BCNF

&

4th Normal Form

Prepared For: CS527
Prepared By: Josh Levine, Pranav Shivkumar, Pratik Mistry, Shounak Rangwala, Swapnil Kamate, Vikhyat Dhamija

BCNF - Boyce-Codd Normal Form

- A normal form used in database normalization that is a slightly stronger version than the third normal form

- Also known as 3.5 normal form

- For a table to be in BCNF it must comply with two rules:
  - It must be in Third Normal Form
  - For any dependency A ➡ B, A should be the super key i.e. for any dependency A -> B , A cannot be non-prime attribute when B is a prime attribute

BCNF: Example

emp_id	emp_nationality	emp_dept	dept_type	dept_no_of_emp
1001	Austrian	Production and planning	D001	200
1001	Austrian	Stores	D001	250
1002	American	Design and technical support	D134	100
1002	American	Purchasing department	D134	600

- Functional dependencies in the table above:
  - emp_id -> emp_nationality
  - emp_dept -> {dept_type, dept_no_of_emp}

- We can easily see that the only KEY is the set {emp_id, emp_dept}
- Candidate key: {emp_id, emp_dept}
- The table is not in BCNF as neither emp_id nor emp_dept alone are keys.

BCNF : Example

To make the table comply with BCNF we can break the table in three tables like this:

emp_nationality table:

emp_id	emp_nationality
1001	Austrian
1002	American

emp_dept table:

emp_dept	dept_type	dept_no_of_emp
Production and planning	D001	200
Stores	D001	250
Design and technical support	D134	100
Purchasing department	D134	600

BCNF : Example

emp_dept_mapping table:

emp_dept	emp_id
Production and planning	1001
Stores	1001
Design and technical support	1002
Purchasing department	1002

- Functional dependencies:
  - emp_id -> emp_nationality
  - emp_dept -> {dept_type, dept_no_of_emp}

- Candidate keys:
  - For first table: emp_id
  - For second table: emp_dept
  - For third table: {emp_id, emp_dept}

- This is now in BCNF as in both the functional dependencies left side part is a key.

4NF - 4th Normal Form

- A normal form used in database normalization that is a slightly stronger version than BCNF.

- Second Normal Form, Third Normal Form, and BCNF are used to normalize functional dependencies, the Fourth Normal Form is used to normalize multivalued dependencies.

- For a table to be in the 4th Normal Form it must comply with two rules:
    - It must be in the Third Normal Form or Boyce-Codd Normal Form.
    - The table should not have any Multi-valued Dependency.

4th Normal Form continued..

Multivalued Dependency is :-

1. In A -> B , for single value of A many values of B exists
2. Relation has at least three columns/attributes like R(A,B,C)
3. If A satisfies first condition for B then there exists C independent of B

Example of non-BCNF table: Movies having movie name,shooting location and listings
- One movie can be shoot at different locations and
- One movie can have multiple category/listings

4th Normal Form : Example

Movies:

Movie_Name	Shooting_Location	Listing
MovieOne	UK	Comedy
MovieOne	UK	Thriller
MovieTwo	Australia	Action
MovieTwo	Australia	Crime
MovieThree	India	Drama

As seen above, table is not in 4NF, since

1. More than one movie can have the same listing
2. Many shooting locations can have the same movie

4th Normal Form : Example

Movie_Shooting:

Movie_Name	Shooting_Location
MovieOne	UK
MovieTwo	Australia
MovieThree	India

Movie_Listing:

Movie_Name	Listing
MovieOne	Comedy
MovieOne	Thriller
MovieTwo	Action
MovieTwo	Crime
MovieThree	Drama

Now the violation is removed and the tables are in 4NF after decomposing the movies table to movie_shooting and movie_listing tables.

Thank You