



# Introduction to Database Concepts

DR. MOHAMMED A. MOHAMMED

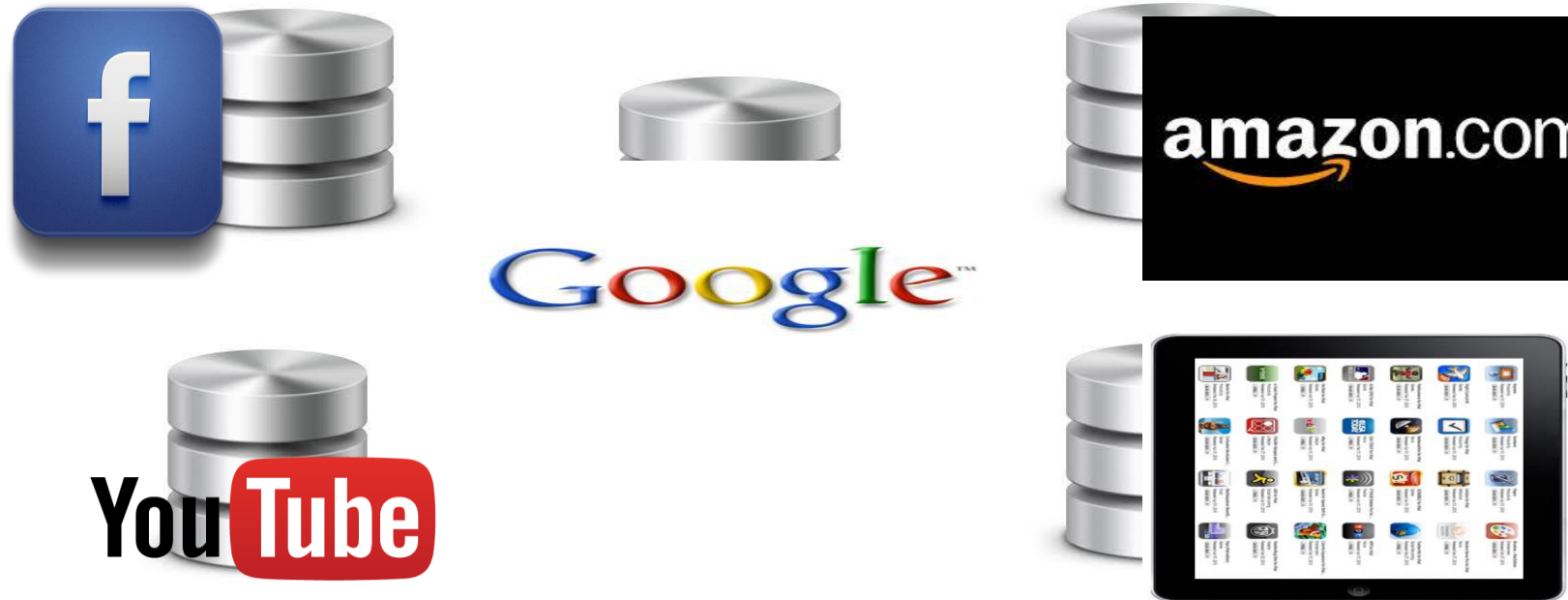
UNIVERSITY OF SULAIMANI | COLLEGE OF SCIENCE | COMPUTER DEPT.

2024 - 2025

# Introduction

- **What is Database (DB)**
- ▶ **Database** is an organized collection of information. It is organized in such a way as to enable easy, optimized storage and use (adding, updating, and searching of data) of large quantities of information.
- A database, through its DBMS, enables data to be made available to users for viewing, entry of new data, or updating of existing data, while protecting the rights of those same users.

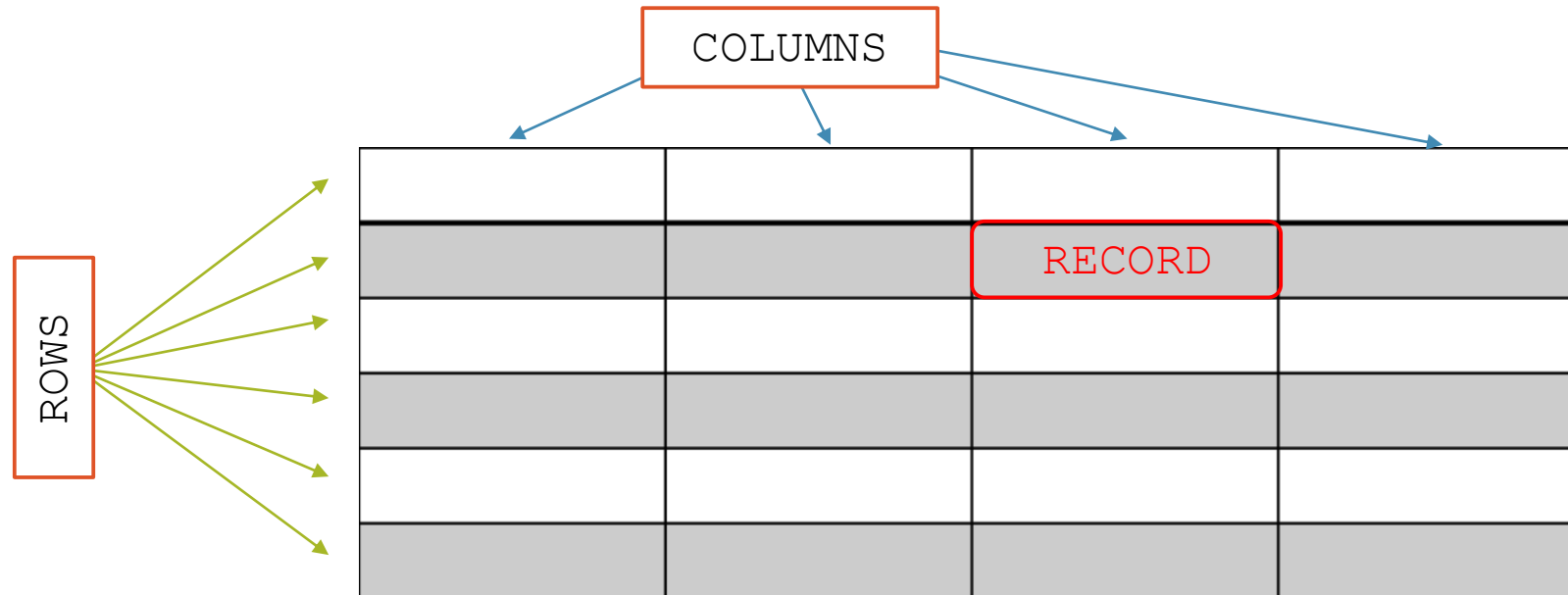
# Where are databases?



- ▶ Databases are everywhere
- ▶ which you never see them
- ▶ They are hidden behind tools and services which you uses every day

# Common DB Structure

- Databases are organized, they have structure.



Relational Database Structure

# Advantages of using database

## 1. Transaction support

- ✓ Atomic transactions guarantee complete failure or success of an operation.

## 2. Snapshots

- ✓ Snapshot is a point-in-time copy/view of the data.
- ✓ Snapshot is implicitly created at the start of every transaction.
- ✓ Snapshots are needed for backup applications.

## 3. Fast Indexing

- ✓ This helps fast retrieval of data, based on the indexed attribute.

FC-R-RST  
عريف  
مواصفات، بالهبة في الساهو

# Advantages of using database (Cont.)

## 4. Clustering

- ✓ Is the ability of several servers or instances to connect to a single database.
- ✓ An instance is the collection of memory and processes that interacts with a database.

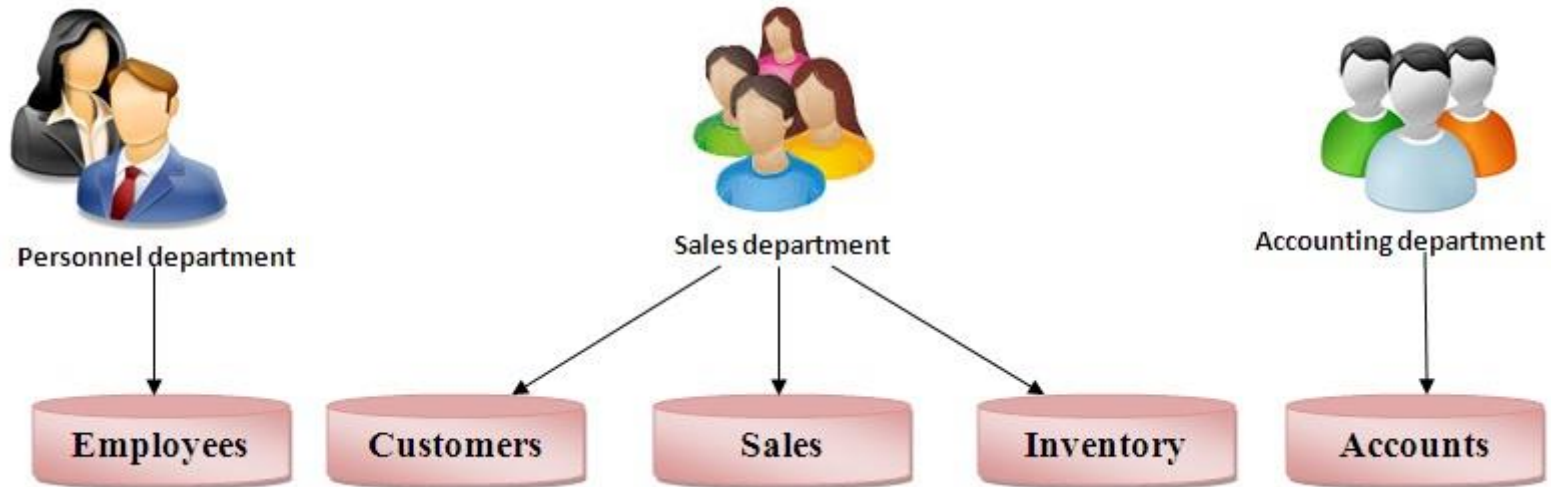
## 5. Replication

- ✓ Is the process of copying and maintaining database objects in multiple databases that make up a distributed database system.

## 6. Relational view of data

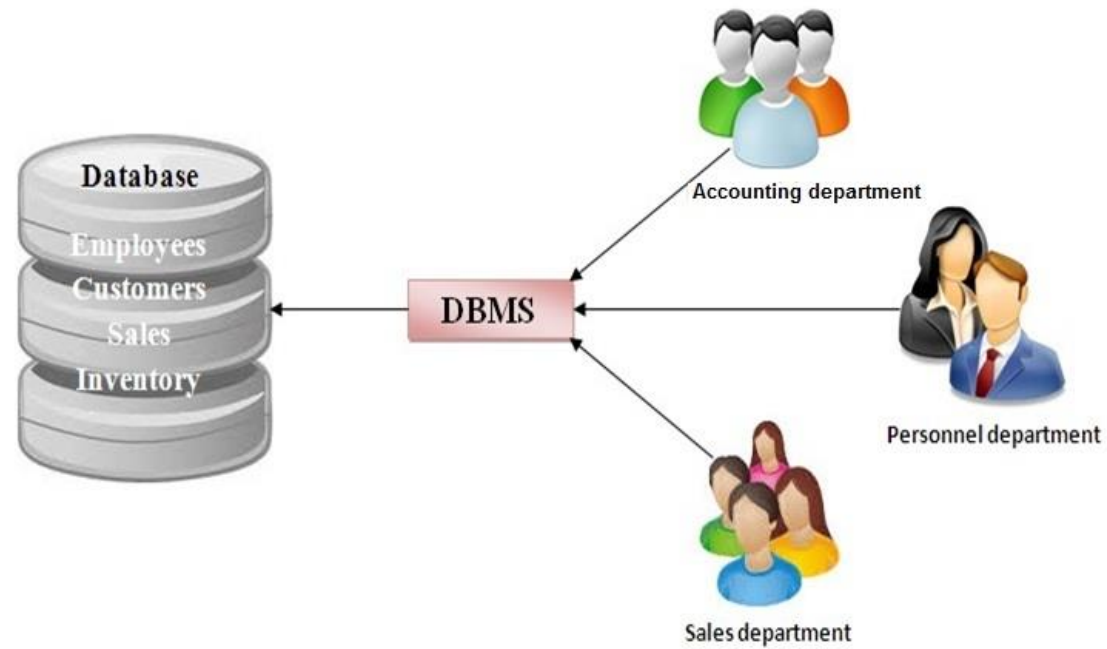
- ✓ In database data can be related in an easy way.
- ✓ Structured Query Language (SQL) is an easy way to retrieve data.

# Database vs. File System



File System

# Database vs. File System



## Database System



# Database Management System (DBMS)

- What is **Database management System(DBMS)**?

It is a software package designed to store and manage databases.

- MS ACCESS
- MYSQL
- MS SQL SERVER
- ORACLE
- PostgreSQL

# Advantages of using DBMS

## 1. Data independence

مفرد

- ✓ Applications are insulated from changes in the way the data are structured and stored.

## 2. Efficient data access

مفرد

- ✓ Sophisticated techniques to store and retrieve data efficiently.

## 3. Reduced application development time

- ✓ Supports functions common to many applications.

## 4. Data integrity and security



- ✓ Enforces integrity constraints (e.g., the department budget is not exceeded when a new salary is inserted).
- ✓ Enforces access controls for different classes of users.

RED-C-RWD

# Advantages of using DBMS (Cont.)

## 5. Uniform data administration

- ✓ Database administrators have the knowledge to minimize data redundancy and fine tune the database to make retrieval efficient.

## 6. Concurrent access

- ✓ Multiple users can access the database concurrently.

## 7. Recovery from crashes

- ✓ Protect the users from the effects of system failures.

# Our used DBMS (Oracle Database 10g Express Edition)

The screenshot shows a web browser window with the title "Application Express Login". The address bar displays the URL "127.0.0.1:8080/apex/f?p=4550:11:722245731681302::NO::". The page header includes the Oracle logo and the text "Database Express Edition". Below the header, there is a "Database Login" section with the instruction "Enter your database username and password." and two input fields: "Username" with the value "system" and "Password" with masked characters. A "Login" button is positioned below the password field. A link "Click here to learn how to get started" is located below the login fields. To the right, a "Links" section contains a list of links: "License Agreement", "Documentation", "Forum Registration", "Discussion Forum", and "Product Page". The footer of the page shows "Language: en-us" on the left and "Application Express Copyright © 1999, 2006, Oracle. All rights reserved." on the right.

Firefox Application Express Login

127.0.0.1:8080/apex/f?p=4550:11:722245731681302::NO::

Most Visited Getting Started Suggested Sites Web Slice Gallery

ORACLE Database Express Edition

**Database Login**

Enter your database username and password.

Username system

Password •••••

Login

[Click here to learn how to get started](#)

**Links**

- License Agreement
- Documentation
- Forum Registration
- Discussion Forum
- Product Page

Language: en-us

Application Express  
Copyright © 1999, 2006, Oracle. All rights reserved.

Login into the system

# Our used DBMS (Oracle Database 10g Express Edition)

Oracle Database Express Edition

User: HR

Home > SQL > SQL Commands

☒ Autocommit Display 10

Save Run

Select \* from Employees

Results Explain Describe Saved SQL History

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID	DEPARTMENT_ID
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000	-	-	90
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000	-	100	90
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000	-	100	90
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000	-	102	60
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000	-	103	60
105	David	Austin	DAUSTIN	590.423.4569	25-JUN-97	IT_PROG	4800	-	103	60
106	Valli	Pataballa	VPATABAL	590.423.4560	05-FEB-98	IT_PROG	4800	-	103	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	4200	-	103	60
108	Nancy	Greenberg	NGREENBE	515.124.4569	17-AUG-94	FI_MGR	12000	-	101	100
109	Daniel	Faviet	DFAVIET	515.124.4169	16-AUG-94	FI_ACCOUNT	9000	-	108	100

More than 10 rows available. Increase rows selector to view more rows.

Executing a Query

# Advantages of using Oracle

1. **Client-Server Environment :** Many users can access it at the same time.
2. **Database size:** It provide a very large space for holding data.
3. **Multi platforms:** Can be used on various platforms such as Windows, MAC and Linux.
4. **Performance:** Transaction can be processed highly.
5. **Security:** Enough security is provided to protect data stored on the database.
6. **Easily accessible by other applications:** Ease combined with other applications such as Oracle Developer is one feature of Oracle Database.
7. **Distributed system managing capabilities.**

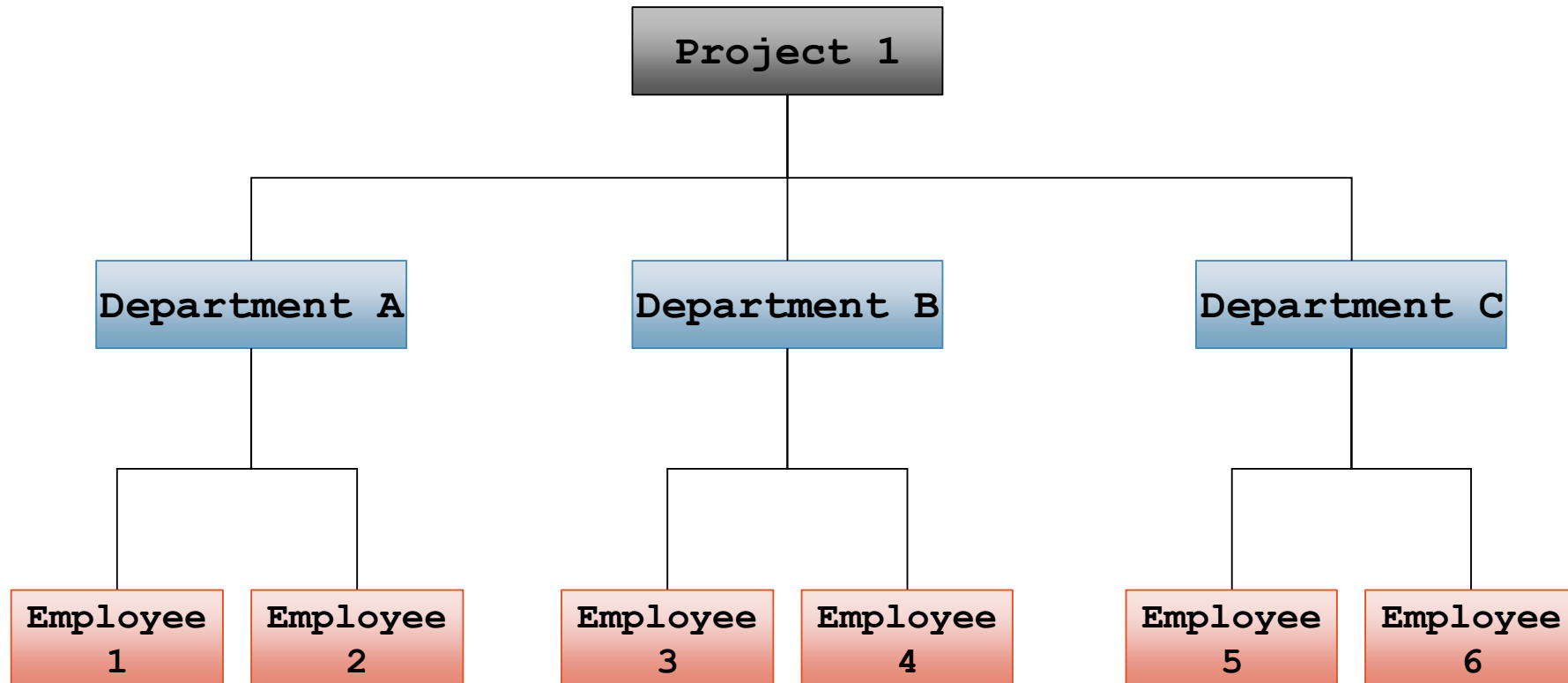
MP-SED-CD

# Data Models

- ▶ **Data model** : Is a collection of concepts for describing data.
- ▶ **Database model**: Is a type of data model that determines the logical structure of a database.
- ▶ **Types of Database models:**
  - 1✓ Hierarchical Model.
  - 2✓ Network Model.
  - 3✓ Relational Model.
  - 4✓ Object/Relational Model.
  - 5✓ Object-Oriented Model.
  - 6✓ Graph Model.
  - 7✓ Dimensional Model.
  - **Other models**

# Hierarchical data model

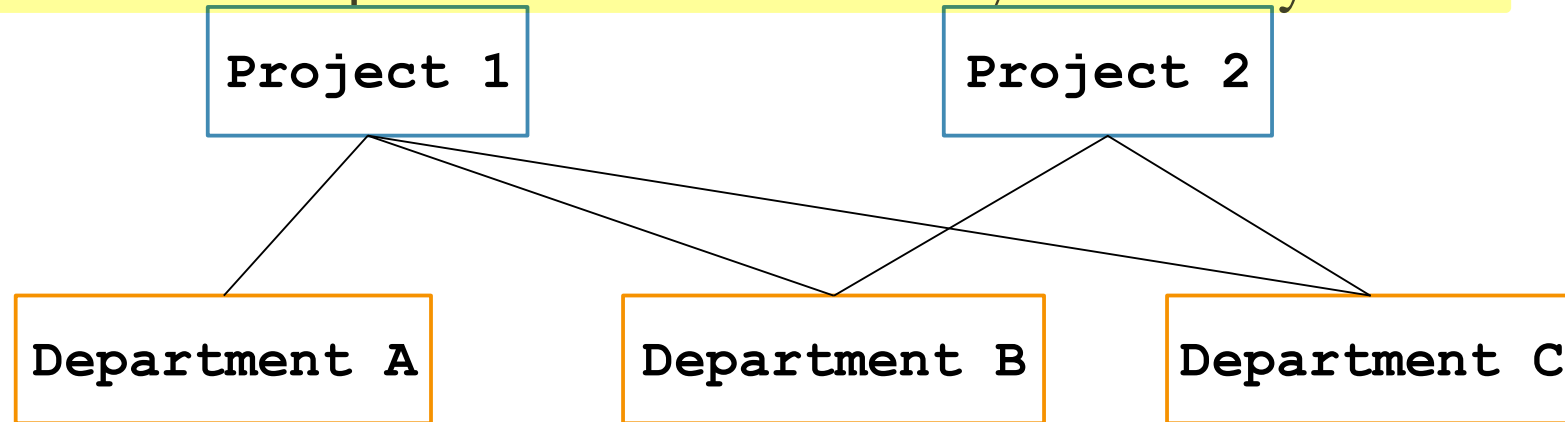
- ▶ A data model in which data are organized in a top-down, or inverted tree structure.





# Network data model

- An expansion of the hierarchical data model with an owner-member relationship in which a member may have many owners.



# Relational data model

- All data elements are placed in two-dimensional tables (**rows** and **columns**), called relations, that are the logical equivalent of files.

**Data Table 1:  
Project Table**

Project Number	Description	Dept. Number
155	Payroll	257
498	Widgets	632
226	Sales manager	598

**Data Table 2:  
Department  
Table**

Dept. Number	Dept. Name	Manager SSN
257	Accounting	421-55-99993
632	Manufacturing	765-00-3192
598	Marketing	098-40-1370

**Data Table 3:  
Manager Table**

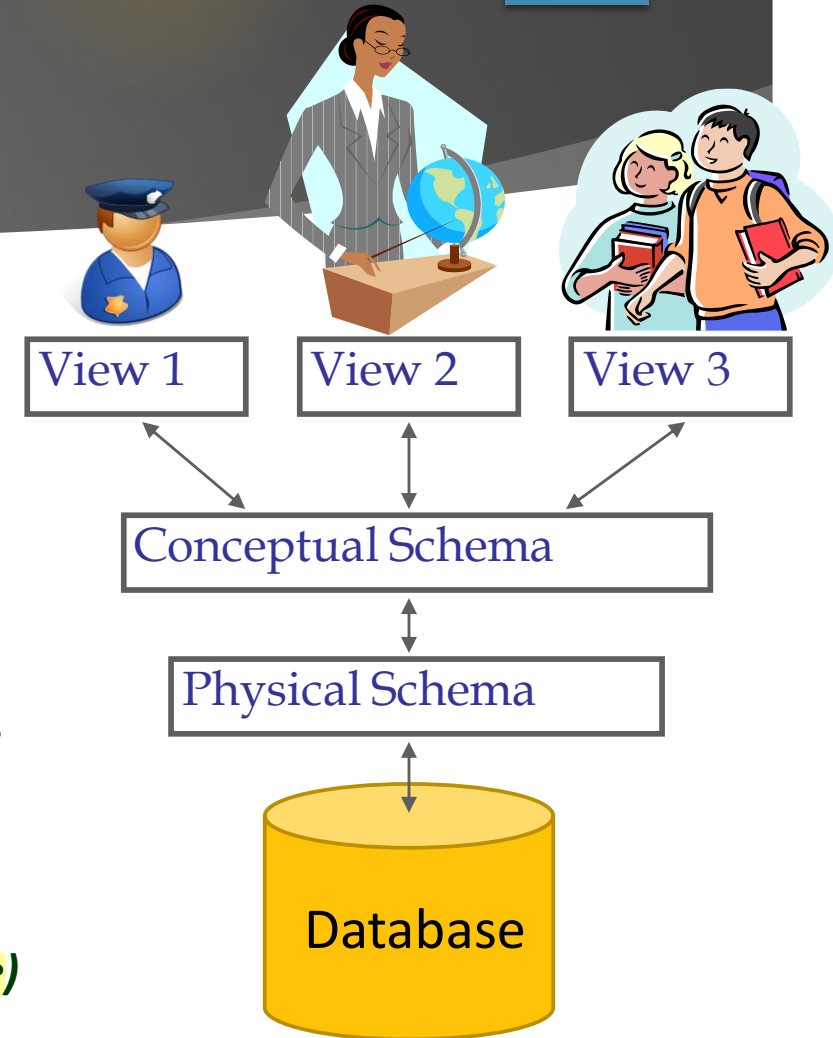
SSN	Last Name	First Name	Hire Date	Dept. Number
005-10-6321	Johns	Francine	10-7-65	257
549-77-1001	Buckley	Bill	2-17-79	650
098-40-1370	Fiske	Steven	1-5-85	598

# Schema

- **Schema** is a description of a particular collection of data, using a given data model.
- Nowadays the most widely used model is **Relational Data Model**.
  - In relational data model:
  - ▶ Main concept: relation, basically a table with rows and columns.
  - ▶ Every relation has a schema, which describes the columns, or fields.

# Levels of Abstraction

- ▶ Many views, single conceptual (logical) schema and physical schema.
  - ▶ **Views** describe how users see the data.
  - ▶ **Conceptual schema** defines logical structure.
  - ▶ **Physical schema** describes the files and indexes used.
- Schemas are defined using DDL (Data Definition Language)
- Data is modified/queried using DML (Data Manipulation Language)



# Example: University Database

- ▶ **Conceptual schema:**

- ▶ *Students(sid: string, name: string, login: string, age: integer, gpa: real)*
- ▶ *Courses(cid: string, cname: string, credits: integer)*
- ▶ *Enrolled(sid: string, cid: string, grade: string)*

- ▶ **Physical schema:**

- ▶ Relations stored as unordered files (data records not sorted)
- ▶ Index on first column of Students

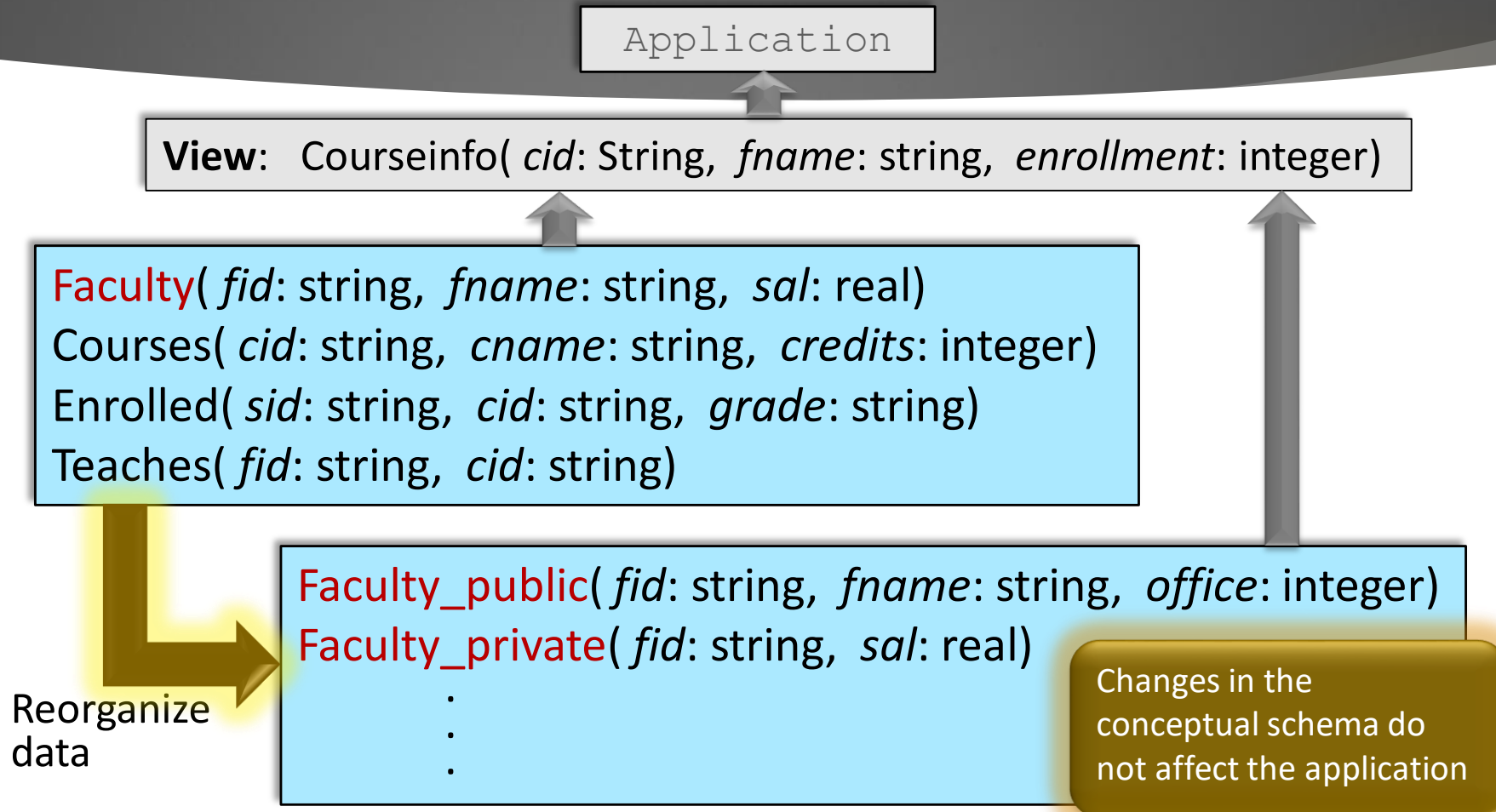
- ▶ **External Schema (View):**

- ▶ *Course\_info(cid: string, enrollment: integer)*

# Data Independence

- Applications insulated from how data are structured and stored.
- Logical data independence: Protection from changes in *logical* structure of data (more on next slide).
- Physical data independence: Protection from changes in *physical* structure of data.
- *One of the most important benefits of using a DBMS!*

# Logical Data Independence



# Summary

- An organized collection of information in such a way user can modify and retrieve it is called database.
- **Advantages of using database:**
  - ✓ Transaction support, Snapshots, Fast indexing, Clustering, Replication and Relational view of data.
- Database is stored and managed by DBMS
- **Advantages of using DBMS:**
  - ✓ Data independence, Efficient data access, Reduced application development time, Data integrity and security, Uniform data administration, Concurrent access, Recovery from crashes.
- Advantages of using Oracle.
- Data Model.
- Database Models.



# Preferred resources

- 1) *Fundamentals of Relational Database Management Systems* by S. Sumathi
- 2) *Database Management System* by Raghu Ramakrishnan & Johannes Gehrke
- 3) *Fundamentals of Database Systems* by Ramez Elmasri & Shamkant B. Navathe
- 4) Solution Manuals for *Database Management System* by Raghu Ramakrishnan & Johannes Gehrke

Any Question ?

