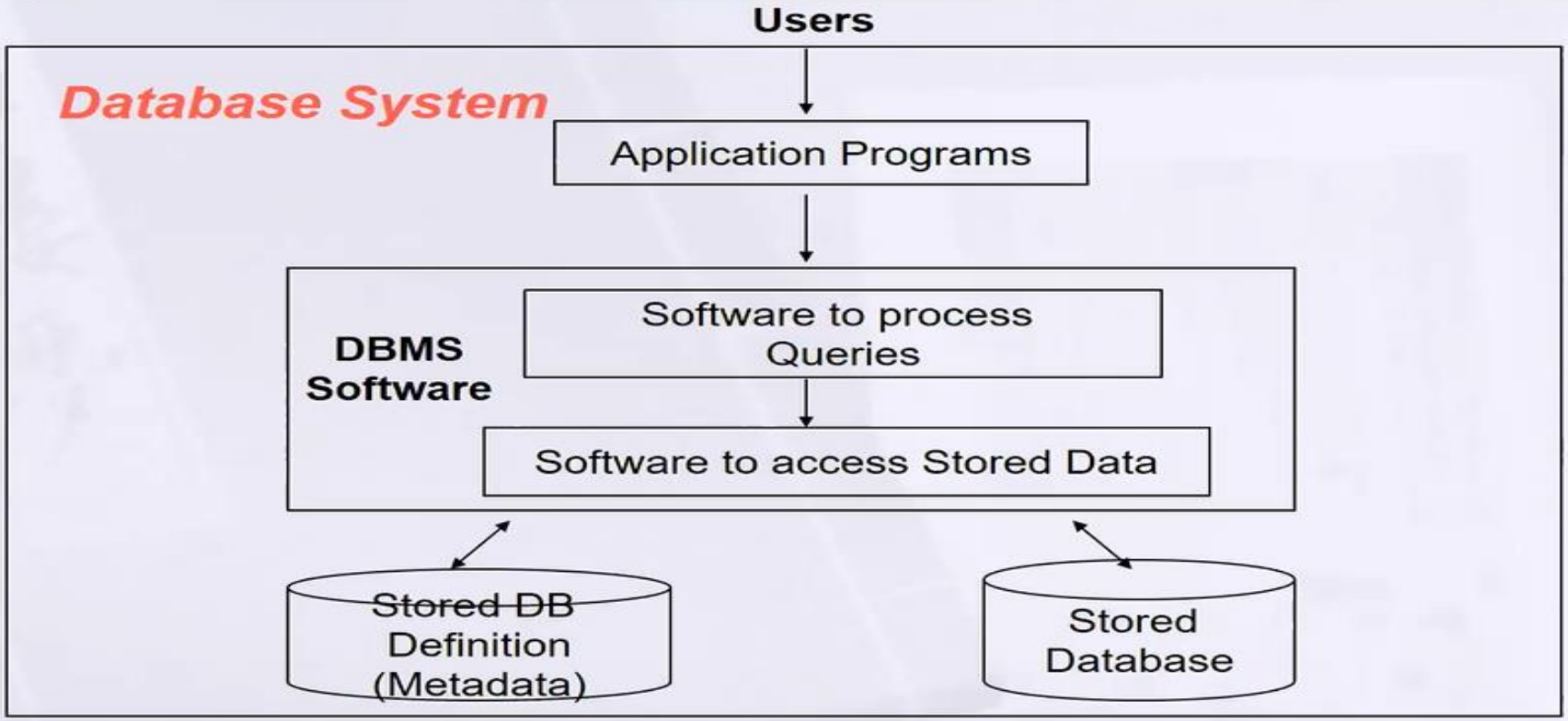
Fundamentals of Database Systems

Module 1: Introduction

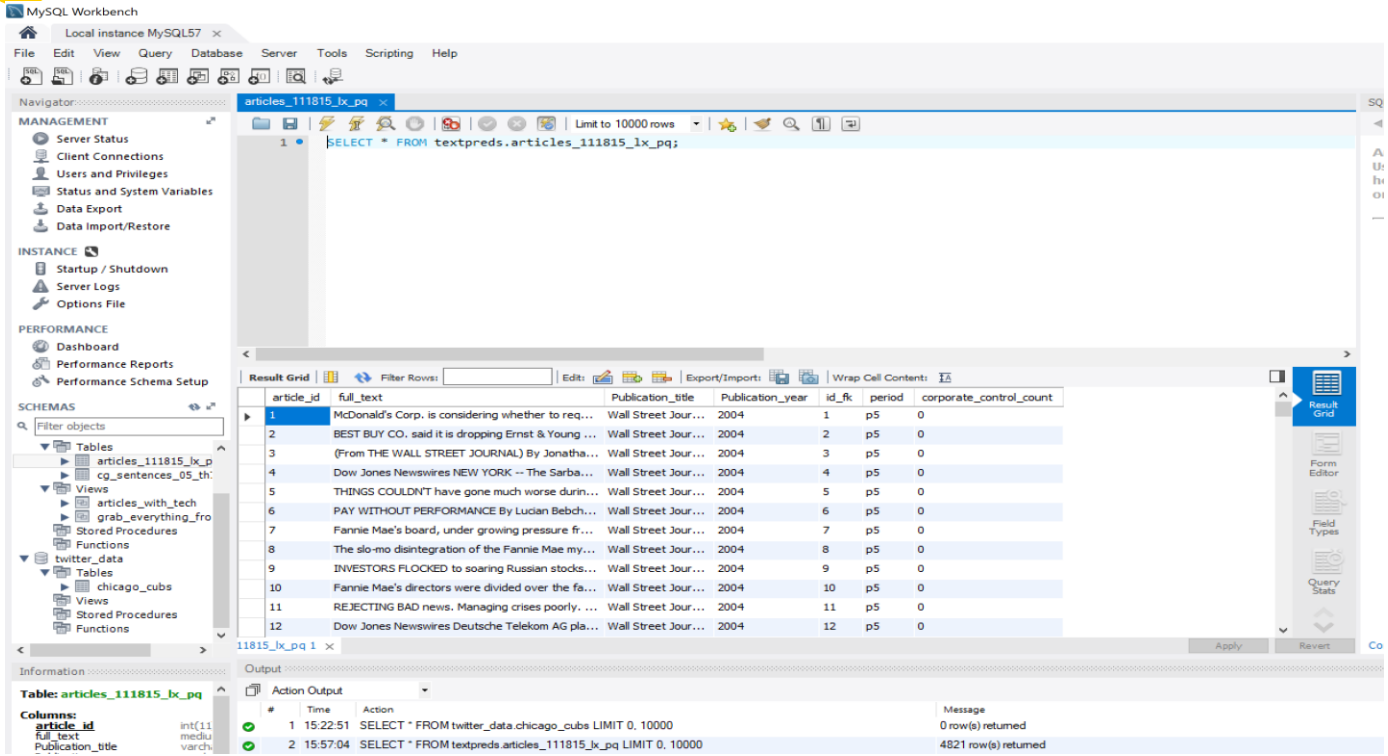
Basic Definitions

- **Database:** A collection of related data
- **Data:** Known facts that can be recorded and have an implicit meaning
- **Database Management System (DBMS):** A software package/ system to store and manage databases
- EX. Oracl,sqlserver,access,mongoDB

Database System



Database Management System (DBMS)



Database Management System (DBMS)

- **Typical functionalities include:**

1. Define a database (tables, datatypes, constraints, and structures)
2. Retrieve from/query a database
3. Update a database (insert, modify or delete)
4. Keeping the data valid
5. Allowing multiple users and applications to access and share the database.

- Other functionalities include preventing unauthorized access and displaying and visualizing the data.

Database

- **Models a real-world enterprise:**
- **1. Entities:** Entities are specific things or objects in the mini-world that are represented in the database

- **2. Attributes:** Properties used to describe an entity

- **3. Relationships:** Relates two or more distinct entities with a specific meaning

Query and Update

1. **Query:** Retrieve from tables

2. **Update:** Change in tables

Example 1:

- **Course management system:**
- Students, courses, sections, and professors

- Professors teach sections
- Students register in sections.
- Courses have sections

- Students have names, students IDs, phone numbers..

Example 1:

- **Course management system:**
- Students, courses, sections, and professors

Entities

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- Students register in sections.
- Courses have sections

Relationships

- Students have names, students IDs, phone numbers..

Attributes

Example 1

STUDENT

Name	Student_number	Class	Major
Smith	17	1	CS
Brown	8	2	CS

COURSE

Course_name	Course_number	Credit_hours	Department
Intro to Computer Science	CS1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

SECTION

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	07	King
92	CS1310	Fall	07	Anderson
102	CS3320	Spring	08	Knuth
112	MATH2410	Fall	08	Chang
119	CS1310	Fall	08	Anderson
135	CS3380	Fall	08	Stone

Example 1:

Query examples:

1. Return all students
2. Classes offered in Spring of 08
3. Courses taught in the CS department

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Example 1:

Update examples:

1. Change Smith major to CE

2. Add new math course

3. Change instructor for CS1310 from Anderson to Kruth

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Exercise 1:

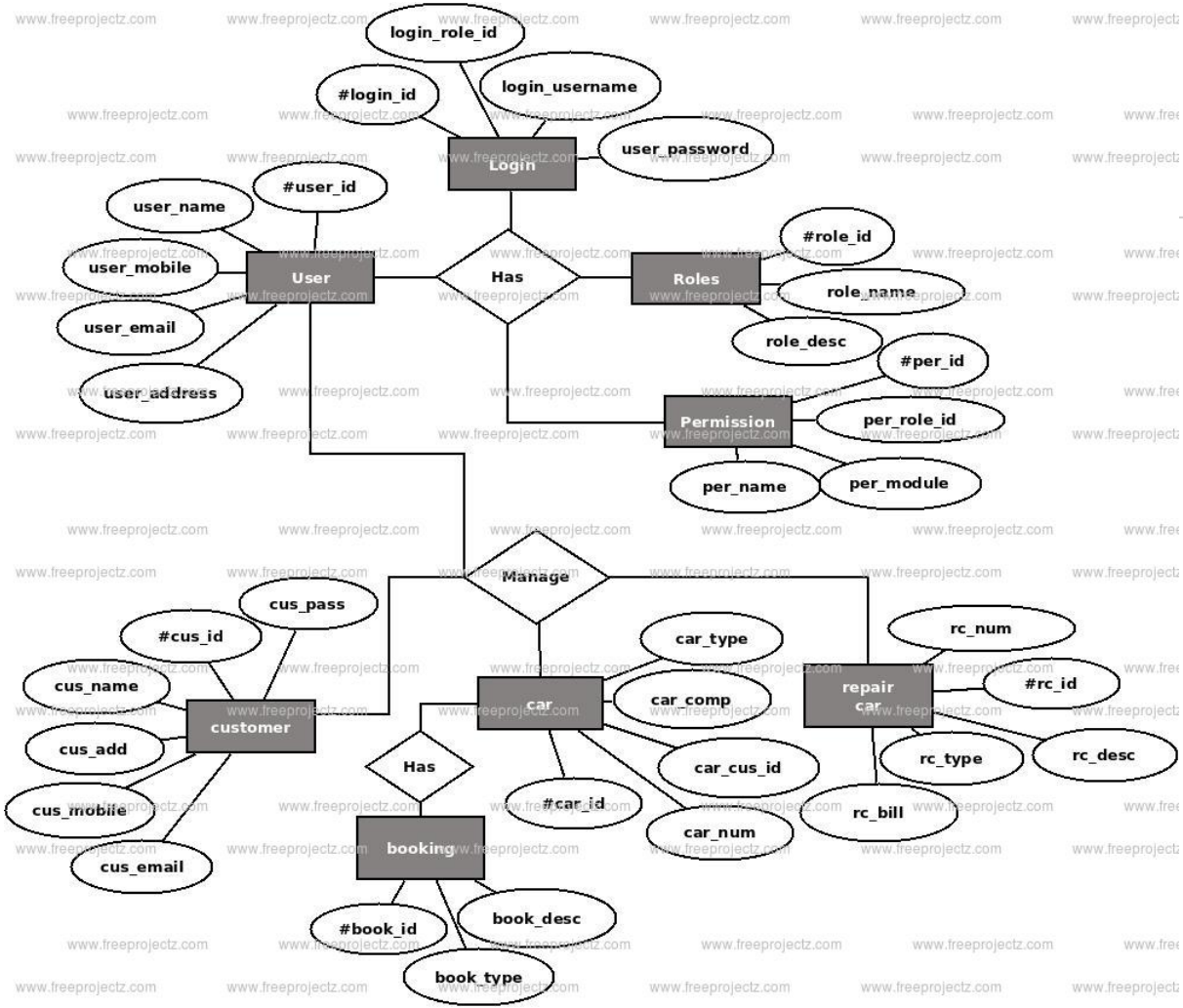
- **Management system for car repair shop**
- What are the entities in the system?
- What are the attributes for each entity?
- What are the relationships

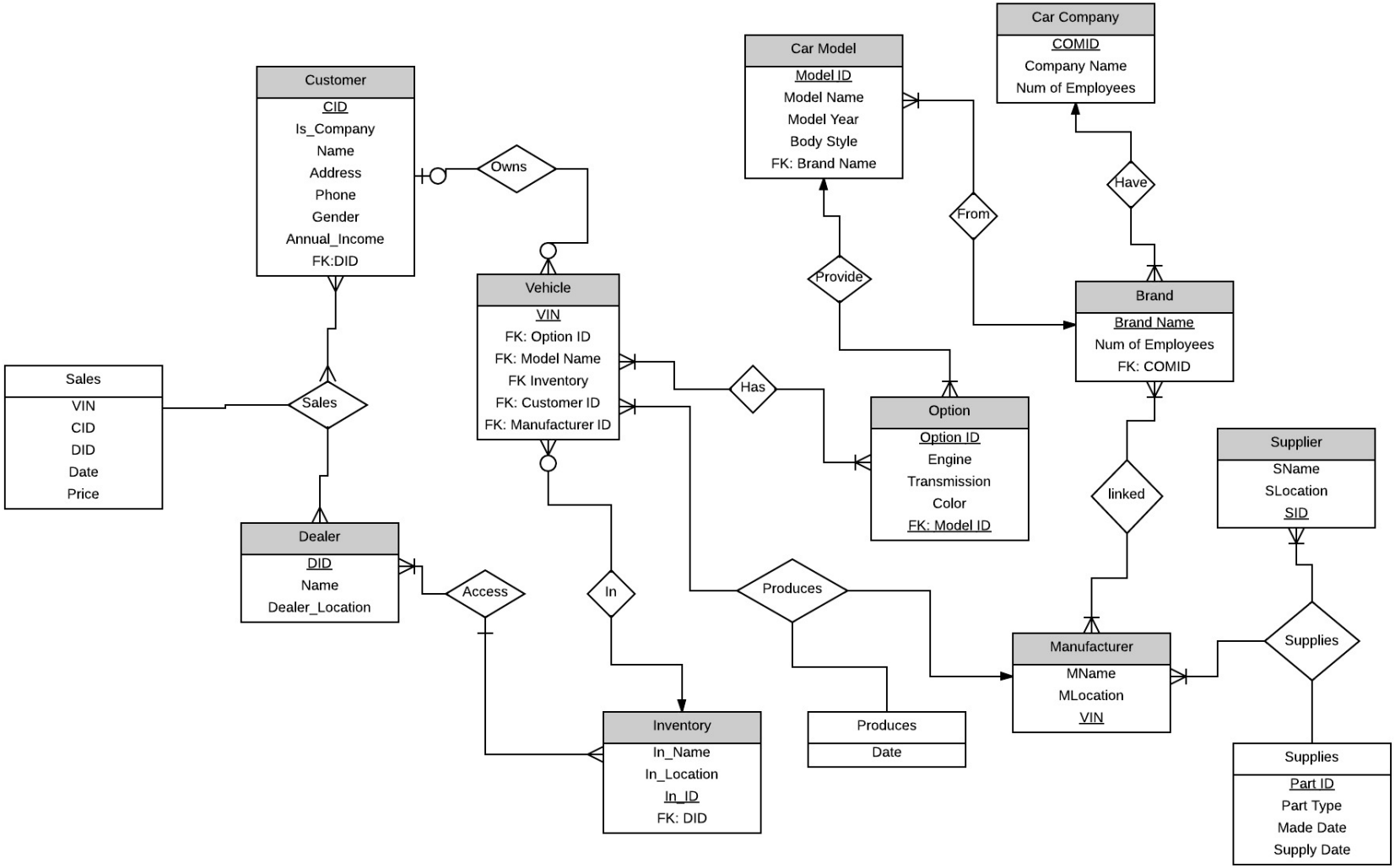
- Examples of queries?
- Examples of updates?

Exercise 2:

- **Management system for final year projects**
- What are the entities in the system?
- What are the attributes for each entity?
- What are the relationships

- Examples of queries?
- Examples of updates?


login_role_id
#login_id
login_username
user_password
Login
user_name
#user_id
user_mobile
User
Has
Roles
#role_id
role_name
role_desc
user_email
user_address
#per_id
Permission
per_role_id
per_name
per_module
Manage
cus_pass
#cus_id
cus_name
customer
cus_add
cus_mobile
cus_email
Has
booking
#book_id
book_desc
book_type
car_type
car_comp
car
car_cus_id
#car_id
car_num
rc_num
#rc_id
repair car
rc_type
rc_desc
rc_bill


Car Company
COMID
Company Name
Num of Employees
Car Model
Model ID
Model Name
Model Year
Body Style
FK: Brand Name
Customer
CID
Is_Company
Name
Address
Phone
Gender
Annual_Income
FK:DID
Owns
Have
From
Provide
Vehicle
VIN
FK: Option ID
FK: Model Name
FK Inventory
FK: Customer ID
FK: Manufacturer ID
Brand
Brand Name
Num of Employees
FK: COMID
Has
Sales
VIN
CID
DID
Date
Price
Sales
Option
Option ID
Engine
Transmission
Color
FK: Model ID
Supplier
SName
SLocation
SID
linked
Dealer
DID
Name
Dealer_Location
Access
In
Produces
Manufacturer
MName
MLocation
VIN
Supplies
Inventory
In_Name
In_Location
In_ID
FK: DID
Produces
Date
Supplies
Part ID
Part Type
Made Date
Supply Date

Actors on the Scene

- Important people

1. **Database Administrator (DBA):** Manages the database
2. **Database Designer:** Specify the data and structures
3. **End User:** Users who access the database
4. **Systems analysts:** Determine the requirements for end users
5. **Application programmers:** Write code to allow end user to access database based on the requirements from systems analysts.

Actors on the Scene

- For the car repair shop example:

1. **Database Administrator (DBA):** Make sure DB is running with no issues. Grant access to database if needed.

2. **Database Designer:** Specify the tables and the attributes needed for each table

3. **End User:** Person at the front desk. Maybe mechanics

4. **Systems analysts:** Specify what the EU needs to see

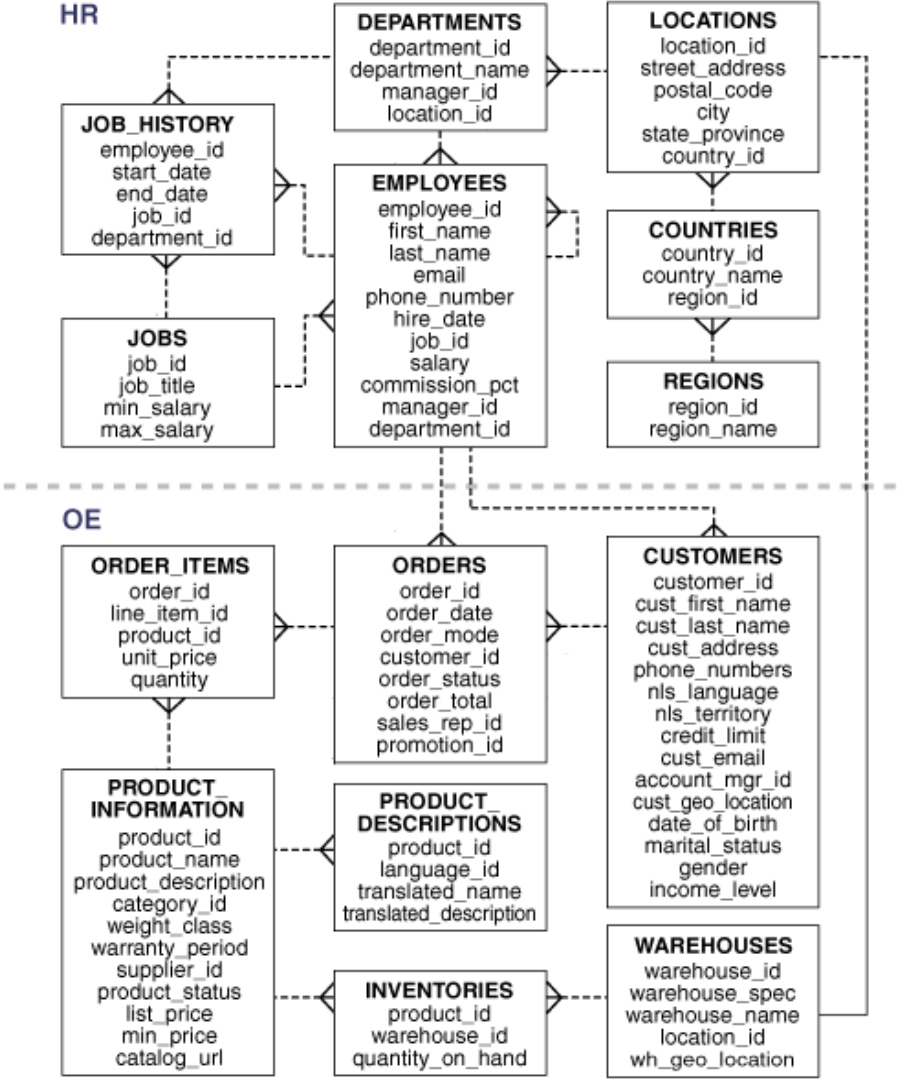
5. **Application programmers:** Write the programmers for EU

Schema and State

- **Database Schema:** The description of a database. Includes descriptions of the database structure, data types, and the constraints on the database.
- **Schema Diagram:** An illustrative display of (most aspects of) a database schema.
- **Database State:** The actual data stored in a database at a *particular moment* in time. This includes the collection of all the data in the database.
- Also called database instance

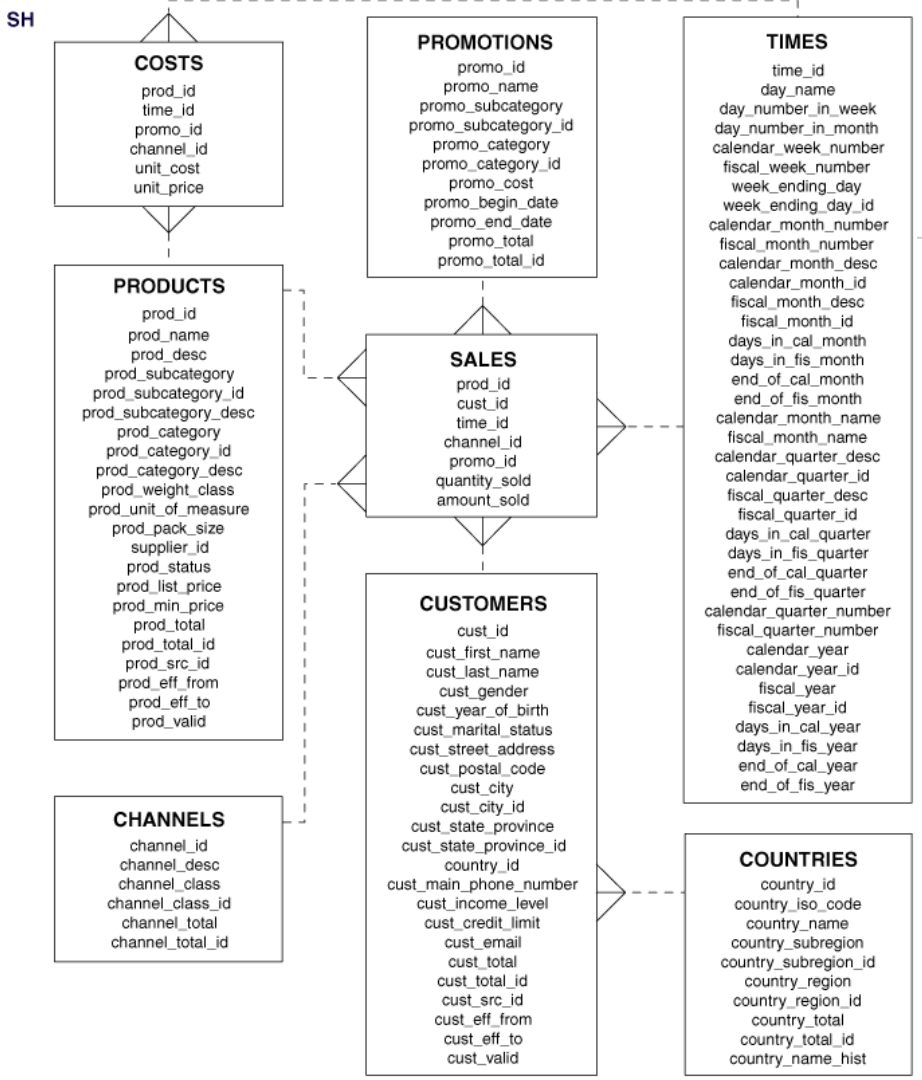
Schema Diagram

Human Resource & Order Entry Schema



Schema Diagram

sales history (SH) Schema



Database State: Example

Player

Online_ID	Date_of_Birth	Country
Maha1	03/12/1991	Saudi Arabia
Hassan99	09/01/1992	Egypt
Nassir_3	01/07/1995	Saudi Arabia

Game

Game_ID	Player_1	Player_2	Winner
1	Maha1	Hassan99	Hassan99
9	Hassan99	Nassir_3	Nassir_3
12	Nassir_3	Maha1	Maha1
43	Maha1	Nassir_3	Maha1
5	Hassan99	Nassir_3	Hassan99
10	Nassir_3	Maha1	Maha1

League

League_ID	Online_ID	Status
0001	Maha1	Active
0002	Hassan99	Active
0003	Maha1	Inactive