Introduction to Database & Database Environment

OBJECTIVES

At the end of this lesson, students should be able to:

- ✓ Describe database approach
- ✓ Differentiate database approach and file-based system
- ✓ Explain the database environment
- ✓ Explain the history of DBMS
- ✓ Describe the advantages and disadvantages of DBMS
- ✓ Explain three level ANSI-SPARC architecture
- ✓ Describe database language
- ✓ Explain data model and conceptual modelling
- ✓ Describe functions of DBMS

Introduction to Database

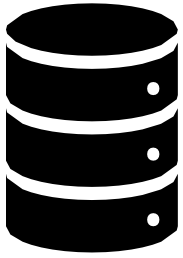
Accessing social media accounts

Buying groceries at supermarket by using credit cards

Data is a fact – quantities, symbols, or characters used for reasoning or analysis later

Data

Data

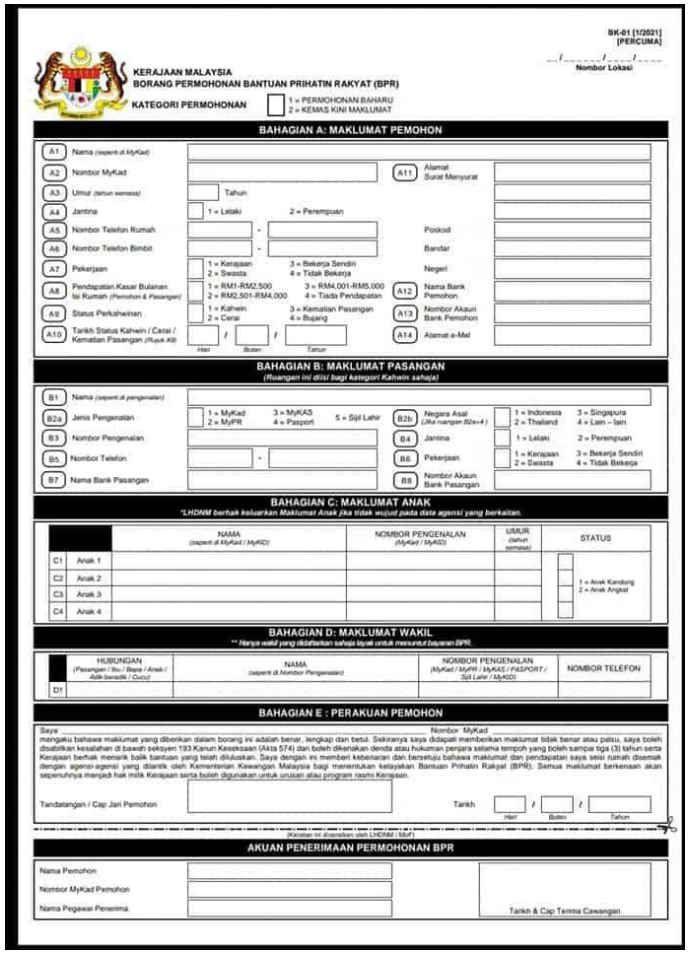


Database

Manual filing system
File-based system
Database system

Database is where the collection of related data is stored

Manual Filing Approach



KERAJAAN MALAYSIA
BORANG PERMOHONAN BANTUAN PRIHATIN RAKYAT (BPR)
KATEGORI PERMOHONAN

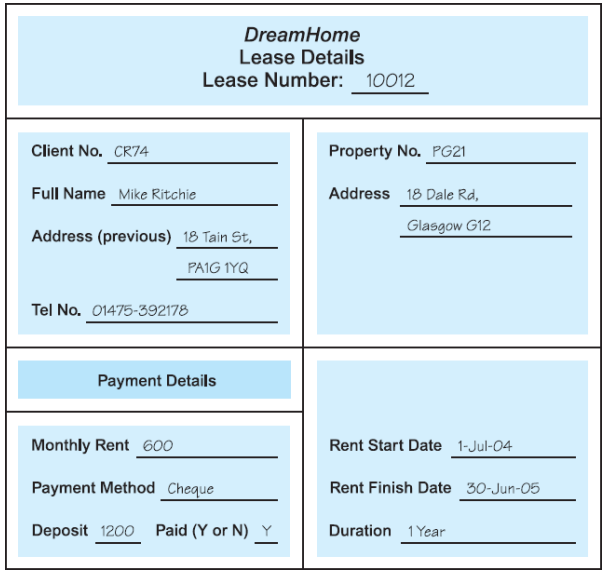
BAHAGIAN A: MAKLUMAT PEMOHON
BAHAGIAN B: MAKLUMAT PASANGAN
BAHAGIAN C: MAKLUMAT ANAK
BAHAGIAN D: MAKLUMAT WAKIL
BAHAGIAN E : PERAKUAN PEMOHON
AKUAN PENERIMAAN PERMOHONAN BPR

Example of form filled by users

All the forms are stored in files which then is put on the cabinet

File-Based System

- ✓ A collection of application programs that perform services for the system end-users such as the production of reports.
- ✓ Each program defines and manages its own data



Form is filled by users

Lease

leaseNo	propertyNo	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	1-Jul-05	30-Jun-05	12

PropertyForRent

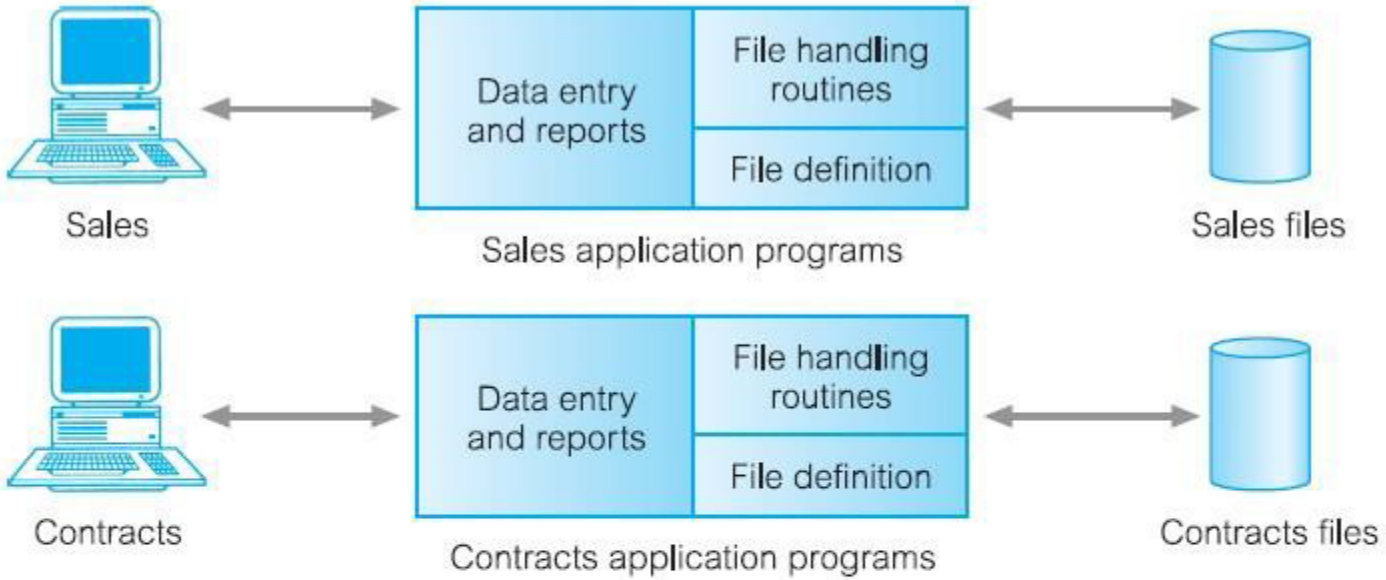
propertyNo	street	city	postcode	rent
PA14	16 Holhead	Aberdeen	AB7 5SU	650
PL94	6 Argyll St	London	NW2	400
PG21	18 Dale Rd	Glasgow	G12	600

Client

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

Data is transferred into different files by the staffs

File-Based System



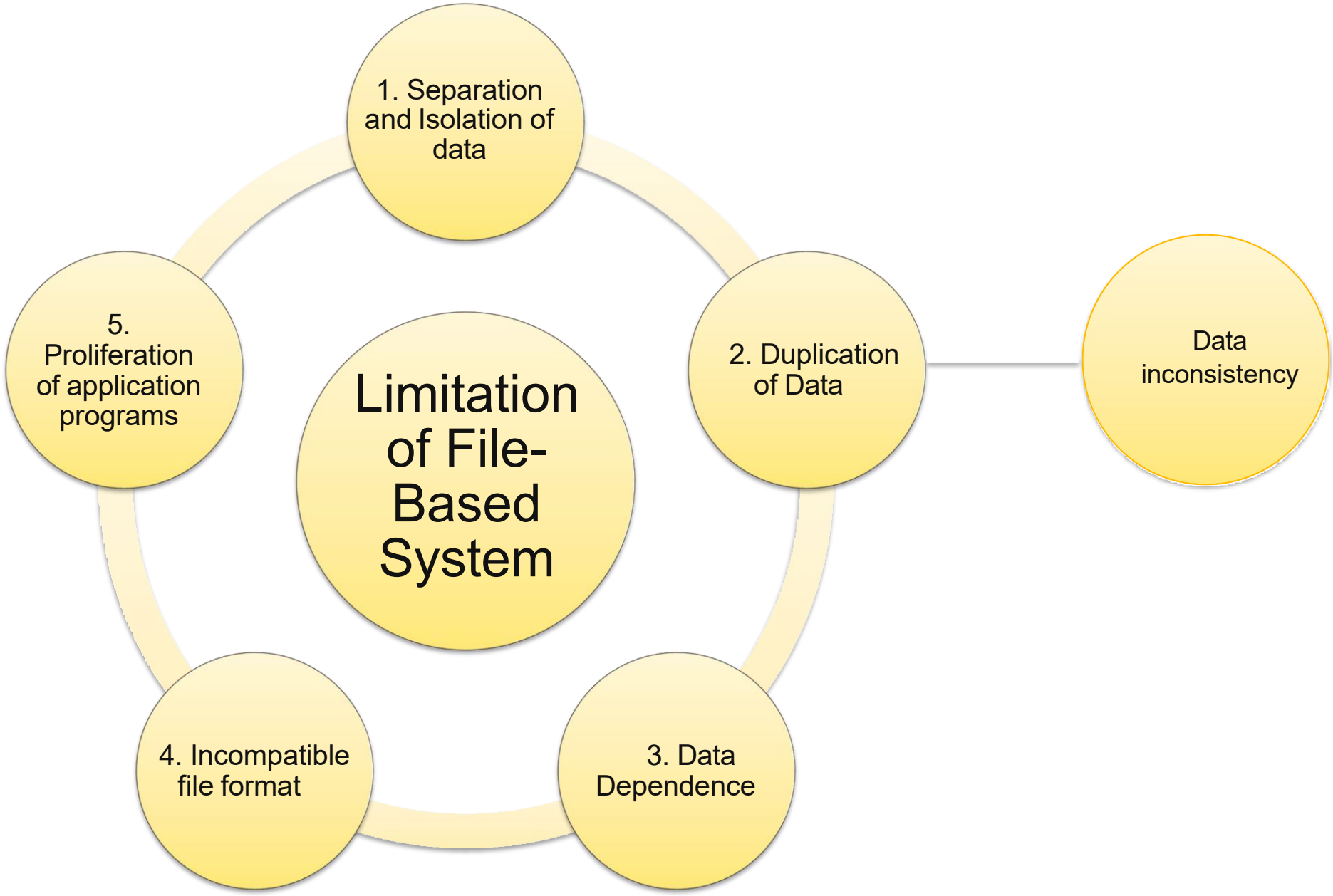
Sales Files

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

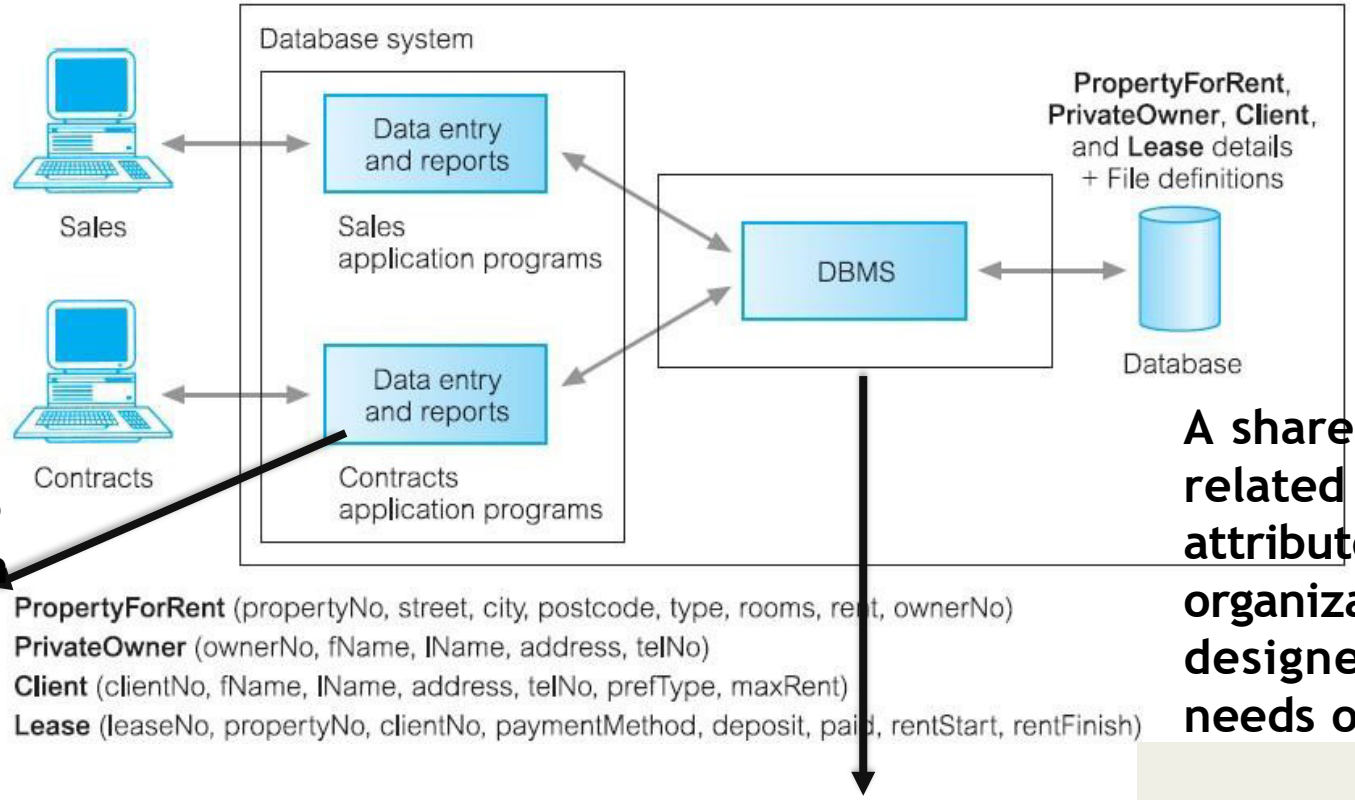
Contracts Files

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

- Confidentiality of data is controlled by each department
- Data is more organized than the manual filing system


Limitation of File-Based System
1. Separation and Isolation of data
2. Duplication of Data
Data inconsistency
3. Data Dependence
4. Incompatible file format
5. Proliferation of application programs

Database Approach

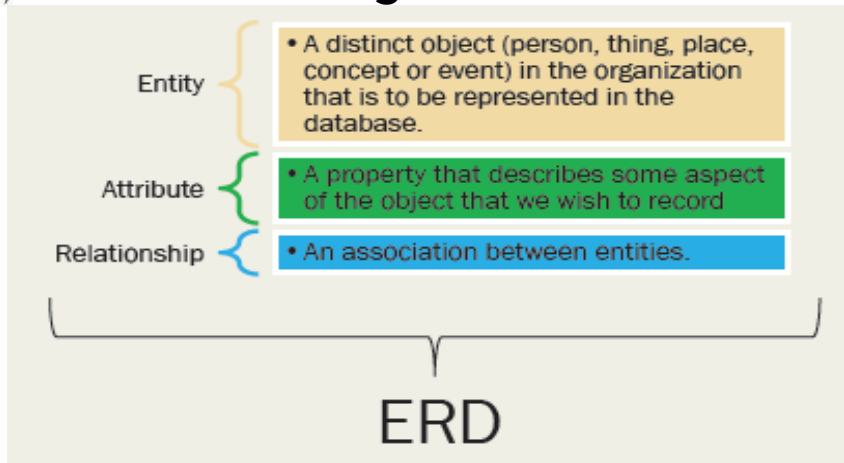


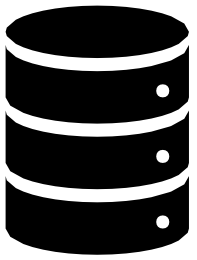
A computer program that interacts with the database by issuing an appropriate request (typically an SQL statement) to the DBMS.

Can you name any application program in UiTM?

A software system that enables users to define, create, maintain, and control access to the database.

A shared collection of logically related data comprises entity, attributes & relationships of an organization's information, designed to meet the information needs of an organization.





Database

Data is separated from the application programs

Have a system catalogue to give a description of the data

Applications programs are unaffected if the new data structures are added, or existing data being modified

Data independence

Logically related data comprises entities, attributes, and relationships of an organization’s information which is known as ERD

DBMS

- Software that interacts with the users' application programs and the database
- Define the database, usually through a Data Definition Language (DDL)
- Insert, update, delete, and retrieve data from the database, usually through a Data Manipulation Language (DML).
- It provides controlled access to the database

Application Program

System used to access data in the database to perform any tasks

View

- ✓ DBMS provides another facility known as a view mechanism, which allows each user to have his or her own view of the database
- ✓ A view is in essence some subset of the database.

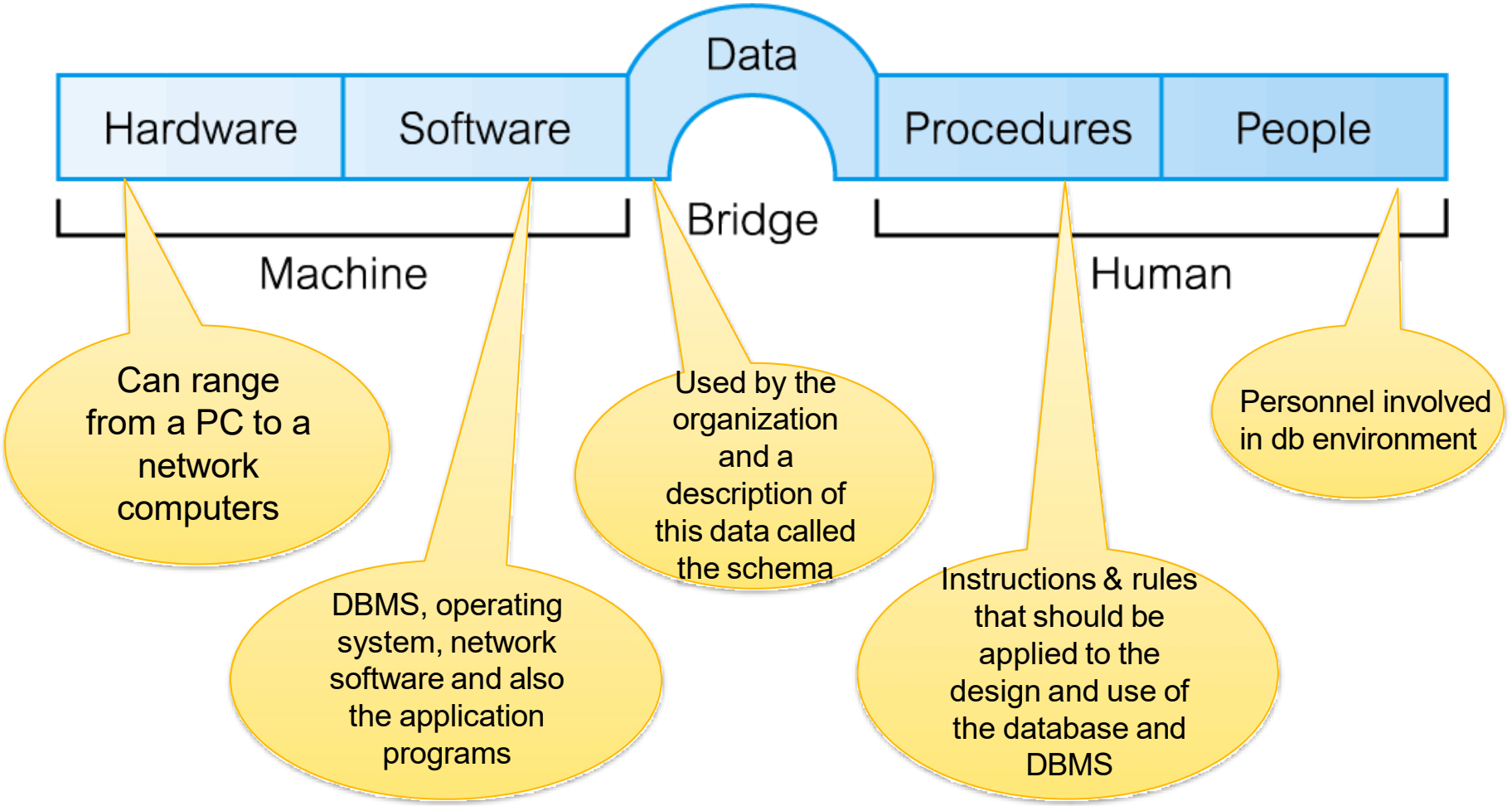
Reduce Complexity

Provide level of security

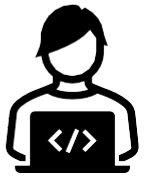
Provide mechanism to customize the appearance of the database

Present a consistent, unchanging picture of the structure of the database

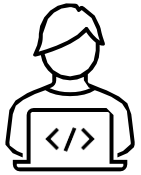
Components of the DBMS Environment



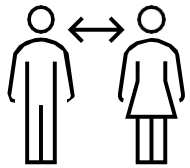
Roles in the Database Environment



Data Administrator (DA) is responsible for the management of the data resource including database planning, development and maintenance of standards, policies and procedures, and conceptual/logical database design.



The **Database Administrator (DBA)** is responsible for the physical realization of the database, including physical database design and implementation, security and integrity control, maintenance of the operational system, and ensuring satisfactory performance of the applications for users



The **logical database designer** is concerned with identifying the data (that is, the entities and attributes), the relationships between the data, and the constraints on the data that is to be stored in the database

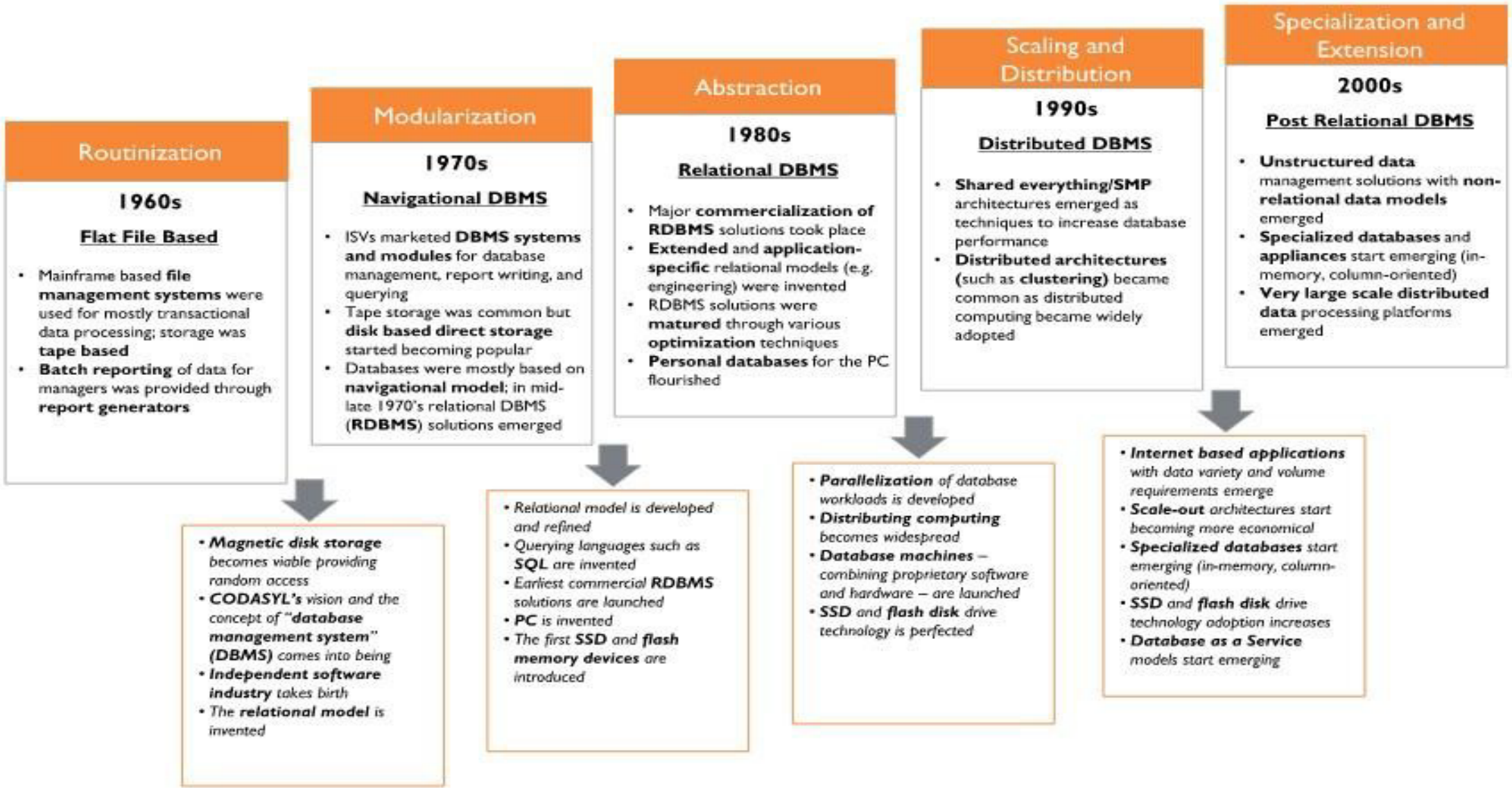
The **physical database designer** decides how the logical database design is to be physically realized

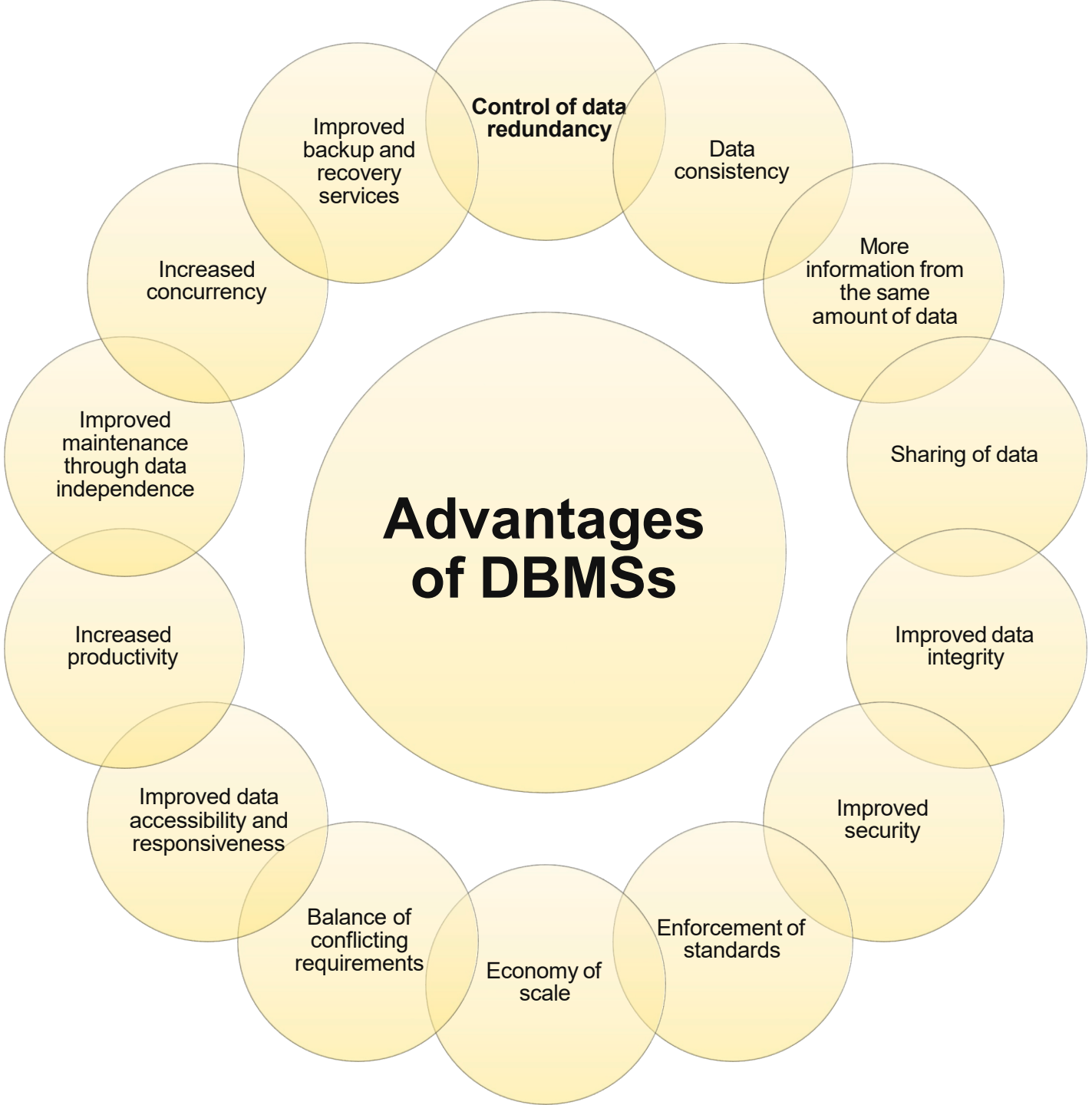
Application Developers code the application programs that provide the required functionality for the end-users must be implemented

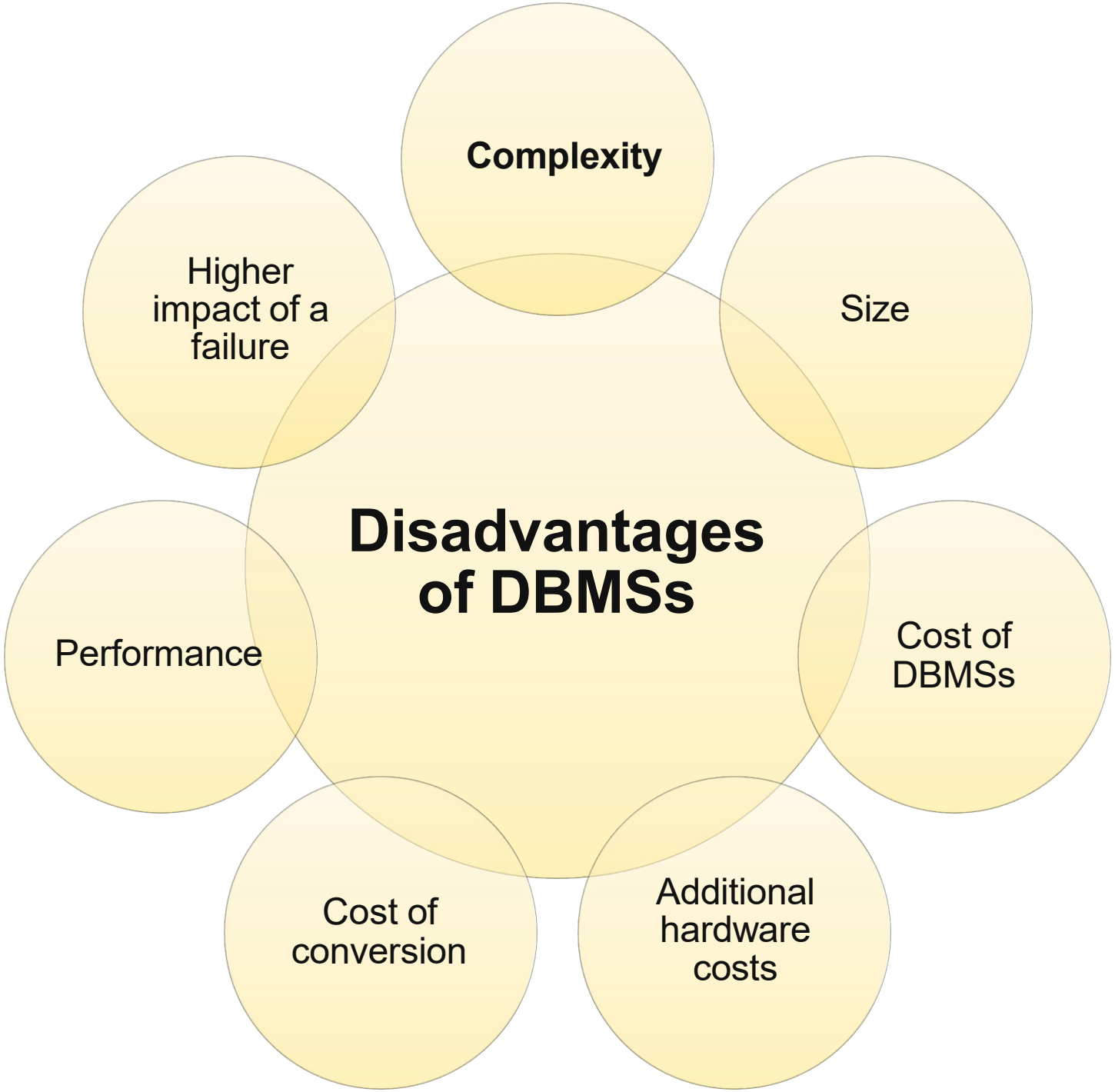
Naïve users are typically unaware of the DBMS. They access the database through specially written application programs that attempt to make the operations as simple as possible.

Sophisticated users. At the other end of the spectrum, the sophisticated end-user is familiar with the structure of the database and the facilities offered by the DBMS

History of Database Management Systems



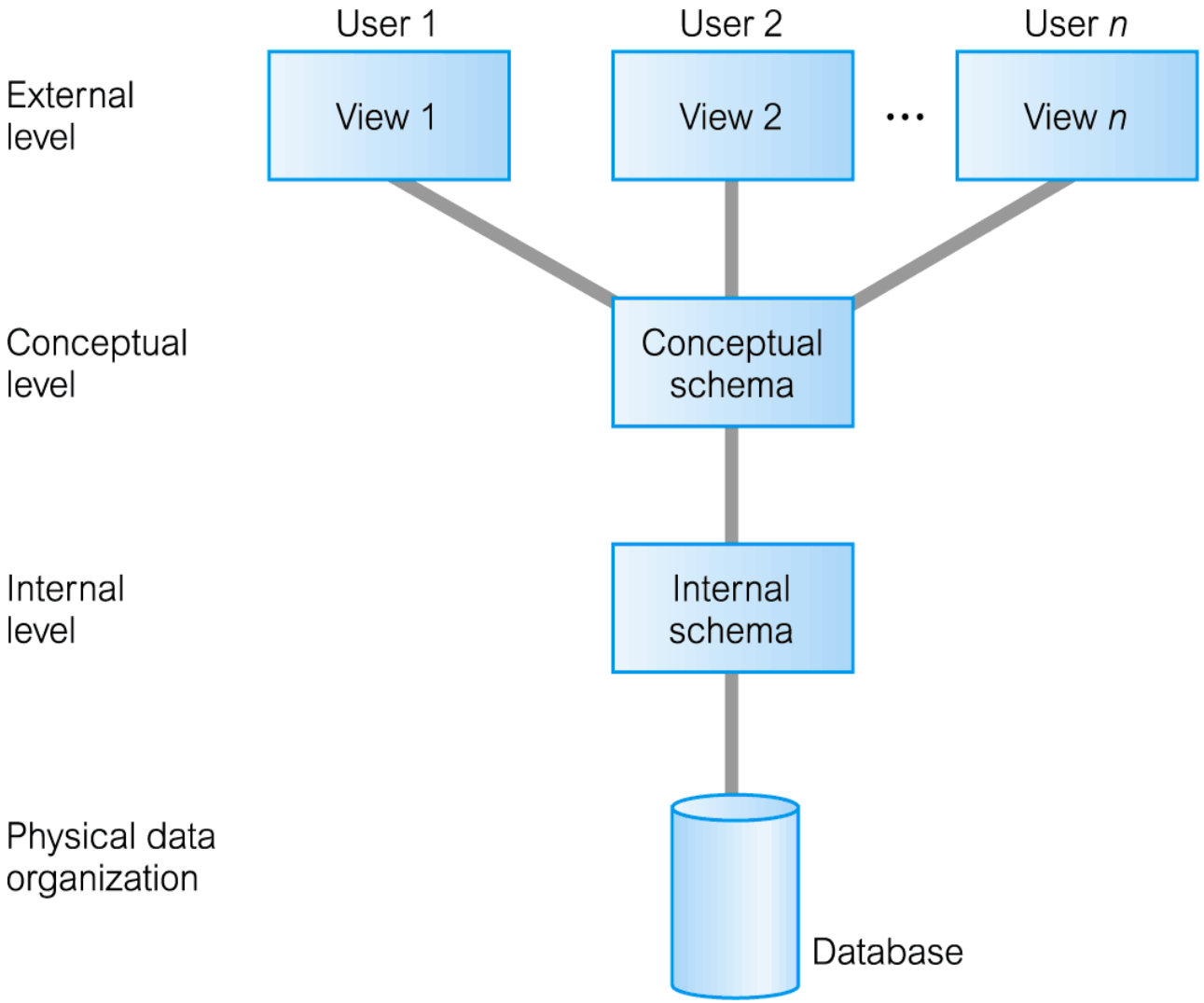

Advantages of DBMSs
Control of data redundancy
Data consistency
More information from the same amount of data
Sharing of data
Improved data integrity
Improved security
Enforcement of standards
Economy of scale
Balance of conflicting requirements
Improved data accessibility and responsiveness
Increased productivity
Improved maintenance through data independence
Increased concurrency
Improved backup and recovery services


Complexity
Size
Cost of DBMSs
Additional hardware costs
Cost of conversion
Performance
Higher impact of a failure
Disadvantages of DBMSs

The Three-Level ANSI-SPARC Architecture

- A major aim of a database system is to provide users with an abstract view of data, hiding certain details of how data is stored and manipulated.
- Design of a database must be an abstract and general description of the info requirements of the organization that is to be represented in the database.
- Each user wants a different view of data stored
- ANSI-SPARC architecture satisfies these needs

The Three-Level ANSI-SPARC Architecture



External level: The way users perceive the data. Describes that part of database that is relevant to a particular user.

Conceptual level: Provides both mapping and the desired independence between the external and internal levels. Community view of the database. Describes what data is stored in database and relationships among the data.

Internal level: The way the DBMS and the operating system perceive the data. Physical representation of the database on the computer. Describes how the data is stored in the database

Objectives of ANSI-SPARC Three Level Architecture

All users should be able to access same data but have different customized view of the data

A user's view is immune to changes made in other views.

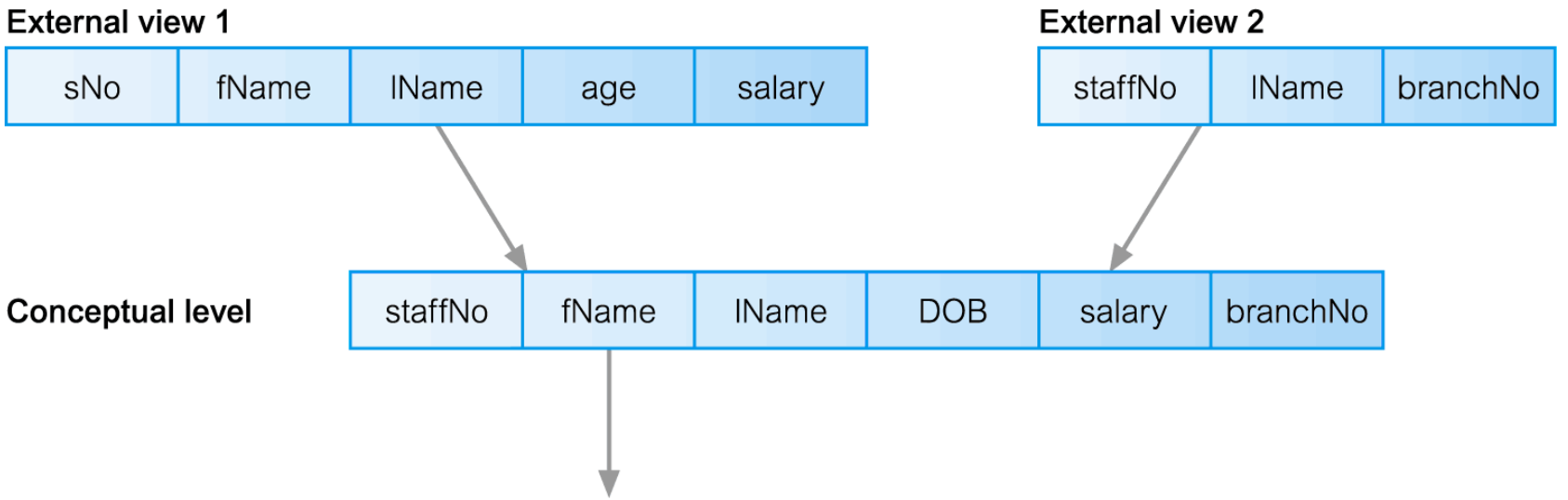
Users should not need to know physical database storage details.

DBA should be able to change database storage structures without affecting the users' views.

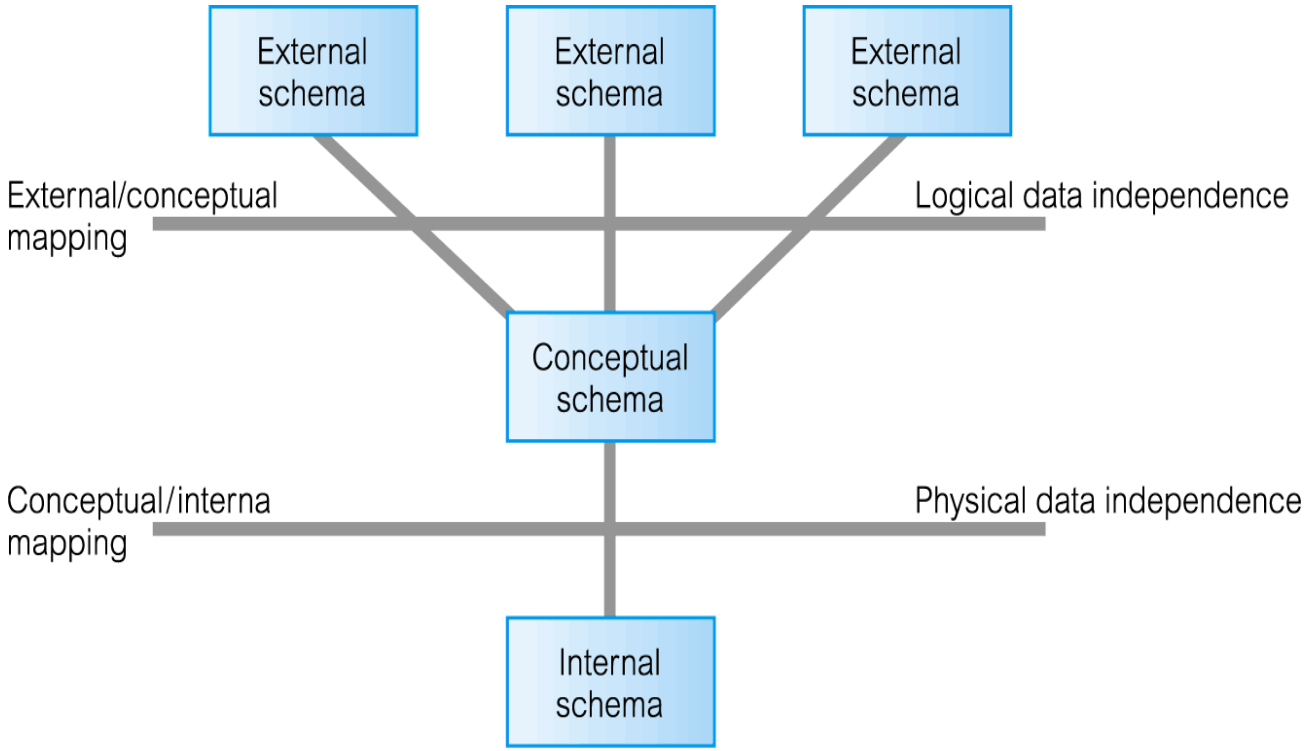
Internal structure of database should be unaffected by changes to physical aspects of storage.

DBA should be able to change conceptual structure of database without affecting all users.

Differences Between the Three Level ANSI-SPARC Architecture



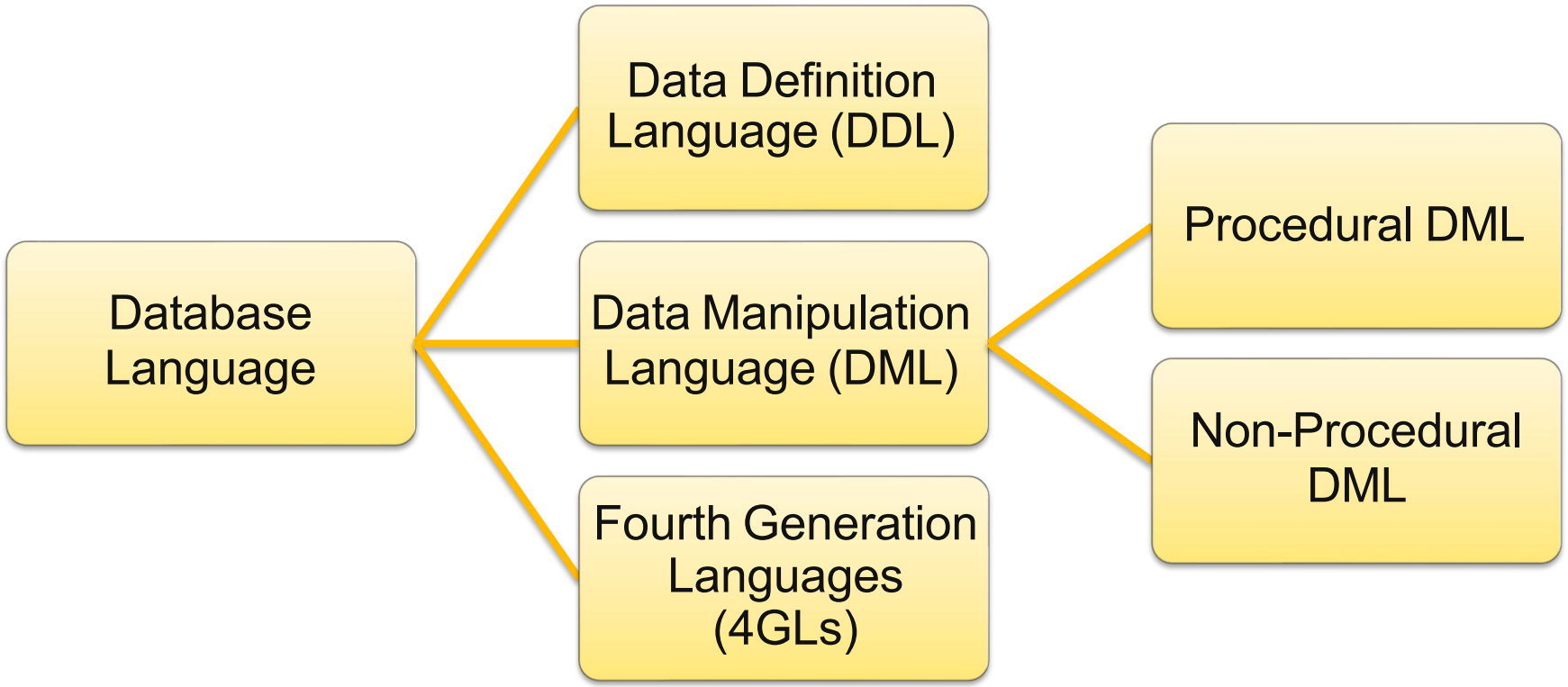
ANSI-SPARC Three Level Architecture-Data Independence



- Refers to immunity of external schemas to changes in conceptual schema.
- Conceptual schema changes (e.g., addition/removal of entities).
- Should not require changes to external schema or rewrites of application programs.

- Refers to immunity of conceptual schema to changes in the internal schema.
- Internal schema changes (e.g., using different file organizations, storage structures/devices).
- Should not require change to conceptual or external schemas.

Database Languages



Data Models & Conceptual Modelling

- Data Model: Integrated collection of concepts for describing data, relationships between data, and constraints on the data in an organization.

- Data Model comprises:
  - A structural part - set of rules
  - A manipulative part - types of operation that are allowed on the data
  - Possibly a set of integrity rules – to ensures that the data is accurate

Data Models & Conceptual Modelling

- Purpose: To represent data in an understandable way.
- Categories of data models include:
  - Object-based (Entity-Relationship, Semantic, Functional, Object-Oriented)
  - Record-based (Relational Data Model, Network Data Model, Hierarchical Data Model)
  - Physical Data Models: for internal data model

for external and conceptual data model

Data Models & Conceptual Modelling

- Conceptual schema is the core of a system supporting all user views
- Should be complete and accurate representation of an organization’s data requirements.
- Conceptual modeling is process of developing a model of information use that is independent of implementation details.
- Result is a conceptual data model.

Function of DBMS

- Data Storage, Retrieval, and Update.
- Authorization services
- A User-Accessible Catalogue.
- Support for data communication
- Transaction Support.
- Integrity services
- Concurrency control services
- Services to promote data independence
- Recovery services
- Utility services

References

- Thomas Connolly and Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation, and Management, 6th Edition, Pearson, 2015, ISBN: 978-01329432
- https://maxkanaskar.wordpress.com/tag/database-management-system/