

# Computer Science & IT

## Database Management System



**Relational Model & Normal Forms**

**Lecture No. 03**



**By- Vishal Sir**



# Recap of Previous Lecture



Topic

Relational Database Model



Topic

Functional dependency



# Topics to be Covered



Topic

Functional dependency



Topic

Types of functional dependency





→ ①

If  $X \rightarrow Y$  exists in relation  $R$ , then either values of attributes of set  $X$  will always be unique, (OR) whenever values of attributes of set  $X$  are same in any two tuples values of attributes of set  $Y$  will also be same in those tuples.

②

If  $X \rightarrow Y$  exists in relation  $R$ , and values of attributes of set  $Y$  are same in any pair of tuples then there is no restriction of the values of attributes of set  $X$ .



#Q. Consider the following relational instance

A	B	C
1	2	3
1	2	4
2	2	1
3	1	2
4	1	2

Which of the following functional dependency may hold true (not necessarily) based on given relational instance.

☒ a)  $A \rightarrow C$

☒ b)  $A \rightarrow B$

☒ c)  $AB \rightarrow C$

☒ d)  $BC \rightarrow A$

#Q. Consider the following relational instance

A	B	C
1	2	3
1	2	4
2	2	1
3	1	2

Which of the following functional dependency **may hold true (not necessarily)** based on given relational instance.

~~a)  $A \rightarrow C$~~

☒ b)  $A \rightarrow B$

~~c)  $AB \rightarrow C$~~

☒ d)  $BC \rightarrow A$



Note:

Functional dependencies that holds in a relation will always be given in the question

{ In reality Functional dependencies are identified }  
by database designer

{ Relational instance of a relation will always satisfy the restrictions enforced by functional dependencies of that relation }

{ Based on relational instance we can only identify the functional dependencies which will not hold in the relation.  
We can never conclude that which functional dependency will hold in  $Rel^n$



#Q. Consider the following relational instance

A	B	C
1	1	1
1	2	2
2	4	3
3	3	4
4	1	5
5	3	6

Which of the following functional dependency **may hold true (not necessarily)** based on given relational instance.

~~a) B → C~~

~~b) A → B~~

~~c) C → B~~

~~d) B → A~~

~~e) C → A~~



Note:

Necessary Condition for  $X \rightarrow Y$  to hold true in a relation is, that whenever values w.r.t.  $X$  are same, values w.r.t.  $Y$  should also be same

It is just a necessary Cond<sup>n</sup> not sufficient.





## Topic : Functional dependency (FD)

- ❑ If necessary condition for functional dependency " $X \rightarrow Y$ " does not hold true based on given relation instance, then functional dependency " $X \rightarrow Y$ " can never exist in the given relation.
- ❑ Even if necessary condition for functional dependency " $X \rightarrow Y$ " does hold true based on given relation instance, then also we can not be sure whether functional dependency  $X \rightarrow Y$  exists in the relation or not, because it is just the relational instance.



#Q. From the following instance of a relation schema  $R(A,B,C)$ , we can conclude that:

A	B	C
1	1	1
1	1	0
2	3	2
2	3	2

$A \rightarrow B$  may hold { But we can not conclude that  $A \rightarrow B$  holds in the relation }

$\therefore B \rightarrow C$  can never hold in the relation

(A) A functionally determines B, and B functionally determines C

(B) A functionally determines B, and B does not functionally determine C

(C) B does not functionally determine C

(D) A does not functionally determine B, and B does not functionally determine C





## Topic : Types of Functional Dependency

We may classify functional dependencies into three types: -

- Trivial functional dependency
- Non-trivial functional dependency
- Semi-non-trivial functional dependency

Not important  
↓

Because we can decompose such functional dependencies into trivial & non-trivial functional dependencies



# Student

Sid	Sname	fee
S <sub>1</sub>	A	500
S <sub>2</sub>	B	1000
S <sub>3</sub>	A	1000
S <sub>4</sub>	C	700

$Sid \rightarrow Sname$  { Something useful?  
is determined  
i.e. Non-trivial }

$Sid, Sname \rightarrow Sname$

$Sid \rightarrow Sid$  { No new information?  
is obtained  
i.e. Trivial }





## Topic : Trivial Functional Dependency

Let  $R$  be the relational schema, and  $X \neq Y$  be set of attributes from relation  $R$ .

Functional dependency  $X \rightarrow Y$  is called a trivial functional dependency if,  $X \supseteq Y$

- \* All trivial functional dependencies possible with the attributes of relation  $R$ , will always hold true in relation  $R$ .  
i.e. All trivial functional dependencies are always implied in the relation





## Topic : Non-trivial Functional Dependency

- Let  $R$  be the relation schema, and  $X$  &  $Y$  be the set of attributes from relation  $R$ .

Function dependency  $X \rightarrow Y$  is called a non-trivial functional dep. if  $X \cap Y = \emptyset$

A non-trivial functional dependency may or may not hold true in a relation





## Topic : Semi non-trivial Functional Dependency

→ let  $R$  be the relational schema, and  $X$  &  $Y$  be the set of attributes from relation  $R$ .

→ FD  $X \rightarrow Y$  is called a semi-non-trivial functional dependency if  $X \not\supseteq Y$  and  $X \cap Y \neq \emptyset$

eg.  $\text{Sid, fee} \rightarrow \text{Sname, fee}$

$\{\text{Sid, fee}\} \not\supseteq \{\text{Sname, fee}\}$  and  $\{\text{Sid, fee}\} \cap \{\text{Sname, fee}\} = \{\text{fee}\} \neq \emptyset$   
∴  $\text{Sid, fee} \rightarrow \text{Sname, fee}$  is a semi-non-trivial FD.



Note: ① Every trivial fd will always hold true is a relation

② We can always decompose semi non trivial FD into trivial FD & non-trivial FD.

∴ Our main concern will be non-trivial FDs.



#Q. Consider the following relational instance

A	B	C
1	1	1
1	1	2
2	1	2
2	2	3
3	3	4

Possible non-trivial FDs with three attributes A, B & C are.

~~$A \rightarrow B$~~

~~$A \rightarrow BC$~~

~~$AB \rightarrow C$~~

~~$A \rightarrow C$~~

~~$B \rightarrow AC$~~

$AC \rightarrow B$

~~$B \rightarrow A$~~

~~$C \rightarrow AB$~~

~~$BC \rightarrow A$~~

~~$B \rightarrow C$~~

~~$C \rightarrow A$~~

$C \rightarrow B$

Find all non-trivial FDs which may hold true in the above relation based on given relational instance.

$C \rightarrow B$  &  $AC \rightarrow B$  are the non-trivial FDs which may hold true in the relation.



H.W.

#Q. Write all possible non-trivial FDs with respect to relational schema

$R(A, B, C, D)$



GATE-2024

GATE:

FD  $X \rightarrow Y$  is called a useful FD  
if both  $X$  &  $Y$  are non-empty set of attributes,  
and

$$X \cap Y = \emptyset$$

How many useful FD are possible in a relation  
with 4 attributes!



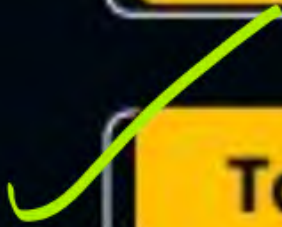


## 2 mins Summary



Topic

Functional dependency



Topic

Types of functional dependency





t.me/vishalRawtiyaPW

Vishal rawtiya PW

**THANK - YOU**