A comparative study of Nature inspired algorithm's for optimization problems.

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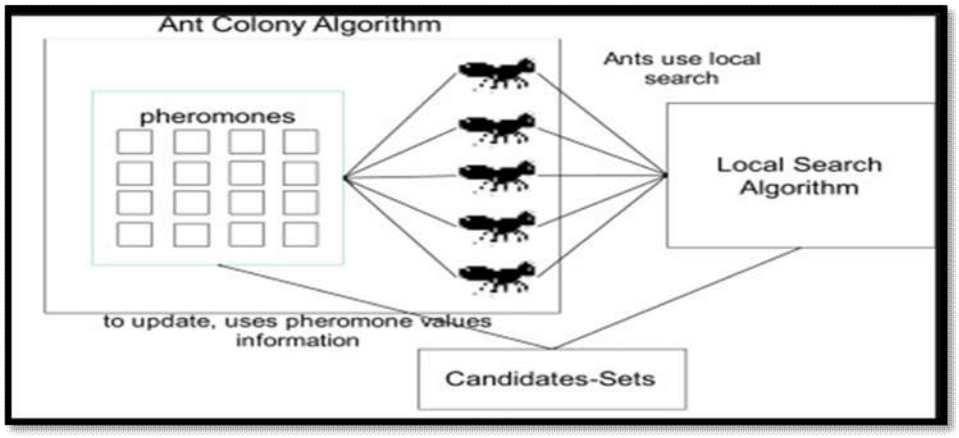
Abstract: This paper studies various nature inspired algorithms to extend an effort towards finding the solution for optimization problems. The algorithms included *are* Ant colony optimization, particle swarm optimization, Genetic algorithm w.r.t travelling salesman problem.An elaborate comparative analysis is carried out to endow these algorithms with fitness sharing, aiming to investigate whether this improves performance which can be implemented in the evolutionary algorithms.PSO is well-known to solve the continuous problems, yet by proper modification, it can also be applied to discrete problems, such as the classical test model: traveling salesman problem (TSP).

Keywords: *Nature inspired algorithm, Ant colony optimization, particle swarm optimization, Genetic algorithm, efficiency parameters.*

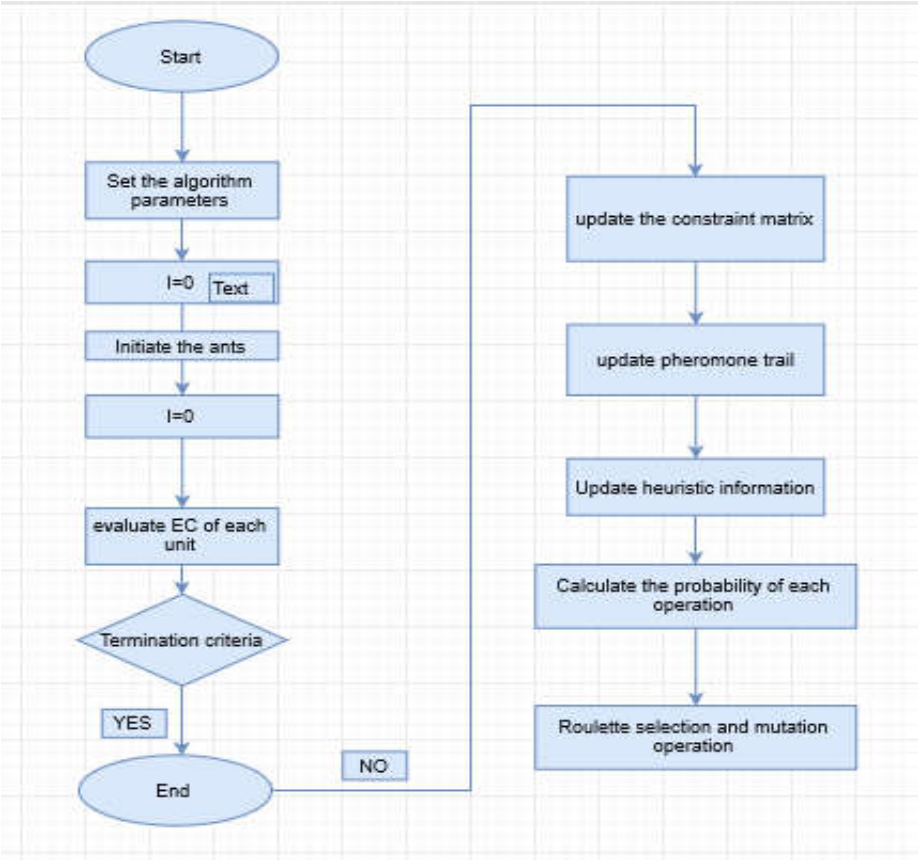
1.1 ANT COLONY OPTIMIZATION:

In mathematical and computer science terms, an optimization problem is the problem of finding the *best* possible solution from all sets of feasible solutions. Optimization problems can be divided into many categories depending on whether the variables are continuous or discrete,they can be constrained or unconstrained, etc. Optimization is an important tool in decision making and in analysing physical process systems. Optimization problems are of high importance both for the industrial world as well as for the scientific world. Such techniques can be used for practical optimization problems including train scheduling problem, timetable allocation, shape optimization hitch, telecommunication network diagrams, and problems from computational bio Technology. The research community has simplified many of these problems in order to obtain optimal solutions for well-known traveling salesman problem (TSP).Various nature inspired algorithms are used as a solution to the above mentioned problem statements. There are multitudinalranges in algorithm can under this category such as Genetic Algorithm (GA), Ant Colony Optimization Algorithm (ACO), Intelligent Water Drops algorithm, Firefly Algorithm (FA),Cuttlefish Algorithm, etc.



The Ant colony optimization is a probabilistic algorithm to solve computational problems by dividing it into smaller modules to achieve optimal paths through graph analysis. The goal was to find optimal path in the graph and was named as Ant structures system, based on the behaviour and working of ants seeking a shortest path

between their nest to the food. The Ant colony is used to produce optimal shortest round-trip to link a series of nodes through edges. This procedure is inspired by ants to find shortest path from nest to food based on their pheromone value. Edge selection: An ant is a simple computational agentin the ant colony optimization algorithm. It iteratively constructs a solution for the problem to produce solution states. At each iteration of the algorithm, each ant moves from a state Ato state B corresponding to a more complete intermediate optimal solution. Thus, each ant n computes a set of feasible set of expansions to its current state in each iteration, moves to one of these in probability.The ACO differs from the classical ant system in the sense that here the pheromone trails are updated in two ways. Firstly, when ants construct a tour they locally change the amount of pheromone on the visited edges by a local updating role. Secondly, after all the ants have built their individual tours, a global updating rule is applied to modify the pheromone level on the edges that belong to the best ant tour found so far.



Advantages of the Ant Colony Optimization

1.Inherent parallelism
2.Positive Feedback accounts for rapid discovery of good solutions
3. Efficient for Traveling Salesman Problem and similar problems
4.Can be used in dynamic applications (adapts to changes such as new distances, etc)

1.2 Particle Swarm Optimization:

The algorithm named Particle swarm optimization (PSO) is a populace put together stochastic improvement system demonstrated with respect to the social practices saw in creatures or creepy crawlies,

e.g., winged animal running, angle tutoring, and creature crowding.

In PSO, singular particles of a swarm speak to potential arrangements, which travel through the issue look space looking for an ideal, or on the other hand adequate, arrangement. The particles communicate their present positions to neighboring particles. The situation of every particle is balanced by its speed (i.e., rate of progress)

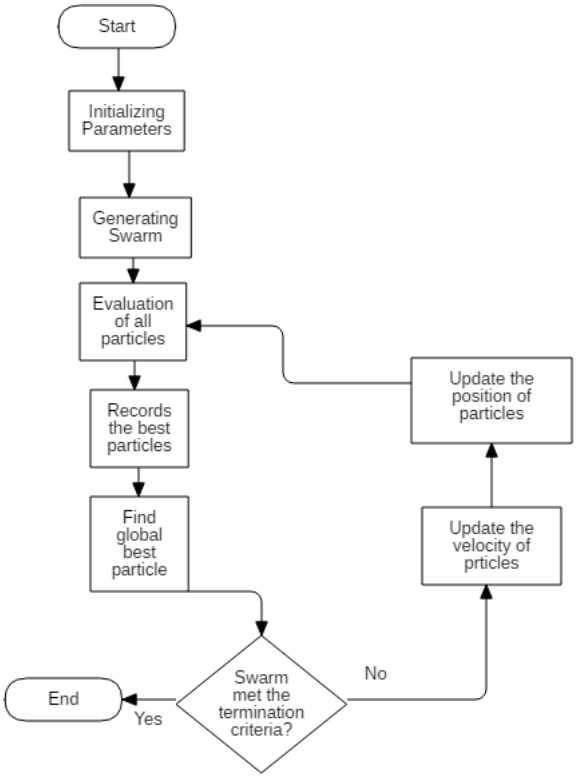
and the contrast between its present position, individually the best position found by its neighbors, and the best position it. Every particles monitors its directions in the issue space which are related with the best arrangement (wellness) it has accomplished up until now. (The wellness esteem is likewise put away.) This esteem is called pbest. Another "best" esteem that is followed by the particle swarm analyzer is the best esteem, acquired so far by any particle in the neighbors of the particle. This area is called lbest. at the point when a particle accepts all the populace as its topological neighbors, the best esteem is a worldwide best and is called gbest.

The particle swarm optimization idea comprises of, at each time step, changing the speed of (quickening) every particle toward its pbest and lbest areas (neighborhood adaptation of PSO). Increasing speed is weighted by an irregular term, with isolated arbitrary numbers being created for quickening toward pbest and lbest areas.

1.2.1 Pseudo Code:

```
Population <-0
pg_best<-0
For (i=0 To psize)
p_velocity<-  RandomVelocity()
p_position<-  RandomPosition()
pp_best<-p_position
   If (Cost(pp_best)<= Cost(pg_best))
pg_best<-pp_best
   End
End
While (~StopCondition())

p_velocity<-UpdateVelocity(p_velocity,pg_best ,pp_best )
p_position<-UpdatePosition(p_position,p_velocity )
      If (Cost(p_position) <= Cost(pp_best))
pp_best<-p_position
         If (Cost(pp_best)<=  Cost(pg_best))
pg_best<-pp_best
         End
      End
   End
End
Return (pg_best)
```



PSO shares numerous likenesses with transformative calculation methods, for example, Genetic Algorithms (GA). The framework is instated with a populace of arbitrary arrangements and scans for optima by refreshing ages. Be that as it may, in contrast to GA, PSO has no development administrators, for example, crossover and mutation.

1.3 GENETIC ALGORITHM:

So as to acquire best arrangements, we require a measure for separating best arrangements from most exceedingly terrible arrangements. The measure could be a target one that is a factual model or a recreation, or it very well may be an abstract one where we pick better arrangements over most exceedingly bad ones. Aside from this the wellness work decides a best answer for a given issue, which is along these lines utilized by the GA to control the development of best arrangements. This paper demonstrates how GA is joined with different strategies and strategy to determine ideal arrangement, increment the calculation time of recovery framework the utilizations of hereditary calculations in different field.Genetic Algorithm is based on the algorithm on finding the solutions for complex programs.They are basically used in the combinations of the products to form and built a new pattern of product .They are used in the fields such as to create very high quality of products through a huge combination of parameters to find the best match .The are many steps which are required for the selection of the product. They can be used to solve in majorly the optimization problems, and to schedule tasks. They majorly help the way in which life uses evolution to help in fetching the solutions to real world problems.

1.3.1 ALGORITHM STEPS:

1. [Begin] Generate irregular populace of n chromosomes (reasonable answers for the issue).

2. [Wellness] Evaluate the wellness f(x) of every chromosome x in the populace.

3. [New population] Create another populace by continuing after strides until the point when the new populace is finished

a. [Choosing] Select two parent chromosomes from a populace as indicated by their wellness (the better wellness, the greater opportunity to be chosen).

b. [Transverse] With a hybrid likelihood traverse the guardians to shape another posterity (kids). On the off chance that no hybrid was performed, posterity is a precise of guardians.

c. [Variation] With a transformation likelihood change new posterity at every locus (position in chromosome).

d. [Accepting] Place new posterity in another populace.

4. [Replace] Use new produced populace for a further keep running of calculation.

5. [Test] If the end condition is fulfilled, stop, and restore the best arrangement in current populace.

6. [Loop] Go to stage 2.

PSEUDO CODE:

```
Calculation EA is

/begin with an underlying time

t := 0;

//initialise a typically irregular populace of people

initpopulation P (t);

//assess wellness of every single beginning individual in populace

assess P (t);

//test for end standard (time, wellness, and so forth.)

while not done do

//increment the time counter
```

```
t := t + 1;

/select sub-populace for posterity creation

P' := selectparents P (t);

//recombine the "qualities" of chose guardians

recombine P' (t);

/bother the mated populace stochastically

transform P' (t);

//assess it's new wellness

assess P' (t);

//select the survivors from genuine wellness

P := endure P,P' (t);

od

end EA.
```

Advantages:

It can find fit solutions in a very less time. (fit solutions are solutions which are good according to the defined heuristic)The random mutation guarantees to some extent that we see a wide range of solutions.Coding them is really easy compared to other algorithms which does the same job.

Disadvantages:

Its really hard for people to come up with a good heuristic which actually reflects what we want the algorithm to do.It might not find the most optimal solution to the defined problem in all cases.Its also hard to choose parameters like number of generations, population size etc. When we are working even though our heuristic was right we were not realizing it because we were running for a fewer generations.

This algorithm is based on combination of individuals and the production,Usually, the calculation ends when either a most extreme number of ages has been created, or an acceptable wellness level has been gone after the populace.

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Conclusion:

The study on comparison of ACO and PSO and genetic algorithm has been presented in this paper by analysing the optimization methods of each algorithm. Both optimization techniques are assigned with a specific task to allocate resources within minimum execution. We consider PSO is best optimization technique with low computational cost. The stimulated annealing method is used as global optimization so search the optimal solution compared with ACO.The ACO and PSO can be analyzed for future enhancement such that new research could be focused to produce better solution by improving the effectiveness and reducing the limitations. More possibilities for dynamically determining the best destination through ACO can be evolved and a plan to endow PSO with fitness sharing aiming to investigate whether this helps in improving performance