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SURVEY ARTICLE

Improve Query Performance Using Effective Materialized View Selection and Maintenance: A Survey

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Abstract— Data warehouse (DW) can be defined as a set of data cubes defined over the source relation. To avoid complex query evaluation based on master table, to increase the speed of queries posted to a data warehouse, we can use some snapshot results from the query processing stored in the data warehouse called materialized views. Appropriate Materialized views selection is one of the better and crucial decisions in designing a data warehouse for high efficiency as well as it is the basic requirement of successful business application. Materialized views are found extremely useful for quick query processing. In this paper, first we are focusing on various techniques that are implemented in past, recent for the selection of materialized view. Second, the most critical issues related to maintaining the materialized view and the effective query maintenance strategy are also discussed along with comparison between all the discussed systems.

Key Terms: - Data Warehouse; Materialized View; View Selection Problem; Query processing cost; View Maintenance; Access Frequency; Threshold; Fuzzy logic

I. INTRODUCTION

Recently, a huge amount of information exchange into database systems of various organizations therefore there should be efficient provision for Data warehouse (DW). DW is nothing but a repository that can bring together selected data from multiple database or other different information sources into a single repository.

To increase the speed of query processing posted to base table of data warehouse, the best way we can use some already processed intermediate query result stored in the data warehouse called materialized views. Therefore, materialized view selection involved query frequency, query processing and storage cost along with materialized view maintenance cost. Selecting cost effective views to materialize for the purpose of supporting the decision making efficiently is one of the most crucial decisions in designing data warehouse. Selecting a set of candidate views to materialize which minimizes the total query response time & maintenance of the selected views is defined as view selection problem. Thus, to select an appropriate set of view is the major target that reduces the entire query response time as well as maintaining the selected views is also equally important. So, the materialized views are designed based on the user's requirements (e.g., frequently used queries, processing & storage cost).

The use of materialized view is definitely beneficial since index structures can be built on materialized views. Consequently, database retrieval to the materialized view is just like a cache, which is copy of the data that can be retrieved quickly. Materialized views are significant for query optimization.

In short, when a view is defined, over the database that normally stores only the query defining the view whereas, in case of a materialized view it is a snapshot or replica of a targeted base table whose contents are dynamically computed and stored. It is cheaper in many cases where the query is complex (e.g., involve many tables and complex calculations) or base tables contain a huge amount of records to compute. Materialized

views are important for improving performance in many business applications in the context on data warehouse therefore recently database research community paying attention to the materialized view selection and maintenance process.

In this paper various methodologies that are used in past and recent for selection of materialized view are discussed. Section 2, 3 gives brief overview of various materialized view selection techniques as well as cost model of maintenance techniques. Section 4 gives the comparison between all the discussed systems based on the various parameters that are considered during materialized view selection/maintenance process.

II. PREVIOUS RELATED WORK

The problem of finding appropriate views to materialize to answer frequent queries has been studied under the name of Materialized view selection process.

Dr. T.Nalini et al. [1]: proposes an Index-Mining algorithm for the selection of materialized views so that query evaluation costs can be optimized as well as materialized view maintenance and storage was addressed in this piece of work. Ashadevi, B and Balasubramanian.[2] Proposed framework for selecting views to materialize(i.e., View selection problem), which takes in to account all the cost metrics associated with the materialized view selection and maintenance cost, including query execution frequencies, base relation update frequencies, cost of query access, view maintenance costs and the system's storage space constraints selects the most cost effective views to materialize and thus optimizes the materialized view maintenance storage, query processing cost.

Himanshu Gupta and Inderpal SinghMumick [3] developed a greedy algorithm to incorporate the maintenance cost and storage constraint in the selection of materialized views for data warehouse. Yang, J et al.[4] Proposed a heuristics algorithm based on individual optimum query plans. Framework is based on specification of multiple views processing plan (MVPP), which is used to present the problem formally. Harinarayan et al. [5] proposed a greedy algorithm for the materialized views selection so that query evaluation costs can be optimized in the special case of "data cubes". This paper provides good tradeoffs between the space used and the average time to answer a query. Here, the costs for view maintenance and storage were not addressed in this piece of work.

Amit Shukla et al.[6] proposed a very simple and fast heuristic algorithm, PBS, to select aggregates for pre computation. PBS runs several orders of magnitude faster than BPUS, and is fast enough to make the exploration of the time-space tradeoff feasible during system configuration. Wang, X et al.[7] View maintenance techniques are classified into four major categories : self-maintainable recomputation, not self-maintainable recomputation, self-maintainable incremental maintenance and not self-maintainable incremental maintenance. Self-maintainable incremental maintenance is significant in terms of both space usage and number of rows accessed.

This survey is used for exploiting the materialize candidate views by taking into consideration of query frequency, query processing cost and space requirement along with materialized view maintenance cost.

III. MATERIALIZED VIEW SELECTION AND COST MODEL

The problem of selecting an appropriate set of views to materialize is called the materialized view selection problem. There are many general as well as research issues related to DW [2], one of them is materialized view selection. Appropriate materialized views speed up query processing. On the other hand, they need to be refreshed when changes occur to the data sources. Therefore, there are following two costs involved in materialized view selection:

1. The query selection cost
2. The materialized view maintenance cost.

The main objective of materialized view selection problem is the minimization of a constraint or a cost function. A constraint can be system oriented (space constraint) or user oriented (query response time constraint). Most of the selection approaches are designed for minimization of a cost function. Gupta, H (1997), and Barlis. E. et al. (1997) defined view selection problem and take as input the queries that the data warehouse has to satisfy for an initial or an incremental design.

The basic goal of view selection problem is to find a set of views that minimizes the expected cost of evaluating the queries that are frequently used. While designing a data warehouse, it is extremely important to minimize the cost of answering queries because the data warehouse is very huge. The selection of most favorable collection of views for available storage space and minimum query cost is primarily referred to as the view selection problem. There are huge numbers of the base tables (with schemas in hundreds attributes) from multiple data sources, it would be very difficult to decide which views should be materialized. To solve the view

selection problem, mathematical formulation is the most required step. In view selection problem, appropriate data structures are used to represent the view selection. For this, the following subsections are generally used.

A. Relational Algebra

It is similar to algebra, except it uses relation as value instead of number. It is procedural query language most commonly used for outer join. A set of operations are used to express a query. Each operation takes one or more relations as arguments and produces a new relation as the result. This property makes it easy to compose operations to form a complex query. The fundamental set of Relational Algebra operations are Selection (sigma σ), Union (U), Set-difference (-), Cartesian product (X), Projection (pi Π), Rename (rho ρ). These fundamental operations are used in the query processing for the query optimization process.

B. Directed Acyclic Graph

In mathematics a directed acyclic graph , is a graph having direction and no directed cycles, which is formed by a collection of vertices and edges having direction, each edge connecting one vertex to another, such that there is no way to start at some vertex V and follow a sequence of edges that eventually loops back to V again. For example, if an edge *e*<=*v* indicates that v is a part of *e*, such a path would indicate that e is a part of itself, which is impossible.

C. AND / OR Graph

It is a form of graph or tree used in problem solving as well as problem decomposition. The nodes of the graph represent states or goals and their successors are labeled as either AND or OR branches. The AND successors are sub goals that must all be achieved to satisfy the parent goal, while OR branches indicate sub goals that are alternative, any one of them could satisfy the parent goal.

IV. COMPARATIVE STUDY

We have deeply analyzed the various research works on several different parameters and presented their comparison in the table below.

Table I. Comparison of Various Research Works

FEATURES AUTHOR	TECHNIQUE	ISSUES ADDRESS	PROPOSED WORK	PROS	CONS
Agrawal, Chaudhari & Narasa ya (2000) [8]	View Selection	Automated view and Index selection	Framework for index & View selection + Candidate selection & Enumeration techniques	Robust tool support + Both indexes & view selected	Only a part of physical design space addressed
Gupta & Mumick (2005) [3]	View Selection	View selection under disk space & maintenance cost constraints.	AND/OR view graphs + Greedy heuristics based algorithms	Optimal solution for special cases (AND/OR views) + Polynomial time heuristics	Approximation in view-selection problem not addressed + Problem in AND view graphs not NP-hard + Solution fairly close to optimum
Yang & Chung (2006) [9]	View Selection	Attribute value density + Clustered tables +	ASVMRT algorithm for view selection	Faster computation time + Reduced	Maintenance of reduced table not addressed + Updating reduced

		Selection of views based on clustered /reduced tables		storage Space + 1.8 times performance better than conventional algorithms	tables needs attention
Ashadevi & Balasubramanian (2008) [2]	View Selection	Cost effective View selection Under storage Space constraints	Framework for selecting views + Algorithm for the same + Cost metrics	All cost metrics considered	Query response time not considered + Threshold value not indicated clearly
Elena Baralis, Tania Cerquitelli, and Silvia Chiusano (2009)[10]	View Selection	Cost effective View selection Under storage space constraints	i-mine algorithm for selecting views	Faster computation time	More memory space
Qingzhou zhang & xia sun, ziqiang wang (2009) [11]	View Selection	Cost effective View selection Under storage Space constraints	MA algorithm for selecting views	Faster computation Time + Comparison of GA & HA algorithm	Only optimal research
Karde & Thakare (2010) [12]	View Selection	Query cost, maintenance cost, storage space &	Algorithm for creation And maintenance of views + Algorithm for node selection	Query performance improved	Only distributed environments highlighted
Almazyd & Siddiqui (2010) [13]	View maintenance	Incremental view maintenance + synchronization between DW and source + lost update notifications	Framework with version store	Synchronization between source and DW + Detection of update notification messages	Process becomes a bit lengthy + large space needed + Version numbers should be handled properly
T.Nalini & A. Kumaravel (2011) [14]	View selection	Cost effective view selection under storage space constraints	i-mine algorithm (modification)for Selecting views + Using multiple Constraints to reduce Storage space	Faster computation Time + Reduced storage space	Selection of Threshold value is not calculated
Dr. T. Nalini, Dr.A. Kumaravel (21012) [1]	View selection & maintenance	Cost effective View selection based on best combination of low storage cost, low query processing cost and high frequency of query	IM-LSI (Itemset Mining using Latent Semantic Index) algorithm.	Faster computation time + Reduced storage space	Selection of Threshold value is not calculated

		+ Updation of materialized view using LSI(Latent Semantic Index)			
Dr. Y.D. Choudhari. Dr. S. K. Shrivastava (2012) [15]	View selection	Cost effective View selection Under storage Space constraints	CBFSMV Algorithm for selection of view	Faster computation time + Reduced storage space	View maintenance problem not addressed

V. CONCLUSION

The appropriate materialized view is truly beneficial for quick query processing as it stores precomputed data, but the selection as well as maintenance of materialize views is one of the most important issues in designing an effective data warehouse. This paper gives the idea regarding the important parameters that plays a vital role in selection of appropriate set of materialized views so that the total cost of processing a set of queries and maintenance of the materialized views are minimized. The query frequencies, query space, query processing time are the constraints that are the most important factors while selecting the views to be materialized.

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