Introduction to Database Concepts

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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.

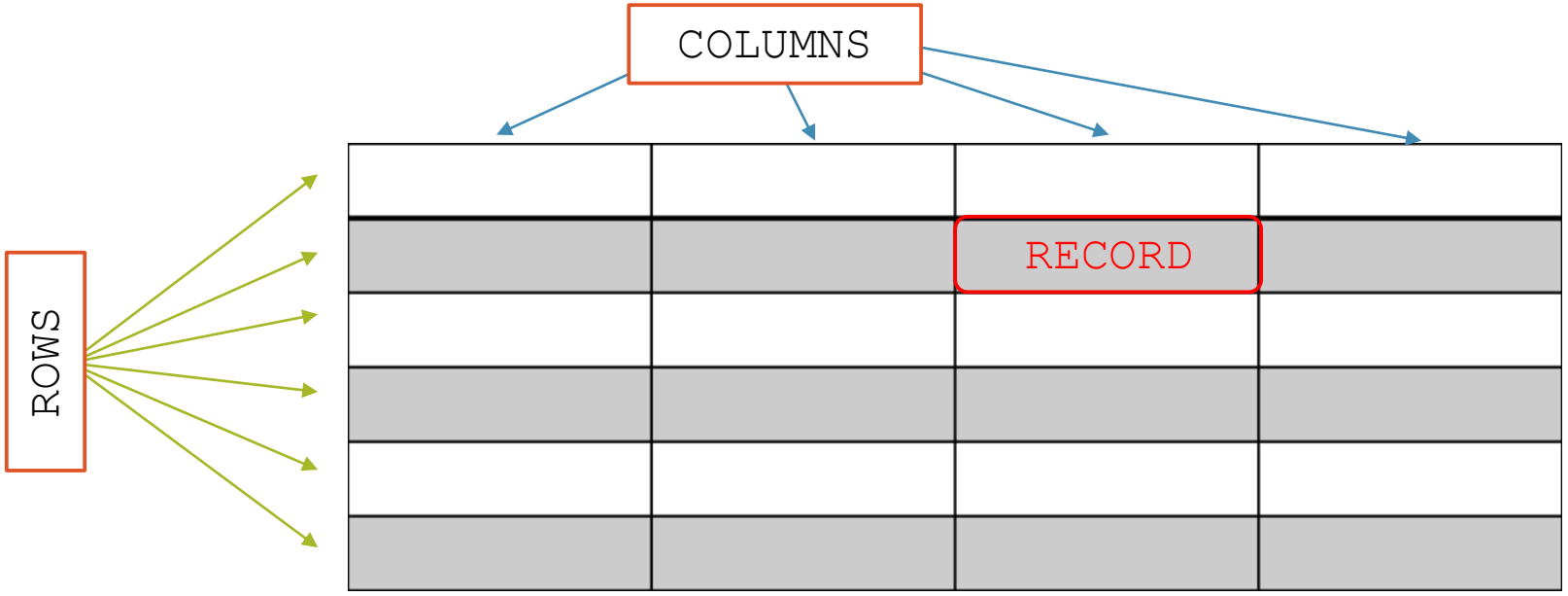
- A **database**, through its DBMS, enables data to be made available to users for viewing, entry of new data, or updating of existing data, while protecting the rights of those same users.

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

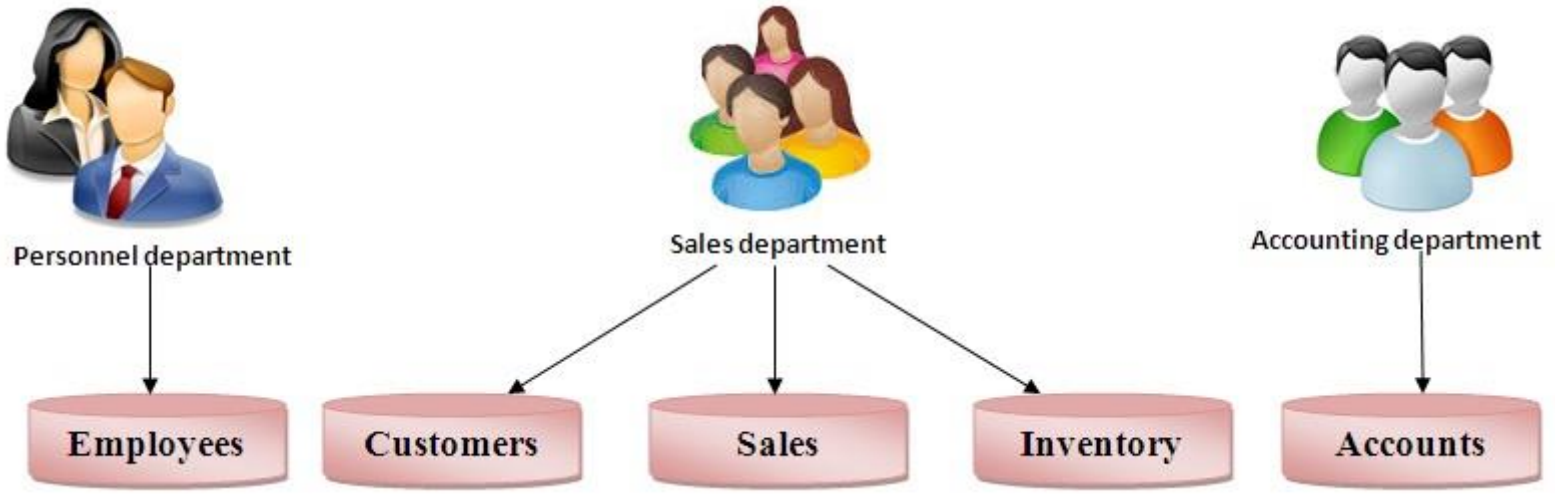
Advantages of using database

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.

Advantages of using database (Cont.)

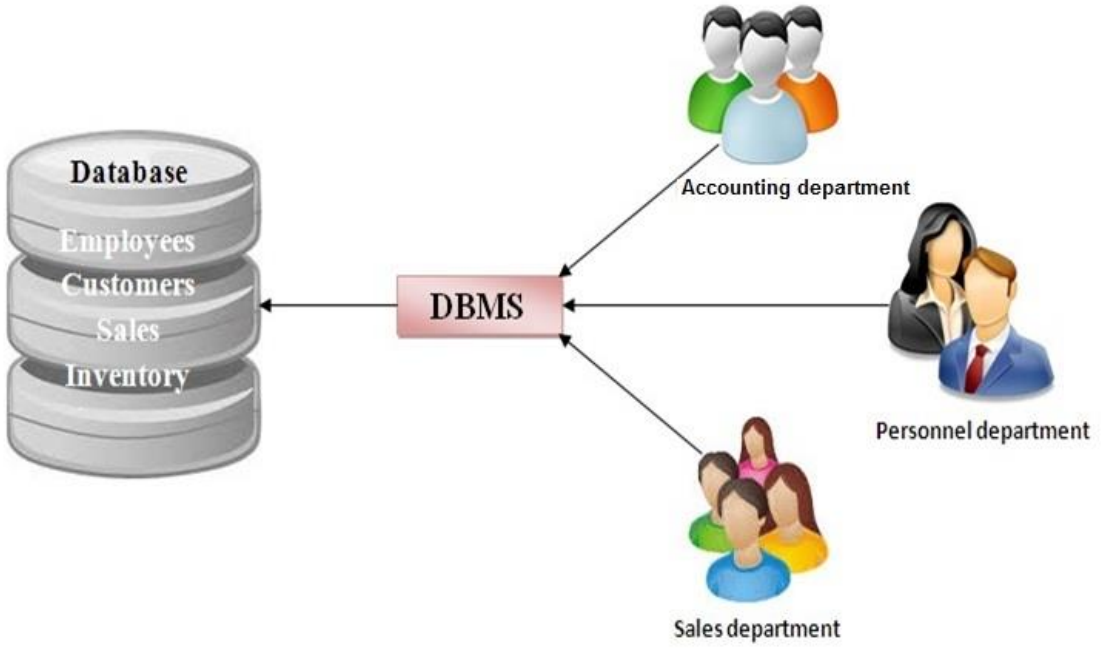
4. **Clustering**
   - ✓ Is the ability of several servers or instances to connect to a single database.
   - ✓ An instance is the collection of memory and processes that interacts with a database.
5. **Replication**
   - ✓ Is the process of copying and maintaining database objects in multiple databases 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

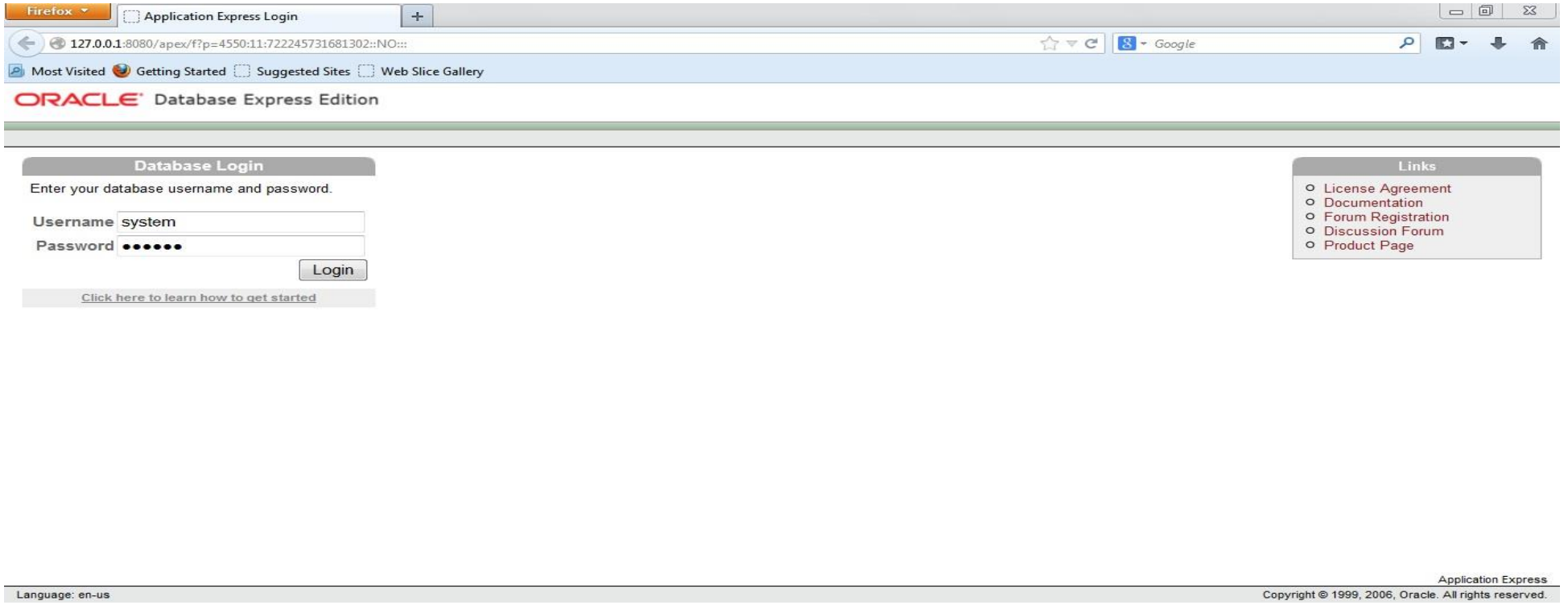
1. **Data independence**
   - ✓ Applications are insulated from changes in the way the data are structured and stored.
2. **Efficient data access**
   - ✓ Sophisticated techniques to store and retrieve data efficiently.
3. **Reduced application development time**
   - ✓ Supports functions common to many 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.)

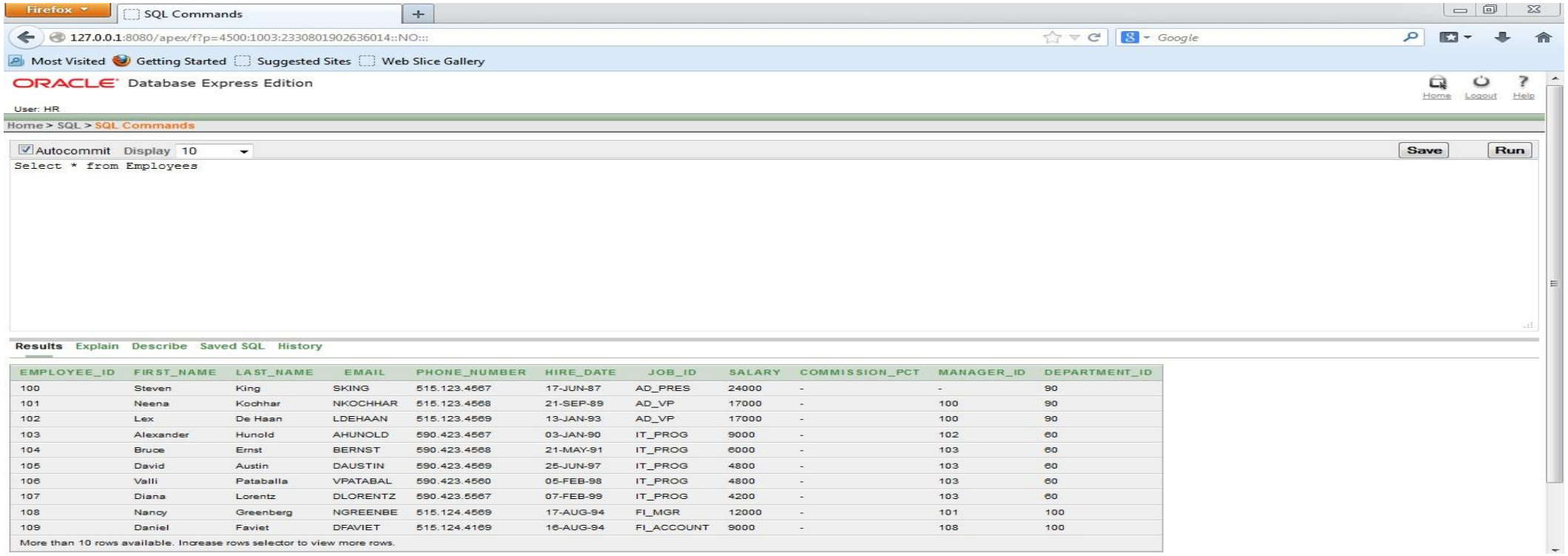
5. **Uniform data administration**
   - ✓ Database administrators have the knowledge to minimize data redundancy and fine tune the database to make retrieval efficient.
6. **Concurrent access**
   - ✓ Multiple users can access the database concurrently.
7. **Recovery from crashes**
   - ✓ Protect the users from the effects of system failures.

Our used DBMS (Oracle Database 10g Express Edition)



Login into the system

Our used DBMS (Oracle Database 10g Express Edition)



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

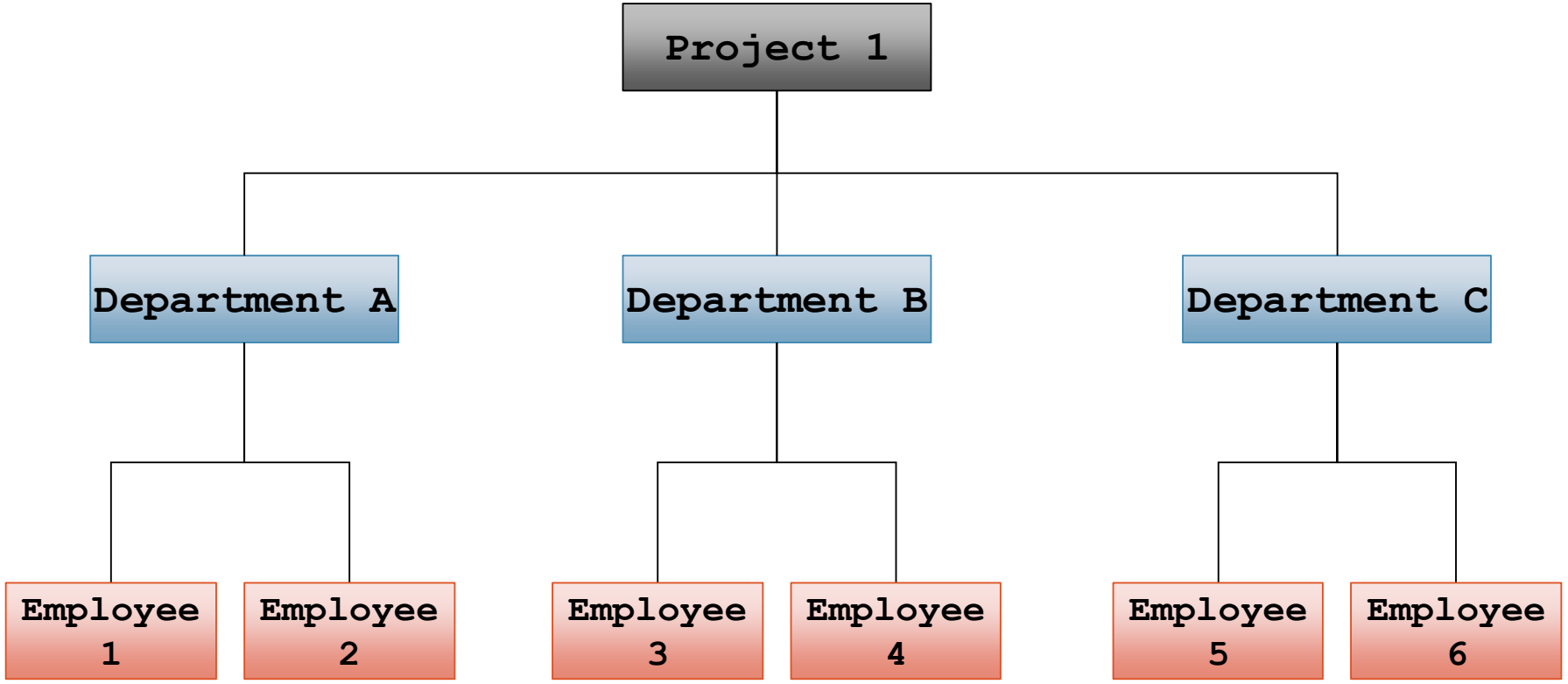
Data Models

- **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**

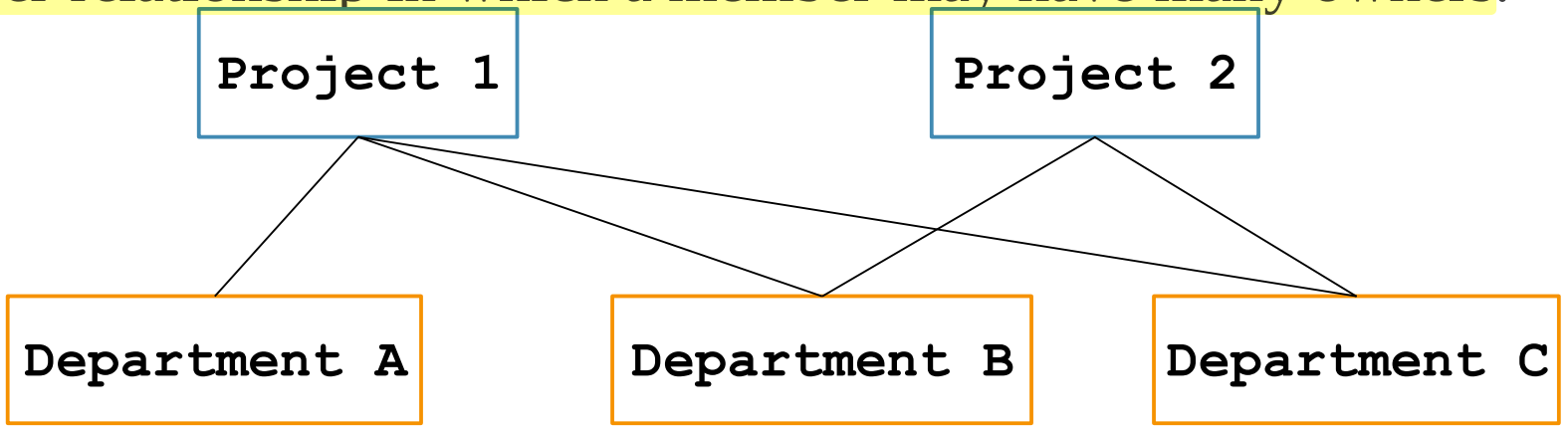
Hierarchical data model

- 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

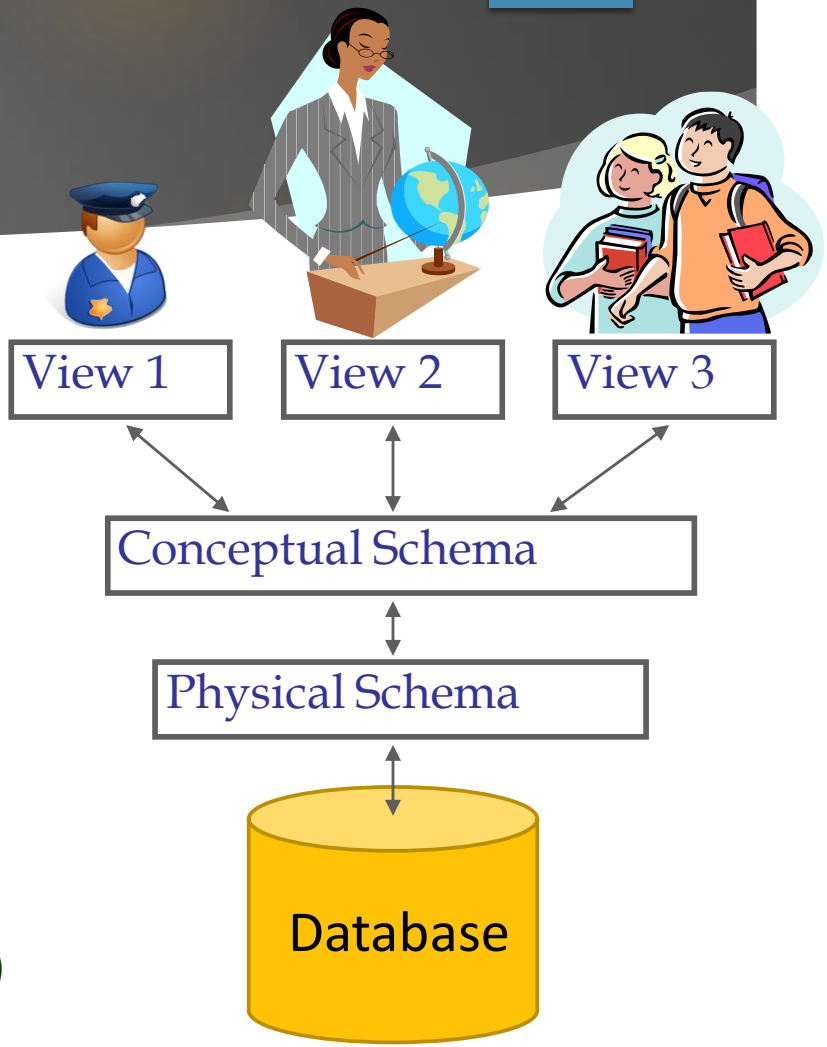
- **Schema** is a description of a particular collection of data, using a given data model.
- Nowadays the most widely used model is **Relational Data Model.**

  - 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)***



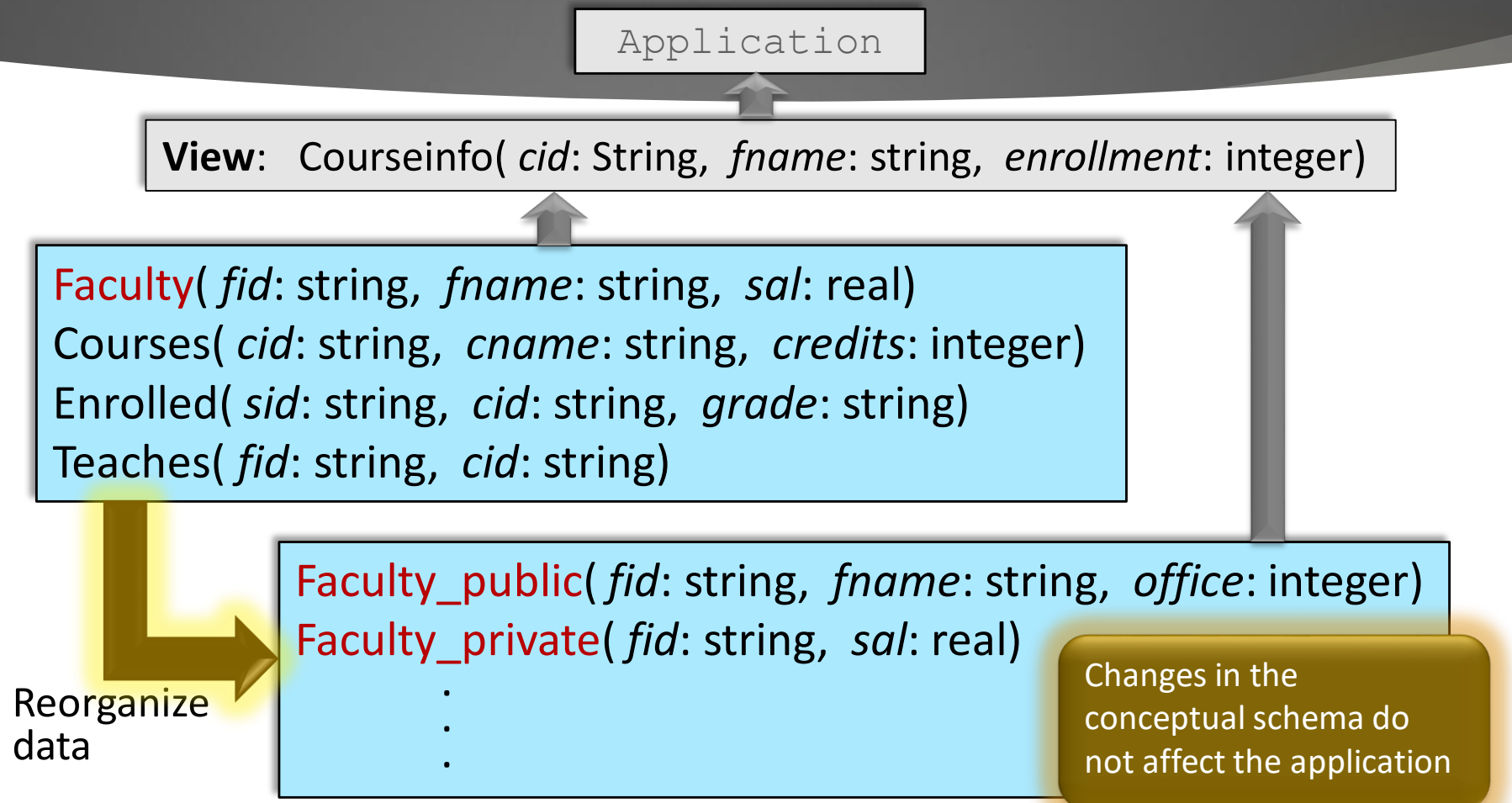
Example: University Database

- **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 ?