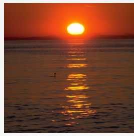
Chapter 7: Query Processing

Database System Concepts, 5th Ed.

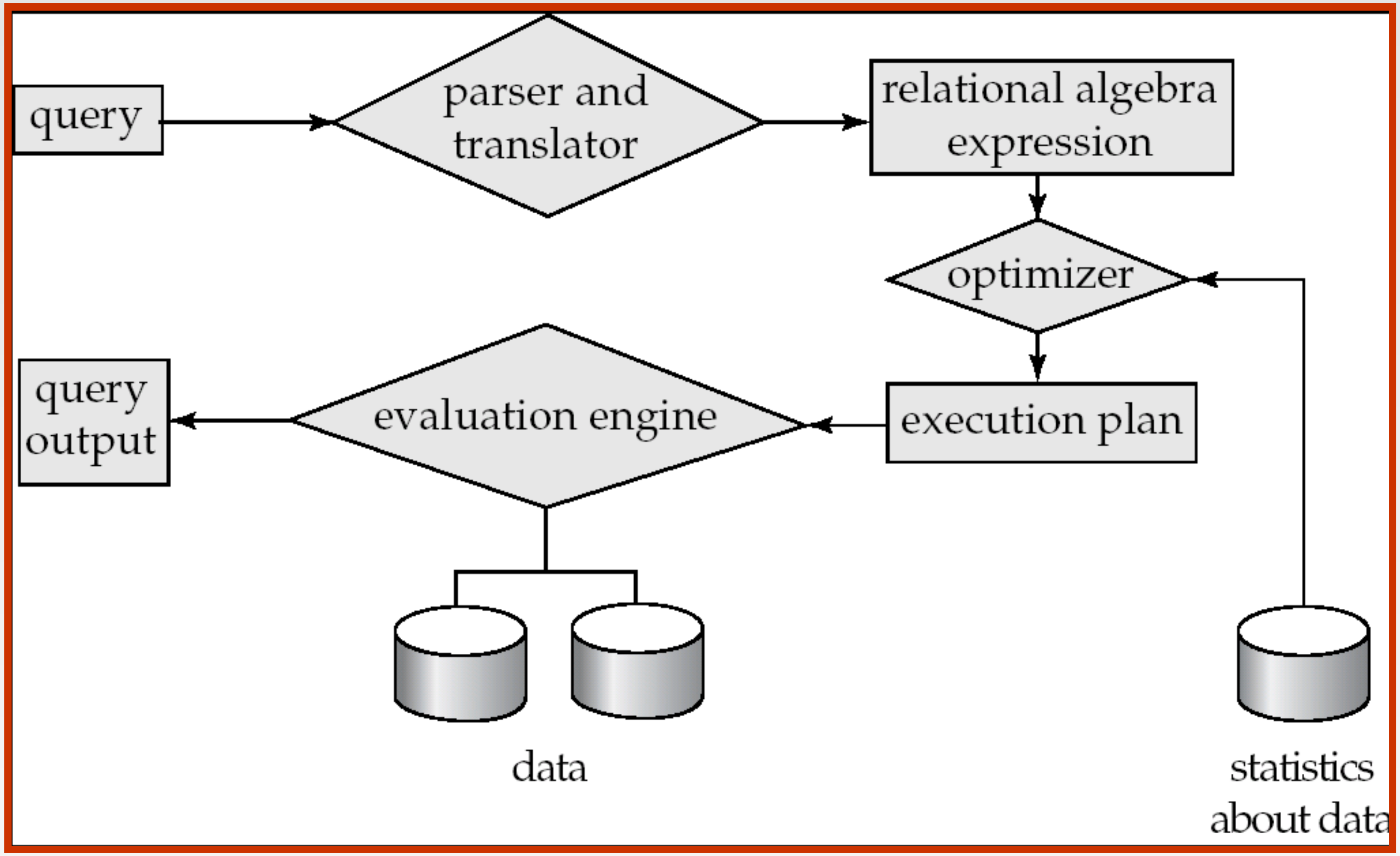


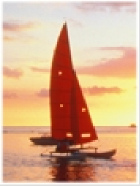
Chapter 13: Query Processing

- Overview
- Measures of Query Cost
- Evaluation of Expressions

Basic Steps in Query Processing

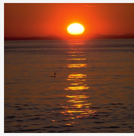
1. Parsing and translation
2. Optimization
3. Evaluation

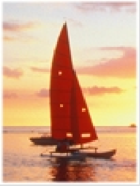




Basic Steps in Query Processing (Cont.)

- 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.



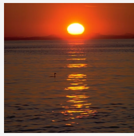


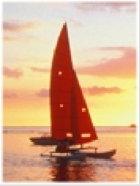
Basic Steps in Query Processing : Optimization

- 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

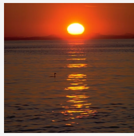
The Query executine engine takes a query-evaluation plan, executes that plan, and returns the answers to the query..

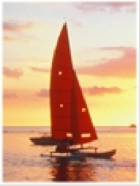




Basic Steps: Optimization (Cont.)

- **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



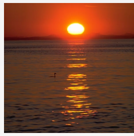


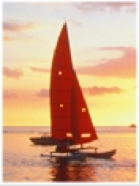
Measures of Query Cost

- 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 *number of block transfers from disk and the number of seeks* as the cost measures
  - t_T – time to transfer one block
  - t_S – time for one seek
  - Cost for b block transfers plus S seeks

    $b * t_T + S * t_S$
- 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

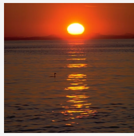
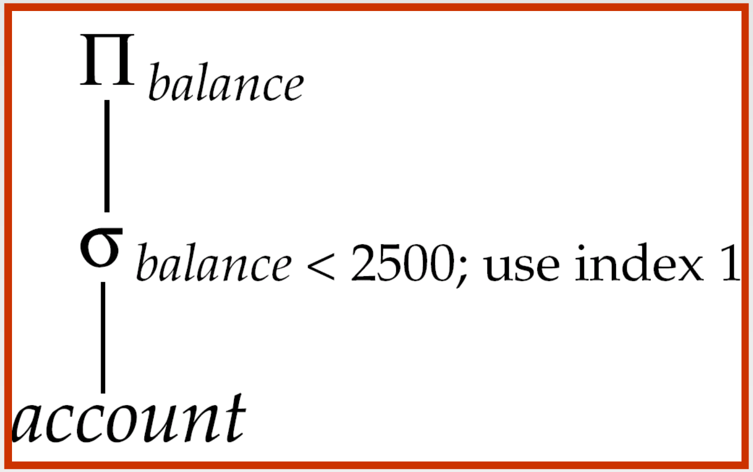


Figure 13.2



Π_{balance}

$\sigma_{\mathit{balance} < 2500;\ \text{use index 1}}$

account