

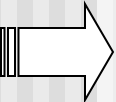
Chapter 1 Introduction

Contents

- The history of Database System
- Overview of a database Management System (DBMS)
- Three aspects of database-system studies

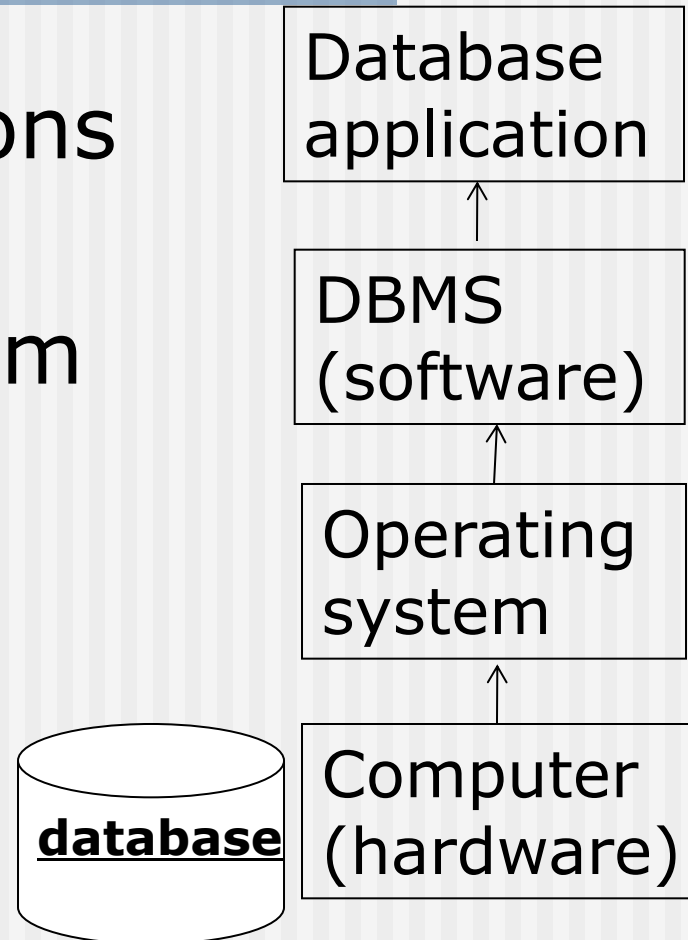
Introduction to Database Systems

What is a Database System?

- Database (data , metadata)
- Hardware (disks)
-  ■ Software (**DBMS**)
- People (users, database designers and database administrators DBA)

Introduction to Database Systems (cont.)

- Database applications
- Database Management System (**DBMS**)
- Operating System (not in this course)



Database Application Systems

- **Databases touch all aspects of our lives**
 - Banking: all transactions
 - Airlines: reservations, schedules
 - Universities: course registration, grades
 - Sales: customers, products, purchases
 - Manufacturing: production, inventory, orders, supply chain
 - Human resources: employee records, salaries, tax deductions ...

The history of DBMS (overview)

- Early database management systems evolved from *file system*
- Network DBMS, Hierarchical DBMS
- **Relational database** Systems (in 1970, Ted Codd proposed tables called relations as a view of data in database)
- **Object-oriented database**
- **Web database and XML**
- JSON and NOSQL system

More detailed History

(From Database Concepts 6th edition)

- 1950s and early 1960s:
 - Data processing using magnetic tapes for storage
 - Tapes provided only sequential access
 - Punched cards for input
- Late 1960s and 1970s:
 - Hard disks allowed direct access to data
 - Network and hierarchical data models in widespread use
 - Ted Codd defines the relational data model
 - he won the **ACM Turing Award** for this work
 - IBM Research begins **System R prototype**
 - UC Berkeley begins **Ingres prototype**
 - High-performance (for the era) transaction processing

More detailed History (cont.)

- 1980s:
 - Research relational prototypes evolve into commercial systems
 - SQL becomes industrial standard
 - Parallel and distributed database systems
 - Object-oriented database systems
- 1990s:
 - Large decision support and data-mining applications
 - Large multi-terabyte data warehouses
 - Emergence of Web commerce
- Early 2000s:
 - XML and XQuery standards
 - Automated database administration
- Later 2000s:
 - Giant data storage systems, noSQL systems
 - stream data, uncertain data,

What is a DBMS (database management system) ?

From Commercial Market:

- Oracle, Sybase are among the largest software companies in the world.
- IBM offers its DB2 system
- Microsoft offers SQL-Server & Microsoft Access for DBMS on desktop

What do you think about DBMS?

From User's point of view:

- Collection of interrelated data
- Set of programs to access the data
- DBMS contains information about a particular enterprise
- DBMS provides an environment that is both *convenient* and *efficient* to use.

Conclusions from user's points

The DBMS is expected to:

- Allow users to **create** new database and specify their structure.
- Give users the ability to **query** the data.
- Support the **storage** of very large amounts of data.
- **Enable durability, recovery** of failures, errors of many kinds.
- **Control access** to data from many users at once.

DBMS (From its Functions)

- Design the structure of their information (e.g. relational model)
- Operate (query, modify) on the data
- Manage huge amount of data and support **efficient, concurrent, secure, atomic access** to very large amounts of data

DBMS (how to manage data)

- Persistent storage: supports the storage of very large amounts of data:
 1. Data: the content of DB itself.
 2. Metadata: describes the structure of, and constraints on, the database.
 3. Log records: recent change to the databases.
 4. Statistics: about data property, such as the sizes of, values of,...
 5. Indexes: support efficient access to the data
- Programming interface: to access and modify data through a powerful query language.

DBMS: how to manage data (cont.)

- Transaction management:
supports **secure, atomic access** to very large amounts of data.
- Concurrent control:
supports **concurrent access** to data.

DBMS (Components)

- Query processor

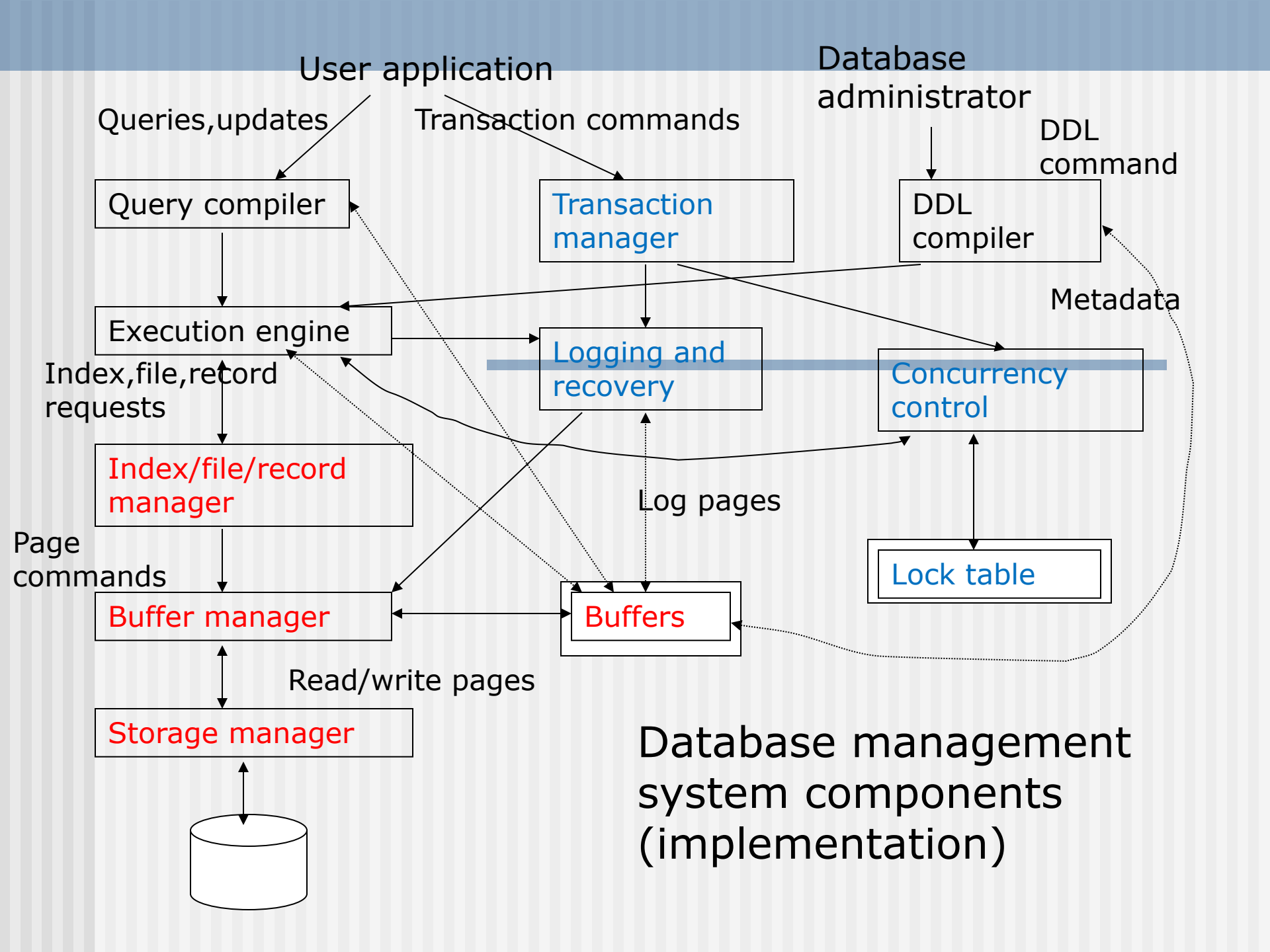
The query compiler, execution engine

- Transaction manager

Logging, concurrency control, deadlock resolution

- Storage manager

Control the placement of data on disk, and its movement between disk and main memory



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

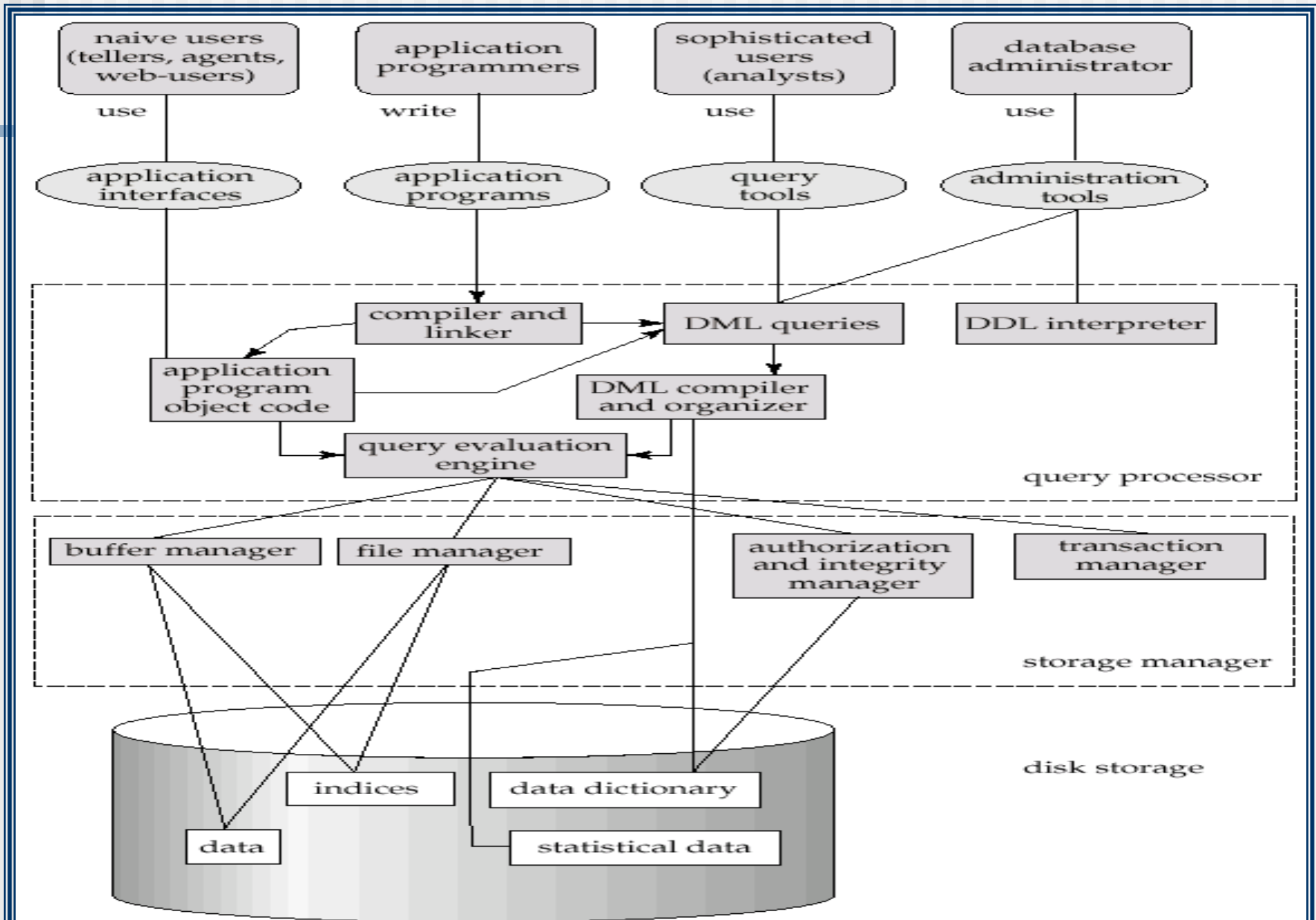
- **Application programmers** – interact with system through database manipulation language
- **Sophisticated users** – form requests in a database query language
- **Specialized users** – write specialized database applications that do not fit into the traditional data processing framework
- **Naïve users** – invoke one of the permanent application programs that have been written previously

👉 E.g. people accessing database over the web, bank tellers, clerical staff

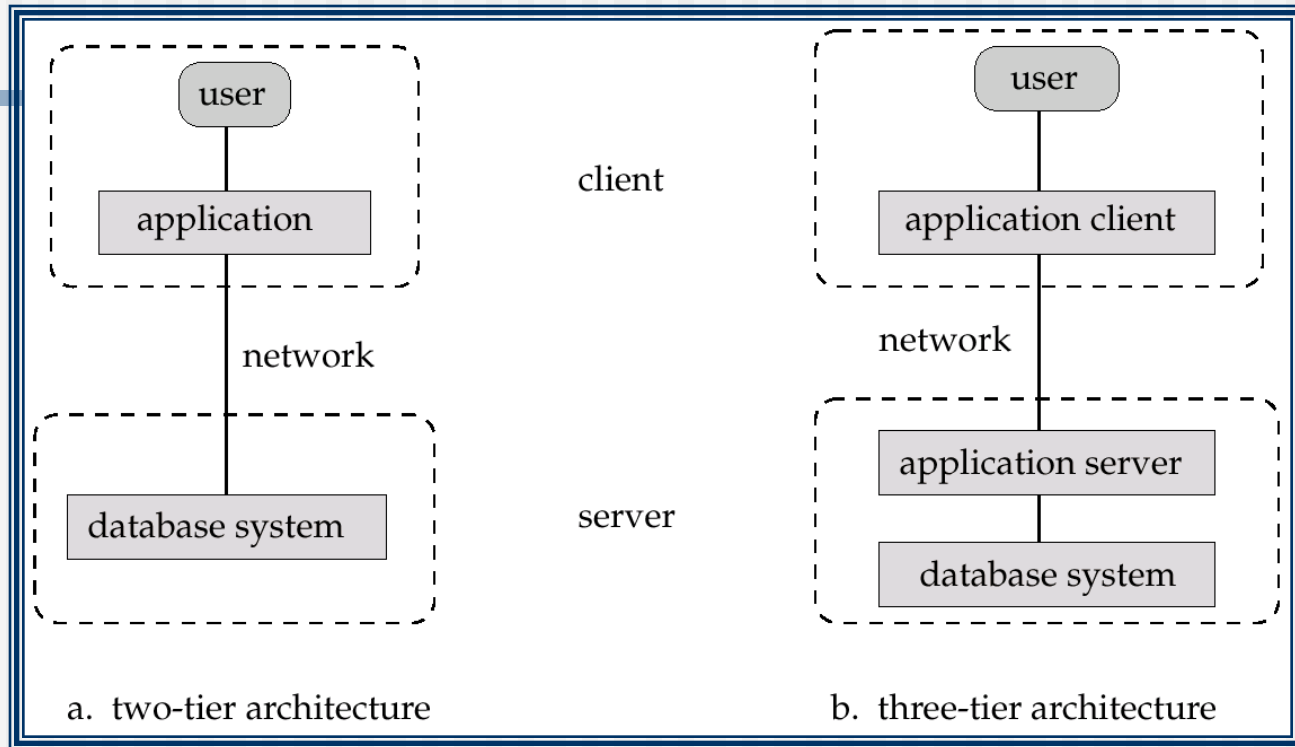
Database Administrator (DBA)

- Coordinates all the activities of the database system; the database administrator **has a good understanding** of the enterprise's information resources and needs.
- Database administrator's **duties** include:
 - Schema definition
 - Storage structure and access method definition
 - Schema and physical organization modification
 - Granting user authority to access the database
 - Specifying integrity constraints
 - Acting as liaison with users
 - Monitoring performance and responding to changes in requirements

Different Users with the System




Application Architectures



- **Two-tier architecture:** E.g. client programs using **ODBC/JDBC** to communicate with a database
- **Three-tier architecture:** E.g. web-based applications, and applications built using “middleware”
- **Multi-tier architecture.**

Three Aspects of Studying DBMS's

- 
- Modeling and design of databases. (how is the information structured?)
 - Programming: queries and DB operations like update. (how does one express queries and other operations on the database)
 - DBMS implementation. (how to build a DBMS)

Summary of chapter 1

- Database System & Applications
- Database management System (DBMS) features, functions, components (**storage manager, the query processor, and the transaction manager**)
- Database Language (DDL, DML)
- The development of DBMS

Past time:

Network DBMS
Hierarchical DBMS
Relational DBMS

Now:

Relational DBMS
Object-Relational/oo DBMS
Web-based database,
noSQL system

Homework

- Read section 1.2