Handling Big Data Analytics Using Swarm Intelligence

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***Abstract*— In the current scenario, the big data analytics is widely in discussion. The characteristics of big data are high volume, high variety and high velocity. These characteristics make big data analysis challenging. Challenges faced are high dimensionality, dynamically changing data. Swarm intelligence has an ability to solve dynamical, huge, and multi-objective problems. Here we focus on proving that various big data analytics problem can be solved using swarm intelligence and it can be applied on hadoop architecture. In this paper we use particle swarm optimisation algorithm to create clusters of given dataset. Many big data analytics problems can be solved using swarm intelligence technique.**

Keywords*— *Big data analytics, Swarm Intelligence(SI), Particle Swarm Optimization (PSO).

I. INTRODUCTION

Big data consists of very large or complex data sets that the data processing applications currently available are inadequate to deal with. The challenges faced include storage, transfer, sharing, querying, updating, search, analysis, data curation, capture and information privacy.

Big data has some specific characters and are defined by 7V's of big data which sometimes are called the spectrum of big data.

- Volume: This is the size of big data. It isvery high and is difficult to manage this huge data in traditional database systems.
- Velocity: Velocity is the rate at which the data is being generated continuously from different sources.
- Variety: Big data is very heterogeneous in nature. This data can be structured, semi-structured and unstructured. Data from different sources is being generated that has different formats and are stored to process and analyse.
- Validity: As the volume of big data is very high, it is our major requirement to get accurate and relevant data for our analysis purpose.
- Veracity: All the data stored in databases is not useful. It has abnormality and redundancy in large amount. To make this data more informative and clean is a major challenge for our analysis purpose.
- Volatility: The most critical issue for big data is data storage. The validity of data and the duration of data to be stored in the databases are the issues related to volatility of big data. The volatility issues of the data need to be fixed for our analysis purpose.
- Viability: It refers to choose the appropriate factors and relevant features of the considered data set. This contributes maximum in predicting the result of analysis

Swarm intelligence was first introduced by Beni. Swarm intelligence is defined as the collective behaviour of decentralized, self-organized natural or artificial systems which is based on a population of individuals where each individual represents a potential solution of a problem being optimized [1]. Swarm intelligence is sub field of artificial intelligence. The nature of swarms called as agents gave birth to the swarm intelligence technique. For example, the ability of bees and ants to orient themselves in the environment. Swarms can interact both locally as well as globally. Ant colonies, bacterial foraging, birds flocking are the swarm intelligence which exists in nature. Principles followed by all swarms are principle of proximity, principle of quality, principle of diversity, principle of stability, principle of adaptability.

- Principle of proximity: It states that during the interaction, swarms respond among each other.
- Principle of quality: It states that the quality factors of solutions are examined along with the simple solution.
- Principle of diversity: It states that the solution is obtained by searching entire search space not only the limited area.
- Principle of stability: It states that whenever there is an environmental change, the behaviour of the swarm should be unchanged that is it should be stable.
- Principle of adaptability: It states that whenever there is an environmental change, the behaviour of the swarms should also change.

II. Literature Review

Shi Cheng, Yuhui Shi, Quande Qin, and RuibinBai [2], presented a paper titled "*Swarm Intelligence in Bigdata Analytics*" which analyses the difficulties of big data analytics problems. It suggests the use of swarm intelligence in big data analytics. It is capable of solving large, multi-objective and dynamic problems.

Lim Kian Sheng et al. [3] proposed a paper on "*Multi-Objective Particle Swarm Optimization Algorithms – A Leader Selection Overview*". Here the paper clearly describes the Multi-Objective Optimization problem. Common features present in Multi-Objective Optimization problem and many performance measures are also explained. The paper also reviewed various Multi-Objective Particle Swarm Optimization Algorithms.

Ajith Abraham et al. [4] proposed a paper titled "*Swarm Intelligence Algorithm for Data Clustering*" which states the basic concepts of Swarm Intelligence and stresses the importance of particle swarm optimization and ant colony optimization algorithm. They also proposed a new fuzzy clustering algorithm which depended on the variant variety of PSO.

Bing Xue and Will N. Browne [5] proposed a paper titled "*Particle Swarm Optimization for Feature Selection in Classification: A Multi-Objective Approach*" which performs searching of an optimized solution in an effective manner and obtains the sequence of non-dominated solution rather than a single search solution. The proposed algorithm assists the users to select their own preferred solution as per their requirement. The limitation of this paper is losing the swarm quickly which limits its performance for feature selection.

Changhe Li and Shengxiang Yang [6] proposed a paper titled "*A Clustering Particle Swarm Optimizer for Dynamic Optimization*" which proposed a new algorithm to handle dynamic optimization problems. Though the proposed clustering algorithm is effective in creating sub swarms, it is still difficult to get the accurate sub swarms.

Dr. M.Seetha, G. Malini Devi, Dr.K.V.N.Sunitha [7] presented a paper titled "*An Efficient Hybrid Particle Swarm Optimization For Data Clustering"* which proposed an efficient hybrid method to solve the large sized fuzzy clustering problem. The proposed system had higher quality of solution as per the objective function value. They have told that the study can be extended further by combining other fuzzy clustering algorithms like K-means and then the best hybrid algorithm can be derived for large sized data set and using other measures like intensity and connectivity.

The paper by Q.Ni and J.Deng[8] proposed Dynamic Particle Swarm Optimization Algorithm which is based on random topology. They also suggested a new PSO algorithm a logistic dynamic particle optimization which discusses the effectiveness of the random and design strategies of population topology.

III. Methodology

Initially upload a dataset sample and apply the concept of Jaccards distance on the dataset. Now on the obtained result apply the particle swarm optimization algorithm. Group of random particles are initialized first and by updating the generation optimal solution is obtained. In each iteration, evaluate the fitness function and update the pbest and gbest value. Pbest is the best solution so far and gbest is the value that is obtained by the particle swarm optimizer, obtained so far by any particle in the population. The Particle Swarm Optimisation Algorithm which gives better seed selection by calculating forces on each particle due to another in each direction and the total force on an individual particle. The output of Particle Swarm Optimisation Algorithm gives us our final clusters.

Step1: Start

Step2: Apply jaccards distance to the given

dataset sample.

Step3: **for** each particle in the dataset **do**

Initialize particles with the random

Vector $x_i \sim U(b_{lo},b_{up})$

Initialize particles position to its initial

Position p_i □x_i

Step4: **if** $f(p_i) < f(g)$ **then**

Update the position of the particle to

G □ p_i

Particles velocity is initialized to

$V_i \sim U(-|bup-b_{lo}| , |bup-b_{lo}|)$

Step5: Update the particles velocity by

$v_{i,d} \leftarrow \omega\, v_{i,d} + \varphi\, \Upsilon_p(p_{i,d} - x_{i,d}) +$

$\varphi\, \Upsilon_g(g_d - x_{i,d})$

$x_i \leftarrow x_i + v_i$

Step6: /*Find and update gbest and pbest.*/

If $f(x_i)<f(p_i)$ **then**

Update the position of the particle

pi ← xi

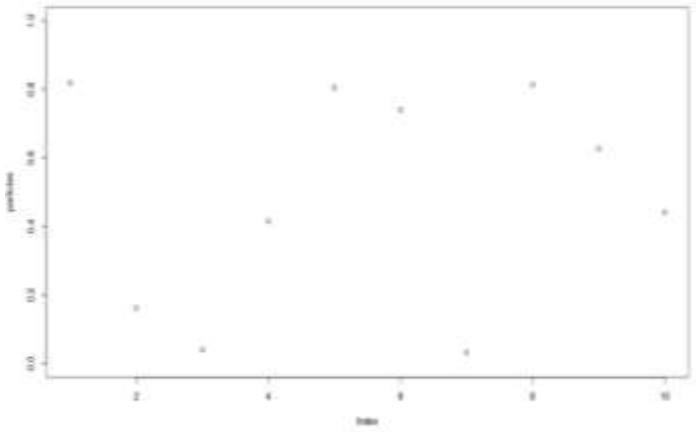
If $f(p_i)<f(g)$ **then**

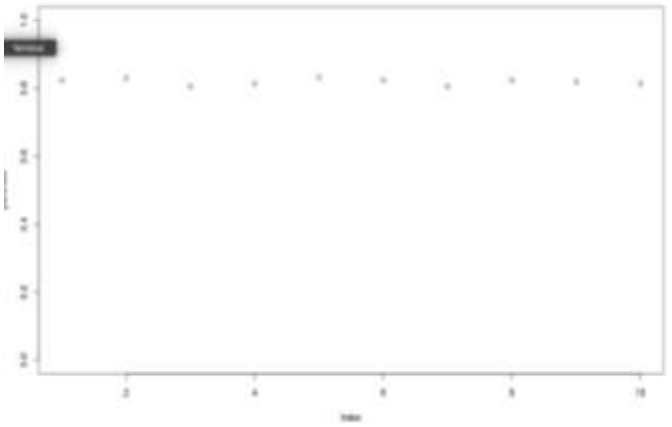
$g \leftarrow p_i$

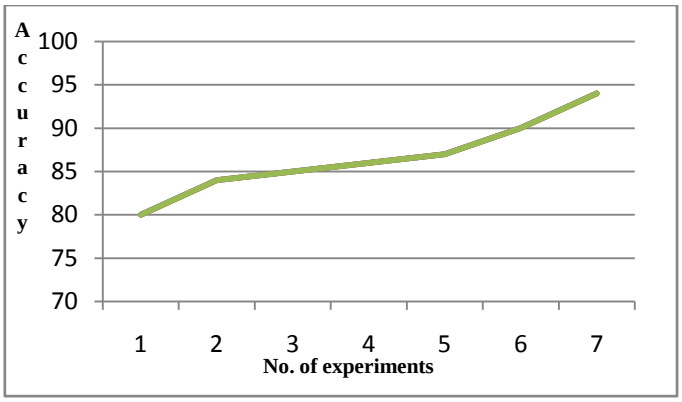
Step7: If termination criteria satisfies then

show the optimal solution.

Step8: Stop.







The output of this paper is the clusters of given dataset. Many big data analytics problems can be solved using swarm intelligence technique.

Here in this experiment particle swarm optimisation algorithm is applied to the sample data set in order to obtain the clusters. Initially a fixed amount of document vector is selected by every particle swarm from the document collection as the centroid of the cluster. Now each particle is assigned with each document vector available in the dataset to the nearest centroid vector. Next as per the fitness function, fitness value will be calculated and finally new solution set is obtained by updating the velocity and particle position of each particle. We have to repeat the above steps until the maximum number of iteration is exceeded to the predefined number.

a) Before updating the position and velocity of the particle

b) After updating the position and velocity of the particle

IV. RESULT

We can calculate the accuracy using the following formula

$$\text{Accuracy}=\frac{totalcorrectlyclassifieddata}{totalsampletoclassify}$$

V. CONCLUSION

The main ambition of this paper is that it suggests the capacity of swarm intelligence to efficiently solve the problems faced in big data analytics. With the application of swarm intelligence robust and effective algorithms can be developed to solve big data analytics problem.

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