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Applying Fuzzy Cluster Index to Improve Searching in Data Warehouse

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ABSTRACT

Data Warehouse (DW) is one of the solutions for decision-making process in a business organization. But it only stores data for managerial purpose and it has no intelligent mechanism for decision making. For improving the process of decision making and searching Data Warehouse (DW) of the medical resources (items), where this study includes an application on a Data Warehouse (DW) of medical resources (items).In this paper, we merged the fuzzy rule with cluster index technique. where The proposed technique is named Fuzzy Cluster Index technique (FCI) to improve and speed up Queries fuzzy rule and process of decision making and management medical (items), The performance evaluation of three data warehouse queries is focused in this paper by comparing with Fuzzy cluster index technique (FCI), Fuzzy Rule and Index-based Apriori Algorithm to observe the results of variable size dataset with respect to time. Eventually, the designed system was constructed and executed by using (C# version 2010) which is a visual and object oriented programming language. This proves the efficiency of the proposed system for improving searching in Data Warehouse (DW) and the decision support system for the medical items in a perfect way.

Keywords: Data Warehouse, Apriori Algorithm, Fuzzy Cluster Index (FCI), Fuzzy Rule.

1 Introductin

Almost every enterprise uses a database to store its vital data and information For instance dynamic websites, accounting information systems payroll systems, stock management systems all rely on internal databases as a container to store and manage their data. In fact, data warehousing is the process of collecting data from operational functional databases, transforming, and then archiving them into special data repository called data warehouse with the goal of producing accurate and timely management information. [1]. A Data Warehouse (DW) is defined as "a subject-oriented, integrated, time-variant non-volatile collection of data in support of management's decision-making process" Data warehouses store huge amount of information from multiple data sources which is used for query and analysis, the data is stored in the multidimensional (MD) structure Multidimensional modeling requires specialized design techniques that resemble the traditional database design methods .[2].

1.1 Data Warehouse Models

The data model mainly used for database designing is the Entity/Relationship model (ERM). This type of model, however, presents problems: as in reality, entities have different characteristics, contain a

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different quantity of data, etc. Therefore it is necessary to adopt a multi-dimensional view. To allow a multi-dimensional visualization of data, techniques have been developed known as “schema”. [3].

- Star schema.
- Snowflake schema.
- Mixed schema.

1.2 Fuzzy Data Warehouse

The numeric values of a classical data warehouse can be difficult to understand for business users, or may be interpreted incorrectly, Therefore for a more accurate interpretation of numeric values, business users require an interpretation in meaningful non-numeric terms fuzzy data warehouse which allows integration of fuzzy concepts directly into the data warehouse By using this approach, the concept of summarize ability is not affected in dimensions as the fuzzy concepts are rolled out in a meta-table structure.The proposed approach is more flexible as it allow integrating and redefining fuzzy concepts without the need for redesigning the core of a data warehouse.[4].

The theory of fuzzy sets facilitates the coding of human knowledge in the form of linguistic concepts. For example, the concept product promotion impact can be scored as low, and high. Each promotion can be assigned degree values (usually between 0 and 1) for each label (e.g., 0.3/low, 0.9/high). Afterwards, these values can be incorporated into a computational framework that will support a decision process (e.g., approval of a promotion).When important business data or business measures or entities are fuzzy, it may be useful to construct a fuzzy data warehouse that can directly support the analysis of fuzzy data.

1.3 Comparison of Classical and Fuzzy Data Warehouse

The following table presents a comparison of the classical and the fuzzy data warehouse model in order to summarize the main advantages of the fuzzy data warehouse approach. [5].

Classical Data Warehouse	Fuzzy Data Warehouse
In a classical DWH, an instance does not belong to more than one class at a time. Because of this, true values of the classification cannot be measured.	Classification of dimension attributes or facts in the FDWH is done in a fuzzy manner, allowing values to belong to more than one class and the classification to be more accurate.
Qualitative interpretation of facts and dimension attributes is not supported in a classical DWH.	A FDWH enables using non-numerical attributes. As a result, both qualitative and quantitative attributes can be used for analysis
Decision-making processes are often verbal. A classical DWH approach does not include any linguistic concept to interpret the data.	The definition of linguistic variables can be derived from the business environment manually. This reduces the effort of interpreting numeric values and facilitates decision-making processes.
Only crisp data is used for analysis and decision making.	Both fuzzy and crisp data can be used for analysis and decision making.
The classical schema consists of dimensions and facts.	The FDWH schema consists of a classical schema together with fuzzy meta tables called fuzzy classification table and fuzzy membership table.
In a classical DWH only extracted data (slices, dices, etc.) can be classified. The classification can therefore not be propagated on other hierarchy levels of dimensions.	In FDWH the fuzzy concepts can be propagated over the dimensions in order to apply the classifications on other hierarchy levels.
The Retrieval of queries in a classical DWH is based on SQL in most cases.	A FDWH can be queried on a linguistic level. For example, fCQL (Meier et al.) allows marketers to classify single customers or customer groups by classification predicates such as ‘loyalty is high and turnover is large

2 Related Work

Lately data warehousing (DW) has gained a lot of attention both from both the industry and research community communities. From the industrial perspective, building an information system for the huge data volumes in any industry requires lots of resources as time and money. Unless those resources add to the industry value, such systems are worthless. Thus, people require that information systems should be capable to provide extremely fast responses to different queries specially those queries that affect decision making. Data warehousing systems address the issue of enabling managers to acquire and integrate information from different sources, and to efficiently query very large databases. The best decisions are made when all the relevant data is taken into consideration. Today, the biggest challenge in any organization is to achieve better performance with least cost, and to make better decisions than competitors. That is why data warehouses are widely used within the largest and most complex businesses in the world. data warehouse (DW) is a collection of consistent, subject-oriented, integrated, time-variant, nonvolatile data along with processes on them, which are based on current and historical information that enable people to make decisions and predictions about the future. The DW is suitable for direct querying and analysis, and it stands as a source for building logical data marts oriented to specific areas of an enter prize.[12]

The authors in [6] presented find out performance optimization and Enhancement techniques which improve the processing time and faster data retrieval in data warehousing .We have seen Performance Optimization and Enhancement Techniques of Data Warehouse. Data Warehousing is not a new phenomenon. All large organizations already have data warehouses, but they had some difficulty to managing them properly. Data warehouse Performance is heavily dependent on proper indexing strategy. B-Tree indexes and bitmapped indexes are suitable. A proper indexing technique is crucial to avoid I/O intensive table scans against large data warehouse tables. It also depends upon the System Configuration and Volume of Data. So proper selecting of right techniques for storing as well as retrieving is necessary for data warehouse other performance improvement schemes that are part of the physical design include the following: data partitioning, data clustering, parallel processing, creation of summaries, adjusting referential integrity checks, proper setting of DBMS Initialization Parameters and Use of Data Array.

The authors in [7] presented this research is to compare some data models considering their data density and their data sparsely management to optimize Data Warehouse environments. In this research paper various techniques for query performance optimization have been explored and a close association of its conceptual aspects with Oracle Warehouse Builder is mapped.

The authors in [9] presented offers analysis and comparison of some of the related facts, which have been drawn from past resources that concern on bitmap indexing for data warehouses. Those resources are reviewed in this research one by one. Due to the importance of DW which is an important element for BI and the main role to improve strategic decision making, this technology is discussed in this research. Moreover, there are many popular techniques are used to enhance the DW treatment queries performance such as indices, views of materialized, and fragmentation of data. The aim of this research is to analyze and to compare many related techniques that concern on bitmap indexing for data warehouses.

The authors in [10] presented new approach of data warehouse minimization by fuzzy-based ETL filter for ETL processes in business intelligence (BI) systems. First part introduces common company

systems and possible data sources in the company. Second part states the problem with interpreting information in BI systems and explains a data representation in the BI systems. Third part of the paper identifies suitable linguistic variables that help with interpreting the data to the user and automated filter as well. We also define a rule base and input and output values of expert system. Last part of the paper proposes a two ways to minimize a data - modification border of the fuzzy set and omitting useless combinations of the linguistic variables and modifiers.

The authors in [11] presented a model of a web-based system for knowledge warehousing and mining of diagnosis and therapy of HIV/AIDs using Fuzzy Logic and data mining approach. A model was developed, using the predictive modeling technique, for predicting HIV/AIDs and monitoring of patient health status. The fuzzy inference rule and a decision support system based on cognitive filtering was employed to determine the possible course of action to be taken. A case study of some data of PLWH was used and the result obtained shows that the developed system is efficient. The system uses XAMP on Windows OS platform. The system was tested and evaluated with satisfactory results.

The authors in [13] presented in some steps, a comparative study between the index B-tree and Bitmap type, their advantages and disadvantages, with a real experiment based on two factors: size of index and clustering factor, this shows that the Bitmap index is more advantageous than the B-tree one. By using the B-tree index, the optimizer opted for a full table scan; this operation makes a higher clustering factor, whereas in the case of bitmap index that makes a low Clustering factor, he used to answer the query. You can deduct the performance by the number of I / O required fetching the result.

3 Proposed Methodology

Characteristics of Proposed System: our Proposed system used to improve and speed up Queries fuzzy rule and process of decision making and management medical (items), i.e., we merged the fuzzy rule with cluster index technique. Where the proposed technique is named Fuzzy Cluster Index technique (FCI), the performance evaluation of three data warehouse queries is focused in this paper by comparing with Fuzzy cluster index (FCI), Fuzzy Rule and Index-based Apriori Algorithm to observe the results of variable size dataset with respect to time. Figure 1: Shows our proposed System.

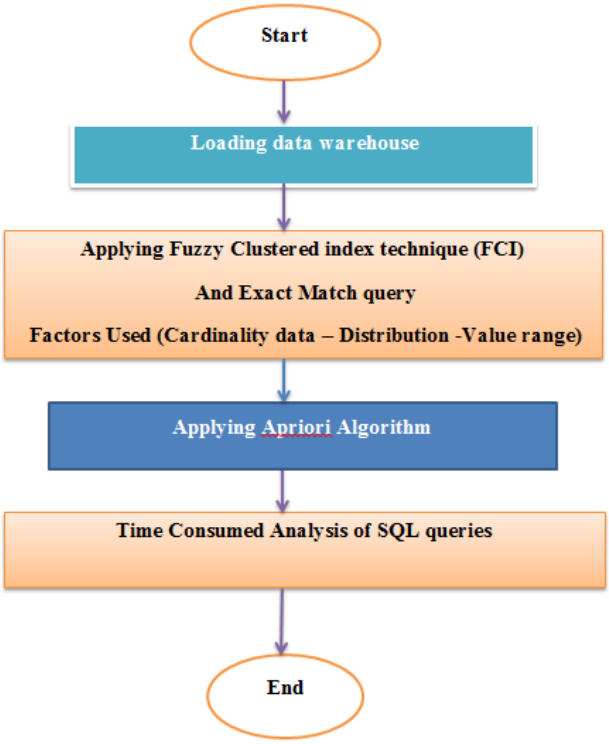

Figure 1: Our proposed System

The Potential problems: In this section, will explain the potential problems that facing of data warehouse users, and the most important cases that may be exposed to data warehouse users, and proposed solution for this cases:

- Using large amounts of data in applications data warehouse and the search process takes a great time, lead to not good decisions by decision-makers.
- Data warehouses are used for analysis of businesses performance. Potential pitfall of the classical data warehouse is that the numeric values of a data warehouse may be difficult to interpret for business users, or may be interpreted incorrectly. For more accurate understanding of numeric values, business users require an interpretation in meaningful, non-numeric terms.

The proposed technical to solve the problem:

in this work a specific system applying fuzzy logic to improve the search in the data warehouse and to reduce the time of the search in a data warehouse that will help decision makers to take the decision easily and more flexible because the fuzzy logic is based on natural language.

3.1 System components:

3.1.1 Apriori Algorithm:

Apriori is very much basic algorithm of Association rule mining. It was initially proposed by R. Agrawal and R Srikant for mining frequent item sets. This algorithm uses prior knowledge of frequent item set properties that is why it is named as Apriori algorithm. Apriori makes use of an iterative approach known as breath-first search, where k-1 item set are used to search k item sets. There are two main steps in Apriori. 1) Join - The candidates are generated by joining among the frequent item sets level-wise. 2) Prune- Discard items set if support is less than minimum threshold value and discard the item set if its subset is not frequent [15].

3.1.2 How Index-based Apriori Algorithm Work

The work steps of Index-based Apriori algorithm are explained in detail with examples. These steps are divided to two main parts which are:

1) Steps of generating candidate and supported item sets.

2) Steps of generating association rules from supported item sets.

1) Steps of Generating Candidate and Supported Item sets

The work steps of the first part of the Index-based Apriori algorithm for generating candidate and supported item sets are explained in detail through example, and figure shows the work mechanism of these steps. [8].

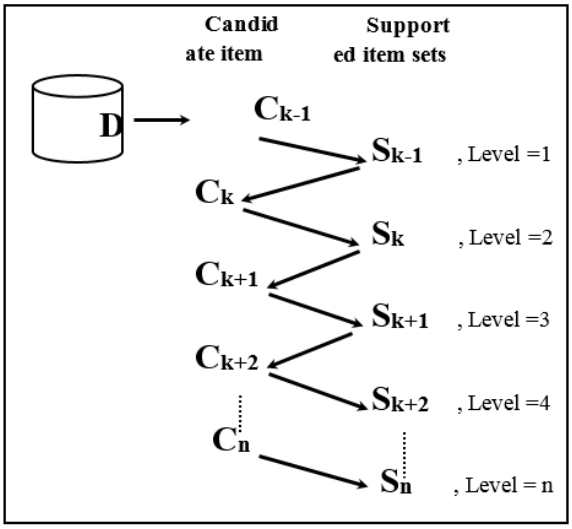

Figure 2: Diagram illustrating the Index-based Apriori algorithm mechanism for finding large set of supported item sets [8]

D is the database of items.
Ck is the set of candidate itemsets (supported and unsupported itemsets)
Sk is the set of supported itemsets
k is the number of level

Figure 3 demonstrates the steps (levels) of Index-based Apriori algorithm generating for candidate and supported item sets, where (*) refers to the join process and (**) Refer to the pruning method supposing that (mincount = 3), where the counts of Item sets are calculated by applying Indexing technique:

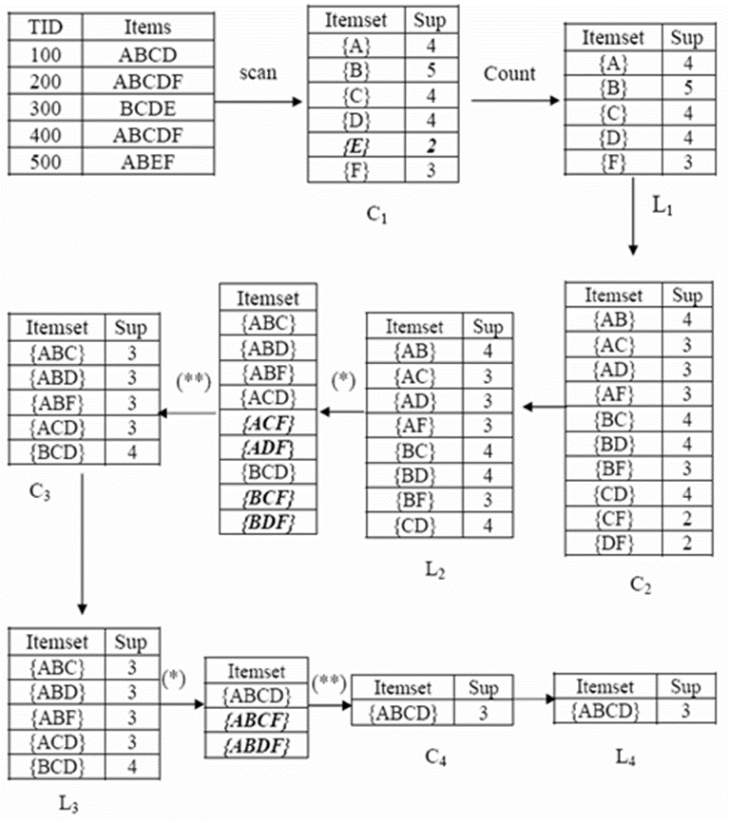

Figure 3: The Steps of Generating Candidate and Supported Item sets [8]

3.2 Fuzzy logic system

The basic configuration of a fuzzy logic system with fuzzifier and defuzzifier. This type of fuzzy logic system was first proposed by Mamdani. The main fours components' functions are shown in figure 4 below. [14].

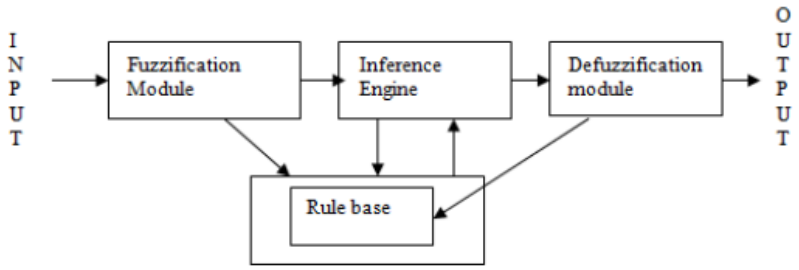

Figure 4: Fuzzy logic system

Fuzzification module: This module does a mapping from input to a fuzzy set.

Fuzzy Rule Base: Fuzzy logic systems use fuzzy IF-THEN rules. In a fuzzy logic system, the collection of fuzzy IFTHEN rules is stored in the fuzzy rule base which is referred to by the inference engine when processing inputs.

Fuzzy Inference Engine: previously all input values have been fuzzified into their respective linguistic values; the inference engine will access the fuzzy rule base of the fuzzy expert system to derive linguistic values for the intermediate as well as the output linguistic variables. The two main steps in the inference process are aggregation and composition. Aggregation is the process of computing for

the values of the IF (antecedent) part of the rules while composition is the process of computing for the values of the THEN (consequent) part of the rules.

Defuzzification module: Defuzzifier does a mapping from the fuzzy output to the crisp output.

3.3 How Clustered Index Work

It is a type of index in which the data is arranged in distinct order (in sequence) which means clustered index determines the physical order of data in table. It is beneficial when there is need to access the records sequentially or in the reverse order. There can only be one clustered index per table, because the data rows themselves can only be sorted in one order. There are row locators which is clustered index key on the row. The only time the data rows in a table are stored in sorted order is when the table contains a clustered index. If a table has no clustered index, its data rows are stored in a heap. [16].

Example:

When creating a clustered index on First Name column, the data in the table is physically alphabetically sorted based on First Name value. When inserting a new row into the database, it will be inserted in a certain position so that the sorting is still kept.

1. The leaf nodes represent the actual data pages while the intermediate nodes of the tree structure are index pages. All the pages in the structure are linked.
2. The top node in the structure is the root index page, while the middle level nodes are intermediate index pages.
3. Each row in an index page refers either another index page or a data page. This reference is a pointer to a page number.

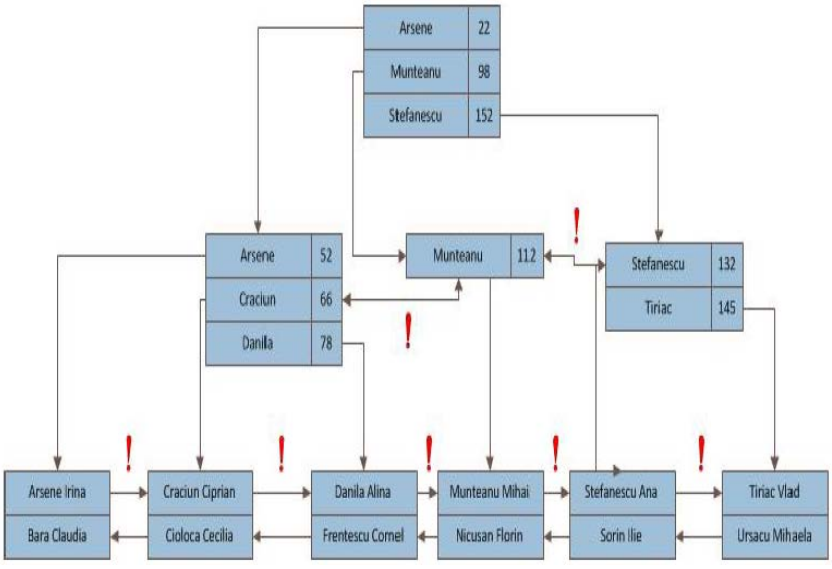

Figure 5: The structure of the clustered index [17]

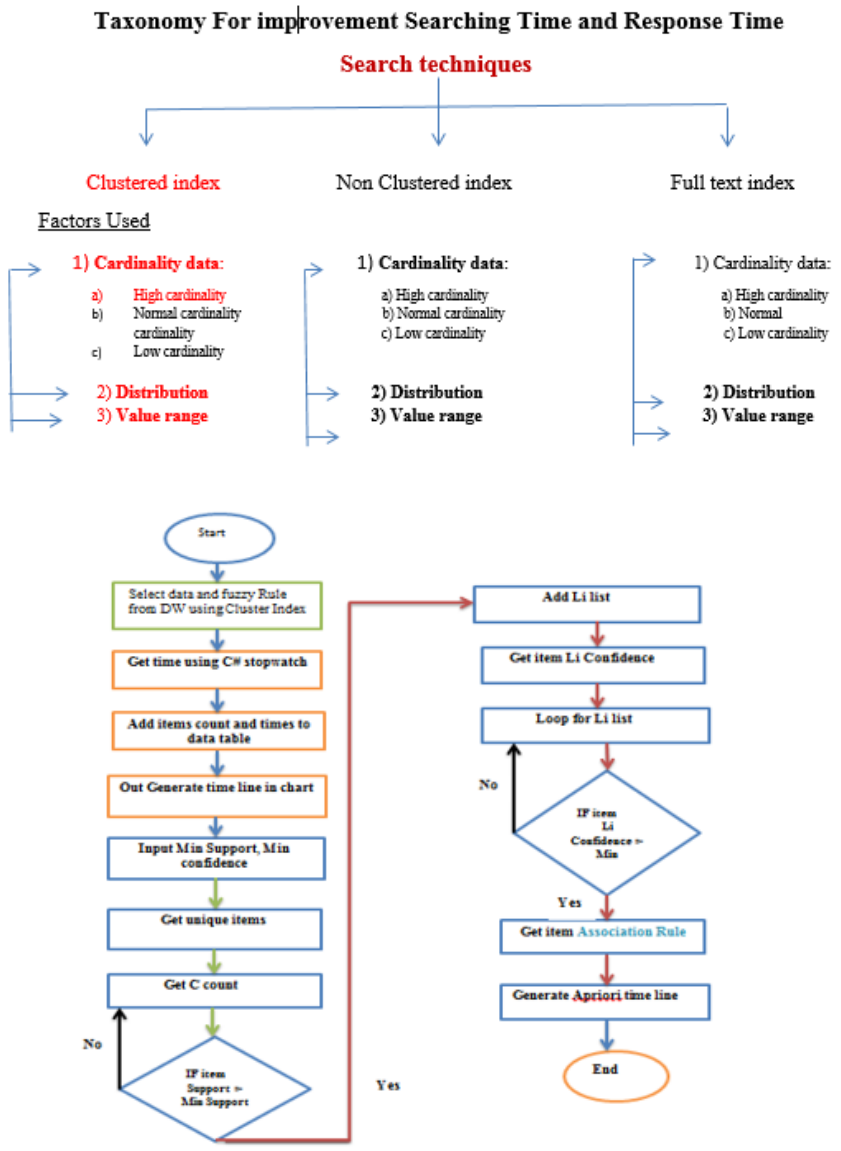

Figure 6: The proposed System architecture to improve searching in DW

Data flow in system architecture:

There are three scenarios for the data flow in the system:

- The first scenario begins the process of recording selected data and Fuzzy Rule from Data Warehouse and using Cluster Index to speed up Queries Fuzzy Rule.
- The second scenario begins the process execution Apriori Algorithm and on the same size of data that has been execution technique Fuzzy Rule Cluster index (FCI) them.
- The third scenario begins the Process execution Fuzzy Rule without Cluster Index and on the same size of data that has been execution first scenario and second scenario.

The results comparison between the three scenarios to demonstrate the technique evaluation of the proposed Fuzzy Rule cluster Index in terms of search time in the selected data from the Data Warehouse.

4 Experiments and Results

4.1 Research Material

4.1.1 Used Device:

The algorithm, presented in this thesis, is implemented with a laptop DELL model with the following specifications of Intel® Core(TM)i5 2430 M CPU @ 2.40 GHz 2.40 GHz with 8 GB RAM, system type 64-bit operating system. This machine is equipped with operating system Windows 7 Ultimate.

4.2 Research Results:

4.2.1 First experiment:

In the first experiment, shows from Table 1 and Figure 7 in SQL,"WHERE. Key word can use for searching of exact keyword in tables of data set. The Index-based Apriori Algorithm consumption is increasing, Fuzzy Rule time consumption is much less. But Fuzzy Cluster index technique (FCI) takes less time. Fuzzy Cluster index (FCI) gives better searching in exact matching of string and results good performance.

Table 1: comparison between the three techniques

Items	Fuzzy Cluster Index (FCI) Time/ S	Fuzzy Rule without Cluster Index Time/ S	Apriori Algorithm Time/ S	Mini Supp	Mini Conf
393665	7.0277	10.0598	87.3459	10	5
207199	5.9843	8.1338	46.7846	10	0
144808	3.3231	7.5228	42.4740	5	5
41658	0.5991	6.3775	12.3150	3	0

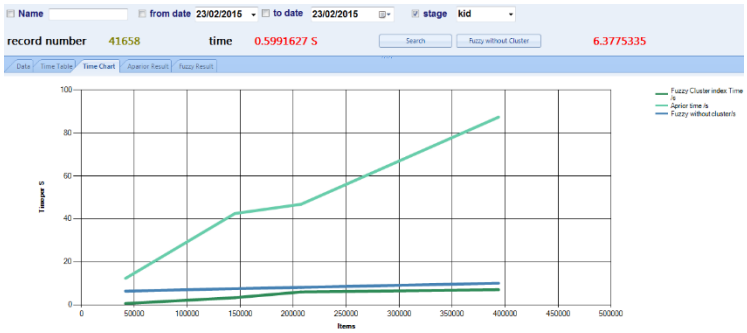

Figure 7: comparison between the three techniques

4.2.2 Second experiment:

In this Second experiment , we show table 2, Figure 8 The Index-based Apriori Algorithm time consumption is 232.7087 s, because the manager chose in Index-based Apriori Algorithm for minimum support= 2 and minimum confident=2 leads to a large search time and the loss of a small number of data and frequent large for data. fuzzy rule the time consumption is much less nearly 220 s approx. Fuzzy Cluster index technique (FCI) takes less time for searching even the records in Data Warehouse are increasing. The Fuzzy Cluster Index technique (FCI) and Fuzzy Rule having the equal elapsed time approx. but Index-based Apriori Algorithm elapsed time having the much elapsed time as the records are increasing from 41658 item to 393665 item.

Table 2: comparison between the three techniques

Items	Fuzzy Cluster Index (FCI) Time/ S	Fuzzy Rule without Cluster Index Time/ S	Apriori Algorithm Time/ S	Mini Supp	Mini Conf
393665	7.4687	10.4023	232.7087	2	2
207199	6.0426	8.003	61.3984	2	0
144808	3.8084	7.4670	42.8171	2	2
41658	0.5655	6.4057	13.1205	1	0

Figure 8: comparison between the three techniques

4.2.3 Third experiment:

In this third experiment, we show table 3, Figure 9 The Index-based Apriori Algorithm time consumption is 24.6466 s, the Index-based Apriori Algorithm searching time better in results good performance of the first and second experiment. Because the manager chose minimum support= 20 and minimum confident=20 leads to a less search time and the loss of a large number of data and few frequent for data. Fuzzy Cluster index technique (FCI) takes less time for searching .The Fuzzy Cluster Index technique (FCI) and Fuzzy Rule having the equal elapsed time approx.

Table 3: comparison between the three techniques

Items	Fuzzy Cluster Index (FCI) Time/ S	Fuzzy Rule without Cluster Index Time/ S	Apriori Algorithm Time/ S	Mini Supp	Mini Conf
393665	7.5840	10.2561	24.6466	20	20
207199	6.1275	8.1139	18.1953	20	10
144808	3.2327	7.5252	12.5262	20	0
41658	0.5683	6.3683	9.4308	10	0

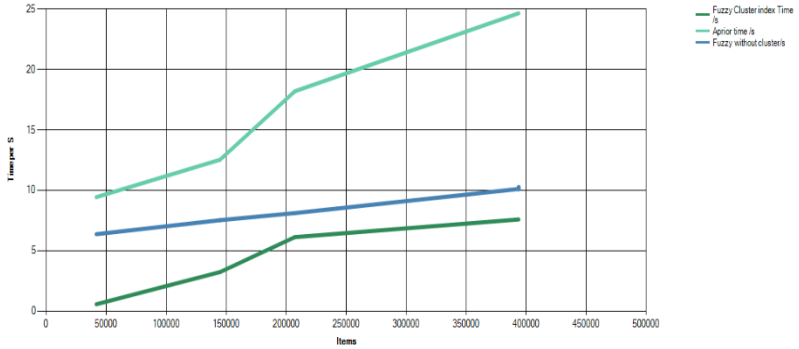

Figure 9: comparison between the three techniques

4.2.4 Fourth experiment:

In this fourth experiment, we show from Figure 10. Cluster index takes much time than other indexes and on the contrary, it takes less memory nearly 500 KB approx. Full text index consumes more memory and on the contrary, it gives best performance than others. After 5 lakh records in full text index, the memory size varies in less but after 8 lakh, memory size hike from 3000 KB to 5000 KB.[16].

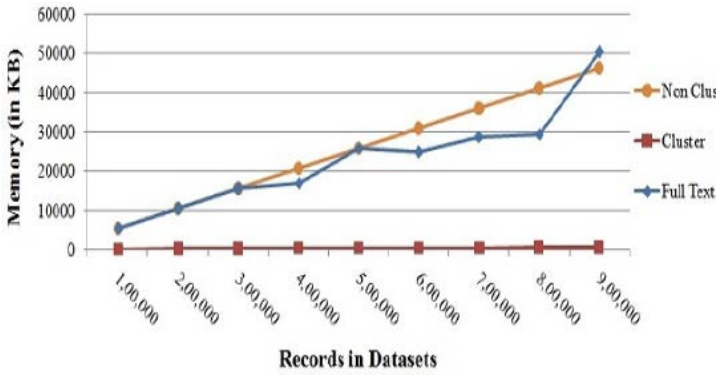

Figure 10: Indexes Memory consumption analysis [16]

5 Summary

In show [27] Figure 10 Cluster Index technique it consumed few memory comparatively other techniques which is costly for large data warehouse.

Note from the second and third experiment that the manager should the required expertise in data management because it determines the minimum support and minimum confidence.

Second experiment, the Index-based Apriori Algorithm time consumption is 24.6466 s. Because the manager chose minimum support= 20 and minimum confident=20 leads to a less search time and the loss of a large number of data and few frequent for data.

third experiment, the Index-based Apriori Algorithm time consumption is 232.7087 s, because the manager chose in Index-based Apriori Algorithm for minimum support= 2 and minimum confident=2 leads to a large search time and the loss of a small number of data and frequent large for data.

6 Conclusion and Future Work

Medical data warehouse is the central management system where, matching and searching are important operations. The traditional data warehouse was designed in such a manner that it can efficiently manage transactional data which is highly dominated by numerical information where as in medical data warehouse textual and non-transactional information is encountered. The data set which contains text data is accessed over the network on the daily basis and performance issue arises. The aim of this paper is to propose Fuzzy Rule with an indexing technique based on few time for data warehouse used in application of medical field. The performance evaluation of three data warehouse queries is focused in this paper by comparing used with Fuzzy cluster index technique (FCI) and to observe the results of variable size data set with respect to time. Different three techniques in our proposed system has been used and analyzed using different types of queries on different size of data sets in medical data warehouse in order to perform operation in efficient manner. Fuzzy Cluster Index technique (FCI) provides better performance than Fuzzy Rule and Index-based Apriori Algorithm.

Future work can add fuzzy logic type 2 for improve performance data Warehouse by reducing the table or index fragmentation. And taking the views of users to identify possible queries that are used in the design of fuzzy rules.

REFERENCES

[1] Y. Bssil, "A Data Warehouse Design for A Typical University Information System", LACSC – Lebanese Association for Computational Sciences Registered under No. 957, 2011, Beirut, Lebanon. Journal of Computer Science & Research (JCSCR) Vol. 1, No. 6, December 2012, pp. 12-17.

[2] R. Jindal1, and S. Taneja2 "COMPARATIVE STUDY OF DATA WAREHOUSE DESIGN APPROACHES: A SURVEY" 1 Associate Professor, Dept. of Computer Engineering, Delhi Technological University Formerly Delhi College of Engineering (DCE), Bawana Road, Delhi-42. 2 Research Scholar, Dept. of Computer Engineering, Delhi Technological University Formerly Delhi College of Engineering (DCE), Bawana Road, Delhi-42. International Journal of Database Management Systems (IJDMS) Vol.4, No.1, February 2012, pp.33-45.

[3] C. Gallo, and M. De Bonis, and M. Perilli "Data Warehouse Design and Management: Theory and Practice" IEEE MEMBERS. DIPARTIMENTO DI SCIENZE ECONOMICHE, MATEMATICHE E STATISTICHE UNIVERSIT`A DI FOGGIA Largo Papa Giovanni Paolo II, 1 - 71121 Foggia, Italy, Quaderno n. 07/2010, pp.1-18.

[4] D. Fasel, and K. Shahzad "A Data Warehouse Model for Integrating Fuzzy Concepts in Meta Table Structures" Information System Research Group Department of Informatics University of Fribourg Boulevard de Prolles 90 ,1700 Fribourg, Switzerland and Information Systems Laboratory Department of Computer and System Science Royal Institute of Technology (KTH) Forum 100, SE 164 40, Stockholm, Sweden,2010,pp.1-10.

[5] L. Sapir, and A. Shmilovici,"A Methodology for the Design of a Fuzzy Data Warehouse" Member IEEE, Lior Rokach, 2009, pp.1-8.

[6] M. Kokate, and Sh. Karwa, and S. Suman, and Prof. R. Chavan, "Performance Enhancement Techniques of Data Warehouse" International Conference on Advanced Computing and Communication Technologies, 2011, pp.67-72.

[7] A. Kumar, and D. Singh, and Dr. V. Sharma, "Achieving Query Optimization Using Sparsity Management in OLAP System" International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT),2014,pp.797-801.

[8] Dr. M. M. Hamad, and B. Anwer, "Applying the Concept of Knowledge Warehouse in Enterprise Resources Management" MSC . Thesis, Iraq, 2013

[9] F. Kausar1, and Sh. Odah Al Beladi, and K. AL Shammari, "Comparative Analysis of Bitmap Indexing Techniques in Data Warehouse"International Journal of Emerging Technology and Advanced Engineering, VoL 4, no.1. 2014, pp.34-41.

[10] J. Zacek, and F. Hunka, “Data warehouse minimization with ELT fuzzy filter" Advances in Information Science and Applications, Vol II, 2014, pp.450-454.

[11] Igodan C. E, and Akinyokun O.C, and O. Olatubosun, "ONLINE FUZZY-LOGIC KNOWLEDGE WAREHOUSING AND MINING MODEL FOR THE DIAGNOSIS AND THERAPY OF HIV/AIDS" International Journal of Computational Science and Information Technology, Vol.1, No.3, 2013, pp.27-40.

[12] M. El-Wessimy, and H. M.O. Mokhtar, and O. Hegazy, "ENHANCEMENT TECHNIQUES FOR DATA WAREHOUSE STAGING AREA" International Journal of Data Mining & Knowledge Management Process (IJDKP) Vol.3, No.6, 2013,pp.1-19.

[13] El. Aoulad Abdelouarit, and M. El Merouani, and A. Medouri, "The impact of indexes on data warehouse performance" International Journal of Computer Science Issues, Vol. 10, No 2, 2013, pp.34-37.

[14] K. Babar, and A. Gosain, "PREDICTING THE QUALITY OF OBJECT-ORIENTEDMULTIDIMENSIONAL (OOMD) MODEL OF DATA WAREHOUSE USING FUZZY LOGIC TECHNIQUE" [IJESAT], Vol 2, pp.1048-1054.

[15] Ms. R. Raval, and Prof. I. Rajput, and Prof. V. Gupta, " Survey on several improved Apriori algorithms" Journal of Computer Engineering (IOSR-JCE), Vol 9,2013,pp.57-61.

[16] A. Bansal, and S. Arora, "Performance Measurement of Indexing Techniques Used in Biomedical Databases" International Journal of Scientific & Engineering Research, Vol 3, 2012, pp.1-5.

[17] C. CIOLOCA, and M. GEORGESCU, "Increasing Database Performance using Indexes" Database Systems Journal, vol. II, no. 2, 2011, pp.13-22.

