



SNS COLLEGE OF TECHNOLOGY, COIMBATORE-35

(AN AUTONOMOUS INSTITUTION)



DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

23CST201-DATABASE MANAGEMENT SYSTEMS

## UNIT-III

### Database Design

Topic: 2NF and 3NF

#### Second Normal Form (2NF)

- In the 2NF, relational must be in 1NF.
- In the second normal form, all non-key attributes are fully functional dependent on the primary key

**Example:** Let's assume, a school can store the data of teachers and the subjects they teach. In a school, a teacher can teach more than one subject.

#### TEACHER table

TEACHER_ID	SUBJECT	TEACHER_AGE
25	Chemistry	30
25	Biology	30
47	English	35
83	Math	38
83	Computer	38

In the given table, non-prime attribute TEACHER\_AGE is dependent on TEACHER\_ID which is a proper subset of a candidate key. That's why it violates the rule for 2NF.

To convert the given table into 2NF, we decompose it into two tables:

**TEACHER\_DETAIL table:**

TEACHER_ID	TEACHER_AGE
25	30
47	35
83	38

**TEACHER\_SUBJECT table:**

TEACHER_ID	SUBJECT
25	Chemistry
25	Biology
47	English
83	Math
83	Computer

**Third Normal Form (3NF)**

- A relation will be in 3NF if it is in 2NF and not contain any transitive partial dependency.
- 3NF is used to reduce the data duplication. It is also used to achieve the data integrity.
- If there is no transitive dependency for non-prime attributes, then the relation must be in third normal form.

A relation is in third normal form if it holds at least one of the following conditions for every non-trivial function dependency  $X \rightarrow Y$ .

1. X is a superkey.
2. Y is a prime attribute, i.e., each element of Y is part of some candidate key.

**Example:**

**EMPLOYEE\_DETAIL table:**

EMP_ID	EMP_NAME	EMP_ZIP	EMP_STATE	EMP_CITY
222	Harry	201010	UP	Noida
333	Stephan	02228	US	Boston
444	Lan	60007	US	Chicago
555	Katharine	06389	UK	Norwich
666	John	462007	MP	Bhopal

**Super key in the table above:**

1. {EMP\_ID}, {EMP\_ID, EMP\_NAME}, {EMP\_ID, EMP\_NAME, EMP\_ZIP}  
... so on

**Candidate key:** {EMP\_ID}

**Non-prime attributes:**In the given table, all attributes except EMP\_ID are non-prime.

Here, EMP\_STATE & EMP\_CITY dependent on EMP\_ZIP and EMP\_ZIP dependent on EMP\_ID. The non-prime attributes (EMP\_STATE, EMP\_CITY) transitively dependent on super key(EMP\_ID). It violates the rule of third normal form.

That's why we need to move the EMP\_CITY and EMP\_STATE to the new <EMPLOYEE\_ZIP> table, with EMP\_ZIP as a Primary key.

**EMPLOYEE table:**

EMP_ID	EMP_NAME	EMP_ZIP
222	Harry	201010
333	Stephan	02228
444	Lan	60007
555	Katharine	06389
666	John	462007

**EMPLOYEE\_ZIP table:**

EMP_ZIP	EMP_STATE	EMP_CITY
201010	UP	Noida
02228	US	Boston

60007	US	Chicago
06389	UK	Norwich
462007	MP	Bhopal