## Introduction

MySQL is an open-source relational database management system (RDBMS) widely used for storing and managing data. It is known for its reliability, performance, scalability, and ease of use, making it a popular choice for developers and organizations of all sizes.

In my mini project, I have created a database named Corp Manager, which refers to a company management system. This project is designed to manage important company information such as departments, employees, company projects, and employee project assignments. Each entity in the database serves a specific purpose. The Departments table stores the different departments available in the company, the Employees table keeps records of all employees, and the Projects and Employee Projects tables manage the company's projects and the employees working on them.

This system is beneficial because it helps organize and maintain company data in an effective and structured way, making it easier to access and manage information efficiently.

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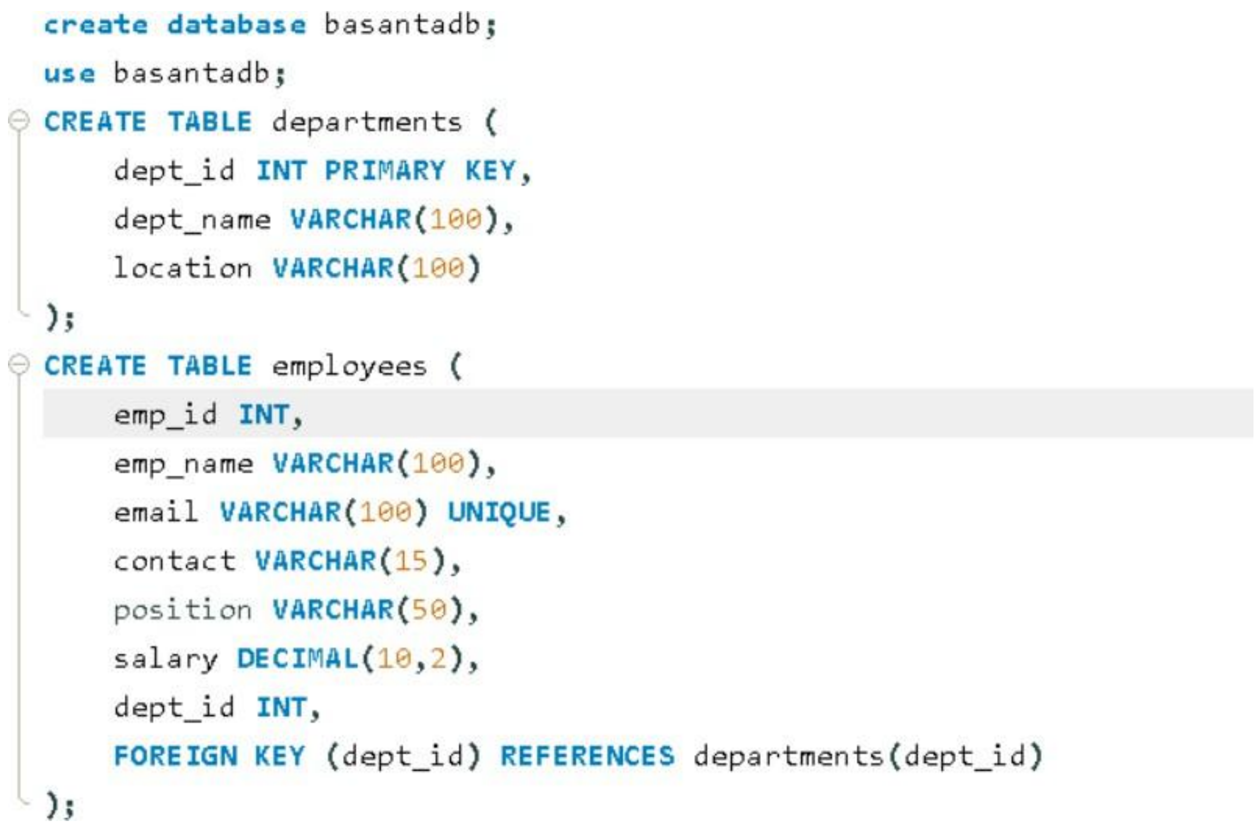
## Lab session works

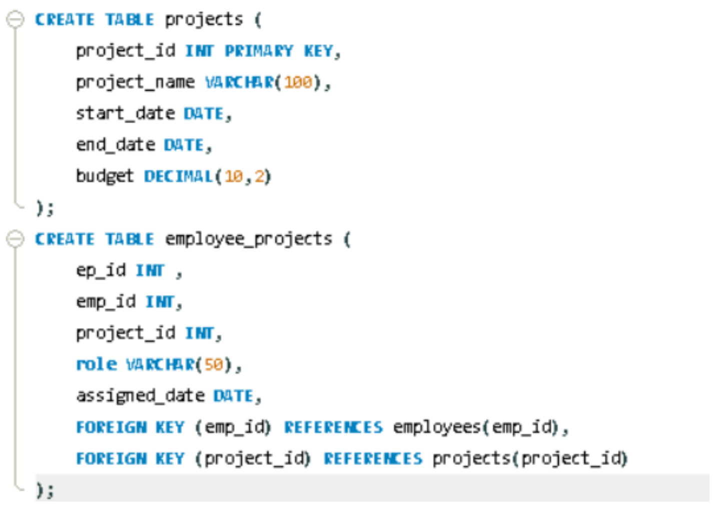
- General SQL table creation and insertion value

I have created a database called basantadb. In this database I created four tables departments employees, employees projects and projects having the  different attributes.

**SQL Query:**



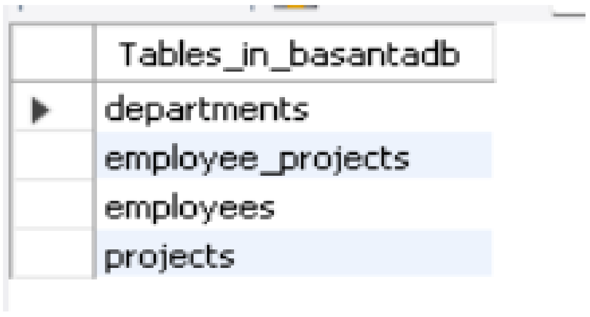
```
create database basantadb;
use basantadb;
CREATE TABLE departments (
    dept_id INT PRIMARY KEY,
    dept_name VARCHAR(100),
    location VARCHAR(100)
);
CREATE TABLE employees (
    emp_id INT,
    emp_name VARCHAR(100),
    email VARCHAR(100) UNIQUE,
    contact VARCHAR(15),
    position VARCHAR(50),
    salary DECIMAL(10,2),
    dept_id INT,
    FOREIGN KEY (dept_id) REFERENCES departments(dept_id)
);
```



```
CREATE TABLE projects (
    project_id INT PRIMARY KEY,
    project_name VARCHAR(100),
    start_date DATE,
    end_date DATE,
    budget DECIMAL(10,2)
);
CREATE TABLE employee_projects (
    ep_id INT ,
    emp_id INT,
    project_id INT,
    role VARCHAR(50),
    assigned_date DATE,
    FOREIGN KEY (emp_id) REFERENCES employees(emp_id),
    FOREIGN KEY (project_id) REFERENCES projects(project_id)
);
```

## Outputs:

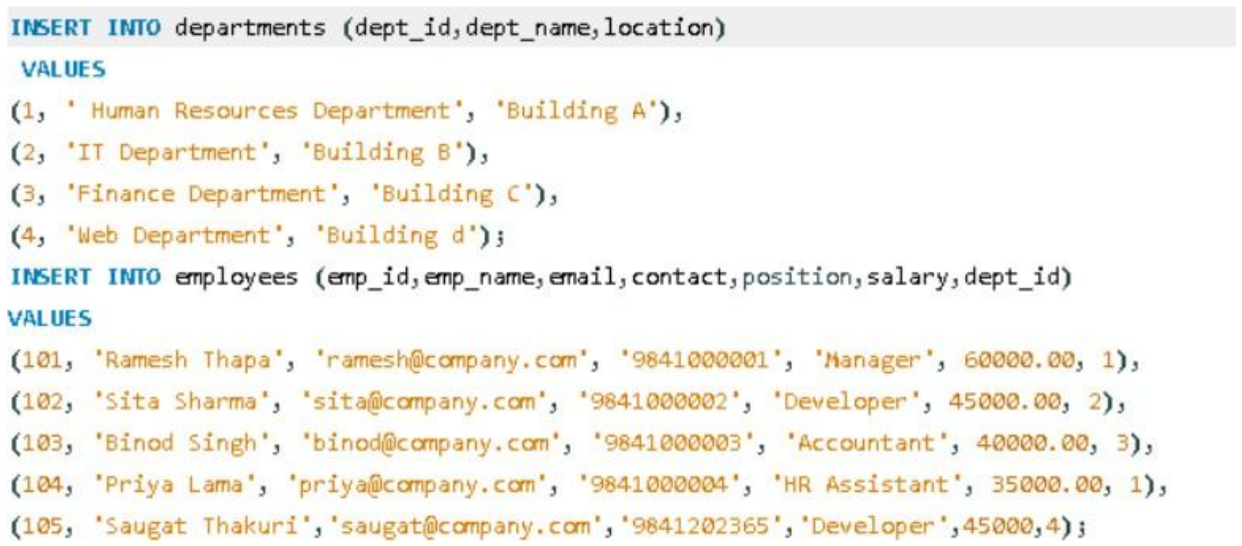
This shows the tables I have created in MY SQL workbench.



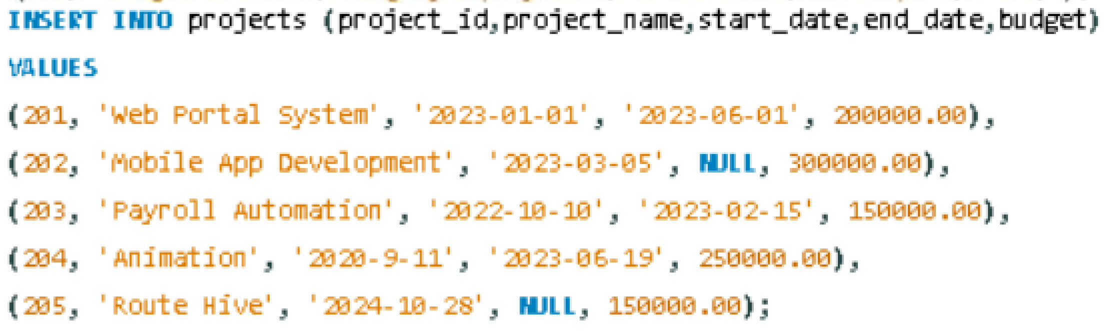
| Tables_in_basantadb |
|---|
| departments |
| employee_projects |
| employees |
| projects |

I have inserted some values in the table having the four  tables according to their attributes described like table department uses the attributes department id ,department name, location and table employees uses employees name, id, salary, email, contact number and projects has attributes like project id, project name, start date end date, budget and employee project has ep id, emp id,  projec id, role, assigned date.

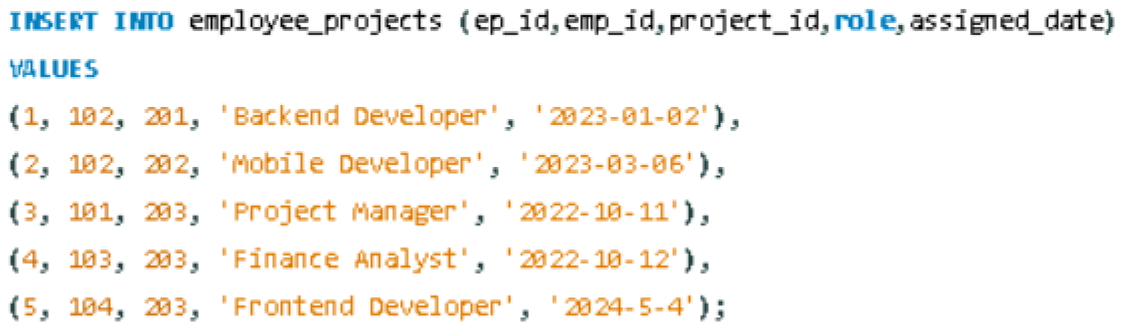
## SQL Query:



```sql
INSERT INTO departments (dept_id,dept_name,location)
 VALUES
(1, ' Human Resources Department', 'Building A'),
(2, 'IT Department', 'Building B'),
(3, 'Finance Department', 'Building C'),
(4, 'Web Department', 'Building d');
INSERT INTO employees (emp_id,emp_name,email,contact,position,salary,dept_id)
VALUES
(101, 'Ramesh Thapa', 'ramesh@company.com', '9841000001', 'Manager', 60000.00, 1),
(102, 'Sita Sharma', 'sita@company.com', '9841000002', 'Developer', 45000.00, 2),
(103, 'Binod Singh', 'binod@company.com', '9841000003', 'Accountant', 40000.00, 3),
(104, 'Priya Lama', 'priya@company.com', '9841000004', 'HR Assistant', 35000.00, 1),
(105, 'Saugat Thakuri','saugat@company.com','9841202365','Developer',45000,4);
```

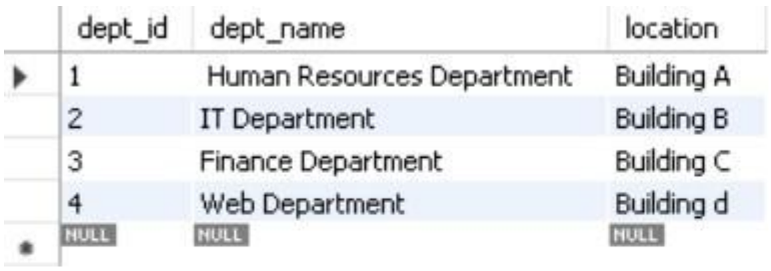


```sql
INSERT INTO projects (project_id,project_name,start_date,end_date,budget)
VALUES
(201, 'Web Portal System', '2023-01-01', '2023-06-01', 200000.00),
(202, 'Mobile App Development', '2023-03-05', NULL, 300000.00),
(203, 'Payroll Automation', '2022-10-10', '2023-02-15', 150000.00),
(204, 'Animation', '2020-9-11', '2023-06-19', 250000.00),
(205, 'Route Hive', '2024-10-28', NULL, 150000.00);
```

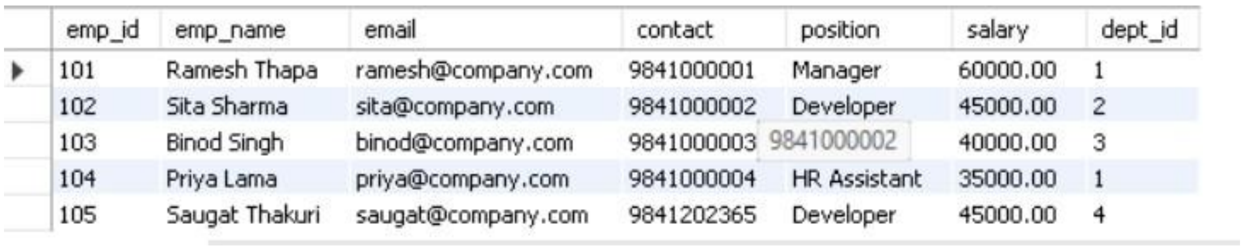


```sql
INSERT INTO employee_projects (ep_id,emp_id,project_id,role,assigned_date)
VALUES
(1, 102, 201, 'Backend Developer', '2023-01-02'),
(2, 102, 202, 'Mobile Developer', '2023-03-06'),
(3, 101, 203, 'Project Manager', '2022-10-11'),
(4, 103, 203, 'Finance Analyst', '2022-10-12'),
(5, 104, 203, 'Frontend Developer', '2024-5-4');
```

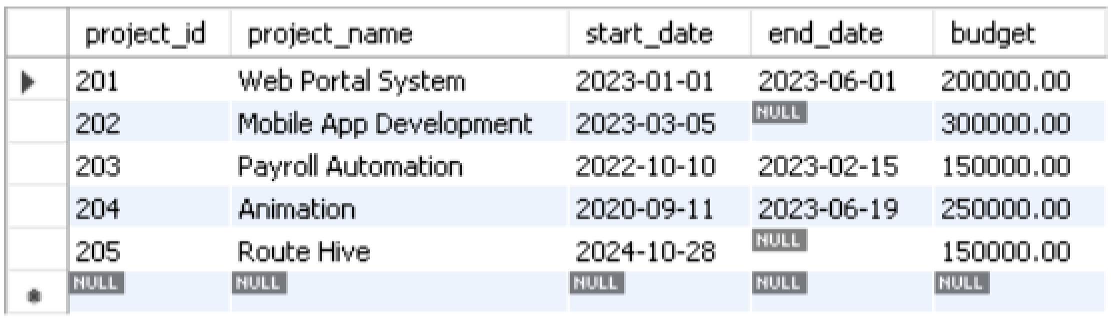
**Output:**



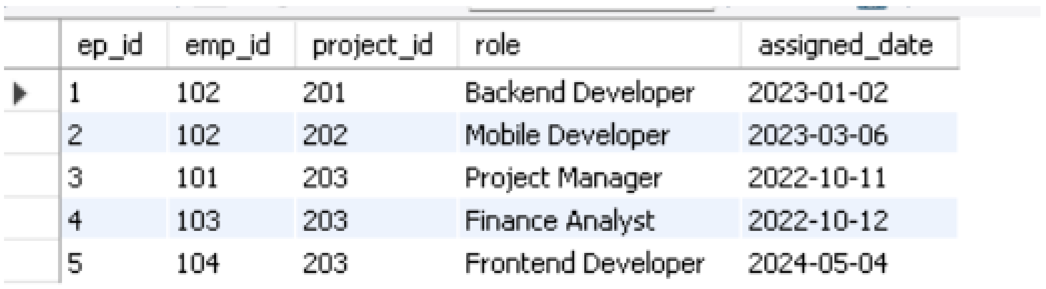
| | dept_id | dept_name | location |
|---|---|---|---|
| ▶ | 1 | Human Resources Department | Building A |
| | 2 | IT Department | Building B |
| | 3 | Finance Department | Building C |
| | 4 | Web Department | Building d |
| * | NULL | NULL | NULL |



| | emp_id | emp_name | email | contact | position | salary | dept_id |
|---|---|---|---|---|---|---|---|
| ▶ | 101 | Ramesh Thapa | ramesh@company.com | 9841000001 | Manager | 60000.00 | 1 |
| | 102 | Sita Sharma | sita@company.com | 9841000002 | Developer | 45000.00 | 2 |
| | 103 | Binod Singh | binod@company.com | 9841000003 | 9841000002 | 40000.00 | 3 |
| | 104 | Priya Lama | priya@company.com | 9841000004 | HR Assistant | 35000.00 | 1 |
| | 105 | Saugat Thakuri | saugat@company.com | 9841202365 | Developer | 45000.00 | 4 |



| | project_id | project_name | start_date | end_date | budget |
|---|---|---|---|---|---|
| ▶ | 201 | Web Portal System | 2023-01-01 | 2023-06-01 | 200000.00 |
| | 202 | Mobile App Development | 2023-03-05 | NULL | 300000.00 |
| | 203 | Payroll Automation | 2022-10-10 | 2023-02-15 | 150000.00 |
| | 204 | Animation | 2020-09-11 | 2023-06-19 | 250000.00 |
| | 205 | Route Hive | 2024-10-28 | NULL | 150000.00 |
| * | NULL | NULL | NULL | NULL | NULL |



| | ep_id | emp_id | project_id | role | assigned_date |
|---|---|---|---|---|---|
| ▶ | 1 | 102 | 201 | Backend Developer | 2023-01-02 |
| | 2 | 102 | 202 | Mobile Developer | 2023-03-06 |
| | 3 | 101 | 203 | Project Manager | 2022-10-11 |
| | 4 | 103 | 203 | Finance Analyst | 2022-10-12 |
| | 5 | 104 | 203 | Frontend Developer | 2024-05-04 |

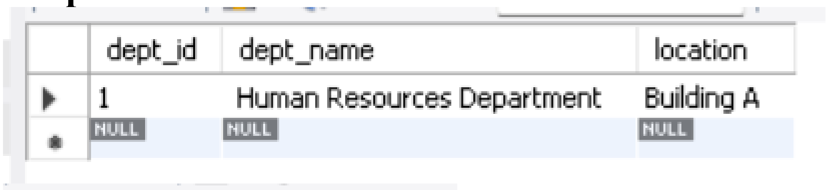
This shows the output generated by the sql query of different insertion values from above.

- Relational operators

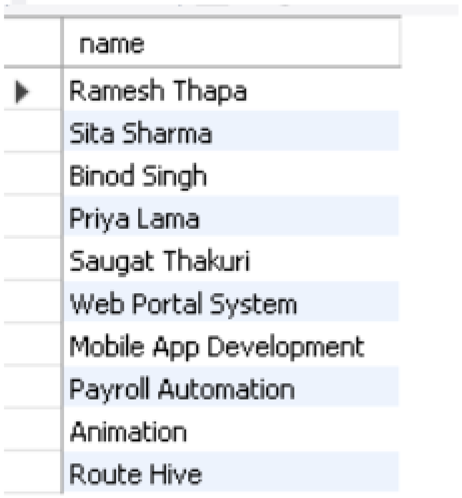
In this line of code I have written to select from department where department id is 1 also I have used union to combine name of employes and projects name. I have use intersect to show the values that are in table projects and employee projects.

```
select * from departments where dept_id=1;
select emp_name as name from employees
union
select project_name as name from projects;
select project_id as id from projects
intersect
select emp_id as id from employees;
```

**Output**

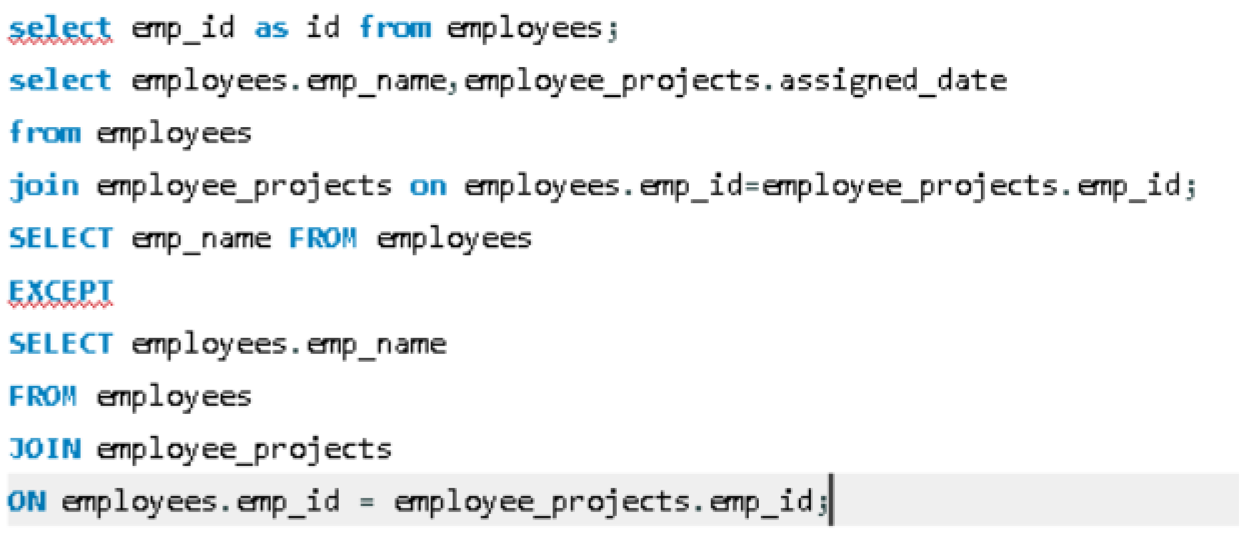


| | dept_id | dept_name | location |
|---|---|---|---|
| ▶ | 1 | Human Resources Department | Building A |
| * | NULL | NULL | NULL |



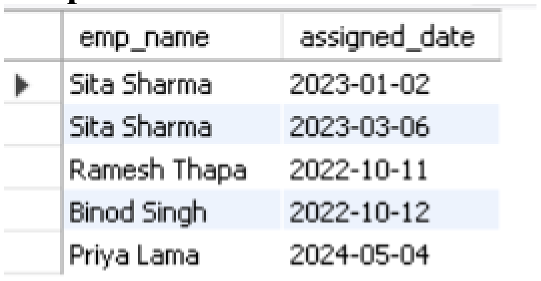
| | name |
|---|---|
| ▶ | Ramesh Thapa |
| | Sita Sharma |
| | Binod Singh |
| | Priya Lama |
| | Saugat Thakuri |
| | Web Portal System |
| | Mobile App Development |
| | Payroll Automation |
| | Animation |
| | Route Hive |

I used join operation to join the two table employees and projects.it shows every employees assigned to a project and I have used except to show the employees that have no projects assigned to them.

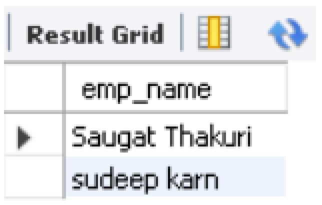


```
select emp_id as id from employees;
select employees.emp_name,employee_projects.assigned_date
from employees
join employee_projects on employees.emp_id=employee_projects.emp_id;
SELECT emp_name FROM employees
EXCEPT
SELECT employees.emp_name
FROM employees
JOIN employee_projects
ON employees.emp_id = employee_projects.emp_id;
```

## Output



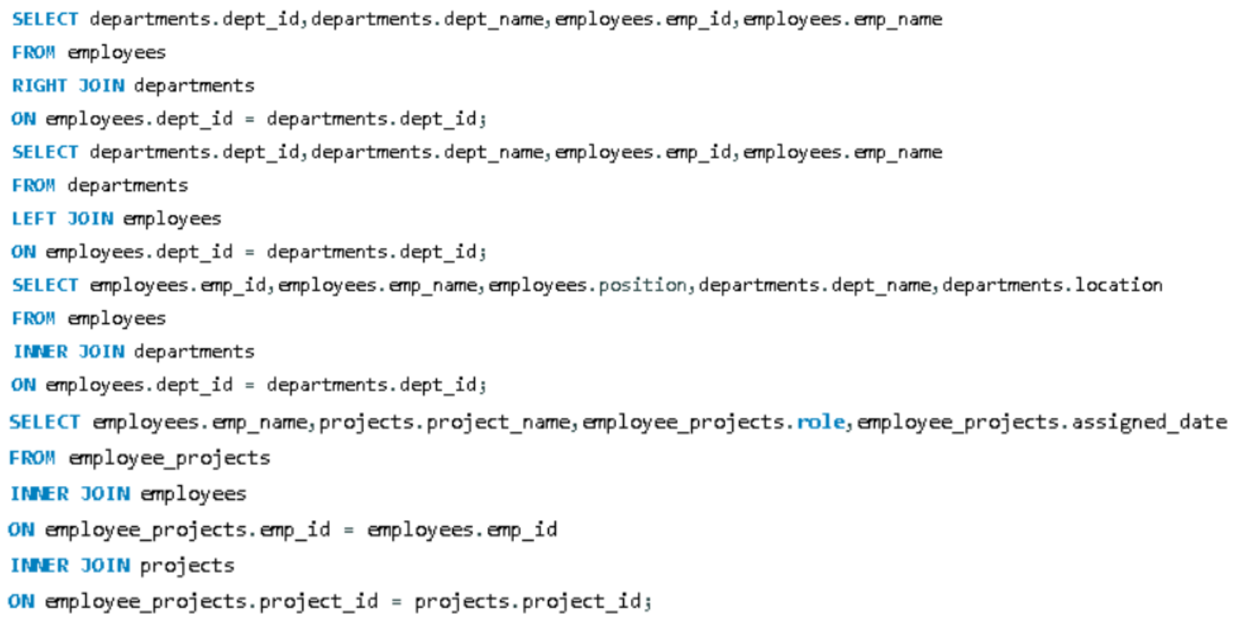
| emp_name | assigned_date |
|---|---|
| Sita Sharma | 2023-01-02 |
| Sita Sharma | 2023-03-06 |
| Ramesh Thapa | 2022-10-11 |
| Binod Singh | 2022-10-12 |
| Priya Lama | 2024-05-04 |



Result Grid

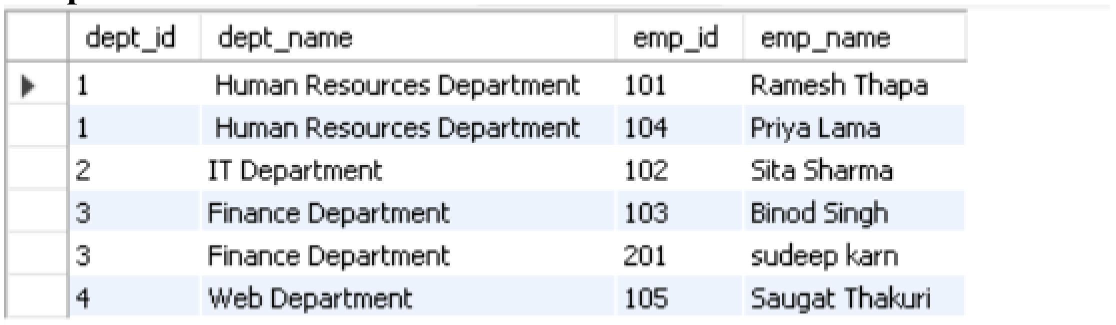
| emp_name |
|---|
| Saugat Thakuri |
| sudeep karn |

The inner join between employees and departments joins only the employees who have a department, showing matched employee and department information. The left join joins all employees with their departments, including employees who are not assigned to any department. The right join joins all departments with their employees, including departments that have no employees, with null for employee fields when there is no match. The full outer join joins all employees and all departments, showing all matches where they exist and filling null for unmatched employees or departments.

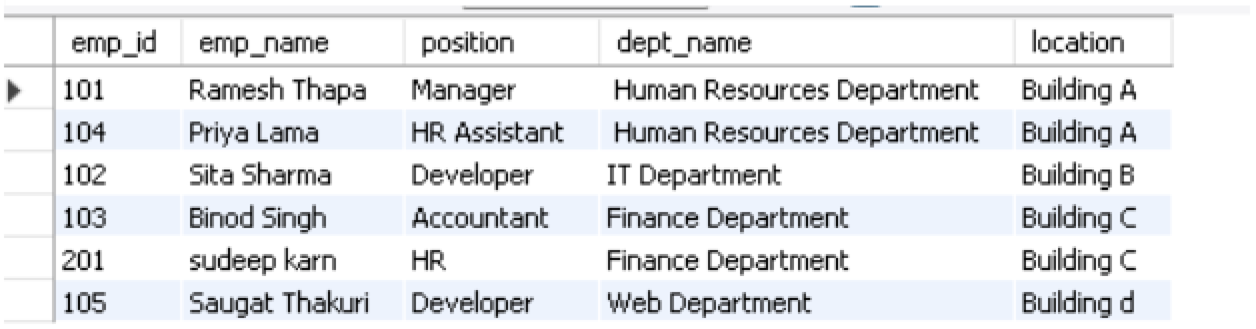


```sql
SELECT departments.dept_id,departments.dept_name,employees.emp_id,employees.emp_name
FROM employees
RIGHT JOIN departments
ON employees.dept_id = departments.dept_id;
SELECT departments.dept_id,departments.dept_name,employees.emp_id,employees.emp_name
FROM departments
LEFT JOIN employees
ON employees.dept_id = departments.dept_id;
SELECT employees.emp_id,employees.emp_name,employees.position,departments.dept_name,departments.location
FROM employees
INNER JOIN departments
ON employees.dept_id = departments.dept_id;
SELECT employees.emp_name,projects.project_name,employee_projects.role,employee_projects.assigned_date
FROM employee_projects
INNER JOIN employees
ON employee_projects.emp_id = employees.emp_id
INNER JOIN projects
ON employee_projects.project_id = projects.project_id;
```

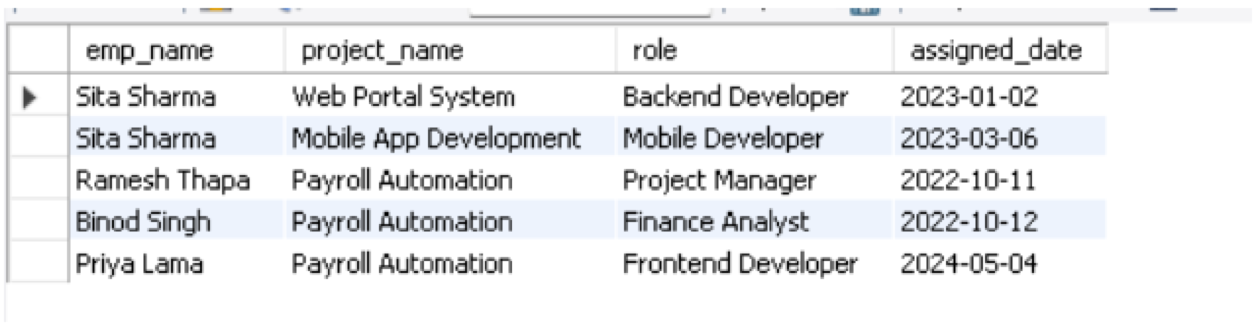
**Output**



| dept_id | dept_name | emp_id | emp_name |
|---|---|---|---|
| 1 | Human Resources Department | 101 | Ramesh Thapa |
| 1 | Human Resources Department | 104 | Priya Lama |
| 2 | IT Department | 102 | Sita Sharma |
| 3 | Finance Department | 103 | Binod Singh |
| 3 | Finance Department | 201 | sudeep karn |
| 4 | Web Department | 105 | Saugat Thakuri |



| emp_id | emp_name | position | dept_name | location |
|---|---|---|---|---|
| 101 | Ramesh Thapa | Manager | Human Resources Department | Building A |
| 104 | Priya Lama | HR Assistant | Human Resources Department | Building A |
| 102 | Sita Sharma | Developer | IT Department | Building B |
| 103 | Binod Singh | Accountant | Finance Department | Building C |
| 201 | sudeep karn | HR | Finance Department | Building C |
| 105 | Saugat Thakuri | Developer | Web Department | Building d |



| emp_name | project_name | role | assigned_date |
|---|---|---|---|
| Sita Sharma | Web Portal System | Backend Developer | 2023-01-02 |
| Sita Sharma | Mobile App Development | Mobile Developer | 2023-03-06 |
| Ramesh Thapa | Payroll Automation | Project Manager | 2022-10-11 |
| Binod Singh | Payroll Automation | Finance Analyst | 2022-10-12 |
| Priya Lama | Payroll Automation | Frontend Developer | 2024-05-04 |

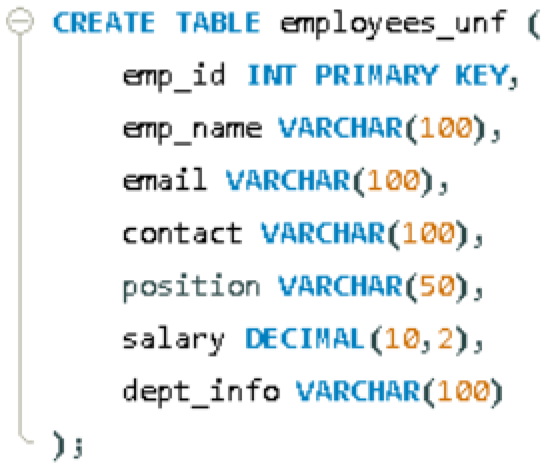
- Normalization

We have studied the concept of normalization in databases. To demonstrate this topic, I created a table that contains unnormalized data. Normalization is a technique used to organize data properly and reduce redundancy.

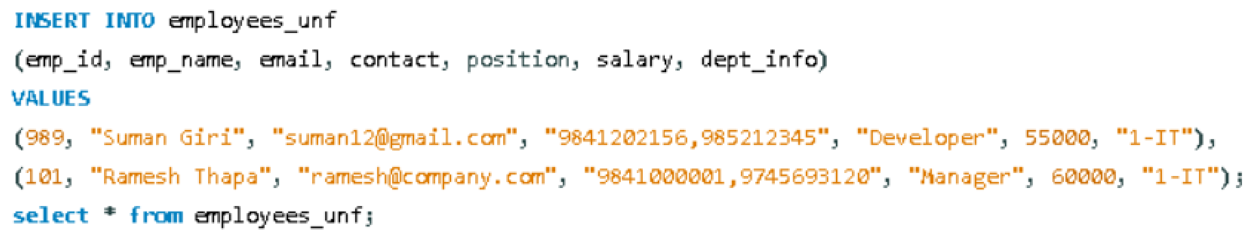
There are three main stages of normalization that we learned:

- First Normal Form (1NF)
- Second Normal Form (2NF)
- Third Normal Form (3NF)

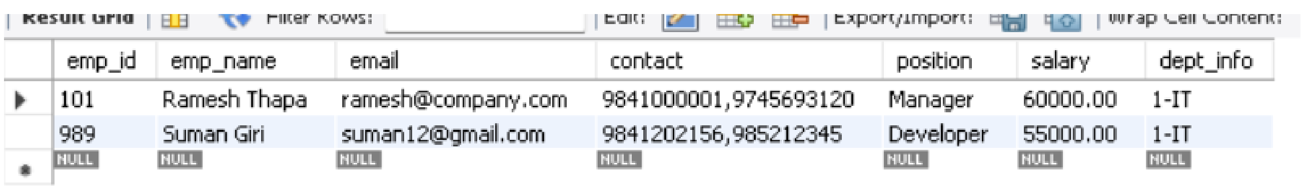
Using the table below, I have explained how data is gradually converted from an unstructured form into a well-organized database structure through these normal forms.



```sql
CREATE TABLE employees_unf (
    emp_id INT PRIMARY KEY,
    emp_name VARCHAR(100),
    email VARCHAR(100),
    contact VARCHAR(100),
    position VARCHAR(50),
    salary DECIMAL(10,2),
    dept_info VARCHAR(100)
);
```



```sql
INSERT INTO employees_unf
(emp_id, emp_name, email, contact, position, salary, dept_info)
VALUES
(989, "Suman Giri", "suman12@gmail.com", "9841202156,985212345", "Developer", 55000, "1-IT"),
(101, "Ramesh Thapa", "ramesh@company.com", "9841000001,9745693120", "Manager", 60000, "1-IT");
select * from employees_unf;
```



| emp_id | emp_name | email | contact | position | salary | dept_info |
|---|---|---|---|---|---|---|
| 101 | Ramesh Thapa | ramesh@company.com | 9841000001,9745693120 | Manager | 60000.00 | 1-IT |
| 989 | Suman Giri | suman12@gmail.com | 9841202156,985212345 | Developer | 55000.00 | 1-IT |
| NULL | NULL | NULL | NULL | NULL | NULL | NULL |

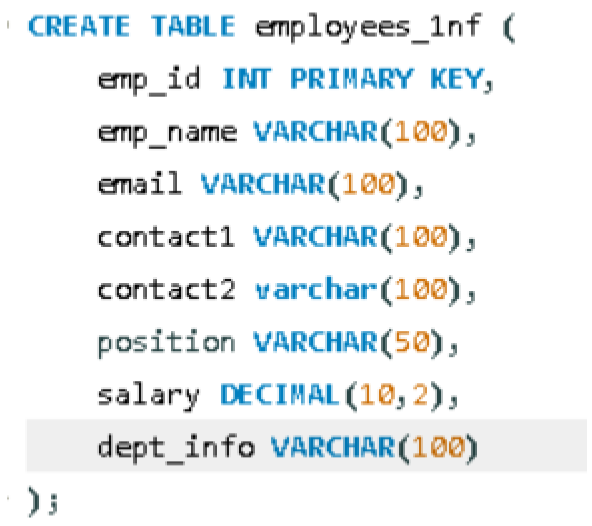
This is my un normalized table now I have to convert it into 1-nf form.

- 1-nf

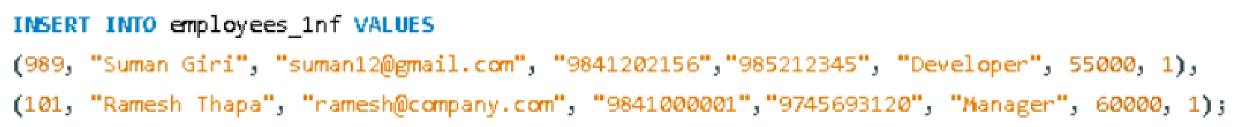
A table is in **First Normal Form** when:

a) Each column contains only atomic (single) values

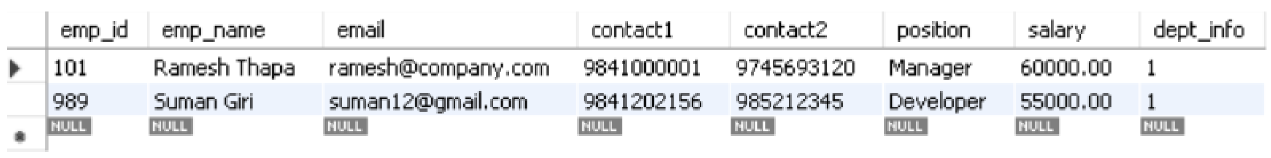
b) No repeating groups or multi-valued attributes exist



```
CREATE TABLE employees_1nf (
    emp_id INT PRIMARY KEY,
    emp_name VARCHAR(100),
    email VARCHAR(100),
    contact1 VARCHAR(100),
    contact2 varchar(100),
    position VARCHAR(50),
    salary DECIMAL(10,2),
    dept_info VARCHAR(100)
);
```



```
INSERT INTO employees_1nf VALUES
(989, "Suman Giri", "suman12@gmail.com", "9841202156","985212345", "Developer", 55000, 1),
(101, "Ramesh Thapa", "ramesh@company.com", "9841000001","9745693120", "Manager", 60000, 1);
```



| emp_id | emp_name | email | contact1 | contact2 | position | salary | dept_info |
|---|---|---|---|---|---|---|---|
| 101 | Ramesh Thapa | ramesh@company.com | 9841000001 | 9745693120 | Manager | 60000.00 | 1 |
| 989 | Suman Giri | suman12@gmail.com | 9841202156 | 985212345 | Developer | 55000.00 | 1 |
| NULL | NULL | NULL | NULL | NULL | NULL | NULL | NULL |

So you can see that data in table are separated in each column have only one data. this is how 1-nf is done. I have separated contacts to contact 1 and contact 2 for converting into 1-nf.

- 2-nf

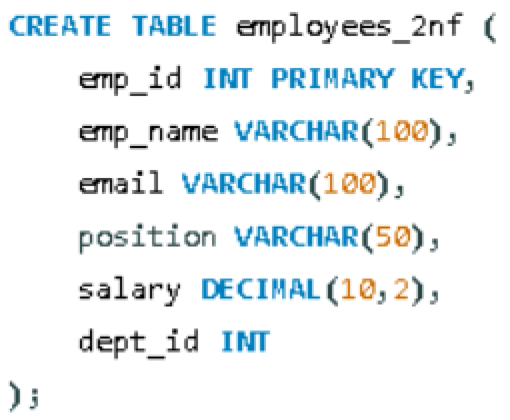
A table is in **Second Normal Form** when:

a) It is already in 1NF

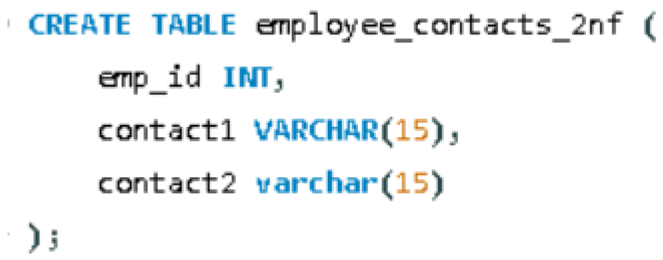
b) Every non-key attribute is fully dependent on the entire primary key

c) Partial dependency is removed

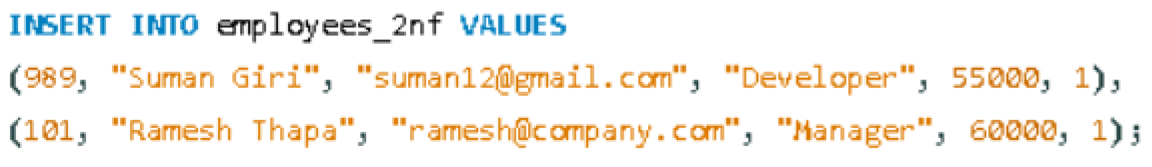
d) 2NF helps separate data into smaller related tables.



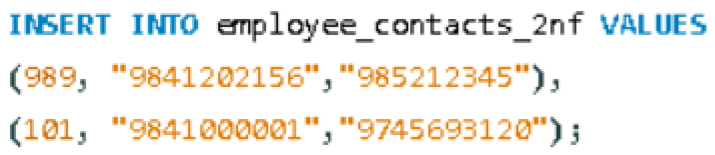
```
CREATE TABLE employees_2nf (
    emp_id INT PRIMARY KEY,
    emp_name VARCHAR(100),
    email VARCHAR(100),
    position VARCHAR(50),
    salary DECIMAL(10,2),
    dept_id INT
);
```



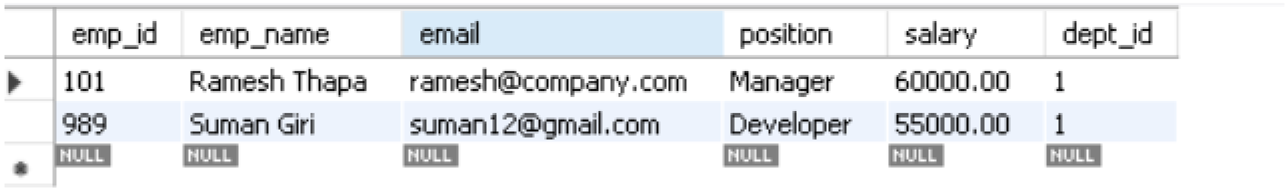
```
CREATE TABLE employee_contacts_2nf (
    emp_id INT,
    contact1 VARCHAR(15),
    contact2 varchar(15)
);
```



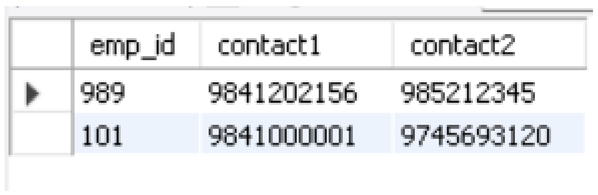
```
INSERT INTO employees_2nf VALUES
(989, "Suman Giri", "suman12@gmail.com", "Developer", 55000, 1),
(101, "Ramesh Thapa", "ramesh@company.com", "Manager", 60000, 1);
```



```
INSERT INTO employee_contacts_2nf VALUES
(989, "9841202156","985212345"),
(101, "9841000001","9745693120");
```



| | emp_id | emp_name | email | position | salary | dept_id |
|---|---|---|---|---|---|---|
| ▶ | 101 | Ramesh Thapa | ramesh@company.com | Manager | 60000.00 | 1 |
| | 989 | Suman Giri | suman12@gmail.com | Developer | 55000.00 | 1 |
| * | NULL | NULL | NULL | NULL | NULL | NULL |



| | emp_id | contact1 | contact2 |
|---|---|---|---|
| ▶ | 989 | 9841202156 | 985212345 |
| | 101 | 9841000001 | 9745693120 |

So for 2 nf  I have created 2 table on for employee and another employee contact. Since employee id is primary key I have used it access the 2 tables data. Employee table  to show the info of employee like name, department id , email, salary , position. The employee contact table to show the contact of employees by employee id.

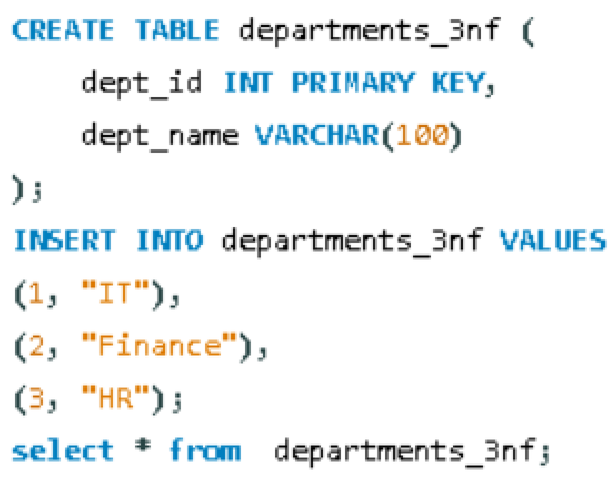
- 3-nf

A table is in Third Normal Form when:

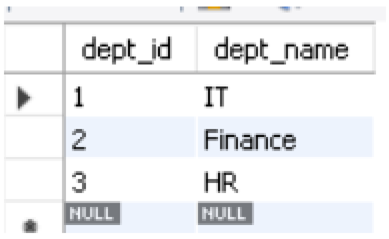
a) It is already in 2NF

b) There are no transitive dependencies

c) 3NF ensures the database is free from unnecessary dependency and duplication.



```
CREATE TABLE departments_3nf (
    dept_id INT PRIMARY KEY,
    dept_name VARCHAR(100)
);
INSERT INTO departments_3nf VALUES
(1, "IT"),
(2, "Finance"),
(3, "HR");
select * from  departments_3nf;
```



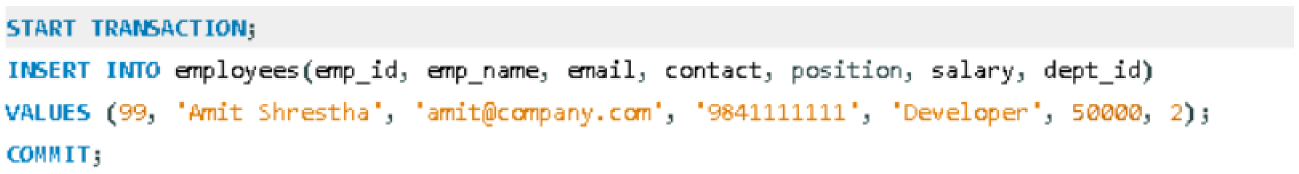
| | dept_id | dept_name |
|---|---|---|
| ▶ | 1 | IT |
| | 2 | Finance |
| | 3 | HR |
| ● | NULL | NULL |

So for the  3-nf form I have separated department id to show the department name.

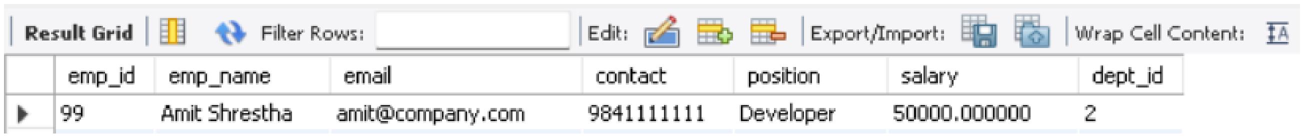
Since my data has no redundancy so I no need to convert it into bcnf.

## • Transactions

A transaction in MySQL is a sequence of one or more SQL operations that are executed as a single unit of work. It ensures that database actions are performed safely and correctly. If one query fails, the entire transaction can be rolled back to avoid incorrect data.

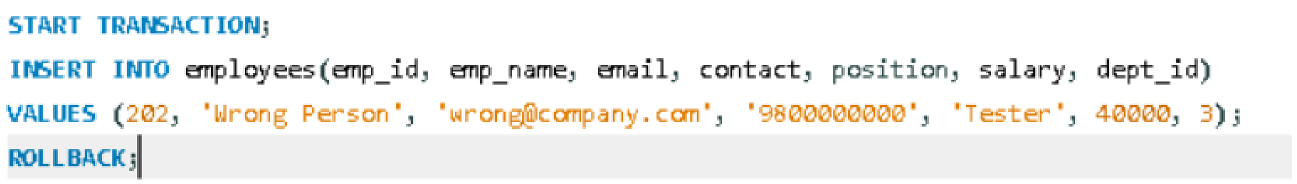


```
START TRANSACTION;
INSERT INTO employees(emp_id, emp_name, email, contact, position, salary, dept_id)
VALUES (99, 'Amit Shrestha', 'amit@company.com', '9841111111', 'Developer', 50000, 2);
COMMIT;
```



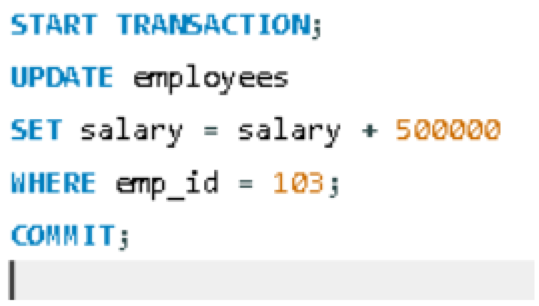
| emp_id | emp_name | email | contact | position | salary | dept_id |
|---|---|---|---|---|---|---|
| 99 | Amit Shrestha | amit@company.com | 9841111111 | Developer | 50000.000000 | 2 |

This transactions is preformed to insert the data in employees table. Start transaction begins a new transactions tells my sql  that sql statement should be treated as one unit work so any changes made after this will not be directly reflected unless commit is used.

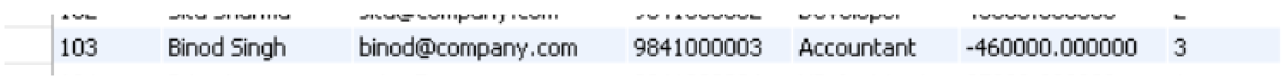


```
START TRANSACTION;
INSERT INTO employees(emp_id, emp_name, email, contact, position, salary, dept_id)
VALUES (202, 'Wrong Person', 'wrong@company.com', '9800000000', 'Tester', 40000, 3);
ROLLBACK;
```

Transaction has started and insert statement is executed, at this stage the record is inserted only temporarily because the transaction has not been completed. Rollback command cancels all the changes made during this transcation.so although the data have been inserted it is not reflected in the database.

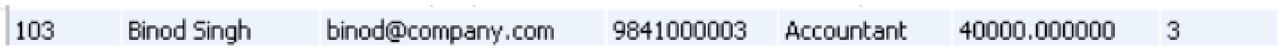


```sql
START TRANSACTION;
UPDATE employees
SET salary = salary + 500000
WHERE emp_id = 103;
COMMIT;
```



| | | | | | | |
|---|---|---|---|---|---|---|
| 103 | Binod Singh | binod@company.com | 9841000003 | Accountant | -460000.000000 | 3 |

So at beginning emp id negative due to errors. After using transaction it is updated.



| | | | | | | |
|---|---|---|---|---|---|---|
| 103 | Binod Singh | binod@company.com | 9841000003 | Accountant | 40000.000000 | 3 |

## Conclusion

This lab report show the expected skills in constructing and working with a MySQL database that includes techniques like constructing tables, inserting and altering data, the use of relational operators and joins, normalization (normal UNF into 1NF, 2NF, 3NF), and employing transactions like COMMIT and ROLLBACK. These steps are useful tools in making database systems more reliable, maintainable, and valid, which are the lab exercises in the report you are expected to prepare.