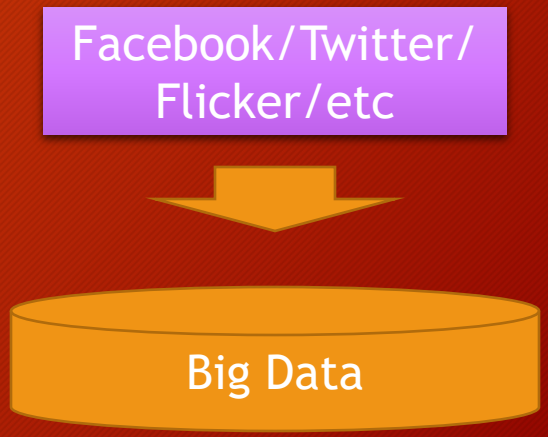
The Need for Databases

- **Databases** and **database systems** are an essential component of life in modern society
- Most of us encounter several activities every day that involve some interaction with a database:
- Adding post/comment to facebook.
- Making a tweet on Twitter!
- Buying from supermarket.
- Reserving a hotel room.
- Bank deposit/withdraw
- You name it!



The Need for Databases..2

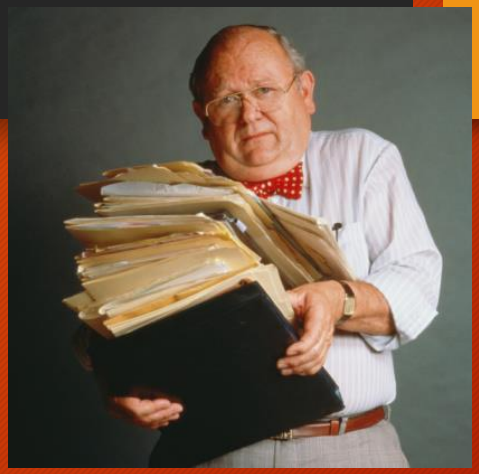
- **Multimedia Databases**: video, images, and sound data.
- **Geographical Databases**: Maps, weather, and satalite data.
- ***It is fair to say that databases play a critical role in almost all areas where computers are used, including business, electronic commerce, social media, engineering, medicine, genetics, law, education, and library science.***

The Need for Databases..2

- Storing and retrieving of **information** has been a necessity in all ages of business and organizations.
- For a business to be successful, a fast access to information is **vital**.
- Important decisions are based on the information being available at any time, and any place

The Need for Databases

- Traditionally, the data was stored in voluminous repositories such as:
  - Files
  - Books
  - Ledgers.
- However, storing data and retrieving information from these repositories was a time-consuming task.



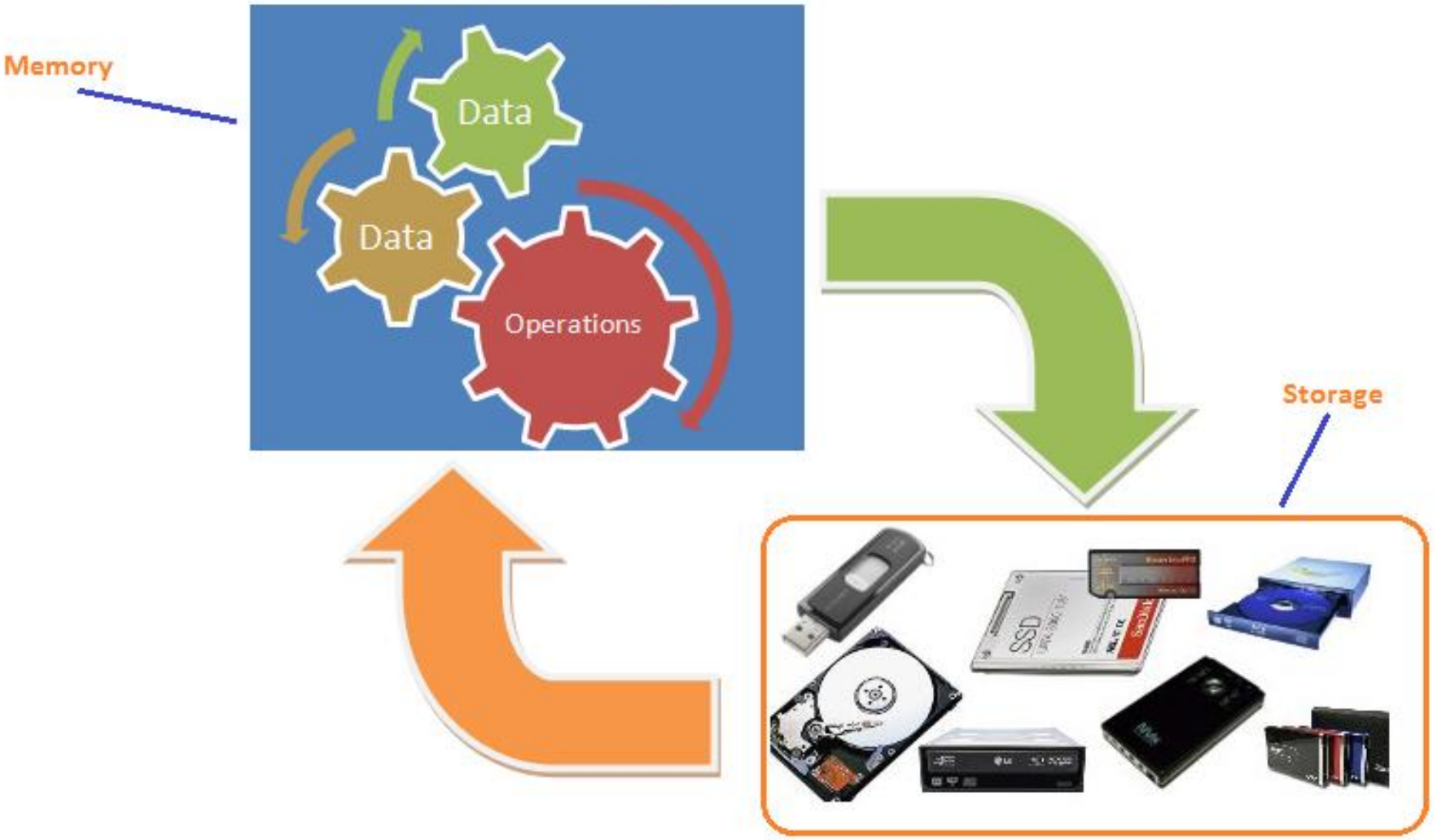
Problems of Manual Systems

- Time consuming
- Storage and Space
- Retrieval and Search
- Reports for Managers
- Security
- Availability
- Use your imagination

Rise of Databases

- With the development of computers, the problem of information storage and retrieval was resolved.
- Computers replaced tons of paper, fi le folders, and ledgers as the principal media for storing important information.
- Information can be accessed any time, anywhere

Data Processing



What is a Database?

- A database can be defined as a collection of related data from which users can efficiently retrieve the desired information.

- It could be as simple as phone book, or as complex as media and videos database to a GPS system.

Database Example

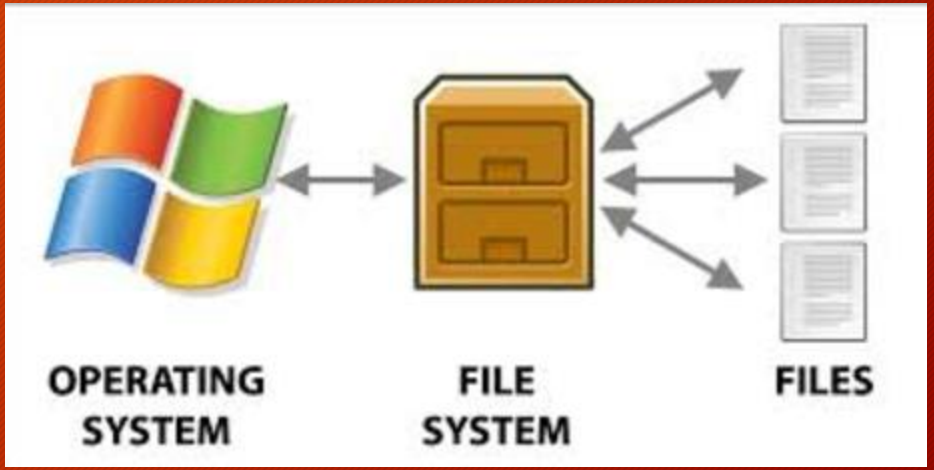
- Imagine a database for a university, it could have data about:
  - Entities such as
    - **Students**
    - **Teachers**
    - **Courses**
    - **Sections**
    - **Departments**
  - Relationships between entities:
    - Students **enroll** in courses and sections
    - Teachers **teach** courses
    - Students and Teachers **belong to** departments

DB History

- Hierarchal Databases…….early 60’s
- …
- Network Databases…..late 60’s
- And finally, someone “genius” came with the relational model.

So what is the problem of using files?

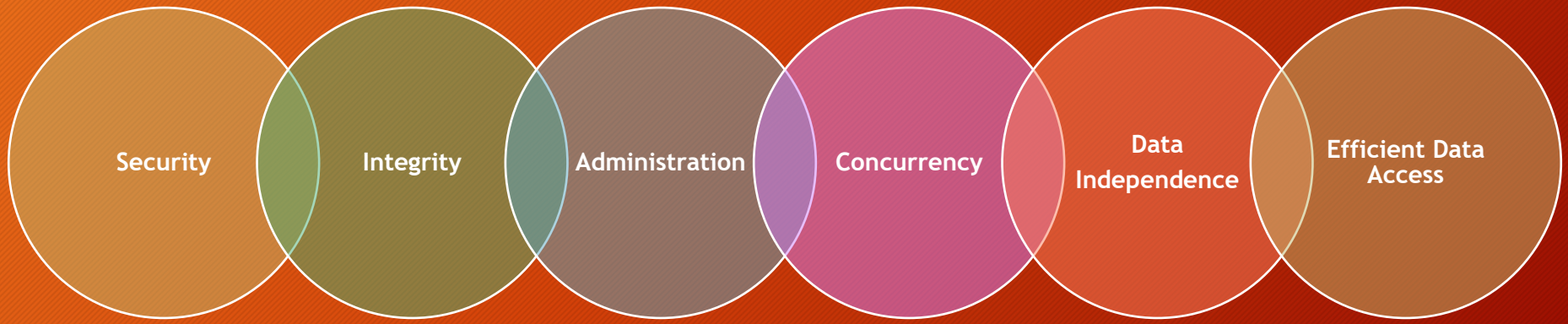
- You name it!!
- Main Memory
- You have to program every query the user may want
- Consistency
- Security
- Multi-user
- ….

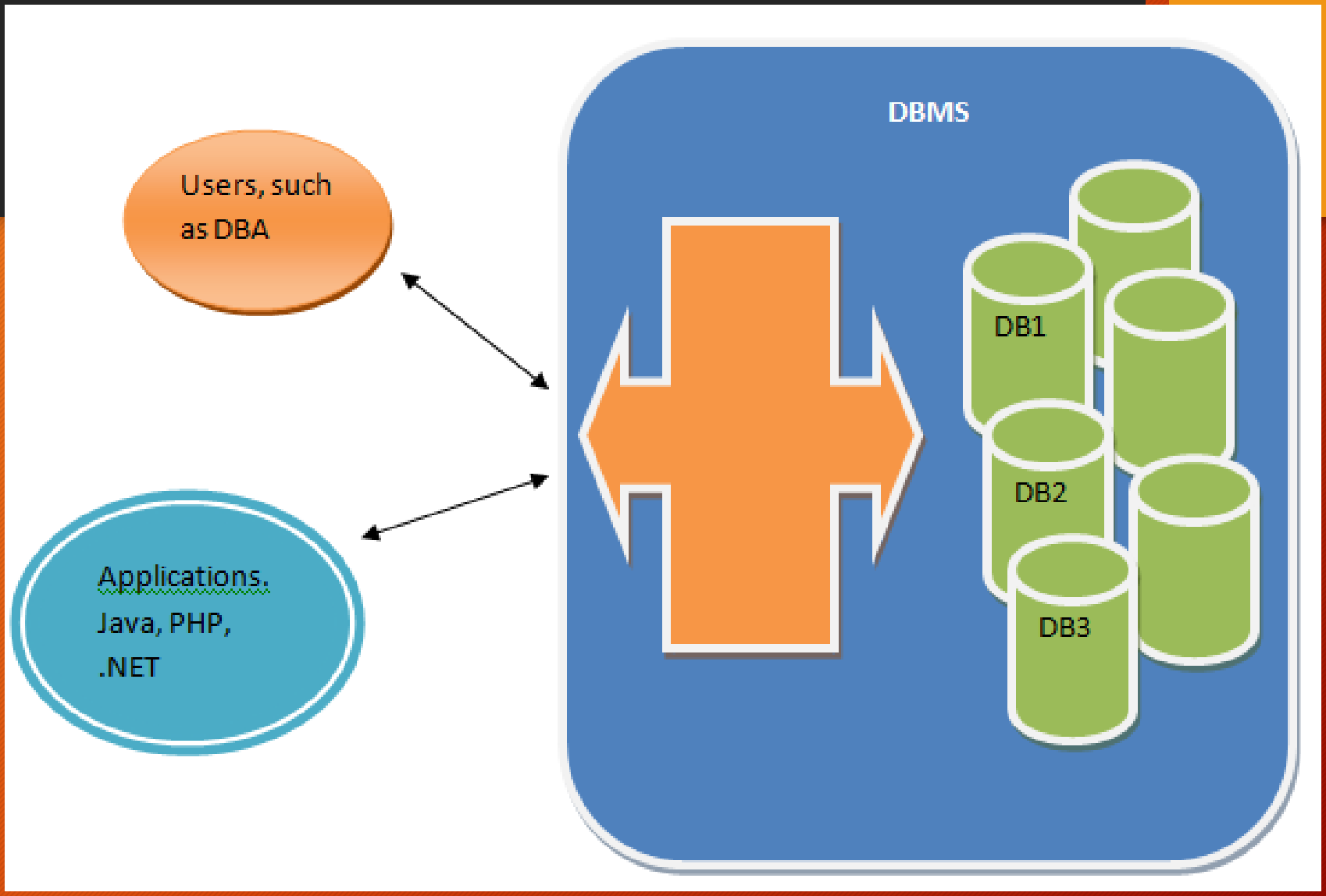


DBMS

- A Database Management System (DBMS) is an integrated set of programs used to create and maintain a database.
- They are very complex systems
- Examples:
  - Oracle
  - DB2
  - MySql
  - SQL SERVER
  - Sybase

Advantages of DBMS





When not to use DBMS

- Few well-defined operations.
- If the required data manipulation is not supported by DBMS, e.g. text data processing
- If the added benefits of a DBMS are not required.
- Access to data by multiple users is not required.
- Tight real-time constrain, specialized performance

DBMS users

- Designers and developers
- Administrators
- End-users

Describing and Using Data in DBMS

- Remember: a database of an enterprise, describes the data for that enterprise

- Data Model: *describes how data is stored and accessed in general.*
- **Example: Relational** data model

- ER Diagram: *describes the entities and the relationships between those entities*
- Schema: *description of data in terms of that data model*

Relational data model example

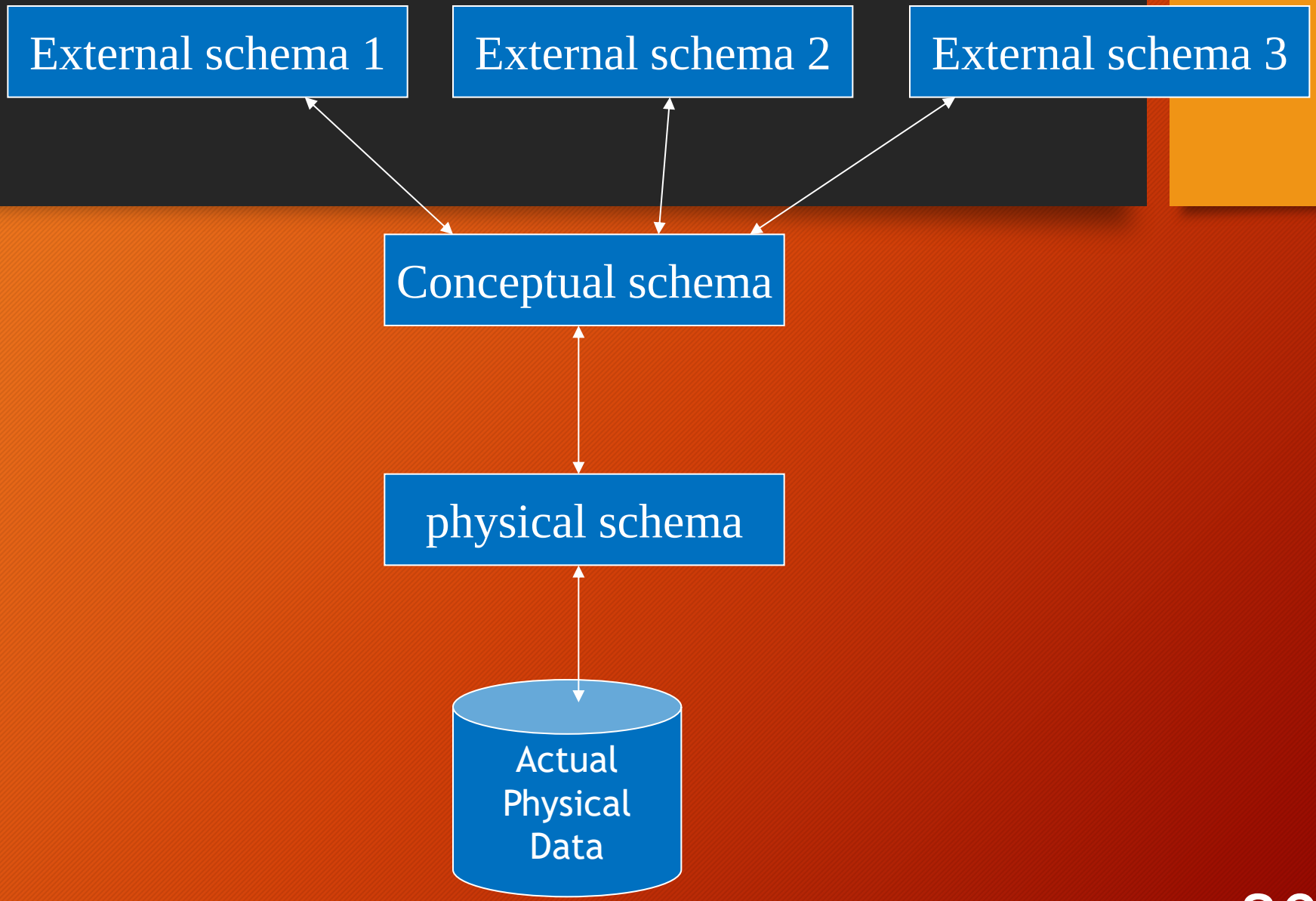
Students(*sid:* `string`, *name:* `string`, *login:* `string`, *age:* `integer`, *gpa:* `real`)

The preceding schema says that each record in the Students relation has five fields, with field names and types as indicated.[2] An example instance of the Students relation

sid	*name*	*login*	*age*	*gpa*
53666	Jones	jones@cs	18	3.4
53688	Smith	smith@ee	18	3.2
53650	Smith	smith@math	19	3.8
53831	Madayan	madayan@music	11	1.8
53832	Guldu	guldu@music	12	2.0

Levels of abstraction in a DBMS

- The data in a DBMS is described in 3 levels of abstraction
- There is a schema at each level
  - **External schema:** allows data access to be customized at the level of individuals or groups.
  - **Conceptual schema:** describes all relations that are stored in DB.
  - **Physical schema:** specifies how the relations with its records are actually stored on secondary storage devices.
- Information about the above schemas are found in the **system catalog**



sNo	fName	lName	age	Salary

empNo	lName	branchNo

Conceptual Level

Staff(stafNo: int, fName: String, lName: String, DOB: Date, salary: String, branchNo: int)

```
Struct staff{
    int staffNo,
    int branchNo,
    char fName[15]
    ....
```

Conceptual schema

- Describes the stored data in terms of data model (relational)

- In a relational data model it describes all relations
- Entities and relationships

- Example in the book
- Note that it hides physical storage details
- We will see that in MySql

Example Conceptual Schema

Students(*sid:* string, *name:* string, *login:* string,
age: integer, *gpa:* real)
Faculty(*fid:* string, *fname:* string, *sal:* real)
Courses(*cid:* string, *cname:* string, *credits:* integer)
Rooms(*rno:* integer, *address:* string, *capacity:* integer)
Enrolled(*sid:* string, *cid:* string, *grade:* string)
Teaches(*fid:* string, *cid:* string)
Meets_In(*cid:* string, *rno:* integer, *time:* string)

Other levels

- **External level:**
  - Based on **views**
- **Physical level**
  - Concerned with how exactly the data is stored in files on storage medium

Data Independence

- Application programs are insulated from changes in the way the data is structured and stored.
- **Logical data independence**
- …
- **Physical data independence**

Queries in DBMS

1. What is the name of the student with student id 123456?
2. What is the average salary of professors who teach the course with cid CS564?
3. How many students are enrolled in course CS564?
4. What fraction of students in course CS564 received a grade better than B?
5. Is any student with a GPA less than 3.0 enrolled in course CS564?

Querying DBMS

- DBMS Supports **a Query Language,** such as
  - Relational Calculus
  - Relational Algebra
- Also Supports SQL
  - DDL
  - DML

HW #1

- DB Administrator.
- What are the responsibility of the DB Admin?