Optimized Algorithms For Materialized View Selection In Data Centric Environment

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Abstract- *The notion of data centric environment can be defined as subject-oriented, integrated, nonvolatile and time-variant collection of data in support of making management's decision effectively, for the success of data warehouse accurate and timely consolidated information as well as quick query response times is the fundamental requirement. To avoid accessing from base table and increase the speed of queries posted to a Data warehouse, we can use some important pre-computed intermediate results from the query processing stored in the data warehouse called materialized views. The result of effective Materialized view selection provides an efficient data warehousing system. However, the materialized view needs to be effectively maintained to keep its contents integrated and consistent with the contents of its data sources. The materialized views have specific maintenance cost, that's why materialization of all views is not possible.*

Keywords- Data Warehouse, Materialized View, View-Maintenance, Access Frequency, Threshold.

I. INTRODUCTION

One of the most important decisions in designing data warehouse is selecting only those views to materialize which eliminates the overhead associated with expensive joins and aggregations for a large set of important class of queries. A materialized view is pre-computed data stored in a table that transparently allows users to query huge amounts of data much more quickly than they could access from the base table. Database retrieval of the materialized view is just like a cache, which is copy of the data that can be retrieved quickly. To select an appropriate set of view is the important target that reduces the entire query response time, however to maintain the selected views is critical but very important aspect of building effective data warehouse.

The process of reflecting changes to a materialized view in response to the changes (insert or update or delete) in the base relation is called as 'View Maintenance' that incurs a 'View Maintenance Cost'. Because of view maintenance cost, it is not possible to make all views materialized under the limited space constraints. This need to select an appropriate set of views to materialize for answering queries, this was denoted Materialized View Selection (MVS) and maintenance of the selected view denoted Maintenance of Materialized View (MMV). [3]

Materialized views are very important for improving performance in many business applications that's why recently database research community paying attention to the materialized view selection and maintenance.

The paper is organized as follows. We describe a related work of materialized view selection and materialized view maintenance in section 2, Materialized Views Selection framework implementation details is explaining in section 3. In section 4, we shown experimental result, and its discussion, in section 5, we concluded the paper and section 6 is used to provide the references.

II. RELATED WORK

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

Dr. T.Nalini et al. [1] proposes an I-Mine algorithm for the selection of materialized views so that query evaluation costs can be optimized as well as 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 views selection, including query processing frequencies, base relation ,update frequencies, query access costs, view maintenance costs and the system's storage space constraints and then selects the most cost effective views to materialize and thus optimizes the maintenance storage, and 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 trade-offs between the space used and the average time to answer 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 algorithm runs faster than BPUS, and is fast enough to make the exploration of the time-space trade -off 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 performs the best in terms of both space usage and number of rows accessed.

Our proposed work main objective is to materialize the effective candidate views by taking into consideration of query frequency, query processing cost and space requirement along with view maintenance cost.

III. MATERIALIZED VIEWS SELECTION FRAMEWORK IMPLEMENTATION DETAILS

This section elaborates the created framework approach for the selection of materialized view. Materialized views are beneficial for the users to quickly get the search results for frequent queries. The ultimate aim behind the proposed materialized view selection framework is to materialize the user views by taking into consideration of query frequency, query processing cost and storage requirement of query.

The developed framework is applied on data warehouse model, *DW* and a user’s selected query file (*UQF*) that contains the list of queries used by the number of users. As it is not possible to create materialized view of all user queries due to the storage space constraints the queries that are frequently used by the users should be selected but, at the same time, the query processing cost and storage cost should be less. Accordingly, we have used the data ware house, *DW* that contains four tables. The schema of the data ware house used in the framework is represented with four various student database tables with some extra materialized view query holding tables.

The first phase of materialized view selection is generation of large arbitrary set of records for the above given database tables using random data insertion record generator. After that generation of all possible set of complex queries are generated on above created records. The queries are selected from the given created query set using following algorithm.

Assumptions:

Q_S	□	Given set of queries
Q_{AF}	□	Queries access frequency
T	□	Threshold value
AL_{SQ}	□	Array List of selected queries

3.1.1 Algorithm1

```
1: begin:
2: for each query in $Q_S$
3: find the frequency of each query $Q_{AF}$
4: if ( $Q_{AF}$ >= T ) then
5: Add query to Array List $AL_{SQ}$;
6: end if
7: end for
```

The candidate queries having access frequency greater than the threshold value T are selected for materialized view selection problem but, at the same time, the query processing and storage cost should be less thus queries processing time and storage cost may be calculated using Algorithm 2.

Assumptions:

Q_{Tot}	□	Total no of queries having Q_{AF} >= T
Q_{MFreq}	□	Maximum query frequency
Q_{PT}	□	Query processing time
Q_S	□	Query storage
Q_{MPT}	□	Maximum Query processing time
Q_{MS}	□	Maximum Query storage
Q_{PC}	□	Query processing cost
Q_{SC}	□	Query storage cost
Q_{FC}	□	Query frequency cost
Q_{RR}	□	Query result record storage value i.e Query data length and index length
Q_{TBE}	□	Query time before execution
Q_{TAE}	□	Query time after execution
Q_{CT}	□	Query cost table
S_Q	□	Query selection cost

M_T □ Minimum threshold
α, β & γ □ Weighted constant values in between 0 to 1

3.1.2 Algorithm 2:

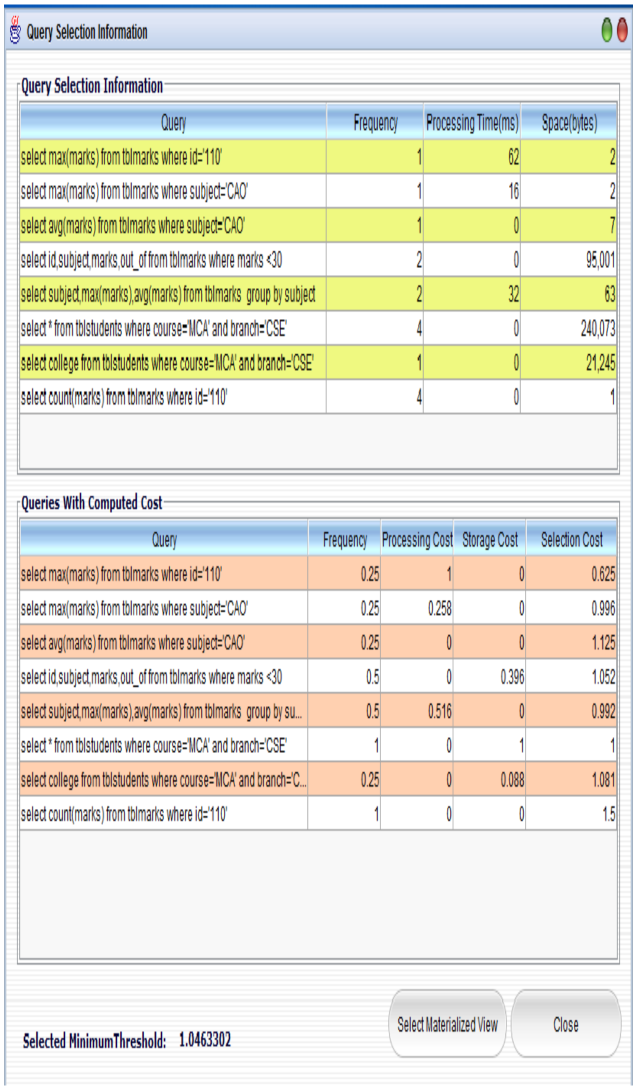
```
1: begin:
3: Repeat for I □ 1 to $Q_{Tot}$
4: $Q_{FC}$ □ $Q_{AF} / Q_{MFreq}$ ;
5: $Q_{PC}$ □ $Q_{TAE} - Q_{TBE} / Q_{MPT}$ ;
6: $Q_{SC}$ □ $Q_{RR} / Q_{MS}$ ;
7: $Q_{CT}$ □ $Q_{FC}$ ;
8: $Q_{CT}$ □ $Q_{PC}$ ;
9: $Q_{CT}$ □ $Q_{SC}$ ;
10: end repeat

14: [Find selection cost]
        Repeat for I □1 to $Q_{Tot}$
         $S_Q = \gamma * Q_{FC} + \beta(1 - Q_{PC}) + \alpha(1 - Q_{ST})$ ;
         $Q_{CT}$ □ $S_Q$ ;
         end repeat
15: [Select MV Selection Threshold]
         $M_T = \sum^{K}_{i=K} S_Q / Q_{Tot}$
16: [Select materialized view having good query response, low processing and storage cost]
Repeat for i □1 to $Q_{Tot}$
$S_Q$ □ $Q_{CT}$ [i]
        if ($S_Q$ >= $M_T$) then
       Build the materialized view for the selected query
 17:  else
        Discard the query
     end repeat
```

Thus, the above algorithm for selection of materialize views can be achieved the desired multi-objective i.e. it provides the best combination of better query response, low query processing cost and low storage space cost.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The section shows the running experiment results that are carried out using above simulated student database schema by applying algotithm1 and 2. The various typical user queries is shown below along with its query frequency, to be calculated using algorithm 1. The processing time, query result size along with query frequency cost, processing cost, storage cost, selection cost and minimum materialized view selection threshold is calculated using algorithm2.



Query Selection Information

Query	Frequency	Processing Time(ms)	Space(bytes)
select max(marks) from tblmarks where id='110'	1	62	2
select max(marks) from tblmarks where subject='CAO'	1	16	2
select avg(marks) from tblmarks where subject='CAO'	1	0	7
select id,subject,marks,out_of from tblmarks where marks <30	2	0	95,001
select subject,max(marks),avg(marks) from tblmarks group by subject	2	32	63
select * from tblstudents where course='MCA' and branch='CSE'	4	0	240,073
select college from tblstudents where course='MCA' and branch='CSE'	1	0	21,245
select count(marks) from tblmarks where id='110'	4	0	1

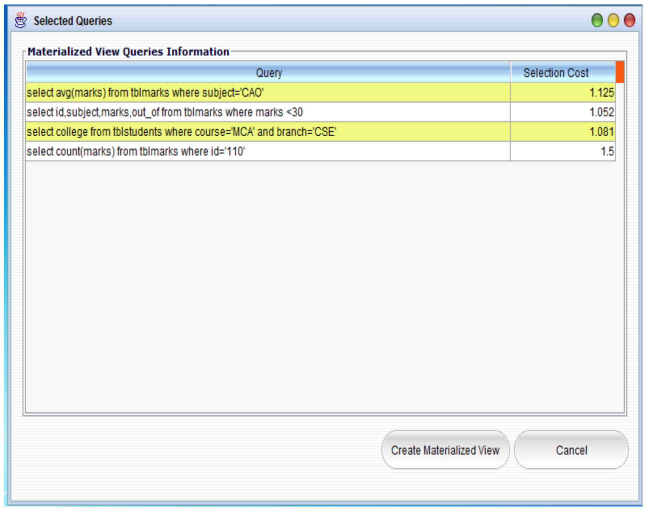
Queries With Computed Cost

Query	Frequency	Processing Cost	Storage Cost	Selection Cost
select max(marks) from tblmarks where id='110'	0.25	1	0	0.625
select max(marks) from tblmarks where subject='CAO'	0.25	0.258	0	0.996
select avg(marks) from tblmarks where subject='CAO'	0.25	0	0	1.125
select id,subject,marks,out_of from tblmarks where marks <30	0.5	0	0.396	1.052
select subject,max(marks),avg(marks) from tblmarks group by su...	0.5	0.516	0	0.992
select * from tblstudents where course='MCA' and branch='CSE'	1	0	1	1
select college from tblstudents where course='MCA' and branch='C...	0.25	0	0.088	1.081
select count(marks) from tblmarks where id='110'	1	0	0	1.5

Selected MinimumThreshold: 1.0463302

Fig1: Materialized View Query Selection Parameter Information Window

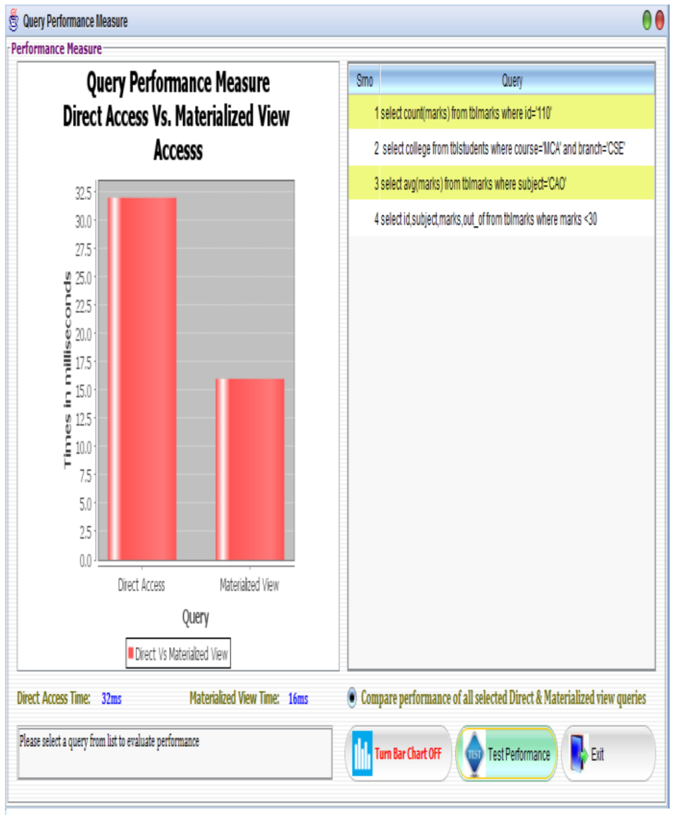
Above fig 1: showing frame window containing query frequency, query processing time, query result storage in bytes with query he frequency, processing, storage and selection cost. The queries having selection cost is greater than the minimum materialized view selection threshold value need to be materialized for quick query processing as shown in fig2.



Query	Selection Cost
select avg(marks) from tblmarks where subject='CAO'	1.125
select id,subject,marks,out_of from tblmarks where marks <30	1.052
select college from tblstudents where course='MCA' and branch='CSE'	1.081
select count(marks) from tblmarks where id='110'	1.5

Fig 2: Selected Materialized View Queries Information Window

Fig 2 shows only those queries which satisfy the multiple constraints so here we are selecting only four queries having selection cost is greater than the minimum materialized view Selection threshold value from the set of queries.



Srno	Query
1	select count(marks) from tblmarks where id='110'
2	select college from tblstudents where course='MCA' and branch='CSE'
3	select avg(marks) from tblmarks where subject='CAO'
4	select id,subject,marks,out_of from tblmarks where marks <30

Direct Access Time: 32ms Materialized View Time: 16ms

Compare performance of all selected Direct & Materialized view queries

Please select a query from list to evaluate performance

Fig:3 Query Performance Window : Direct Vs Materialized View Access

Fig 3 shows comparison of execution time of the query using materialized view selection framework and execution time of the query if it is posed for original database (without framework).

Above fig3 represents the calculation results, from which following observations can be stated: The all-direct base table access method requires the highest query processing cost with no view maintenance and storage costs are incurred. The all-materialized-views method can provide the best query performance with some view maintenance and storage costs are incurred.

V. CONCLUSION

As materialized view store the precomputed data it is used to improve query performance by minimizing query processing time. But due to view maintenance cost it is impossible to create materialized view of all the queries. Thus how to select the set of queries to be materialized so that query performance increases significantly and storage cost for storing materialized view minimized.

This research work gives the idea regarding how to select a set of materialized view with the help of various parameters like: frequency of query cost of query processing and storage space. We have presented proposed methodology that determines which queries are more beneficial for the creation of materialized view so as to achieve the high query performance.

For experimentation, the proposed framework is executed on the randomely created student data warehouse model using list of query, to find the efficiency of the proposed approach in selection of materialized view. For future research in this area could focus on validating this model against some real-world data warehouse systems and also concentrate on incremental materialized view maintenance framework.

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