Databases-Week03

BASIC TASKS

Task 1.

a. Candidate key: A candidate key is a minimal set of attributes within a table that can uniquely identify each record in that table. There can be one or more candidate keys in a table.

b. Composite key: A composite key is a key that consists of two or more attributes that together uniquely identify a record in a table.

c. Foreign key: A foreign key is an attribute or a set of attributes in one table that refers to the primary key of another table. It is used to establish a relationship between two tables and maintain referential integrity.

d. Functional dependency: In a database, a functional dependency is a relationship between two sets of attributes in a table, where the value of one set of attributes (the dependent attributes) is determined by the value of another set of attributes (the determinant
attributes). It is denoted as A -> B, where A is the determinant and B is the dependent.

Task 2.

In the relational model, the three integrity rules/constraints are:

1. Entity Integrity: This rule states that the primary key of a table must have a unique value and cannot be null. Each row in the table must be uniquely identifiable by the primary key.

2. Referential Integrity: This rule ensures that the values of foreign keys in a table must match the values of the primary keys in the referenced table. If a foreign key value exists in a table, it must refer to an existing row in the referenced table.
3. Domain Integrity: This rule specifies that the values entered into a column must be of the correct data type and must fall within a specified range or set of values.

It ensures the validity and consistency of the data stored in the database.

Task 3

Table1：

1. The line film No: 008 is missing the value of genre.
2. There is no director No value for "Snakes on a Plane" stored in the Table Directors: 753.

Table2：

Violation of referential integrity: The value of the Price column of the Aziz row is ABC, which does not meet the numerical requirements, which may lead to data inconsistency and affect the referential integrity (assuming that the correct data is a numerical value).

Table3：

The song A Kind of Magic is missing the primary key

Artist value

MEDIUM TASKS

Task 4

The answer:

a. The newproject lacks a primary key called Employee

b. Deleting Prc10 will losethe information of employees

c. Moving J Kirk from department L004 to Department L009 results in inconsistent department information in multiple related records

d. 1NF

Analyze the original table structure

The original Project Employee table contains a variety of information about projects and employees, For example, Project Code, Project Title, Project Manager, Project Budget, Employee, Employee Name, Department No, Department Name, and Hourly Rate. Where there may be multiple employees involved for each project, there are issues of data redundancy and duplicate groups.

Steps to convert to 1NF

Split the duplicate sets of data so that each tuple (row) represents an employee's information on a project. In this way, each cell in the table contains only one atomic value, meeting the 1NF requirement. For example, if there is a project PRC10 in the original table with three employees involved, there will be three rows of data in the table 1NF that correspond to the information of those three employees in the PRC10 project.

e. 2NF

Project: Includes Project Code (primary key), Project Title, Project Manager, and Project Budget. This relationship mainly stores basic information about the project.

Employee relationship: Contains Employee (primary key), Employee Name, Department No, Department Name, and Hourly Rate. This relationship mainly stores basic information about employees.

f. 3NF

Employee relationship is further decomposed into two relationships:

Employee Basic: Contains Employee (primary key),

Employee Name, and Department No. This relationship stores the employee's basic information and department number.

Department: Includes Department No (primary key) and Department Name. This relationship stores department information separately.

Through such decomposition, the transfer function dependence is eliminated and the requirement of 3NF is satisfied.

Task 5

a. anomaly analysis

1. Insert exception: When inserting a new order, if there is No customer information (such as ac.no. Is empty), it may not be inserted correctly.

2. Deletion exception: Deletion of an order may result in loss of customer information.

3. Modification exception: To modify the customer address, it needs to be modified in multiple order records, which is prone to error

b. 1NF

Split the item information in each order so that each item has its own separate row and each cell in the table contains only one atomic value. In this way, the data in the table meets the requirements of 1NF. For example, if an order contains three items, there will be three rows of data in the 1NF table for each item. b. 2NF

Decompose the table into three new relationships:

1. Order relation (Order) : Contains Order No. (primary key), Date, Acano., Customer, Address. This relationship mainly stores the basic information of the order and the customer information.
2. Item relation: Contains Item (primary key), Qty., and Price. This relationship mainly stores basic information about the product.
3. Order Item relation: contains Order No. (foreign key, refer to the Order No.), Item (foreign key, refer to the Item of the commodity relation). This relationship is used to establish many-to-many connections between orders and goods. d. 3NF

The order relationship is further decomposed into two relationships:

1. Order Basic information relationship (Order Basic) : contains Order No. (primary key), Date, Acano. This relationship stores the basic information of the order and the customer account number.

2. Customer relationship (Customer) : Contains AC.no. (primary key), Customer, and Address. This relationship stores customer information separately.

Task 6

a. Patient (Patient No,Surname, FirstName)

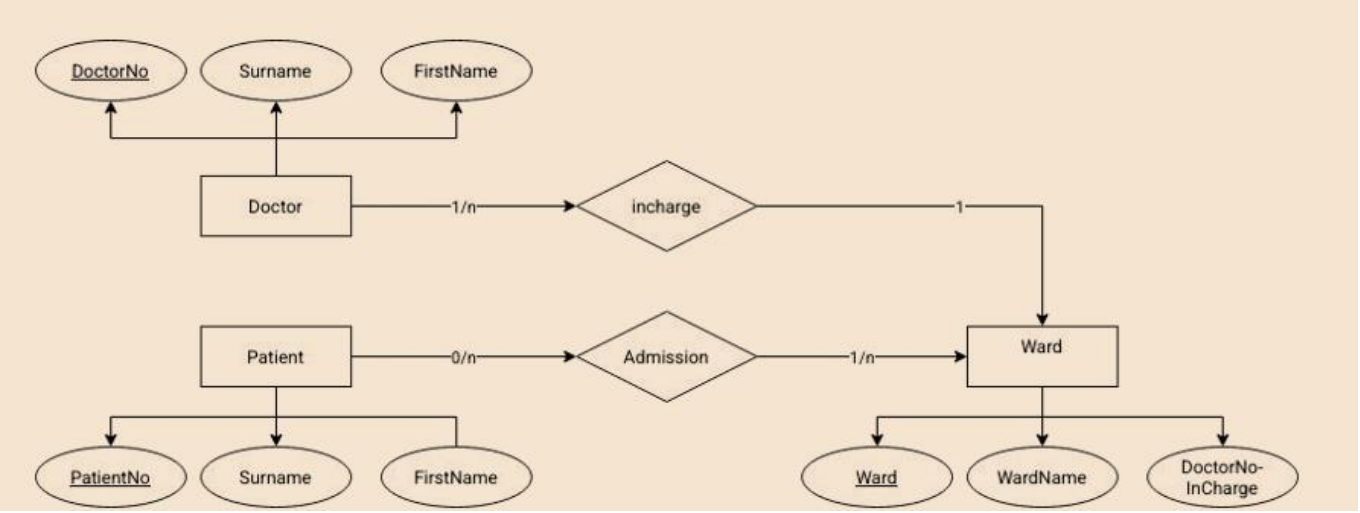
Admission (PatientNo, Admitted, Discharged, Ward)

Doctor (DoctorNo, Surname, FirstName, Ward)

Ward (Ward, WardName, DoctorNo-InCharge)

b. The relationshipsbetween tables are as follows: The Patient table and the Admission table are associated through PatientNo. Admission tables and Ward tables are associated by Ward

c.



ADVANCED TASKS

Task 7.

Table 1

- Order No → Account No, Customer, Address, Date (Order No determines the customer and their details)
- Order No, Item → Quantity, Item Price (The combination of Order No and Item determines the quantity and item price)

Table 2:

- Student No → Name, Course, Course Duration (A student number determines the student's details)
- Student No, Module No → Module Name, Lecturer (The combination of student number and module number determines the module name and lecturer)

Table 1

1NF

Table 1 is already in 1NF as all attributes contain atomic values, and there are no repeating groups.

2NF

- Orders Table:
  - Order No → Account No, Customer, Address, Date
- Order Details Table:
  - Order No, Item → Quantity, Item Price

3NF:

In this case, there are no transitive dependencies, as all non-key attributes directly depend on the primary key, so the table is already in 3NF after the 2NF step.

Table 2 1NF:

The table is already in 1NF since all the data values are atomic and there are no repeating groups.

2NF:

The primary key here is Student No, Module No. The non-key attributes Name, Course, Course Duration depend only on Student No, not Module No. So, we split the table to achieve 2NF:

- Students Table: o Student No → Name, Course, Course Duration
- Student Modules Table: o Student No, Module No → Module Name, Lecturer

3NF (Third Normal Form):

To ensure 3NF, we must remove any transitive dependencies. In this case, there are no transitive dependencies, so the tables are already in 3NF after the 2NF step.

a. Branch Code → Branch Name, Supervisor ID, Supervisor Name

- Car Plate No → Car Type
- Bill No → Bill Date, Penalty, Final Bill Amount
- Supervisor ID → Supervisor Name

b.

1NF

The data already meets the 1NF criteria, as each field contains atomic values and there are no repeating groups.

2NF

1. Branch Table: o Branch Code → Branch Name, Supervisor ID, Supervisor Name

2. **Car Table**: o Car Plate No → Car Type
3. **Bill Table**:
    - Bill No → Bill Date, Penalty, Final Bill Amount
4. **Branch-Car-Bill Table**:
    - Branch Code, Car Plate No, Bill No (to associate branches, cars, and bills)

3NF:

1. **Branch Table**: o Branch Code → Branch Name, Supervisor ID
2. **Supervisor Table**:
    - Supervisor ID → Supervisor Name

Task 8

a.

Branch Code → Branch Name, Supervisor ID, Supervisor NameCar Plate No → Car Type`

(Car plate number determines the car type)

Bill No → Bill Date, Penalty, Final Bill Amount
Supervisor ID → Supervisor Name

b. Normalization Process: 1NF, 2NF, and 3NF

1NF

The data already meets the 1NF criteria, as each field contains atomic values and there are no repeating groups.

2NF:

1. Branch Table:

-Branch Code → Branch Name, Supervisor ID, Supervisor Name

2. Car Table

Car Plate No → Car Type`

3. Bill Table:

-Bill No → Bill Date, Penalty, Final Bill Amount

4. Branch-Car-Bill Table:

-Branch Code, Car Plate No, Bill No 3NF:

1. Branch Table:

Branch Code → Branch Name, Supervisor ID

2. Supervisor Table:

Supervisor ID → Supervisor Name