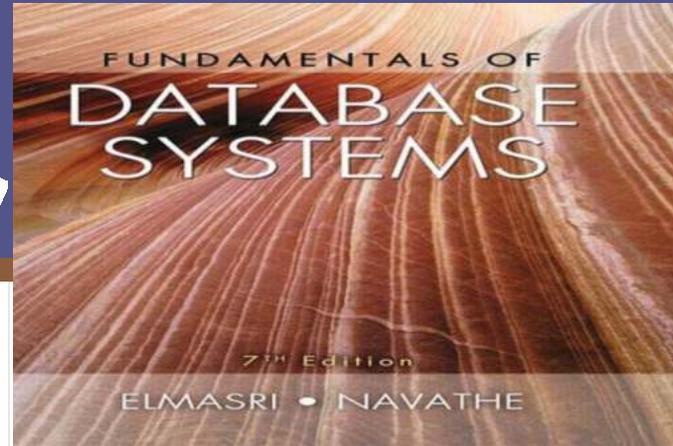**University of Bisha**

Faculty Of Computing and Information Technology

Database Management Systems – CIT 313

Dr.Nadhem Sultan

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3/3/2020

Course Objectives:

- Define a Database, characteristics and functions of Database Management System and types of Database Users.
- Distinguish between a Traditional File System and a Database System.
- Compare the advantages and disadvantages of Database System with traditional File system.
- Describe Data Models, Schemas, Instances, Three Schema Architecture and DBMS Component
- Model the real-world database systems using Entity Relationship Diagrams (ERD) from the requirements specification.
- Define the Relational Data Model, its Constraints and the Relational Database Schemas.
- Explain the normalization and de-normalization techniques to normalize or de-normalize a database.
- Demonstrate the use of SQL for database creation and maintenance

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Course Outlines

Week	Dates	Topics (Lectures)	CLOs	Chapter	Assignment/ Project/Test
1	5-6-1441 30-1-2020	Introduction: Databases		1	
2	12-6-1441 6-2-2020	Database Architecture and Design		2	
3	19-6-1441 13-2-2020	Data Models			
4	26-6-1441 20-2-2020	Entity- Relationship (E-R) Model		3	
5	3-7-1441 27-2-2020	Entity- Relationship (E-R) Model		3	
6	10-7-1441 5-3-2020	Relational Database Management System (RDBMS		5	
7	**17-7-1441 12-3-2020**	**Midterm Test**			
8	24-7-1441 19-3-2020	Data Normalization and Demoralization		14	
9	2-8-1441 26-3-2020	The Relational Algebra and Relational Calculus		8	
10	9-8-1441 2-4-2020	The Relational Algebra and Relational Calculus		8	
11	16-8-1441	Structure Query Language (SQL)		6	

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Class Administration:

Grades distribution:

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Quizzes and Discussions	Weekly	6%
2	Assignments	3th -6th -9th - 12th	6%
3	Project and presentation	13th	8%
4	Midterm Exams	7th -14th	20%
5	Lab Test	15th	10%
6	Final Exam	16 th	50%

Required Textbooks List
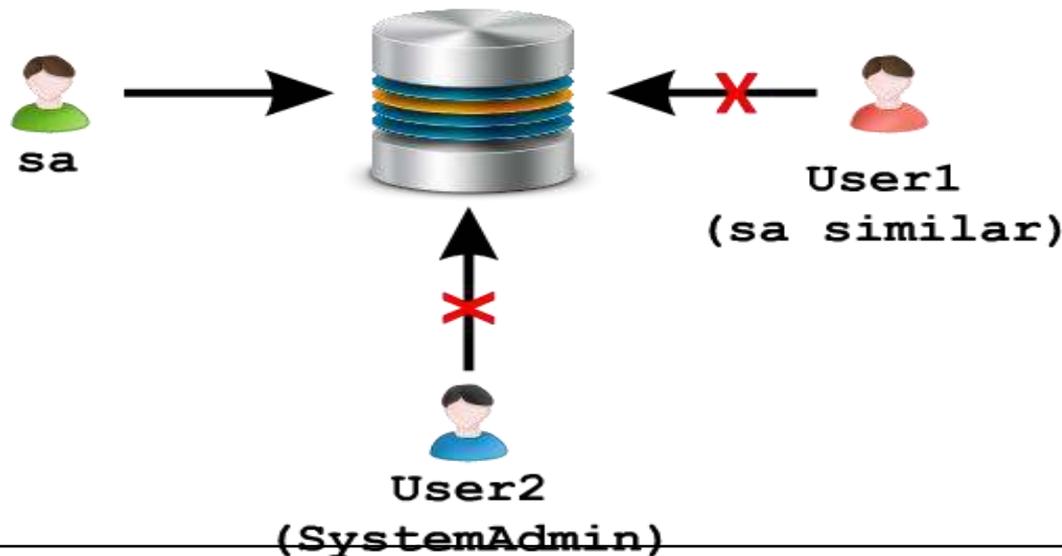
- Required Textbooks

  Fundamentals of Database Systems, 7th Edition, Ramez Elmasri, Shamkant B. Navathe, 2016.

- Essential References Materials

"Fundamentals of Database Management System" by Alexis Leon & Mathews Leon, Date, "An Introduction to Database Systems", Addison Wesley , 8th Edition, 2013

Part (1)

Introduction To Database
&
Database Users

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Outlines of Part 1 ➡ use Chapter 1

- Introduction to DBMS

- Data and Information,

- File Based Data Management system
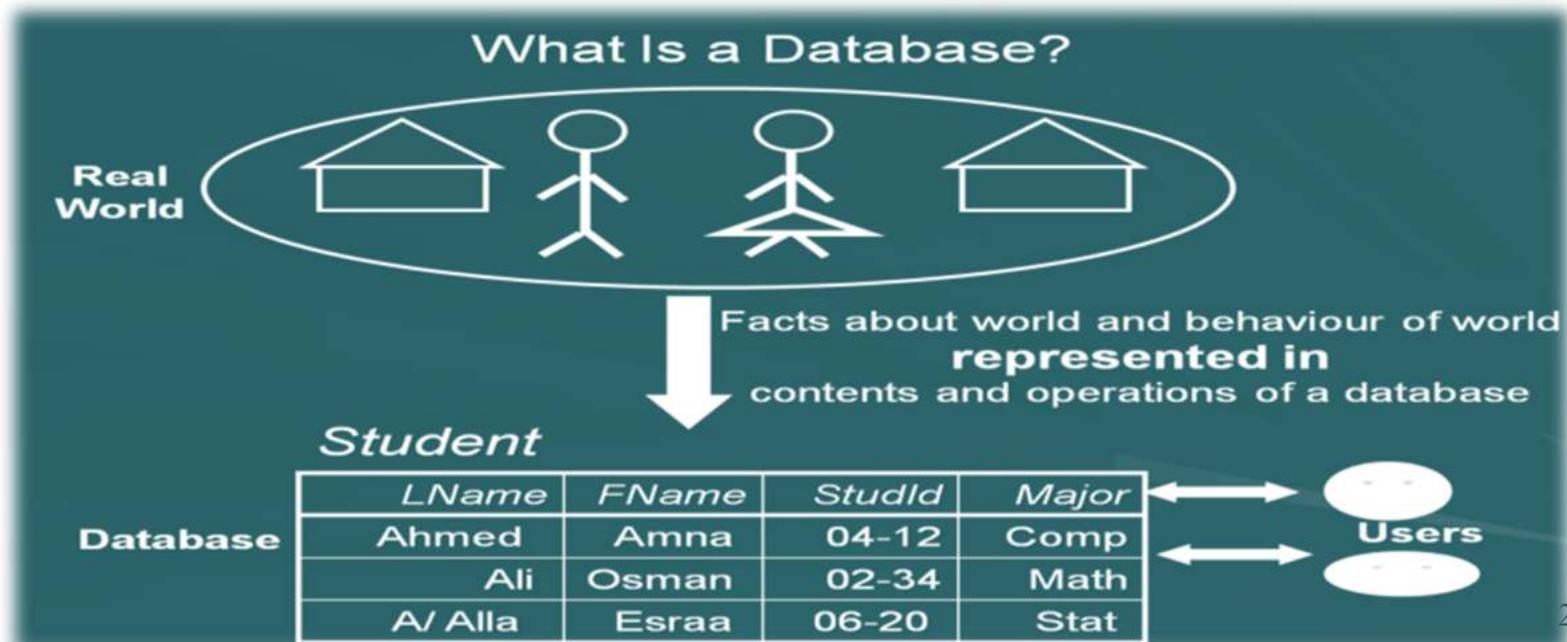
- Database System

- Database Users

Database management systems are important in businesses and organizations because they provide a highly efficient method for handling multiple types of data.

Examples of Database Applications:

- Using the ATM machine.

- Purchases from the supermarket

- Purchases using your credit card

- Booking a holiday at the travel agents

- Using the local library

- Using the Internet

- **Database** is of collection of related data.

- **Another definition:** A DB is a shared collection of logically related data (and description of this data),designed to meet the information needs of an organization.

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- **Database Management System (DBMS):** a software system that enables users to create, maintain, and control access to the database.

Functions of a DBMS:

- Data Storage and Retrieval.

- Concurrency Control Services.

- Recovery Services.

- Authorization Services.

- Support for Data Communication.

- Integrity services

- **An application program:** accesses the database by sending queries or requests for data to the DBMS

- **DB system ==** DB+DBMS

- The database definition or descriptive information is stored by the DBMS in the form of a database **catalog** or dictionary; it is called **meta-data.**

- **Metadata i**s the "data about data."

RELATIONS

Relation_name	No_of_columns
STUDENT	4
COURSE	4
SECTION	5
GRADE_REPORT	3
PREREQUISITE	2

Figure 1.3
An example of a database catalog for the database in Figure 1.2.

COLUMNS

Column_name	Data_type	Belongs_to_relation
Name	Character (30)	STUDENT
Student_number	Character (4)	STUDENT
Class	Integer (1)	STUDENT
Major	Major_type	STUDENT
Course_name	Character (10)	COURSE
Course_number	XXXXNNNN	COURSE
....	....	.....
....	....	.....
....	....	.....
Prerequisite_number	XXXXNNNN	PREREQUISITE

An example of database catalog

- The database contains both the operational data and the

Users/Programmers

Database System

Application Programs/Queries

DBMS Software

Software to Process Queries/Programs

Software to Access Stored Data

Stored Database Definition (Meta-Data)
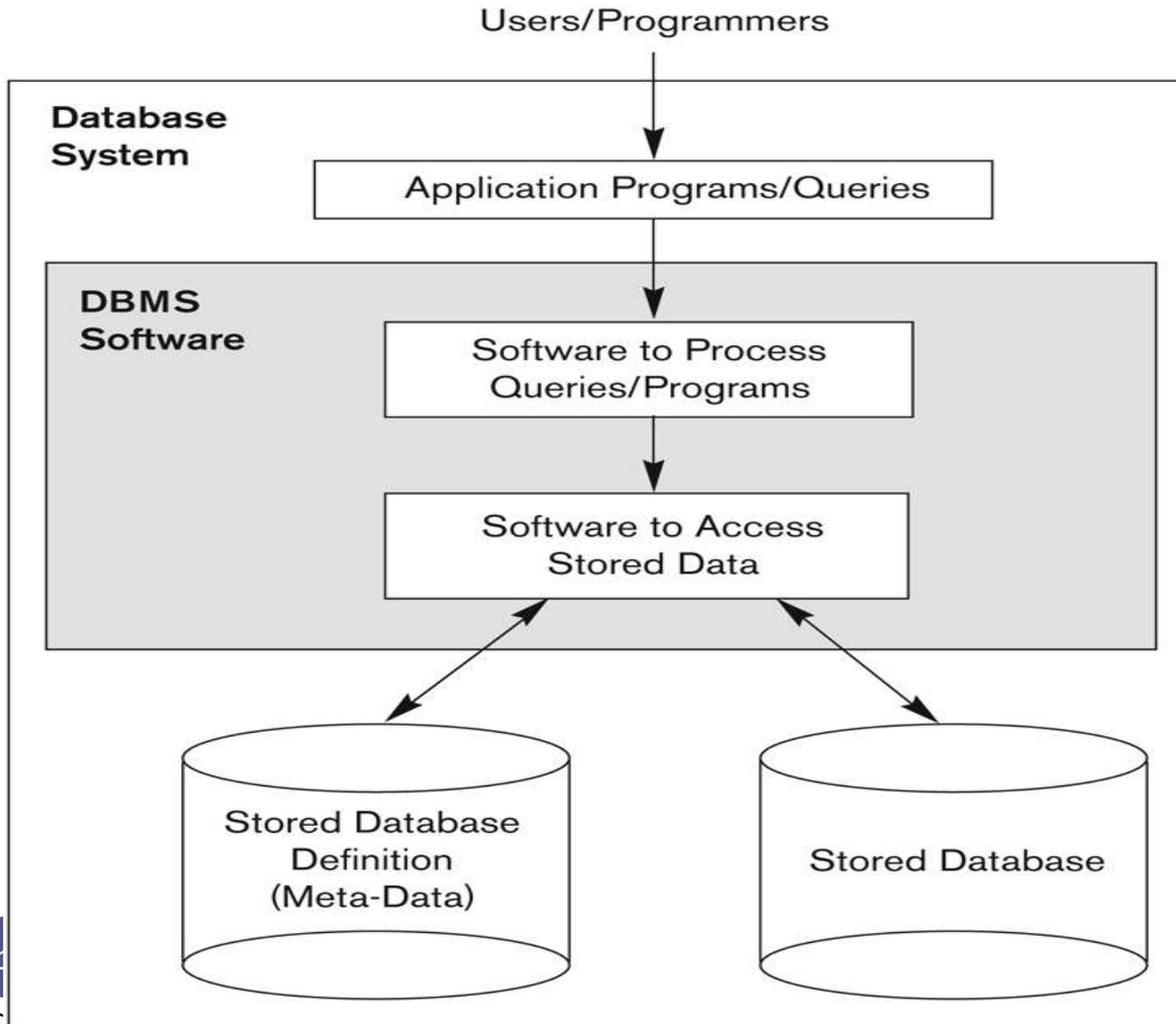
Stored Database

Figure 1.1
A simplified database system environment.

- **Data** known facts that can be recorded and have implicit meaning.

Ex. Each student's test score is one piece of data. (the names, telephone numbers, and addresses of the people you know)

- **Information** is a set of data which is processed in a meaningful way according to the given requirement.

Ex. The average score of a class or of the entire school is information that can be derived from the given data.

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Database System components

- The four components of a *database system* are:

  - Users

  - Database Application (User Interface)

  - Database Management System (DBMS)

  - Database

File Based Data Management system
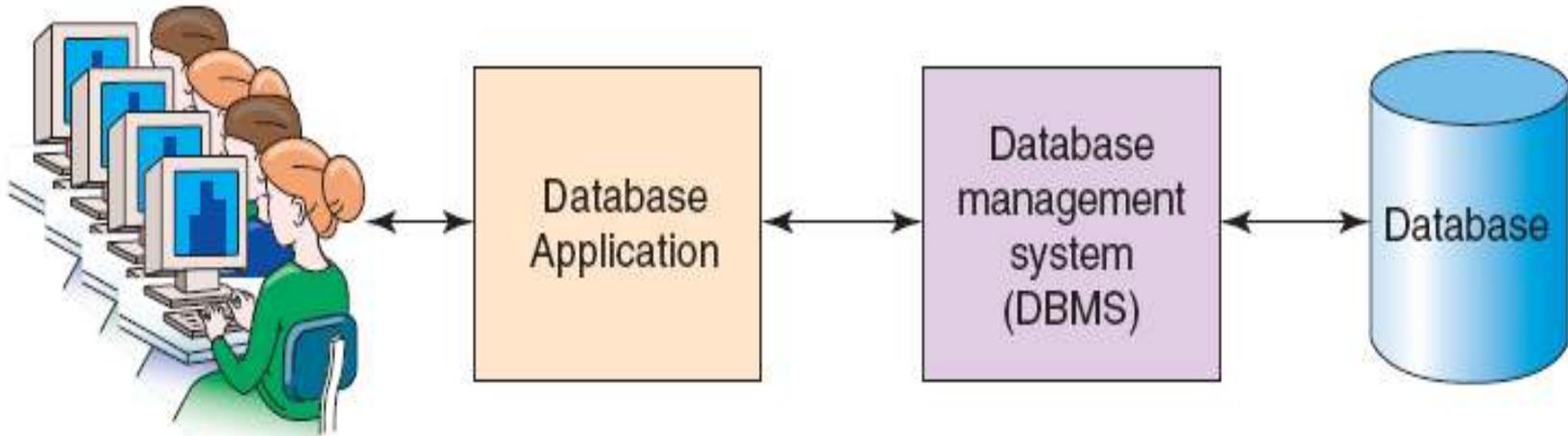
- File based systems were developed as better alternatives to paper based filing systems.

- A file based system is a collection of application programs that perform services for the end users (e.g. reports).

- Each program within a file based system defines and manages its own data. Because of this, there are limits as to how that data can be used or transported.

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Example of a file based system:
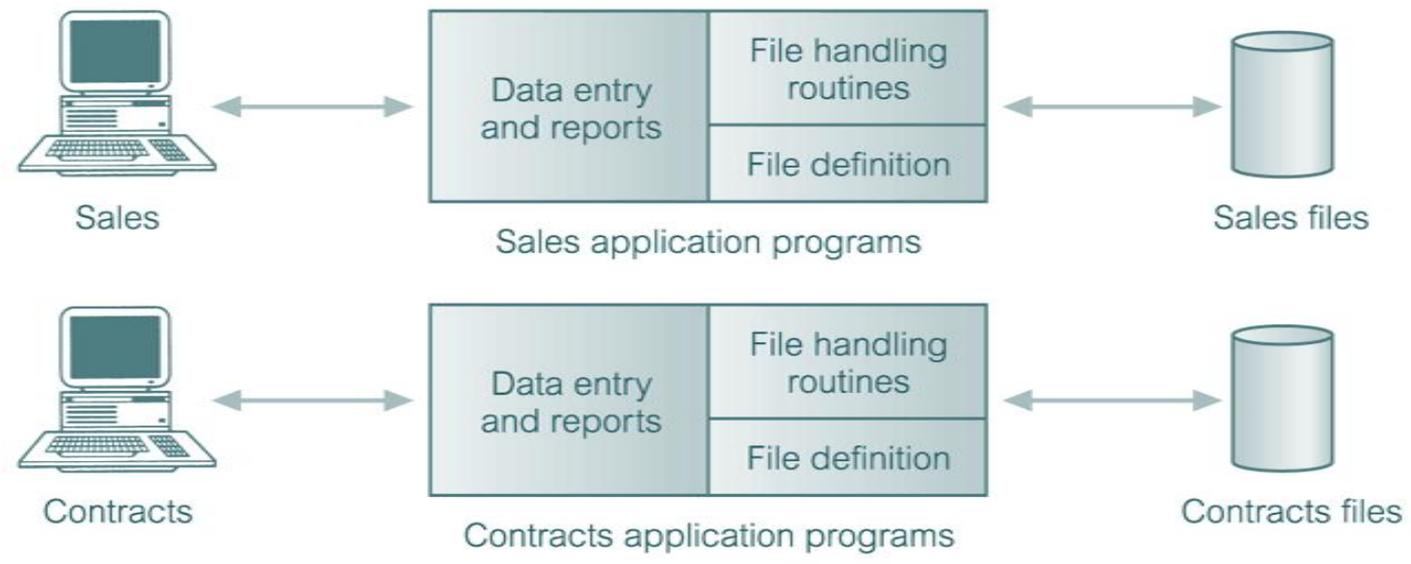
Sales Files

PropertyForRent (propertyNo, street, city, postcode, type, rooms, rent, ownerNo)

PrivateOwner (ownerNo, fName, lName, address, telNo)

Client (clientNo, fName, lName, address, telNo, prefType, maxRent)

Contracts Files

Lease (leaseNo, propertyNo, clientNo, rent, paymentMethod, deposit, paid, rentStart, rentFinish, duration)

PropertyForRent (propertyNo, street, city, postcode, rent)

**Client** (clientNo, fName, lName, address, telNo)

Data Redundancy

Redundancy means having multiple copies of the same data. In computer file-based processing system, each application program has its own data files. The duplication of data may create many problems such as:

➢To update a specific data/record, the same data must be updated in all files, otherwise different file may have different information about a specific item.
➢A valuable storage space is wasted.

FIGURE 1-2   Old file processing systems at Pine Valley Furniture Company
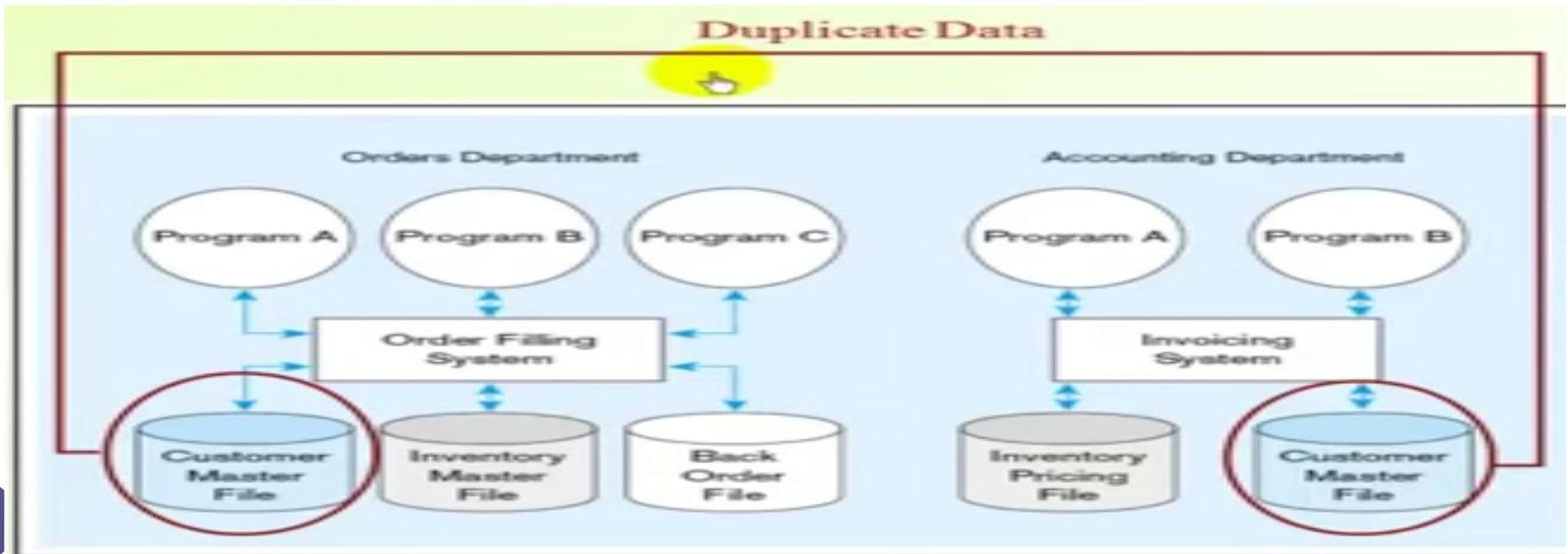
Data Inconsistency

Data inconsistency mean that different files may contain different information of a particular object or person. Actually redundancy leads to inconsistency. When the same data is stored in multiple locations, the inconsistency may occur.

Data Sharing

In computer file-based processing systems, each application program uses its own private data files. The computer file-based processing systems do not provide the facility to share data of a data file among multiple users on the network.

Data Isolation

In computer file-based system, data is isolated in separate files. It is difficult to update and to access particular information from data files

Data Dependence

In computer file-based processing systems, the data stored in file depends upon the application program through which the file was created. It means that the structure of data files is coupled with application program.

The physical structure of data files and records are defined in the application program code. It is difficult to change the structure of data files or records. If you want to change the structure of data file (or format of file), then you have to modify the application program.

Data Security

The computer file-based processing system do not provide the proper security system against illegal access of data. Anyone can easily change or delete valuable data stored in the data file. It is the most complicated problem of file-processing system.

Main Characteristics of the Database Approach:

❖**Self-describing nature of a database system:**
- ▪A DBMS **catalog** stores the description of a particular database (e.g. data structures, types, and constraints)
- ▪The description is called **meta-data**.
- ▪This allows the DBMS software to work with different database applications.

❖**Insulation between programs and data:**
- ▪Called **program-data independence**.
- ▪Allows changing data structures and storage organization without having to change the DBMS access programs.

❖**Support of multiple views of the data:**
Each user may see a different view of the database, which describes **only** the data of interest to that user.

❖**Data Abstraction:**

▪A **data model** is used to hide storage details and present the users with a conceptual view of the database.

▪Programs refer to the data model constructs rather than data storage details

❖**Sharing of data and multi-user transaction processing:**

▪Allowing a set of **concurrent users** to retrieve from and to update the database.

▪*Concurrency control* within the DBMS guarantees that each **transaction** is correctly executed or aborted

▪*Recovery* subsystem ensures each completed transaction has its effect permanently recorded in the database

▪**OLTP** (Online Transaction Processing) is a major part of database applications. This allows hundreds of concurrent transactions to execute per second.
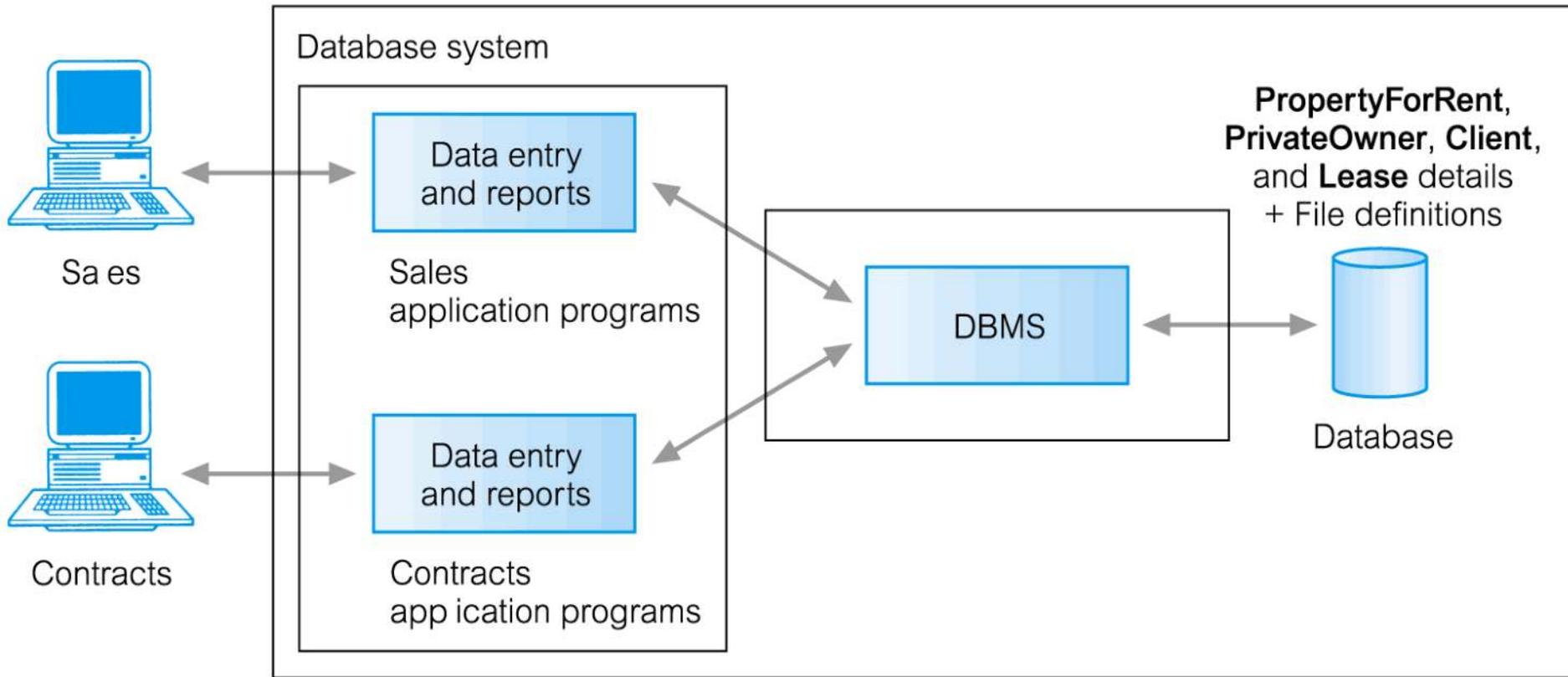
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PropertyForRent (propertyNo, street, city, postcode, type, rooms, rent, ownerNo)

PrivateOwner (ownerNo, fName, lName, address, telNo)

Client (clientNo, fName, lName, address, telNo, prefType, maxRent)

Lease (leaseNo, propertyNo, clientNo, paymentMethod, deposit, paid, rentStart, rentF nish)

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Advantages of Using the DBMS Approach

❑ Controlling redundancy in data storage and in development and maintenance efforts.

- Sharing of data among multiple users.

❑ Restricting unauthorized access to data (Improved security).

❑ Providing persistent storage for program Objects

- In Object-oriented DBMSs.

❑ Providing Storage Structures (e.g. indexes) for efficient Query Processing

❑ Data consistency

❑ Improved data integrity

❑ Improved backup and recovery services

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Users may be divided into

- Those who actually use and control the database content, and those who design, develop and maintain database applications (called "Actors on the Scene"), or (Direct users) and

- Those who design and develop the DBMS software and related tools, and the computer systems operators (called "Workers Behind the Scene") or (Indirect users) .

❖**Database administrators (DBA):**

Responsible for:

- authorizing access to the database.

- coordinating and monitoring its use, acquiring software and hardware resources.

- controlling its use and monitoring efficiency of operations.

❖**Database Designers:**

Responsible to define the content, the structure, the constraints, and functions or transactions against the database. They must communicate with the end-users and understand their needs.

❖ **System Analysts and Application Programmers (Software Engineers):**

- System analysts

-determine the requirements of end users including.(software + hardware)

- **Application programmers** implement these specifications as programs; then they test, debug, document.

Such analysts and programmers—commonly referred to as software developers or software engineers.

❖ **End-users:** They use the data for queries, reports and some of them update the database content.

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❖ **DBMS system designers and implementers:**

design and implement the DBMS modules and interfaces as a software package.

❖ **Tool developers:**

design and implement tools—the software packages that facilitate database modeling and design, database system design, and improved performance. Tools are optional packages that are often purchased separately —ex.(Apricot DB"-ERD- tools - UML)

❖ **Operators and maintenance personnel (system administration personnel)**

are responsible for the actual running and maintenance of the hardware and software environment for the database system.

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