

# Department of CSE

**COURSE NAME: DBMS**

**COURSE CODE:23AD2102R**

**Topic: Normalization –Normal forms 3NF & BCNF**

**Session - 8**

## AIM OF THE SESSION



To familiarize students with the basic concept of normalization and its forms

## INSTRUCTIONAL OBJECTIVES



This Session is designed to: discuss and study the concepts of normalization, its need, types with examples.

## LEARNING OUTCOMES



At the end of this session, you should be able to: understand and apply the concepts of normalization.

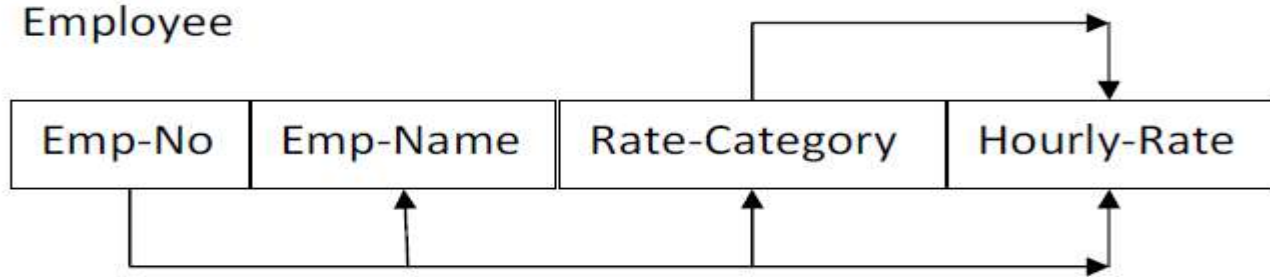
## Third Normal Form (3NF)

- ❑ A Relation is said to be in **Third Normal Form (3NF)** if and only if:
  - ❑ It is in Second Normal Form (2NF)
  - ❑ **No transitive dependency** exists between non-key attributes and key attributes.
- ❑ When a non-prime attribute depends on other non-prime attributes rather than depending upon the prime attributes or primary key, then we say it is ***Transitive Dependency***

### How to remove Transitive Dependency?

- Again the solution is very simple.
- Take out the columns that caused transitive dependency from the existing table and move them to some other table where it fits in well.

For example, consider the following Employee table.



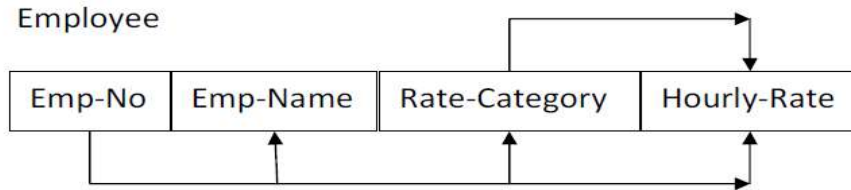
This table contains a **transitive dependency** as given below;

**Emp-No → Rate-Category → Hourly-Rate**

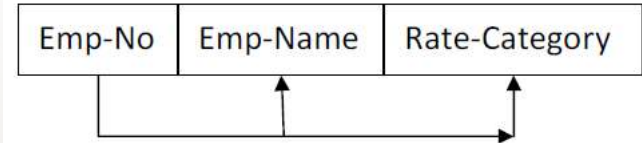
Hence, Employee **table is not in 3NF**

- ❑ To make it **3NF compliant**, we need to remove this transitive dependency.
- ❑ To do that, we need to split Employee table into two tables (Employee table and Rate table) as given below

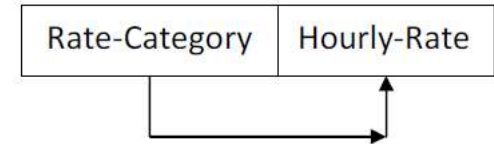
For example, consider the following Employee table.



Employee Table



Rate Table



- ❑ Now, both Employee and Rate tables are in 3NF as **they do not have transitive dependencies.**

## Boyce-Codd Normal Form (BCNF)

- ❖ A relation is said to be in BCNF *if and only if all the determinants are candidate keys.*
- ❖ BCNF relation is a strong 3NF relation. i.e. all BCNF relations are in 3NF *but the reverse is not true.*

For example, consider the following Result table

Result Table			
Student#	EmailID	Course#	Marks

This table has two candidate keys – {**Student#, Course#**} and {**EmailID, Course#**}.

- ❑ This table is in **3NF** because it has **no partial** and **transitive dependencies** between key attributes and non-key attributes.
- ❑ But this table is **Not in BCNF** because **all determinants are not candidate keys**.
- ❑ This can be observed from the following FDs;

- $\{Student\#, Course\# \} \rightarrow Marks$
- $\{EmailID, Course\# \} \rightarrow Marks$
- $Student\# \rightarrow EmailID$
- $EmailID \rightarrow Student\#$

❑ Though the determinants of **first** two FDs are candidate keys but the determinants of the last two FDs are not candidate keys. Thus it is violating the BCNF condition

let a FD be

$$X \rightarrow Y$$

Here '**X**' is called **Determinant**  
and '**Y**' is called **Dependent**



- ❑ To make this table into BCNF compliant, we need to decompose the Result table into two tables as shown below;

Result Table

Student#	EmailID	Course#	Marks
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Student Table

Student#	EmailID
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Result Table

Student#	Course#	Marks
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## SUMMARY

- Normalization is the process of organizing data in a database to reduce data redundancy and improve data integrity.
- It involves breaking down larger tables into smaller, more focused tables that are related by common attributes.
- This is accomplished through a series of normal forms, each of which has specific requirements that must be met in order to be considered fully normalized. Normalization eliminates redundant data, helps prevent data anomalies and inconsistencies, and makes databases more efficient, accurate, and easy to manage.
- The most commonly used normal forms are first normal form (1NF), second normal form (2NF), and third normal form (3NF), with higher levels of normalization available for more complex databases.

## SELF-ASSESSMENT QUESTIONS

1. Which of the following is a benefit of normalization in database design?

- (a) Reduced data redundancy**
- (b) Decreased data consistency
- (c) Improved data integrity
- (d) Reduced storage space

2. Which normal form requires that all non-key columns in a table be dependent only on the primary key and not on other non-key columns?

- (a) First Normal Form (1NF)
- (b) Second Normal Form (2NF)**
- (c) Third Normal Form (3NF)
- (d) Fourth Normal Form (4NF)

- 1. Define normalization and why it is required.**
- 2. List out various normalization forms.**
- 3. Analyze various relations to identify its normal form.**
- 4. Summarize partial functional and transitive dependency.**

## REFERENCES FOR FURTHER LEARNING OF THE SESSION

### Reference Books:

1. Database System Concepts by Abraham Silberschatz, Henry F. Korth, and S. Sudarshan
2. Fundamentals of Database Systems by Ramez Elmasri and Shamkant B. Navathe

THANK YOU



Team – DBMS