#### Outline

- Normalization basics
- Normal Forms
- 1. 1NF (First Normal Form)
- 2. 2NF
- 3. 3NF
- 4. BCNF (Boyce Codd Normal Form)



Process of analyzing the given relation schemas based on the FD's and candidate keys to achieve the desirable properties of

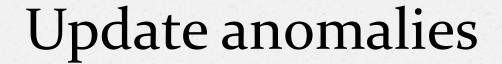
- 1) Minimizing the redundancy.
- 2) Minimizing insertion, deletion and update anomalies.

#### Insertion anomalies

It is difficult to insert a new department that has no employees as yet in the EMP\_DEPT relation. The only way to do is to place NULL values in the atttributes for employee. This causes a problem because SSN is primary key of EMP\_DEPT and each tuple is supposed to represent an employee entity - not department entity.



If we delete from EMP\_DEPT an employee tuple that happens to represent the last employee working for a particular department, the information concerning the department is lost from the database.



In EMP\_DEPT, if we change the value of one of the attributes of a particular department- say the manager of department 5- we must update all employee who work in that department; otherwise the database will be inconsistent.

#### Normal Forms

- 1NF (Atomic)
- 2NF (No partial dependencies)
- 3NF (No transitive dependencies)
- BCNF (Stronger than 3NF)

## First Normal Form (1NF)

The relation is in 1NF if we say domains of all attributes of R are atomic.

## Example of 1NF

Roll No	Name	Phone No.
1	Harsh	9890385807
		9920297878
2	Kumar 	9561922284
3	Prashant	9819740847
		9920625758

#### Conversion in 1NF

Roll No	Name	Phone No.
1	Harsh	9890385807
1	Harsh	9920297878
2	Kumar	9561922284
3	Prashant	9819740847
3	Prashant	9920625758

#### Second Normal Form

A relation schema R is in 2NF if it is in 1NF and every nonprime attirbute A in R is fully functionally dependent on Candidate key of R.

### Example 1 on 2NF

Student (sid, sname, cname)

F.D. = { sid, cname -> sname, sid -> sname}

Then here Candidate key is (sid ,cname)

But sname is dependent on part of the candidate key sid for second F.D. Hence it is not in 2NF.

2NF decomposition =
 Table 1 (sid, sname) and
 Table 2 (sid, cname)

### Example 2 on 2NF

Guest (phone, name, address, room, floor, stay)
F.D. = { phone , name --> address, phone --> room, name --> floor, stay}

- Not in 2NF
- Decomposition in 2NF is:
   Table1 (phone, name, address)
   Table 2 (phone, room)
   Table 3 (name, floor, stay)

## Example 3 on 2NF

Report (rid, title, author, subject)

```
F.D. = { rid --> title, rid --> author,
rid --> subject, author --> subject }
```

In 2NF

#### Third Normal Form

A relation schema R is in 3NF if it is in 2NF and there should not be any transitive dependencies present inside the relation.

### Conditions of 3NF

A relational schema R is in 3NF if for every F.D.

- X --> A associated with R either
- A should be a subset of X (i.e. trivial F.D.) or
- X is superkey of R or
- A is a part of some key (not just superkey)

#### Example 1 on 3NF

```
Sup_city (sid, status, city) and F.D. are { sid --> status, sid --> city and city --> status}
```

- It is already in 2NF
- After applying 3 conditions, it is not in 3NF
- Hence decomposition in 3NF is
   Table 1 (sid,city) and Table 2 (city, status)

### Example 2 on 3NF

dept\_advisor ( sid, iid, dname)

F.D. = { sid, dname --> iid, iid --> dname}

- C.K. are (sid,dname) and (sid,iid)
- Hence super keys are: (sid,dname) and (sid,iid)
- Hence after applying conditions the relation is in 3NF.

# Boyce Codd Normal Form (BCNF)

A relation schema is in BCNF if whenever a nontrivial functional dependency X -> A holds in R, then X is a super key of R.

## Example 1 of BCNF

- $\circ$  R(A, B, C) and F.D. = { A -> B, B -> C}
- Not in BCNF
- Decomposition is

Table 1 (A,B)

Table 2 (B, C)

## Example 2 of BCNF

- R(A, B, C) andF.D. = { A -> B, B -> C, C -> A}
- In BCNF