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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)?
* How does this algorithm works/ functions?
* Analyze its complexity and efficiency.
* What are its applications in computational world?
* 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 speed 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:
  + In this project we will provide a Python implementation of the Particle Swarm Optimization Algorithm using list and dictionary data structure for storing and iterating the values in the variable.

**Project Outcomes:**

* Why PSO is preferred most amongst other optimization algorithms?
  + PSO has been widely used in continuous optimization problems because of its speed, accuracy and better performance amongst other algorithms. Through this project we will also analyze the efficiency of PSO algorithm which will justify the robustness of this algorithm.
  + PSO algorithm is able to solve complex optimization problems especially in science and engineering field. Due to its wide ranging applications, hybrid PSO algorithms are being widely introduced to improve its performance and output more accurate optimal solutions.
* Applications of PSO:

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.

**Libraries/Resources to be used:**

<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.intechopen.com/books/particle-swarm-optimization-with-applications/introductory-chapter-swarm-intelligence-and-particle-swarm-optimization>