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Green Fields, Guntur District, A.P., India – 522502
Department of Electronics and Communication Engineering
(DST - FIST Sponsored Department)

Active Learning Method

Program: B. Tech Academic Year / Yr-Sem : 2024 - 25 / II - II Sem

Course Title & Code: **DBMS & 23AD2102R**

Date: Time: Venue:

CO#	1
Topics	3NF and BCNF
Type of ALM	Case Study
Learning Approach	Participatory Learning

Activity: Analyze the following table to determine if it is in 3rd Normal Form. If it is not, normalize it to 3NF and explain the concept of Boyce-Codd Normal Form (BCNF). How does it differ from the Third Normal Form (3NF)?

- **Table: Employee Data**
  - EmployeeID
  - EmployeeName
  - DepartmentID
  - DepartmentName
  - Location
  - SupervisorID
  - SupervisorName

ANSWER

Step 1: Analyze the Table for 3NF

The table **Employee Data** contains the following attributes:

1. **EmployeeID**: Unique identifier for each employee (assumed to be the primary key).
2. **EmployeeName**: Name of the employee.
3. **DepartmentID**: Unique identifier for each department.
4. **DepartmentName**: Name of the department.
5. **Location**: Location of the department.
6. **SupervisorID**: Unique identifier for the supervisor (an employee who supervises others).
7. **SupervisorName**: Name of the supervisor.

Dependencies:

- **EmployeeID → EmployeeName, DepartmentID, SupervisorID** (Direct dependency on the primary key).
- **DepartmentID → DepartmentName, Location** (Department details depend on DepartmentID).
- **SupervisorID → SupervisorName** (Supervisor details depend on SupervisorID).

The table is **not in 3NF** because there are transitive dependencies:

1. **EmployeeID → DepartmentID → DepartmentName, Location**
2. **EmployeeID → SupervisorID → SupervisorName**

Step 2: Normalize the Table to 3NF

Decomposition into 3NF Tables:

We split the table into smaller tables to eliminate transitive dependencies:

1. **Employee Table:**
   - **Attributes:** EmployeeID (PK), EmployeeName, DepartmentID (FK), SupervisorID (FK)
2. **Department Table:**
   - **Attributes:** DepartmentID (PK), DepartmentName, Location
3. **Supervisor Table:**
   - **Attributes:** SupervisorID (PK), SupervisorName

Final Tables in 3NF:

1. **Employee Table:**

EmployeeID	EmployeeName	DepartmentID	SupervisorID

2. **Department Table:**

DepartmentID	DepartmentName	Location

3. **Supervisor Table:**

SupervisorID	SupervisorName

Each table now satisfies 3NF:

- No transitive dependencies exist.
- All non-prime attributes are dependent only on the primary key.

Step 3: Explain Boyce-Codd Normal Form (BCNF)

BCNF is a stricter version of 3NF. A table is in BCNF if:

1. It is in 3NF.
2. For every functional dependency $X \rightarrow Y$, X must be a superkey.

Difference Between 3NF and BCNF:

1. **3NF** allows a functional dependency where $X \rightarrow Y$ and X is not a superkey, provided Y is a prime attribute (part of a candidate key).
2. **BCNF** does not allow this exception. Every determinant (left side of a functional dependency) must be a superkey.

Example of 3NF but not BCNF:

- Consider a table with attributes A, B, C and dependencies:
  - $A \rightarrow B$ (A is a superkey).
  - $B \rightarrow C$ (B is not a superkey, but C is a prime attribute).
- This table is in 3NF but violates BCNF because $B \rightarrow C$ does not have B as a superkey. To normalize further, the table must be decomposed.