

# Objectives

---

- ❑ **Some common uses of database systems.**
- ❑ **Characteristics of file-based systems.**
- ❑ **Problems with file-based approach.**
- ❑ **Meaning of the term database.**
- ❑ **Meaning of the term Database Management System (DBMS).**
- ❑ **Web Databases**

# First thing First!

---

- What is data?
- Why: you need data?
- Where: is data reside?
- Who: data belongs to?
- How: is it a worthwhile data?

# Information Hierarchy

---

- Data: The raw Material of Information
- Information: Data organized and presented in a particular manner.
- Knowledge: Justified True belief. Information that can be acted upon.
- Wisdom: Integrated knowledge. High level understanding

# Some examples

## **Purchases from a supermarket**

- Bar code reader to scan each purchase.
- Bar code reader is linked to an application program that uses the bar code to find out the price of the item from a product database.
- This program reduces the number of such items in stock and displays the price on the cash register.
- If the reorder level falls below a specified threshold, the database system may automatically place an order to obtain more stocks of that item.

# Credit Card Example

- Purchases using your credit card
  - Assistant normally checks you have sufficient credit left to make the purchase. This can be done on the telephone or may be done automatically by a card reader linked to a computer system.
  - There is a database somewhere that contains information about the purchases you have made on your credit card.
  - To check your credit there is a database application program that uses your credit card number to check that the price of the goods you wish to buy together with the sum of the purchases you have already made this billing period is within your credit limit.

## Credit Card Example (conti..)

- After confirmation of the purchase the details of the purchase are added to this database.
- The application program also accesses the database to check that the credit card is not on a list of stolen credit cards before authorising the purchase.
- There are other application programs to send out monthly statements to each credit card holder and to credit accounts when payment is received

# Before Computers! How People Manages Data?

## Paper Based Records



# Traditional File-Based Systems

- The file-based system is the predecessor of the database system.
- This approach is mostly obsolete but:
  - understanding the problems inherent in file based systems may prevent us from repeating these problems in our database systems,
  - understanding how the file system works is extremely useful when converting a file-based system to a database system.



# File-Based Approach

- **The File-based system is 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.
- These were an early attempt to computerise the manual filing system that most of us are familiar with.
- Really only works well when the number of items to be stored is small.
- It works adequately when there are large numbers and we have only to store and retrieve them

# Terminology used in file-based systems

- A file is simply a collection of **records**, which contain **logically related data**.
- Each **record contains a logically** connected set of one or more **fields**,
- where each field represents some characteristics of the real-world object that is being modelled.

## When does the manual filing system break down?

- The manual filing system breaks down when we have to cross-reference or process information in the files.
- **Example: A typical real estate agent's** office might have a separate file for each property for sale or rent, each potential buyer and renter, and each member of staff.

# Real Estate Example ctd...

- How easy would it be to answer these questions using this set up?
  - ▣ What flats do you have for rent within three kilometres of the city centre?
  - ▣ What is the average rent for a two-bedroom flat?
  - ▣ What is the total annual salary bill for staff?
  - ▣  
for this month?
  - ▣ What is the expected monthly turnover for next financial year?

# University Management System

- Typically, a university might have different departments:
  - Administration Management Department
    - Entry test, student enrolment, fee collection, course registration etc.
  - Examination Management Department
    - Exams announcements, student results etc
  - Employees Management Department.
    - Course allocation, salaries etc.

## University Management System ctd...

- Which students taking the course of CCNA which is allocated to 'Sir Amjad
- How many students passed the prerequisite subject Introduction to Networks taking course CCNA.
- Which students eligible for scholarship according to university criteria?

# Data Processing Staff (DP)

- The **file-based system was developed in** response to the needs of industry for more efficient data access. A decentralised approach was taken, where each department, with the assistance of **Data Processing (DP) staff**, stored and controlled its own data.
- We will illustrate this using an example

## Example Real Estate ctd..

- The Sales Department is responsible for selling and renting property.
- The form that landlord has to fill out before property is marketed for rent is
  - This gives details of rental property as well as owner (landlord) details.

DreamHome Property for Rent Details Property Number: <u>PG21</u>	
Address <u>18 Dale Rd</u>	Allocated to Branch:
City <u>Glasgow</u>	<u>163 Main St Glasgow</u>
Postcode <u>G12</u>	Branch No. <u>B002</u>
Type <u>House</u> Rent <u>000</u>	Staff Responsible
No. of Rooms <u>5</u>	<u>Ann Beech</u>
Owner's Details	
Name <u>Carol Farrel</u>	Business Name _____
Address <u>6 Achray St</u> <u>Glasgow G32 9DX</u>	Address _____
Tel. No. <u>0141-357-7419</u>	Tel. No. _____
Owner No. <u>C087</u>	Contact Name _____
	Business Type _____



- Sales Department also handles enquiries from clients (renters) (b) Client Details form.

DreamHome Client Details Client Number: <u>CR74</u>	
First Name <u>Mike</u>	Last Name <u>Ritchie</u>
Address <u>18 Tain St</u> <u>PA1G 1YQ</u>	Tel. No. <u>0475-392178</u>
Property Requirement Details	
Preferred Property Type <u>House</u> Maximum Monthly Rent <u>750</u>	
General Comments <u>Currently living at home with parents</u> <u>Getting married in August</u>	
Seen By <u>Ann Beech</u>	Date <u>24-Mar-04</u>
Branch No. <u>B003</u>	Branch City <u>Glasgow</u>

- With assistance of **Data Processing (DP)** Department, Sales Department creates an information system to handle renting the property
- This consists of three files containing property owner and client details

Property

propertyNo	street	city	postcode	type	rooms	rent	ownerNo
PA14	16 Holthead	Aberdeen	AB7 5SU	House	6	650	CO46
PL94	6 Argyll St	London	NW2	Flat	4	400	CO87
PG4	6 Lawrence St	Glasgow	G11 9QX	Flat	3	350	CO40
PG36	2 Manor Rd	Glasgow	G32 4QX	Flat	3	375	CO93
PG21	18 Dale Rd	Glasgow	G12	House	5	600	CO87
PG16	5 Novar Dr	Glasgow	G12 9AX	Flat	4	450	CO93

Owner

ownerNo	fName	lName	address	telNo
CO46	Joe	Keogh	2 Fergus Dr, Aberdeen AB2 7SX	01224-861212
CO87	Carol	Farrel	6 Achray St, Glasgow G32 9DX	0141-357-7419
CO40	Tina	Murphy	63 Well St, Glasgow G42	0141-943-1728
CO93	Tony	Shaw	12 Park Pl, Glasgow G4 0QR	0141-225-7025

client

clientNo	fName	lName	address	telNo	prefType	maxRent
CR76	John	Kay	56 High St, London SW1 4EH	0207-774-5632	Flat	425
CR56	Aline	Stewart	64 Fern Dr, Glasgow G42 0BL	0141-848-1825	Flat	350
CR74	Mike	Ritchie	18 Tain St, PA1G 1YQ	01475-392178	House	750
CR62	Mary	Tregear	5 Tarbot Rd, Aberdeen AB9 3ST	01224-196720	Flat	600

- Contracts Department is responsible for rental agreements.
- Whenever a client agrees to rent a property a form is filled out by one of the Sales staff which is passed to the Contracts Department which allocates a lease number and completes the payment and rental period details.

DreamHome Lease Details Lease Number: <u>10012</u>	
Client No. _____	Property No. <u>PG21</u>
Full Name _____	Address <u>18 Dale Rd</u>
Address (previous) <u>18 Tain St.</u>	<u>Glasgow G12</u>
<u>PA1G 1YQ</u>	
Tel No. <u>01475-382178</u>	
Payment Details	
Monthly Rent <u>600</u>	Rent Start Date <u>1-Jul-04</u>
Payment Method <u>Cheque</u>	Rent Finish Date <u>30-Jun-05</u>
Deposit <u>1200</u> Paid (Y or N) <u>Y</u>	Duration <u>1 Year</u>

- With assistance from the Data Processing (DP) Department the Contracts Department creates an information system to handle lease agreements.
- This consists of three files containing lease, property, and client details
- The data is similar to that held by the Sales Department.

leaseNo	propertNo	clientNo	rent	payment Method	deposit	paid	rentStart	rentFinish	duration
10024	PA14	CR62	650	Visa	1300	Y	1-Jun-05	31-May-05	12
10075	PL94	CR76	400	Cash	800	N	1-Aug-05	31-Jan-05	6
10012	PG21	CR74	600	Cheque	1200	Y	30-Jun-05	30-Jun-05	12

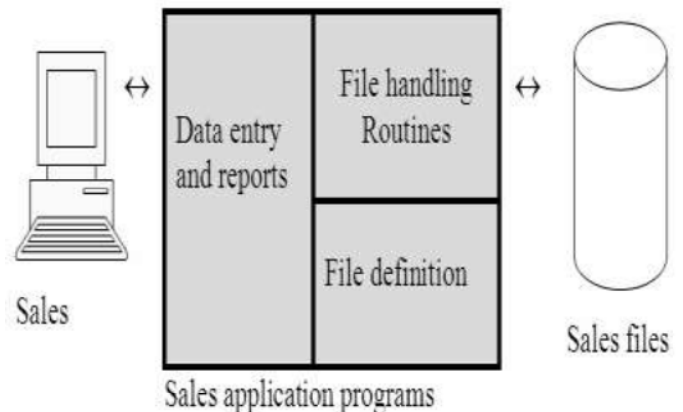
propertyNo	street	city	postcode	rent
PA14	16 Holhead	Aberdeen	AB7 5SU	650
PL94	6 Argyll St	London	NW2	400
PG21	18 Dale Rd	Glasgow	G12	600

clientNo	fName	lName	address	telNo
CR76	John	Kay	56 High St, London SW1 4EH	0171-774-5632
CR74	Mike	Ritchie	18 Tain St, PA1G 1YQ	01475-392178
CR62	Mary	Tregear	5 Tarbot Rd, Aberdeen AB9 3ST	01224-196720

# Sales Department

## □ Sales Files

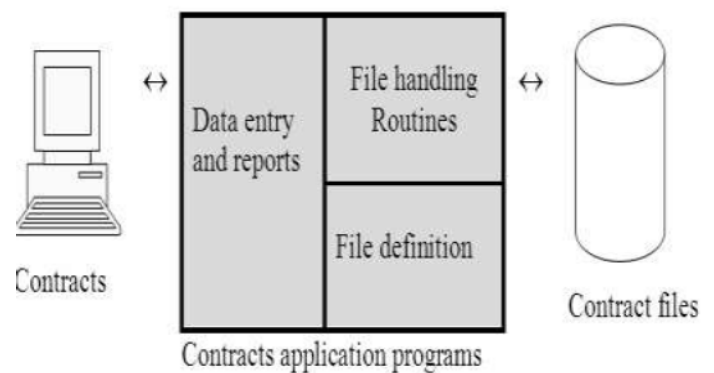
- PropertForRent(propertyNo, street, city, postcode, type, rooms, rent, ownerNo)
- PrivateOwner(ownerNo, fName, lName, address, telNo)
- Client(clientNo, fName, lName, address, telNo, prefType, maxRent)



# Contract Department

## □ Contract Files

- Lease(leaseNo, propertyNo, clientNo, rent, paymentMethod, deposit, paid, rentStart, rentFinish, duration)
- PropertyForRent(propertyNo, street, city, postcode, rent)
- Clientv(clientNo, fName, lName, address, telNo)



# Limitations of file-based systems

- There is a significant amount of duplication of data in the two departments.
- This duplication of data is generally true of file-based systems.

# Limitations of file-based systems

- ❑ Each department accesses their own files through applications programs written specially for them.
- ❑ Each set of application programs handles data entry, file maintenance, and the generation of a fixed set of specific reports.
- ❑ The physical structure and storage of the data files and records are defined in the application code.



# Limitations of file-based systems

## □ Separation and isolation of data

- ▣ It is more difficult to access data that should be available when the data is isolated in separate files.
- ▣ The difficulty is compounded if we required data from more than two files.

# Limitations of file-based systems

## □ **Duplication of data**

- Uncontrolled duplication of data is undesirable
- It is wasteful. It costs time and money to enter the data more than once.
- It takes up additional storage space which has costs attached. Often duplication can be avoided by sharing files. Privacy? Security??
- Duplication can lead to loss of data integrity; the data is no longer consistent.

# Limitations of file-based systems

- **Data dependence**

- The physical structure and storage of the data files and records are defined in the application code. Making changes to an existing structure is difficult.

# Limitations of file-based systems

- ❑ **Incompatible file formats**
- ❑ The structure of files is embedded in the applications program (??? Any example? ).
- ❑ The structures are dependent on the application programming language.
  - Example: The structure of a file generated by a COBOL program may be different from the structure of a file generated by a 'C' program. The direct incompatibility of such files makes them difficult to process jointly. They need to be converted to some common format to facilitate processing.

# Limitations of file-based systems

- ❑ **Fixed queries/proliferation of application programs**
- ❑ File-based systems are very dependent upon the application developer, who has to write any queries or reports that are required.
- ❑ For some organisations the query or report that could be produced was fixed.

# Limitations of file-based systems

- Certain types of data functionality were often sacrificed:
  - ▣ no provision for security or integrity,
  - ▣ In the event of hardware or software failure recovery was limited or non-existent,
  - ▣ no provision for shared access, access to files was restricted to one user at a time.

# Limitations of file-based systems

- The limitations of the file-based approach can be attributed to two factors:
  - The definition of the data is embedded in the applications program, rather than being stored separately and independently;
  - There is no control over the access and manipulation of data beyond that imposed by the applications programs.

# Here comes Database!

- A **database** is a collection of related data.
- The **Database Management System (DBMS)** is the software that manages and controls access to the database.
- A **database application** is a program that interacts with the database at some point of its execution.
- The **database system** is a collection of application programs that interact with the database along with the DBMS and the database itself.



## Data Models

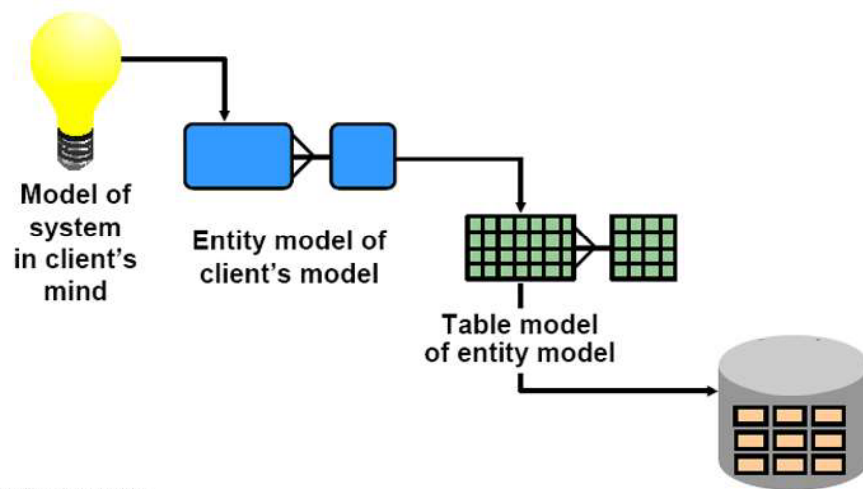
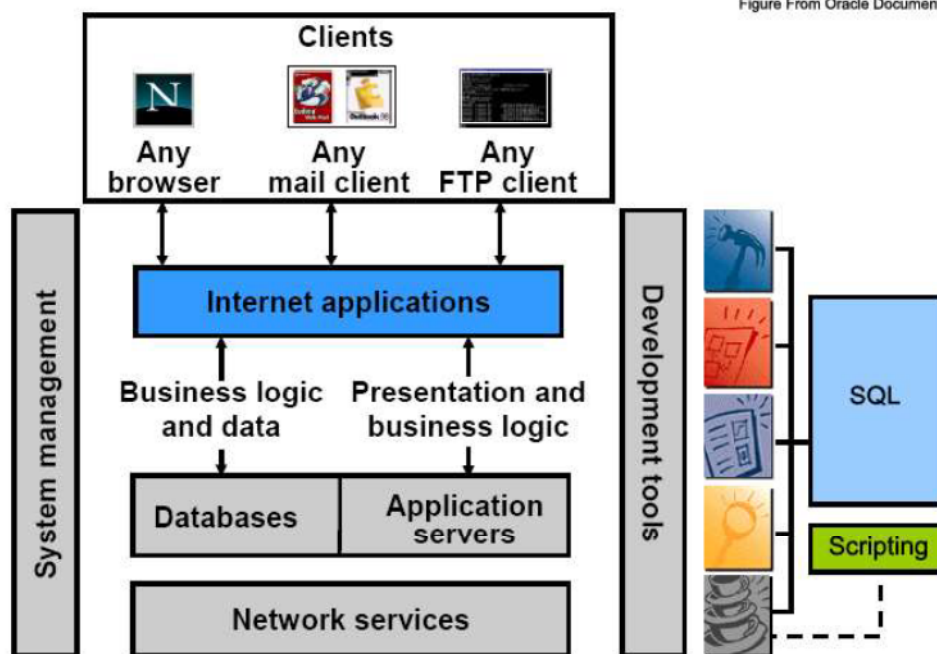
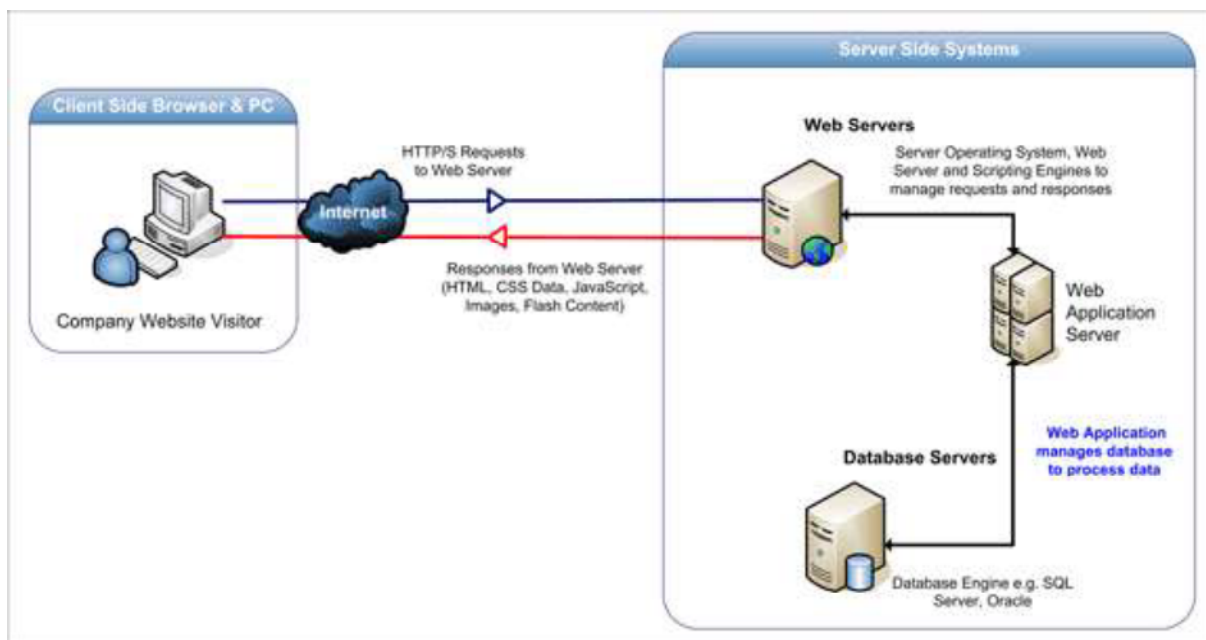


Figure From Oracle Documentation

# Here comes Web!



# Environment



# Objectives

---

- ❑ **Typical functions of a DBMS.**
- ❑ **Major components of the DBMS environment.**
- ❑ **Personnel involved in the DBMS environment.**
- ❑ **Advantages and disadvantages of DBMSs**
- ❑ **DBMS Architectures**

# Needs for DBMS

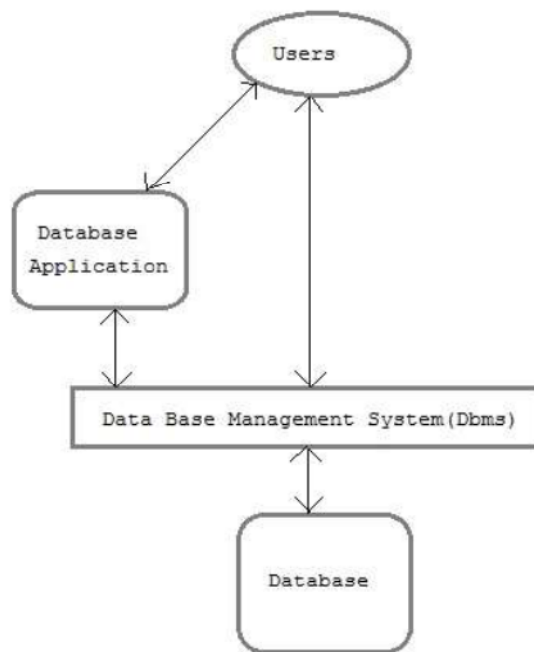
- **Arose because:**

- Definition of data was embedded in application programs, rather than being stored separately and independently.
- No control over access and manipulation of data beyond that imposed by application programs.

- **Result:**

- the database and Database Management System (DBMS).

# Components of Database System



# So Here comes Database!

- A **database** is a collection of related data.
- The **Database Management System (DBMS)** is the software that manages and controls access to the database.
- A **Database Application** is a program that interacts with the database at some point of its execution.
- The **Database System** is a collection of application programs that interact with the database along with the DBMS and the database itself.

# Database

---



- Description of the data. **System Catalog**



# Database

- The database approach separates data and program structure
- If the new data structures are added or existing structures are modified then the application programs are unaffected, provided they do not directly depend upon what has been modified.
  - If we add a new field or record or create a new file, existing applications are unaffected.
  - If we remove a field from a file that an application program uses, then that application program is affected by this change and must be modified accordingly.

## Some Definitions

- An **entity** is a **distinct object** (a **Person**, place, thing, concept, or event) in the organisation that is to be represented in the database.
- An **attribute** is a **property that describes** some aspect of the object that we wish to record.
- A **relationship** is an **association between** entities.

# Logically Related data???

---

- The database represents the entities, the attributes, and the logical relationships between the entities. That is, the database holds data that is logically related.

# Database Management System

- **DEFN: The Database Management System (DBMS) is a software system** that enables users to define, create, maintain, and control access to the database.
- The DBMS is the software that interacts using DDL and DML with the users' application programs and the database.

# Data Definition language

- A DBMS usually provides the following facilities
  - ▣ It allows users to define the database, usually through a **Data Definition Language (DDL)**. The **DDL allows** users to specify the data types and structures and the constraints on the data to be stored in the database.

# Data manipulation language

- It allows users to insert, update, delete, and retrieve data from the database, usually through a **Data Manipulation Language** (DML). Having a central repository for all data and data descriptions allows the DML to provide a general inquiry facility to this data, called a **query language**. The most common query language is the **Structured Query Language (SQL)**.

# DBMS Functions

- ❑ Provides data Independence
- ❑ Concurrency Control
- ❑ Provides Recovery services
- ❑ Provides Utility services
- ❑ Provides a clear and logical view of the process that manipulates data.

# DBMS Functions

---

- It provides access to the database.
  - ▣ A security system
  - ▣ An integrity system
  - ▣ A concurrency system
  - ▣ A recovery
  - ▣ A user-accessible catalogue