Niagara CQ : A Scalable Continuous Query System for Internet Databases

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Outline

- Motivation
- What is NIAGARA CQ?
- What is Incremental Group Optimization?
- What is Query Split?
- Minor details + Performance
- Conclusion

Motivation

Continuous queries (CQ) : allow users to receive new results when available.

Internet : large amount of frequently updating data.

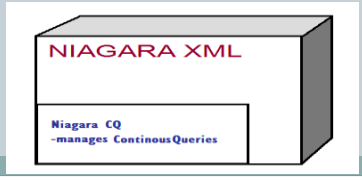
CQs are popular & essential

Challenges

How can we manage millions of CQs to scale to the Internet most efficiently?

What is NIAGARA CQ?

- The Continuous Query sub-system of NIAGARA, which is a distributed database system for querying distributed XML data.
- Supports scalable continuous query processing



NiagaraCQ : Novelty and Approaches

- Groups CQs based on similar query structure.
  - Grouped CQs share computation and data
    - -reduce I/O
    - -reduce unnecessary query invocations

Niagara CQ's Grouping Technique

1) Incremental Group Optimization Strategy
2) Query Split Strategy
3) Uniform grouping of both time/change based queries

NiagaraCQ Command Language

- **CREATE *CQ_name***
- *XML-QL query*
- **DO *action***
- **{START *start_time*} {*EVERY time_interval*} {*EXPIRE expiration_time*}**
- **Delete *CQ_name***

Incremental Group Optimization Strategy

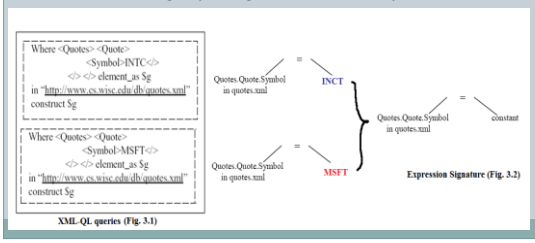
How do you group these continuous queries most efficiently????

Incremental Group Optimization Strategy

- Groups are created for existing queries according to their signatures
  - Signatures= similar structures among the queries
- Groups allows the 'common parts' of queries to be shared
  - Common parts share result data from the 'Group Plan'
- New query is merged into those existing groups that match its signatures.

Expression Signature

- Represent the same syntax structure, but possibly different constant values, in different queries.
- Expression signatures allow queries with the same syntactic structure to be grouped together to share computation



Group

- Groups are created for queries based on their expression signatures. Consists of 3 parts:
  - *Group signature*: The common expression signature of all queries in the group.
  - *Group constant table*: The *group constant table* contains the signature constants of all queries in the group.

Constant value | Destination buffer

....	....
INTC	Dest. i
MSFT	Dest. j
....	....

Figure 3.4 an example of group constant table

Group (cont.)

- *Group plan*: the group plan is the query plan shared by all queries in the group. It is derived from the common part of all single query plans in the group.

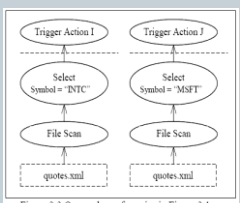


Figure 3.3 Query plans of queries in Figure 3.1

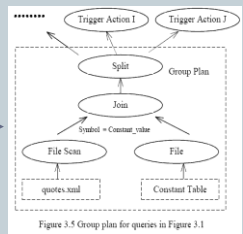
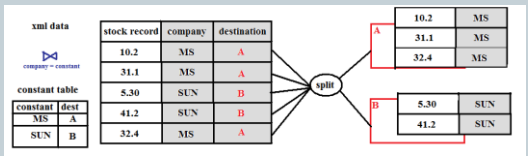


Figure 3.5 Group plan for queries in Figure 3.1

Group (cont.)



Discussion

- Expression signatures as described here are a very simple transformation. Are they *too* simple? That is, do they group together enough of the kinds of queries that this system is meant to handle?
- Do you think they would work better or worse for SQL queries instead of XML?

Incremental Grouping Algorithm

- When a new query is submitted:
  - Group optimizer traverses query plan bottom up to match its expression signature with the signatures of existing groups.
  - If no match, a new group will be generated.

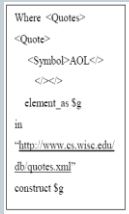


Figure 3.6 XML-QL query examples

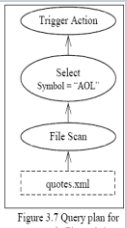


Figure 3.7 Query plan for query in Figure 3.6

Query Split Strategy

- How do we implement the destination buffer for 'split operator'?

Constant value	Destination buffer
....	....
INTC	Dest. i
MSFT	Dest. j
....	....

1)Pipeline (BAD)

2)Intermediate file (GOOD)

Pipeline buffer

- 1) Timer-based CQ… which tuple to store and for how long?
- 2) results in a single execution plan for all queries in the group
  - -the query structure is a directed graph thus the plan may be too complicated
  - -The combined plan can be very large
  - -A large portion of the query plan may not need to be executed at each query invocation
  - -Bottleneck

Materialized Intermediate Files

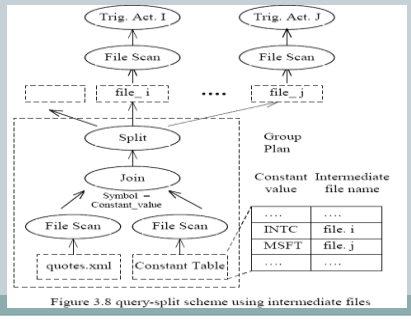


Figure 3.8 query-split scheme using intermediate files

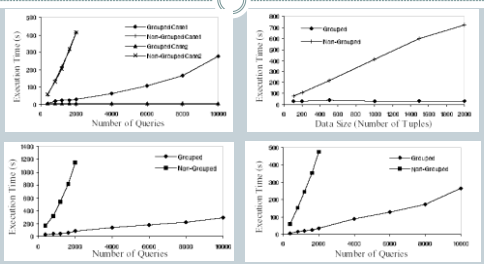
Materialized Intermediate Files (cont.)

- **Advantages**
  - Each query is scheduled independently.
  - The potential bottleneck problem of the pipelined approach is avoided.
- **Disadvantages**
  - Extra disk I/Os.
  - Split operator becomes a blocking operator.

Other details

- Timer-based continuous queries fires at specific times, but only if the corresponding input files have been modified.
- Incremental evaluation allows queries to be invoked only on the changed data = 'delta file'

Some performance comparisons



Conclusion

NIAGARA CQ :
Incremental Group Optimization with Query Split

-scalable
-works better than non-groupings
-requires minimal change in query engine

Discussion

- The authors motivate Niagara with a simple stock quote monitoring application. Is Niagara the best way to support this particular application? What other kinds of applications would Niagara be appropriate for?