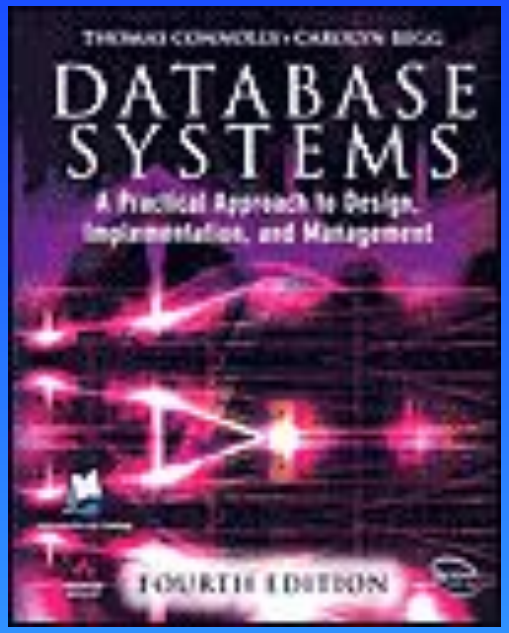
Lecture One
Introduction to Databases

Based on Chapter One of this book:



Database Systems: A Practical Approach to Design, Implementation and Management

International Computer Science S.

Carolyn Begg, Thomas Connolly

Lecture 1 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).

Lecture 1 Objectives

- Typical functions of a DBMS.
- Major components of the DBMS environment.
- Personnel involved in the DBMS environment.
- History of the development of DBMSs.
- Advantages and disadvantages of DBMSs.

Examples of Database Applications

- Purchases from the supermarket
- Purchases using your credit card
- Booking a holiday at the travel agents
- Using the local library
- Taking out insurance
- Using the Internet
- Studying at university

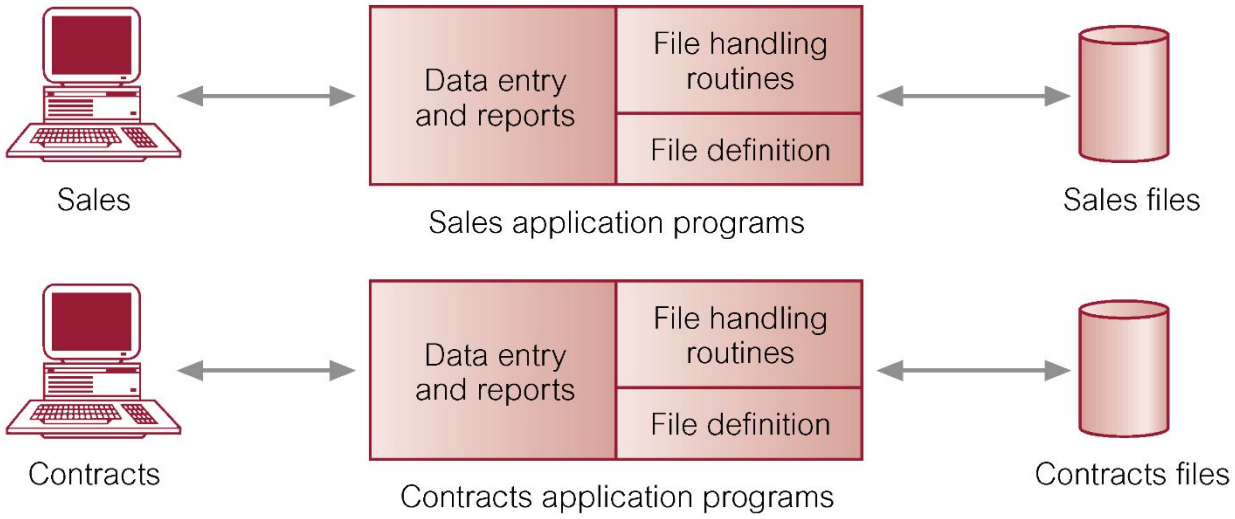
Tutorial Exercise

Identify four further examples of database systems

File-based Systems

- Collection of application programs that perform services for the end users (e.g. reports).
- Each program defines and manages its own data.

File-based Processing



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)

Limitations of File-based Approach

- Separation and isolation of data
  - Each program maintains its own set of data.
  - Users of one program may be unaware of potentially useful data held by other programs.

- Duplication of data
  - Same data is held by different programs.
  - Wasted space and potentially different values and/or different formats for the same item.

Limitations of File-based Approach

- **Data dependence**
  - **File structure is defined in the program code.**
- **Incompatible file formats**
  - **Programs are written in different languages, and so cannot easily access each others files.**
- **Fixed Queries/Proliferation of application programs**
  - **Programs are written to satisfy particular functions. Any new requirement needs a new program.**

Instructor-Led Practical Exercise

- We will take a look at an example program written in Visual Basic that stores data in a simple sequential file.

Tutorial Question

Describe the approach taken to the handling of data in the early file-based systems. Discuss the disadvantages of this approach.

Possible Solution to Tutorial Question

- This answer is intended to give you an idea of the level of detail I am expecting in the discussion questions that will come up on this module
- I won't be providing answers to all these questions!

Possible Solution to Tutorial Question

- Focus was on applications for which programs would be written, and all the data required would be stored in a file or files owned by the programs.
- Clearly, each program was responsible for only its own data, which could be repeated in other program's data files. Different programs could be written in different languages, and would not be able to access another program's files. This would be true even for those programs written in the same language, because a program needs to know the file structure before it can access it.

Database Approach

- 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).

Database

- Shared collection of logically related data (and a description of this data), designed to meet the information needs of an organization.
- System catalog (metadata) provides description of data to enable program–data independence.
- Logically related data comprises entities, attributes, and relationships of an organization's information.

Database Management System (DBMS)

- A software system that enables users to define, create, and maintain the database and which provides controlled access to this database.

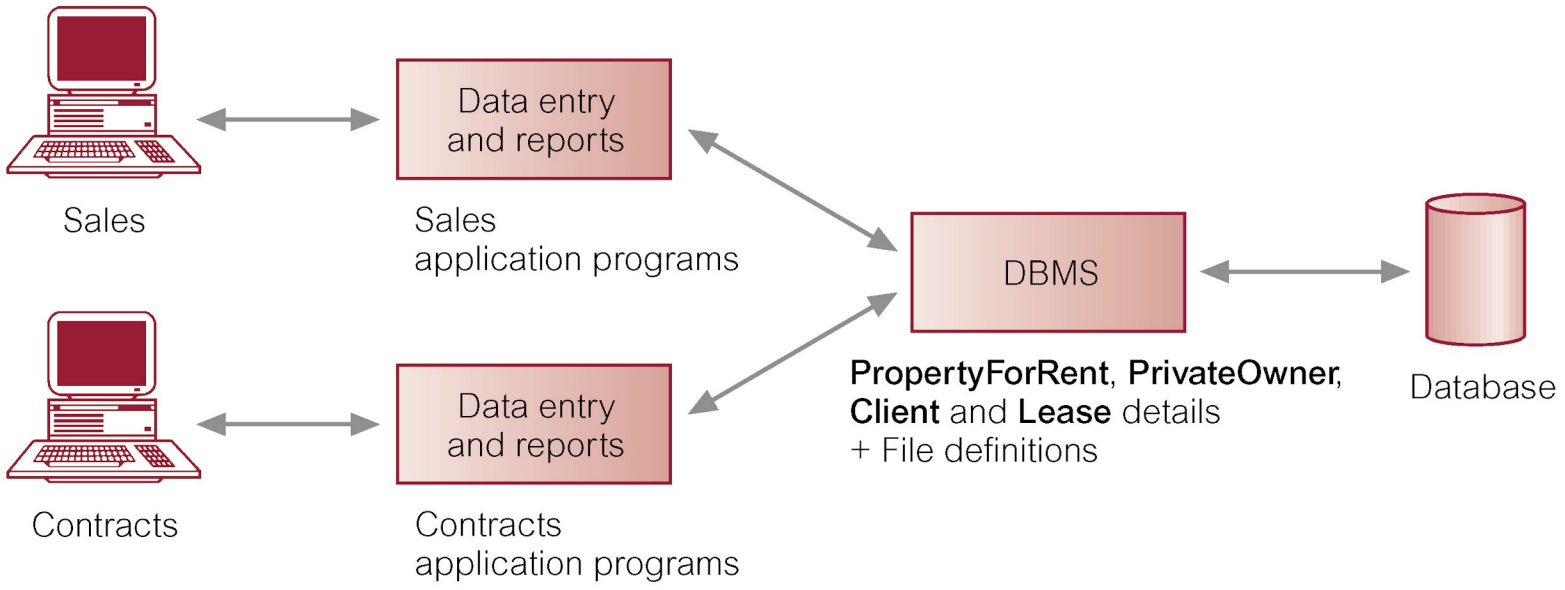
Tutorial Question

Describe the main characteristics of the database approach and contrast it with the file-based approach.

Class Discussion

- We will consider this tutorial question and list a number of key points on the whiteboard

Database Management System (DBMS)



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Database Approach

- Data definition language (DDL).
  - Permits specification of data types, structures and any data constraints.
  - All specifications are stored in the database.

- Data manipulation language (DML).
  - General enquiry facility (query language) of the data.

Database Approach

- Controlled access to database may include:
  - A security system.
  - An integrity system.
  - A concurrency control system.
  - A recovery control system.
  - A user-accessible catalog.

- A view mechanism.
  - Provides users with only the data they want or need to use.

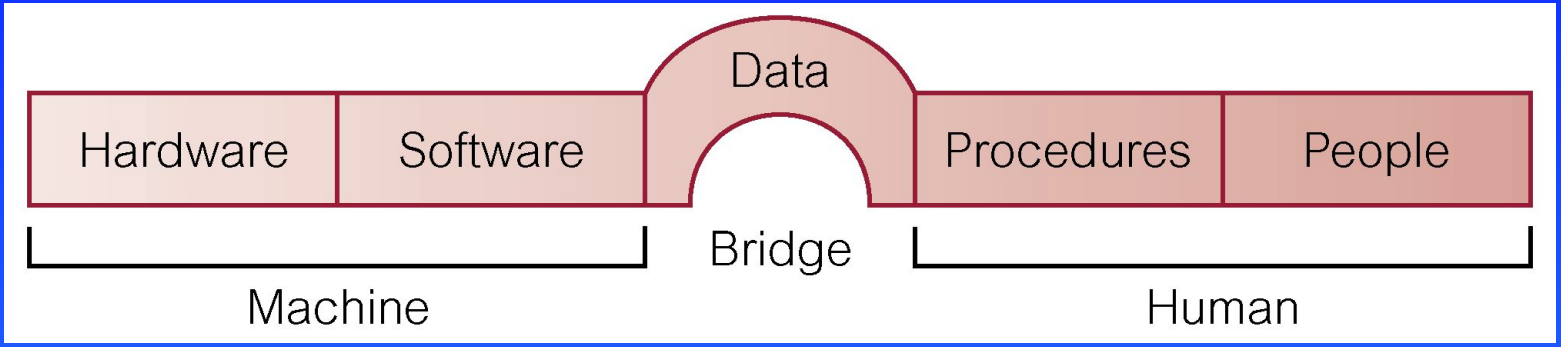
Views

- Allows each user to have his or her own view of the database.
- A view is essentially some subset of the database.

Views

- **Benefits include:**
  - **Reduce complexity;**
  - **Provide a level of security;**
  - **Provide a mechanism to customize the appearance of the database;**
  - **Present a consistent, unchanging picture of the structure of the database, even if the underlying database is changed.**

Components of DBMS Environment



Components of DBMS Environment

- Hardware
  - Can range from a PC to a network of computers.
- Software
  - DBMS, operating system, network software (if necessary) and also the application programs.
- Data
  - Used by the organization and a description of this data called the schema.

Components of DBMS Environment

- **Procedures**
  - **Instructions and rules that should be applied to the design and use of the database and DBMS.**
- **People**

Roles in the Database Environment

- Data Administrator (DA)
- Database Administrator (DBA)
- Database Designers (Logical and Physical)
- Application Programmers
- End Users (naive and sophisticated)

Tutorial Question

Discuss the roles of the following personnel in the database environment:

- **Data Administrator (DA)**
- **Database Administrator (DBA)**
- **Database Designers (Logical and Physical)**
- **Application Programmers**
- **End Users (naive and sophisticated)**

Class Discussion

- Again we will list main points on the whiteboard