
# Introduction to RDBMS & MYSQL

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# MODULE 1:
# DBMS & RDBMS CONCEPTS

# File System

- Flat Files is a file of data that **does not contain links** to other files or is a non-relational database
- Example

```
Bob |123 street | California | $200.00
Nathan | 800 Street | Utah | $10.00
```


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# Disadvantage of File System

- In the early days, database applications were built directly on top of file systems
- Drawbacks of using file systems to store data:
  - Potential duplication
  - Non-unique records
  - Harder to update
  - Inherently inefficient
  - Harder to change data format
  - Poor at complex queries
  - Security issues


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# Database Management System (DBMS)

- DBMS contains information about a particular enterprise
  - Collection of interrelated data
  - Set of programs to access the data
  - An environment that is both convenient and efficient to use
- Database Applications:
  - Banking: all transactions
  - Airlines: reservations, schedules
  - Universities:  registration, grades
  - Sales: customers, products, purchases
  - Online retailers: order tracking, customized recommendations
  - Manufacturing: production, inventory, orders, supply chain
  - Human resources:  employee records, salaries, tax deductions
- Databases touch all aspects of our lives


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# DBMS Level of Abstraction

- **Physical level**: describes how a record (e.g., customer) is stored.
- **Logical level:** describes data stored in database, and the relationships among the data.

```
type customer = record
                    customer_id : string;
                    customer_name : string;
                    customer_street : string;
                    customer_city : string;
    end;
```

- **View level:** application programs hide details of data types. Views can also hide information (such as an employee's salary) for security purposes.


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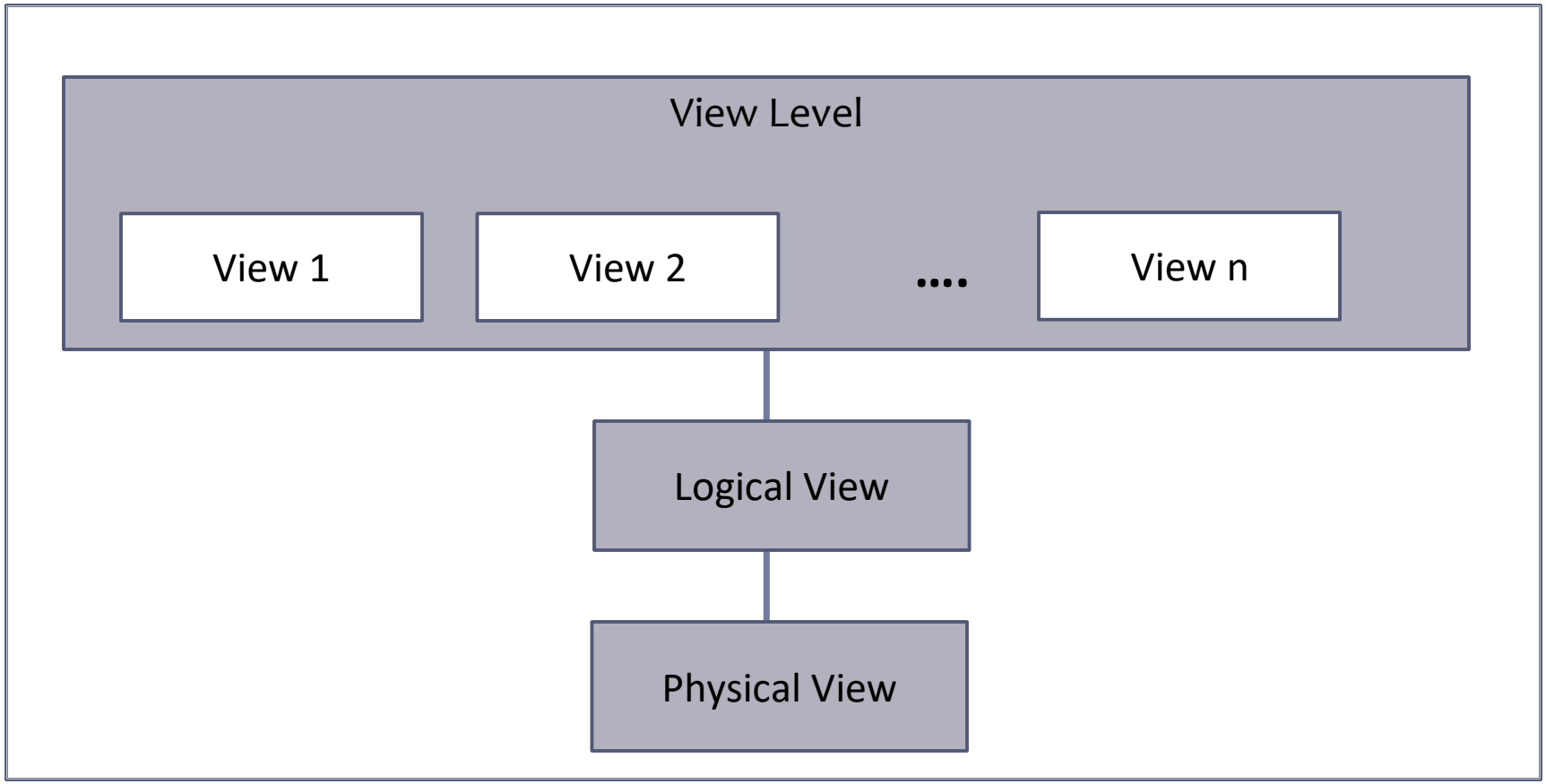
# View of Data

- An architecture for a database system





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# Instances and Schemas

- **Schema** – the logical structure of the database
  - Example: The database consists of information about a set of customers and accounts and the relationship between them)
- **Instance** – the actual content of the database at a particular point in time


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# Data Models

- A model is a representation of reality, '**real world**' objects and events, and their associations. It is an abstraction that concentrates on the essential, inherent aspects of an organization and ignore the accidental properties.
- The purpose of a data model is to represent data and to make the data understandable.



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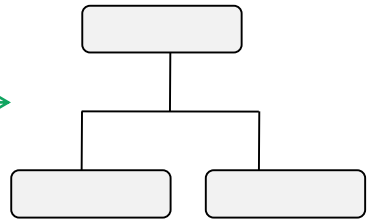
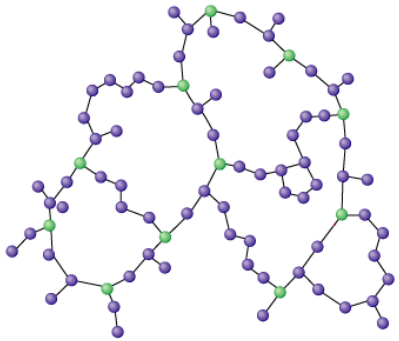
# Data Models Continue…

- Data Models are categorized into:

Hierarchical Model





Network Model

Relational Model

| | | |
|---|---|---|
| | | |
| | | |
| | | |





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# Data Manipulation Language (DML)

- Language for accessing and manipulating the data organized by the appropriate data model
  - DML also known as query language
- Two classes of languages
  - **Procedural** – user specifies what data is required and how to get those data
  - **Declarative (nonprocedural)** – user specifies what data is required without specifying how to get those data
- SQL is the most widely used query language



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# Data Definition Language (DDL)

- Specification notation for defining the database schema
  - Example: create table account (
    account_number char(10),
    branch_name char(10),
    balance integer)
- DDL compiler generates a set of tables stored in a data dictionary
- Data dictionary contains metadata (i.e., data about data)
  - Database schema
  - Data storage and definition language
    - Specifies the storage structure and access methods used
  - Integrity constraints
    - Domain constraints
    - Referential integrity (e.g. branch_name must correspond to a valid branch in the branch table)
- Authorization


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# Introduction to RDBMS

- RDBMS stands for **R**elational **D**ata**b**ase **M**anagement **S**ystem
- A DBMS in which **data** is stored in **tables** and the **relationships** among the data are also stored in **tables**.
- A Relational database management system (RDBMS) is a database management system (DBMS) that is based on the relational model as introduced by E. F. Codd.



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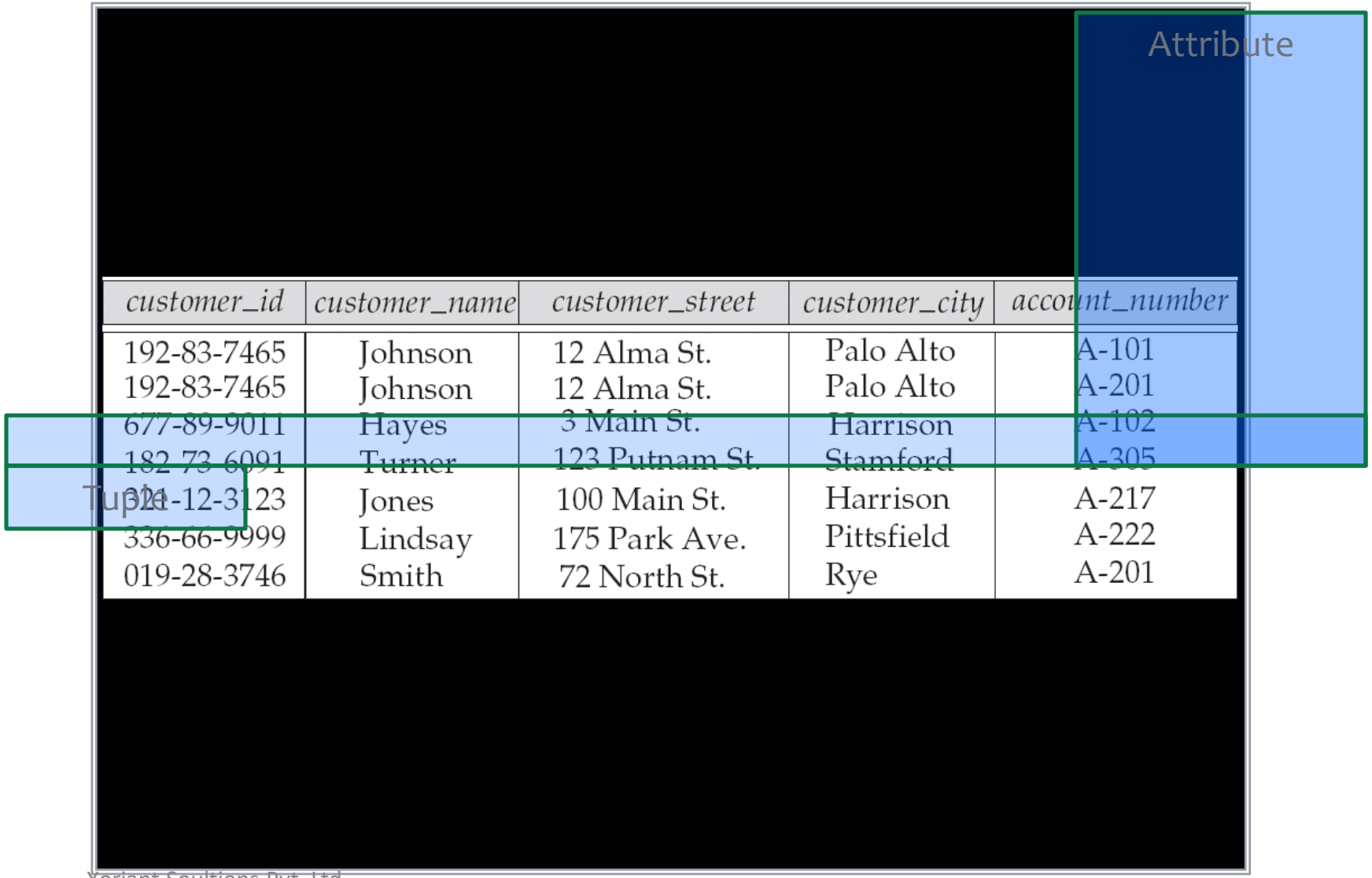
# Relational Database Model




| *customer_id* | *customer_name* | *customer_street* | *customer_city* | *account_number* |
|---|---|---|---|---|
| 192-83-7465 | Johnson | 12 Alma St. | Palo Alto | A-101 |
| 192-83-7465 | Johnson | 12 Alma St. | Palo Alto | A-201 |
| 677-89-9011 | Hayes | 3 Main St. | Harrison | A-102 |
| 182-73-6091 | Turner | 123 Putnam St. | Stamford | A-305 |
| 321-12-3123 | Jones | 100 Main St. | Harrison | A-217 |
| 336-66-9999 | Lindsay | 175 Park Ave. | Pittsfield | A-222 |
| 019-28-3746 | Smith | 72 North St. | Rye | A-201 |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# Sample Relational Database

| *customer_id* | *customer_name* | *customer_street* | *customer_city* |
|---|---|---|---|
| 192-83-7465 | Johnson | 12 Alma St. | Palo Alto |
| 677-89-9011 | Hayes | 3 Main St. | Harrison |
| 182-73-6091 | Turner | 123 Putnam Ave. | Stamford |
| 321-12-3123 | Jones | 100 Main St. | Harrison |
| 336-66-9999 | Lindsay | 175 Park Ave. | Pittsfield |
| 019-28-3746 | Smith | 72 North St. | Rye |

(a) The *customer* table

| *account_number* | *balance* |
|---|---|
| A-101 | 500 |
| A-215 | 700 |
| A-102 | 400 |
| A-305 | 350 |
| A-201 | 900 |
| A-217 | 750 |
| A-222 | 700 |

(b) The *account* table

| *customer_id* | *account_number* |
|---|---|
| 192-83-7465 | A-101 |
| 192-83-7465 | A-201 |
| 019-28-3746 | A-215 |
| 677-89-9011 | A-102 |
| 182-73-6091 | A-305 |
| 321-12-3123 | A-217 |
| 336-66-9999 | A-222 |
| 019-28-3746 | A-201 |

(c) The *depositor* table



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# Relationship

| EmpCode | EmpName | Address | Salary | Deptno |
|---|---|---|---|---|
| E001 | Rajendra | Mumbai | 20000 | 10 |
| E002 | Rupesh | Mumbai | 15000 | 10 |
| E003 | Vandana | Pune | 25000 | 30 |
| E004 | Anju | Chennai | 22000 | 20 |
| E005 | Ajay | Pune | 35000 | 30 |

| Deptno | Dname | Location |
|---|---|---|
| 10 | Admin | Mumbai |
| 20 | IT | Pune |
| 30 | Sales | Chennai |

A relationship is an association between two or more tables.


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# Keys

- Keys are fundamental part of relational database because they enable tables in the database to be related with each other.
- Types of keys are:
  - **Primary Key**

    Primary key is a key that uniquely identify each record in a table. It cannot be NULL.
  - **Composite Key**

    Key that consist of two or more columns that uniquely identify an entity occurrence is called Composite key.
  - **Foreign Key**

    A foreign key is  column or set of columns in a table whose values match a primary key in another table.



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# Keys continue…

- **Candidate Key**

  Candidate keys are defined as the set of fields from which primary key can be selected.

- **Alternate Key**

  The candidate keys that are not selected as primary key are known as alternate keys.

- **Super Key**

  Super key is a column or combination of columns that identifies a record within the table.



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# Keys continue…

- **Primary Key:** {Id}
- **Composite Key:** {Id, companyId}
- **Foreign Key:** {Address_id}
- **Candidate Key:** {Id}, {F_Name,L_Name}, {Phone}, {Email}
- **Alternate Key:** {F_Name, L_Name}, {Phone}, {Email}
- **Super Key:** {Id}, {F_Name, L_Name}, {Phone}, {Email}, {Id, Salary}, {Id, Phone}, {Id, Email}, {Phone, Email}

| Id | F_Name | L_Name | Phone | Email | Salary | Address_id |
|---|---|---|---|---|---|---|
| 101 | John | Obama | 11111 | a@a.in | 10000 | 505 |
| 102 | Tom | Bush | 22222 | b@a.in | 20000 | 302 |
| 103 | Ivan | Kerry | 33333 | c@a.in | 30000 | 211 |



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# MODULE 2:
# BUILDING A LOGICAL DATABASE

# Database Design

- To design database following are the steps:
  - Requirement Analysis
  - Diagrammatic representation
  - Translating Diagrams to tables
  - Refining the tables based on fixed set of rules.


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# Data Modeling

- **Data modeling** in software engineering is the process of creating a **data model** for an information system by applying formal data modeling techniques.
- The goal of the data model is to make sure that the all data objects required by the database are completely and accurately represented.


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# Modeling Methodology

- Data models represent information areas of interest. While there are many ways to create data models:
  - Bottom-up models or View Integration models
    - The methodology  is often the result of reengineering effort.
  - Top-down logical data models
    - This methodology  on other hand,  are created in an abstract way by getting information from people.



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# Entity relationship diagrams

- An entity-relationship model (ERM) is an abstract conceptual representation of structured data.
- Entity-relationship modeling is a **relational schema database modeling method**, used in software engineering to produce a type of **conceptual data model** (or semantic data model) of a system, often a relational database, and its requirements in a **top-down** fashion.



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# Entity

- In relation to a database , an entity is a single person, place, or thing about which data can be stored.
- In data modeling (a first step in the creation of a database), an entity is some unit of data that can be classified and have stated relationships to other entities.
- Example



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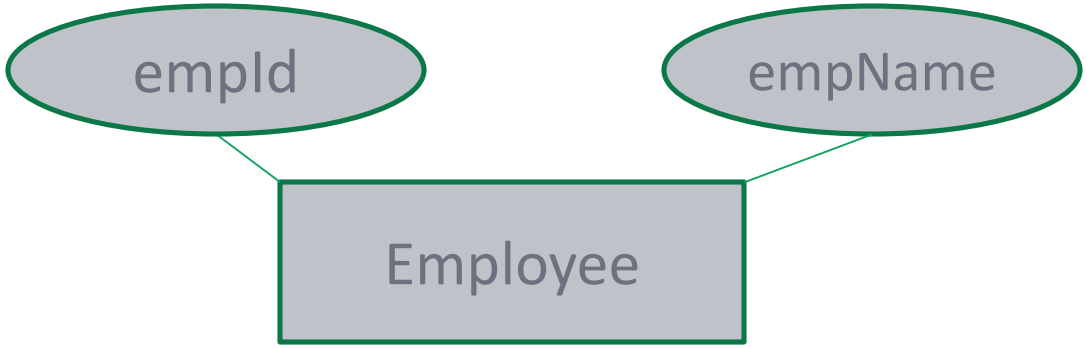
# Attributes

- **Characteristics/properties** of an entity, that provide descriptive details of it.
- every attribute must be given a **name** that is **unique** across the entity.
- Attributes are represented by **ovals** and are connected to the entity with a line.





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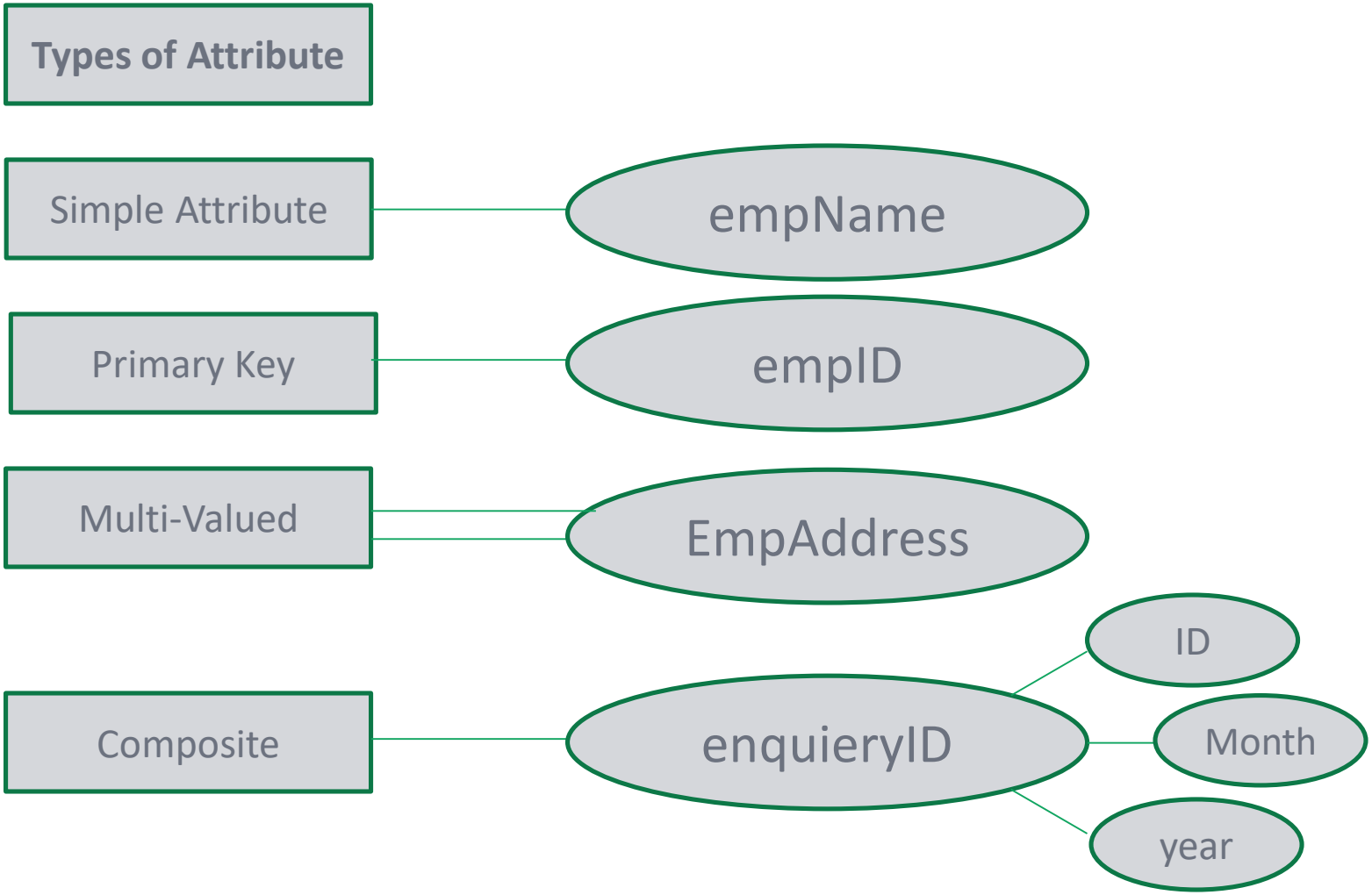
# Chain Notation Attribute



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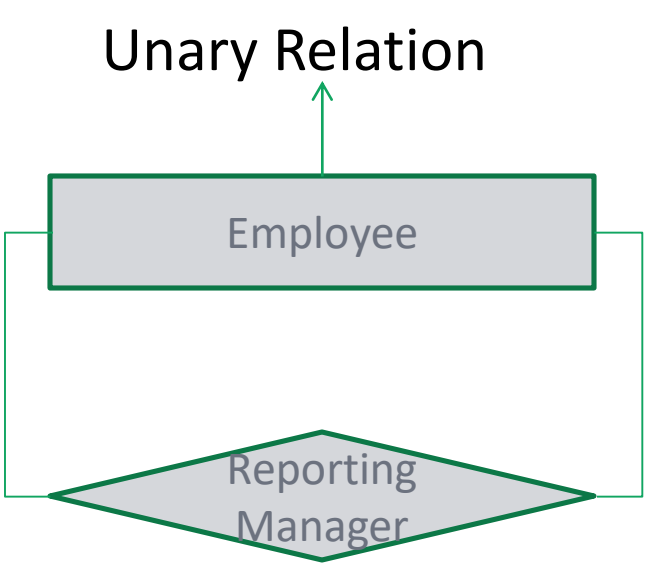
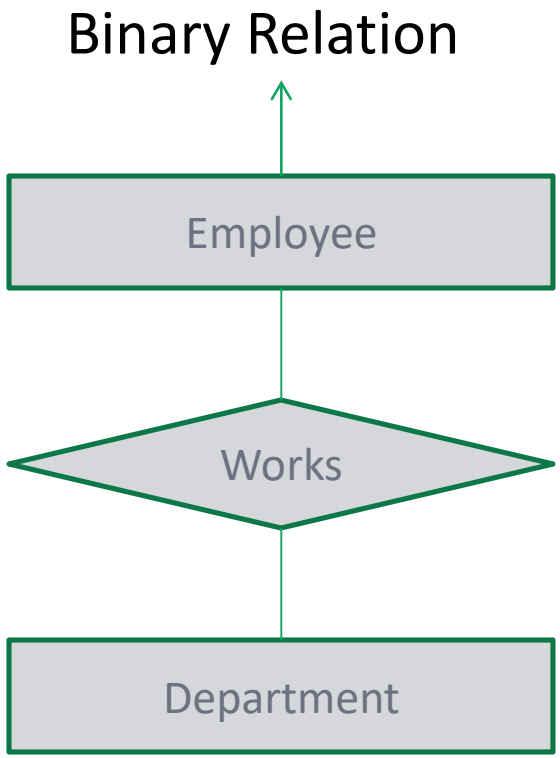
# Relationship Degree

- Relationship degree indicates the number of  entities involved in the relationship



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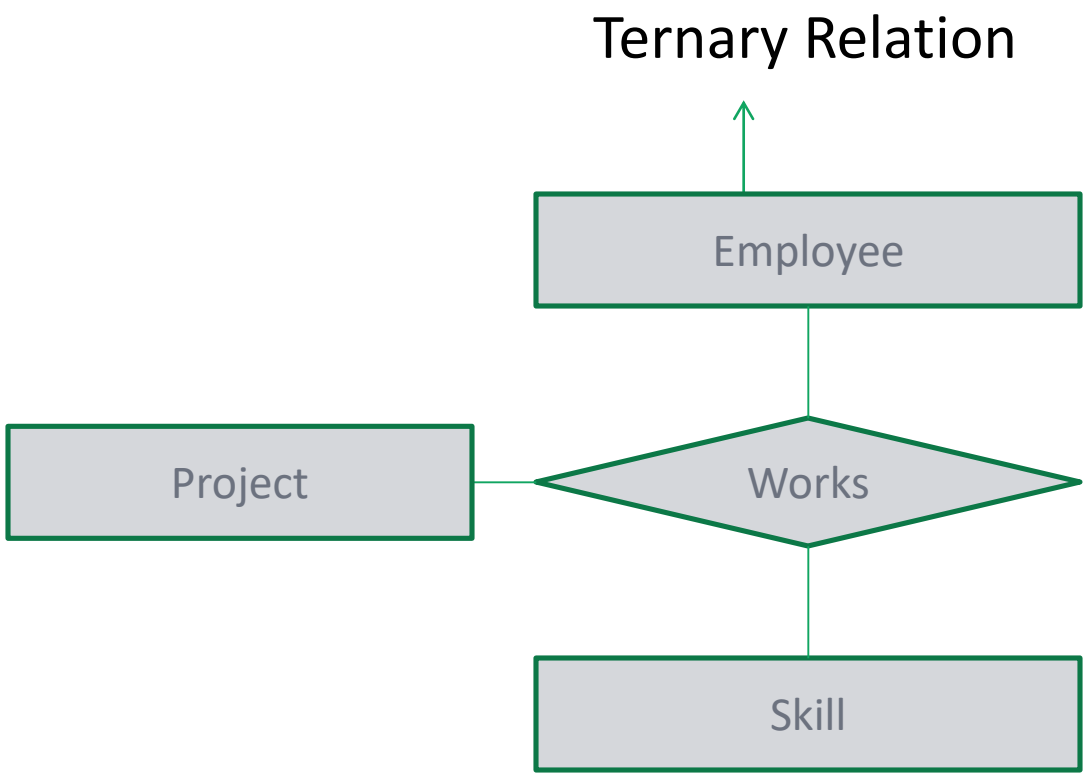
# Relationship Degree Continue…



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# Relationships among Tables

- A database consisting of independent and unrelated tables serves little purpose. The power of relational database lies in the relationship that can be defined between tables.
- The types of relationship include
  - One-to-one
  - One-to-many
  - Many-to-many



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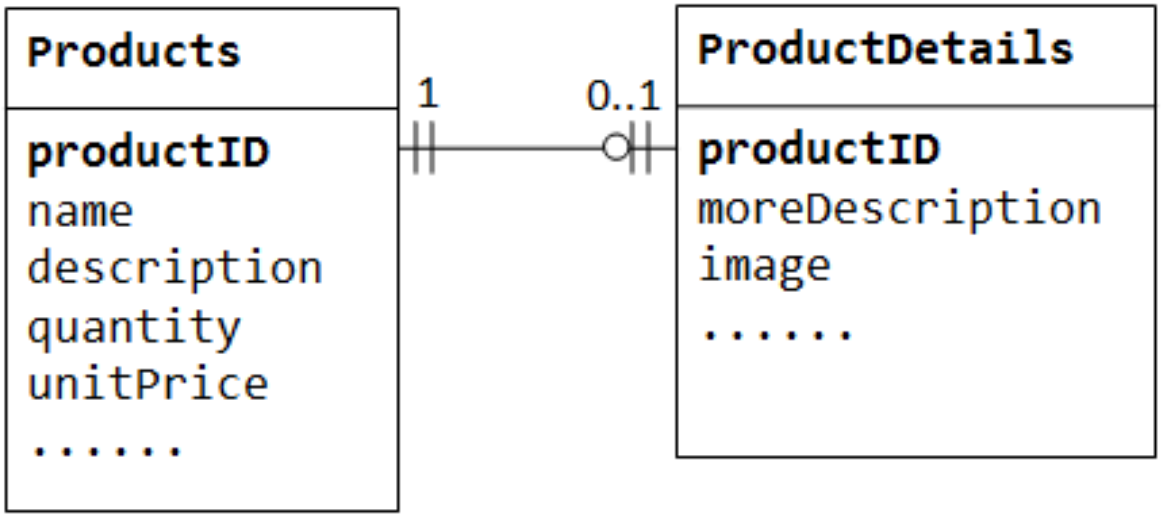
# One to One





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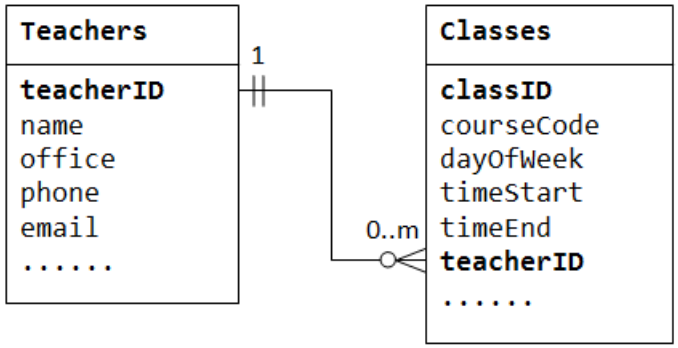
# One to Many





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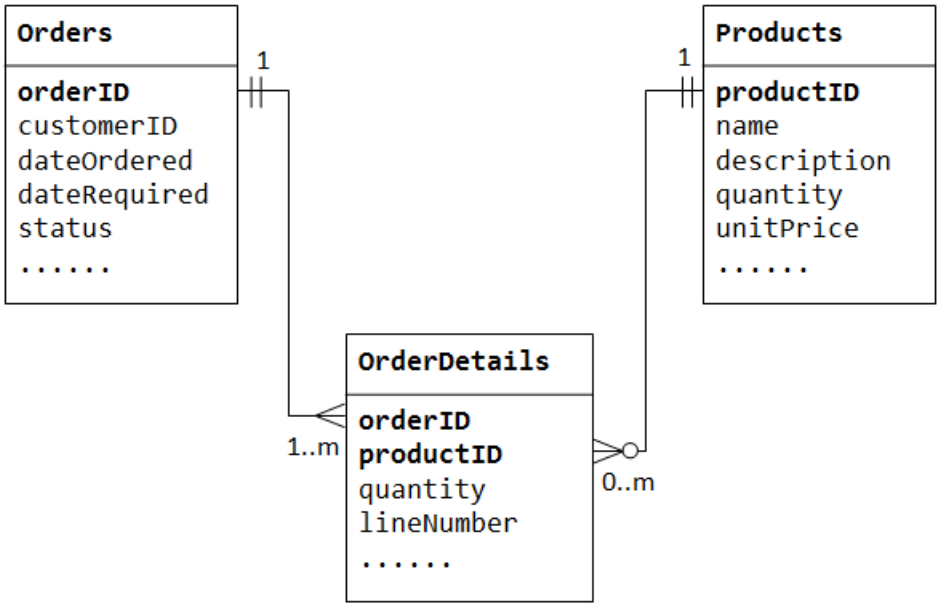
# Many to Many



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# Relationship Participation

- **Fundamental/Strong entity**
  - an entity that is capable of its own existence - i.e. an entity whose instances exist not with standing the existence of other entities.

## – Weak Entities

- an entity that is not capable of its own existence.

## – Associative Entities

- Associative entity is an entity that is used to resolve a many: many relationship.


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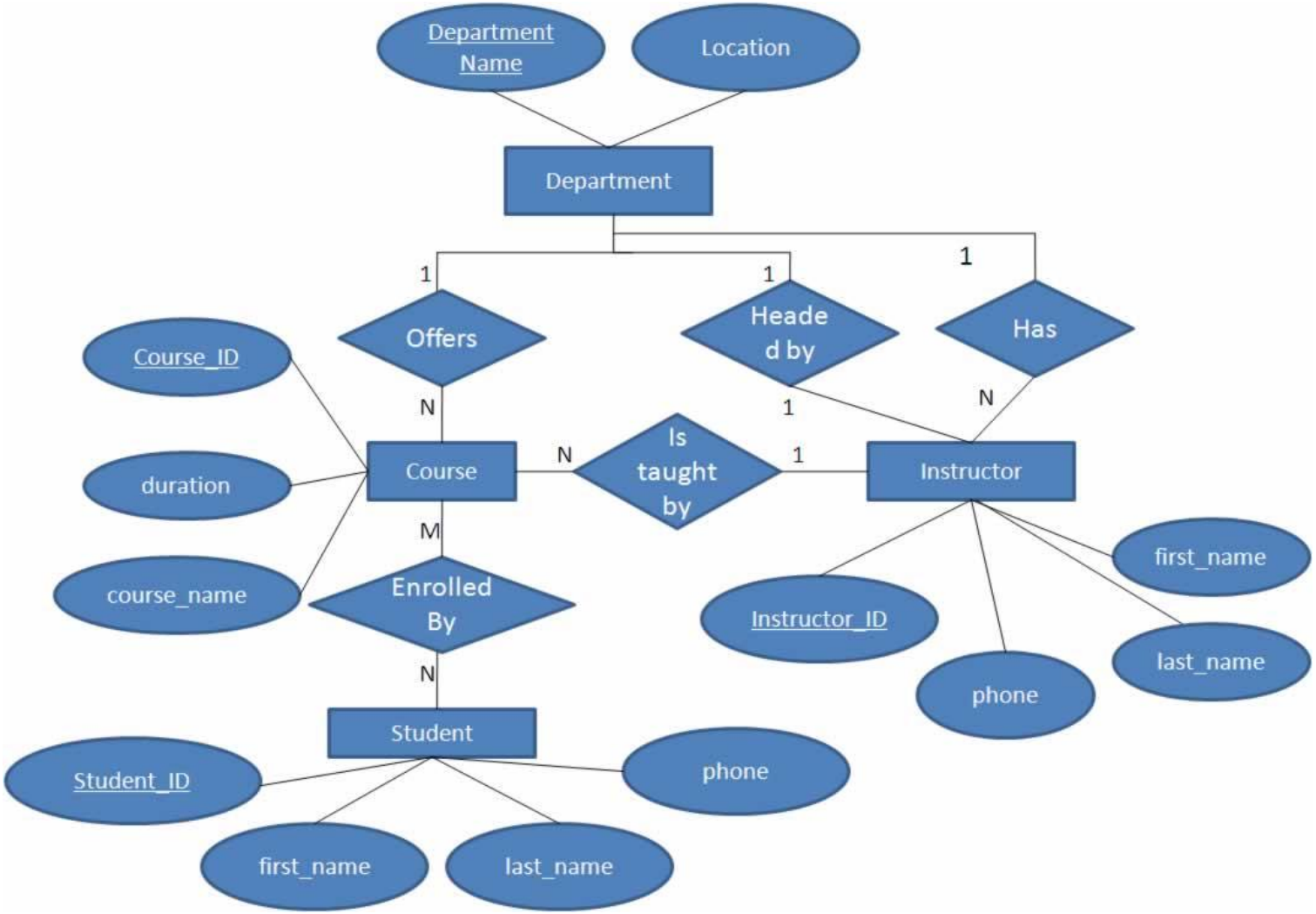
# E-R Diagram Example





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# Bank ERD exercise

The person opens an Account in a Bank and gets a account number and ATM card. The person can make transactions in ATM centers.



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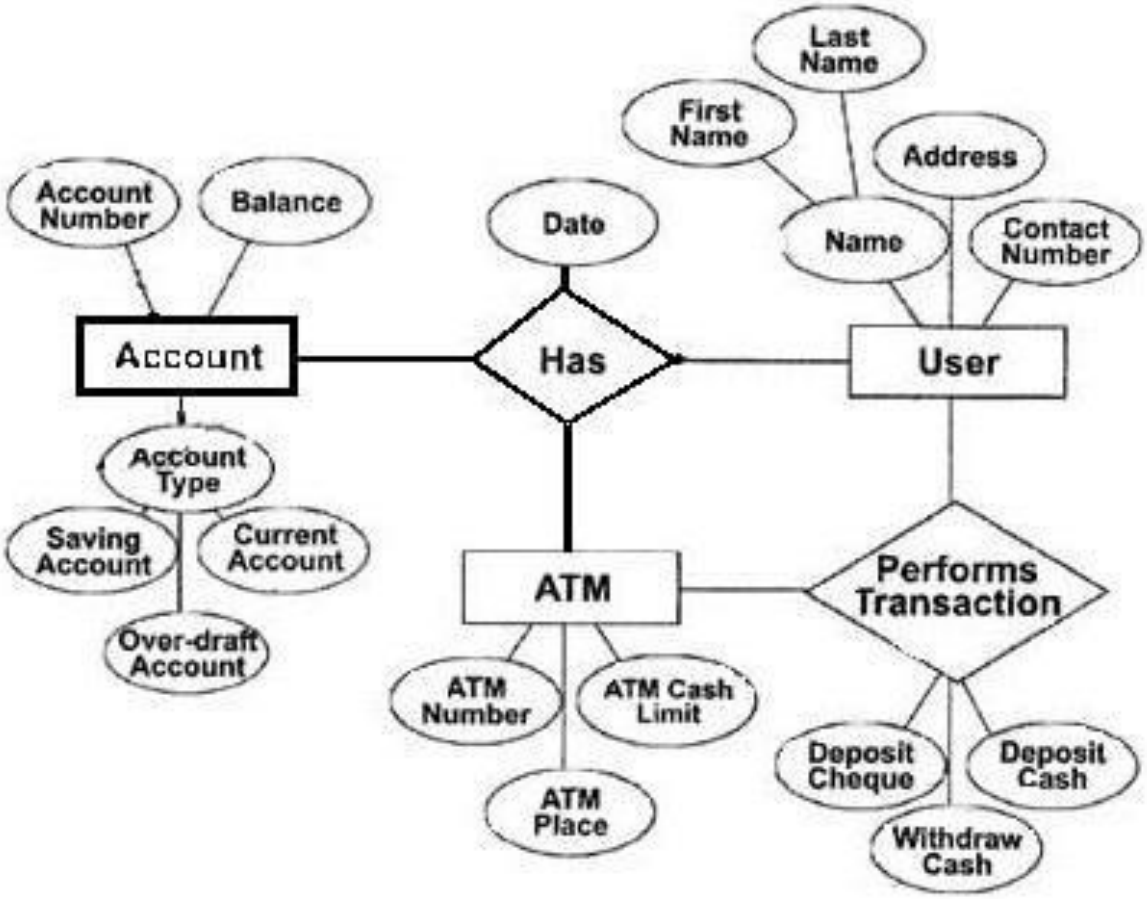
# Bank ERD




ER Diagram of Banking System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# Company ERD exercise

A company has several departments. Each department has a supervisor and at least one employee. Employees must be assigned to at least one, but possibly more departments. At least one employee is assigned to a project, but an employee may be on vacation and not assigned to any projects. The important data fields are the names of the departments, projects, supervisors and employees, as well as the supervisor and employee number and a unique project number.

Note:

1) Supervisor is not an employee.

2) One employee can work on many projects.


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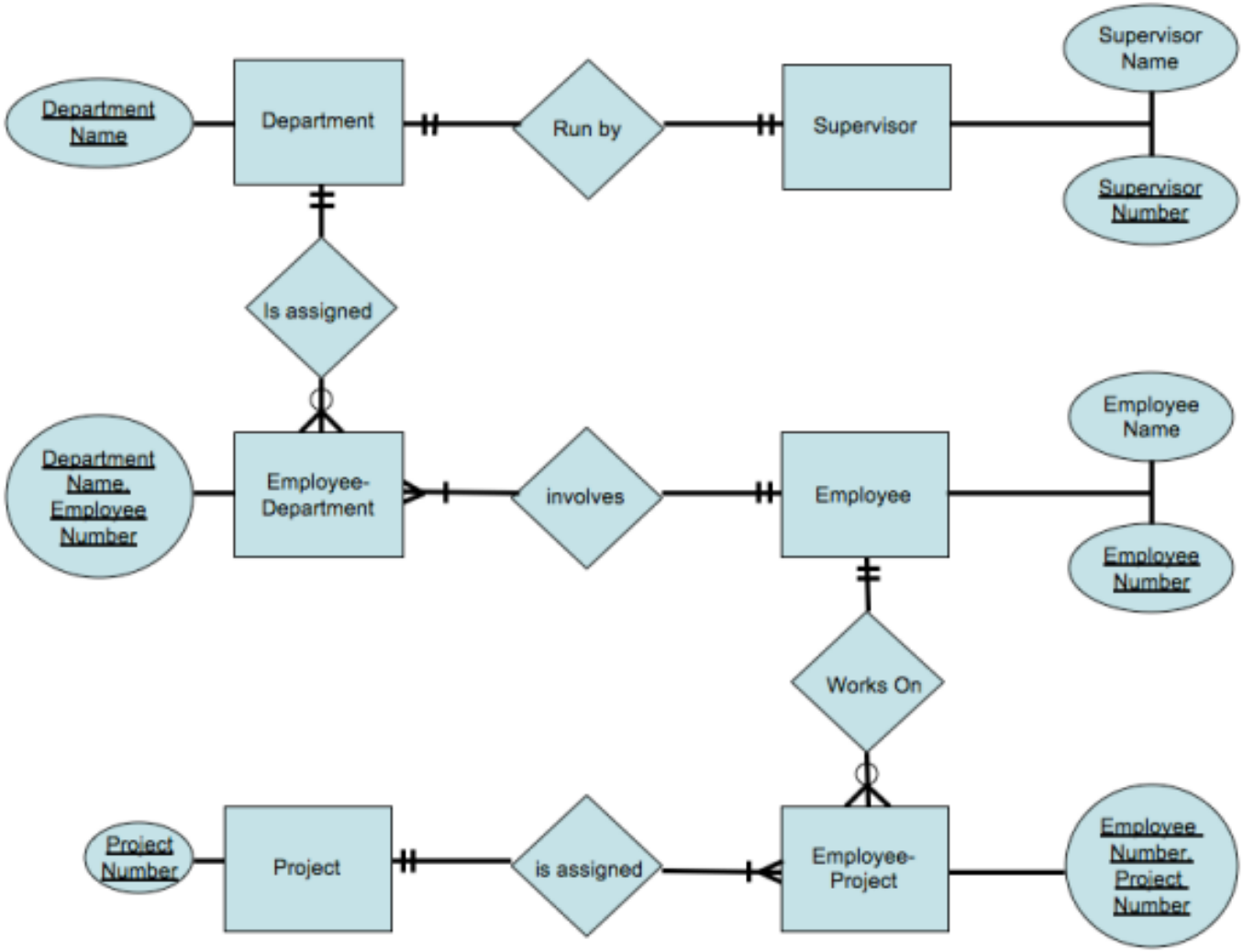
# Company ERD





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# Integrity Constraints

- Integrity means something like 'be right' and consistent. The data in a database must be right and in good condition.
  - Domain Integrity
  - Entity Integrity Constraint
  - Referential Integrity Constraint
  - Foreign Key Integrity Constraint


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# Domain Integrity

- Domain integrity means the definition of a valid set of values for an attribute. You define
  - data type,
  - length or size
  - is null value allowed
  - is the value unique or not
  - for an attribute.
  - You may also define the default value, the range (values in between) and/or specific values for the attribute.



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# Integrity Constraints continue…

- **Entity Integrity Constraint**
  - The entity integrity constraint states that primary keys can't be null. There must be a proper value in the primary key field.
- **Referential Integrity Constraint**
  - The referential integrity constraint is specified between two tables and it is used to maintain the consistency among rows between the two tables.
- **Foreign Key Integrity Constraint**
  - There are two foreign key integrity constraints: cascade update related fields and cascade delete related rows.


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# MODULE 3 :
# DATABASE NORMALIZATION

# Introduction to Normalization

- Database Normalization **is a technique** of organizing the data in the database. Normalization is a systematic approach of decomposing tables to eliminate data redundancy and undesirable characteristics like Insertion, Update and Deletion.



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# Why Normalization?

Database without normalization face the following deviation from standards also called anomalies:

- Insert anomaly
- Update anomaly
- Delete anomaly

Take an example of following PRODUCT table:

| Id | Product_name | Product_cost | Product_location |
|---|---|---|---|
| 1001 | Solar Cooker | 3000 | Pune |
| 1002 | Solar AC | 25000 | Mumbai |
| 1003 | Solar Lamp | 2000 | Kolkata |
| 1004 | Solar Cooker | 3000 | Indore |


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# Why Normalization continued…

- **Insert anomaly:**

Insert Anomaly occurs when certain attributes cannot be inserted into the database without the presence of other attributes. For example we cannot insert new product information into PRODUCT table unless we know the location where we wish to launch it.

- **Update anomaly:**

Update Anomaly exists when one or more instances of duplicated data is updated, but not all. Suppose we want to update the price of ‘Solar Cooker’ in PRODUCT table.



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# Why Normalization continued…

- **Delete anomaly:**

Delete Anomaly exists when certain attributes are lost because of the deletion of other attributes. Suppose we want to delete ‘Mumbai’ manufacturing location then information about ‘Solar AC’ will also be lost.

Thus, in order to overcome the anomalies, we need database normalization.



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# Normalization Rule

- Normalization rule are divided into following normal form.
  - First Normal Form (1NF)
  - Second Normal Form (2NF)
  - Third Normal Form (3NF)
  - BCNF (Boyce and Codd Normal Form)


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# First Normal Form (1NF) continued…

Table will be in 1st normal form if

- There are no duplicated rows in the table.
- Each cell is single-valued (i.e., there are no repeating groups or arrays).
- Entries in a column (attribute, field) are of the same kind.



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# First Normal Form (1NF) continued…

Consider the following table:

| College | Student | Age | Subject |
|---|---|---|---|
| Fergusson | Adam | 15 | Biology, Maths |
| MIT | Alex | 14 | Maths |
| BMCC | Stuart | 17 | Maths |



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# First Normal Form (1NF) continued…

Table after 1st Normal Form:

| College | Student | Age |
|---|---|---|
| Fergusson | Adam | 15 |
| MIT | Alex | 14 |
| BMCC | Stuart | 17 |

| College | Student | Subject |
|---|---|---|
| Fergusson | Adam | Biology |
| Fergusson | Adam | Maths |
| MIT | Alex | Maths |
| BMCC | Stuart | Maths |



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# Second Normal Form (2NF)

- Table should be in 1st Normal Form
- As per the 2NF there must not be **any partial dependency of any column on primary key**
- It means that for a table that has concatenated primary key, each column in the table that is not part of the primary key must depend upon the entire concatenated key for its existence. If any column depends only on one part of the concatenated key, then the table fails **Second normal form**.



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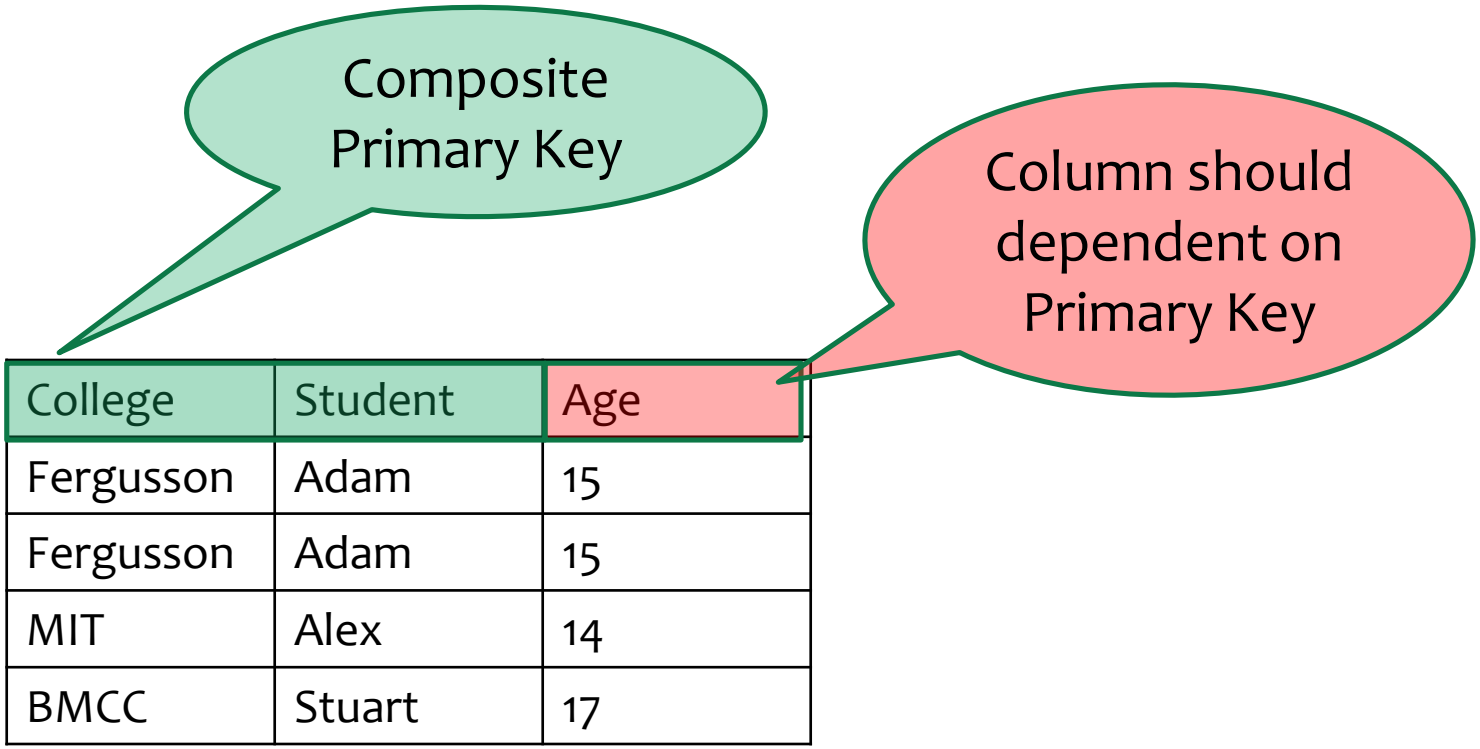
# Second Normal Form (2NF) Continue…




| College | Student | Age |
|---|---|---|
| Fergusson | Adam | 15 |
| Fergusson | Adam | 15 |
| MIT | Alex | 14 |
| BMCC | Stuart | 17 |

Student Table in 1st Normal Form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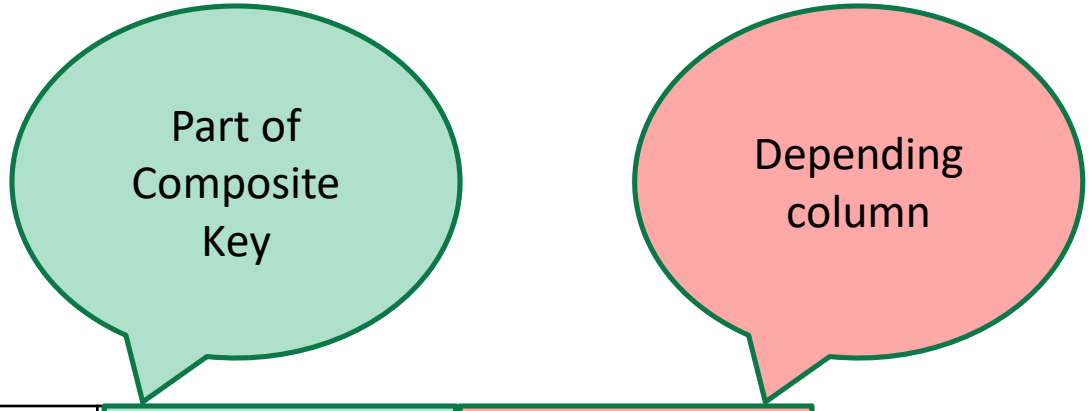
# Second Normal Form (2NF) Continue…




| College | Student | Age |
|---|---|---|
| Fergusson | Adam | 15 |
| Fergusson | Adam | 15 |
| MIT | Alex | 14 |
| BMCC | Stuart | 17 |

Student Table in 1st Normal Form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# Second Normal Form (2NF) Continue…

## Student Table in 1st Normal Form

| College | Student | Age |
|---|---|---|
| Fergusson | Adam | 15 |
| MIT | Alex | 14 |
| BMCC | Stuart | 17 |

**New Student Table following 2NF will be :**

| Student | Age |
|---|---|
| Adam | 15 |
| Alex | 14 |
| Stuart | 17 |

**New Subject Table following 2NF will be :**

| College | Student | Subject |
|---|---|---|
| Fergusson | Adam | Biology |
| Fergusson | Adam | Maths |
| MIT | Alex | Maths |
| BMCC | Stuart | Maths |



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# Third Normal Form (3NF)

- **Third Normal form** applies that every non-prime attribute of table must be dependent on primary key. The *transitive functional dependency* should be removed from the table. The table must be in **Second Normal form**. For example, consider a table with following fields.



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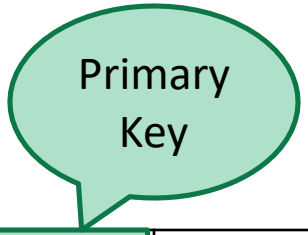
# Example

- Student_Detail Table




| Std_id | Std_name | DOB | Street | city | State | Zip |
|---|---|---|---|---|---|---|
| 1088 | Rahul | 01-Jan-1987 | G.G. Road | Thane | MH | 400601 |
| 1092 | Kiran | 08-Aug-1989 | Karve Road | Dombivali | MH | 4210202 |
| 2010 | Amit | 19-Sep-1984 | G.G. Road | Thane | MH | 400601 |
| 2211 | Geeta | 01-Feb-2000 | Karve Road | Dombivali | MH | 4210202 |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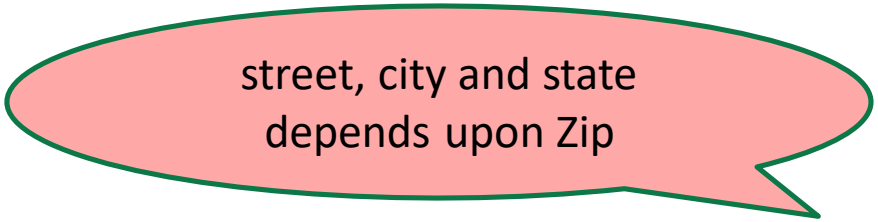
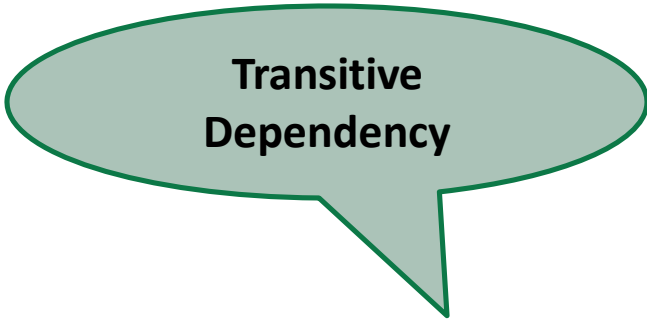
# Example

- Student_Detail Table




| Std_id | Std_name | DOB | Street | city | State | Zip |
|---|---|---|---|---|---|---|
| 1088 | Rahul | 01-Jan-1987 | G.G. Road | Thane | MH | 400601 |
| 1092 | Kiran | 08-Aug-1989 | Karve Road | Dombivali | MH | 4210202 |
| 2010 | Amit | 19-Sep-1984 | G.G. Road | Thane | MH | 400601 |
| 2211 | Geeta | 01-Feb-2000 | Kare Road | Dombivali | MH | 4210202 |



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# Example

- Address Table :

| Student_id | Student_name | DOB | Zip |
|---|---|---|---|
| 1088 | Rahul | 01-Jan-1987 | 400601 |
| 1092 | Kiran | 08-Aug-1989 | 4210202 |
| 2010 | Amit | 19-Sep-1984 | 400601 |
| 2211 | Geeta | 01-Feb-2000 | 4210202 |

| Zip | Street | city | State |
|---|---|---|---|
| 400601 | G.G. Road | Thane | MH |
| 4210202 | Karve Road | Dombivali | MH |

The advantage of removing transitive dependency is,

- Amount of data duplication is reduced.
- Data integrity achieved.


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# BCNF (Boyce-Codd Normal Form)

BCNF is a slightly stronger version of the third normal form (3NF). Hence it is also known as 3.5NF.
A relational schema R is in BCNF if and only if for every one of its dependencies X → Y, at least one of the following conditions hold:

- X → Y is a trivial functional dependency
- X is a super key of schema R



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# BCNF continue...

| Zip | Street | city |
|---|---|---|
| 400601 | G.G. Road | Thane |
| 4210202 | Karve Road | Dombivali |

In the above table, let us examine the relationship Zip > City.
Here Zip is not a super key & hence this relationship may be valid in 3NF but not in BCNF. In order to make it BCNF, we need to create 2 tables:
Table 1: {zip, street}
Table 2: {zip, city}


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# BCNF continue…

| Zip | Street | city |
|---|---|---|
| 400601 | G.G. Road | Thane |
| 4210202 | Karve Road | Dombivali |

| Zip | Street |
|---|---|
| 400601 | G.G. Road |
| 4210202 | Karve Road |

| Zip | city |
|---|---|
| 400601 | Thane |
| 4210202 | Dombivali |



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# Case study

## Project Management Report

**Project Code:** PC010
**Project Title:** Pensions System

**Project Manager:** M Philips
**Project Budget:** $24500

| Employee No | Employee Name | Department No. | Department Name | Hourly Rate |
|---|---|---|---|---|
| S10001 | A Smith | L004 | IT | $22 |
| S10030 | L Jones | L023 | Pensions | $18 |
| S21010 | P Lewis | L004 | IT | $21 |
| S00232 | R Smith | L003 | Programming | $26 |

**Total Staff:** 4

**Average Hourly Rate:** $21.88



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# Case study continued…

## Table in unnormalized form (UNF)

| Project Code | Project Title | Project Manager | Project Budget | Employee No. | Employee Name | Department No. | Department Name | Hourly Rate |
|---|---|---|---|---|---|---|---|---|
| PC010 | Pensions System | M Phillips | 24500 | S10001 | A Smith | L004 | IT | 22.00 |
| PC010 | Pensions System | M Phillips | 24500 | S10030 | L Jones | L023 | Pensions | 18.50 |
| PC010 | Pensions System | M Phillips | 24500 | S21010 | P Lewis | L004 | IT | 21.00 |
| PC045 | Salaries System | H Martin | 17400 | S10010 | B Jones | L004 | IT | 21.75 |
| PC045 | Salaries System | H Martin | 17400 | S10001 | A Smith | L004 | IT | 18.00 |
| PC045 | Salaries System | H Martin | 17400 | S31002 | T Gilbert | L028 | Database | 25.50 |
| PC045 | Salaries System | H Martin | 17400 | S13210 | W Richards | L008 | Salary | 17.00 |
| PC064 | HR System | K Lewis | 12250 | S31002 | T Gilbert | L028 | Database | 23.25 |
| PC064 | HR System | K Lewis | 12250 | S21010 | P Lewis | L004 | IT | 17.50 |
| PC064 | HR System | K Lewis | 12250 | S10034 | B James | L009 | HR | 16.50 |


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# Case study continued…

## Table after 1st Normal Form (1NF) Repeating Attributes Removed

| Project Code | Project Title | Project Manager | Project Budget |
|---|---|---|---|
| PC010 | Pensions System | M Phillips | 24500 |
| PC045 | Salaries System | H Martin | 17400 |
| PC064 | HR System | K Lewis | 12250 |

| Project Code | Employee No. | Employee Name | Department No. | Department Name | Hourly Rate |
|---|---|---|---|---|---|
| PC010 | S10001 | A Smith | L004 | IT | 22.00 |
| PC010 | S10030 | L Jones | L023 | Pensions | 18.50 |
| PC010 | S21010 | P Lewis | L004 | IT | 21.00 |
| PC045 | S10010 | B Jones | L004 | IT | 21.75 |
| PC045 | S10001 | A Smith | L004 | IT | 18.00 |
| PC045 | S31002 | T Gilbert | L028 | Database | 25.50 |
| PC045 | S13210 | W Richards | L008 | Salary | 17.00 |
| PC064 | S31002 | T Gilbert | L028 | Database | 23.25 |
| PC064 | S21010 | P Lewis | L004 | IT | 17.50 |
| PC064 | S10034 | B James | L009 | HR | 16.50 |


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# Case study continued…

## Table after 2nd Normal Form (2NF) Partial Key Dependencies Removed

| Project Code | Project Title | Project Manager | Project Budget |
|---|---|---|---|
| PC010 | Pensions System | M Phillips | 24500 |
| PC045 | Salaries System | H Martin | 17400 |
| PC064 | HR System | K Lewis | 12250 |

| Project Code | Employee No. | Hourly Rate |
|---|---|---|
| PC010 | S10001 | 22.00 |
| PC010 | S10030 | 18.50 |
| PC010 | S21010 | 21.00 |
| PC045 | S10010 | 21.75 |
| PC045 | S10001 | 18.00 |
| PC045 | S31002 | 25.50 |
| PC045 | S13210 | 17.00 |
| PC064 | S31002 | 23.25 |
| PC064 | S21010 | 17.50 |
| PC064 | S10034 | 16.50 |

| Employee No. | Employee Name | Department No. | Department Name |
|---|---|---|---|
| S10001 | A Smith | L004 | IT |
| S10030 | L Jones | L023 | Pensions |
| S21010 | P Lewis | L004 | IT |
| S10010 | B Jones | L004 | IT |
| S31002 | T Gilbert | L028 | Database |
| S13210 | W Richards | L008 | Salary |
| S10034 | B James | L009 | HR |



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# Case study continued…

## Table after 3rd Normal Form (3NF) Removed transitive dependency

| Project Code | Project Title | Project Manager | Project Budget |
|---|---|---|---|
| PC010 | Pensions System | M Phillips | 24500 |
| PC045 | Salaries System | H Martin | 17400 |
| PC064 | HR System | K Lewis | 12250 |

| Project Code | Employee No. | Hourly Rate |
|---|---|---|
| PC010 | S10001 | 22.00 |
| PC010 | S10030 | 18.50 |
| PC010 | S21010 | 21.00 |
| PC045 | S10010 | 21.75 |
| PC045 | S10001 | 18.00 |
| PC045 | S31002 | 25.50 |
| PC045 | S13210 | 17.00 |
| 064 | S31002 | 23.25 |
| PC064 | S21010 | 17.50 |
| PC064 | S10034 | 16.50 |

| Department No. | Department Name |
|---|---|
| L004 | IT |
| L023 | Pensions |
| L028 | Database |
| L008 | Salary |
| L009 | HR |

| Employee No. | Employee Name | Department No. * |
|---|---|---|
| S10001 | A Smith | L004 |
| S10030 | L Jones | L023 |
| S21010 | P Lewis | L004 |
| S10010 | B Jones | L004 |
| S31002 | T Gilbert | L023 |
| S13210 | W Richards | L008 |
| S10034 | B James | L0009 |


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# MODULE 4:
# GETTING STARTED WITH MYSQL

# Introduction to Databases

| EMPNO | ENAME | JOB | MANAGER | HIREDATE | SALARY | COMMISSION | DEPTNO |
|---|---|---|---|---|---|---|---|
| 7369 | SMITH | CLERK | 7902 | 17-DEC-1980 | 800 | | 20 |
| 7499 | ALLEN | SALESMAN | 7698 | 20-FEB-1981 | 1600 | 300 | 30 |
| 7521 | WARD | SALESMAN | 7698 | 22-FEB-1981 | 1250 | 500 | 30 |
| 7566 | JONES | MANAGER | 7839 | 02-APR-1981 | 2975 | | 20 |
| 7654 | MARTIN | SALESMAN | 7698 | 28-SEP-1981 | 1250 | 1400 | 30 |
| 7698 | BLAKE | MANAGER | 7839 | 01-MAY-1981 | 2850 | | 30 |
| 7782 | CLARK | MANAGER | 7839 | 09-JUN-1981 | 2450 | 0 | 10 |
| 7788 | SCOTT | ANALYST | 7566 | 19-APR-1987 | 3000 | | 20 |

Computerized record-keeping system



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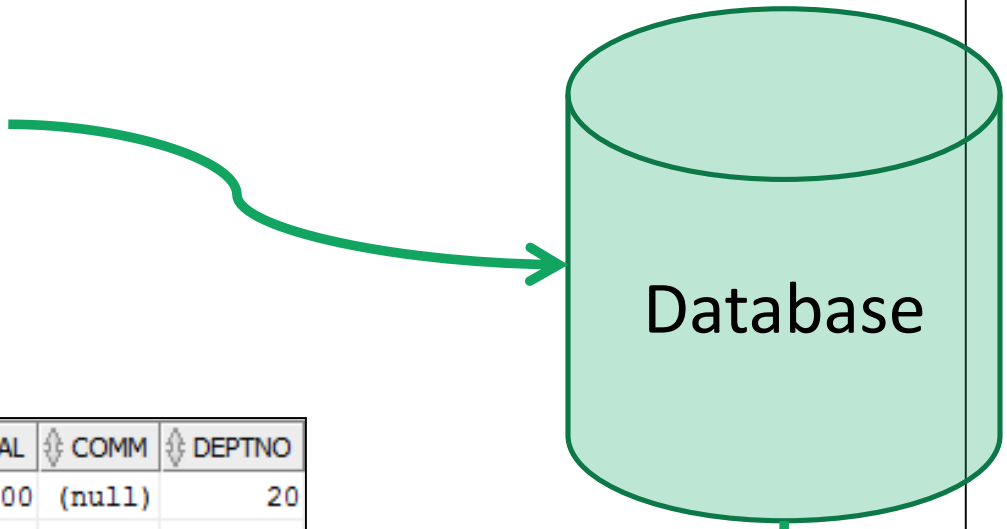
# Introducing SQL

SQL statement entered

Select * from Emp




| EMPNO | ENAME | JOB | MGR | HIREDATE | SAL | COMM | DEPTNO |
|---|---|---|---|---|---|---|---|
| 7369 | SMITH | CLERK | 7902 | 17-DEC-80 | 800 | (null) | 20 |
| 7499 | ALLEN | SALESMAN | 7698 | 20-FEB-81 | 1600 | 300 | 30 |
| 7521 | WARD | SALESMAN | 7698 | 22-FEB-81 | 1250 | 500 | 30 |
| 7566 | JONES | MANAGER | 7839 | 02-APR-81 | 2975 | (null) | 20 |
| 7654 | MARTIN | SALESMAN | 7698 | 28-SEP-81 | 1250 | 1400 | 30 |
| 7698 | BLAKE | MANAGER | 7839 | 01-MAY-81 | 2850 | (null) | 30 |
| 7782 | CLARK | MANAGER | 7839 | 09-JUN-81 | 2450 | (null) | 10 |
| 7788 | SCOTT | ANALYST | 7566 | 19-APR-87 | 3000 | (null) | 20 |
| 7839 | KING | PRESIDENT | (null) | 17-NOV-81 | 5000 | (null) | 10 |
| 7844 | TURNER | SALESMAN | 7698 | 08-SEP-81 | 1500 | 0 | 30 |
| 7876 | ADAMS | CLERK | 7788 | 23-MAY-87 | 1100 | (null) | 20 |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# Create Database

- To create database use following command

```
create database database_name;
```

- Connect to created database to create tables.

```
connect database_name;
```

```
create database mydatabase;
connect mydatabase;
```


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# Data Types

- MySQL uses many different data types broken into three categories
  - Numeric
  - Date and Time
  - String Types.


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# Numeric Data Types

| Data Type | Description |
|---|---|
| Int | If signed, the allowable range is from -2147483648 to 2147483647. If unsigned, the allowable range is from 0 to 4294967295. specify a width of up to 11 digits. |
| Tinyint | If signed, the allowable range is from -128 to 127. If unsigned, the allowable range is from 0 to 255. specify a width of up to 4 digits. |
| Smallint | If signed, the allowable range is from -32768 to 32767. If unsigned, the allowable range is from 0 to 65535. specify a width of up to 5 digits. |
| Mediumint | If signed, the allowable range is from -8388608 to 8388607. If unsigned, the allowable range is from 0 to 16777215. You can specify a width of up to 9 digits. |
| Bigint | If signed, the allowable range is from -9223372036854775808 to 9223372036854775807. If unsigned, the allowable range is from 0 to 18446744073709551615. You can specify a width of up to 20 digits. |
| Float | A floating-point number that cannot be unsigned. default to 10,2, where 2 is the number of decimals and 10 is the total number of digits |
| Double | A double precision floating-point number that cannot be unsigned. default to 16,4, where 4 is the number of decimals. |


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# Date and Time Types

| Data Type | Description |
|---|---|
| Date | A date in YYYY-MM-DD format, between 1000-01-01 and 9999-12-31. |
| DateTime | A date and time combination in YYYY-MM-DD HH:MM:SS format, between 1000-01-01 00:00:00 and 9999-12-31 23:59:59. |
| Timestamp | A timestamp between midnight, January 1st, 1970 and sometime in 2037. |
| Time | Stores the time in a HH:MM:SS format. |
| year | Stores a year in a 2-digit or a 4-digit format. |


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# String Types

| Data Type | Description |
|---|---|
| Char | A fixed-length string between 1 and 255 characters in length |
| Varchar | A variable-length string between 1 and 255 characters in length. |
| Blob or text | A field with a maximum length of 65535 characters. BLOBs are "Binary Large Objects" and are used to store large amounts of binary data, such as images or other types of files. |
| Tinyblob or tinytext | A BLOB or TEXT column with a maximum length of 255 characters. |
| Mediumblob or mediumtext | A BLOB or TEXT column with a maximum length of 16777215 characters. |
| Longblob or longtext | A BLOB or TEXT column with a maximum length of 4294967295 characters. |
| enum | a list of items from which the value must be selected |


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# Create tables

- A generic SQL syntax to create a MySQL table

```
CREATE TABLE table_name (column_name
column_type);
```

```
CREATE TABLE emp(
        ID int(5),
        name  varchar(20),
        salary double(8,2 )
);
```


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# Drop MySQL Tables

- A generic SQL syntax to drop a MySQL table

```
DROP TABLE table_name;
```


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# Insert data in table

- Following command is used to insert record in table

```
INSERT INTO table_name ( field1,
field2,...fieldN ) VALUES ( value1,
value2,...valueN );
```


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# Customized Insertion

```
INSERT INTO emp (empno, sal, ename)
VALUES(1051, 5000, 'Sunil');

INSERT INTO RESEARCH_EMP
SELECT  * FROM  employee WHERE deptno=20;

Create table RESEARCH_EMP
As
SELECT  * FROM  employee WHERE deptno=20;
```


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# MODULE 5:
# DATA RETRIEVAL & ORDERING OUTPUT

# Describing table

DESC dept

| Name | Null | Type |
| --- | --- | --- |
| DEPTNO | NOT NULL | NUMBER(2) |
| DNAME | | VARCHAR2(14) |
| LOC | | VARCHAR2(13) |
| BUDGET | | NUMBER |


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# Data Retrieval

```
SELECT  * FROM  emp;

SELECT  empno, ename FROM emp;

SELECT  distinct deptno FROM emp;
```


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# Conditional Retrieval

```
SELECT  * FROM  emp WHERE sal > 35000;

SELECT   empno, ename FROM emp WHERE
deptno = 20;
```


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# Relational Operators

- = equal to
- != not equal to
- ^= not equal to
- <> not equal to
- > greater than
- < less than
- >= greater than or equal to
- <= less than or equal to

```
SELECT * FROM emp
WHERE sal> 3000;

SELECT ename FROM
emp WHERE
deptno!= 10;

SELECT * FROM
employee WHERE
ename = 'ALLEN';
```


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# Logical Operators

- The AND Operator

```
SELECT  * FROM  emp  WHERE deptno = 10 AND job =
'SALESMAN';
SELECT  * FROM  emp WHERE sal >= 3000 AND sal <= 4000;
```

- The OR Operator

```
SELECT  * FROM  emp WHERE deptno = 20 OR deptno = 10;
```

- The NOT Operator

```
SELECT  * FROM  employee WHERE NOT deptno = 10;
```


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# Range & List Operators

- The BETWEEN operator

```
SELECT  * FROM  emp WHERE sal BETWEEN 3000 and 4000;
SELECT  * FROM  emp  WHERE hiredate BETWEEN '01-JAN-80'  and '31-DEC-89’;
```

- The IN operator

```
SELECT  * FROM  emp WHERE deptno IN (10,20);
SELECT  * FROM  emp WHERE deptno NOT IN (10,20);
```


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# Wildcard & is Null  Operators

- The LIKE operator

```
SELECT  * FROM  emp WHERE ename LIKE ‘J%';
SELECT  * FROM  emp WHERE ename LIKE '%AD';
SELECT  * FROM  emp WHERE ename LIKE  '%AD%';
SELECT  * FROM  emp WHERE grade LIKE ‘A____';
```

- The IS NULL operator

```
SELECT  * FROM  emp WHERE comm IS NULL;
SELECT  * FROM  emp WHERE comm IS NOT NULL;
```



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# Arithmetic Operators

- + addition
- - subtraction
- * multiplication
- / division

```
SELECT  * FROM  emp WHERE sal + com >
3000 and comm is not null;

SELECT  ename, sal + comm FROM emp
WHERE comm is not null;

SELECT  ename, sal+ comm “Total
Earning” FROM emp WHERE comm is not
null;
```


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# Sorting Output

- Ordering on single column

```
SELECT  * FROM  emp ORDER BY empno;
SELECT  * FROM  emp WHERE deptno= 10 ORDER BY ename;
SELECT  * FROM  emp ORDER BY sal DESC;
```

- Ordering on multiple columns

```
SELECT  * FROM  emp ORDER BY depno, ename;
SELECT  * FROM  emp ORDER BY deptno, job DESC;
```


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# Aggregate Functions

```
SELECT  COUNT (*) FROM emp;
SELECT  SUM (sal) FROM emp;
SELECT  AVG (sal) FROM emp;
SELECT  MAX (sal) FROM emp;
SELECT  MIN (sal) FROM emp;
SELECT  * FROM  employee WHERE salary = (SELECT  MIN
(salary) FROM employee);
```



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# The GROUP BY clause

```
SELECT  deptno, sum (sal)
FROM emp
GROUP BY deptno;
```



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# The HAVING Clause

```
SELECT  deptno, sum (sal) FROM emp
GROUP BY deptno
HAVING sum (sal) > 7000;
```

```
SELECT  deptno, sum (sal)
FROM emp
WHERE deptno in (10, 30)
GROUP BY deptno
HAVING sum (sal) > 8000
ORDER BY sum (sal) desc;
```


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# Modifying and Deleting Data

```
UPDATE emp SET sal = sal + 100;
UPDATE emp SET sal = sal + 200 WHERE deptno= 10;

DELETE FROM emp;
DELETE FROM emp WHERE deptno = 30;
```



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# MODULE 6:
# MODIFYING TABLE STRUCTURE

# Modifying a Table Structure

```
ALTER table emp
ADD (age number (2));

ALTER table emp
MODIFY (age number (3));

ALTER table emp DROP column age;

ALTER table employee DROP (comm, age);
```


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# Dropping a Table

**DROP TABLE table-name;**

**DROP table dept;**



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# MODULE 7: INTEGRITY CONSTRAINTS

# Integrity Constraints

- Not Null
- Unique
- Primary Key
- Foreign Key


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# Column Constraints

```
CREATE TABLE employee (
        empno int (5) NOT NULL,
        ename varchar (25) NOT NULL,
        deptno varchar (4) );
```


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# UNIQUE Constraints

```
CREATE TABLE emp(
        empno int (5)  CONSTRAINT emp_uq UNIQUE,
        ename varchar (25) CONSTRAINT emp_null NOT NULL );

SELECT  constraint_name FROM USER_CONSTRAINTS
        WHERE table_name = 'EMP';
```


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# Primary key Constraint

```
CREATE TABLE supplier (
        supp_code int (4) CONSTRAINT code_pk PRIMARY KEY,
        supp_name varchar (30)  CONSTRAINT name_uq
UNIQUE
);

CREATE TABLE supplier (
        supp_code int (4)
        CONSTRAINT  code_pk PRIMARY KEY,
        supp_name varchar (30)
        CONSTRAINT  name_uq UNIQUE
        CONSTRAINT  name_null NOT NULL
);
```


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# Adding Constraints to Columns of an existing Table

```
ALTER TABLE emp
MODIFY (
        hiredate constraint emp_hiredate not null
);

ALTER TABLE dept
ADD
CONSTRAINT cd_pk PRIMARY KEY (deptno);

ALTER TABLE emp
ADD
        CONSTRAINT cd_fk
        FOREIGN KEY(dept_code) REFERENCES dept (deptno);
```


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# Dropping a Constraint

```
ALTER TABLE emp
        DROP CONSTRAINT hiredate;

ALTER TABLE employee
        DROP CONSTRAINT hiredate CASCADE;

ALTER TABLE dept
        DROP COLUMN depno
         CASCADE CONSTRAINTS;
```


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# MODULE 8: JOINS & SUB QUERIES

# SQL Joins

- SQL Joins are used to **relate information in different tables**. A Join condition is a part of the sql query that **retrieves rows from two or more tables**.
- A SQL Join condition is used in the SQL WHERE Clause of select, update, delete statements.

**The Syntax for joining two tables is:**

```
SELECT col1, col2, col3...
FROM table_name1, table_name2
WHERE table_name1.col2 = table_name2.col1;
```


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# Types of Joins

- SQL Inner Join
- SQL Outer Join
  - Left
  - Right
  - full
- SQL Self Join


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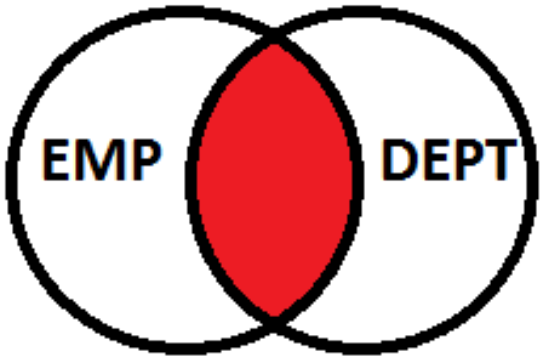
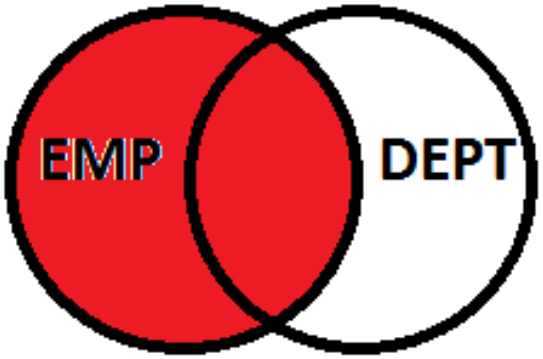
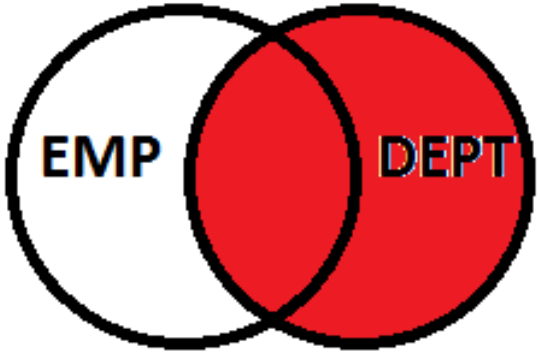
# Types of Joins continue…



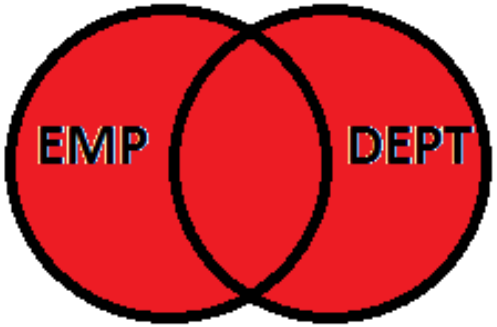

Inner Join




Left Outer Join




Right Outer Join




Full Join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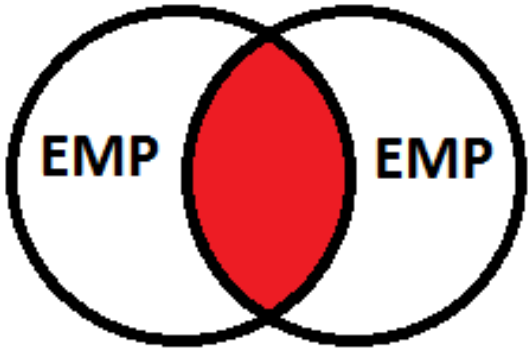
# Types of Joins continue…




**Self Join**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# SQL Inner Join (Equi Join)

Show the employees with their department name who are associated with any department.

```
SELECT  ename, dname
        FROM EMP JOIN DEPT
        ON dept.dept_code = emp.dept_code;
```



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# Outer Join

**Right Outer Join:** Show the employees with their department name who are associated with any department along with departments with no employees associated.

```
SELECT  a.empno, a.deptno, b.dname
        FROM emp a RIGHT OUTER JOIN dept b
        ON (a.deptno=b.deptno);
```

**Left Outer Join:** Show the employees with their department name whether or not they are associated with any department.

```
SELECT  a.empno, a.deptno, b.dname
        FROM emp a LEFT OUTER JOIN dept b
        ON (a.deptno=b.deptno);
```


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# Outer Join continue…

**Self Join:** Show the employees with their department name irrespective whether employees associated with departments or departments associated with employees.

```
SELECT  a.empno, a.deptno, b.dname
        FROM emp a FULL OUTER JOIN dept b
        ON (a.deptno=b.deptno);
```



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# Self Join

Show the employees with their manager's name.

```
SELECT  employee.ename, manager.ename
        FROM emp employee join emp manager
        on emloyee.mgr = manager.empno;
```



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# SUBQUERIES

- Subquery is a query within a query.
- Subquery can be nested inside SELECT, INSERT, UPDATE, or DELETE statements.
- Subqueries must be enclosed within parentheses.
- There are three types of subqueries:
  1. Single Row Sub Query
  2. Multiple Row Sub Query
  3. Correlated Sub Query



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# Subquery Types

- Single Row Sub Query

  Single row subquery always returns a single row with single column only.

  SELECT order_name order_price FROM Orders where order_price = (SELECT MAX(order_price) FROM Orders)

- Multiple Row Sub Query

  Multiple row sub query returns more than one row. Hence it is generally handled using IN comparison operator.

  SELECT order_name order_price FROM Orders where item_id IN (SELECT itemId FROM Items where item_price > 1000)



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# Subquery Types

- Correlated Sub Query

  In correlated subquery the inner query depends on values provided by the outer query.

```
SELECT EMPLOYEE_ID, salary, department_id
FROM   employees E
WHERE salary > (SELECT AVG(salary)
                FROM   EMP T
                WHERE E.department_id = T.department_id)
```


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# SUBQUERIES

```
SELECT  * FROM  orders
        WHERE cust_code IN (
        SELECT  cust_code FROM customer
        WHERE city_code = 'PUNE‘ );

SELECT  * FROM  dept
        WHERE EXISTS (
        SELECT  * FROM  emp
        WHERE emp.deptno = dept.deptno);

SELECT  * FROM  dept
        WHERE NOT EXISTS (
        SELECT  * FROM  employee
        WHERE employee.dept_code = dept.dept_code);
```


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# THANK YOU

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