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Requisite for Web Usage Mining – A Survey

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Abstract **-** The World Wide Web (Web) has been providing an important and indispensable platform for receiving information and disseminating information as well as interacting with society on the Internet. With its astronomical growth over the past decade, the Web becomes huge, diverse and dynamic. The application of data mining techniques to the web is called Web Mining. Web Mining aims to discover interesting patterns in the structure, the contents and the usage of web sites. An indispensable tool for the webmaster, it has, nevertheless, a long road ahead in which visualisation plays an important role. Currently, Web mining techniques has emerged as an important research area to help Web users find the information needed. This paper is an effort in analysing the views and methodologies stated by various authors on various processes in mining the web.

Key words **-** *Data Pre-processing, Information Retrieval, Pattern Analysis, Pattern Discovery, Personalization, Web Mining.*

I. INTRODUCTION

Magnanimous amount of resource is found for the people on the web which the people use to search for pages depending on their needs. Web mining research is an area which is fast moving and has encountered a great number of challenges such as scalability, spam, content quality, unstructured data and so on [5]. Web usage Mining is the application of data mining techniques to Web click stream data in order to extract usage patterns .As Web sites continue to grow in size and complexity, the results of Web usage mining have become critical for a number of applications such as Web site design, business and marketing decision support, personalization, usability studies and network traffic analysis. The two major challenges involved in Web usage mining are pre-processing the raw data to provide an accurate picture of how a site is being used, and filtering the results of the various data mining algorithms in order to present only the rules and patterns that are potentially interesting [10]

The following sections brief about web mining. Sections 2 describes the journey of web, Section 3 elaborates on the web mining concept, 3.1, 3.2 and 3.3 will explain content, structure and usage mining respectively. Section 4 describes the areas where web mining can be applied. In Section 5 future work and the conclusions are discussed.

II. PROGRESSION OF THE WEB

The term Web Mining was coined by O. Etzioni. In 1996 he checked out whether effective Web mining is feasible in practice. He believed that the Web is too unstructured for Web mining to succeed. He has stated that effective search and retrieval are enabling technologies for realizing the full potential of the Web. Furthermore, much of the information on the Web is presented in natural language text with no machine readable semantics; HTML annotations structure the display of Web pages, but provide little insight into their content [34].

In 1998 Alex G. Biichner, Maurice D. Mulveena proposed a concept which included marketing expertise and combined existing online analytical mining as well as web usage mining approaches .A generic web log data hypercube is formally defined and schematic designs for analytical and predictive activities are given. From these materialized views, various online analytical web usage data mining techniques are shown, which include marketing expertise as domain knowledge and are specifically designed for electronic commerce purposes [35].

A very challenging task faced by researchers is to make predictions, according to frequent patterns coming from the analysis of an access log file [36]. In order for the obsolescence of the behavioural patterns to become

as null as possible, the ideal method would provide frequent patterns in real time, allowing the result to be available immediately. They proposed a method in 2001 which allows us to find frequent behavioural patterns, whatever the number of connected users is.

In 2006, Natheer Khasawneh and Chien-Chung Chan presented new techniques for preprocessing web log data including identifying unique users and sessions. They introduced a fast active user-based user identification algorithm with time complexity of O (n). In July 2007, I-Hsien Ting, Chris Kimble and Daniel Kudenko proposed a users browsing behavior analysis approach which is based on applying web usage mining techniques. Two web usage mining techniques in the approach are introduced, including Automatic Pattern Discovery (APD) and Co-occurrence Pattern Mining with Distance Measurement (CPMDM). A combination method is also discussed to show how potential browsing problems can be identified [36]. In Dec 2007, they focused on extraction of Sequential Patterns (SPs) with very low support from a large pre-processed Web usage data, to discover the behaviors of minority users of a Web site. They presented an approach for discovering and tracking evolving user profiles. They also described how the discovered user profiles can be enriched with explicit information need that is inferred from search queries extracted from Web log data. Profiles are also enriched with other domain specific information facets that give a panoramic view of the discovered mass usage modes. The study reveals that discovery of such Sequential Patterns by a traditional SPM algorithms were impractical. In Feb 2008, they proposed a complete framework and findings in mining Web usage patterns from Web log files of a real Web site that has all the challenging aspects of real-life Web usage mining, including evolving user profiles and external data describing ontology of the Web content. They also described how the discovered user profiles can be enriched with explicit information need that is inferred from search queries extracted from Web log data. Profiles are also enriched with other domain specific information facets that give a panoramic view of the discovered mass usage modes.

III. ANATOMY OF WEB MINING

Web mining aims to discover useful information or knowledge from the Web hyperlink structure, page content, and usage data. Although Web mining uses many data mining techniques, it is not purely an application of traditional data mining due to the heterogeneity and semi-structured or unstructured nature of the Web data. Many new mining tasks and algorithms were invented in the past decade.

Web Mining is the use of data mining techniques to automatically discover and extract information from World Wide Web documents and services [7]. According to analysis, these methods can be divided into three different types, including Web content mining, Web structure mining and Web usage mining [6] as in Fig. 1. In all three areas, a wide range of general data mining techniques, in particular association rule discovery, clustering, classification, and sequence mining, are employed and developed further to reflect the structures of Web resources and the questions posed in Web Mining.

3.1 Web Content Mining

Web content mining focuses on the discovery of useful information from the web contents[38]. The Web content consists of a large variety of different types of data. The two most important characteristics of WWW data are large volume and heterogeneity. Dealing with problems in these two aspects, Web content mining can be categorized into IR view (agent-based approach) and DB view (database approach).

In the DB view, Web content mining task is to integrate and organize the heterogeneous and semi-structured Web data into well-organized and high-level collections of resources, such as relational databases, to provide more sophisticated Integrating Web Content Mining into Web Usage Mining for queries instead keyword-based searches. [38].

The applications include categorization, clustering, finding extracting rules, finding patterns in text, as well as user modeling. N-grams, bag of words, terms, phrases, concepts and ontologies are usually used to represent these documents. Document clustering is an important part of the Web content mining

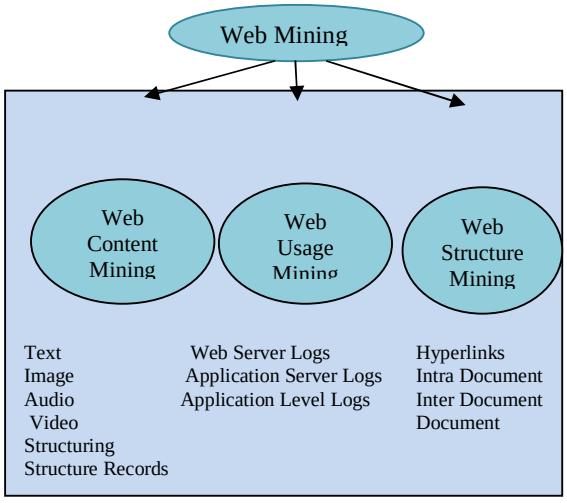

Fig. 1 : Web Mining Anatomy

3.2 Web Structure Mining

This can be defined in terms of graph structure. Nodes are identified by Web pages and edges by hyperlinks. The idea behind Web Structure Mining is to obtain structured summaries about information on web pages/webs. It shows the links between pages. This can further be divided into Hyperlinks and Document Structure based on the type of structural data used.

A Hyperlink is a structural unit that connects a Web page to different location, either within the same Web page or to a different Web page. A hyperlink that connects to a different part of the same page is called an Intra-Document Hyperlink, and a hyperlink that connects two different pages is called an Inter-Document Hyperlink. There has been a significant body of work on hyperlink analysis. [33]

3.3 Web Usage Mining

Web Usage Mining is the application of data mining techniques to discover interesting usage patterns from Web data, in order to understand and better serve the needs of Web-based applications [35]. Usage data captures the identity or origin of Web users along with their browsing behavior at a Web site. Web usage mining itself can be classified further depending on the kind of usage data considered. There are three main tasks for performing Web Usage Mining or Web Usage Analysis. The process of Web Usage Mining is shown in Fig. 2.

3.3.1 Pre-Processing

Data Pre-Processing has a number of open issues like Data Collection, Data Integration and Transaction Identification. Pre-processing consists of converting the usage, content, and structure information contained in the various available data sources into the data abstractions necessary for pattern discovery. Log file pre-processing consists of data cleansing, user identification, session identification. In data cleansing irrelevant records are eliminated. Records with GIF, JPEG, CSS and so on as suffixes are eliminated. In the second step, we have the task of user and session identification is to find out the different user sessions from the original web access log. One way is to bifurcate them based on their IP addresses.

3.3.2 Pattern Discovery

Pattern Discovery is the key component of the Web mining, which converges the algorithms and techniques from data mining, machine learning, statistics and pattern recognition etc research categories. Once user transactions or sessions have been identified, there are several kinds of access pattern mining that can be performed depending on the needs of the analyst, such as path analysis, discovery of association rules and sequential patterns and clustering and classification. Path analysis could be used to determine most frequently visited paths in a Web site so that they can be recommended further to the user. Normally a transaction consists of a set of items. In this case we apply Association rule discovery techniques [39,40] to databases In such a framework the problem is to discover all associations. In of Web mining an example of an association rule is the correlation among accesses to various files on a server by a given client For example using association rule discovery techniques we can find the following correlations (i)60% of clients who accessed the page with URL/company/products also accessed the page company/products/product1.html also accessed company/products/product2.html and (ii) 30% of clients who accessed the Web page with URL /company/special-offer.html placed an online order in company/products/product1.In Web mining additional properties of data can be used to prune the search space since information about a site's structural hierarchy can be used For example if the support for /company/products/ is low one may conclude that the search for association between the two secondary pages with URLs /company/products/product1 and /company/products/product2 should be pruned since neither are likely to have adequate support . According to [29,30] sequential patterns are used to find the intertransaction patterns i.e. the presence of a set of items followed by another item in the time stamp ordered transaction set given a database of time stamped transactions.

By analysing this information we can determine temporal relationships among data items such as (i) 30% of clients who visited /company/products/product1.html had done a search in Yahoo within the past week on keywords w1 and w2 and (ii) 30% of clients who placed an online order in /company/products/product1.html also placed an online order in /company/products/product4 within 15days. Another important kind of information we may b e interested in is the common characteristics of all clients that visited a particular file within the time period [t1, t2]. Alternatively we may b e interested in a time interval ie

an hour day or week during which a particular file is most accessed. [1]

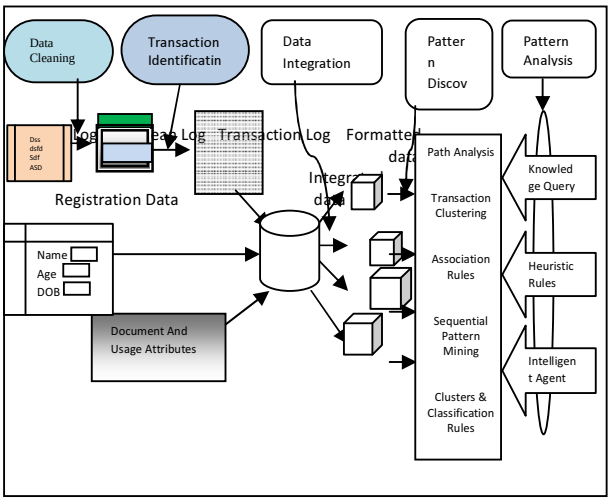

Fig. 2:Web Usage Mining

In Web mining, classification techniques allow one to develop a profile for clients who access particular server files based on demographic information available on those clients, or based on their access patterns. For example classification on WWW access logs may lead to the discovery of relationships such as the following:

- Clients from state or government agencies who visit the site www.kleit.ac.in tend to be interested in the details of that college
- Around sixty percent of the clients, who placed an online order in /company/products /soaps, were in the 35-45 age group and lived in Karnataka.

In [27,28] they have proclaimed that Clustering analysis allows one to group together clients or data items that have similar characteristics. Clustering of client information or data items on Web transaction logs, can facilitate the development and execution of future marketing strategies, both online and off-line, such as automated return mail to clients falling within a certain cluster, or dynamically changing a particular site for a client, on a return visit, based on past classification of that client. For web usage mining, clustering techniques are mainly used to discover two kinds of useful clusters, namely user clusters and page clusters. User clustering attempts to find groups of users with similar browsing preference and habit, whereas web page clustering aims to discover groups of pages that seem to be conceptually related according to the users' perception. Such knowledge is useful for performing market segmentation in ecommerce and web personalization applications.

A number of clustering algorithms are present like K Means Clustering Algorithm, Clustering using Similarity Upper Approximation, Fuzzy, K Modes, Fuzzy K Modes, Subtractive Clustering, Clustering using silhouette co-efficient

3.3.3 Pattern Analysis

Pattern Analysis is the final stage of the Web usage mining. The goal of this process is to eliminate the irrelative rules or patterns and to extract the interesting rules or patterns from the output of the pattern discovery process. Analysis methodologies and tools: query mechanism like SQL, OLAP, Visualization etc. This is a very fertilized research area. The discovery of Web usage patterns, carried out by techniques described earlier, would not be very useful unless there were mechanisms and tools to help an analyst better understand them. Hence, in addition to developing techniques for mining usage patterns from Web logs, there is a need to develop techniques and tools for enabling the analysis of discovered patterns. These techniques are expected to draw from a number of fields including statistics, graphics and visualization, usability analysis, and database querying. Usage analysis of Web access behavior being a very new area, there is very little work in it, and correspondingly this survey is not very extensive. Visualization has been used very successfully in helping people understand various kinds of phenomena, both real and abstract. Hence it is a natural choice for understanding the behavior of Web users.

In [26] they have illustrated a system for visualizing WWW access patterns Here sets of server log entries are used to extract sub sequences of Web traversal patterns called Web paths. This system allows the analyst to selectively analyse the portion of the Web that is of interest by One of the reasons attributed to the great success of relational database technology has been the existence of a high-level, declarative, query language, which allows an application to express what conditions must be satisfied by the data it needs, rather than having to specify how to get the required data. Given the large number of patterns that may be mined, there appears to b e a definite need for a mechanism to specify the focus of the analysis. Such focus may be provided in at least two ways. First, constraints may be placed on the database (perhaps in a declarative language) to restrict the portion of the database to be mined for. Second, querying may be performed on the knowledge that has been extracted by the mining process, in which case a language for querying knowledge filtering out the irrelevant portions. The Web is visualized as a directed graph with cycles, where nodes are pages and edges are (inter-page) hyperlinks. On-Line Analytical Processing (OLAP) is emerging as a powerful paradigm for

strategic analysis of databases in business settings. It has been recently demonstrated that the functional and performance needs of OLAP require that new information structures b e designed.

This has led to the development of the data cube information model [41], and techniques for its efficient implementation [42, 43, 45]. Recent work [44] has shown that the analysis needs of Web usage data have much in common with those of a data warehouse, and hence OLAP techniques are quite applicable. The access information in server logs is modelled as an append-only history, which grows over time. Since the size of server logs grows quite rapidly, it may not b e possible to provide on-line analysis of all of it. Therefore, there is a need to summarize the log data, perhaps in various ways, to make its on-line analysis feasible. Making portions of the log selectively (in)visible to various analysts may be required for security reasons.[46]

IV. APPLICATIONS

4.1 Health care is one of the areas where a lot of web mining work could be done. Tracking down whether the Information retrievers are doctors, patients or employers is a very tedious task. Recommending genome based medicine are all approaches to Personalization. In [26], an automatic and autonomous methodology to discover taxonomies of terms from the Web and represent retrieved web documents into a meaningful organization

4.2 Agriculture is another domain where our work could be used. It could be used for producing interesting recommendations to organic farmers/growers.

4.3 Web-based learning environments provide the students with new opportunities for learning. Many cognitive, meta-cognitive and affective aspects of learning which are relevant to the way students control their learning and implement it online - such as self-regulation, self-efficacy and autonomousity - might be reflected by the hidden traces they leave in log files [31,36]. In [39], we have demonstrated the potential of using log file analysis for enhancing our understanding of the online learning process.

4.4 The main purpose in mobile content personalization, is to know the needs of the users, and formulate methods on how to customize the contents and deliver to the user' at the right time.

4.5 E-Commerce is another area where this approach could be used. The best way to accomplish this is to streamline and personalize web page interfaces for customers so that browsing is an efficient and enjoyable process, while at the same time, increasing e-business operations.

V. CONCLUSIONS AND THE ROAD AHEAD

The survey done above has given an insight into some of the findings. Web is an area which can be mined for a lot of research. Various issues were addressed. Foremost amongst them is the identification of the users. Identifying them based on their browsing patterns is a very crucial. If we don't identify the users accurately, then the later part of the analysis will be erroneous. The term Web mining has been used to refer to techniques that encompass a broad range of issues. However, while meaningful and attractive, this very broadness has caused Web mining to mean different things to different people (Han, 1996), and there is a need to develop a common vocabulary. This provides a wide scope for research in semantic web mining and keeping track of dynamic interests of users.

Since one of the principal goals of the Web is to act as a world-wide distributed information resource, a number of efforts are underway to develop techniques that will make it more useful in this regard. The term Web mining has been used to refer to different kinds of techniques that encompass a broad range of issues. We assume that the future of Web Mining will be more acquiescent to people from various backgrounds. In this area the tools are becoming extremely simpler to use and the data available on the web is growing exponentially.

REFERENCES

[1] Bamshad Mobasher, Namit Jain, EuiHong, Sam Han, Jaideep Srivastava, "Web Mining Pattern Discovery from World Wide Web Transactions", SIGMOD'96, Workshop on Research Issues on Data Mining and Knowledge Discovery 1996, pp 33-47

[2] Raymond Kosala, Hendrick Blockeel , "Web Mining Research: A Survey", SIGKDD, 2000, pp. 1-15.

[3] A.G. Büchner, M. Baumgarten, S.S. Anand, M.D. Mulvenna, J. G. Hughes, "Navigation Pattern Discovery from Internet Data", in WEBKDD, San Diego, CA 1999,pp 26-29

[4] Jaideep Srivastava, Robert Cooley, Mukund Deshpande, Pang-Ning Tan , " Web Usage Mining: Discovery and applications of usage patterns from Web Data", 2002

[5] M. Henzinger, R. Motwani, and C. Silverstein," Challenges in web search engines", In ACM

SIGIR Forum, volume 36, pp. 11–22. ACM New York, NY, USA, 2002.

[6] R. Kosala and H. Blockeel,"Web mining research: A survey", SIGKDD Explorations, 2(1): 1–15, 2000

[7] S. K. Pani, L. Panigrahy, V.H.Sankar, Bikram Keshari Ratha, A.K.Mandal, S.K.Padhi," Web Usage Mining: A Survey on Pattern Extraction from Web Logs", International Journal of Instrumentation, Control & Automation (IJICA), Volume 1, Issue 1, 2011

[8] LIU Dejun , ZHANG Guangsheng , "Application of Data Mining Technology in Modern Agricultural Logistics Management Decision "

[9] J.Srivastava, R.Cooley, M.Deshpande, P-N, "Web usage mining: discovery and applications of usage patterns from web data" ,SIGKDD Explorations 1 (2) (2000) 12-23.

[10] Florent Masseglia, Maguelonne Teisseire, Pascal Poncelet, "Real time Web usage mining: a Heuristic based Distributed miner", 2001

[11] Evaluating the Novelty of Text-Mined Rules Using Lexical Knowledge (Published in 2008), http://en.scientificcommons.org/42299937

[12] O.R. Zaiane, "Web usage mining for a better web-based learning environment", in Proceeding of Conference on Advanced Technology for Education, 2001,pp.450-455.

[13] A.F. Hadwin, J.C. Nesbit, D. Jamieson-Noel, J. Code and P.H. Winne," Examining trace data to explore self regulated learning. Meta cognition and Learning", 2, pp. 107-124 (2007).

[14] Chuang-Hue Moh, Ee-Peng Lim, Wee Keong Ng, "DTD-Miner: A Tool for Mining DTD from XML Documents", WECWIS 2000, pp. 144-151.

[15] P. Desikan, J. Srivastava, V. Kumar, P.-N. Tan, "Hyperlink Analysis – Techniques & Applications", Army High Performance Computing Center Technical Report, 2002

[16] K. Wang and H. Lui, "Discovering Typical Structures of Documents: A Road Map Approach", in Proceedings of the ACM SIGIR Symposium on Information Retrieval, 1998

[17] J. Srivastava, R. Cooley, M. Deshpande and P-N. Tan. "Web Usage Mining: Discovery and Applications of usage patterns from Web Data", SIGKDD Explorations, Vol 1, Issue 2, 2000.

[18] M. Cocea and S. Weibelzahl ," Cross-system validation of engagement prediction from log files", Second European Conference on Technology Enhanced Learning (EC-TEL 2007), Crete, Greece, 2007.

[19] C. Pahl,"Data mining technology for the evaluation of learning content interaction", International journal of e-Learning, 3, pp. 47-55 (2004).

[20] A. Hirami, "The design and sequencing of e-learning interactions. A Grounded approach",2002, International Journal on E-Learning, Vol. 1, No.1, pp.19-27

[21] Galit Ben-Zadok Arnon Hershkovitz, Rachel Mintz and Rafi Nachmias," Examining online learning processes based on log files analysis: A case study", Research, Reflections and Innovations in Integrating ICT in Education, 2004,pp 55-59

[22] Worapat Paireekreng , Kok Wai Wong ," Intelligent Mobile User Profile Classification for Content Personalisation ", In Proceedings of WKDD'2010. pp.241-244

[23] R. Agrawal and R. Srikant. Fast algorithms for mining association rules. In Proc. of the 20th VLDB Conference, pp. 487-499, Santiago, Chile, 1994.

[24] A. Savasere, E. Omiecinski, and S. Navathe. An efficient algorithm for mining association rules in large databases. In Proc. of the 21th VLDB Conference, pp. 432-443, Zurich, Switzerland, 1995.

[25] David Sánchez, Antonio Moreno," Web mining techniques for automatic discovery of medical knowledge"

[26] J. Pitkow and Krishna K. Bharat. "Webviz: A tool for world-wide web access log analysis", In First International WWW Conference, 1994 , pp 451-454.

[27] L. Kaufman and P.J. Rousseeuw,"Finding Groups in Data: an Introduction to Cluster Analysis",John Wiley & Sons, New York: Wiley ,1990, pp 53-65

[28] R.Ng and J.Han , "Efficientand effective clustering method for spatial data mining", In Proc. of the 20th VLDB Conference, Santiago, Chile,1994, pp. 144-155,

[29] H. Mannila, H. Toivonen, and A. I. Verkamo. Discovering frequent episodes in sequences. In Proc. Of the First International Conference on Knowledge Discovery and Data Mining, Montreal, Quebec,1995, pp. 210-215

[30] R. Srikant and R. Agrawal, “Mining sequential patterns: Generalizations and performance improvements”, In Proc. of the Fifth International Conference on Extending Database Technology, Avignon, France, 1996

[31] R. Cooley, B. Mobasher, J. Srivastava, "Web Mining: Information and Pattern Discovery on the World Wide Web," ictai, 9th International Conference on Tools with Artificial Intelligence (ICTAI '97), 1997, pp.55-65

[32] Sachin yele, Beerendra Kumar,Nitin Namdev, Devilal Birla, Kamlesh Patidar, “Web Usage Mining for Pattern Discovery “

[33] Bamshad Mobasher, Honghua Dai, Tao Luo Miki Nakagawa,“Using sequential and Non-Sequential Patterns in Predictive Web Usage Mining Tasks”,2002,An International Journal of Advanced Engineering and Applications, Vol. 1, pp. 135-141

[34] O.Etzioni.The World Wide Web: Quagmire or gold mine.Communications of the ACM, pp. 65-68,1996.

[35] Alex G. Biichner, Maurice D. Mulveena” Discovering Internet Marketing Intelligence through Online Analytical Web Usage Mining”, (1998).

[36] O.R. Zaiane,”Web usage mining for a better web-based learning environment”, Proceeding of Conference on Advanced Technology for Education, 2001, pp.450-455.

[37] Natheer Khasawneh , Chien-Chung Chan “Active User-Based and Ontogy-Based Web Log Data Preprocessing for Web Usage Mining” ,Dec 2006

[38] Raymond Kosala, Hendrik Blockeel, “ Web Mining Research: A Survey “,ACM SIGKDD,Vol 2, Issue 1, pp 1-15

[39] P. Resnik, N. Iacovou, M. Sushak, P. Bergstrom, and J. Riedl,” Grouplens: An open architectureforcollaborative ltering of netnews”, In Proc. of the 1994 Computer Supported Cooperative Work Conference,ACM, 1994.

[40] A. Savasere, E. Omiecinski, and S. Navathe,” An efficient algorithm for mining association rules in large databases”, In Proc. of the 21th VLDB Conference, pp. 432{443, Zurich, Switzerland, 1995

[41] J. Gray, A. Bosworth, A. Layman, and H. Pirahesh,” Data cube: A relational aggregation operator generalizing group-by, cross-tab, and sub-totals”, In IEEE 12th International Conference on Data Engineering, pp. 152-159, 1996.

[42] S. Agrawal, R. Agrawal, P.M. Deshpande, A. Gupta, J. Naughton, R. Ramakrishna, and S. Sarawagi, “ On the computation of multidimensional aggregates”, In Proc. of the 22nd VLDB Conference, pp. 506-521, Mumbai, India, 1996

[43] V. Harinarayan, A. Rajaraman, and J.D. Ullman,” Implementing data cubes efficiently”,. In Proc. of 1996 ACM-SIGMOD International Conference on Management of Data, pp. 311-322, Montreal, Canada, 1996.

[44] C. Dyreson,” Using an incomplete data cube as a summary data sieve”, Bulletin of the IEEE Technical Committee on Data Engineering, pp. 19-26, March1997.

[45] A. Shukla, P.M. Deshpande, J. Naughton, and K. Ramaswamy,” Storage estimation for multidimensional aggregates in the presence of hierarchies”, In Proc. Of the 22nd VLDB Conference, pp. 522-531, Mumbai, India, 1996

[46] VinodKumar P Kizhakke, “MIR: A Tool for Visual Presentation of Web Access Behaviour”, 2000, A Thesis presented for the degree of Master of Science, university of Florida.

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