CAB
Introduction to Database System

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Learning Objectives

➢ Meaning of a Database.

➢ Definition of Database Management System (DBMS).

➢ Evolution/History of DBMS.

➢ Importance of DBMS.

➢ Advantages and Disadvantages of using DBMS to the users.

➢ Applications of DBMS.

Learning Objectives (Contd.)

➢ Meaning of Traditional File based System.

➢ Important terminologies.

➢ Advantages and disadvantages of Traditional File based System.

➢ Traditional File based System Vs. Database Management System.

What is a Database?

▶ A Database is a **set of logically related data** that is organised so that it can easily be retrieved, managed and updated.

▶ The modern database is managed by sophisticated software known as **Database Management System (DBMS).**

▶ A **database system** is a computer based record keeping system which is a collection of tables, files, and datasets.

Database Management System

➤ A database management system (DBMS) is a software package designed to **define, manipulate, retrieve and manage data** in a database.

➤ For example, University database organizes the data about students, faculty, and admin staff etc. which helps in efficient retrieval, insertion and deletion of data.

➤ DBMS generally manipulates the data itself, the data **format, field names, record structure and file structure.**

➤ It also **defines rules** to validate and manipulate the data.

➤ A DBMS relieves users of **framing programs** for data maintenance.

Database Management System

▶ People who design, construct and maintain database system are known as **database programmers** and database administrators**.**

▶ They use specialized languages such as Database Definition Language (DDL), Data Manipulation Language (DML) and query languages.

▶ **Data Definition Language** deals with database schemas and descriptions of how the data should reside in the database.

▶ **Data Manipulation Language** deals with data manipulation and is used to store, modify, retrieve, delete and update data in a database.

Database Management System

▶ The most widely supported database language is **Structured Query Language (SQL)** which combines the roles of both DDL/DML and a query language.

▶ It is developed for **relational data models**.

▶ Some other DBMS examples include:

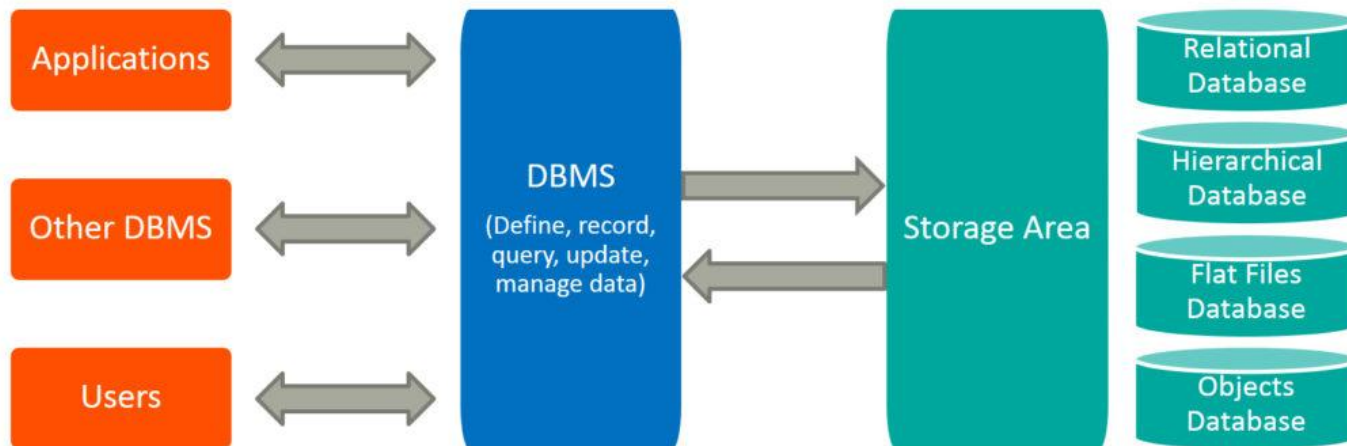> ➢ MySQL
> ➢ SQL Server
> ➢ Oracle
> ➢ dBASE
> ➢ FoxPro

Database Management System

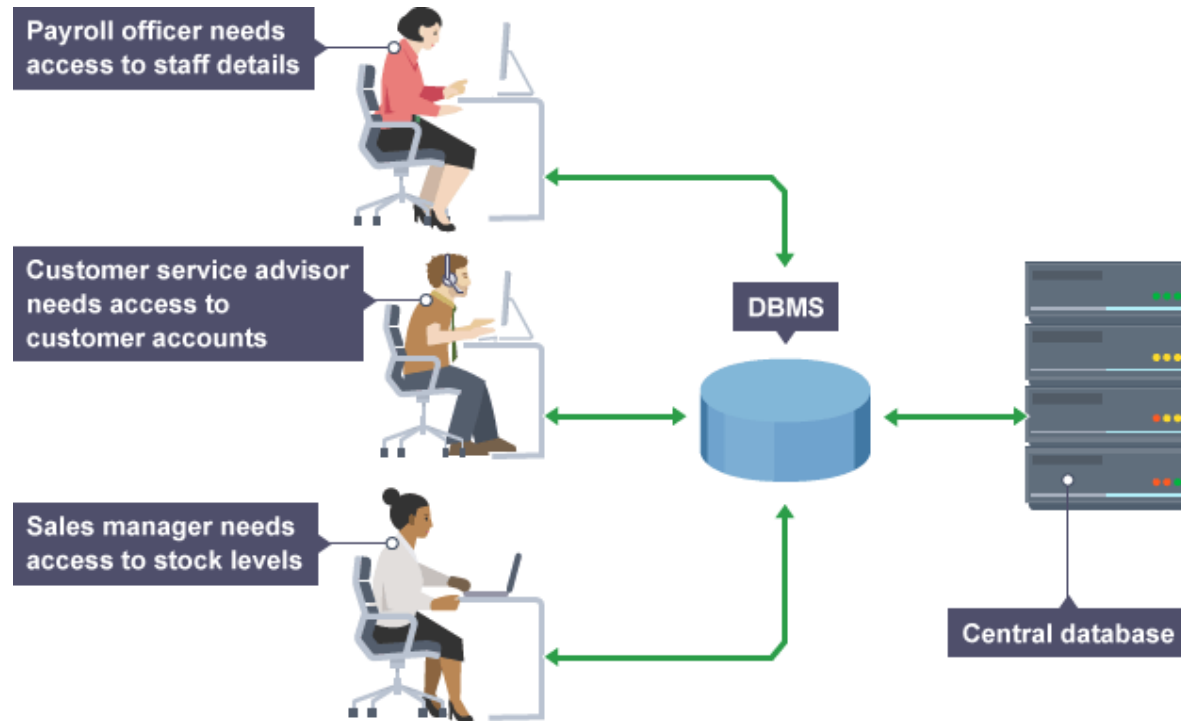A Database Management System offers the following to the users:

▶ An easy way to collect, update and retrieve stored information.

▶ Data stability by preventing unnecessary loss of data.

▶ Data protection by preventing unauthorised use of data.

▶ Ensures data quality in terms of accuracy, availability and usability.

Why DBMS?

Database Management System

Applications ⟷ DBMS (Define, record, query, update, manage data) ⟶ Storage Area ⟶ Relational Database, Hierarchical Database, Flat Files Database, Objects Database

Other DBMS ⟷

Users ⟷

Applications of DBMS

Applications of DBMS

Computerized Library system

Online banking and Automated Teller Machines

Train and Flight reservations

Hotel bookings

Weather Forecasting

Patient registration in hospitals

Evolution of DBMS

▶ **Ancient Times:**

   ▶ Data was not stored on disk.

   ▶ Programmer defined both logical data structure and physical structure, such as storage structure, access methods, I/O modes etc.

   ▶ One data set per program: high data redundancy.

   ▶ There was no persistence.

   ▶ Random access memory (RAM) was expensive and limited.

   ▶ Programmer productivity was low.

Evolution of DBMS

▶ **1960s:**

▶ Computerized database started in the 1960s.

▶ Network and Hierarchical database products were developed.

▶ Data was stored in files with interface between programs and files.

▶ There were two popular data models in this decade: a network model called CODASYL and a hierarchical model called IMS.

▶ One database system that proved to be a commercial success was the SABRE system that was used by IBM to help American Airlines manage its reservations data.

▶ Separation and isolation, duplication, high maintenance costs, and weak security were some of its limitations.

Evolution of DBMS

▶ **1970s**

▶ E.F. Codd published an important paper to propose the use of a **relational database model.**

▶ In his model, the database's schema, or logical organization, was disconnected from physical information storage, and this became the standard principle for database system.

▶ Two major relational database system prototypes were created between the years 1974 and 1977, and they were the Ingres, which was developed at UBC, and System R, created at IBM San Jose.

▶ Based on relational calculus, shared collection of logically related data and description of data were designed to meet the information needs of an organization.

Evolution of DBMS

▶ **1976**

▶ A new database model called Entity-Relationship, or ER, was proposed by P. Chen this year.

▶ This model made it possible for designers to focus on data application, instead of logical table structure.

▶ **1980s**

▶ Structured Query Language, or SQL, became the standard query language.

▶ Relational database systems became a commercial success.

▶ This caused a major decline in the popularity of network and hierarchical database models.

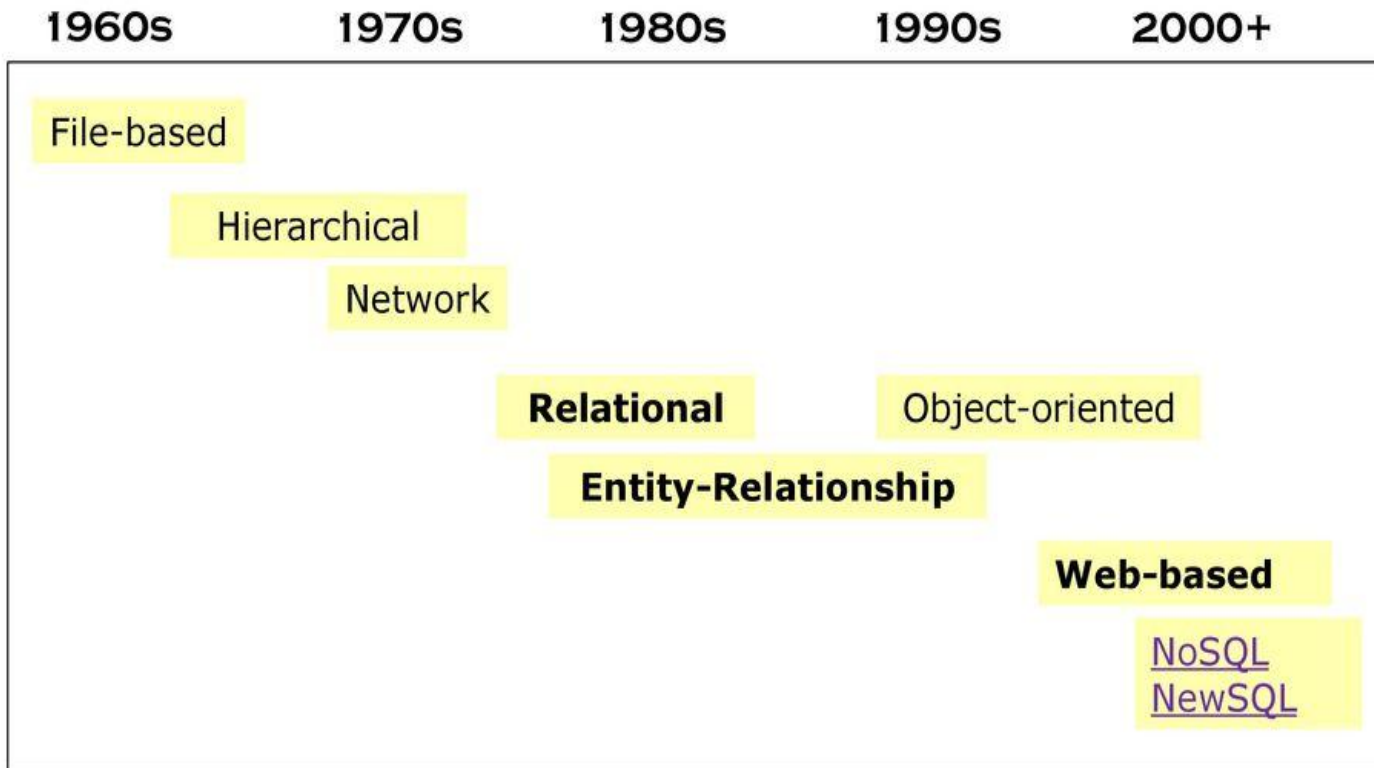▶ DB2 became the flagship database product for IBM.

Evolution of DBMS

▶ **1990s**

▶ Around this time, new client tools for application development were released.

▶ These included the Oracle Developer, PowerBuilder, VB, and others.

▶ A number of tools for personal productivity, such as ODBC and Excel/Access, were also developed.

▶ Prototypes for Object Database Management Systems, or ODBMS, were created in the early 1990s.

▶ The advent of the Internet led to exponential growth of the database industry.

▶ Average desktop users began to use client-server database systems to access computer systems that contained legacy data.
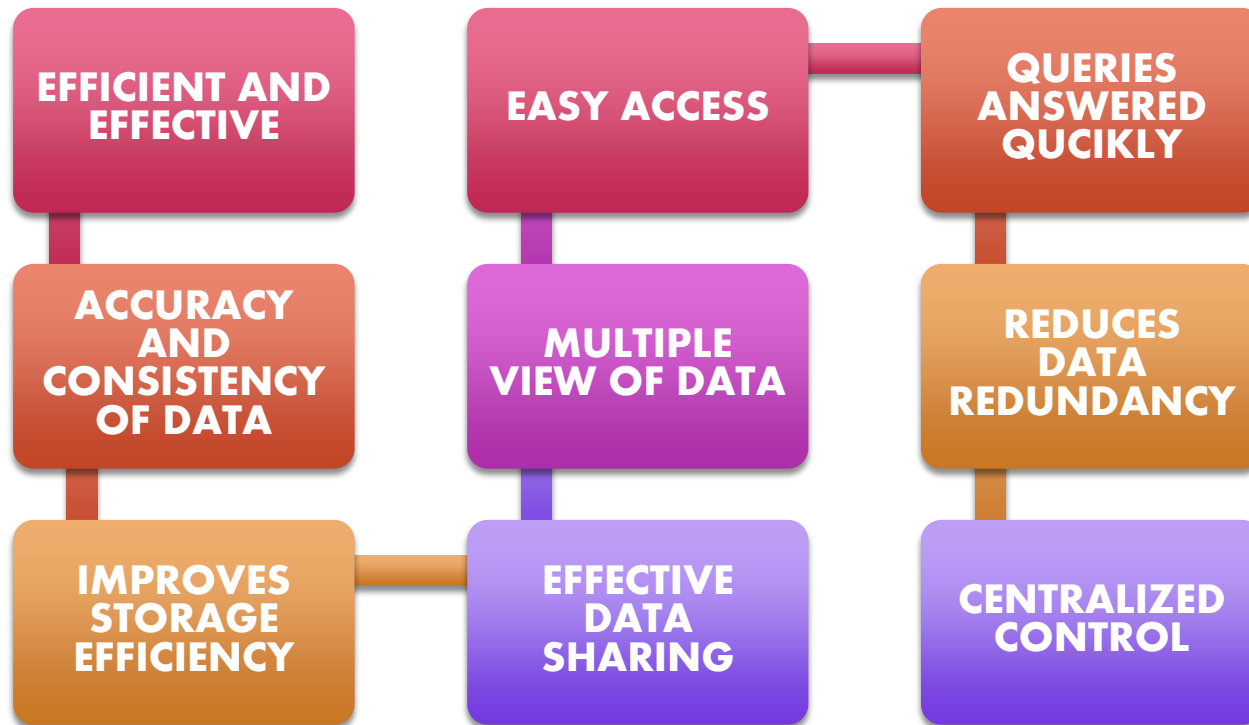
Evolution of DBMS

▶ **Today**

➢ Databases are everywhere and are used to improve our day-to-day life activities.

➢ From personal cloud storage to predicting the weather, many of the services we utilize today are possible due to databases.

➢ Presently, there are many new players in the **non-relational database space** offering specific solutions.

➢ Some of the current relational databases include giants such as Oracle, MySQL, and DB2.
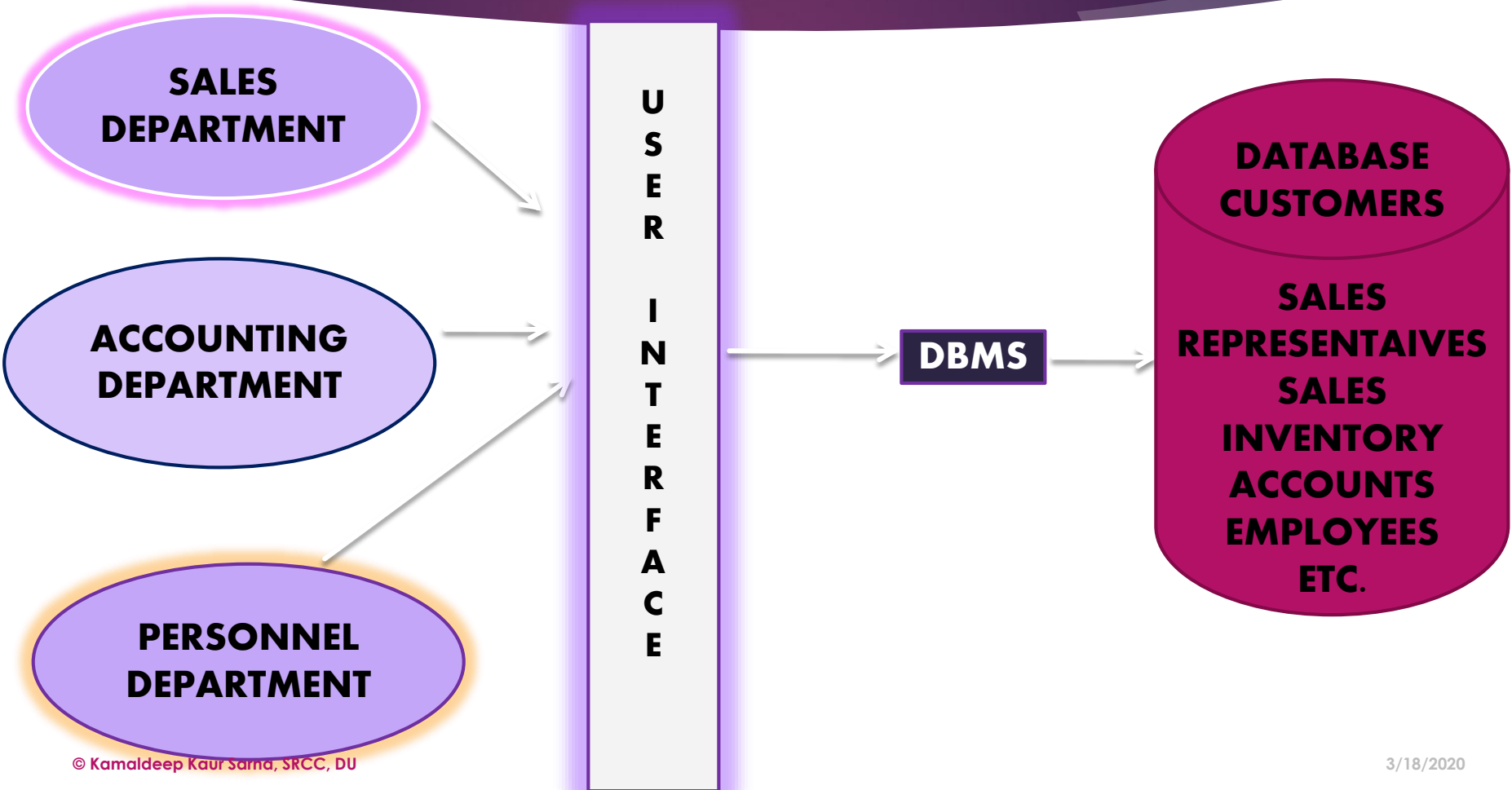
Evolution of Database

1960s	1970s	1980s	1990s	2000+

File-based

Hierarchical

Network

Relational   Object-oriented

Entity-Relationship

Web-based

NoSQL
NewSQL

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Importance of DBMS

EFFICIENT AND EFFECTIVE

EASY ACCESS

QUERIES ANSWERED QUCIKLY

ACCURACY AND CONSISTENCY OF DATA

MULTIPLE VIEW OF DATA

REDUCES DATA REDUNDANCY

IMPROVES STORAGE EFFICIENCY

EFFECTIVE DATA SHARING

CENTRALIZED CONTROL

Importance of DBMS

DATA SECURITY

SUPPORTS MANY PROGRAMS

Importance of DBMS

SALES DEPARTMENT

ACCOUNTING DEPARTMENT

PERSONNEL DEPARTMENT

USER INTERFACE

DBMS

DATABASE CUSTOMERS

SALES REPRESENTAIVES SALES INVENTORY ACCOUNTS EMPLOYEES ETC.

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Advantages of using DBMS

REDUCED DATA REDUNDANCY

- **Avoids duplication of data and wastage of storage resources**

- **Allows the users to access centrally managed database and saves storage space**

ELIMINATION OF INCONSISTENCIES

- Changes are required to made once only in case elimination of data error/updation is required.
- This reduces the possibility of having different records of same item in the same organization.

EASIER DATA ACCESS TO THE USERS

- **Obtain new and combined information easily**

- **Data sharing**

- **Multiple view of data**

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Advantages of using DBMS

LOWER OVERALL COST

Overall cost is low compared to traditional file based system.

BACKUP AND RECOVERY

Protects on a regular basis from failures like:

Power failure

Disk crash

Software errors

EASIER STANDARD ENFORCEMENTS

It can be accessed by the users only through DBMS.

Easier to enforce the standards relating to their data and software requirements.

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Advantages of using DBMS

Development of Data Model

- Overall data model can be easily developed

- Application independent

Data Security

- Allows enforcement of authentications

- Reduces the possibility of unauthorized access of the database.

Disadvantages of using DBMS

High Initial Cost
- Cost of Setting Up: Designing, analysing and administering.
- Heavy initial investment and maintenance.

Complex-ity
- Database Management systems are:
  - Complex
  - Difficult
  - Time Consuming to implement, administer & design

Security Issues
- Might lead to unauthorised access by outsiders

Problems of Slower Response
- Centrally managed and might lead to slower downloads.
- Example: IRCTC

Traditional File System

File based system

Users insert, update or delete files

Manually or through computers

Traditional File System

▶ File-based System (Predecessor to the DBMS)

▶ A collection of application programs that perform services for the end-users such as the production of reports.

▶ Each program defines and manages its own data.

▶ Information are stored in data files.

▶ File has a collection of records with each record having an identical structure.

▶ The record is decomposed into 'a set of fields' each field carrying a group of characters having a specific meaning.

▶ Each field has a specific type of data (numeric, character, or boolean) etc.

Traditional File System

▶ Each file is a sequence of records as shown below.

▶ Eg., if each record contains 100 bytes of data, then the 1st record occupies the 1st 100 bytes in the file, the 2nd record occupies the 2nd 100 bytes in the file.

S. No.	L Name	Position	NIN	Bno
SL 21	Jones	Manager	WK440211B	B5
SG 37	Beech	Snr. Asst.	WL432514C	B3
SG 14	Ford	Deputy	WL220658D	B3

Description of data

Logical Description

Manner of data representation to the application programmer

Physical Description

Manner of data being physically recorded on storage media
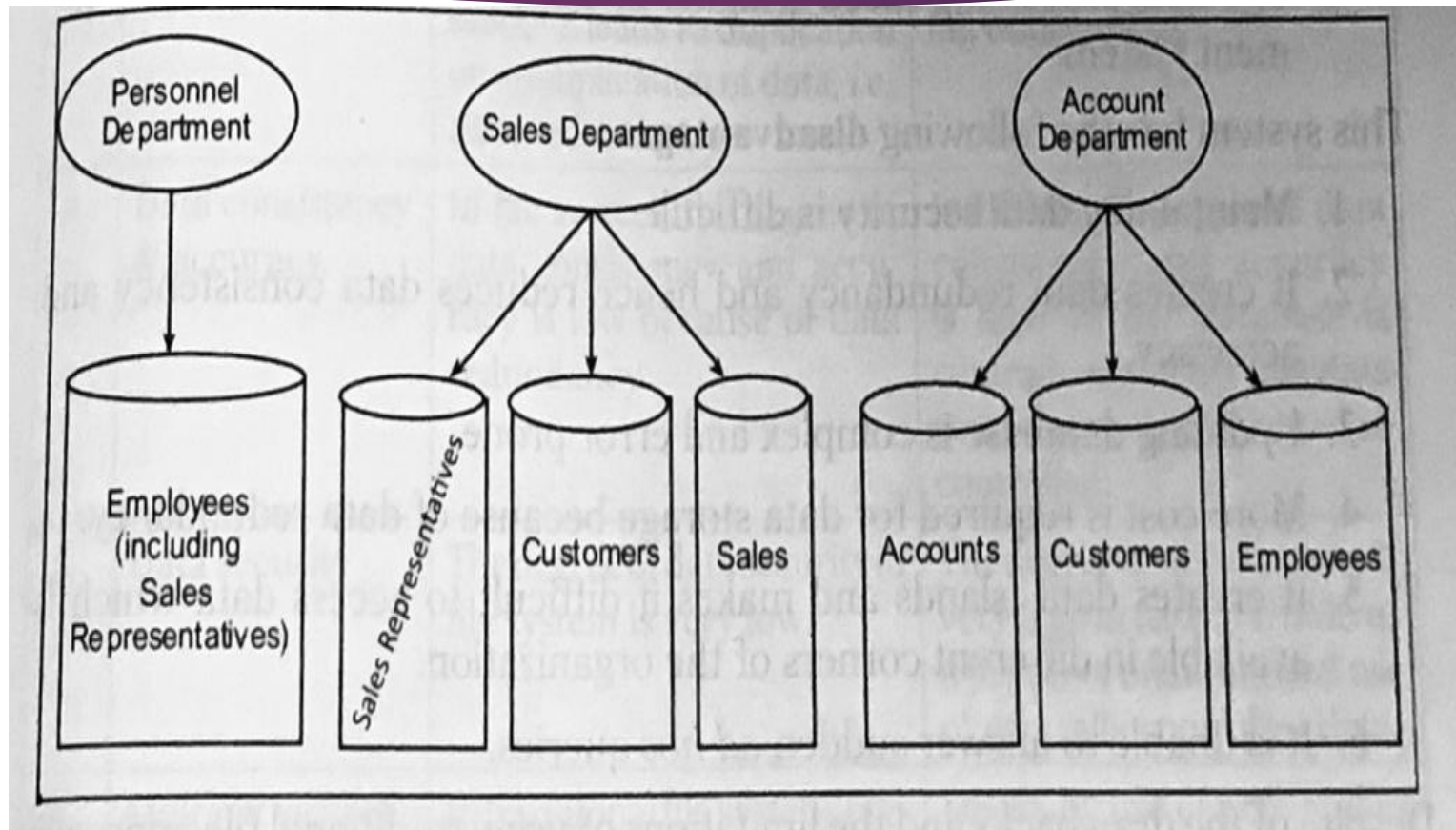
Some important terms

Data Redundancy

- Duplication of data in separate files.

Data Integrity

- Degree to which data in the files of various departments are accurate and consistent.

Example of data redundancy

Advantages of traditional file based system

▶ No need for external central storage.

▶ No need for highly specialized persons.

▶ Data processing speed is higher as compared to database management system.

Disadvantages of traditional file based system

▶ Maintaining data security is difficult.

▶ It creates data redundancy.

▶ Updating database is complex and error prone.

▶ More cost is required.

▶ It creates data islands.

▶ It is unable to answer sudden ad hoc queries.

Difference

BASIS	TRADITIONAL FILE SYSTEM	DATABASE MANAGEMENT SYSTEM
Data program interdependence	• Data and program are dependent on each other.	• Data and program are not dependent.
Data sharing	• Data sharing throughout the organisation is difficult.	• Data sharing can be done in a very quick time.
Data redundancy	• There is duplication of data i.e. data redundancy.	• Since data is stored centrally, duplication of data is removed.
Data consistency and accuracy	• Degree of data consistency and accuracy is low.	• Degree of data consistency and accuracy is high.
Data security	• Degree of data security is very low.	• Degree of data security is high.

Difference

BASIS	TRADITIONAL FILE SYSTEM	DATABASE MANAGEMENT SYSTEM
Multiple view of data	• Creating multiple views of data is next to impossible.	• It is possible to create multiple views of data.
Cost	• Low cost approach of database management.	• Requires very heavy expenditure on set up.
Error of correction	• Correction of errors is very difficult and it is a complex procedure.	• Error correction is very fast and smooth.
Data retrieval	• Retrieval of stored data is difficult.	• Data retrieval is very easy and quick.

Instructions/Assignment

▶ Students are required to thoroughly read the slides (along with the reference books).

▶ They need to submit an assignment in pdf format answering the following questions in around 700 words each:

  ▶ How is database management system better than the traditional file based system?

  ▶ Explain the applications of database management systems in different sectors of the economy.

▶ All are required to e-mail their assignments on email ID (kamaldeepkaur.sarna@srcc.du.ac.in) before 6 pm, 22 March, 2020.

▶ For any queries, feel free to contact through email, phone or WhatsApp during the CAB scheduled lecture timings.

Thank You!