

M.Sc. IV Sem. (Mathematics)

Paper 2nd - Fundamentals of Computer Science - II

Unit III

Reference Book : C. J. Date, *An Introduction to Database Systems*, Addison Wesley

Topic : Database Systems

Database :

A database system is basically a computerized record keeping system, in other words, it is a computerized system whose overall purpose is to store information and to allow users to retrieve and update that information on demand.

A database is usually controlled by a database management system (DBMS). Together, the data and the DBMS, along with the applications that are associated with them, are referred to as a database system, often shortened to just database. The following figure shows the simplified picture of a database system.

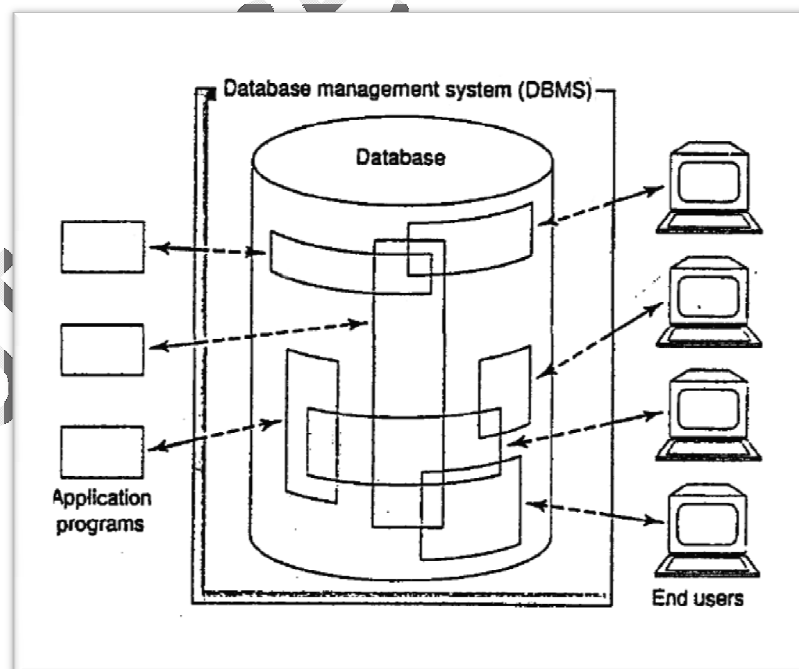


Figure : Simplified picture of a database system

As the figure shows, such a system involves four major components : *data, hardware, software and users.*

Data :

Data is a collection of facts and figures. The data in the database will be both integrated and shared. These two aspects, data integration and data sharing, represent a major advantage of database systems in the "large" environment, and data integration, at least, can be significant in the "small" environment as well.

- By integrated, we mean the database can be thought of as a unification of several otherwise distinct files, with any redundancy among those files partly or wholly eliminated. For example, in the following figure, a given database might contain both an EMPLOYEE file, giving employee names, addresses, departments, salaries, and so on, and an ENROLLMENT file, representing the enrollment of employees in training courses. Now suppose that, in order to carry out the process of training course administration, it is necessary to know the department for each enrolled student. Then there is clearly no need to include that information redundantly in the ENROLLMENT file, because it can always be discovered by referring to the EMPLOYEE file instead.
- By shared, we mean the database can be shared among different users, in the sense that different users can have access to the same data, possibly even at the same time ("concurrent access"). Such sharing, concurrent or otherwise, is partly a consequence of the fact that the database is integrated. In the following figure, for instance, the department information in the EMPLOYEE file would typically be shared by users in the Personnel Department and users in the Education Department. (A database that is not shared in the foregoing sense is sometimes said to be "personal" or "application-specific.")

EMPLOYEE	NAME	ADDRESS	DEPARTMENT	SALARY	...
ENROLLMENT	NAME	COURSE	...		

Figure : The EMPLOYEE and ENROLLMENT Files

Hardware :

The hardware components of the system consist of:

- The secondary storage volumes—typically magnetic disks—that are used to hold the stored data, together with the associated I/O devices (disk drives, etc.), device controllers, I/O channels, and so forth.
- The hardware processor(s) and associated main memory that are used to support the execution of the database system software.

Software :

Between the physical database itself—that is, the data as physically stored—and the users of the system is a layer of software, known variously as the database manager or database server or, most commonly, the database management system (DBMS). All requests for access to the database are handled by the DBMS; the facilities like adding and removing files (or tables), retrieving data from and updating data in such files or tables, and so on, are all facilities provided by the DBMS. One general function provided by the DBMS is thus the shielding of database users from hardware-level details (much as programming language systems shield application programmers from hardware-level details). In other words; the DBMS provides users with a perception of the database that is elevated somewhat above the hardware level, and it supports user operations that are expressed in terms of that higher-level perception.

Users :

We consider three broad classes of users:

- First, there are **application programmers**, responsible for writing database application programs in some programming language, such as COBOL, PL/I, C++, Java, or some higher-level "fourth-generation" language. Such programs access the database by issuing the appropriate request (typically an SQL statement) to the DBMS. The programs themselves can be traditional batch

applications, or they can be online applications, whose purpose is to allow an end user to access the database interactively (e.g., from an online workstation or terminal or a personal computer). Most modern applications are of the online variety.

- Next, there are **end users**, who access the database interactively as just described. A given end user can access the database via one of the online applications, or he or she can use an interface provided as an integral part of the system. Such vendor-provided interfaces are also supported by means of online applications, of course, but those applications are built in, not user-written. Most systems include at least one such built-in application, called a query language processor, by which the user can issue database requests such as SELECT and INSERT to the DBMS interactively. SQL is a typical example of a database query language. Most systems also provide additional built-in interfaces in which end users do not issue explicit database requests such as SELECT and INSERT at all, but instead operate by (e.g.) choosing items from a menu or filling in boxes on a form. Such menu- or forms-driven interfaces tend to be easier to use for people who do not have a formal training in IT (information technology). By contrast command-driven interfaces—that is, query languages—do tend to require a certain amount of professional IT expertise, though perhaps not much (obviously not as much as is needed to write an application program in a language like COBOL). Then again, a command-driven interface is likely to be more flexible than a menu- or forms-driven one, in that query languages typically include certain features that are not supported by those other interfaces.
- The third class of user is the **database administrator or DBA**. One of the main reasons for having a DBA is to have central control of both the data and programs accessing that data. The person having such central control over the system is called the database administrator.

The functions of DBA include :

- ❖ Scheme definition.
- ❖ Storage structure and access method definition.
- ❖ Scheme and physical organization modification.
- ❖ Granting of authorization for data access.

Example of a Database :

Let us see a simple example of a university database. This database is maintaining information concerning students, courses, and grades in a university environment. The database is organized as five files:

- The STUDENT file stores data of each student
- The COURSE file stores contain data on each course.
- The SECTION stores the information about sections in a particular course.
- The GRADE file stores the grades which students receive in the various sections
- The TUTOR file contains information about each professor.

Characteristics of Database Management System :

- Provides security and removes redundancy.
- Self-describing nature of a database system.
- Insulation between programs and data abstraction.
- Support of multiple views of the data.
- Sharing of data and multiuser transaction processing.
- DBMS allows entities and relations among them to form tables.
- It follows the ACID concept (Atomicity, Consistency, Isolation, and Durability).
- DBMS supports multi-user environment that allows users to access and manipulate data in parallel.

Popular DBMS Software :

Here, is the list of some popular DBMS system:

- MySQL
- Microsoft Access
- Oracle
- PostgreSQL
- dBASE
- FoxPro
- SQLite
- IBM DB2
- LibreOffice Base
- MariaDB
- Microsoft SQL Server etc.

Disadvantages of Database Management System :

- Data redundancy and inconsistency.
- Difficulty in accessing data.
- Data isolation.
- Concurrent access anomalies.
- Security and integrity problems.