Database System and Database Design
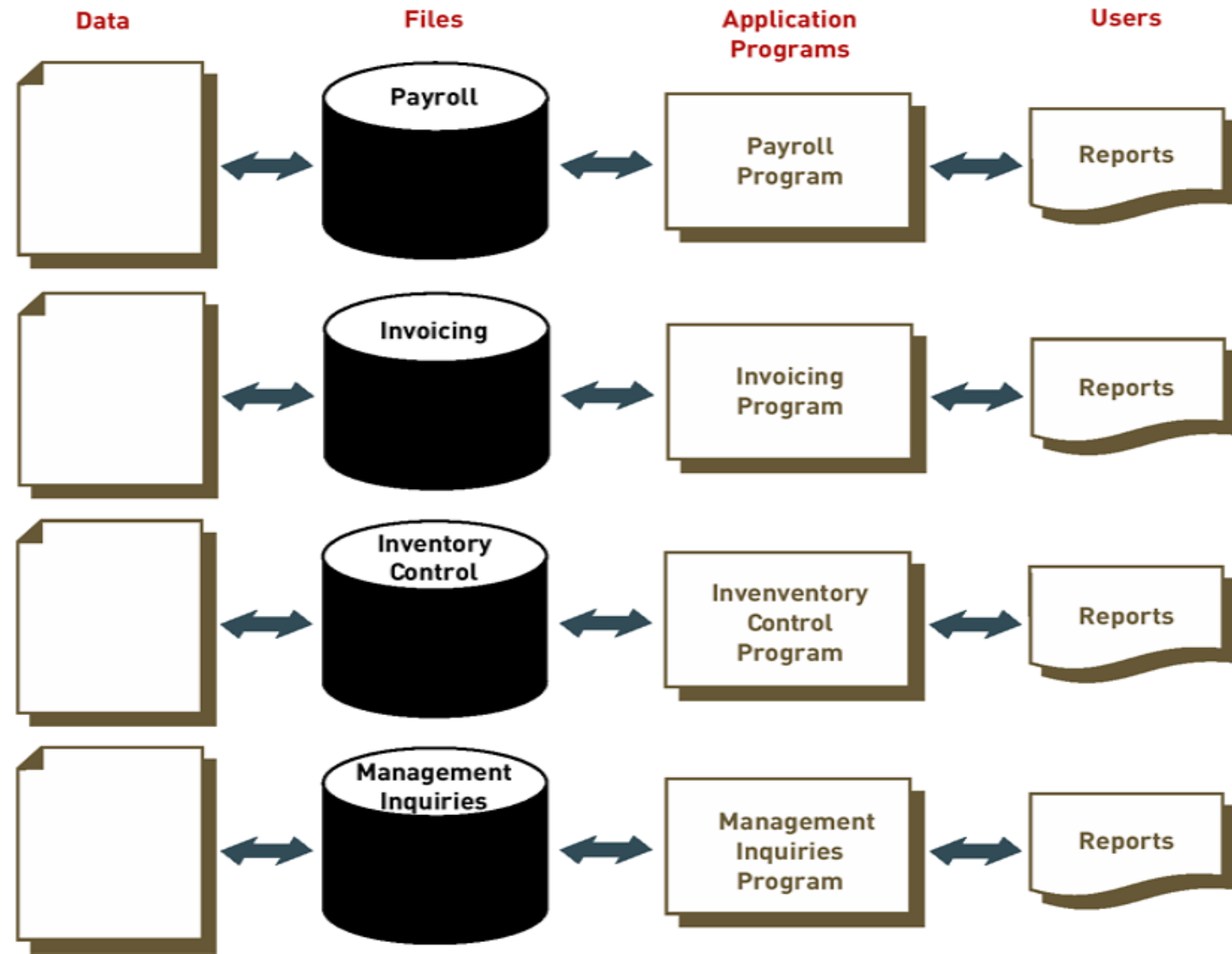
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Agenda

- File-based vs Hierarchy model, Network, and Relational Database
- DBMS Architecture
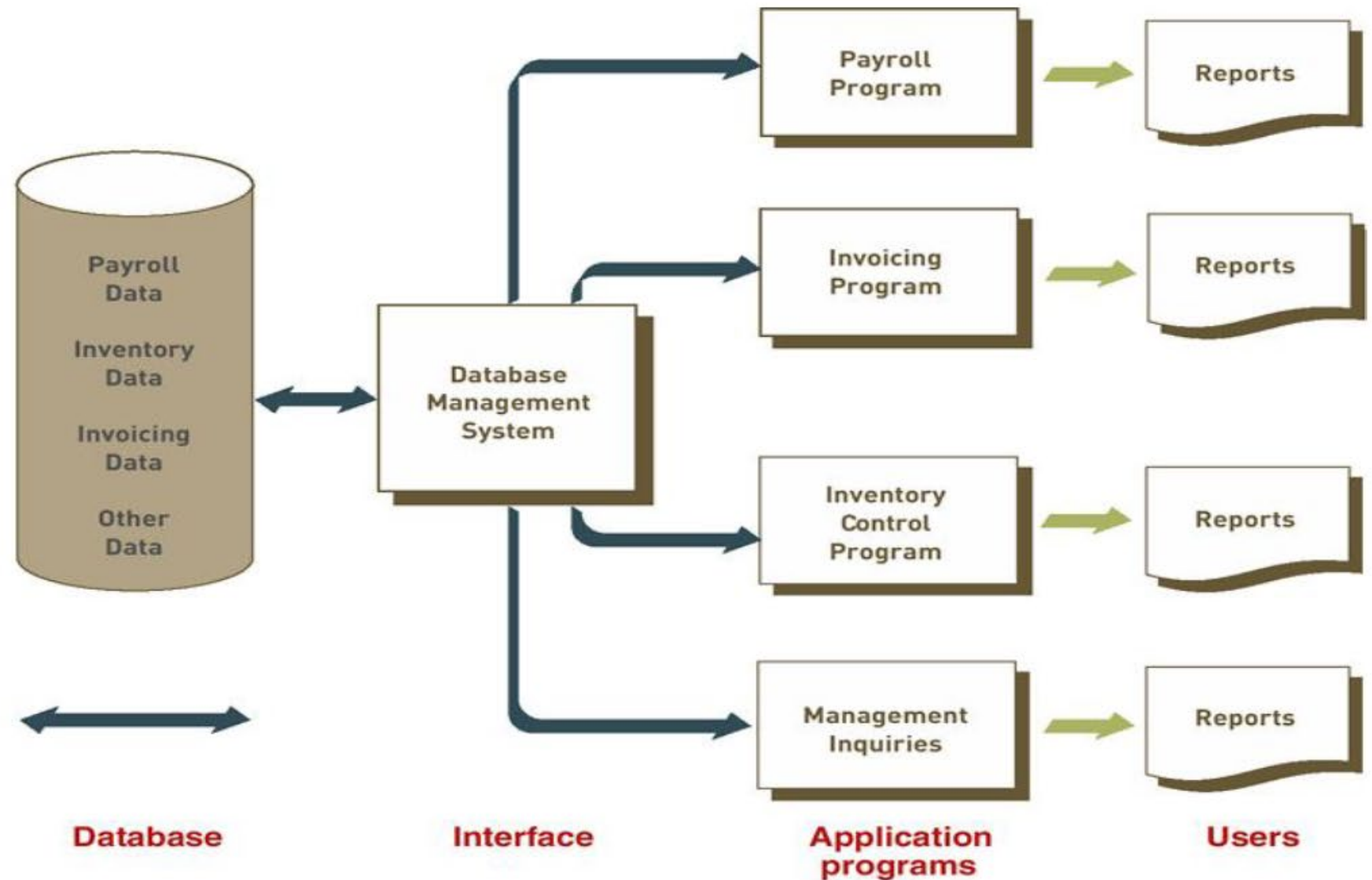- The range of DB applications

What type of system is this?

1. **File-based System**

2. **Database System**

Data	Files	Application Programs	Users
	Payroll	Payroll Program	Reports
	Invoicing	Invoicing Program	Reports
	Inventory Control	Invenventory Control Program	Reports
	Management Inquiries	Management Inquiries Program	Reports

What type of system is this?

1. **File-based System**

2. **Database System**

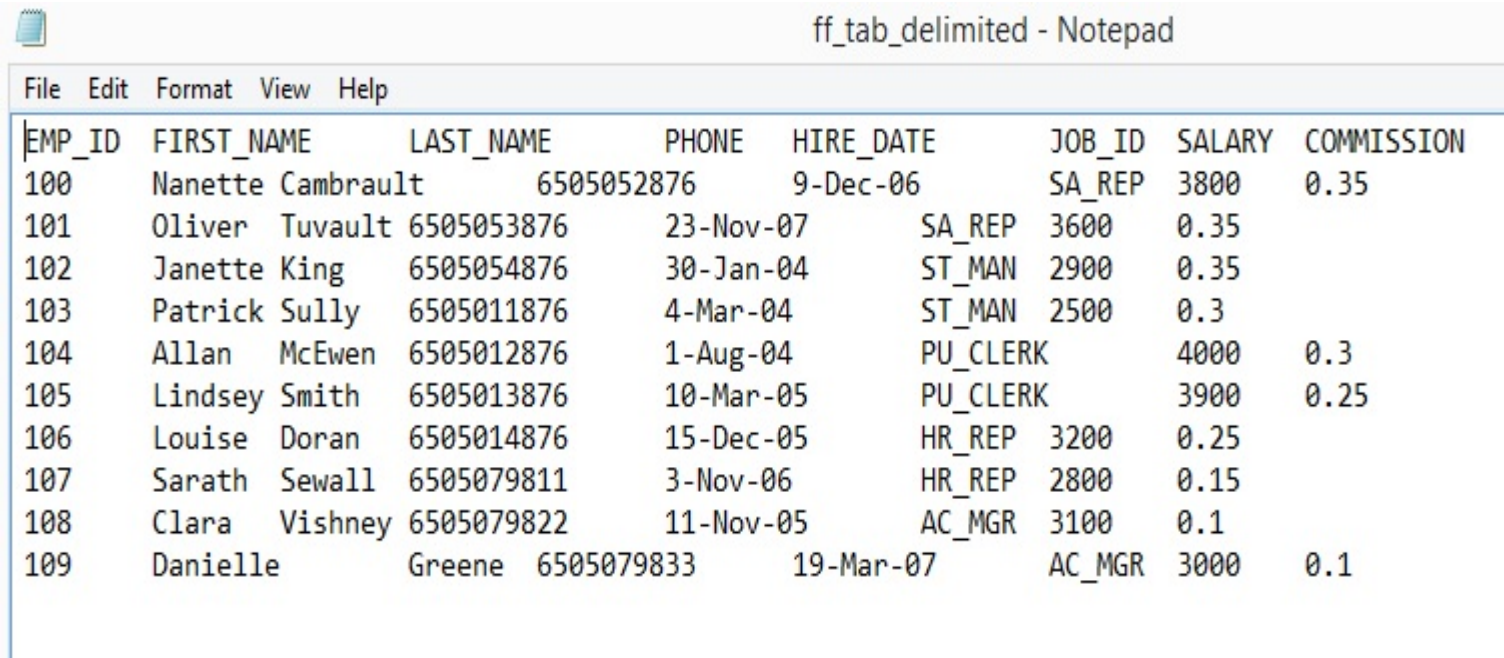| Database | Interface | Application programs | Users |

File-based System

- A **file-based system** is a collection of application programs that perform services for the users wishing to access information.

- Each program within a **file-based system** defined and manages its own data

Flat Files

- Is a way of describing a simple text file, containing no structure whatsoever — data is simply dumped in a file.

- Consisting of a single Table

- Advantages:
  - Simple to create, easy to use, inexpensive

- Disadvantages:
 - Increased data redundancy and inconsistency

Flat files

ff_tab_delimited - Notepad

File Edit Format View Help

EMP_ID	FIRST_NAME	LAST_NAME	PHONE	HIRE_DATE	JOB_ID	SALARY	COMMISSION
100	Nanette	Cambrault	6505052876	9-Dec-06	SA_REP	3800	0.35
101	Oliver	Tuvault	6505053876	23-Nov-07	SA_REP	3600	0.35
102	Janette	King	6505054876	30-Jan-04	ST_MAN	2900	0.35
103	Patrick	Sully	6505011876	4-Mar-04	ST_MAN	2500	0.3
104	Allan	McEwen	6505012876	1-Aug-04	PU_CLERK	4000	0.3
105	Lindsey	Smith	6505013876	10-Mar-05	PU_CLERK	3900	0.25
106	Louise	Doran	6505014876	15-Dec-05	HR_REP	3200	0.25
107	Sarath	Sewall	6505079811	3-Nov-06	HR_REP	2800	0.15
108	Clara	Vishney	6505079822	11-Nov-05	AC_MGR	3100	0.1
109	Danielle	Greene	6505079833	19-Mar-07	AC_MGR	3000	0.1

- Is a way of describing a simple text file, containing no structure whatsoever — data is simply dumped in a file.
- Consisting of a single Table

Advantages:

Simple to create, easy to use, inexpensive

Disadvantages:

Increased data redundancy and inconsistency

The Hierarchical Model

- The earliest databases

- Records arranged in a hierarchy much like an organization chart

- is an inverted tree-like structure. The tables of this model take on a child-parent relationship. Each *child table* has a single *parent table,* and each parent table can have multiple child tables. Child tables are completely dependent on parent tables; therefore, a child table can exist only if its parent table does.
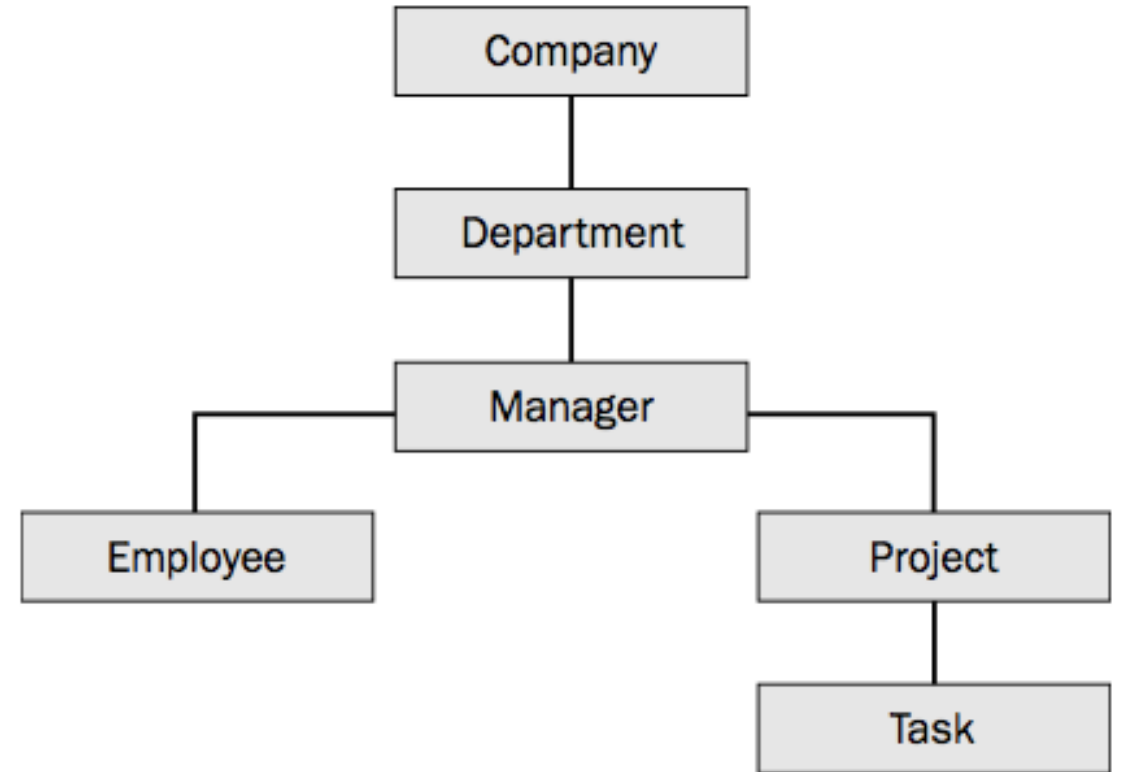
The Network Model

- The network database model evolved at around the same time as the hierarchical database model

- The network model provided greater flexibility, but—as is often the case with computer systems—with a loss of simplicity.

- The network model allows child tables to have more than one parent, thus creating a networked-like table structure. Multiple parent tables for each child allows for *many-to-many* relationships
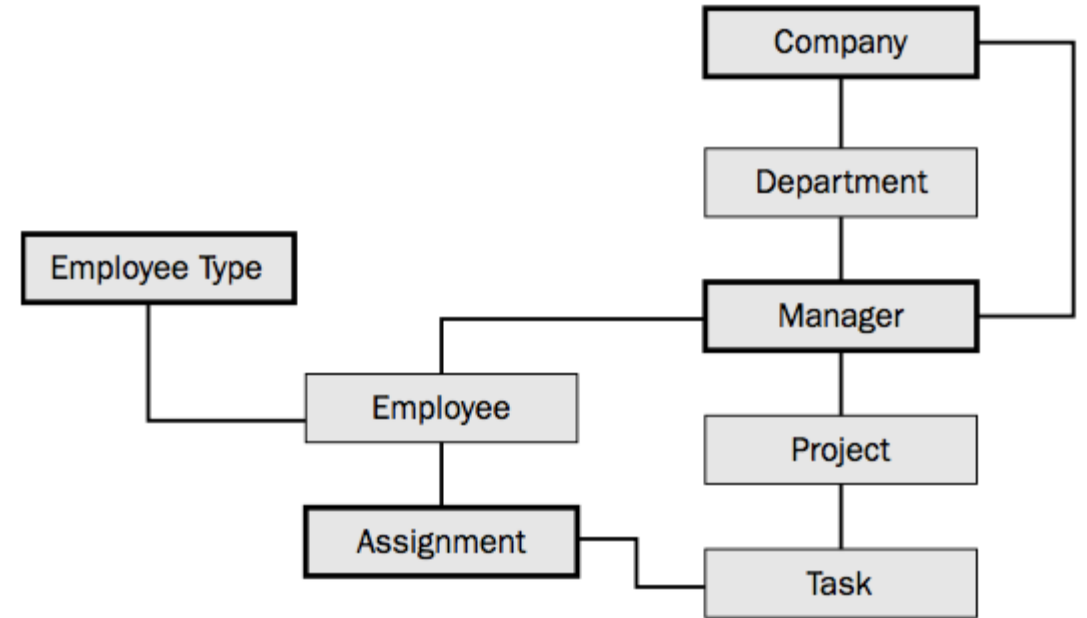
The Relational Model

- The relational model allows users to relate records *as needed* rather than as predefined when the records are first stored in the database.

- The relational model is constructed such that queries work with *sets* of data

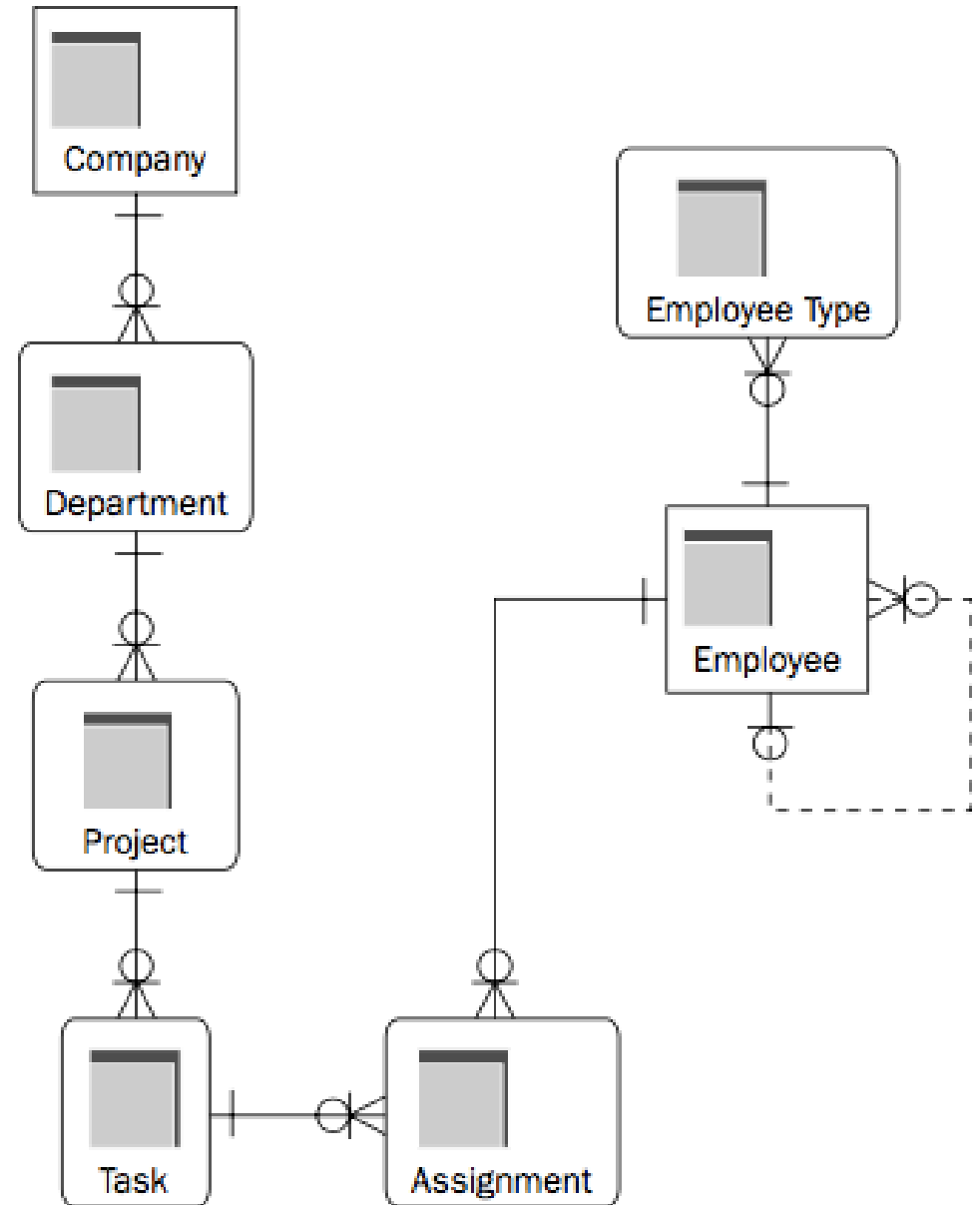- The relational model presents data in familiar two-dimensional tables, much like a spreadsheet does.

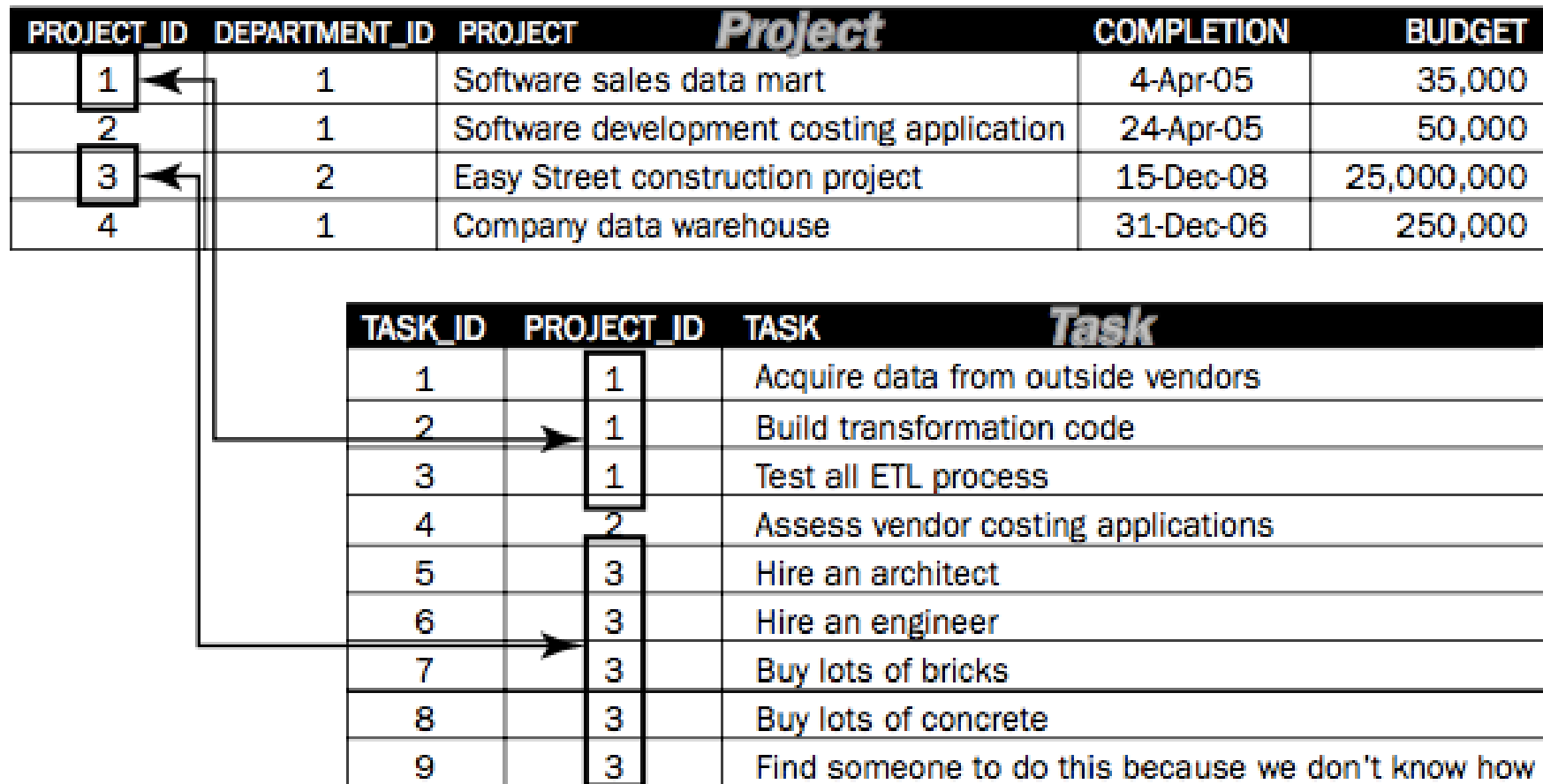Figure 1-6: The relational database model.

The Relational Model

PROJECT_ID	DEPARTMENT_ID	PROJECT *Project*	COMPLETION	BUDGET
1	1	Software sales data mart	4-Apr-05	35,000
2	1	Software development costing application	24-Apr-05	50,000
3	2	Easy Street construction project	15-Dec-08	25,000,000
4	1	Company data warehouse	31-Dec-06	250,000

| TASK_ID	PROJECT_ID	TASK *Task*
1	1	Acquire data from outside vendors
2	1	Build transformation code
3	1	Test all ETL process
4	2	Assess vendor costing applications
5	3	Hire an architect
6	3	Hire an engineer
7	3	Buy lots of bricks
8	3	Buy lots of concrete
9	3	Find someone to do this because we don't know how

Figure 1-7: The relational database model — a picture of the data.

Old File Processing Systems at Pine Valley Furniture Company
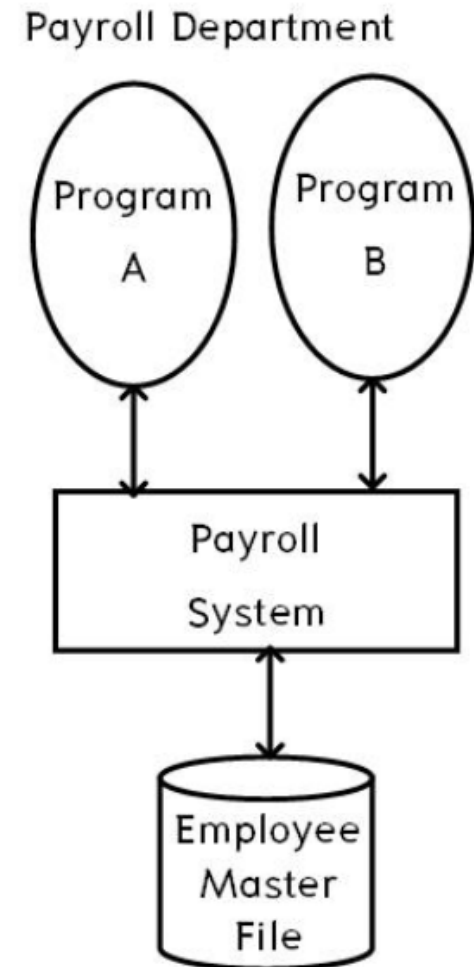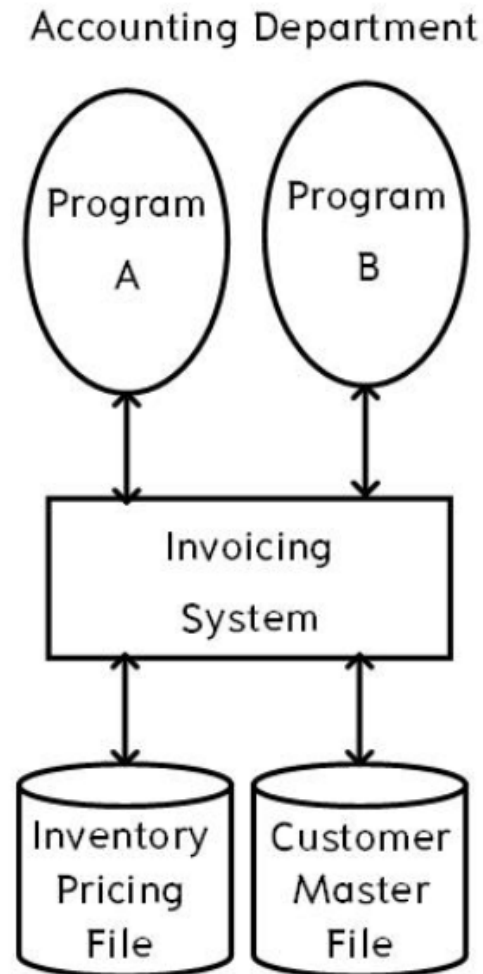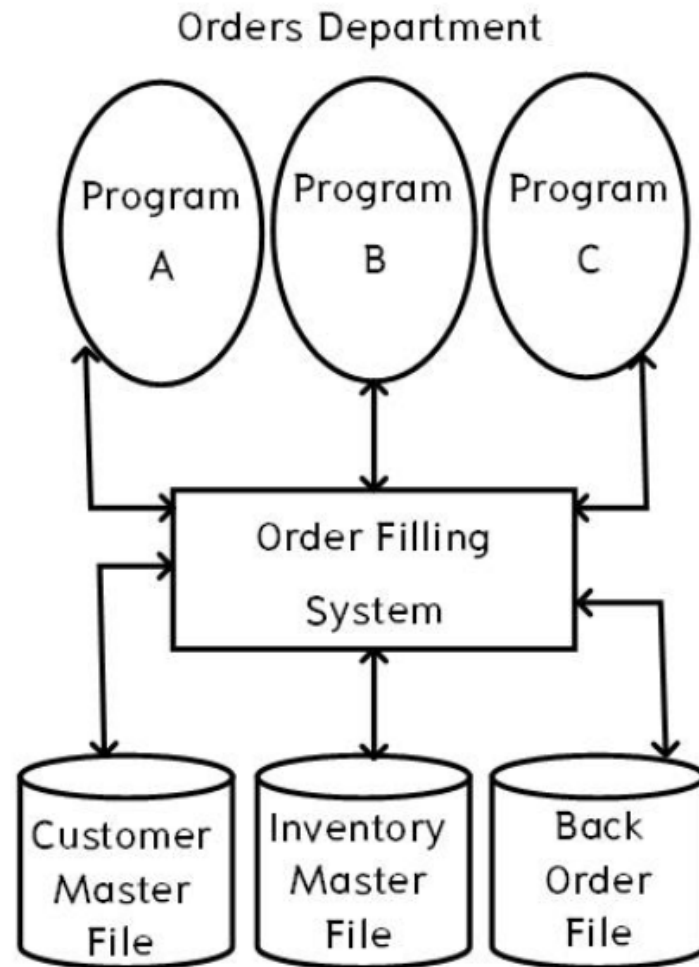
Example of data models
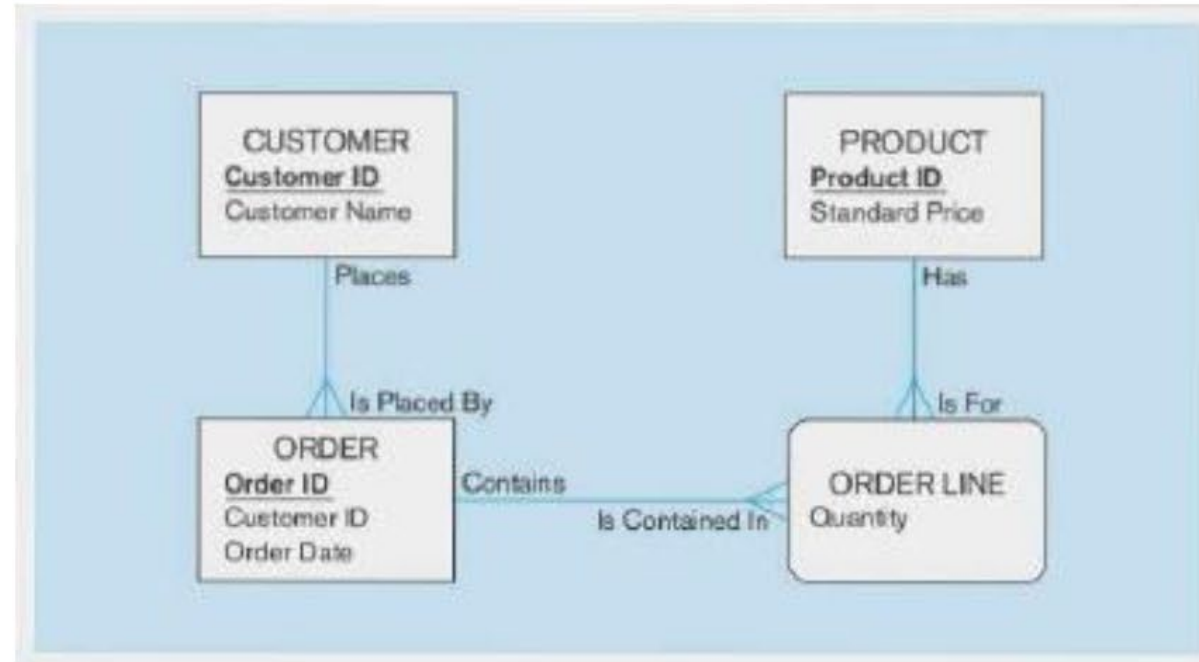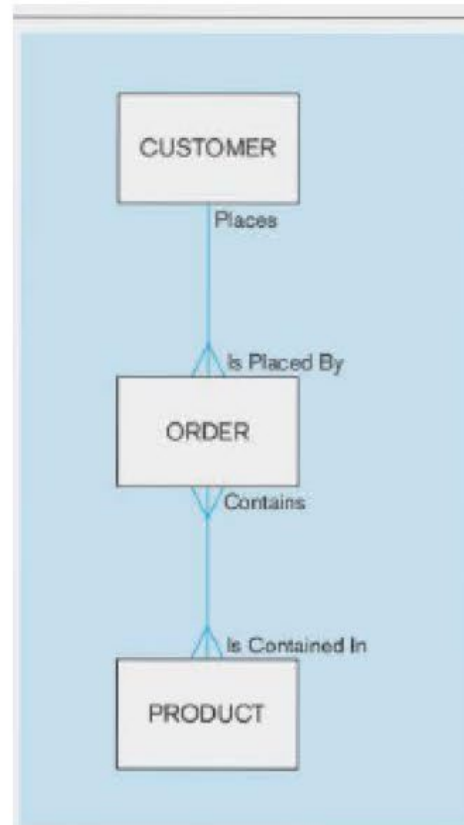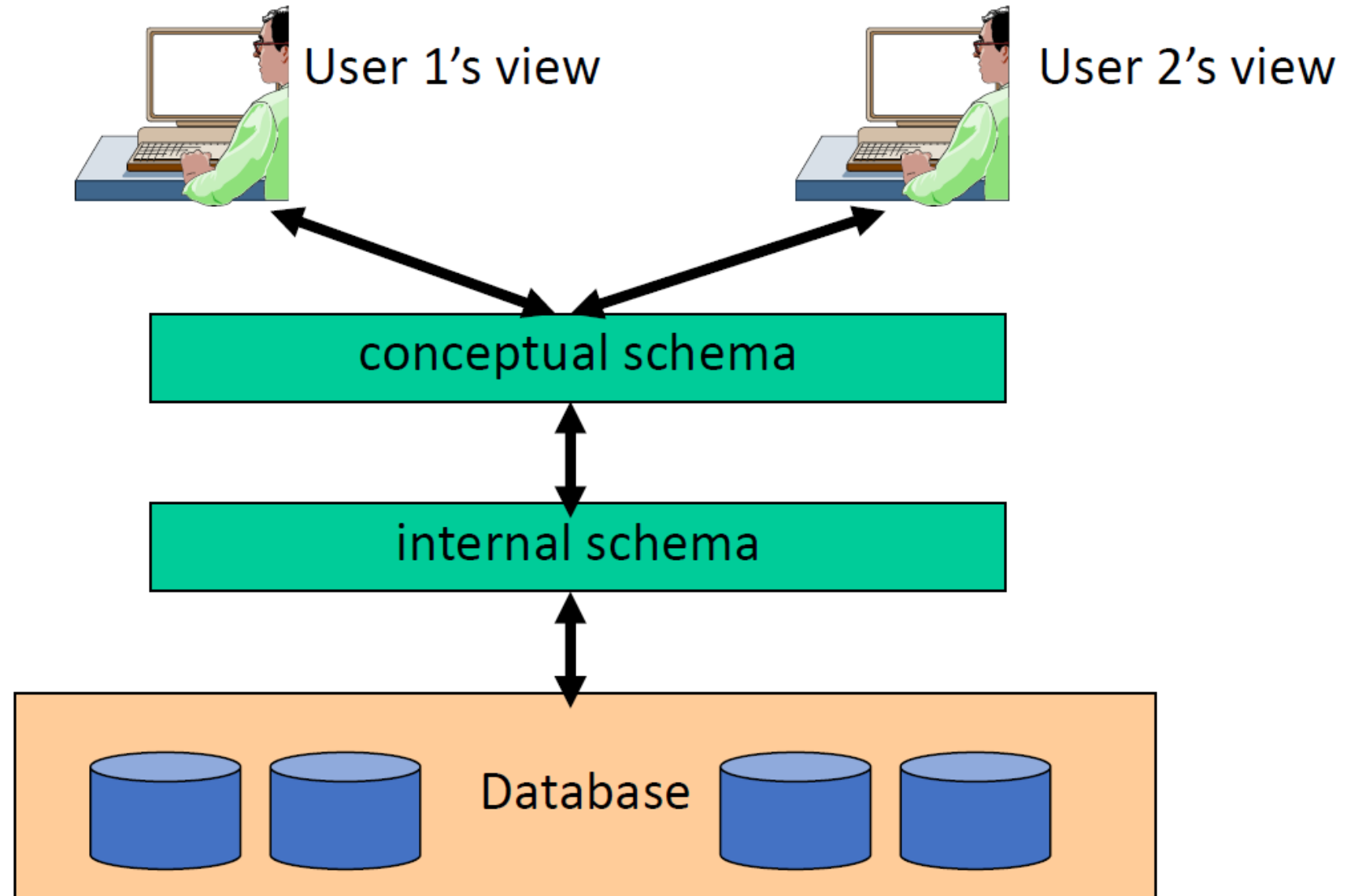
5. DBMS Architecture/designing level

- **External Level**

- **Conceptual Level**

- **Internal Level**

User 1's view

User 2's view

conceptual schema

internal schema

Database

DBMS Architecture

- External-level
  - Describes that part of database(s) that are relevant to each users
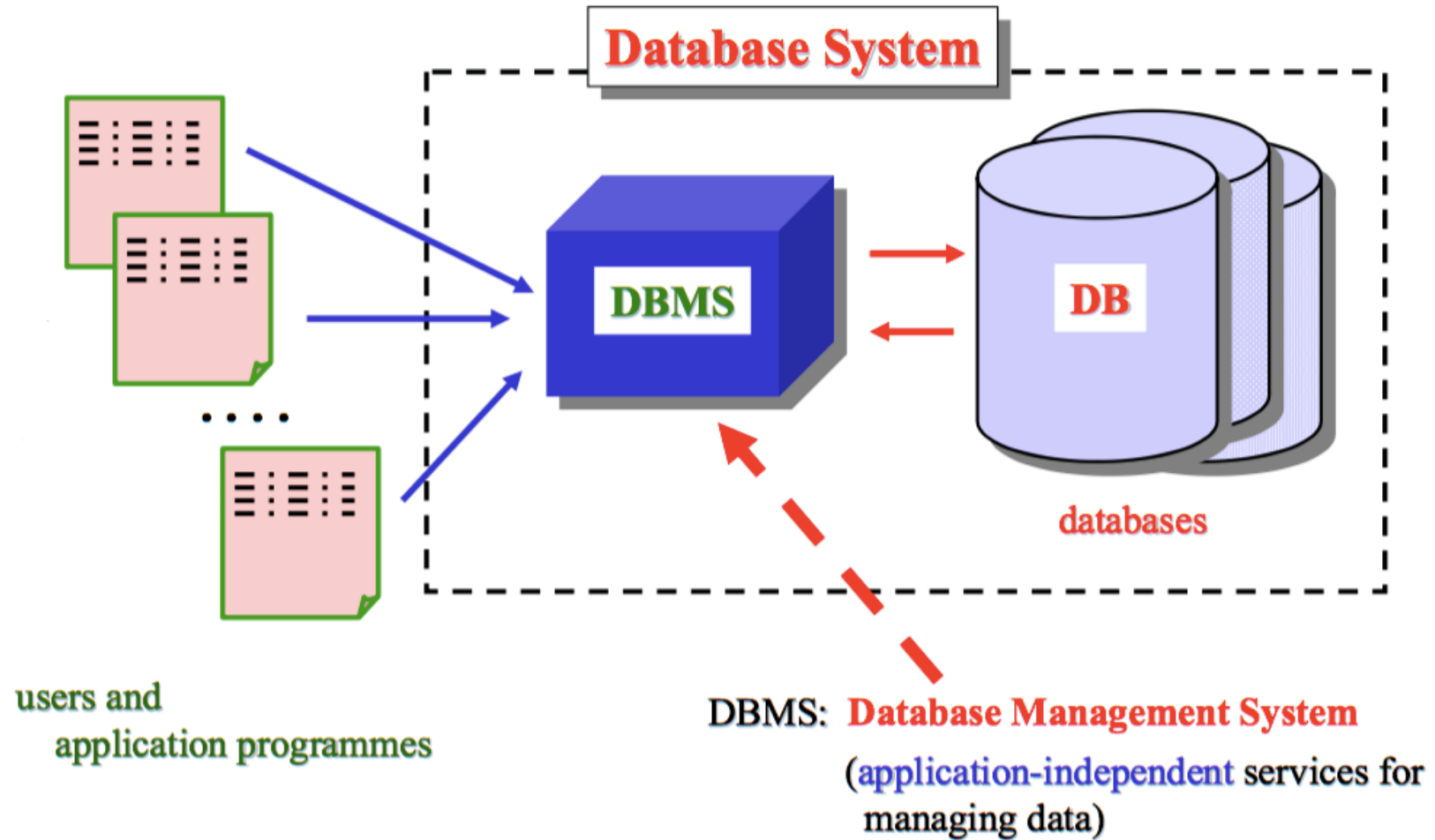 - A single database can have any number of views at the external level

DBMS Architecture

- Conceptual-level
  - Describes what data is stored in database and relationship among data
  - All entities, attributes and their relationship
  - Security and integrity constraints.

DBMS Architecture

- Internal-level
  - Physical representation of data
  - Concerned with cost, performance, scalability
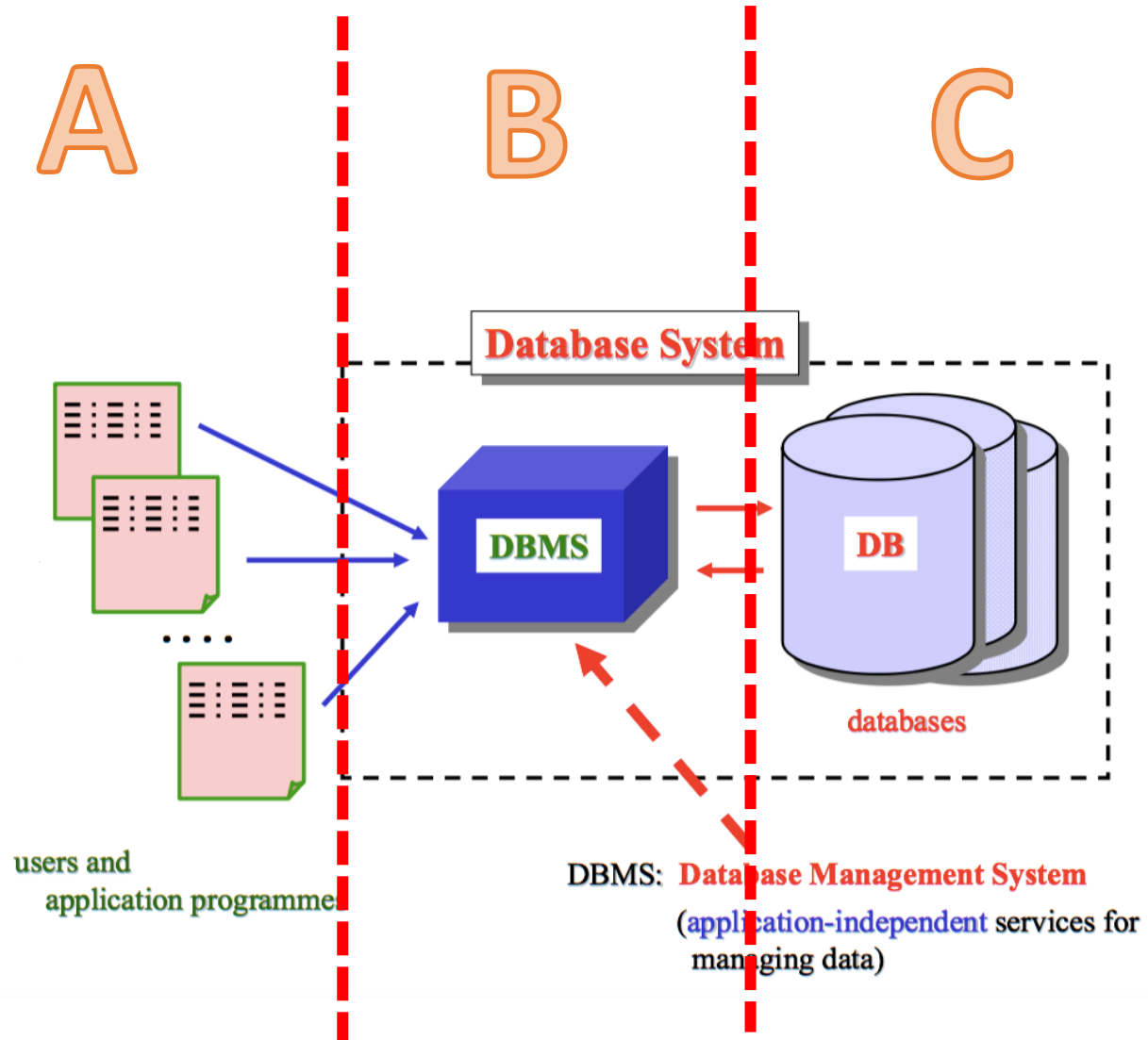 - How the data is stored (data structure and file organization)
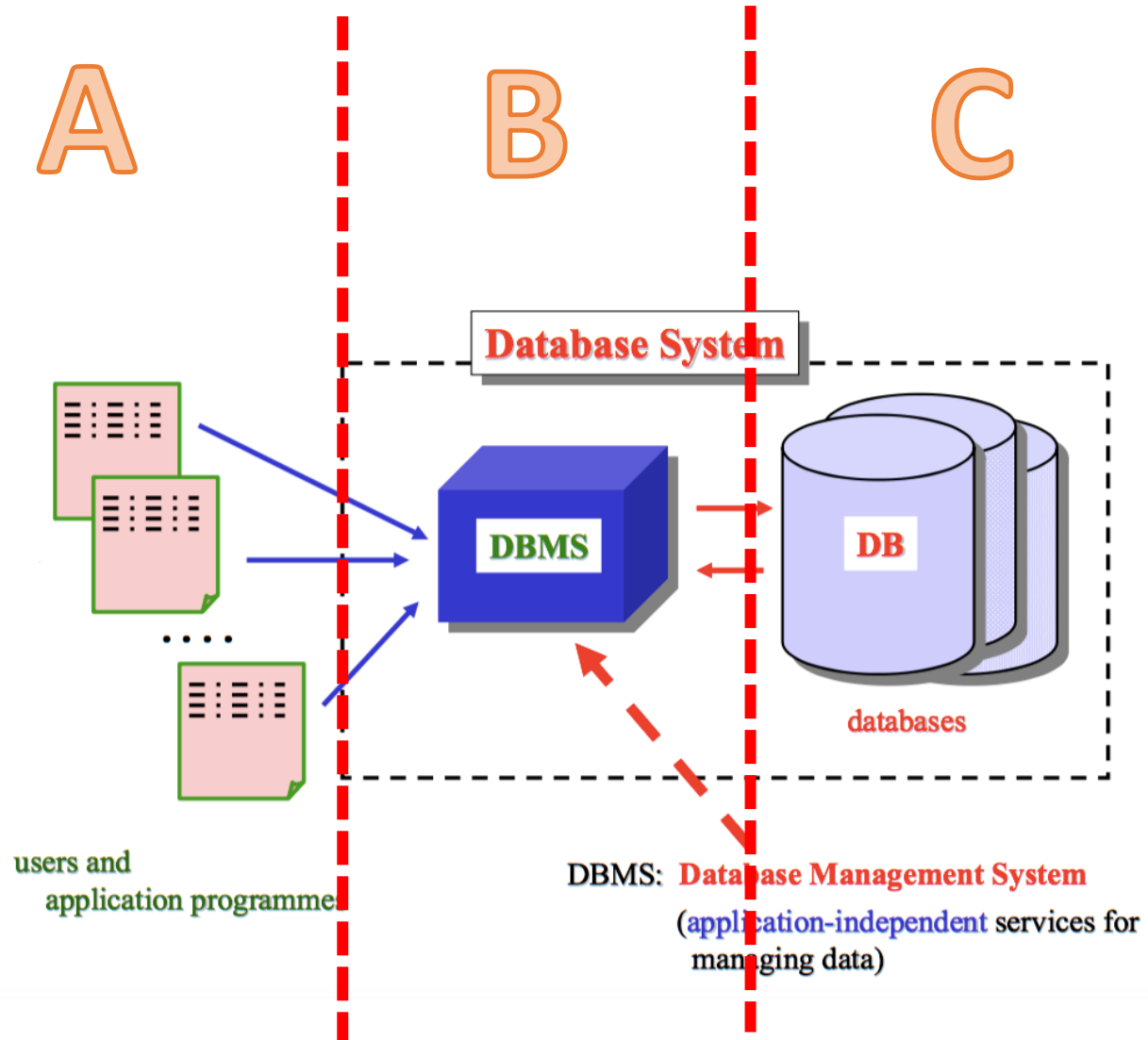
Database System Concept
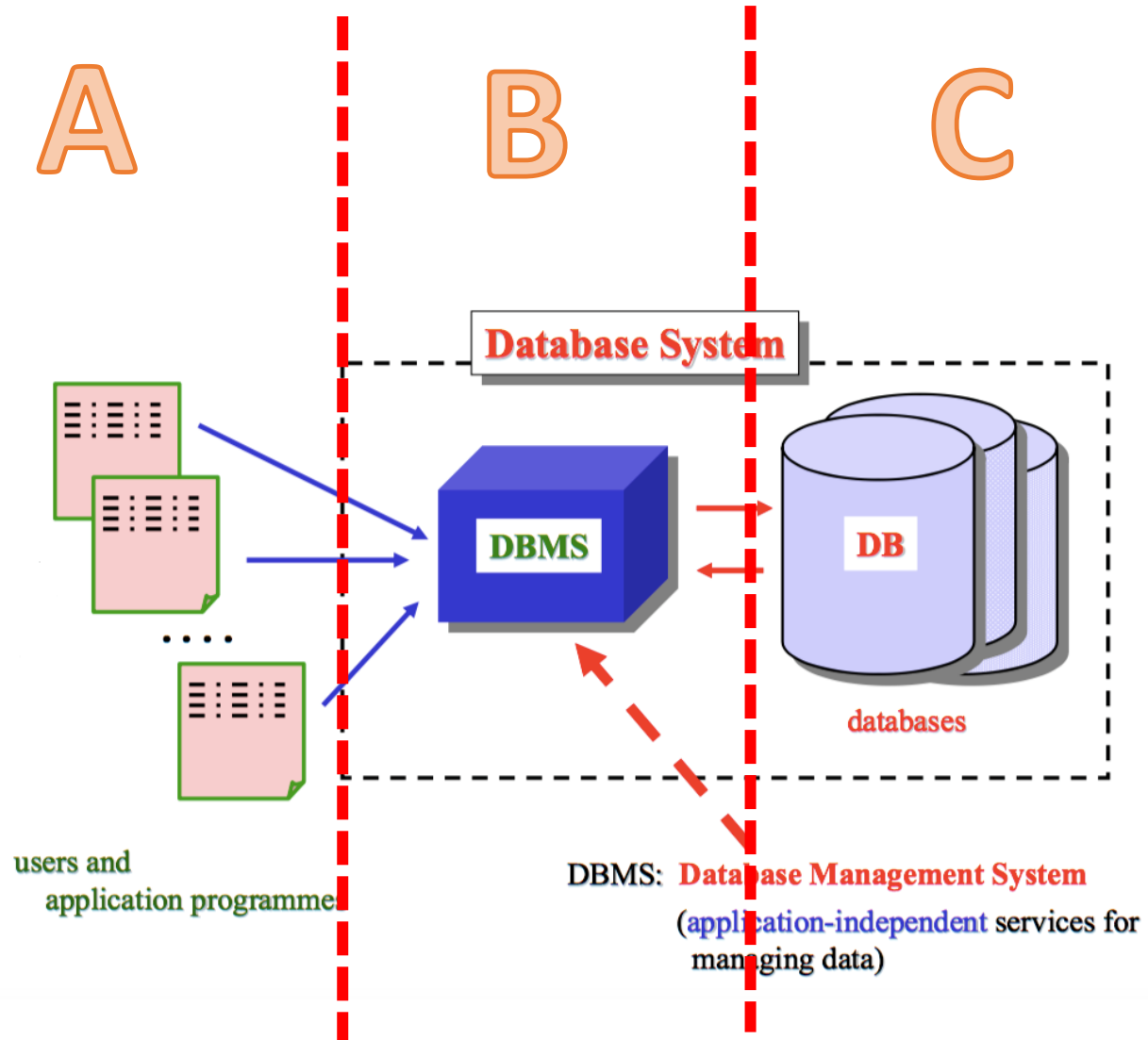
Which level do the users operate on?

users

A B C

Database System

DBMS

DB

databases

users and
application programmes

DBMS: Database Management System
(application-independent services for
managing data)

Which level is hardware installed on?

?

A   B   C

Database System

DBMS

DB

databases

users and
application programmer

DBMS: **Database Management System**
(application-independent services for
managing data)

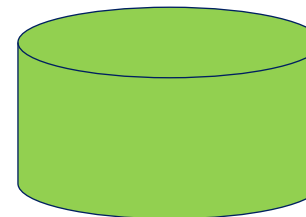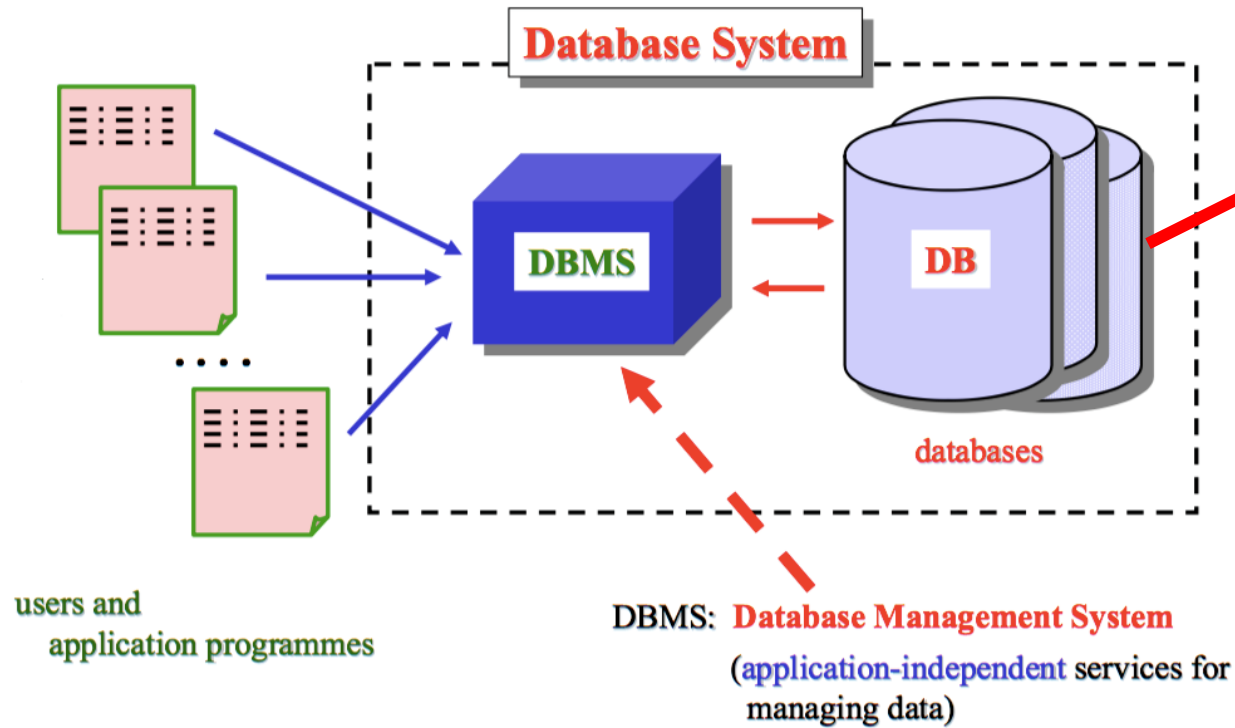# Which level is software installed on?

Oracle
IBM DB2
Microsoft SQL Server
MySQL
PostgreSQL

Database System Concept

Database System

DBMS

DB

databases

users and application programmes

DBMS: Database Management System

(application-independent services for managing data)

The Range of Database Applications

- It is important to understand that the applications and the database do not need to reside on the same computer.

- We divide the range of database applications into three categories based on the location of the client (application) and the database software itself.
    1. Personal databases
    2. Two-tier
    3. Multitier databases

Personal Databases

- Are designed to **support one user** and have long residence on **PCs, laptops, smart phones and PDAs.**

- Is widely used because they **improve personal productivity.**

- Also the **data cannot easily be shared** with other users and has **other limitations**

- Also known as 1 tier
  - When the database is directly available to the user
  - Local development
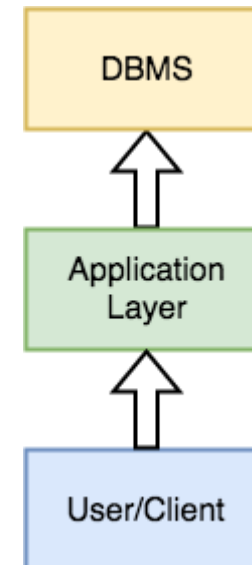
Personal Database

Purpose

- To provide the user with the ability to manage (store, update, delete, and retrieve) small amounts of data in and efficient manner.

For example

❑ Personal database can be used to store customer information and the details of contacts.

❑ Consider a company that has a number of salespersons who call on actual or prospective customers. A database of customers and pricing application can enable the salesperson to determine the best combination of quantity and type of items for the customer to order.

DBMS 2-Tiers

- 2 tier consists of application layer sit between DBMS and User

- The app layer acts as message known as ODBC

- ODBC (Open Database Connectivity) provides API to allow client side to call the DBSM

- Provide more security
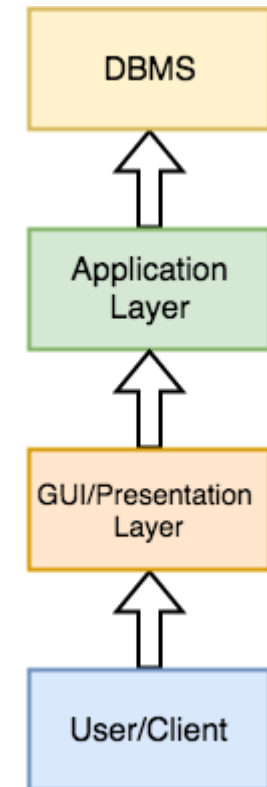
Two-tier Database with LAN
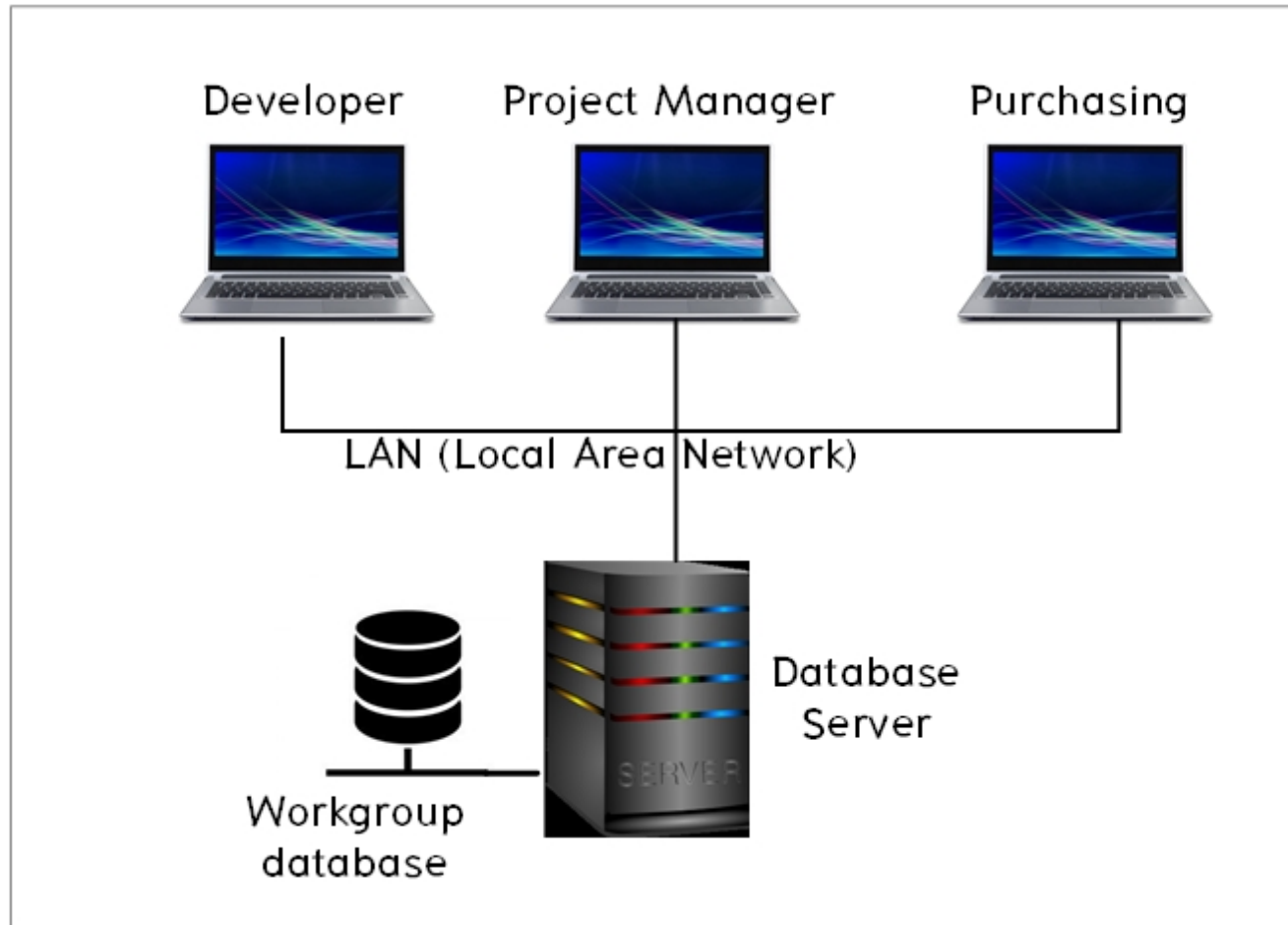
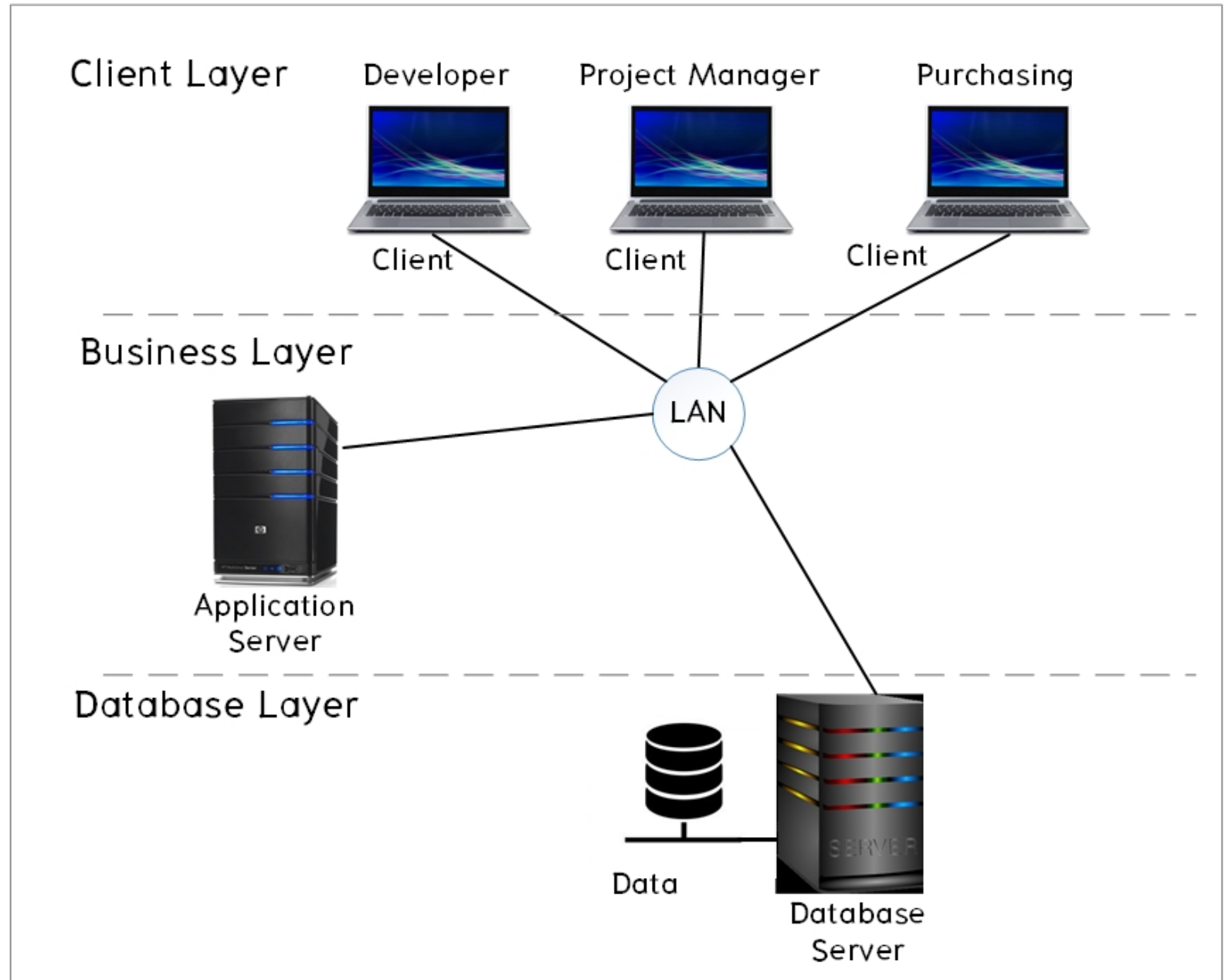Characteristics of the two-tier databases

- Workgroup (<100 persons)
- Linked by network
- Sharing data
- Different user views (Authentication)

DBMS 3-Tiers

- Most commonly used architecture for web app
- Added GUI layer provide user interface for end user
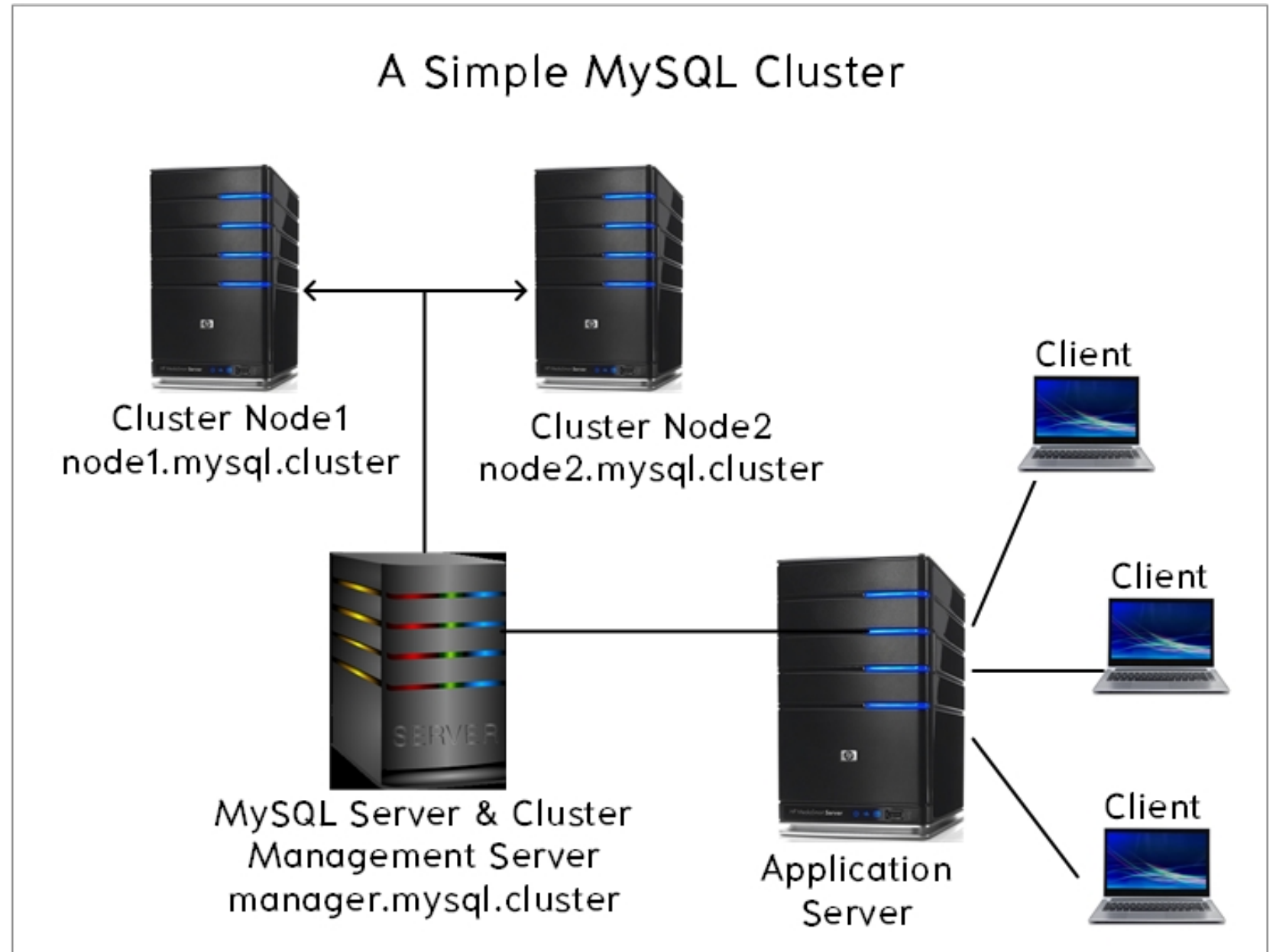
To interact with DBMS

Three-tier client/server database Architecture

Client Layer

Developer   Project Manager   Purchasing

Client   Client   Client

Business Layer

LAN

Application Server

Database Layer

Data

Database Server

n-tier

- Client

- Server
  - ✓ Application servers
  - ✓ Database servers
  - ✓ Management servers

- Support large size of databases and even more users

A Simple MySQL Cluster

Cluster Node1
node1.mysql.cluster

Cluster Node2
node2.mysql.cluster

MySQL Server & Cluster
Management Server
manager.mysql.cluster

Application
Server

Client

Client

Client

Client

Beyond three-tier

- Enterprise Resource Planning (ERP)
  - Business management system that integrates all function of the enterprise (e.g., sales, inventory, accounting, HR, etc.)
- Data Warehousing
  - An integrated decision support database whose content is derived from the various operational database.
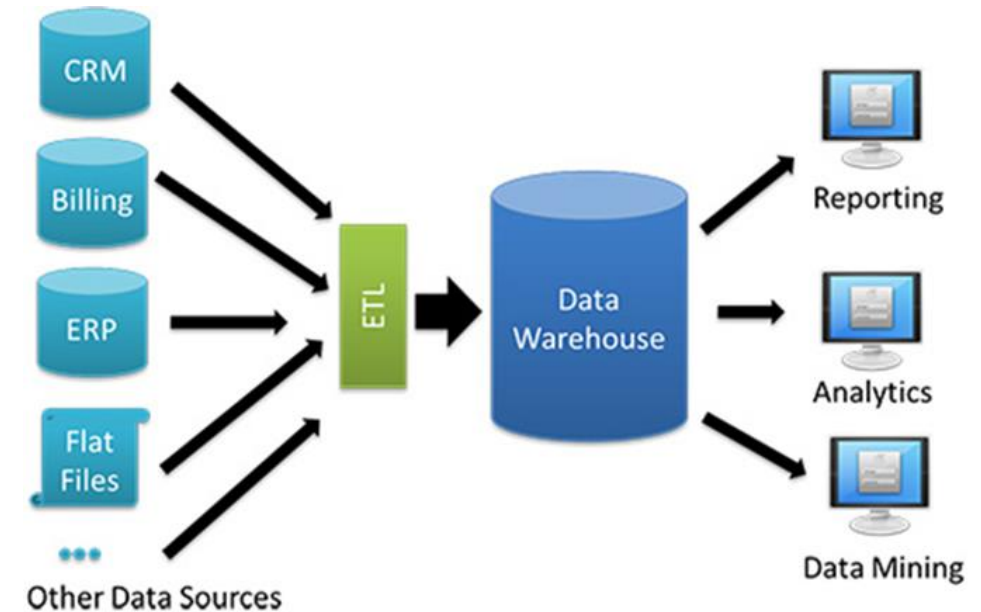
Summary of Database Applications

Type of Database/Application	Typical Number of Users	Typical Size of Database
Personal	1	Megabytes
Two-tier	5-100	Megabytes-gigabytes
Three-tier	100-1,000	Gigabytes
Enterprise resource planning (ERP)	>100	Gigabytes-terabytes
Data warehousing	>100	Terabytes-petabytes

Database System

- **Advantage**
- Minimized data inconsistency
- Reduced data redundancy
- Sharing data
- Accurate and reliable data
- Use the same standard
- Security

- **Disadvantage**
- Have higher costs of hardware, software, and others
- The application and programs are complex for the users
- High risk and high impact of system failure