Paper Presentation and Discussion

on

Automated Statistics Collection in DB2 UDB

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Optimizer Impact on System Availability

- Example with 4 tables. ‘Claim’ <1 minute
  - say 45 seconds in worst case is downtime if executed during normal workload
- Once every 7 days
- 2160 seconds = 36 minutes of ‘downtime’

  => Not a highly-available system

- **Simple** system with 4 tables and ‘controlled-workload’ may not be able to achieve five 9s (**just** because of re-optimization, without considering failures).

Motivation

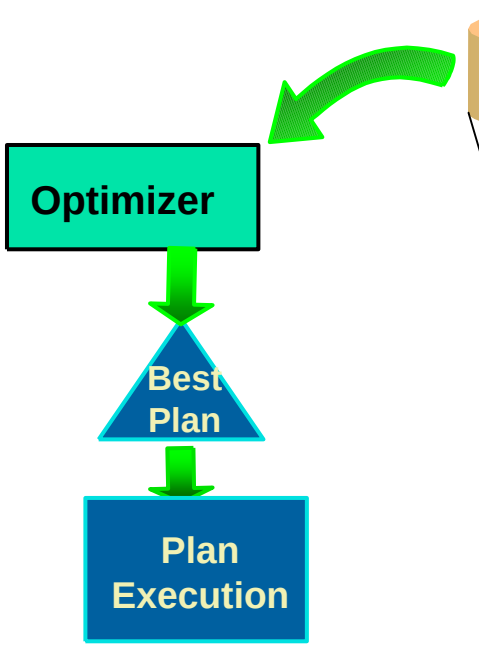
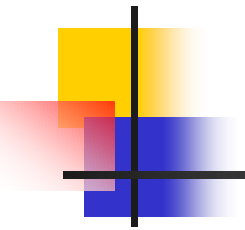


Table Name	Content
tables	number of rows in a table
columns	number of distinct values for that column
indexes	number of distinct index keys, clustering of the table with respect to. the index, physical properties of the index
coldist	quantiles and frequent values of a column
colgroups	distinct number of values for a group of columns

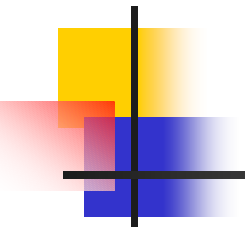


Motivation

- DB stat.s are not incrementally updated
  - Maintenance is too expensive
  - => statistics are likely to be out of date
- If stat.s are refreshed frequently
  - If proper config. Parameters are not set properly (# of frequent values, # of quantiles to maintain etc)
- Previous systems

➢Utility method

- DB2: RUNSTATS on a per table basis (RunStats profiles in SYSSTAT.PROFILE)
- ORACLE: ANALYZE
- INFORMIX: UPDATE STATISTICS
- SYBASE: UPDATE STATISTICS

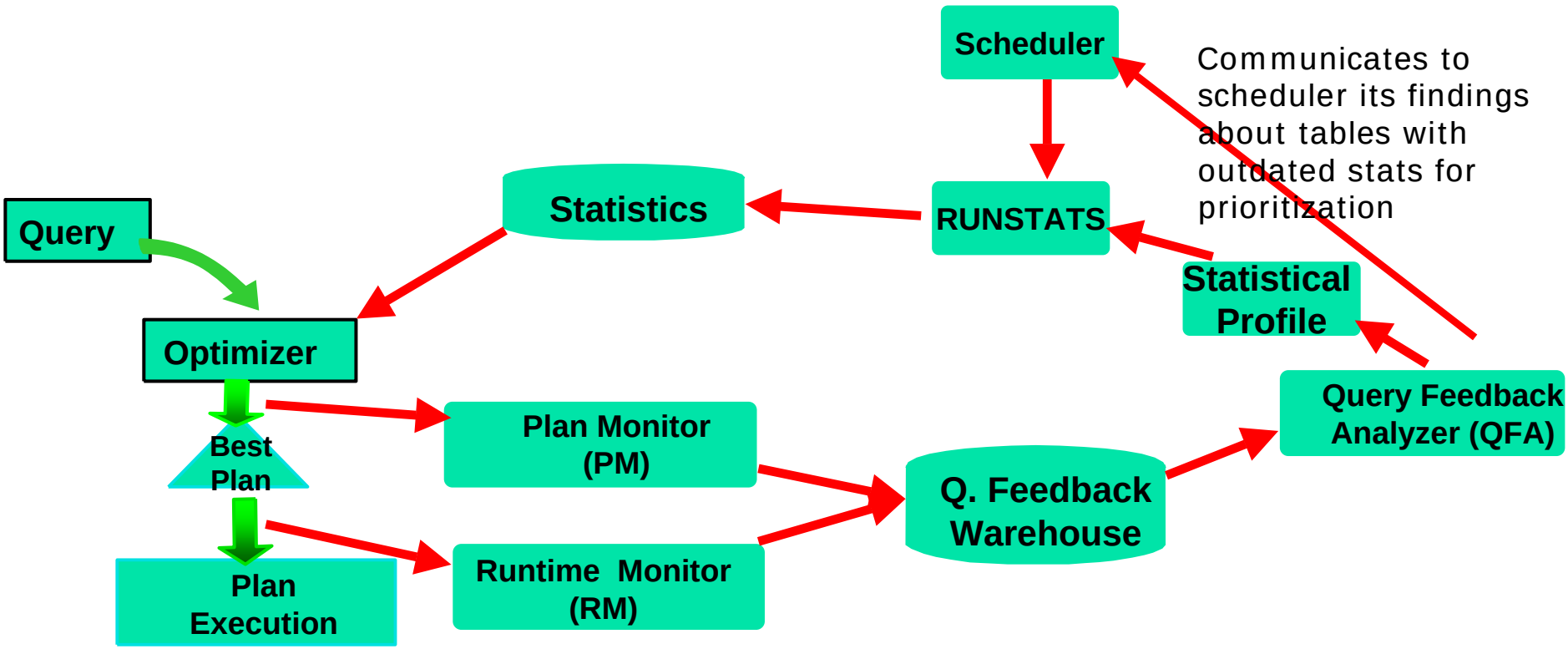


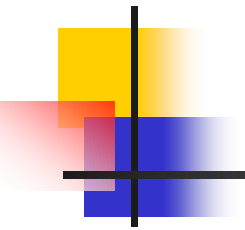
Motivation

- Query Feedback
- UDI activity

- Without **ANY** DBA Intervention
  - ASC decides
    - Which statistics to gather
    - What level of detail to gather
    - When to gather

Feedback Loop

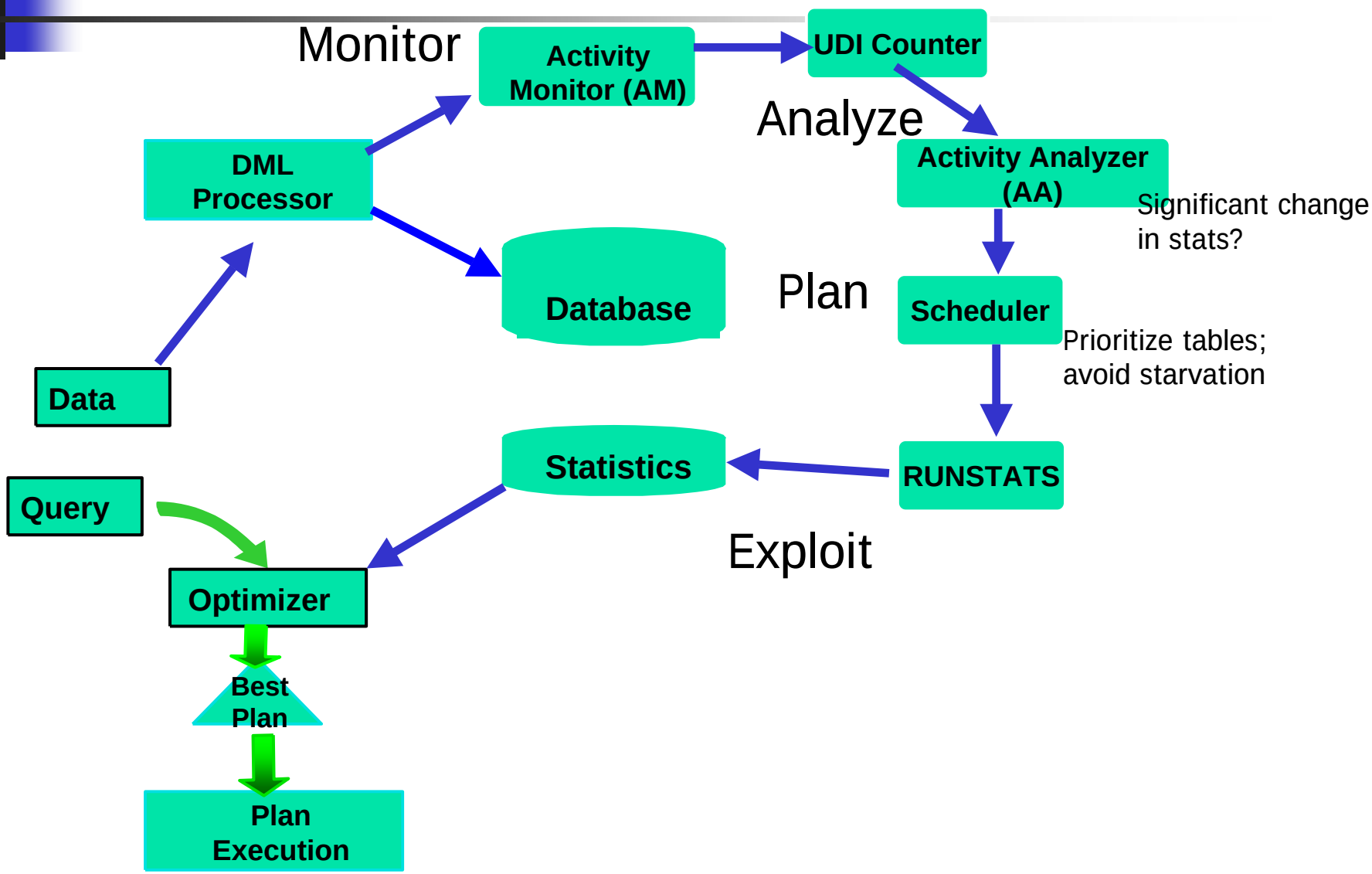


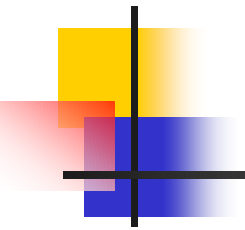


QF-driven summary

- Monitors query results
- Modifies RUNSTATS profile
- Recommends execution whenever
  - config params are improper
  - stat.s out of date

Another Feedback Loop

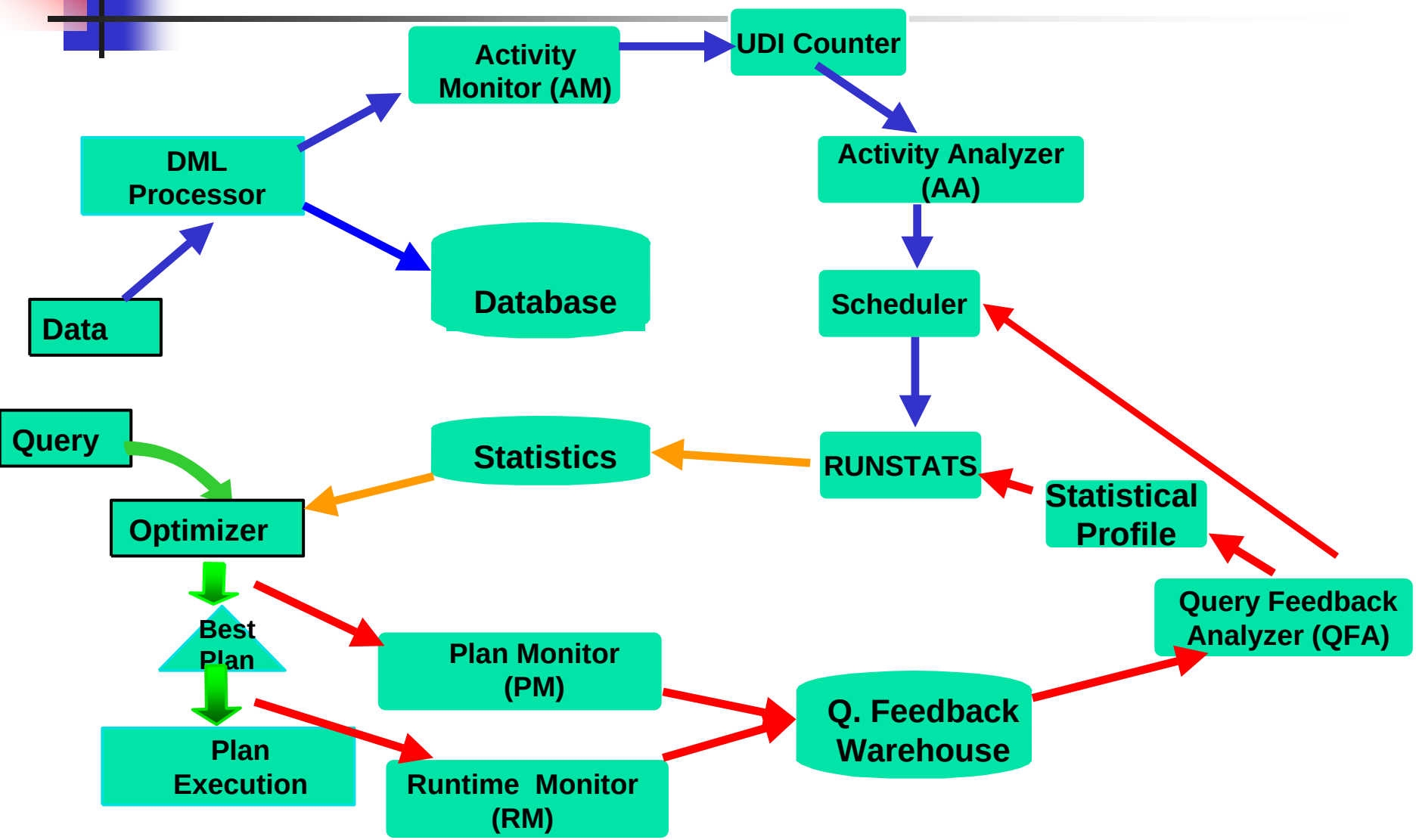




UDI-driven summary

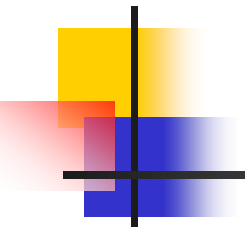
- Monitors UDI
- Recommends execution of RUNSTATS

Automated Statistics Collection



UDI and QF - driven

- Scheduler combines and triggers RUNSTATS
- Maintenance window
  - RUNSTATS allocated a large resources
  - Throttled background process - impact < 7% (non-maintenance window)
  - Frequency and length controlled by DBA
  - End of maintenance window



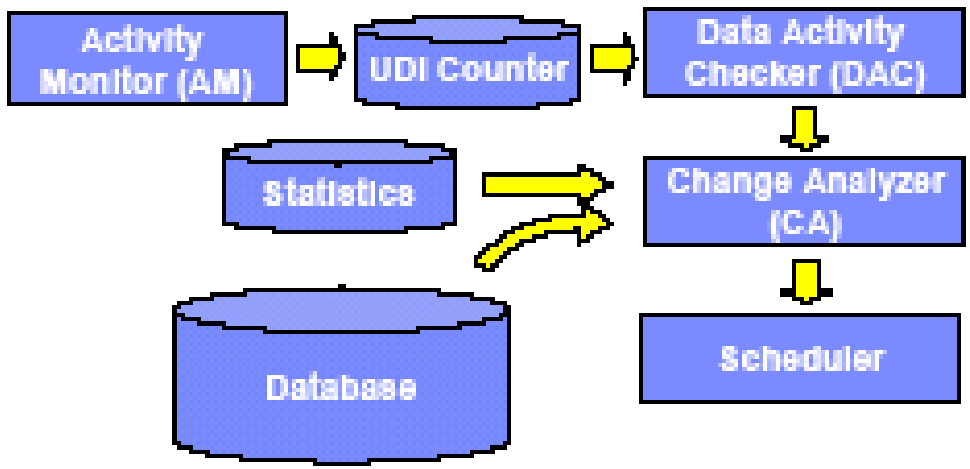
Neither one is sufficient

- Neither one is sufficient
  - UDI driven approaches are proactive
    - can handle ‘unforeseen queries’
    - May not concentrate on maintaining statistics critical to workload
  - QF-driven are reactive
    - Future data-querying pattern follows past pattern
    - Require learning time
    - focus on critical stats

UDI Driven Process

Checks for reasonable amount of UDI and Load

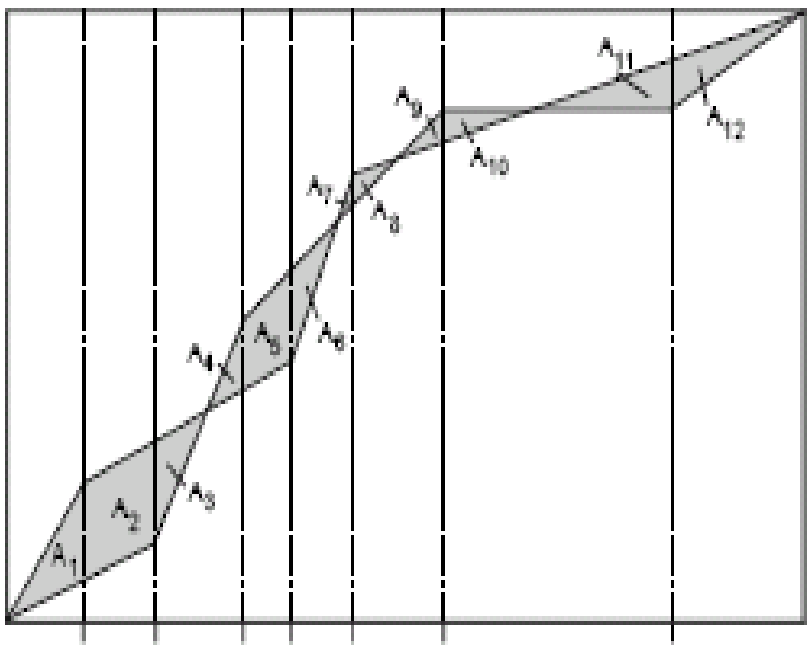
I/P: list of tables



Checks if 'analyzable' columns stats have significantly changed

O/P: prioritized list of tables

Change Analyzer

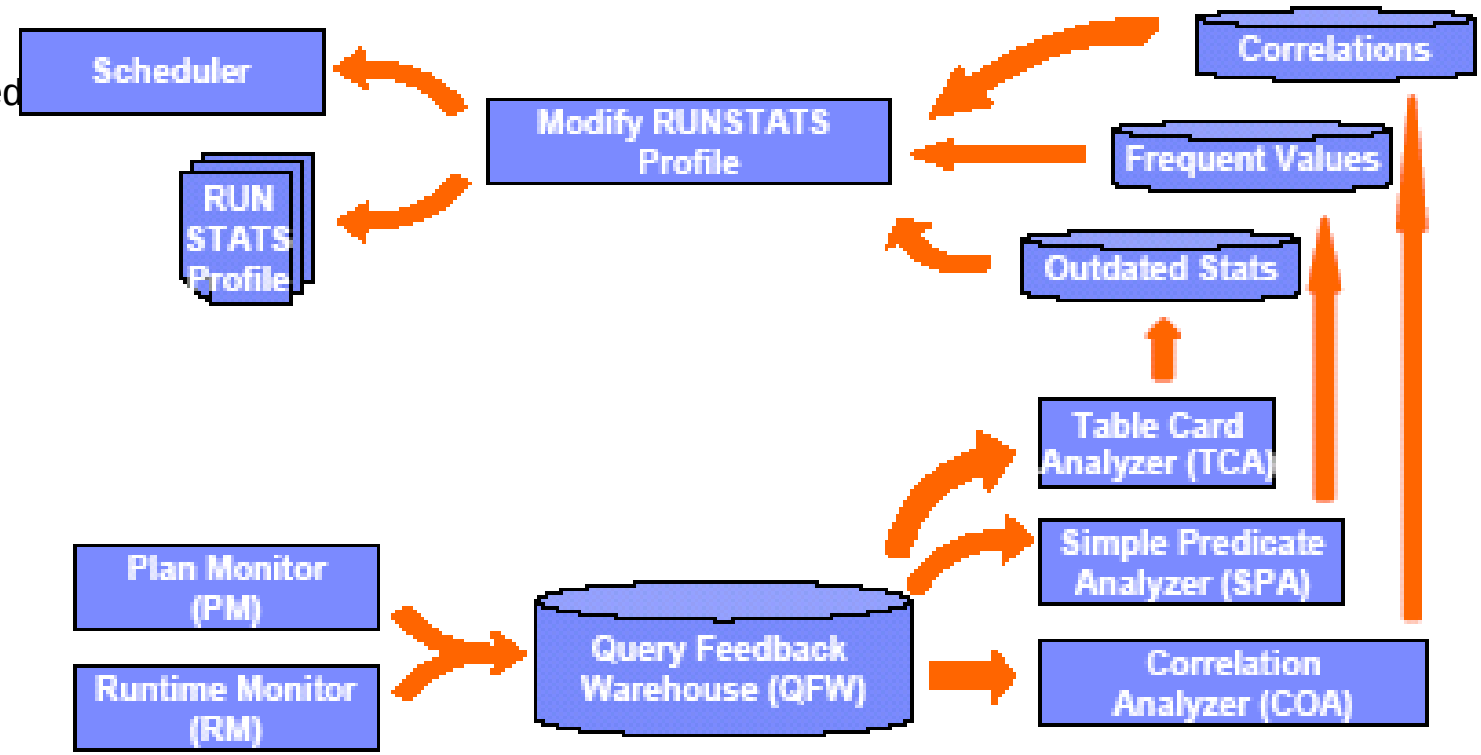


UDI Driven Process

- DAC verifies that table-related structures are cached in memory
- At least τ% are modified (τ = 10)

QFA Driven Process

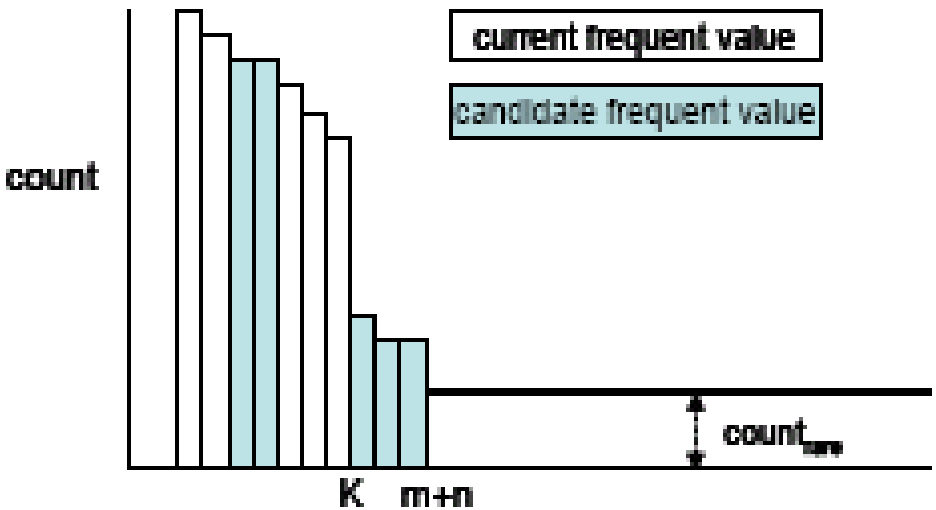
O/P: prioritized list of tables



I/P: list of tables

Operation of the QFA

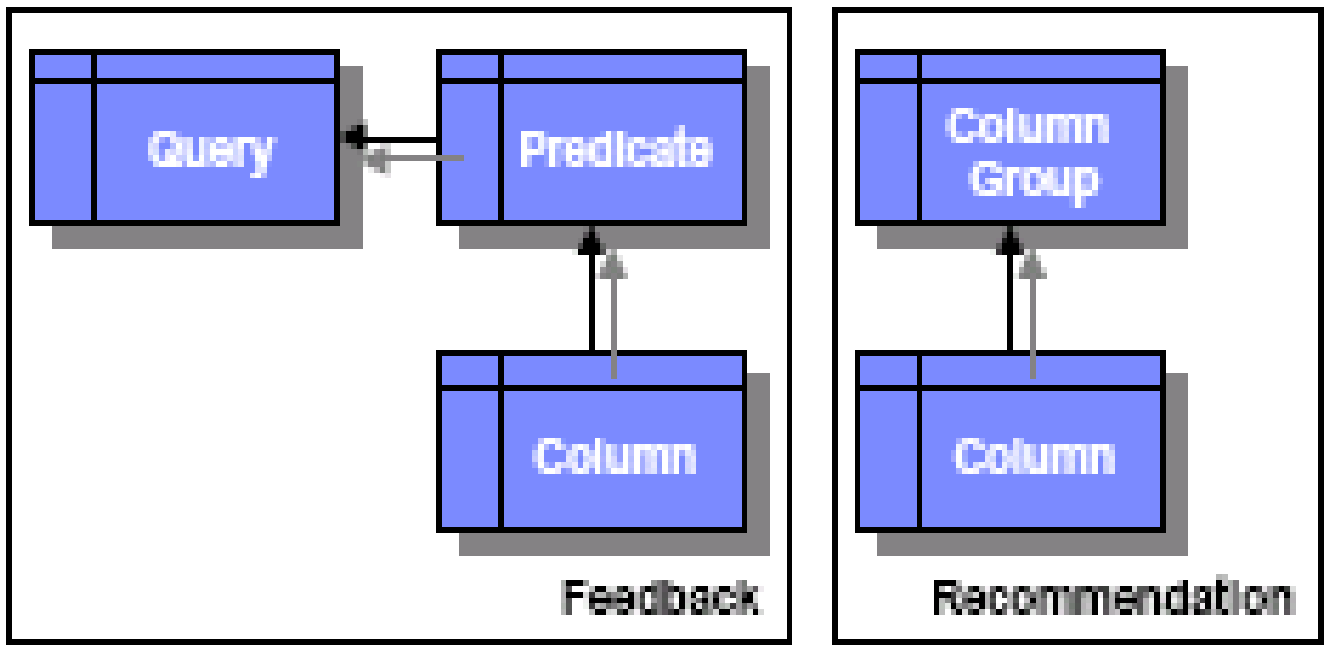
- TCA similar to UDI. Is there any difference and use?
- SPA:

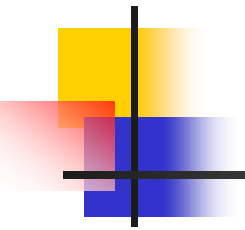


$$newcount_{new} = \left(C - \sum_{i=1}^{K} f_i\right) / (d - K)$$

- Correlation Analyzer : Pair-wise correlation

QFW Tables


Query
Predicate
Column
Feedback
Column Group
Column
Recommendation



Scheduling Statistics Collection

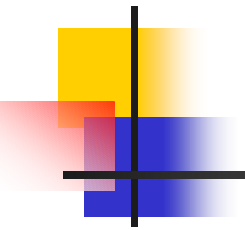
- Invokes QFA and AA
- DBA controls
  - QFA or AA or both
  - Maximum allowable space for QFW
- Scheduler also invokes RUNSTATS as a throttled background process to collect stats of high priority tables
- CA is invoked to check rate of change

Scheduling Statistics Collection

```
// G, P, D, Q, C are lists of tables
// T is a table
G := tables to be checked by AA during the initial
            maintenance iteration
P, D, Q, C := {}
while(true)
{
   // Call the AA on the Tables in G
   D := AA(G);
   // Call the Query Feedback Analyzer
   Q := QFA();
   // prioritize D and Q based on the ranking criteria
   // and merge with list of critical tables C
   P := prioritizeMerge(D, Q, C);
    while (still time in maintenance window)
    {
        T := Pop(P); // T is table in P with highest priority
        execute RUNSTATS on T
                and estimate the data change rate;
    }
    // Construct list for next maintenance interval
    (G, C) := constructDueTables()
    sleep until the next maintenance window;
}
```

Prioritizing Tables (1000s of tables and Terabytes of data)

- Useful – more than 0% and less than 50% experiencing change
- Needed – recommended by QFA
- Pressing – 50% or more rows
- Urgent – both Needed and Useful or Pressing
- Critical – has been starved either
  - UDI counter is +ve, but an excessive # of iterations have passed since last refresh
  - RUNSTATS has never been executed
- Tables are prioritized within each class



Recap: Neither one is sufficient

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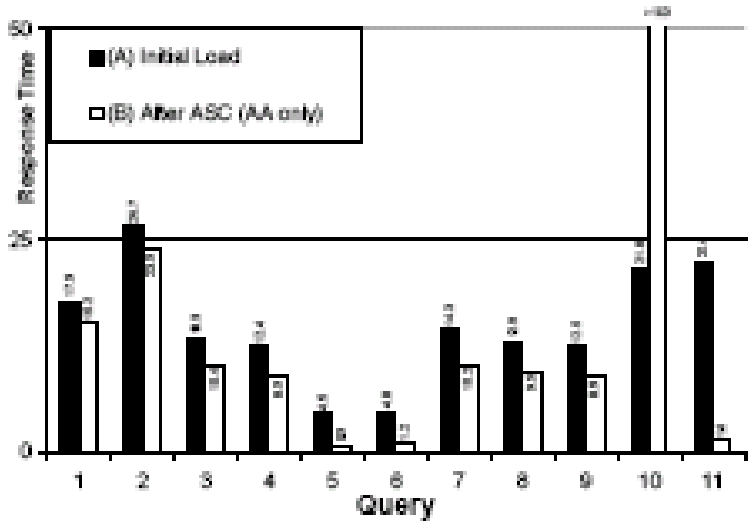


Figure 10: Performance after Loading

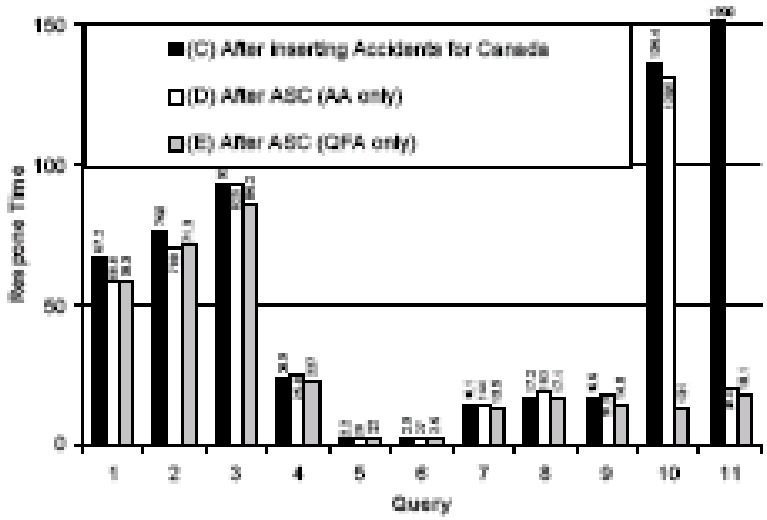
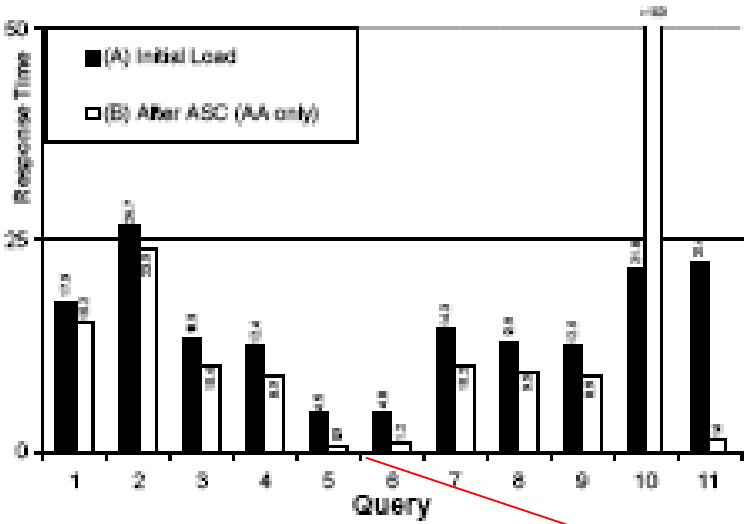


Figure 11: Performance after Inserting Additional Accident Records

Is there an advantage of having both AA and QFA?

=>If yes, what is the '% gain' over AA only and QFA only methods?

=> Or, is it just more resource consuming without 'considerable' advantage, if any?



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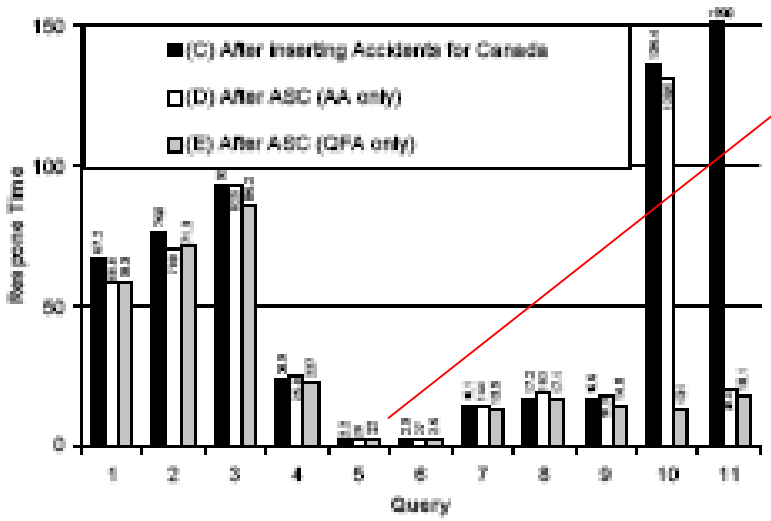
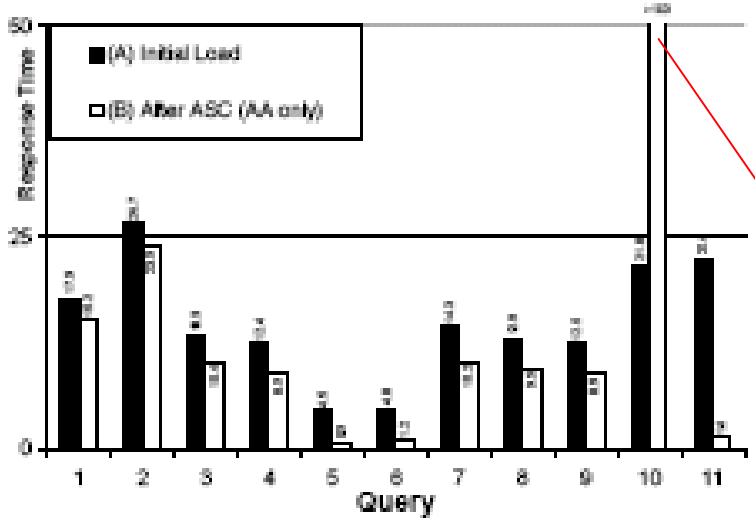


Figure 11: Performance after Inserting Additional Accident Records

After additional insertions, response time decreased

⇒Is query 5 and 6 independent of insertions?



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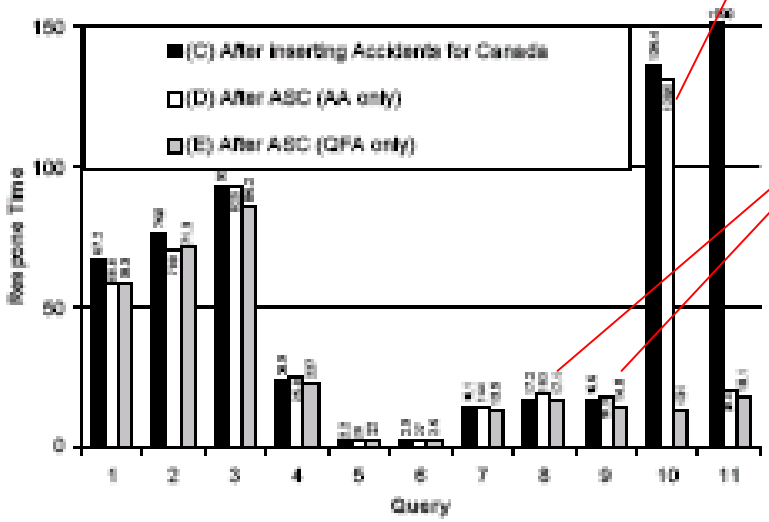
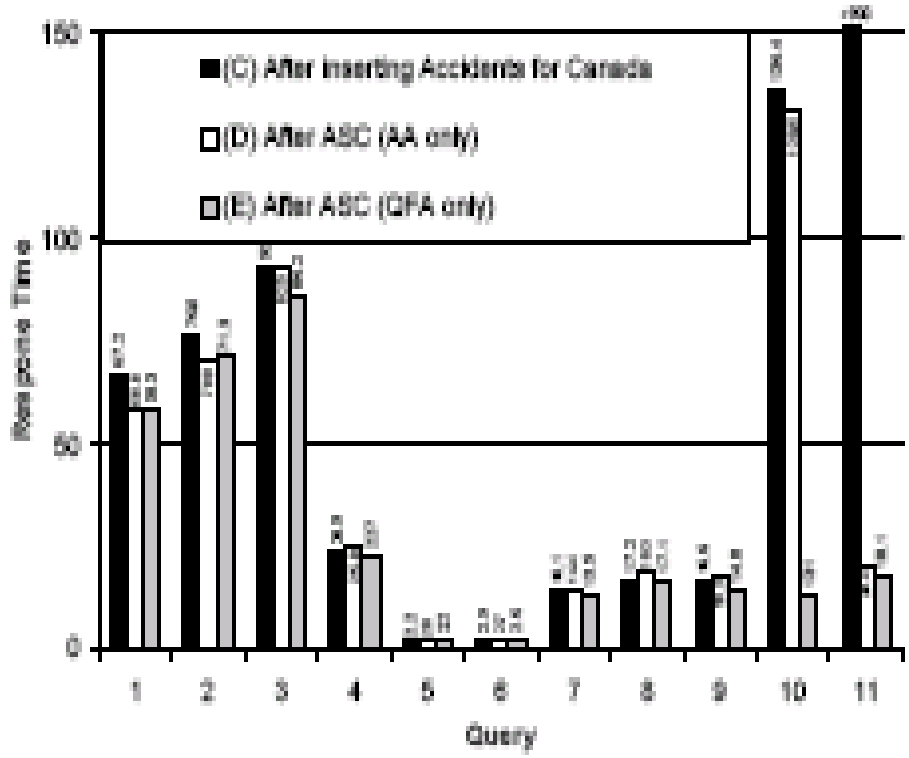


Figure 11: Performance after Inserting Additional Accident Records

After inserting and doing AA only, there is an advantage. Why?

what kind of queries would increase response time after AA or QFA. And why?

Related discussion about combined AA and QFA result



- QFA only/ AA only/ both?
  - May be tables/queries can be classified wrt QFA or AA or both?

Thank You