

Module - I

Lecture-04

- Database Design
- Database Engine
- Database Architecture
- Database Users and Administrators

Database Design

*The process of designing the **general structure** of the database:*

- **Logical Design** – Deciding on the database schema. Database design requires that we find a “good” collection of relation schemas.
 - ✓ **Business decision** – What attributes should we record in the database?
 - ✓ **Computer Science decision** – What relation schemas should we have and how should the attributes be distributed among the various relation schemas?
- **Physical Design** – Deciding on the physical layout of the database

Database Engine

- A **database system** is partitioned into modules that deal with each of the responsibilities of the overall system.
- The **functional components** of a **database system** can be divided into
 - ✓ The storage manager,
 - ✓ The query processor component,
 - ✓ The transaction management component.

Storage Manager

- A **program module** that provides the **interface** between the **low-level data** stored in the database and the **application programs** and **queries** submitted to the system.
- The **storage manager** is responsible to the following tasks:
 - ✓ Interaction with the **OS file manager**
 - ✓ Efficient **storing, retrieving** and **updating** of data

Storage Manager

- The **storage manager** components include:
 - ✓ Authorization and integrity manager
 - ✓ Transaction manager
 - ✓ File manager
 - ✓ Buffer manager

Storage Manager

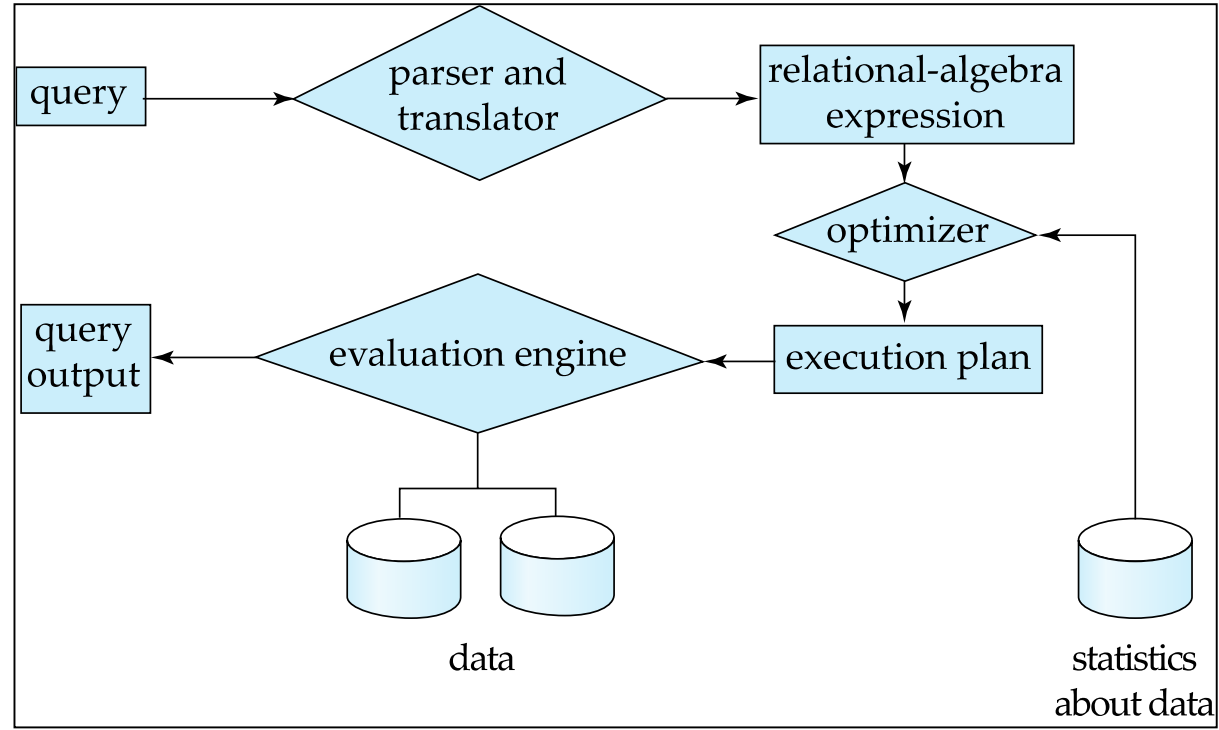
- The **storage manager** implements several **data structures** as part of the **physical system** implementation:
 - ✓ **Data files** -- store the database itself
 - ✓ **Data dictionary** -- stores metadata about the structure of the database, in particular the schema of the database.
 - ✓ **Indices** -- can provide fast access to data items. A database index provides pointers to those data items that hold a particular value.

Query Processor

- The **query processor** components include:
 - ✓ **DDL interpreter** -- interprets **DDL** statements and records the definitions in the data dictionary.
 - ✓ **DML compiler** -- translates **DML** statements in a query language into an evaluation plan consisting of low-level instructions that the query evaluation engine understands.
 - The **DML** compiler performs **query optimization**; that is, it picks the lowest cost evaluation plan from among the various alternatives.
 - ✓ **Query evaluation engine** -- executes low-level instructions generated by the **DML** compiler.

Query Processing

1. Parsing and translation
2. Optimization
3. Evaluation



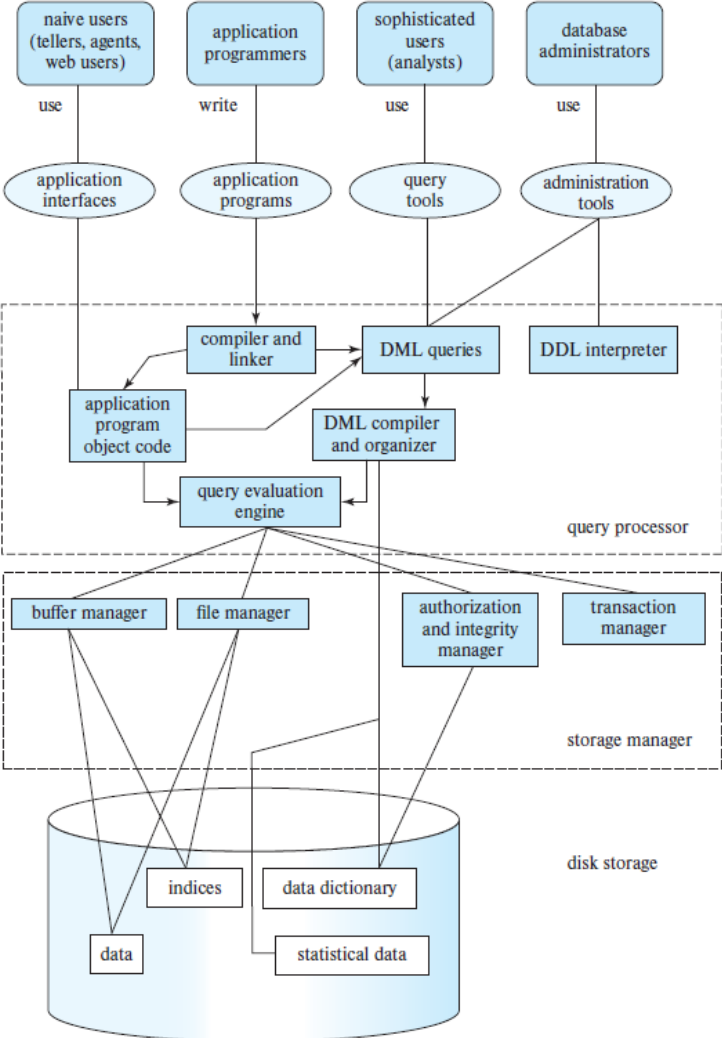
Transaction Management

- A **transaction** is a collection of operations that performs a single logical function in a database application
- **Transaction-management component** ensures that the database remains in a consistent (correct) state despite system failures (e.g., power failures and operating system crashes) and transaction failures.
- **Concurrency-control manager** controls the interaction among the concurrent transactions, to ensure the consistency of the database.

Database Architecture

- **Centralized databases**
 - One to a few cores, shared memory
- **Client-server**
 - One server machine executes work on behalf of multiple client machines.
- **Parallel databases**
 - Many core shared memory
 - Shared disk
 - Shared nothing
- **Distributed databases**
 - Geographical distribution
 - Schema/data heterogeneity

Database Architecture (Centralized / Shared-Memory)

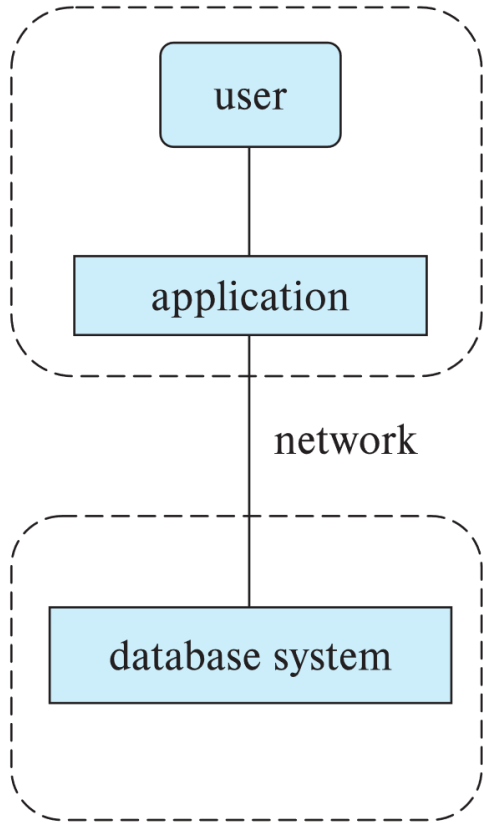


Database Applications

Database applications are usually partitioned into **two** or **three** parts

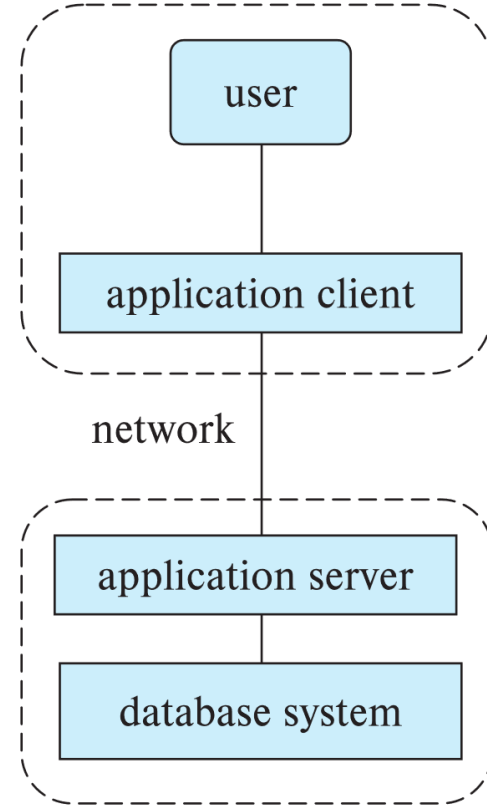
- **Two-tier architecture** -- the application resides at the client machine, where it invokes database system functionality at the server machine
- **Three-tier architecture** -- the client machine acts as a front end and does not contain any direct database calls.
 - ✓ The client end communicates with an application server, usually through a forms interface.
 - ✓ The application server in turn communicates with a database system to access data.

Two-tier and three-tier architectures



(a) Two-tier architecture

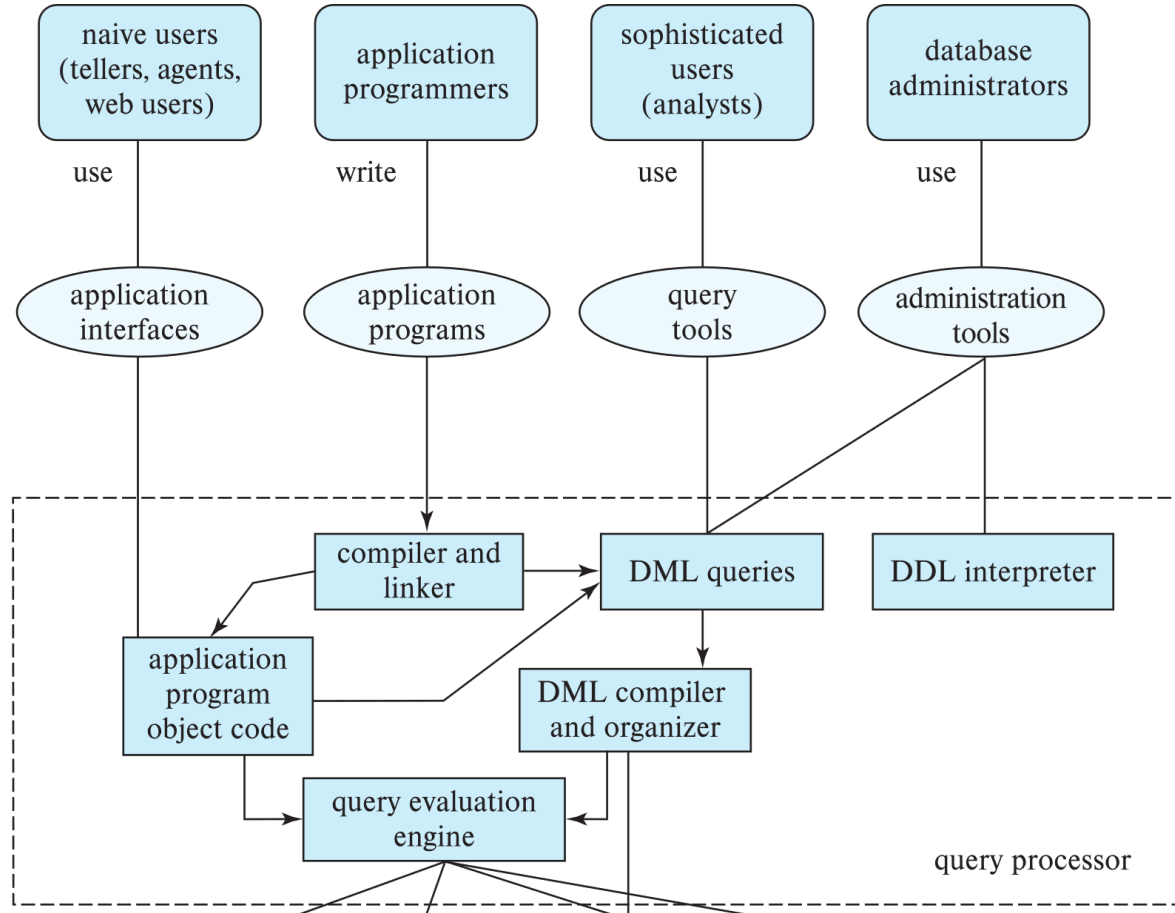
client



(b) Three-tier architecture

server

Database Users



Database Administrator

A person who has central control over the system is called a **Database Administrator (DBA)**.

Functions of a **DBA** include:

- | | |
|--|--|
| <ul style="list-style-type: none">• Schema definition• Storage structure and access-method definition• Schema and physical-organization modification• Granting of authorization for data access | <ul style="list-style-type: none">• Routine maintenance• Periodically backing up the database• Ensuring that enough free disk space is available for normal operations, and upgrading disk space as required• Monitoring jobs running on the database |
|--|--|

Copyright Note

Database System Concepts by *Avi Silberschatz, Henry F. Korth and S. Sudarshan*. 7th Edition

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