**Group Members:**

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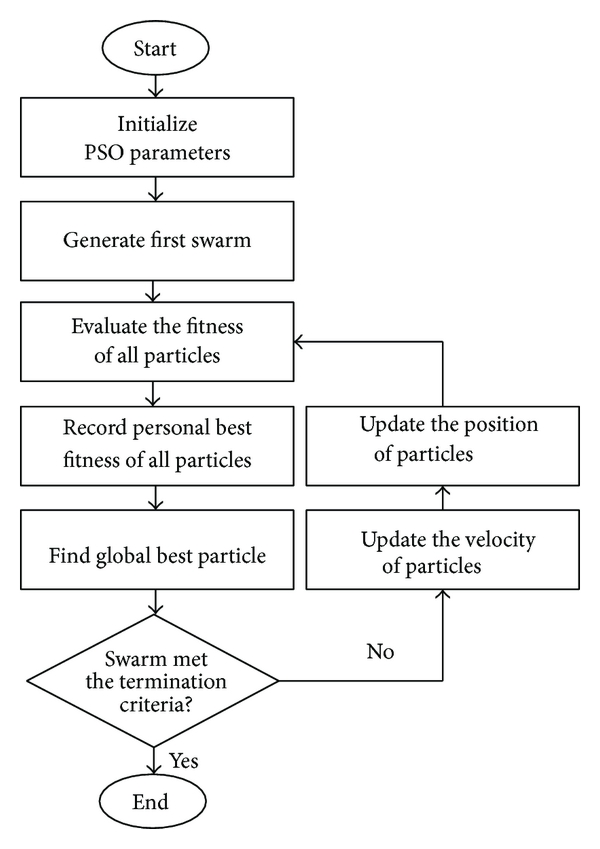
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**Particle Swarm Optimization (PSO)**

**Project Description:**

* This project will look in to following:
* What is PSO?
* Where did it come from (inspiration)?
* What are its applications?
* How does this algorithm works/ functions?
* Analyze the complexity and efficiency of PSO algorithm.
* 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 Python implementation of PSO algorithm using list and dictionary data structures for storing and iterating values.
* Flowchart of standard PSO:



**Project Outcomes:**

* PSO has been widely used in continuous optimization problems because of its speed, accuracy and better performance amongst other optimization algorithms. Also, PSO algorithm is able to solve complex optimization problems using swarm intelligence that is why many of the problems related to science and engineering discipline have been solved using PSO algorithm. In addition, its simple implementation makes it one of the best optimization algorithms.
* Collectively, this project will include:
  + Implementation of basic PSO in python using list data structure.
  + Theoretical analysis and time complexity of PSO
  + Experimental analysis of PSO
  + Validation and performance of PSO using different input values for PSO parameters. Alongside we would also discuss the limitations to make variations in input values.
  + Comparison between theoretical and experimental analysis of PSO.

**Libraries/Resources to be used:**

<https://nathanrooy.github.io/posts/2016-08-17/simple-particle-swarm-optimization-with-python/>

<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>

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

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

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

<https://www.hindawi.com/journals/tswj/2014/973093/fig1/>