Database Systems

Lab Manual (Lab 10)

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## **Lab Manual: Understanding Functional Dependencies**

### **Objective:**

To understand and identify functional dependencies in a relational schema

### **Pre-requisites:**

* Basic understanding of relational databases.
* Knowledge of schema, attributes, and relations.

#### **What is Functional Dependency (FD)?**

Functional Dependency is a relationship between two sets of attributes in a relation.

* **Notation:** X→Y
* This means the value of X determines the value of Y.
* Example: In an employee database, EmployeeID→Name, meaning a unique EmployeeID determines the employee's Name.

#### **Key Concepts:**

1. **Determinant:** Attribute(s) on the left-hand side (X) of the FD.
2. **Dependent:** Attribute(s) on the right-hand side (Y) of the FD.
3. **Trivial FD:** When Y⊆X (A→A).
4. **Non-Trivial FD:** When Y⊈ (e.g., A→B).

#### **Why Are FDs Important?**

* Helps understand relationships between attributes.
* Reduces data redundancy and inconsistencies when used to design schemas.
* Provides insights into constraints and rules in a database.

### **Steps to Perform the Lab:**

#### **1. Defining the Schema:**

* Choose a domain (e.g., student records, order management, etc.).
* Define a relational schema with attributes.

Example:  
Student(StudentID,Name,Course,Instructor,Grade)Student(StudentID, Name, Course, Instructor, Grade)Student(StudentID,Name,Course,Instructor,Grade)

#### **2. Listing Functional Dependencies:**

* Analyze the schema and list potential FDs based on logical rules or business requirements.

Example:

* StudentID→Name (A student ID uniquely identifies a student).
* Course→Instructor (A course is taught by one instructor).
* StudentID,Course→Grade (A student's grade depends on their ID and course).

#### **3. Populating the Schema:**

* Create a table in your DBMS and insert sample data.

Example:

CREATE TABLE Student (

StudentID INT,

Name VARCHAR(50),

Course VARCHAR(50),

Instructor VARCHAR(50),

Grade CHAR(1)

);

INSERT INTO Student (StudentID, Name, Course, Instructor, Grade)

VALUES

(101, 'Alice', 'Math', 'Dr. Smith', 'A'),

(102, 'Bob', 'Math', 'Dr. Smith', 'B'),

(103, 'Charlie', 'Physics', 'Dr. Taylor', 'A'),

(101, 'Alice', 'Physics', 'Dr. Taylor', 'A');

#### **4. Verifying Functional Dependencies:**

* Use SQL queries to check if FDs hold in the data.

**Example FD Verification: Course→Instructor**

SELECT Course, COUNT(DISTINCT Instructor)

FROM Student

GROUP BY Course;

If the count is 1 for each course, the FD Course→Instructor

**Example FD Verification: StudentID→Name**

SELECT StudentID, COUNT(DISTINCT Name)

FROM Student

GROUP BY StudentID;

If the count is 1 for each StudentID, the FD StudentID→NameStudentID holds.

### **Tasks:**

#### **Task 1: Identify FDs**

* Given the schema R(EmployeeID,Name,Department,Manager,Salary)
  1. Write down potential FDs.
  2. Insert sample data into the table.
  3. Verify each FD using SQL queries.

#### **Task 2: Analyze Complex Dependencies**

* For the schema R(OrderID,CustomerID,ProductID,Quantity,Price)
  1. Identify FDs (e.g., OrderID→CustomerID
  2. Populate the table and test if each FD holds.

### **Lab Questions:**

1. Define functional dependency. Provide an example.
2. How can you verify a functional dependency in a database?
3. What are trivial and non-trivial FDs? Provide examples.
4. Identify and list FDs for the schema R(DoctorID,PatientID,AppointmentDate,Diagnosis)R(DoctorID, PatientID, AppointmentDate, Diagnosis)R(DoctorID,PatientID,AppointmentDate,Diagnosis).