Ferhat Abbas University
Faculty of Sciences
Computer Science Département

2nd year Computer Science Database Lectures

Dr: Zahia LALALAM
z.lalama@univ-setif.dz

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Introduction to Databases

INTRODUCTION

- In computerized information system, information is represented by means of **data** which are the basic resource of the organization. So, proper organization and management for data is required for organization to run smoothly.

Database applications

- Databases touch all aspects of our lives

Airlines: reservations, schedules

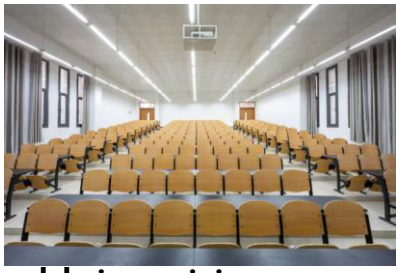
Sales: customers, products, purchases

DB are behind almost everything you do on the web

Google

amazon

ebay



Universities: registration, grades

Banking: all transactions

Data and Information

Data: "John Smith" and 0798424242

Information: Who is the head of mathematic department and what is his telephone number?

- Data alone has no significance, but once interpreted, it provides information that allows us to improve our knowledge of the world.
- Data can be stored into a DB

Example of DB

A company DB

EMPLOYEE

Fname	Minit	Lname	Ssn	Bdate	Address	Sex	Salary	Super_ssn	Dno
John	B	Smith	123456789	1965-01-09	731 Fondren, Houston, TX	M	30000	333445555	5
Franklin	T	Wong	333445555	1955-12-08	638 Voss, Houston, TX	M	40000	888665555	5
Alicia	J	Zelaya	999887777	1968-01-19	3321 Castle, Spring, TX	F	25000	987654321	4
Jennifer	S	Wallace	987654321	1941-06-20	291 Berry, Bellaire, TX	F	43000	888665555	4
Ramesh	K	Narayan	666884444	1962-09-15	975 Fire Oak, Humble, TX	M	38000	333445555	5
Joyce	A	English	453453453	1972-07-31	5631 Rice, Houston, TX	F	25000	333445555	5
Ahmad	V	Jabbar	987987987	1969-03-29	980 Dallas, Houston, TX	M	25000	987654321	4
James	E	Borg	888665555	1937-11-10	450 Stone, Houston, TX	M	55000	NULL	1

DEPARTMENT

Dname	Dnumber	Mgr_ssn	Mgr_start_date
Research	5	333445555	1988-05-22
Administration	4	987654321	1995-01-01
Headquarters	1	888665555	1981-06-19

DEPT_LOCATIONS

Dnumber	Dlocation
1	Houston
4	Stafford
5	Bellaire
5	Sugarland
5	Houston

WORKS_ON

Essn	Pno	Hours
123456789	1	32.5
123456789	2	7.5
666884444	3	40.0
453453453	1	20.0
453453453	2	20.0
333445555	2	10.0
333445555	3	10.0
333445555	10	10.0
333445555	20	10.0
999887777	30	30.0
999887777	10	10.0
987987987	10	35.0
987987987	30	5.0
987654321	30	20.0
987654321	20	15.0
888665555	20	NULL

PROJECT

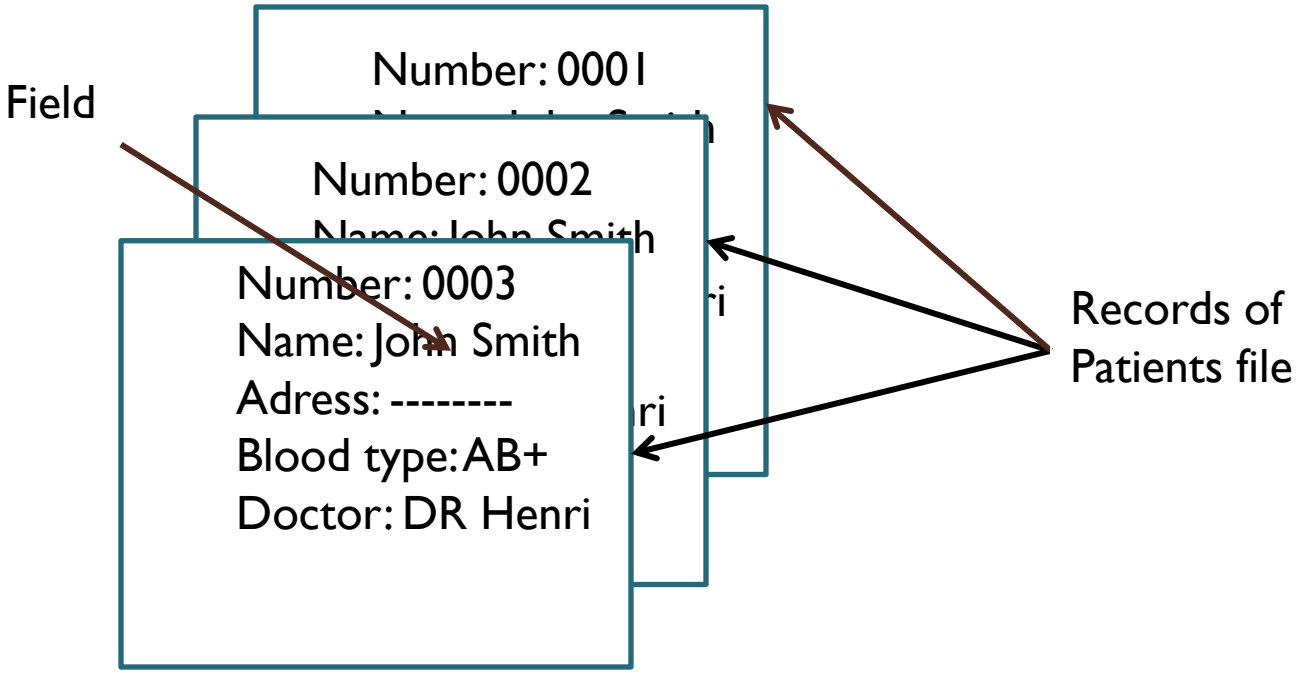
Pname	Pnumber	Plocation	Dnum
ProductX	1	Bellaire	5
ProductY	2	Sugarland	5
ProductZ	3	Houston	5
Computerization	10	Stafford	4
Reorganization	20	Houston	1
Newbenefits	30	Stafford	4

DEPENDENT

Essn	Dependent_name	Sex	Bdate	Relationship
333445555	Alice	F	1986-04-05	Daughter
333445555	Theodore	M	1983-10-25	Son
333445555	Joy	F	1958-05-03	Spouse
987654321	Abner	M	1942-02-28	Spouse
123456789	Michael	M	1988-01-04	Son
123456789	Alice	F	1988-12-30	Daughter
123456789	Elizabeth	F	1967-05-05	Spouse

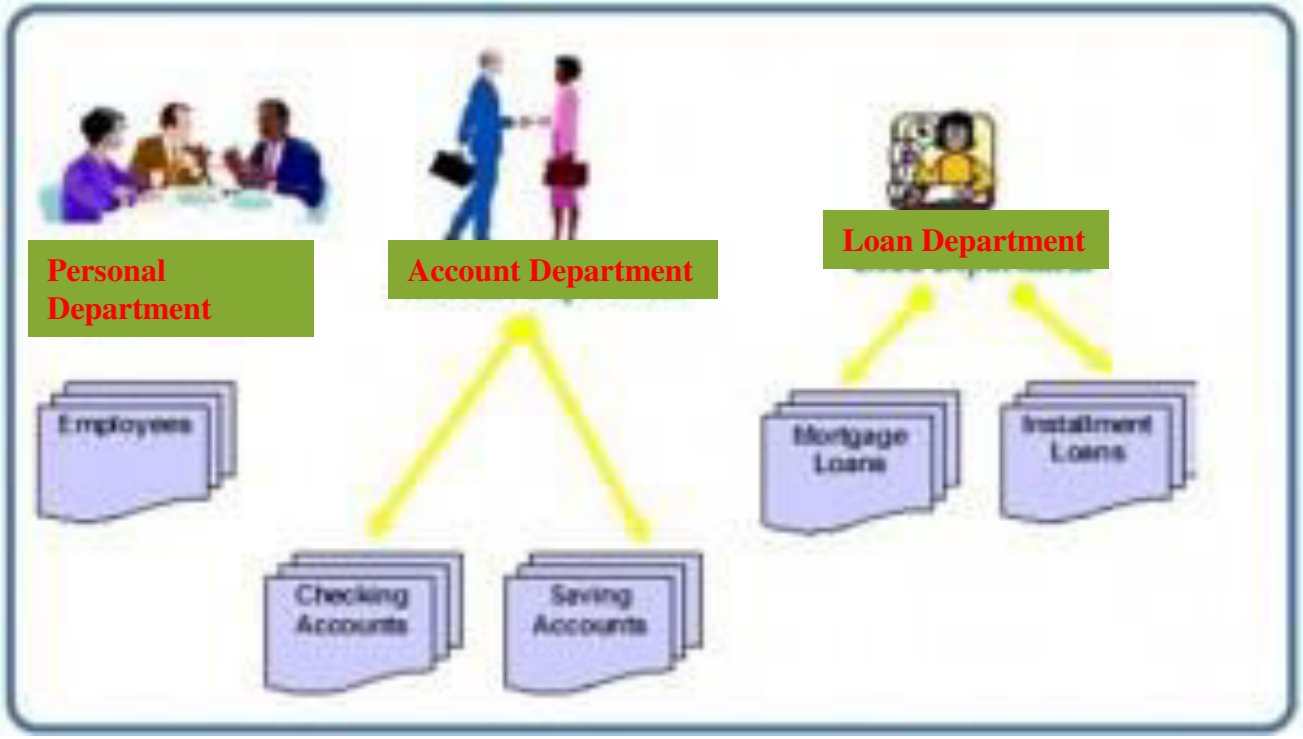
File Oriented Approach to data management :

- The conventional approach to data management exploits the presence of *files to store data permanently*.
- **File** is a collection of related data stored in secondary memory.
- **So Database = File**



Example:

Consider a traditional banking system that uses the file-based system to manage the organization's data . As we can see, there are different departments in the bank. Each has its own applications that manage and manipulate different data files. For banking systems, the programs may be used to debit or credit an account, find the balance of an account, add a new mortgage loan and generate monthly statements.



Example of a file-based system used by banks to manage data.

File system desadvantages

1)Data redundancy and inconsistency: The same information may be written in several files. This redundancy leads to higher storage and access cost. It may lead data inconsistency that is the various copies of the same data may present at multiple places for example a changed customer address may be reflected in single file but not else where in the system.

2)Difficulty in accessing data: The conventional file processing system do not allow data to be retrieved in a convenient and efficient manner according to user choice. (one program for application).

3)Data isolation: Because data are scattered in various files and files may be in different formats writing new application programs to retrieve the appropriate data is difficult.

4)Integrity Problems: Developers enforce data validation in the system by adding appropriate code in the various application program. However when new constraints are added, it is to change the programs to enforce them.

5) Concurrent access: In the file processing system it is not possible to access the same file for transaction at same the time.

6) Security problems: There is no security provided in file processing system to secure the data from unauthorized user access.

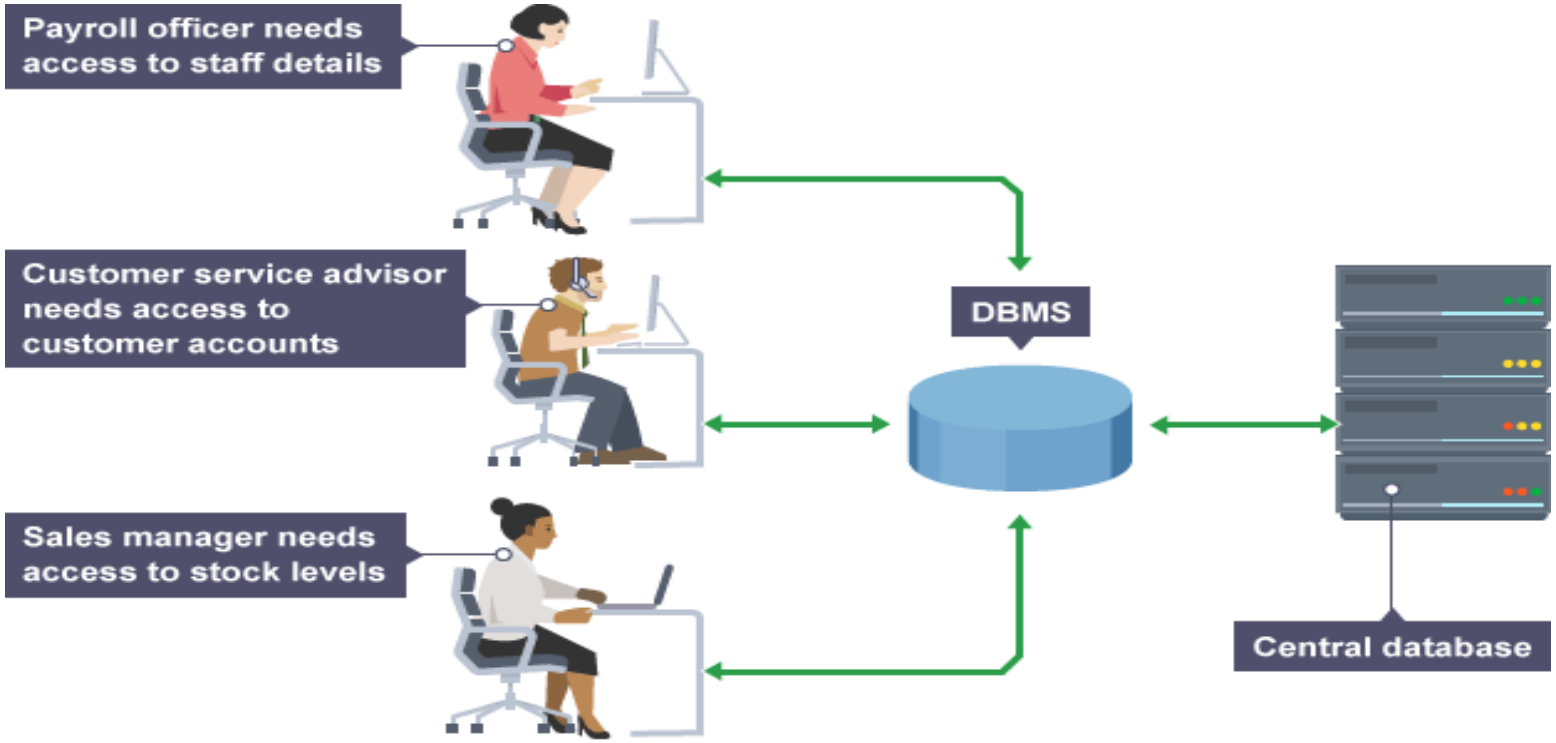
DBMS

What is DBMS?

- Database Management System (DBMS) is a software for storing and retrieving data while considering appropriate security measures. It consists of a group of programs that manipulate the database.

DBMS Example:

A database in a DBMS



Empolyees are accessing Data through DBMS

Database: Organized collection of **interelated** and **non-redundant** data that can be **efficiently stored, accessed** and **manipulated** by different application systems

Database Access Languages

- **Definition**: Database Access Language is a simple language designed to write commands to access, insert, update and delete data stored in any database.
- **Example**: Structured Query Language **(SQL)** is the database language used to perform certain operations on the existing database as well as to create a database. SQL uses certain commands like Create, Drop, and Insert etc.
- to carry out the required tasks The SQL commands are mainly categorized into five categories as:

  i. **DDL** – Data Definition Language

  ii. **DQL** – Data Query Language

  iii. **DML** – Data Manipulation Language

  iv. **DCL** – Data Control Language

  v. **TCL** – Transaction Control Language

DDL(**Data Definition Language**)

DDL is used to define the database Structure

Examples of DDL commands:

- **CREATE:** used to create the database or its objects (like table, index).
- **DROP:** is used to delete objects from the database.
- **ALTER:** is used to alter the structure of the database.
- **RENAME:** is used to rename an object existing in the database.

DQL (Data Query Language):

The purpose of DQL Command is to get some schema relation based on the query passed to it.

- **Example of DQL commands :**
- **SELECT :**is used to retrieve data from the database

DML (Data Manipulation Language):

- **Examples of DML commands :**
- **INSERT :** is used to insert data into a table.
- **UPDATE :** is used to update existing data within a table.
- **DELETE:** is used to delete records from a database table.

DCL (Data Control Language):

- DCL includes commands such as GRANT and REVOKE which mainly deals with the rights, permissions and other controls of the database system.
- **Examples of DCL commands:**
- **GRANT:** gives user's access privileges to database.
- **REVOKE:** withdraw user's access privileges given by using the GRANT command.

TCL (transaction Control Language):

- TCL commands deals with the transaction within the database.

Examples of TCL commands:

- **COMMIT:** commits a Transaction.
- **ROLLBACK:** rollbacks a transaction in case of any error occurs.
- **SAVEPOINT:** sets a save point within a transaction.
- **SET TRANSACTION:** specify characteristics for the transaction.

DBMS Users

There are three type of users of the DBMS:

- **Database Administrators (DBA):** Database Administrator or DBA is the one who manages the complete database management system. DBA takes care of the security of the DBMS, its availability, managing the license keys, managing user accounts and access etc.

- **Application Programmer or Software Developer:** This user group is involved in developing and designing the parts of DBMS.

- **End User:** These days all the modern applications, web or mobile, store user data **.** How do you think they do it? Applications are programmed in such a way that they collect user data and store the data on DBMS systems running on their server.
- End users are the one who store, retrieve, update and delete data.

Data Models

- Underlying the structure of a database is the **data model: a collection of conceptual tools for describing data,**

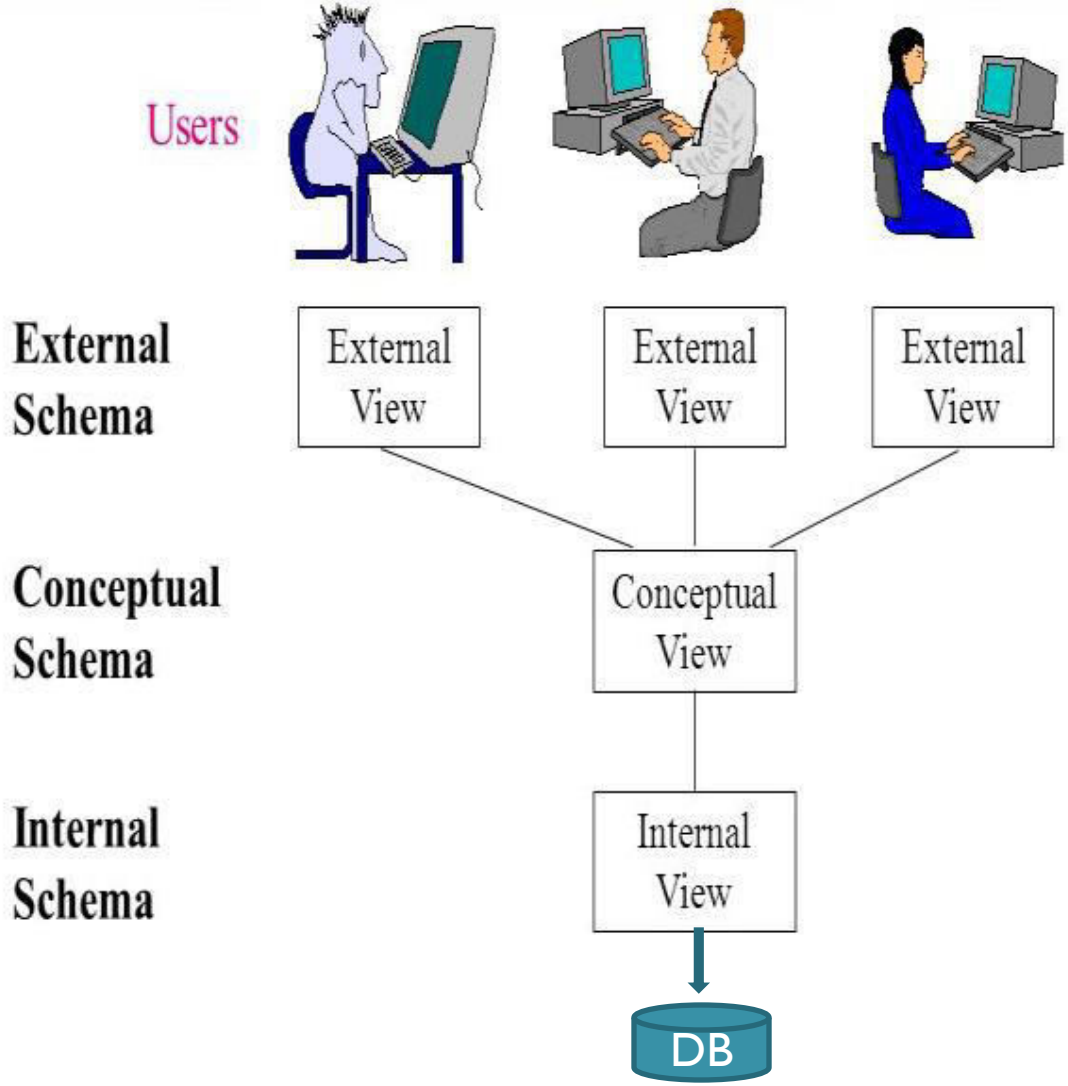
data relationships, data semantics, and consistency constraints. A data model provides a way to describe the design of a database at the physical, logical, and view levels.

Examples : Entity-Relationship Model, Relational Model.

Instances and Schemas

- Databases change over time as information is inserted and deleted. The collection of information stored in the database at a particular moment is called an **instance** of the database. The overall design of the database is called the **database schema (using data model)**.

Data Abstraction



Levels of Abstraction in a DBMS According to the ANSI/SPARC

- **Physical level (or Internal View / Schema):** it describes how the data are actually stored. The physical level describes complex low-level data structures in detail.

- **Logical level (or Conceptual View / Schema):** it describes what data are stored in the database, and what relationships exist among those data.

- **View level (or External View / Schema):** it describes the users views.

Advantages of DBMS:

- **1)Reduction of redundancies:** Centralized control of data avoids unnecessary duplication of data and effectively reduces the total amount of data storage required also elimination of the inconsistencies that tend to be present in redundant data files.
- **2)Sharing of Data:** A database allows the sharing of data under its control by any number of application programs or

users.

- **3)Data Integrity:** data values being entered for storage could be checked to ensure that they fall with in a specified range and are of the correct format.
- **4)Data Security:** To ensure that proper access procedures are followed including proper authentication to access to the Database and additional check before permitting access to sensitive data.

- **5) Data Independence:**

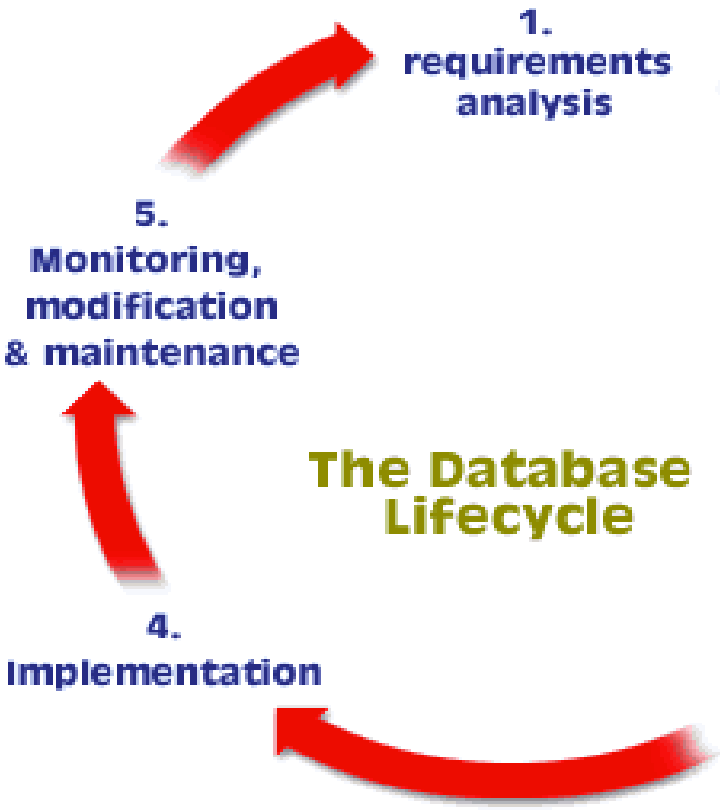
Physical Data Independence: allows changes in the physical shema (storage devices or organization of the files to be made) without requiring changes in the conceptual shema or any of the external views and hence in the application programs using the data base.

Logical Data Independence: indicates that the conceptual schema can be changed without affecting the existing external schema or any application program.

- 6) **Enforcements of Standards :** With the centralized of data, DBA can establish and enforce the data standards.

- 7) **Reduced Application Development and Maintenance Time:** DBMS supports many important functions that are common to many applications, accessing data stored in the DBMS, which facilitates the quick development of applications.

Relational Database Life cycle



1-Create (ER) diagram
2- Transform the ER to Relational schema

Using mecanisms to speed up updation DB

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