

Computer Science & IT

Database Management System



Relational Model & Normal Forms

Lecture No. 02



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Recap of Previous Lecture



Topic

Syllabus

Topic

Introduction to DBMS



Topics to be Covered



Topic

Relational Database Model



Topic

Functional dependency





Topic : Relational database

In relational database model, information is stored in the form of table.

Table is a collection of rows & columns.



Topic : Relational database

Attributes / field

In the example,

it is a relation

Degree of
Relation Student = 3

Number of tuples
in given example = 4

Cardinality of
relation is = 4

Student

Roll-no.	Sname	Cont-No.
S ₁	A	123
S ₂	B	456
S ₃	A	789
S ₄	C	123

tuples / records
of the relation

Relational Schema:

Student (Roll-No, Sname, Cont-No.)

(S₁, A, 123)
(S₂, B, 456)
(S₃, A, 789)
(S₄, C, 123)

Four
tuples
in
relation



Topic : Relational database



i.e., No of Columns

Degree / Arity :-

No. of attributes/field in a relation is defined as degree/arity of that relation

tuple / record :-

Each row of the relational table is called is called a tuple/record

Cardinality :-

Cardinality of a relational table is defined as number of tuples/records in the relation.



Topic : Relational database

Relational schema: It is used to provide the abstract detail of the relation in the database

Relational schema for the relational table in the above example

Student (Roll-no, Sname, Cont-No.)

Name of relational table

first attribute in the relation

2nd attribute of relation

3rd attribute in the relation



Topic : Relational database



Relational Instance : If data exists in the relation at a given time, then that set of data (tuple) is called relational instance of that time.

★ Current Relational instance
w.r.t. above example = $\{(S_1, A, 123), (S_2, B, 456), (S_3, A, 789), (S_4, C, 123)\}$

Note:- Relational instance may change with time because of insert, delete or update operations.



Topic : Functional dependency (FD)

Let R be the relation and X & Y are set of attributes from relation R

$R(A_1, A_2, A_3, A_4, A_5, A_6)$

X may be $\{A_1, A_3\}$
or $\{A_3, A_4\}$ or $\{A_2\}$
or any set of attributes

Same for Y

- Functional dependency from X to Y may be denoted by $X \rightarrow Y$

- In functional dependency $X \rightarrow Y$
 X is called determinant
& Y is called dependent.



Topic : Functional dependency (FD)

eg.

Student

Sid	Sname	Contact
S1	A	123
S2	B	456
S3	A	789
S4	C	123

Based on the given relational instance following functional dependencies may hold true.

$Sid \rightarrow Sname$
 $Sid \rightarrow Contact$

$Sid, Sname \rightarrow Contact$

$Sid, Contact \rightarrow Sname$

$Sname, Contact \rightarrow Sid$

*** If we know Sid of the student then we can uniquely determine Sname of that student in the table.
i.e. functional dependency $Sid \rightarrow Sname$ holds in the relation.
Then Sid will become determinant & Sname becomes dependent w.r.t. functional dependency.

" $Sid \rightarrow Sname$ "

* If we know the Sname of the student, then we may not determine the 'Sid' uniquely w.r.t that Sname.
i.e. $Sname \rightarrow Sid$ does not hold in the relation.



Topic : Functional dependency (FD)

- Functional dependency defines the relationship between two sets of attributes in a relational table.

- It states that the values of dependent attribute set can be completely determined by the values of determinant attributes set. In other words, if a determinant attribute's value is known, the value of the dependent attribute can be deduced.



Topic : Functional dependency (FD)

$P \text{ only if } Q = \text{if } P \text{ then } Q$



- Let R be the relational schema with X and Y as the attribute sets over relation R .

Functional dependency $X \rightarrow Y$ exists in R only if

For all pair of tuples $t_1, t_2 \in R$

If $t_1.X = t_2.X$ then $t_1.Y = t_2.Y$

If functional dependency $X \rightarrow Y$ exists in relation R then,

for all pair of tuples $t_1, t_2 \in R$

if $t_1.X = t_2.X$ then $t_1.Y = t_2.Y$

let $A_2 \rightarrow A_3$ exists in R. R
 & $A_1 \rightarrow A_5$ also exists in R

Let $A_3 \rightarrow A_4$
 also exists in R

A_1	A_2	A_3	A_4	A_5	
1	1	5	8	2	
2	2	4	5	2	
3	2	4	5	4	
4	4	7	6	6	

Values of A_1 & A_5 are valid w.r.t. $A_1 \rightarrow A_5$

Values of A_2 & A_3 are valid w.r.t. $A_2 \rightarrow A_3$

w.r.t. Functional dep
 $A_3 \rightarrow A_4$
 Values of A_3 & A_4
 are invalid

A_3	A_4	
7	5	} Not allowed
7	8	



Topic : Functional dependency (FD)

If functional dependency $X \rightarrow Y$ exists in $R = P$
then

Whenever values of attribute set X are same in any two tuples then corresponding value of Y should also be same in those tuples. $= Q$

In a relational instance whenever values of attribute set X are same in any pair of tuples, if values of Y are also same in those tuples, then functional dependency $X \rightarrow Y$ may or may not hold true

Consider the following relational instance

Relation = R

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

from this relational instance
What can we conclude about
functional dependency $B \rightarrow A$

→ From the given relational
instance we can conclude
that functional dependency

$B \rightarrow A$ will never
hold true in Relation R

When values of B are same values of A are
not same

Consider the following relational instance

Relation = R

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

from this relational instance
What can we conclude about
functional dependency $A \rightarrow B$

In given relational instance whenever
values of A are same in two tuples
Corresponding values of B is also same in
those tuples.

$\therefore A \rightarrow B$ may or may not hold

It is just a
relational instance
Values may change
if we can add a
new tuple

then
 $A \rightarrow B$ does
not hold.

#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	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) $B \rightarrow C$

b) $A \rightarrow B$

c) $C \rightarrow B$

d) $B \rightarrow A$

e) $C \rightarrow A$



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) 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



2 mins Summary



Topic

Relational Database Model

Topic

Functional dependency

THANK - YOU