A Survey on Data Mining and Its Current Research Directions

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Abstract: Data mining is extracting the knowledge from a large amount of data which stores in multiple heterogeneous databases. Knowledge is converting the message through direct or indirect. A survey of various mining techniques. These techniques are including association, correlation, clustering and neural network. It also conducts a formal review of the application of data mining such as the education sector, marketing, fraud detection, manufacturing and telecommunication. Data mining are based on the data models and clusters. These are divided for the different paths for research the information.

Keywords: Data, Mining, knowledge, Database, cluster, regression, technique.

I. INTRODUCTION

Nowaday’s databases are comprised of terabytes or more data in it. As they are able to accommodate huge mass of heterogeneous data, different variety of strategic information lies hidden inside it. So, through effective data mining only we can able to draw meaningful conclusions which are the basic purpose of data mining. As data are being accumulated continuously as well as rapidly whether it is a research field, education, and market products, medical science, electronic information, media, entertainment etc. It is difficult to get faster and appropriate information by traditional manual analysis which is tedious as well as very cumbersome. So, data mining is used basically i) to reduce costs through proper detection and prevention of waste and fraud, ii) obtaining appropriate and up-to-date information and iii) increase revenues through improved marketing strategy. We can take an example of research of finding presence of water in the planet Mars. Scientists receive different data from Mars through satellites. Those data are changing time to time as the satellite provides new sets of data in different time duration. The job is very challenging as well as required effective research analysis. So through an effective data mining analysis scientists can able to find the outcome more scientifically which is not that possible or easier in Traditional analysis. So data mining finds patterns and relationships in data which are stored in databases, data warehouses, or other information repositories providing more advanced and effective information which is augmented by utilizing models equipped with sophisticated techniques. In other way, Data Mining allow to [1] explore massive data in such a way that its end result is obtaining of fruitful knowledge information multidisciplinary field, drawing work from various areas like i) Artificial intelligence, ii) Neural networks, iii) Machine learning, iv) Database technology, v) statistics, vi) pattern recognition, vii) signal processing, viii) spatial data analysis, ix) Business, x) Economics, xi) Bio-informatics etc. Data mining can be done in different types of data but one of the interesting facts is that it can process spatial data which is used for geographical, chip design, medical and satellite image databases.

Data mining is also known as [2] KDD i.e. Knowledge Discovery in databases. KDD is the automated extraction of novel, understandable and potentially useful patterns implicitly stored in large databases, data warehouses and other massive information repositories comprising textual, Numerical, graphical, spatial data.

A. Pre mining tasks
1) Data Cleaning basically emphasizes on removing noisy and inconsistent data.
2) Data Integration accumulates data from various sources to a single location as well as into a common format.

B. Post mining tasks
1) Pattern Evaluation focuses on identifying the truly interesting patterns that represents knowledge.
2) Knowledge Presentation provides discovered rules using visualization and different knowledge representation techniques.

II. BASIC TAXONOMY OF DATA MINING MODELS

Generally two types of models can be classified or built in data mining:-

Predictive models: These models predict or forecast explicit value of a particular attribute i.e. when the model predicts according to class membership it is called as classification model or simply classifier. If the model predicts a number...
from a wide range of possible values, then it is referred as regression model.

III. CLASSIFICATION OF DATA MINING SYSTEMS

Classification of data mining systems is performed according to types of databases are mined i.e. relational, transaction, spatial databases etc., what types of knowledge comprised of mining functionalities like association, customization, clustering etc. are applied to it, what types of data mining techniques are being deployed like machine learning, neural networks, pattern recognition etc.

IV. RELATED WORK

Though varieties of data mining techniques, like association rule mining, cluster analysis etc. are being used so often in different applications, in this section we have specified most of the work related to association rule mining and others. AIS Algorithm was the first association rule mining algorithm which was proposed in [3] where generation of candidate itemsets is done at the time of scanning the database through extending known-frequent itemsets with items from the supports of each transaction. It is a multipass algorithm. An estimate of the supports of these candidates is used to steer whether these candidates are needed to be extended further for production of more candidates. The chief drawback of this algorithm is that it generates too many candidates which are small and requires much more space and is thereby inefficient.

Apriori algorithm which is introduced in [4] that is more efficient than AIS by an order of magnitude. The foremost advantage of Apriori is that it incorporates the subset frequency based pruning optimization that means, it only process any itemset whose subsets are frequent also. It utilizes a data structure that is known as hashtree which is used for storing the counters of candidate itemsets. The main drawbacks of Apriori are I) it performs n passes over the database, where n is the length of the longest frequent itemset. The counts of candidate itemsets of length k are obtained in kth pass, ii) it follows a tuple-by-tuple approach where counters of candidate itemsets are updated after reading in individual transaction of whole database so that much redundant work are performed after each and individual transaction. Based on this algorithm, lots of new algorithms are deliberated with enhancements or modifications.

An algorithm called DIC Algorithm introduced in [5] where candidates are generated as well as removed after every m transactions where M is used as a parameter in the algorithm. The algorithm utilizes multi-pass technique but typically it can be completed within two passes. The drawback of this is that, it also follows a tuple-by-tuple approach.

V. CURRENT RESEARCH DIRECTIONS

In [6], a novel approach is specified to build data mining models from perturbed data which preserves privacy of the data mining. In this paper, before the data is sent to the data miner, random noise from a known distribution is added to the privacy sensitive data. Consequently an approximation to the original data distribution from the perturbed data is reconstructed by the data miner and reconstructed Distribution is used for data mining purposes. As noise is added here, loss of information versus preservation of privacy both the concepts are made trade off in the perturbation based approaches. The proposed model is based on an individually adaptable perturbation model, which enables the individuals to choose their own privacy levels. The focus is laid on mining non-derivable frequent itemsets in an incremental fashion. In their approach researchers have designed a compact data structure NDFlOtD which can able to maintain a dynamically selected set for itemsets more efficiently. An optimized algorithm named NDFlOtD is proposed for generating non-derivable frequent itemsets over stream sliding window and the method has an edge over previous approaches. In a prototype multidimensional association mining system is proposed where users can build effective data mining models through the intelligence support of the ontology’s that can prevent ineffective pattern generation, discover concept extended rules, and provide an active knowledge re-discovering mechanism. For improving the warehousing mining process more effective, in the proposed technique, schema ontology, schema constraint ontology, domain ontology and user preference ontology is incorporated also for making the model more perfect one. In [7], a system model is proposed.
where the personal route of a user is predicted using a probabilistic model built from the historical trajectory data. A novel mining algorithm called CRPM (Continuous Route Pattern Mining) is proposed here through which route patterns are extracted from personal trajectory data. The advantage of this approach is that it can withstand different kinds of disturbance in trajectory data. Apart from that a clientserver architecture is employed which augments both the privacy of personal data to a certain extent and reducing the computational load on mobile devices also.

VI. Data Mining Techniques

Data mining means collecting relevant information from unstructured data. So it is able to help achieve specific objectives. The purpose of a data mining effort is normally either to create a descriptive model or a predictive model. A descriptive model presents, in concise form, the main characteristics of the data set. The purpose of a predictive model is to allow the data miner to predict an unknown (often future) value of a specific variable; the target variable.

The goal of predictive and descriptive model can be achieved using a variety of data mining techniques as shown in figure 2[8].

![Data Mining Technique](image)

1) **Classification**: Classification based on categorical (i.e. discrete, unordered). This technique based on the supervised learning (i.e. desired output for a given input is known). It can be classifying the data based on the training set and values (class label). These goals are achieved using a decision tree, neural network and classification rule (IF- Then). For example, we can apply the classification rule on the past record of the student who left for university and evaluate them. Using these techniques we can easily identify the performance of the student.

2) **Regression**: Regression is used to map a data item to a real valued prediction variable [8]. In other words, regression can be adapted for prediction. In the regression techniques target value are known. For example, you can predict the child behavior based on family history.

3) **Time Series Analysis**: Time series analysis is the process of using statistical techniques to model and explain a time-dependent series of data points. Time series forecasting is a method of using a model to generate predictions (forecasts) for future events based on known past events. For example stock market.

4) **Prediction**: It is one of a data mining techniques that discover the relationship between independent variables and the relationship between dependent and independent

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products in close proximity of each other and making them more visible and accessible for customers at the time of shopping [14].

4) Data Mining in Earthquake Prediction: Predict the earthquake from the satellite maps. Earthquake is the sudden movement of the Earth’s crust caused by the abrupt release of stress accumulated along a geologic fault in the interior. There are two basic categories of earthquake predictions: forecasts (months to years in advance) and short-term predictions (hours or days in advance) [15].

5) Data Mining in Telecommunication: The telecommunications field implement data mining technology because of telecommunication industry have the large amounts of data and have a very large customer, and rapidly changing and highly competitive environment. Telecommunication companies use data mining technique to improve their marketing efforts, detection of fraud, and better management of telecommunication networks.

6) Data Mining in Agriculture: Data mining than emerging in agriculture field for crop yield analysis a with respect to four parameters namely year, rainfall, production and area of sowing. Yield prediction is a very important agricultural problem that remains to be solved based on the available data. The yield prediction problem can be solved by employing Data Mining techniques such as K Means, K nearest neighbor (KNN), Artificial Neural Network and support vector machine (SVM).

7) Data Mining in Cloud Computing: Data Mining techniques are used in cloud computing. The implementation of data mining techniques through Cloud computing will allow the users to retrieve meaningful information from virtually integrated data warehouse that reduces the costs of infrastructure and storage. Cloud computing uses the Internet services that rely on clouds of servers to handle tasks. The data mining technique in Cloud Computing to perform efficient, reliable and secure services for their users.

VIII. Data Mining Algorithms and Techniques

Various algorithms and techniques like Classification, Clustering, Regression, Artificial Intelligence, Neural Networks, Association Rules, Decision Trees, Genetic Algorithm, Nearest Neighbour method etc., are used for knowledge discovery from databases.

A. Classification

Classification is the most commonly applied data mining technique, which employs a set of pre-classified examples to develop a model that can classify the population of records at large. Fraud detection and credit risk applications are particularly well suited to this type of analysis. This approach frequently employs decision tree or neural network-based classification algorithms. The data classification process involves learning and classification. In learning the training data are analyzed by classification algorithm. In classification test data are used to estimate the accuracy of the classification rules. If the accuracy is acceptable the rules can be applied to the new data tuples. For a fraud detection application, this would include complete records of both fraudulent and valid activities determined on a record-by-record basis. The classifier-training algorithm uses these pre-classified examples to determine the set of parameters required for proper discrimination. The algorithm then encodes these parameters into a model called a classifier.

Types of classification models:
- Partitioning Methods
- Hierarchical Agglomerative (divisive) methods
- Density based method
- Grid-based methods
- Model-based methods

B. Clustering

Clustering can be said as identification of similar classes of objects. By using clustering techniques we can further identify dense and sparse regions in object space and can discover overall distribution patterns and a correlation among data attributes. Classification approach can also be used for effective means of distinguishing groups or classes of object but it becomes costly so clustering can be used as reprocessing approach for attribute subset selection and classification. For example, to form group of customers based on purchasing patterns, to categories genes with similar functionality.

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IX. METHODOLOGIES OF DATA MINING

A. Neural Network

Neural Network or an artificial neural network is a biological system that detects patterns and makes predictions. The greatest breakthroughs in neural network in recent years are in their application to real world problems like customer response prediction, fraud detection etc. Data mining techniques such as neural networks are able to model the relationships that exist in data collections and can therefore be used for increasing business intelligence across a variety of business app locations. Neural Networks are used in a variety of applications. Artificial neural network have become a powerful tool in tasks like pattern recognition, decision problem or prediction applications. It is one of the newest signals processing technology. ANN is an adaptive, non-linear system that learns to perform a function from data and that adaptive phase is normally training phase where system parameter is change during operations. After the training is complete the parameter are fixed. If there are lots of data and problem is poorly understandable then using...
ANN model is accurate, then non-linear characteristics of ANN provide it lots of flexibility to achieve input output map.

B. Decision Trees

A decision tree is a flow chart like structure where each node denotes a test on an attribute value, each branch represents an outcome of the test and tree leaves represent classes or class distribution. A decision tree is a predictive model most often used for classification. Decision trees partition the input space into cells where each cell belongs to one class. The partitioning is represented as a sequence of tests. Each interior node in the decision tree tests the value of some input variable, and the branches from the node are labelled with the possible results of the test. The leaf nodes represent the cells and specify the class to return if that leaf node is reached. The classification of a specific input instance is thus performed by starting at the root node and, depending on the results of the tests, following the appropriate branches until a leaf node is reached. Decision tree is represented in figure 2.

Decision tree is a predictive model that can be viewed as a treeware where each branch of the tree is a classification question and leaves represent the partition of the data set with their classification. The author defines a Decision Tree as a schematic tree-shaped diagram used to determine a course of action or show a statistical probability. Decision trees can be viewed from the business perspective as creating a segmentation of the original data set. Thus marketing managers make use of segmentation of customers, products and sales region for predictive study. These predictive segments derived from the decision tree also come with a description of the characteristics that define the predictive segment. Because of their tree structure and skill to easily generate rules the method is a favoured technique for building understandable models.

CONCLUSION

Data mining can be concluded that data mining is a very demanding and most sought after area now a days. Data mining enhance understanding by showing which factors most affect specific outcome. For any development analysis purpose effective study of data provides an effective outcome which is possible through perfect data mining. In today’s advanced world, by implementing various advanced data mining techniques. We can also to obtain effective data mining outputs provides immense knowledge through which a system works perfectly and reasonability according to their own requirement and extreme satisfaction. Not only that, it provide definite and appropriate results thought which more and more appropriate and valuable information can be found out. In turn, one can able to explore in a wide range of application in a varieties way of true aspects.

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