UNIVERSITY OF MINES AND TECHNOLOGY

DATABASE SYSTEMS

DR ERIC AFFUM

COURSE DESIGN

- **Course Code: CE, CY ,IS 170 Credits:** (1,2,2)
- **Prerequisites: Fundamentals of computer Science**
- **References :**

i. *Coronel, C. and Morris, S. (2018), Database Systems: Design, Implementation, & Management, Cengage Learning, Boston, U.S.A., 13th Edition, 816 pp.*

ii. Gupta, S. B. and Mittal, A. (2017), Introduction to Database Management System, Laxmi Publications Pvt Ltd, New Delhi, India, 2nd Edition, 288 pp.

iii. Elmasri, R. (2017), Fundamentals of Database Systems, Pearson, London, U.K., 7th Edition, 1280 pp.

iv. Masood-Al-Farooq, B. A. (2014), SQL Server 2014 Development Essentials, Packt Publishing, Birmingham, U.K., 1st Edition, 214 pp.

EVALUATION METHODS

- Assignments
- Labs
- Quizzes

30 marks

- Attendance

10 marks

- Final Exam

60 marks

COURSE OUTLINE

- Fundamental Database Concepts
- Entity Relationship (ER) Model
- Relational Data Model
- Relations
- Integrity Constraints
- Normalization Theory

COURSE OUTLINE

- Logical Database Design
- Database language SQL
- Querying and Manipulating Data using SQL
- Transaction Management
- Concurrency Control

Advice

- **Textbook** – *Read BEFORE corresponding lecture*
- **Homework** – *Completed in study groups*
  - Will reinforce in-class coverage
  - Will help you prepare for midterm exams
- **Study Groups**
  - Groups of 3, should meet weekly, learn from each other
  - Review material, complete homework assignments
  - Each submitted homework should include consensus-based statement of work

Fundamental Database Concepts

Presentation Outline

- Basic Definitions
- Benefits Database
- Types of databases
- Database Management Systems
- Database Architecture

Presentation Outline

- Properties of Database
- A simplified database System Environment
- Examples of university Database

DATABASE SYSTEMS

Read the following materials

CHAPTER 1

Gupta, S. B. and Mittal, A. (2017), Introduction to Database Management System, Laxmi Publications Pvt Ltd, New Delhi, India, 2nd Edition, 288 pp.

CHAPTER 1 & 2

Elmasri, R. (2017), Fundamentals of Database Systems, Pearson, London, U.K., 7th Edition, 1280 pp.

Database

The traditional approach of storing data (flat file) poses the following problems:

- Data redundancy and inconsistency
- Program-data dependence
- Lack of flexibility
- Poor security/ integrity problem
- Limited data sharing and accessing data
- Atomicity problem
- Concurrent access anomalies

Flat File System

Staff ID	Name	Department	Salary
100	Tom Ofori	Human Resource	20000
101	Alice Agyei	Human Resource	21000
102	Oscar Apo	IT	13000
103	Bob King	Cyber Security	23000
104	Dan Yeboah	Information System	20000
105	Bingo Max	Computer Engineering	22000
106	Dan Lee	Mining Engineering	19000

Flat File System

Inconsistency

Integrity

Redundancy

Staff ID	Name	Department	Salary
100	Tom Ofori	HR	0
100	Alice Agyei	Human Resource	21000
102	Oscar Apo	IT	13000
103	Bob King	Cyber Security	23000
104	Dan Yeboah	Information System	20000
105	Bingo Max	Computer Engineering	22000
106	Dan Lee	Mining Engineering	19000

Flat file system

Limited data sharing and accessing data

Staff ID	Name	Department	Salary
100	Tom Ofori	Human Resource	20000
101	Alice Agyei	Human Resource	21000
102	Oscar Apo	IT	13000
103	Bob King	Cyber Security	23000
104	Dan Yeboah	Information System	22000
105	Bingo Max	Computer Engineering	30000
106	Dan Lee	Mining Engineering	39000

What about if we want to access all the salaries greater than 20000 but less than 30000 and share it with the school management?

Database System

A database is a collection of information that is organized so that it can easily be accessed, managed, and updated.

Databases are designed to store data, provide organizational structure for data and a mechanism for efficient querying, modifying, creating and deleting data.

Definitions

Data: Raw, unprocessed facts

Example: Tom, 20, Accra

Information: Processed data

Example: The age of Tom is 20

Database: Collection of related data

Example: Online banking system, School management system

Hierarchy of Database

- Bit: Smallest unit of data; binary digit (0, 1)
- Byte: Group of bits that represents a single character (8 bits= 1 byte)
- Field: Group of related bytes - related words or complete number
- Record: Group of related fields
- File: Group of records of same type
- Database: Group of related files

Benefits of Database

The benefits of databases include:

- Data can be shared easily
- Redundancy can be reduced
- Inconsistency can be avoided
- Data integrity can be maintained
- Security can be enforced

Database Users

Database users include:

- Naïve Users: They interact with the database
- Specialized Users: Use query language to request data
- Application Programmers: Write the application programs
- Database Administrators: Have central control over the database

Properties of Database

Properties of database include:

- A Database represents some aspect of the real world (Mini world)
- A Database is a logically coherent of data with some inherent meaning
- A database is design, built and populated with data for specific purpose

Types of Databases

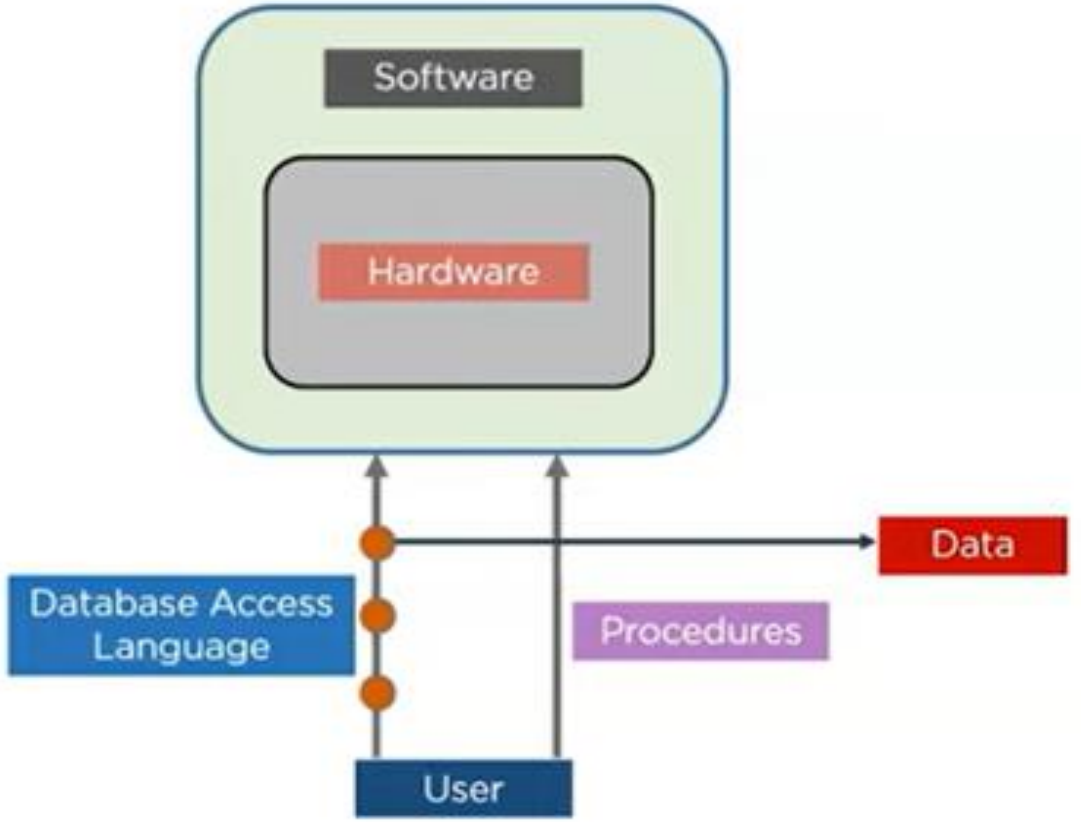
Basically databases can be grouped into two:

- On-Line Analytical Databases (OLAP): rarely updated
  - ✓for reporting, decision making, and planning
  - ✓mostly SELECT command is used for reporting
  - ✓Complex query processing
- On-Line Operational Databases (OLTP): often updated
  - ✓Data is recorded in real time
  - ✓Fast processing because queries are simple

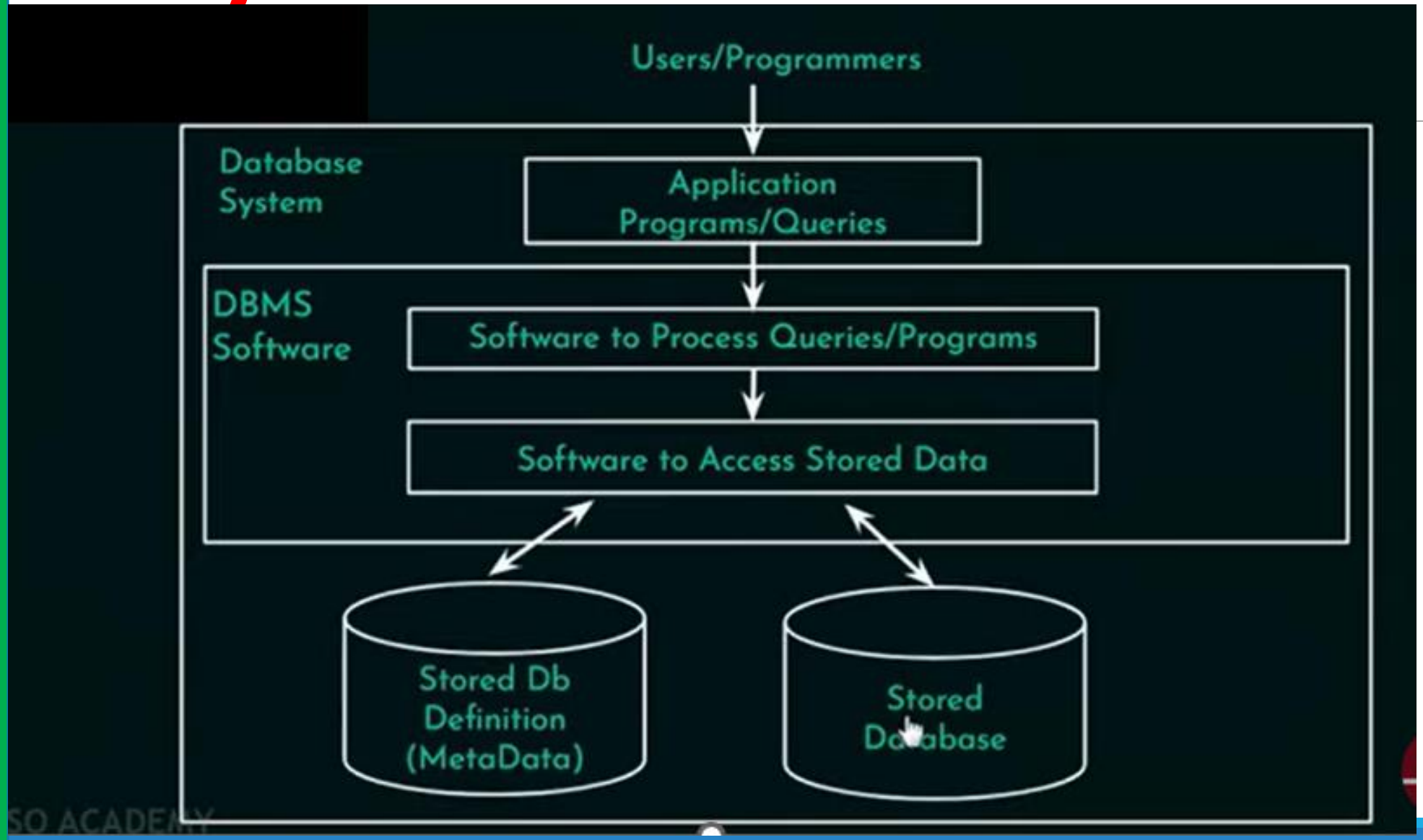
Database System

The database system consists of the following components

- ✓Hardware
- ✓Software
- ✓Data
- ✓Procedures
- ✓People



DB System Environment



Examples of University Database

STUDENT	Name	Roll_No	Class	Major
	Smith	17	1	CS
	Brown	8	2	CS

COURSE	CourseName	CourseNo	Dept
	Data Structures	CS1310	CS
	Discrete Mathematics	MATH2410	MATH
	Database	CS380	CS

GRADE_REPORT	Roll_No	CourseNo	Grade
	17	MATH2410	B
	17	CS1310	A
	8	CS1310	A

A Database that stores student and course information

Database Management Systems

- A software system that enables users to define, create, maintain, and control access to the database
- Group of programs (software) to maintain database
- It provide interface between user and database

- **Manipulate**
  - Insert
  - Update
  - Delete
  - View
  - backup

Database Management Systems

A DBMS: A collection of program that enable users to create and maintain database

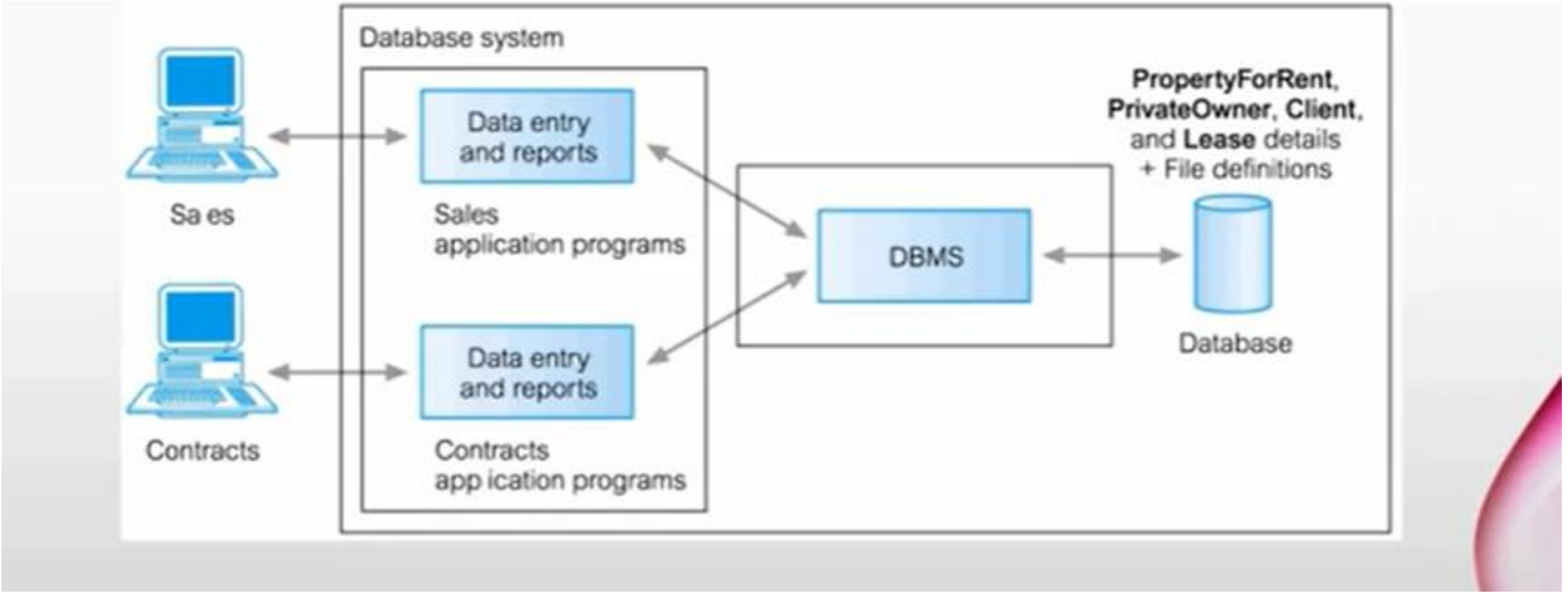
A DBMS is software used to manage the structure, elements and data within a database.

A DBMS is responsible for providing user-friendly access and controls between end user and database.

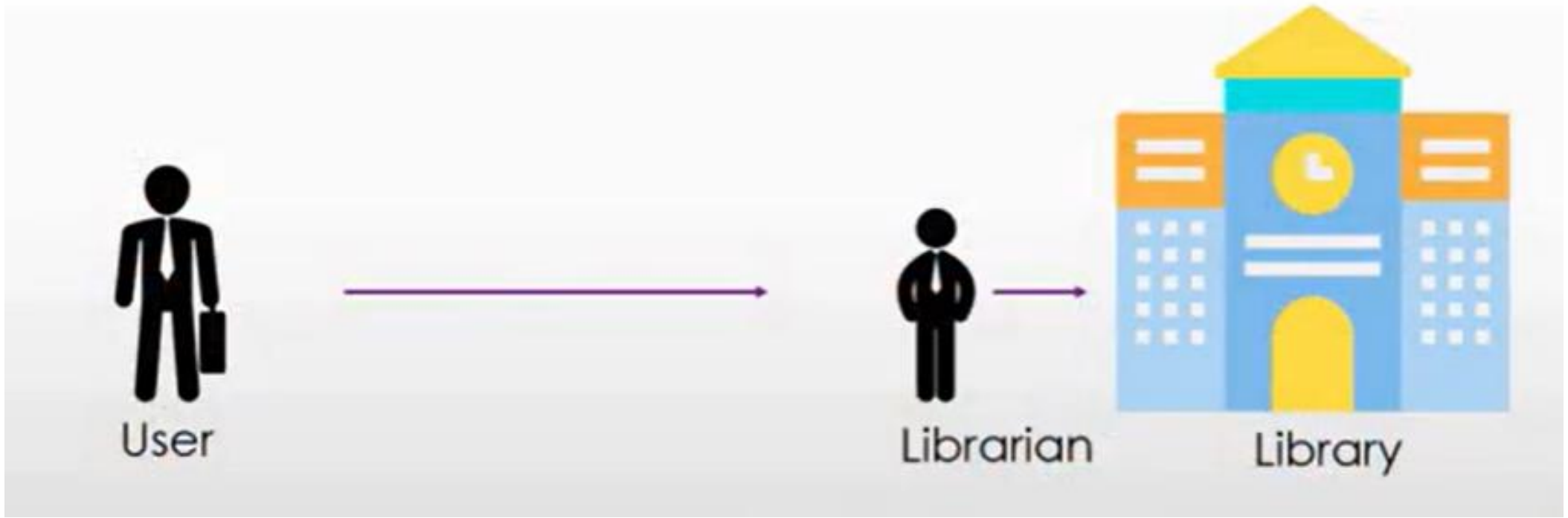
A program that makes it easy for you to manipulate large amounts of data.

Database Management Systems

EXAMPLE



Database Management System



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Database Management System

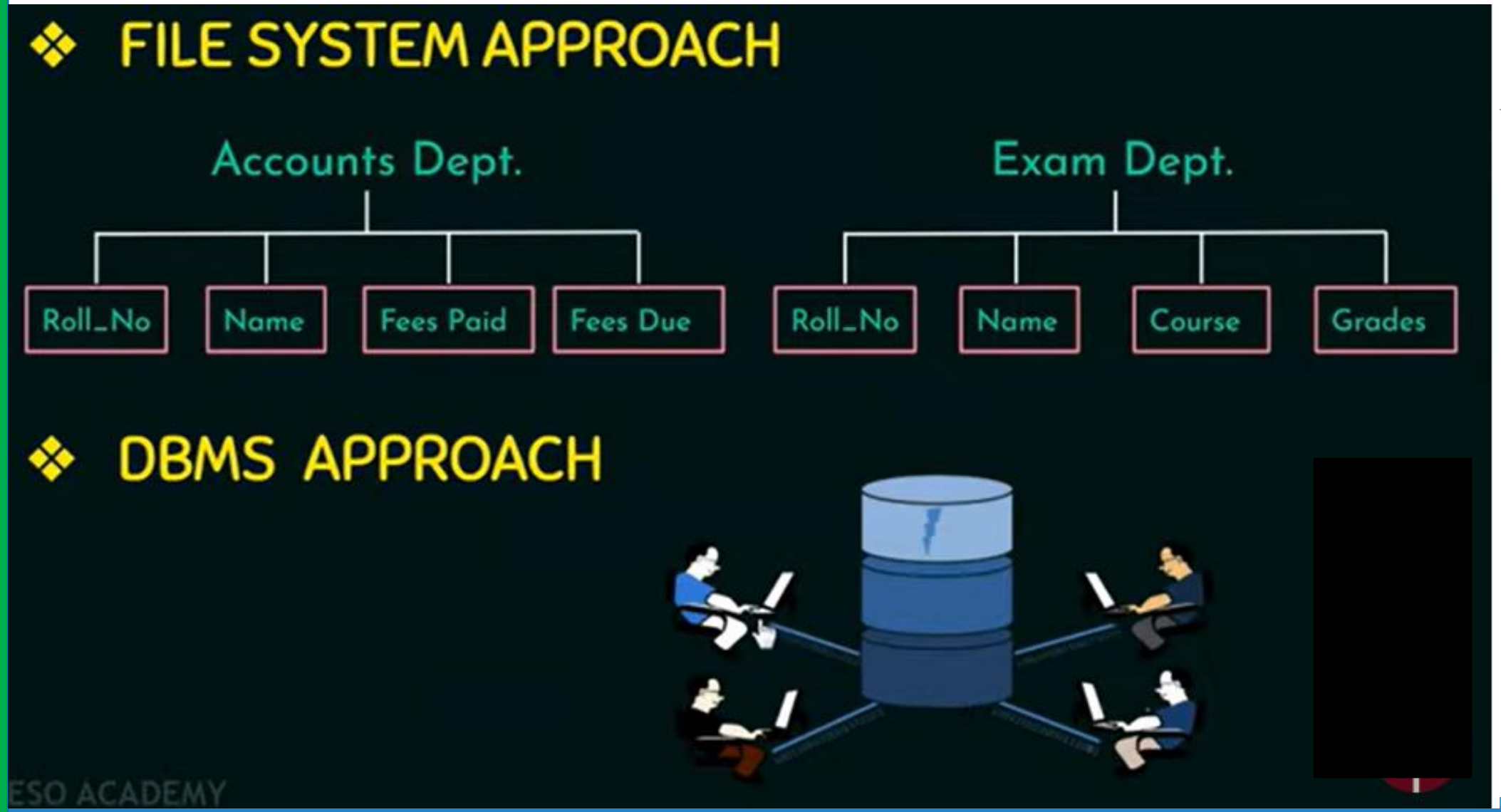
Database Management System

Functions of DBMS

The functions of DBMS include:

- Database creation
- Retrieval (query and reporting)
- Update (Manipulation)
- Database revision and restructuring
- Database integrity control
- Performance Monitoring

File system and DBMS approach



Characteristics of DBMS Approach

- ❖ Self-Describing nature of database system
  - Database system: Database + meter-data.
  - Metadata stores in DBMS catalog Used by DBMS software and Database users
  - Works with different number of applications
- ❖ Insulation between programs and data and data abstraction
- ❖ Support of multiple views of the data
- ❖ Sharing of Data and Multiuser Transaction Processing

Database Model

A **database model** is the theoretical foundation of a database and fundamentally determines in which manner data can be stored, organized, and manipulated in a database system.

The structure or format of storing data in the database

It thereby defines the infrastructure offered by a particular database system.

Types of Database Models

How to organize data?

Different database models include:

- Hierarchical model
- Network model
- Relational model
- Object-oriented model

Types of Database Models

Hierarchical Model

- Data is organised in tree like structure
- Data entities has one to many relationship

Network Model

- Data is organised in a graph like structure
- Data entities has one to one or many to many relationship

Relational Model

- Data is organised in two dimensional tables using rows and columns
- Stored in fixed structures and updated using SQL

Object Oriented Model

- Data is stored in the form of objects
- It is a combination of relational database features and OOPS concepts

Basic Concepts

An Entity refers to a specific theme, concept or business in a database.

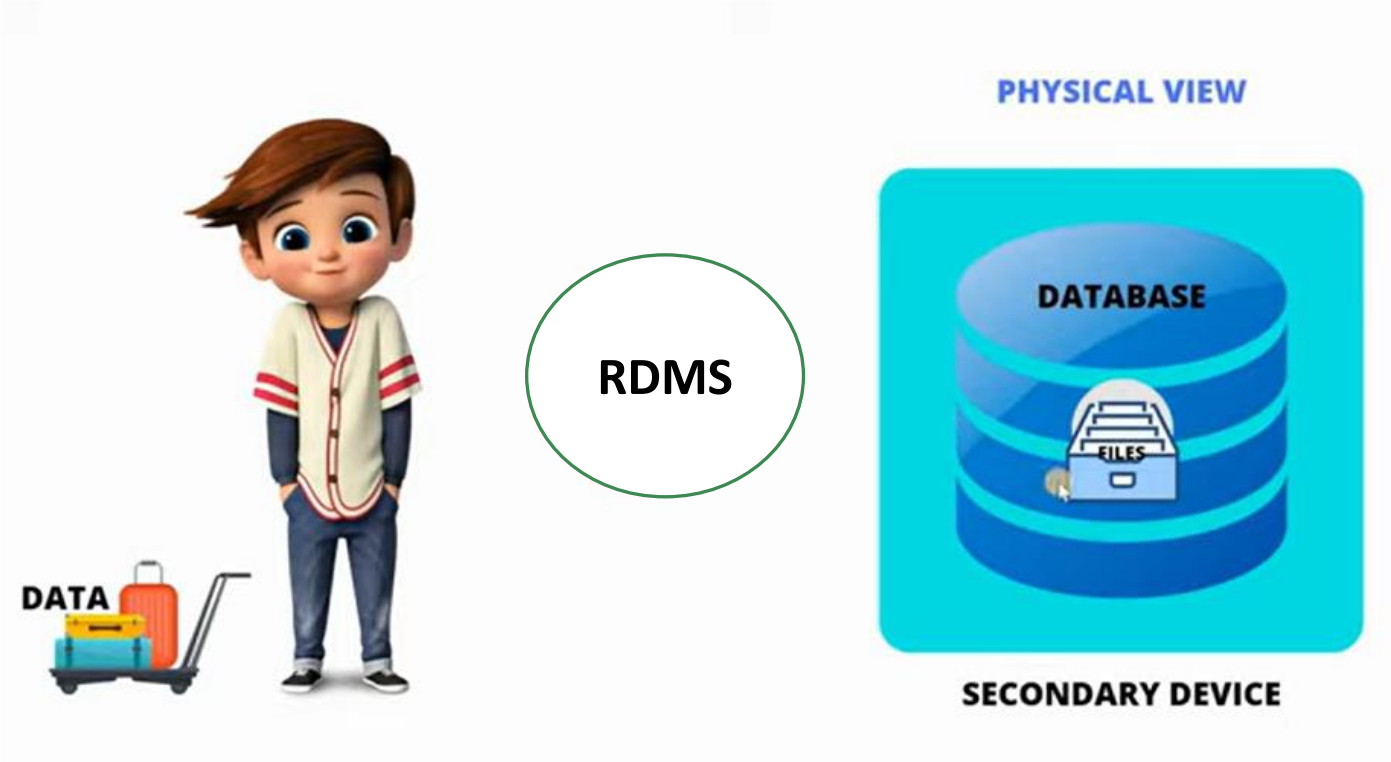
Database can be modeled as:

- A collection of entities
- Relationship among entities
- And their attributes

Relational Database Management System

RDBMS is DBMS based of relational models

RMBMS helps create and maintain relational databases.



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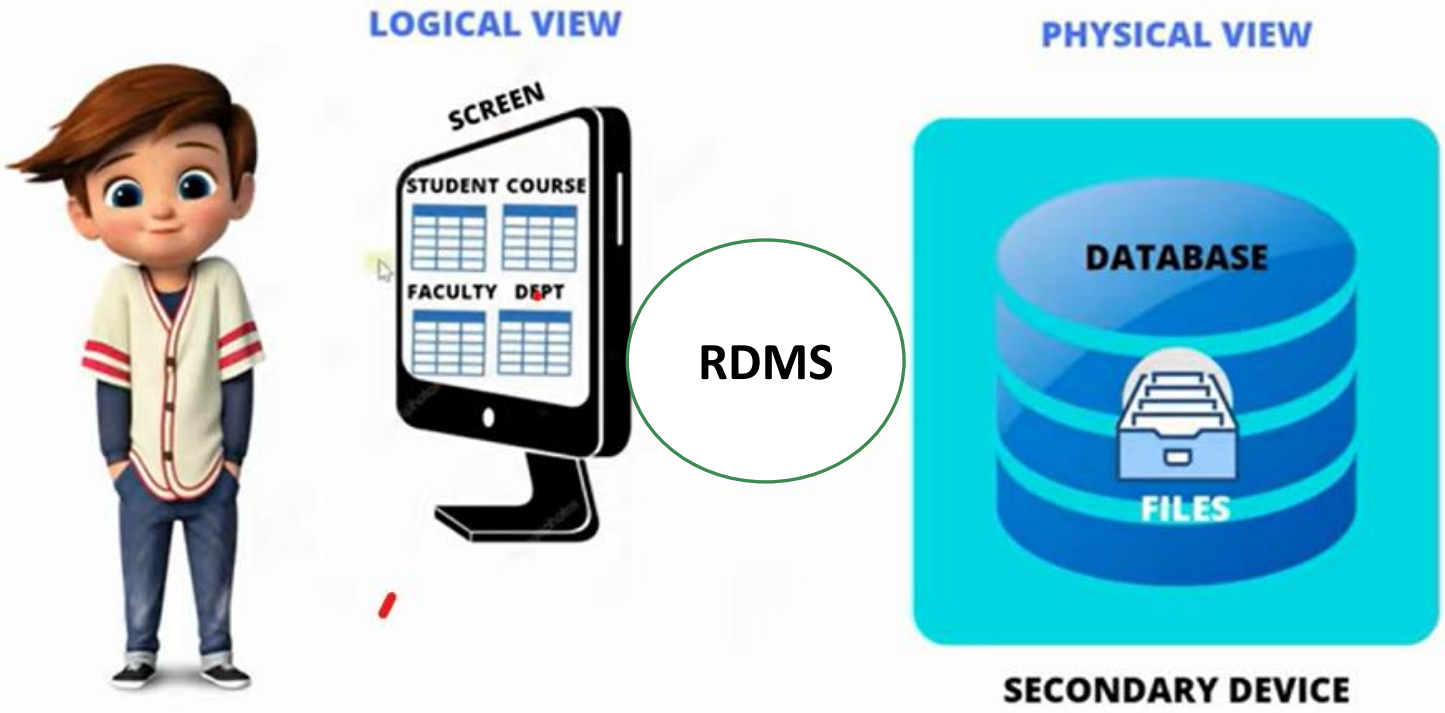

Relational Database Management System

RDBMS is DBMS based of relational models

RMBMS helps create and maintain relational databases.

There are 3 important elements in a RDBMS environment:

- Field/Column/Attribute
- Record/Row/Tuple
- Keys(Primary key, Foreign key)

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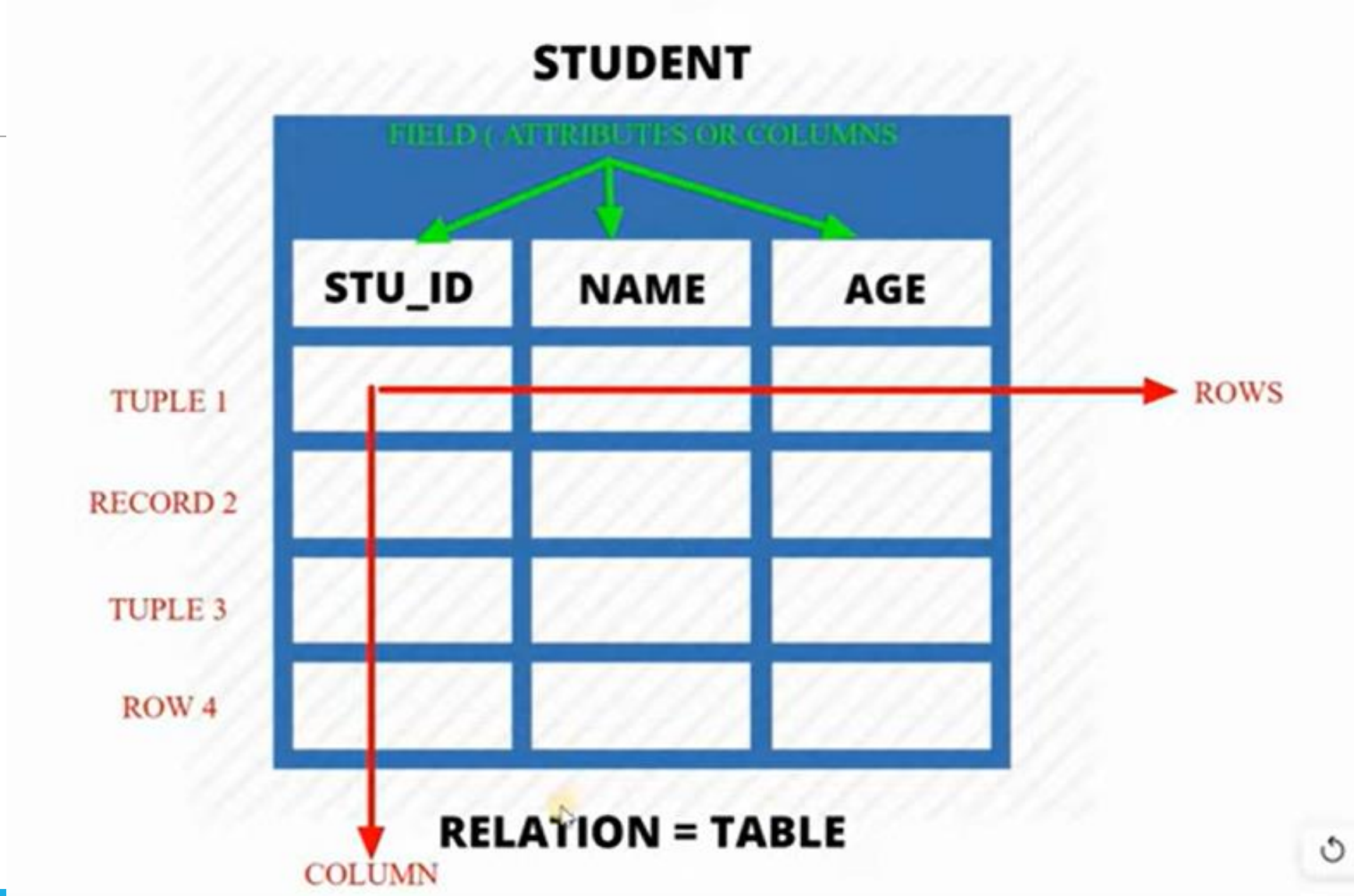
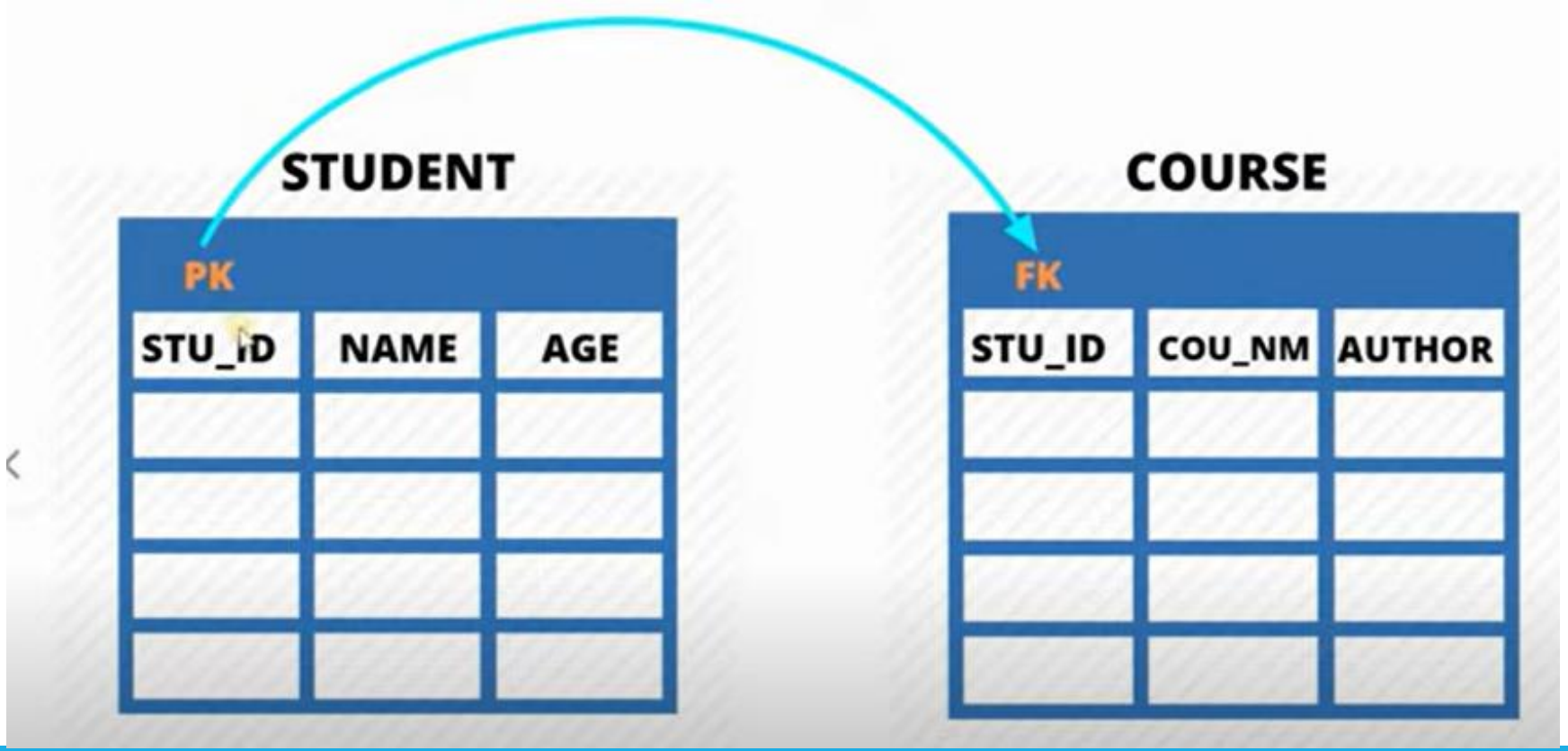
Relational Database Management System



Relational Database Management System

- Keys(Primary key, Foreign key)



Properties of Relational Tables

Properties of relational tables include:

- Values are Atomic
- Each Row is Unique
- Each Row is an instance of the Entity
- Column Values are of the Same Kind
- Each Column has a Unique Name
- Row and column order are not important

DBMS and RDBMS

DBMS

Interface between User and Database and to Organize data in the database.

There are many way s to organize data

Examples of DBMS software

dBase, MS Access, LibreOffice Base, FoxPro

RDBMS

Interface between User and Database

RBDMS is a type of DBMS that is based on relational model

Examples of RDBMS Software

SQL Server, Oracle, SQLite, MySQL, Maria DB

Thanks