

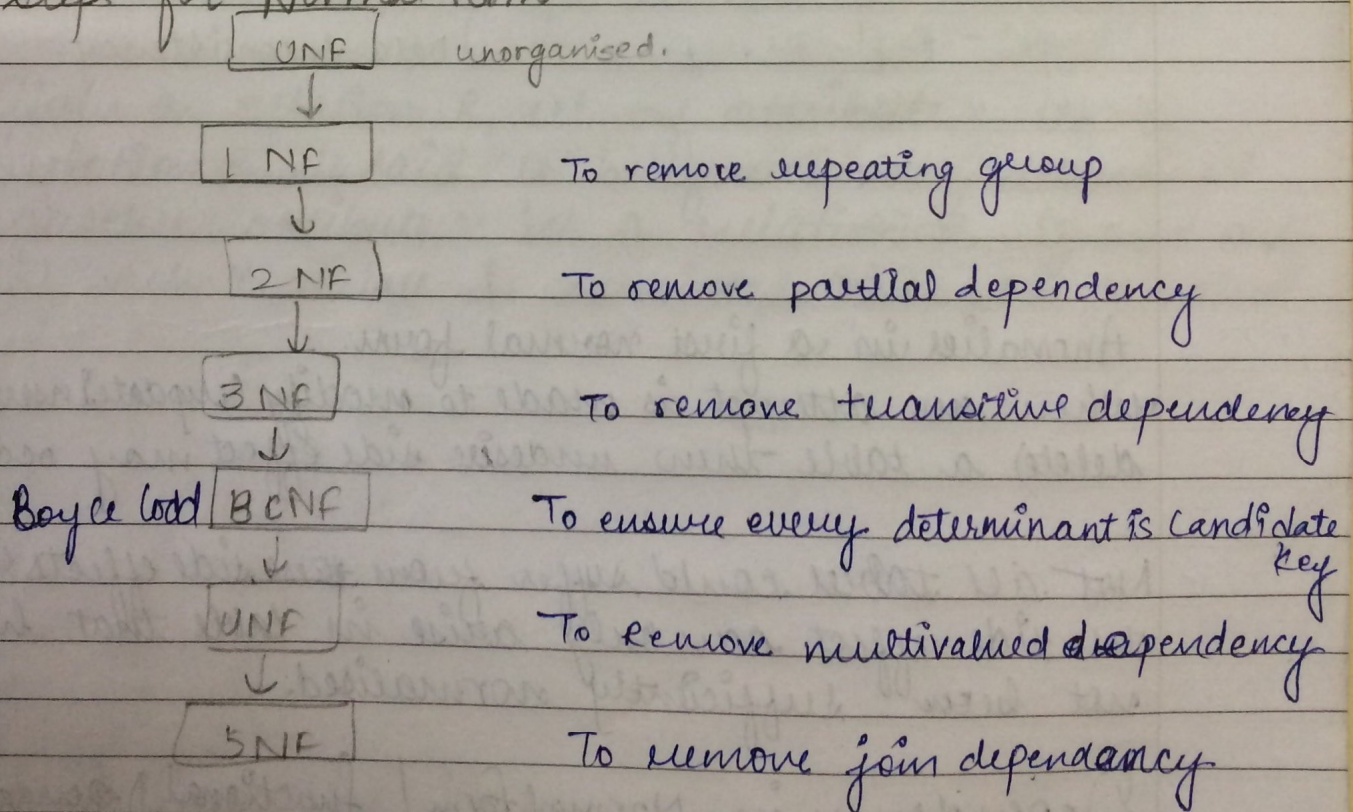
# Normalization



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- 1) It is the process of efficiently organising data in a data base.
- 2) The basic objective of normalisation is to reduce the redundancy (duplication).
- 3) In Relational data base design, the process of organizing the data to minimise redundancy is known as Normalization.
- 4) It involves ~~dividing~~ dividing data base into two or more relation (table) & defining relationship b/w them.
- 5) It is step by step process of removing redundancy & dependency of attributes in a data base. It maximise the query flexibilities.
- 6) It eliminates the insertion, deletion, updation, anomalies (problem) in a data base.
- 7) It improves the data base design.
- 8) It ensure that data model is complete & correct.

## Steps for Normal form



**1NF** A table is said to be in first Normal form if a





values in the domain of each attribute of relation are atomic. In other words, only one value is associated with each attribute.

# A table in first normal form, when it contains no repeating groups i.e., each & every cell in a relation there can be only one value.

first method.

| emp-ID | emp. Name | Dept.    |
|--------|-----------|----------|
| 101    | Akash     | MCA, BCA |
| 102    | Ajith     | BCA      |
| 103    | Ankur     | BBA      |

UNF

|     |       |     |
|-----|-------|-----|
| 101 | Akash | MCA |
| 101 | Akash | BCA |
| 102 | Ajith | BCA |
| 103 | Ankur | BBA |

INF

second method - decomposition of a table.

empID - Dept.

Data Inconsistency.

101 MCA

101 BCA

102 BCA

103 BBA

Anomalies in a first normal form.

when an attempt is made to modify (update, insert or delete) a table then undesire side effect may occur.

Not all tables could suffer from these side effects rather the side effect can only arise in table that have not been sufficiently normalised.

Dependency in Normal form / functional Dependency in Data Base.



Functional Dependency.

| X | Y | Roll No. | Name   | Name  | Course |
|---|---|----------|--------|-------|--------|
| 1 | 2 | 3001     | Amit   | Amit  | BCA    |
| 2 | 5 | 3002     | Ajay   | Ajay  | MCA    |
| 6 | 7 | 3003     | Puneet | Amit  | MCA    |
| 2 | 8 | 3004     | Vijay  | Vijay | BBA    |

R.

$$X \rightarrow Y$$

X determine Y

Y depend upon X

X is determinant &amp; Y is determiner.

- 1) Functional dependency
- 2) Fully functional "
- 3) Partially "
- 4) Transitive "
- 5) Multi valued "

FUNCTIONAL DEPENDENCY.

- A functional dependency occurs when one attribute in a relation uniquely determine another attribute. It describe relationship b/w attributes.

- Given a relation R, set of attribute X in a relation R is said to be functionally determined another attribute Y in a relation R if and only if each X value is associated with one Y value

| X              | Y              | Z              |                              |
|----------------|----------------|----------------|------------------------------|
| x <sub>1</sub> | y <sub>1</sub> | z <sub>1</sub> | $x \rightarrow y \checkmark$ |
| x <sub>1</sub> | y <sub>2</sub> | z <sub>2</sub> | $y \rightarrow x \times$     |
| x <sub>1</sub> | y <sub>2</sub> | z <sub>2</sub> | $y \rightarrow z \times$     |
| x <sub>2</sub> | y <sub>2</sub> | z <sub>3</sub> | $z \rightarrow y \checkmark$ |
| x <sub>2</sub> | y <sub>4</sub> | z <sub>4</sub> | $x \rightarrow z \times$     |
| x <sub>3</sub> | y <sub>4</sub> | z <sub>5</sub> |                              |

FULLY FUNCTIONAL DEPENDENCY.

When all non-key attribute are dependent on the key attribute.





is called fully functional dependency.

- If  $A \neq B$  are attributes of Relation  $R$ , then  $B$  is fully functionally dependent on  $A$  if  $B$  is functionally dependent on  $A$  but not functionally dependent on any proper subset of  $A$ . In other words, fully functional dependency means when primary key is composite key i.e., consist of two or more attributes.

$(x, y) \xrightarrow{\text{key attribute}} z$  P.K.  
 $z \rightarrow$  Non-key.

$(x, y) \rightarrow z$  ✓

$x \rightarrow z$  ✗  
 $y \rightarrow z$  ✗ [  $z$  is not FFD ]

## PARTIAL DEPENDENCY.

It occurs when some non-key attribute depend upon a Primary key attribute & some non-key attribute depend upon other non-key attribute. In other words it indicate that if  $A$  &  $B$  are attribute of relation  $B$  is partially depend upon  $A$  if there is some attribute that can be removed from  $A$  and dependency still hold.

①  $R(x, y, z)$   
key attribute  $(x, y) \rightarrow z$   
 $z$  - non key attributes

②  $R(x, y, z)$   
key attribute  $x$   
non-key attribute  $y, z$   
 $x \rightarrow y$  ✓  
 $y \rightarrow z$  ✗ P.D





## TRANSITIVE DEPENDENCY

A transitive dependency can occur only in a relation that has three or more attributes.

Let's suppose A, B, C are three attributes in a relation which hold following dependency

$R(A, B, C)$

$A \rightarrow B$  and  $B \rightarrow C$   
 $\Downarrow$   
 $A \rightarrow C$

## MULTI VALUED DEPENDENCY

A multi-valued dependency is a full constraint b/w two set of attributes in a relation, i.e., one attribute value can have multiple values for another attribute value.

| Course | Book       | Lecturer |
|--------|------------|----------|
| MCA    | DBMS       | Kulveer  |
| MCA    | C language | Akash    |
| MCA    | DBMS       | Akash    |
| MBA    | DBMS       | Kulveer  |

Course  $\twoheadrightarrow$  Book  
Course  $\twoheadrightarrow$  Lecturer

1<sup>st</sup> NF  $\rightarrow$  2NF

A given relation is in second normal form. If and only if:-

- It is in a 1<sup>st</sup> NF
- If all non-key attribute fully functionally dependent on candidate key (key attribute) i.e., each attribute must be dependent on entire key.
- A relation in 1<sup>st</sup> NF, if it does not contain any partial dependency





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| Order No. | Order Date | Item No. | Unit | Price | 1. (order No, item No)        |
|-----------|------------|----------|------|-------|-------------------------------|
| 100       | 15/2/18    | 1000     | 200  | 600   | ← Order Date<br>unit<br>price |
| 101       | 16/2/18    | 1001     | 300  | 700   |                               |
| 102       | 16/2/18    | 1002     | 400  | 800   |                               |
| 103       | 17/2/18    | 1003     | 500  | 900   |                               |

| Order No. | Order Date | Item No. | Price | Order No. | Item No. | Unit. |
|-----------|------------|----------|-------|-----------|----------|-------|
| 100       | 15/2/18    | 1000     | 600   | 100       | 1000     | 200   |
| 101       | 16/2/18    | 1001     | 700   | 101       | 1001     | 300   |
| 102       | 16/2/18    | 1002     | 800   | 102       | 1002     | 400   |
| 103       | 17/2/18    | 1003     | 900   | 103       | 1003     | 500   |

### Third Normal Format → 3NF

- A given relation is in third normal form if it is in a second NF.
- Non-key attribute should not be transitively functionally dependent on Primary Key i.e., every non-key attribute should be fully and directly depend on Primary key attribute. In other words, there should be no transitive dependency.

P.K. ←

| ID No. | Name   | Dept.   | Course | Hostels |
|--------|--------|---------|--------|---------|
| 101    | Anit   | Comp.   | MBA    | Satli   |
| 102    | Ajay   | Comp.   | BBA    | Beas    |
| 103    | Prince | Science | B.Sc.  | Ganga   |
| 104    | Kulvir | Maths   | M.Sc.  | Jamuna  |

| Course | Hostel |
|--------|--------|
|        |        |
|        |        |
|        |        |

ID No. → Name

→ Dept.

→ Course

Course → Hostels

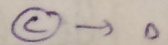
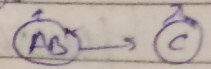
ID No → Hostel.



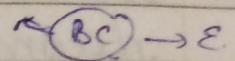


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R(ABCDE)

Determinant Determined



CK



## BCNF (Boyce Codd Normal Form) →

- It is a part of Third NF.
- A relation is in BCNF, if it is in third normal form.
- Every determinant is a candidate key.
- It should have multiple candidate key i.e., there should be no overlapping of candidate key.

## Fourth Normal form →

R(ABC)  $A \xrightarrow{\text{independent attribute}} B$   
 $A \twoheadrightarrow C$

- A given relation R is in fourth Normal form, if it is in BCNF or 3NF.
- It has no multi-valued dependency

|                | Name   | Dept  | Language |
|----------------|--------|-------|----------|
| t <sub>1</sub> | John   | Sales | English  |
| t <sub>2</sub> | John   | Sales | Punjabi  |
| t <sub>3</sub> | John   | Comp  | English  |
| t <sub>4</sub> | John   | Comp  | Punjabi  |
| t <sub>5</sub> | Nickel | Sales | English  |
| t <sub>6</sub> | Nickel | Sales | Punjabi  |

$$t_1(x) = t_2(x) = t_3(x) = t_4(x)$$

$$t_1(y) = t_2(y)$$

$$t_1(z) = t_3(z)$$

$$\text{Name} \rightarrow \text{Dept.}$$

$$\text{Name} \rightarrow \text{Language}$$

| Name   | Dept  |
|--------|-------|
| John   | Sales |
| Nickel | Sales |
| John   | Comp. |

| Name   | Language |
|--------|----------|
| John   | English  |
| John   | Punjabi  |
| Nickel | English  |
| Nickel | Punjabi  |

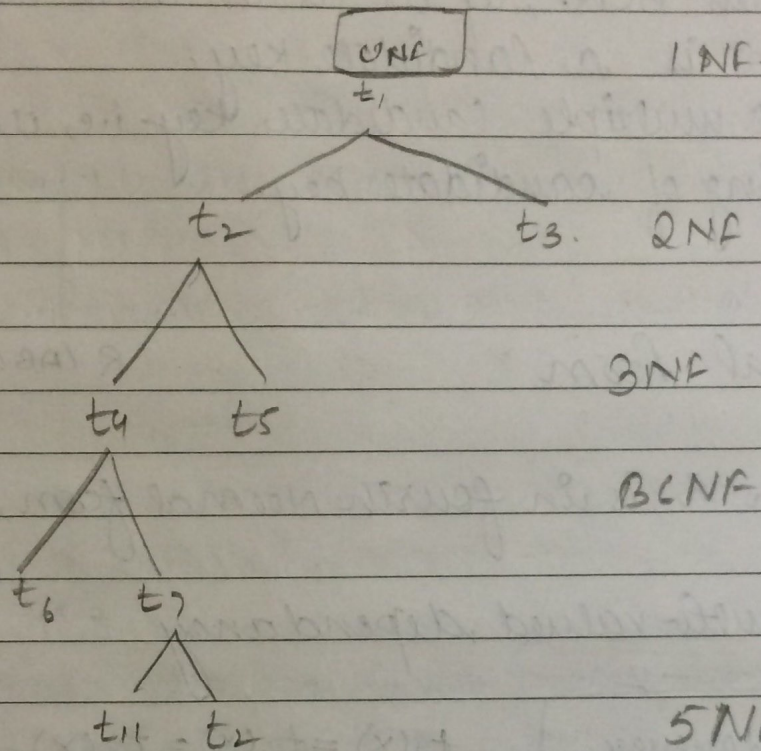
## Fifth Normal form →

- A relation R is in fifth NF, if it is already in



fourth NF

- It has no joint dependency i.e., relation cannot be decomposed any further.



In the fifth Normal form further decomposition is not possible.

Chap

9 DATABASE SECURITY & INTEGRITY.

