

Chapter 7: Query Processing

Database System Concepts, 5th Ed.

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Chapter 13: Query Processing

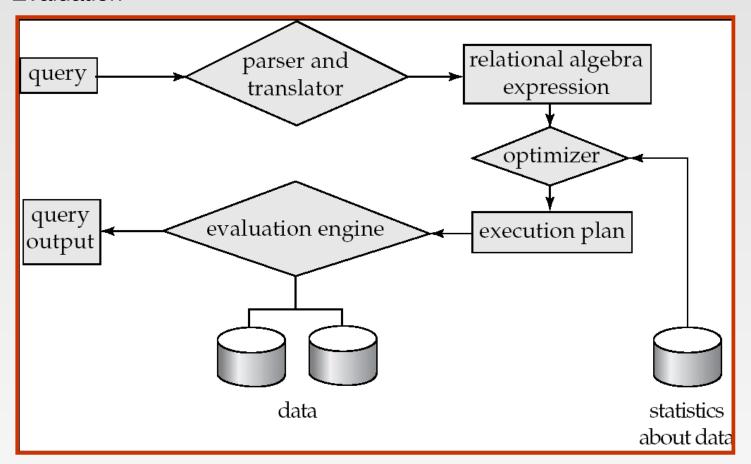
- Overview
- Measures of Query Cost
- Evaluation of Expressions





Basic Steps in Query Processing

- Parsing and translation
- Optimization
- **Evaluation**







Basic Steps in Query Processing (Cont.)

- Parsing and translation
 - translate the query into its internal form. This is then translated into relational algebra.
 - Parser checks syntax, verifies relations
- Evaluation
 - The query-execution engine takes a query-evaluation plan, executes that plan, and returns the answers to the query.



Basic Steps in Query Processing: Optimization

- A relational algebra expression may have many equivalent expressions
 - E.g., $\sigma_{balance<2500}(\Pi_{balance}(account))$ is equivalent to $\Pi_{balance}(\sigma_{balance<2500}(account))$
- Each relational algebra operation can be evaluated using one of several different algorithms
 - Correspondingly, a relational-algebra expression can be evaluated in many ways.
- Annotated expression specifying detailed evaluation strategy is called an evaluation-plan.
 - E.g., can use an index on balance to find accounts with balance < 2500,
 - or can perform complete relation scan and discard accounts with balance ≥ 2500

The Query executine engine takes a query-evaluation plan, executes that plan, and returns the answers to the query.





Basic Steps: Optimization (Cont.)

- Query Optimization: Amongst all equivalent evaluation plans choose the one with lowest cost.
 - Cost is estimated using statistical information from the database catalog
 - e.g. number of tuples in each relation, size of tuples, etc.
- In this chapter we study
 - How to measure query costs
- In Chapter Query Optimization
 - We study how to optimize queries, that is, how to find an evaluation plan with lowest estimated cost





Measures of Query Cost

- Cost is generally measured as total elapsed time for answering query
 - Many factors contribute to time cost
 - disk accesses, CPU, or even network communication
- Typically disk access is the predominant cost, and is also relatively easy to estimate. Measured by taking into account
 - Number of seeks * average-seek-cost
 - + Number of blocks read * average-block-read-cost
 - + Number of blocks written * average-block-write-cost
 - Cost to write a block is greater than cost to read a block
 - data is read back after being written to ensure that the write was successful
 - Assumption: single disk
 - Can modify formulae for multiple disks/RAID arrays
 - Or just use single-disk formulae, but interpret them as measuring resource consumption instead of time





Measures of Query Cost (Cont.)

- For simplicity we just use the <u>number of block transfers fro</u>m disk and the <u>number of seeks</u> as the cost measures
 - t_{τ} time to transfer one block
 - t_s time for one seek
 - Cost for b block transfers plus S seeks $b * t_{\tau} + S * t_{s}$
- We ignore CPU costs for simplicity
 - Real systems do take CPU cost into account
- We do not include cost to writing output to disk in our cost formulae
- Several algorithms can reduce disk IO by using extra buffer space
 - Amount of real memory available to buffer depends on other concurrent queries and OS processes, known only during execution
 - We often use worst case estimates, assuming only the minimum amount of memory needed for the operation is available
- Required data may be buffer resident already, avoiding disk I/O
 - But hard to take into account for cost estimation





Figure 13.2

