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Data Mining Approach For Exploring Soil Fertility

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Abstract:- Predication of crop is a widespread problem . Farmer always had a curiosity to know his yield production, climatic condition, how the yield will be better. Simplifying the agriculture production is the essentiality of agriculture improvement. There is need to develop good techniques for crop prediction and other related aspects. Data mining has been emerged a great field in the agriculture. Data mining enables farmers to identify potentially interesting and unknown patterns in large volume of datasets. This paper discuss about the techniques of data mining that helps the farmers to overcome the problems and provide a suitable solution to them.

Keywords:- Data mining , Clustering , Bi -Clustering , K-Nearest Method , Support Vector Machines(SVMs)

INTRODUCTION:-

The major problem of using data mining in agriculture is that to solve issues based on the available data and its meaningful outcomes. In this paper, the techniques of predicting yield production of a crop are the centre of focus. Yield prediction is very important in agriculture. This study supposed to discuss how data mining is act in agricultural field. Nowadays areas were irrigated are less. Therefore, as the percentage, the productivity is less. Because of the less productivity demand of the market is increasing. Therefore, people who are interesting to agriculture field put more effort and advanced techniques to increase the productivity to supply the demand. Result of that extra effort, the agricultural data increases day by day. Therefore, there should be involuntary mechanism to extract the data when required

Data Mining and Agriculture

in traditional crop field management, uniform input application not only consider the concept of spatial and temporal variability within a crop field, but also results in environmental pollution and reduction of farm profits. The need of site-specific management or precision agriculture has been advocated by researchers, producers and farmers in the worldwide. Advanced information technology that can provide quick and cost-effective ways to identify spatial variability within crop fields is the basis of precision agriculture. Moreover, remote sensing technologies have advanced rapidly in recent years and have become effective tools for site-specific management in crop protection and production.

To extract the patterns and models from large volume of data set involves applications which consisting algorithms and set of steps such as preparing data, selection of the data, cleaning the data, interpret the useful data. Data mining is used to identify and display the statistical information according to soil, climate situations, history of crop yield, government strategies related to agricultural field.

Data mining represents a set of specific methods and algorithms aimed solely at extracting and patterns patterns from raw data. It helps in the process of discovering previously unknown and potentially interesting patterns in large datasets [4]. Data mining, which is also termed as knowledge discovery, is the process of analyzing data from different perspectives and summarizing it into valuable information for future use [5, 6]. This “mined’

information produced from data mining can be used for variety of purposes like research, future forecasting or prediction, classification etc. in agriculture. Analysis of data in effective way requires understanding of appropriate techniques of data mining.

Data mining tasks can be classified into two categories: Descriptive data mining and Predictive data mining. Descriptive data mining tasks characterize the general properties of the data in the database while predictive data mining is used to predict explicit values based on patterns determined from known results. Prediction involves using some variables or fields in the database to predict unknown or future crop, weather forecasting, use of pesticides and fertilizers to be used and revenue to be generated. Different techniques and algorithms used in data mining for improving agriculture productivity are described in this section.

Techniques Used In Data Mining

Descriptive and Predictive data mining are two different categories in data mining to classify the data. Descriptive data mining set out the data according to general properties and Predictive data mining helps to predict future values considered the past results [4].

Clustering, Regression and Association rules are the main data mining techniques that have been used to address the agricultural problem. Association rules mainly use to find the relationships on transactional databases. Also find the elements that occur in repeatedly. Partition, Pruning (DHP), Apriori Algorithm (AA) are examples for association rule data mining algorithm. In agricultural field, association rules used to identify diseases which are spreading by insect. Clustering is a data mining technique which used to shift the elements through set of data to extract the relevant information that has been used to take decisions. Farmers use clustering to find most suitable data for development and management of crops. Regression is a data mining technique that has been used to predict and estimate the probabilities of a data item. It is used to predict the demand of the products. Likewise, field of agriculture were encouraged to use data mining to discover the knowledge [4][15].

Clustering

Clustering is an unsupervised learning technique that takes unlabeled data points (data records) and classifies them into different groups or clusters. This is done in such a way that points assigned to the same cluster have high similarity, while the similarity between points assigned to different clusters is low [7]. In clustering, the focus is on finding a partition of data records into clusters such that the points within each cluster are close to one another. It can also be defined as a process which partitions a set of data (or objects) into a set of meaningful sub-classes called clusters [8].

k-means approach: The k-means is a data mining technique for clustering [9, 10]. The aim is to find a partition of the set in which similar data are grouped in the same cluster given a set of data with unknown classification. Samples that are close to each other are considered similar and the measure of similarities between data samples is calculated using a suitable distance. The parameter k in the k-means algorithm plays an important role as it specifies the number of clusters in which the data must be partitioned. The center of the cluster can be considered as the representative of the cluster because the center is quite close to all samples in the cluster. It follows that a cluster contains similar data if all its samples are closer to its center and not to the center of some other cluster. Therefore, the k-means algorithm moves the corresponding data samples from their original cluster to the new cluster, when samples belonging to a cluster are closer to the center of a different cluster. Figure 1 shows an optimal partition in clusters of a set of points in a cartesian space.

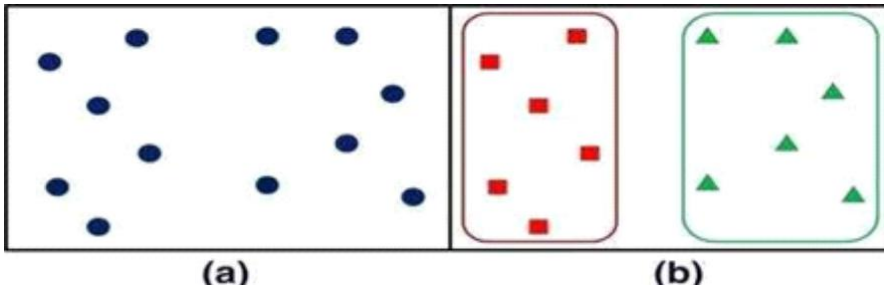

Figure 1. An optimal partition in clusters of a set of points in a cartesian space: (a) the points are not assigned yet to any cluster; (b) points belonging to the same cluster are marked using the same symbol.

The k-means algorithm is an algorithm for local optimization, because it identifies a sequence of partitions in clusters which have strict decreasing function values. Hence, the k-means algorithm is able to find only one of the local minima of the function f, that may or may not correspond to the global minimum. For this reason, the k-means algorithm is usually performed several times using different initial partitions. The partition corresponding to the smallest value of the function f is considered to be the optimal solution. The k-means algorithm belongs to the category of expectation maximization (EM) algorithms that are elegant and powerful methods for finding maximum likelihood solutions for models with latent variables [11]. There are some disadvantages in using the k-means algorithm. One of the disadvantages could be the choice of the parameter k. In some applications, this choice can be trivial, if the samples have to be divided in a predetermined number of categories, such as „„good and „„bad samples, then in this case k = 2. In the majority of cases, however, the parameter k is unknown apriori. The computational cost of the algorithm is another issue that needs attention. Most of the cost is due to the computation of distances and new centers. The standard k-means algorithm computes new centers every time a sample migrates from one cluster to another. There is a variant of the standard algorithm that computes new centers only when all samples in the set of data have been checked and eventually moved. This variant is referred to as the h-means algorithm. The two algorithms are sometimes combined together in which the h-means algorithm can be initially used to identify a partition close to the optimal one that is then used by the k-means algorithm as a starting partition. Over the years, other variants of the basic k-means algorithm have been proposed. The most popular implementation of this algorithm is the Lloyd algorithm [12].

Bi-clustering:

Bi-clustering of a set of data, is actually a technique for classification that exploits the information from a training set. A set of data is basically formed by samples, which are represented by a sequence of features that are considered to be relevant for the representation of the samples. Instead of considering samples only, bi-clustering aims at finding simultaneous classifications of samples and of their features. Moreover, if a training set is known, a bi-clustering can be constructed by exploiting this training set. The corresponding partition in bi-clusters is able to associate subgroups of samples to subgroups of features, so that the features causing the classification of the training set are revealed. This information can then be exploited for performing classification of samples which do not belong to the training set. **1.3. Fuzzy clustering:** Studies were conducted by using fuzzy clustering in detection of leaf spots in cucumber crop [13, 14]. Spots on leaves gave an indication of plant diseases, which were examined manually and were then subjected to expert advice. Then the experts declared the disease after proper investigation. Scientists proposed a segmentation technique for identifying leaf batches in cucumber crop using fuzzy clustering algorithm. The first step of image analysis and pattern recognition is the segmentation of image [15]. Segmentation is very critical and inevitable component of image analysis and pattern recognition. Image segmentation is carried out by partitioning the image into homogeneous disjoint regions pertaining to some criterion as intensity or colour and none of the union of any two adjoining region should be homogeneous.

2. Classification Classification and prediction are two forms of data analysis that can be used to extract models describing important data classes or to predict future data trends. It is a process in which a model learns to predict a class label from a set of training data which can then be used to predict discrete class labels on new samples. A classification problem arises when an object needs to be assigned to a predefined class or group according to its characteristics. A classification task is also referred to as a supervised learning task since the classes or groups are defined before hand and can be used to steer the learning process.

k-nearest neighbour: k-nearest neighbour classifiers (KNN) classify a data instance by considering only the k most similar data instances in the training set [16]. The class label is then assigned according to the class of the majority of the k-nearest neighbours. A training set is known and it is used to classify samples of unknown classification. The basic assumption in the k-NN algorithm is that similar samples should have similar classification. As in the k-means approach, the similarities between samples are measured using suitable distance functions. A sketch of the k-NN algorithm is given in Fig. 2.

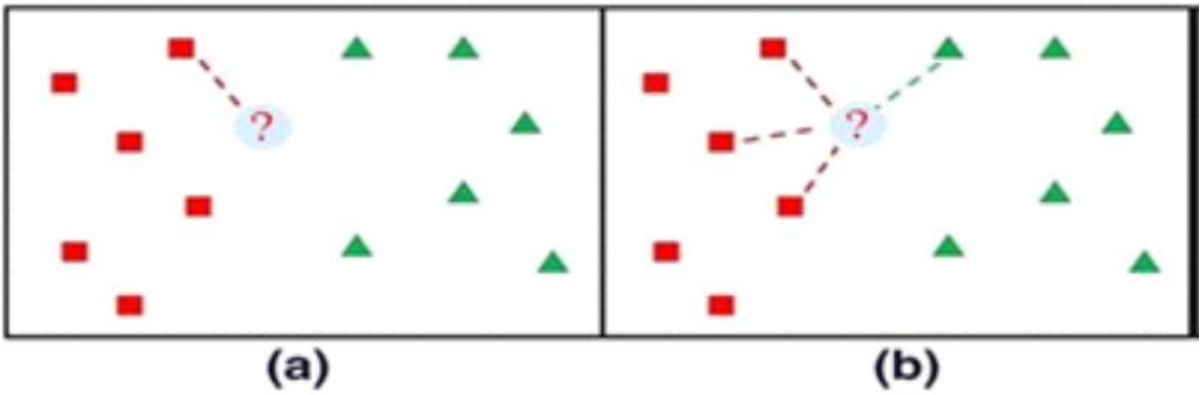

Figure 2. The point marked by the symbol is classified according to the classification of its nearest neighbors: (a) k = 1 and the unknown point is classified as belonging to the class marked by squares; (b) k = 4 and the unknown point is classified as belonging to the class marked by squares as well.

Support vector machines (SVMs):

These machines are binary classifiers that are able to classify data samples in two disjoint classes [18].

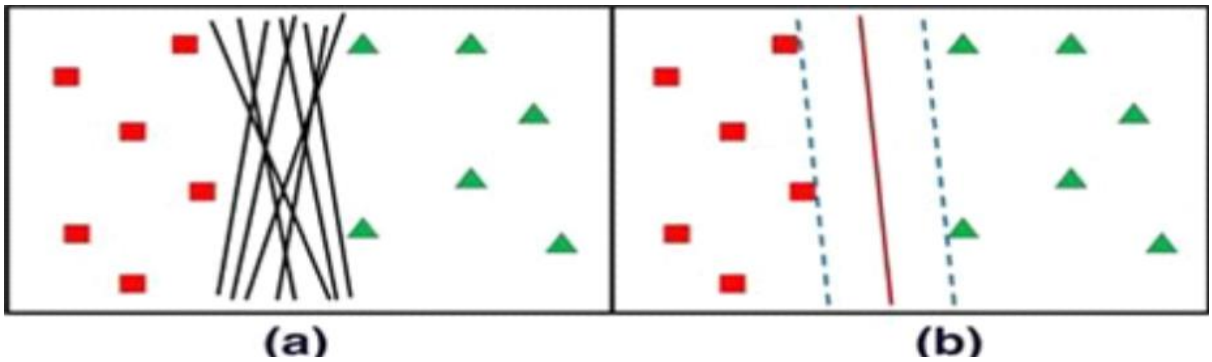

Figure 3. Points in a Cartesian system are separated on the basis of their features and are assigned to two different classes: (a) possible separating hyperplanes that do not maximize the margin between the two classes; (b) the separating hyperplane found by SVMs, providing the maximum margin.

In this technique, two considered classes are linearly separable. In such a case, there exists a hyperplane which is able to separate all samples in two classes. Actually, in most of the cases, more than one hyperplane satisfying this condition exists and one of them is chosen as classifier on the basis of the margin it creates between the two classes. Intuitively, the larger is the margin, the less are the possibilities of misclassifications. Figure 3 shows points in a cartesian system to be classified in two different classes.

Applications of Data Mining

Data mining techniques and systems have been used in agricultural field by addressing the various problems in diverse fields such as soil characterizing, diseases identification, identify demand in a market.

Neural network has been used to weather forecasting. The system is developed to record the parameters which are relevant to weather situation such as speed and direction of the wind, temperature and humidity of area, rainfall size and time range. If there were any change in those parameters, can be predict the upcoming weather situation by using Neural network. Prediction can be done for the large area by increasing the result of small area [4]. Also, a system to identify the bad apples from good apples and a system to classify the eggs have been developed by using neural network [12]. Another Artificial neural network's application is a system to find the relationship between yield measurements and limiting factors [24].

Pakistan researchers was built the system to check whether the usage of pesticide is maximized the yield prediction. In this system data perform through the unsupervised clustering. As the result system gave negative relationship between yield prediction and pesticide usage. when the usage of pesticide is increased it was harmful for farmers in financially, healthy and environmentally [6].

Helps of the Support Vector Machine (SVM) technique developed a system to recognize the sounds of birds, a system to classify the spread of source on pizza, a system to measure the nitrogen pressure in corn and a system to classify the crops [12].

k-means approach is used to build a system to solve the fermentation problem which could be slow or get stuck when occurred the wine making process [20]. Also, k-means approach is applied to identify the unknown parameters related to water in soil. That parameters includes clay, carbon, other organic characteristic and textures. k-mean approach used to identify soil parameters by identifying the similar textures [3].

An automated system to improve the process of soil classification was developed. Fertility of the soil sample is the key point of that system. According to fertility, soil samples labeled as very Low, Low, Moderate, Moderately High, High, Very High. The system helps to label the soil samples. For further comparative study, use classification algorithms [25].

Applications of Naive Bayes classifier such as Unified Soil Classification System (USCS), AASHTO Soil Classification System and the Modified Burmister, French Soil Reference System are used to soil classification process in different countries. There are three main classification groups in USCS like Highly organic soils, Fine-grained soils, Coarse-grained soils [21].

How Data Mining help farmers?

Data mining help the farmer and other person who are directly and indirectly related to the soil. Information of soil includes content of sand , slit and clay, acidity and alkalinity, floozd hazard ,depth to water table, natural drainage , erodibility , organic matter content and fertility .data mining helps in describing properties of soil this

basic information help for managing soil on a farm or ranch.To earn profit farmers have to evaluate data stored in agriculture management.

Data Management practices :-Production depends largely on soil properties . farmers should use right practices to get the optimum results. Data mining helps in providing various combination of tillage methods , conservation measures , fertilizers and water management techniques. The main focus of farmer is to yields on soil , at the least cost.

Special crop:- THE data about soil of your area help to know the soil properties that help to identify properties that affect crop growth and provides information to manage your field for unfamiliar crops.

Crop yield:-details about the estimated yield of major crops are mentioned in the data mining .this help to find whether the increase yield help to earn more and to pay the extra cost.

Conservation plan:- data reterived from data mining help you to find how intensively we are able to use the soil without damaging it.it provides details about the soil conservation measures that help to control soil erosion and how to increase productivity

Reclaiming land:- help to provide the information about the repairing method of soil like fertilizer, lime and green manure. Data mining help to determine whether treatment going to reclaim soil is going to be succeed.

Waste disposal;- data mining help in providing information about how much waste the soil can absorb and in what form.

Recreation: a data mining of soil help in searching areas for man made ponds and planning to develop supplement incomes through fishing, hunting, camping and different way for the supplement income.

Conclusion

The objective of the data mining methods and techniques are association , prediction , clustering and pattern recognition. This paper show the advantage of the proposed methods with respect to existing techniques.

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