

# Database Architecture

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# Session Objective

- To learn about Data Base Architecture

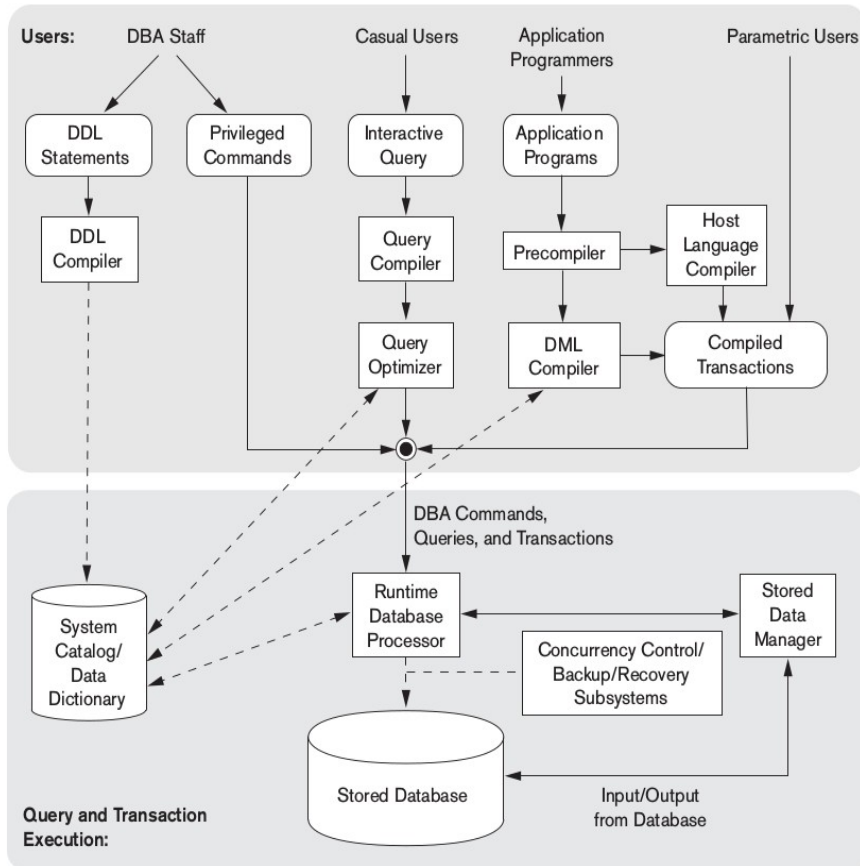
At the end of this session, participants will be able to:

- Understand the Data Base Architecture

# Table of Contents

- 1 Database System Environment
- 2 Database Users
- 3 Two Tier Architecture
- 4 Three Tier Architecture
- 5 Reference

# Database Environment



# Database Users

Users are differentiated by the way they expect to interact with the system

- **Naïve users / Data entry operators**

- Invoke one of the application programs using GUI.
- Do data entry by supplying parameters for predefined transactions. (canned)
- No deep (technical) knowledge of the database required.
- E.g. people accessing database over the web, bank tellers, clerical staff.

- **Application programmers**

- Interact with system through application programs.
- User interfaces are developed using RAD tools.
- Should thoroughly understand the logical schema or relevant views

- **Sophisticated users / Data Analyst**

- Form requests in a database query language
- Uses SQL to generate answers for complex queries

# Database Administrators

Coordinates all the activities of the database system which includes enterprise's information resources and needs.

- Schema definition
- Storage structure and access method definition
- Schema and physical organization modification
- Granting user authority to access the database
- Periodical backup to prevent loss of data
- Ensuring enough free disk space is available and upgrading disk space
- Monitoring performance and responding to changes in requirements

- The database and the DBMS catalog are usually stored on disk.
- Access to the disk is controlled primarily by the **operating system (OS)**, which schedules disk read/write.
- Many DBMSs have their own buffer management module to schedule disk read/write
- Reducing disk read/write **improves performance** considerably.
- **Data manager module** of the DBMS controls access to DBMS information that is stored on disk, it is a part of the database or the catalog.



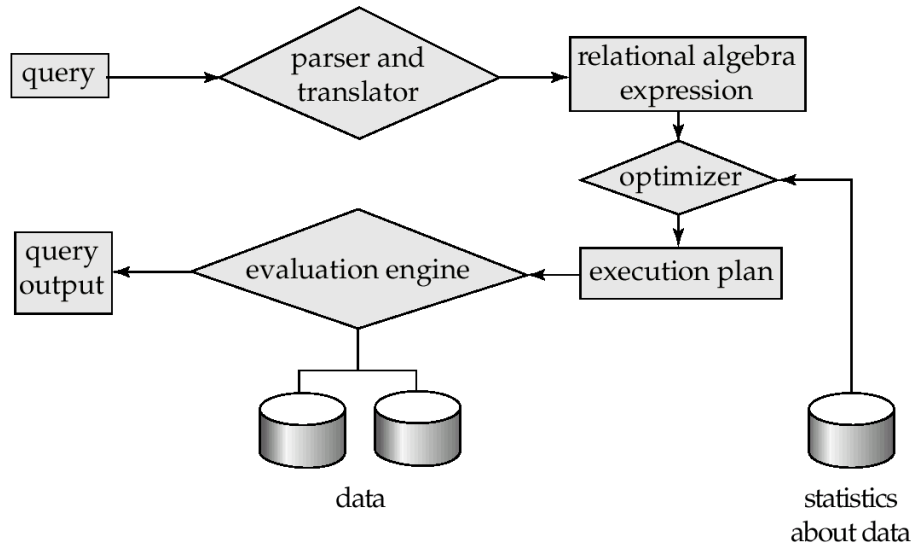
DBA staff works on defining the database and tuning it using the DDL and other privileged commands.

- The DDL compiler processes schema definitions, specified in the DDL
- Stores descriptions of the schemas (meta-data) in the DBMS catalog.
- The catalog includes information such as:
  - Names and sizes of files
  - Names and data types of data items
  - Storage details of each file
  - Mapping information among schemas, and constraints.
- The catalog also stores many other types of information that are needed by the DBMS modules

# Query Processor

- Casual users and persons with occasional need for information interact with db using **interactive query interface**
- These queries are **parsed and validated for correctness** of the query syntax, the names of files and data elements
- Query compiler compiles them into an **internal form**.
- The query optimizer is concerned with:
  - The rearrangement and possible reordering of operations, elimination of redundancies, and use of correct algorithms and indexes during execution.
  - It consults the system catalog for statistical and other physical information
  - Generates executable code that performs the necessary operations for the query
  - Makes calls on the runtime processor.

# Query Processor



# DML Compiler

- Application programmers write programs in host languages such as Java, C, or C++ that are submitted to a precompiler.
- The precompiler extracts DML commands from an application program written in a host programming language.
- Commands sent to DML compiler for compilation into object code.
- The rest of the program is sent to the host language compiler.
- The object codes for the DML commands and the rest of the program are linked, forming a canned transaction
- Executable code make calls to the runtime database processor.

# Runtime database processor

The runtime database processor executes :

- The privileged commands
- The executable query plans and
- The canned transactions with runtime parameters.
- It works with the system catalog and may update it with statistics.
- It also works with the stored data manager

# Storage Manager

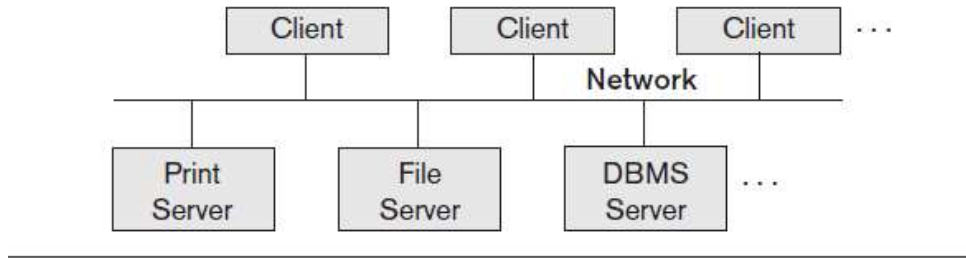
A program module that provides the interface between:

- the lowest level data stored in the database and the application programs and queries submitted to the system
- Translates the DML statements into low-level file-system commands

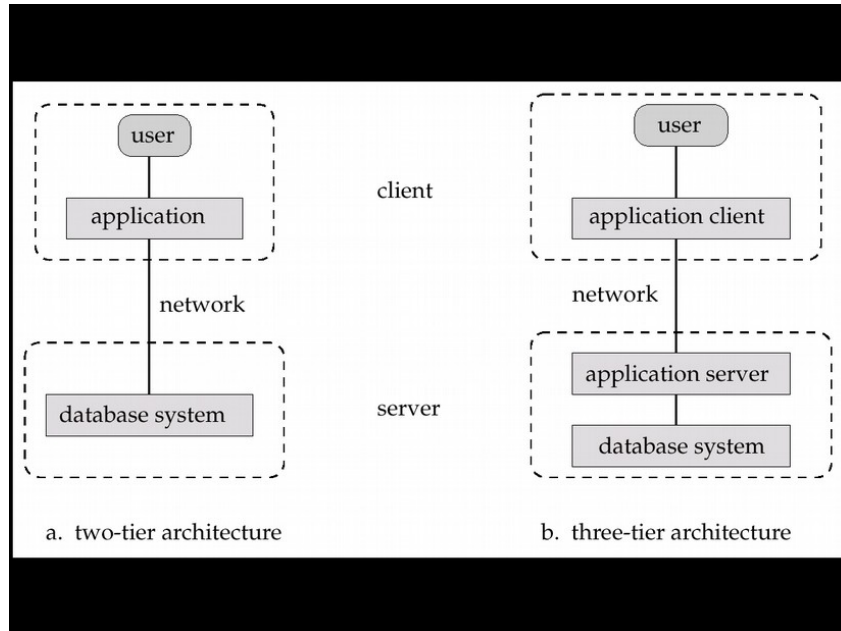
Storage manager components:

- **Authorization and Integrity Manager:** Tests integrity constraints and checks the authority of users to access data
- **Transaction Manager:** Ensures that the database remains in a consistent state despite failures and Concurrent transaction executions proceed without conflicting
- **File Manager:** Manages the allocation of space on disk storage and the data structures used to represent information stored on disk
- **Buffer Manager:** Responsible for fetching data from disk into main memory, deciding what data to cache in main memory

# Two Tier Architecture



# Three Trier Architecture







Fundamentals of Database systems 7<sup>th</sup> Edition by Ramez Elmasri.