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**Particle Swarm Optimization(PSO).**

**Project Description:**

* This project will look in to following:
* What is PSO?
* Where did it come from (inspiration)?
* What are its applications in computational world?
* How does this algorithm works/ functions?
* Why computer and data scientists prefer such algorithms (efficiency)?
* Particle Swarm Optimization (PSO):
  + A technique in artificial intelligence (swarm intelligence) to solve a numerical optimization problem.
  + Basically, goal is to minimize error terms (difference between actual answer and predicted answer).
  + Based on metaheuristic ( a higher level procedure used to find optimal solution for any optimization problem with imperfect data or limited computation capacity)
  + A population based stochastic (something randomly determined)algorithm.
  + Initial example is of predicting score of a football team using a math equation.
* Inspiration of PSO:
  + From social foraging behaviors of animals like birds’ flocking, schooling of fishes etc.
  + Hence, it is also classified as swarm intelligence algorithm like bacterial foraging algorithm, ant colony algorithm etc.
  + Each animal (specie) in swarm is considered as particle having its own spped and movement.
* Function :
  + PSO works on collection of particles.
  + Iteratively, values for position and velocity for each particle are updated.
  + Velocity for each particle is calculated using an equation and then updated.
  + Position of each particle is updated with respect to neighbor’s position.
  + With increasing number of iterations values reach to closer to optimal solution.
  + Much like a group of birds in search of food gets closer to actual location of food with increasing iterations and finally reach to it.
  + Stimulates swarms’ behaviors for optimization, iteratively.
  + It is aimed to update swarm’s best position.
* Data Structures

**Project Outcome:**

* Its efficiency (Why project scientists are preferring such algorithms)
* What we can find from its code?
* Applications of it in computational field

1. Heart Disease Prediction System: Heart disease diagnosing is difficult and important task in order to get patients exact condition with respect to other diseases linked to the heart (chest pains, heart attacks). Earlier, using the traditional method/technique to predict such diseases, were inefficient and inaccurate. Binary PSO divides the working of the system in two parts i.e. prediction model and performance model. The accuracy and efficiency of BPSO is proved to be better than the early traditional methods.
2. PSO-BP Prediction Model of amount of Coliform in food and drinking water: Coliform is a type of bacteria which is usually not harmful but some such as strains of E.Coli can cause illness. To predict the amount of coliform in food and drinking water, PSO-BP neural network model is used because of its accuracy and robustness.
3. Analysis of basketball free throw using PSO algorithm: PSO algorithm can be used to track the ball. While this research was carried out, it showed that there is a significant relation between the height and the shape of a free throw trajectory. This method can also be used in the training process as a tool to improve the performance of the free throw.
4. Micro strip antenna using Neural Networks optimized by PSO: the use of micro strip antennas has increased drastically overtime due to its features like small dimensions and low cost of production. Designing such antennas isn’t an easy thing to do as it requires accuracy of calculations. The known models (e.g. cavity model) gives less accurate results and are time consuming. This problem can be satisfied using neural network models which are optimized by PSO which consumes less time and are more accurate.

**Libraries/Resources to be used:**

**Python library.**

<https://nathanrooy.github.io/posts/2016-08-17/simple-particle-swarm-optimization-with-python/> (will use arrow dig)

<https://jamesmccaffrey.wordpress.com/2015/06/09/particle-swarm-optimization-using-python/>

<https://www.ijert.org/research/heart-disease-prediction-system-using-binary-particle-swarm-optimization-algorithm-IJERTV5IS080032.pdf>

<http://www.moldbacteriafacts.com/what-are-bacteria/what-is-coliform/>

<https://www.sciencedirect.com/science/article/pii/S1319562X19301160>

<https://ieeexplore.ieee.org/document/6684759>