A database management system (DBMS) or database system in short, is a software that can be used to create and manage databases. DBMS lets users to create a database, store, manage, update/modify and retrieve data from that database by users or application programs. Some examples of open source and commercial DBMS include MySQL, Oracle, PostgreSQL, SQL Server, Microsoft Access, MongoDB.

A database system hides certain details about how data are actually stored and maintained. Thus, it provides users with an abstract view of the data. A database system has a set of programs through which users or other programs can access, modify and retrieve the stored data.

The DBMS serves as an interface between the database and end users or application programs. Retrieving data from a database through special type of commands is called querying the database. In addition, users can modify the structure of the database itself through a DBMS.

Some database management systems include a graphical user interface for users to create and manage databases. Other database systems use a command line interface that requires users to use programming commands to create and manage databases.

Databases are widely used in various fields. Some applications are given in Table 7.3.

Table 7.3 Use of Database in Real-life Applications

Application	Database to maintain data about
Banking	customer information, account details, loan details, transaction details, etc.
Crop Loan	kisan credit card data, farmer's personal data, land area and cultivation data, loan history, repayment data, etc.
Inventory Management	product details, customer information, order details, delivery data, etc.
Organisation Resource Management	employee records, salary details, department information, branch locations, etc.
Online Shopping	items description, user login details, users preferences details, etc.

7.3.1 File System to DBMS

Let us revisit our school example where two data files were maintained (Table 7.1 by office and Table 7.2 by teacher). Let us now design a database to store data of those two files. We know that tables in a database are linked or related through one or more common columns or fields. In our example, the STUDENT (Table 7.1) file and ATTENDANCE (Table 7.2) file have RollNumber and SName as common field names. In order to convert

these two files into a database, we need to incorporate the following changes:

a) SName need not be maintained in ATTENDANCE file as it is already there in STUDENT. Details for a student can be retrieved through the common field RollNumber in both the files.

b) If two siblings are in the same class, then same guardian details (GName, GPhone and GAddress) are maintained for both the siblings. We know this is a redundancy and by using a database we can avoid this. So let us split the STUDENT file into two file (STUDENT file and GUARDIAN) file so that each guardian data are maintained only once.

c) One and more guardians can have the same name. So it will not be possible to identify which guardian is related to which student. In such case, we need to create an additional column, say GUID (Guardian ID) that will take unique value for each record in the GUARDIAN file. The column GUID will also be kept with STUDENT file for relating these two files.

High Cost is incurred while shifting from file system to DBMS:

- Purchasing sophisticated hardware and software.
- Training users for querying.
- Recurrent cost to take regular backup and perform recovery operations.

Note: We could distinguish guardians by their phone numbers also. But, phone number can change, and therefore may not truly distinguish guardian.

Figure 7.1 shows the related data files for the STUDENT, GUARDIAN and ATTENDANCE details. Note that this is not the complete database schema since it does not show any relationship among tables.

STUDENT	GUARDIAN	ATTENDANCE
RollNumber SName SDateofBirth GUID	GUID GName GPhone GAddress	AttendanceDate RollNumber AttendanceStatus

Figure 7.1: Record structure of three files in STUDENTATTENDANCE Database

The tables shown at Figure 7.1 are empty, which are to be populated with actual data as shown in Table 7.4, 7.5 and 7.6.

Table 7.4 Snapshot of STUDENT table

RollNumber	SName	SDateofBirth	GUID
1	Atharv Ahuja	2003-05-15	444444444444
2	Daizy Bhutia	2002-02-28	111111111111

3	Taleem Shah	2002-02-28	
4	John Dsouza	2003-08-18	333333333333
5	Ali Shah	2003-07-05	101010101010
6	Manika P.	2002-03-10	466444444666

Table 7.5 Snapshot of GUARDIAN table

GUID	GName	GPhone	GAddress
444444444444	Amit Ahuja	5711492685	G-35, Ashok Vihar, Delhi
111111111111	Baichung Bhutia	3612967082	Flat no. 5, Darjeeling Appt., Shimla
101010101010	Himanshu Shah	4726309212	26/77, West Patel Nagar, Ahmedabad
333333333333	Danny Dsouza		S -13, Ashok Village, Daman
466444444666	Sujata P.	3801923168	HNO-13, B- block, Preet Vihar, Madurai

Table 7.6 Snapshot of ATTENDANCE table

Date	RollNumber	Status
2018-09-01	1	P
2018-09-01	2	P
2018-09-01	3	A
2018-09-01	4	P
2018-09-01	5	A
2018-09-01	6	P
2018-09-02	1	P
2018-09-02	2	P
2018-09-02	3	A
2018-09-02	4	A
2018-09-02	5	P
2018-09-02	6	P

Figure 7.2 shows a simplified database called STUDENTATTENDANCE, which is used to maintain data about the student, guardian and attendance. As shown here, the DBMS maintains a single repository of data at a centralized location and can be used by multiple users (office staff, teacher) at the same time.

7.3.2 Key Concepts in DBMS

In order to efficiently manage data using a DBMS, let us understand certain key terms:

(A) Database Schema

Database Schema is the design of a database. It is the skeleton of the database that represents the structure (table names and their fields/columns), the type of data each column can hold, constraints on the data to be stored (if any), and the relationships among the tables.