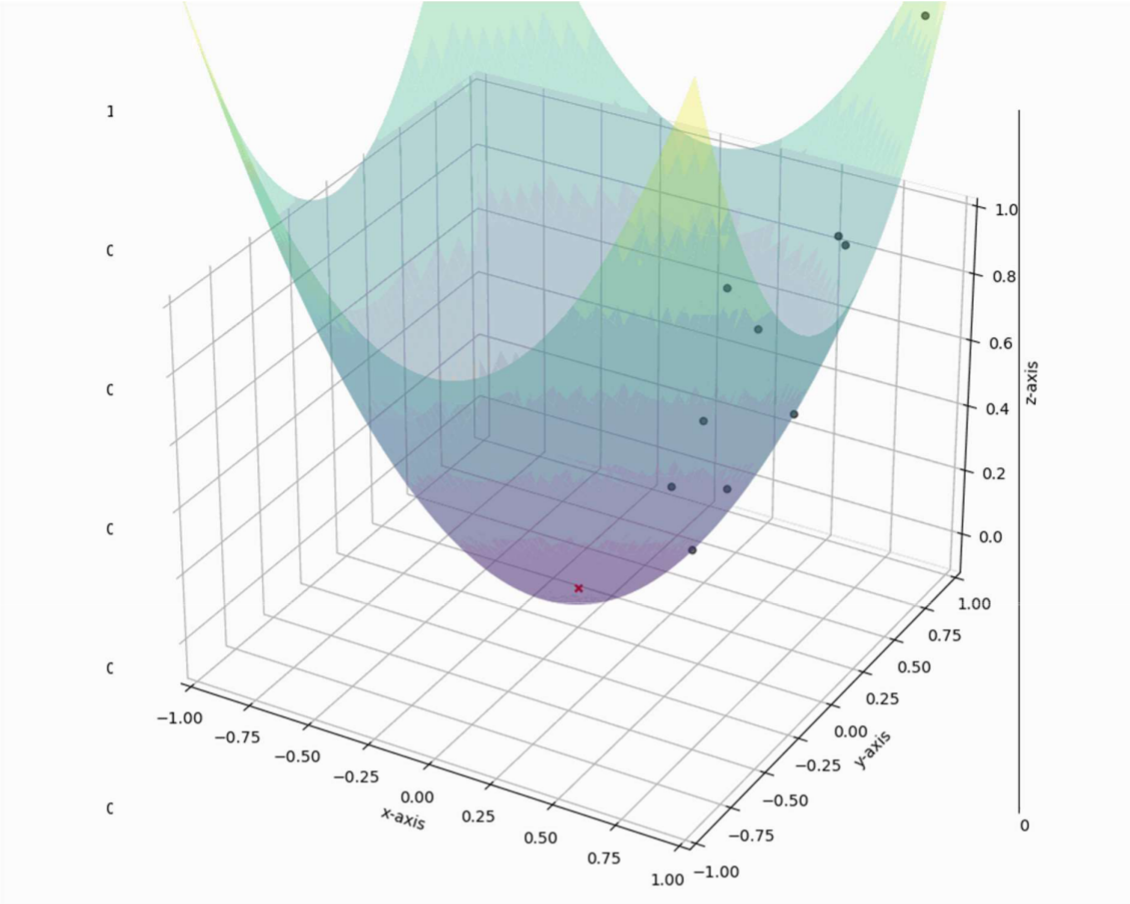


In [9]:

```
# preprocessing
pos_history_3d = m.compute_history_3d(optimizer.pos_history)
# adjust the figure
d  = Designer(limits=[(-1,1), (-1,1), (-0.1,1)], label=['x-axis', 'y-axis', 'z-axis'])

# Make animation
animation3d = plot_surface(pos_history=pos_history_3d, mesher=m, designer= d,
mark=(0,0,0)) # Mark minima
animation3d.save('myTraj.gif', writer='PillowWriter')
```

```
2022-12-06 21:55:55,660 - matplotlib.animation - WARNING - MovieWriter Pil
lowWriter unavailable; using Pillow instead.
2022-12-06 21:55:55,660 - matplotlib.animation - INFO - Animation.save usi ng
<class 'matplotlib.animation.PillowWriter'>
```



Conclusion:

Particle Swarm Optimization (PSO) is a global optimization algorithm and probabilistic in nature since it contains random processes. The swarm concept was originally studied to graphically simulate the graceful and unpredictable choreography of a bird flock.

Reference:

https://towardsdatascience.com/complete-step-by-step-particle-swarm-optimization-algorithm-from-scratch-74471d064f91
https://www.geeksforgeeks.org/introduction-to-particle-swarm-optimizationpso/
https://analyticsindiamag.com/a-tutorial-on-particle-swarm-optimization-in-python/