Optimization of Cluster Points Using Particle Swarm Algorithm

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Abstract- **"K- Means" Clustering is an unsupervised literacy technique used to solve clustering problems in information wisdom or machine literacy. Viscosity grounded DBSCAN is a clustering technique for spatial grouping of processes with noise. Since it is a non-parametric approach, it groups the points that are more tightly spaced apart given a collection of points in a certain space. DBSCAN outperforms the k-means technique and may be used to locate non-spherical clusters. K-means requires that the value of k be specified in advance, and the resultsof k-means might fluctuate greatly across iterations. We employ the DBSCAN technique to get around this flaw. DBSCAN algorithm uses density between the points to make clusters. Same density points make a cluster. Major problem with DBSCAN is choosing the correct parameters for clustering process. Bases on the value of parameters eps and minimum number of points the result of DBSCAN might change and might result in poor clustering results on the varying density dataset. To remove these restrictions, we can optimize the algorithm by optimize the selection of parameters. We can use the particle swarm optimization algorithmon the parameter selection so that every time while choosing the parameter for clustering we choose the best parameters. Particle swarm optimization algorithm can be applied to improve the clustering result efficiency by choosing the best value of eps and minimum number of points in the algorithm Procedure.**

Keywords— K Means Clustering, DBSCAN algorithm, unsupervised literacy technique.

I. INTRODUCTION

Data mining is used to find useful patterns among the data. Outlier detection is a process to find out the objects which differs from the rest of the population. Finding outliers from a set of data is an important aspect of data mining. Outliers describe the suspicious behaviour.

Outlier detection can find outliers in the dataset and can help to remove these outliers from the dataset and can improve the quality of data. Detecting outliers can help us to find hidden patterns in the dataset. Most people ignore the outliers and treat it as a garbage but these outliers contain the hidden knowledge which need to be extracted. Outlier detection has various applications in fraud detection, Dos attack in the networks, find terrorism activities etc.

There are various types of outliers depending on the context in which we are analysing the data. A data point is called global outliers if its value lies outside the whole set of data points. It is the simplest form of outlier. If a data point is different from all other data points in a particular context, then it is called as contextual outlier. Outlier can differ with respect to the context in which we are applying outlier detection. In one context a point might not be the outlier but in other context the samepoint can be the outlier. Sometimes it might so happen that a single data point might not be the outlier but in the collectionof the data points it behaves as an outlier. This type of outlier is known as collective outlier. There might be the case that due to some inherent problem some observation might be noted incorrectly as an outlier. These observations are known as erroneous outliers and treated as the noise in data sets.

There are two approaches for outlier:

1) Clustering-based methods are unsupervised methods. We cannot use the clustering algorithm on labelled data in clustering. Data points that are similar to one another are preserved in one cluster while data points that are not similar to one another are kept in another cluster, resulting in two distinct clusters. A distance metric is employed in the clustering process.

2) Statistical based approach is based upon probabilistic model and it identifies outliers based on the model used. Statistical approach can be divided into two types named as parameterized and non-parameterized approaches

II. PRELIMINARIES

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PROBLEMS DEFINITION

When the k-means clustering technique is ineffective, the DBSCAN algorithm is used. With the exception of non-spherical form clusters, which the K-means algorithm cannot identify, the amount of clusters that will be formed must be determined beforehand. DBSCAN algorithm may create clusters with non-spherical shapes while taking the density of the data points between the databases into account. The DBSCAN technique has another drawback since it performs poorly with datasets with varied densities. The cost of eps and the required minimum number of points also affect DBSCAN results. The algorithm's output may change and its performance may deteriorate for different eps values and minimum points requirements. This method's biggest disadvantage is that it earns the fewest points and costs the most eps. The end product's quality is greatly influenced by the amount of minimum points inside the eps radius and the eps's selected price.

DBSCAN also encounters difficulties anytime there is a significant discrepancy in the densityof the datasets. Our goal is to optimize the algorithm's efficiency by doubling the cost of the eps parameters and the required minimum number of points. The algorithm's efficiency can beimproved if we can somehow determine the right evaluation of eps and the bare minimum of points.

2. K-MEANS CLUSTERING

K-means clustering algorithm is used to partition n data points into k partition. It is a distance-based clustering algorithm. In k-means distance is used to partition the data set into k-clusters. The value of k is provided by the user. It is an iterative algorithm.

Initially k random points are chosen as centroid in the dataset. Each centroid calculates the distance and makes a cluster of the nearby data points. So, data points which are near to one another makes one cluster. So, data points belong toa cluster are similar.

DBSCAN. The density between the data points is used as the basis for grouping in the DBSCAN method. A cluster of data points formed by those in the same density zone. One cluster will differ from another in terms of density since cluster densities vary from clusterto cluster. The k-means clustering method's difficulty of requiring us to specify the value of k in the prior is solved by the DBSCAN algorithm. With this technique, we are not need to predetermine the number of clusters. Another benefit of this technique is that, unlike with k-means clustering, we may locate clusters of various forms.

Terminology: Two parameters are needed by the DBSCAN algorithm: eps (radius) and minimum number of points. The procedure begins with a random data point, retrieves the points from the eps neighborhood from this point, and starts a cluster if there are at least a certain number of points in the eps neighborhood.

Core points and border points are two categories for data points. If a point has more than the required number of points inside an episode, it is said to be a core point. Border points are those that are close to core points but have fewer points than the required minimum within eps. A point that is neither a border point nor a core point is referred to as an outlierpoint.

III. RELATED WORKS

In [1] author has presented a novel algorithm called CURIO for outlier and outlier cluster detection in large datasets. In this paper author has proposed an algorithm that usedquantization and distance matrix for outlier detection in large datasets. The algorithm uses two linear scans. From two of the phases of algorithm the quantization phase identifies the potential candidate data points for noise and the second phase which is discovery phase do the validation of these candidates whether selected data point is really a outlier or not.

In quantization phase to partition the dataset algorithm uses the hash table for fast access and dynamic construction which represent an abstraction of hypercube which can be access directly using a hash table. The objects are allocated to cells using hash index.

In [2] author has described the various implementations of DBSCAN and SNN (shared nearest neighbor) clustering algorithm. In this implementation author has devised an algorithm in which the value of eps and minimum number of points is derived from the value of K. The value of K is provided by the user and based on this value of K, the value of K ^3will determine the values of eps and the minimum number of points. This algorithm has used two approaches named as Graph approach and Core approach respectively. Accordingto the conclusion of this implementation the devised algorithm is better than DBSCAN in terms of separating the varied density datasets.

In [3] In order to improve the DBSCAN's weak clustering performance on huge datasets, the author has employed a parallel programming framework based on MapReduce. The algorithm is parallelized using the Map and Reduce functions. The algorithm's low efficiency issue is lessened by this method. The MapReduce framework's energy usage is decreased by using a job distribution method.

In [4] Convex hull is used in the author's modified onion peeling approach to find outliersin a Gaussian 2-D space. The Mahalanobis Distance Metric, Euclidean Distance Metric, and Standardized Euclidean Distance Metric have each been used in three separate outlier identification scenarios. According to the algorithm first scatter all n data points in a 2-D plane. Then compute the convex hull of the 2-D plane and repeat the process till there is no point in the plane remaining. The points which are at the boundary of the convex hull are treated as the outliers. This study shows that the Mahalanobis distance metric is best suitable than other distance metric with 80% accuracy.

In [5] The author has developed a method to solve the K-Means algorithm's local optimal problem. The algorithm confronts a local optimal problem when we select the value of K ink-means and select the random points. In order to enhance the initial population for k- means clustering, the author of this study developed a method known as an adaptive genetic algorithm. This approach uses an enhanced density estimation technique, an optimized k-means clustering algorithm, and an adaptive crossover function to build a population with reduced complexity while retaining population variety.

In [6] By combining a genetic algorithm with subtracting clustering and Bayesian cluster validation, the author has overcome the flaw in fuzzy C-means clustering that requires us to determine the number of clusters beforehand. This method accurately determines the number of clusters and allows for the most efficient cluster construction. Chromosomes serve as the dataset's whole population in this approach, and the crossover operator is utilized to create new offspring from the specified pair of parents. To represent changes made to the member by the crossover, the mutation operator is utilized. The population's fitness is assessed using the fitness function. The generation is the most appropriate demographic.

In [7] author has presented a comparison between the studies of distance based and angle- based algorithm and also introduce a fusion of both distance and angle-based approaches.

Distance based approaches uses distance metric between data points to form cluster while angle-based approach uses angle between two data points to form a cluster. Angle based technique is non-parametric technique. In this study author has showed the comparison between various clustering algorithms and also compared the fusion of distanceand angle-based approaches result to the rest of the techniques. The distance used in the study is Euclidean and Manhattan distance.

In [8] author has worked with spatial data to detect outlier in meteorological data to detect natural calamity. By using the spatial data outlier detection, the natural disaster events can be identified. This study has used wavelet analysis-based approach for the detection of regional outliers. Wavelet analysis is a tool for image processing and signal analysis. Fouriertransform can be used to convert signal into frequency. This study devised two algorithms called wavelet analysis and verification. Analysis algorithm will apply on the image datasets. Verification is done through Z-value approach. This approach is used to detect the outliers in the regional data.

In [9] author has presented a technique for detecting kernel Rootkits. Rootkits are malicious software by using it an attacker can access the system. Previously there were two methods to detect the rootkits named as a priori knowledge in which system before infection and afterinfection is compared to detect the rootkits. In this we need to know the system state beforethe attack and the second technique was to install a rootkit detection program to detect the malicious program. These both techniques were based on the a priori knowledge of the system. The author in this paper has developed a modified normality-based approach whichdetects the rootkits via system call modification attack. Since the system calls are higher priority based so there are more chances of the infection in system call.

In [10] The author has put into practice a method that makes use of the dataset's localization of the data points. This study recommends categorizing every data point's degree of outlier Dom. This degree is referred to as an object's local outlier factor. How far a thing is from all other objects in its immediate vicinity determines its locality. This paper also demonstrates the shortcomings of other outlier techniques and how local outlier factor technique is far more useful than the other available techniques.

IV. METHODOLOGY ADOPTED

1. PARTICLE SWARM ALGORITHM

The flyspeck mass algorithm will be used to enhance the clustering outcome. A notable meta- heuristic optimization technique, flyspeck mass Optimization (PSO), was inspired by the way that mass is seen in nature, for instance in the training of fish and raspberries. PSO simulates a streamlined social structure. The purpose of the PSO algorithm was to graphically mimic the graceful yet mutable dance of a flock of raspberries. The center of PSO is a cluster of catcalls.A swarm of these catcalls is how people refer to them [11-18]. Let's comprehend the flyspeck mass optimization from the script that follows.

2. EXAMPLE

Let's say there is a swarm of catcalls. All of the catcalls are currently hungry and empty. The procedures in a computation scheme that are empty for coffers can be used to identify these empty catcalls. There is now only one messed-up flyspeck in the vicinity of these catcalls. A resource may be used to identify this mess flyspeck [19-25]. Operations are many and funds are scarce, as is well known. So, a similar situation to one in a certain computation terrain has emerged. The catcalls are currently unaware of the location or hiding place of the mess flyspeck. How the search algorithm for the muddled flyspeck should be written in such a script [26]. However, if any, it may result in destruction and workout countless times.

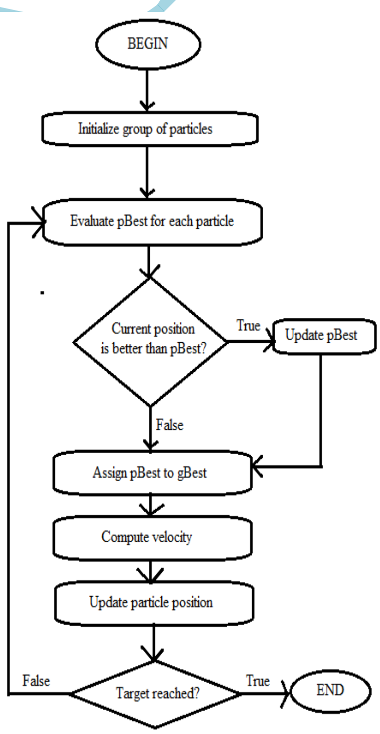

Fig. 3. Particle swarm algorithm flow chart

V. EXPERIMENT RESULTS

After applying the DBSCAN algorithm on dataset we have obtained the different outcomes for different values of eps(radius) and minimum number of points.

Results. We can see here that for different values of eps and minimum number of points how thenumber of clusters are also changing along with execution time.

Eps (Radius)	Min No Of Points	Execution Time (s)
0.1	25	4.19
0.2	25	4.37
0.3	25	4.69
0.1	50	2.08
0.2	50	2.10
0.3	50	4.64

Table 1. DBSCAN Algorithm Comparison Table

After observing this behavior, we have applied particle swarm algorithm on the synthetic 2-D data set. We have performed 50 iterations to calculate the best solution for the cluster points [27-35].

VI. BEST SOLUTION ITERATION PLOT

We have calculated the best solution from the plot graph at every of iteration. The blue point signifies food particle and red points are particles in search of food according to the particle swarm algorithm [36-45].

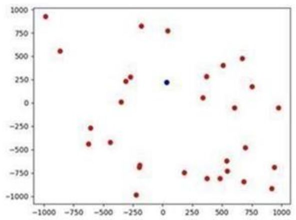

Fig 10: Plot for iteration 1 in PSO algorithm

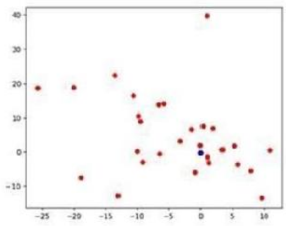

Fig 11: Plot for iteration 10 in PSO logorithm

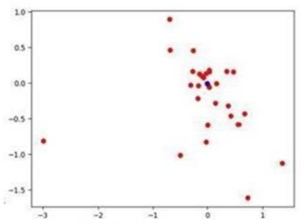

Fig 12: plot for iteration 18 in PSO algorithm

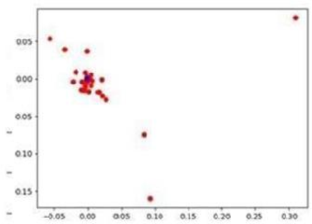

Fig 13: plot for iteration 25 in PSO algorithm

In the above output we got to know that at certain number of iterations we will be getting bestsolution for the given dataset. We can use the best solution value to generate clusters efficiently [36-52].

VII. CONCLUSION

The DBSCAN algorithm cannot function with datasets of different densities. In the worst scenario, an algorithm's complexity may be O (n2). Therefore, we may use the particle swarm method to increase the algorithm's effectiveness. Within the dataset, the particle swarm algorithm determines the optimum solution. We may use DBSCAN to these data points with the aid of the finest solution. By lowering the number of iterations, it will simplify the job of the DBSCAN algorithm. In this manner, the algorithm's complexity can drop below O (nlogn).

We can take out the unpredictability of the data points that will be distributed over the dataset bycomputing the optimum solution.

VIII. FUTURE WORK

To reduce the clustering cost of the DBSCAN technique, we used the particle swarm approach inthis. To further increase the algorithm's efficiency, there are several more algorithms that may beused that operate on the evolutionary model.

To increase the algorithm's effectiveness, differential evolutionary and genetic algorithms can alsobe used.

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