TOPICS TO BE COVERED

01 Introduction of RDBMS

02 Functional Dependency

DBMS

Lecture schedule

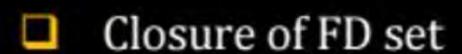## DBMS GATE Syllabus (8-10 marks)

➤ Functional dependencies and Normalization.

➤ Transaction and Concurrency control.

➤ SQL

➤ Relational Algebra & TRC

➤ File Organization and Indexing

➤ ER model and Integrity constraints.

Functional Dependency (FD's)

- ✓ FD concepts
- ✓ FD types
- ✓ Armstrong's axioms/Inference rules
- ✓ Attribute closure
- ✓ Keys Concept
  - ✓ Super key
  - ✓ Candidate key
  - ✓ Primary key
  - ✓ Alternative / secondary key
- ❏ Finding multiple candidate keys
- ❏ Membership set

- ❑ Closure of FD set
- ❑ Equality between 2 FD sets.
- ❑ Minimal cover (Canonical cover).
- ❑ Lossy and Lossless Join Decomposition.
- ❑ Dependency preserving Decomposition.

Normalization

- Need of Normalization ? / Problem with Unnormalized Data

  Normal Forms

  - ❖ 1 NF

  - ❖ 2 NF

  - ❖ 3 NF

  - ❖ BCNF

  Multi-Valued Dependencies

  NF Decomposition

  - ❖ 2NF Decomposition ✓

  - ❖ 3NF Decomposition ✓

  - ❖ BCNF Decomposition ✓

Transaction & Concurrency Control

- ☑ Transaction concept
- ☑ ACID Properties
- ☑ Schedules (serial & non serial schedule)
- ☑ Serializable schedule
    - ❖ conflict Serializable
    - ❖ View serializable
- ☑ Testing method for conflict serializability
- ☑ Conflict equivalent schedule
- ☑ Problem due to concurrent execution
- ☑ Recoverable, cascadeless, strict recoverable schedule.

- ❑ Implementation of concurrency control

  - ❖ Lock based protocol.

- ❑ 2 Phase locking protocol (Basic 2PL, Strict 2PL, Rigorous 2PL, Conservative 2PL)

- ❑ Time stamp based protocol

  - ❖ Thomas Write rule

  - ❖ Deadlock Avoidance (Wait - die & Wound - wait)

Query Language

- Introduction of Relational Algebra (RA)

Operations

- ❖ Section (σ)
- ❖ Projection (π)
- ❖ Union (∪)
- ❖ Set Difference (−)
- ❖ Cross Product (×)
- ❖ Rename (ρ)
- ❖ Intersection (∩)
- ❖ Division (/)
- ❖ Join & its type.

- ❏ TRC (Tuple Relational Calculus) & DRC(Domain Relational Calculus)
- ❏ SQL & its clauses
  - ❖ Aggregate operators
  - ❖ Set operators
  - ❖ Nested Query
  - ❖ Correlated nested query
- ❏ Null value concept

File Organization & Indexing

❑ Spanned and unspanned organization

❑ Sparse & Dense Index

❑ Indexing type (Primary, Clustered, Secondary index)

❑ Multi level indexing

❑ B Tree

❑ Insertion & Deletion in B tree

❑ B$^+$ Tree

ER Model & Integrity Constraints.

- ✓ Introduction of ER Model
- ✓ Attributes and its type
- ✓ Relationship set
- ✓ Participation constraints
- ✓ Cardinality Ratio
- ✓ Strong and weak entity set
- ✓ Specialization & Generalization

Foreign key concept and its constraint

Conversion of ER model to Relations (Tables).

Books:

Henry F. Korth (Transaction Concept), ER   File org & Indexing

Navathe (FD & NF)

Raghu Ramakrishnan (SQL, RA, TRC), ER, File org

Jeffrey D. Ullman (FD & NF), Indexing.

Poll

(a) Enjoying & Chamka CC Concept

(b) CC: Crystal clear.

(c) C: clear.

(d) Doubt ?

10th Pass

More than 100+

GATE PYQ

111 +

125 +

- Basic to Complete Depth.

- More than Sufficient.

- FULL SCORING SUBJECT.

DATA   (Facts , Row Material)

↓

Information   (Preprocess Data
                (or) Meaning Data)

↓

Database (DB) [Collection of Logical Related Data
                 (or)
                 Collection of similar Record]

↓

DBMS   [Set of Programs (S/w) which used to
                Access & Manipulate the Data in efficient
                          & fast manner.]

RDBMS $\longrightarrow$ Relational DBMS

Relation $\longrightarrow$ Table $\longrightarrow$ Row (Tuple/Record)

Column (Field/Attribute)

STUDENT

Roll no	Name	Branch	State	Gender	CGPA
1	A	CS	MP	M	9
2	B	IT	UP	F	10
3	C	CS	HP	M	10
4	D	IT	RJ	F	9
5	E	EC	Punjab	M	10
6	F	CS	Bihar	M	9
7	G	IT	Maharash	F	10

(Degree)
Arity   :   Number
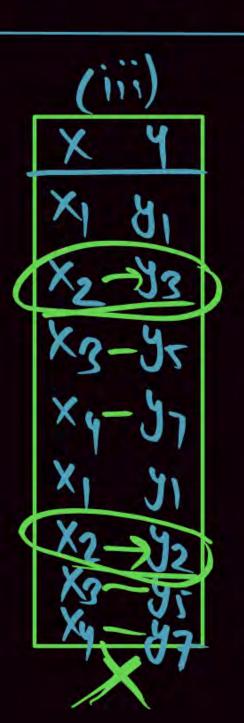   # of Attributes/Fields/Column
                        [6]

Cardinality : Number(#) of Tuples/Records/Row
                        [7]

Number : #

Relational schema : Table Abstraction/Heading of Table/Structure of Table

STUDENT (Rollno, Name, Branch, State, Gender, CGPA)

Relational Instance : Set of Records

Relation extension: Table itself.

FD [Functional Dependency] [X ⟶ Y]   X→Y ✓

(2,4,6) ✓

(i)

X	Y
1	6
2 →→ 7	7
3	7
4	8
5 →→ 9	9
6	5
2 →→ 7	7
5	8

(ii)

X	Y
1	8
2	8
3	8
4	9
5	9
6	9
7	9

(iii)

X	Y
x_1	y_1
$x_2 →→ y_3$	
$x_3 - y_5$	
$x_4 - y_7$	
x_1	y_1
$x_2 →→ y_2$	
$x_3 - y_5$	
$x_4 - y_7$	

(iv)

X	Y
x_1	y_1
x_2	y_1
x_3	y_2
x_4	y_2
x_5	y_5

(v)

X	Y
1 →→ 8	8
2	6
3	2
4	3
7	5
8	1
1 →→ 7	7

X	Y
x_1	y_1
$x_2 →→ y_5$	
x_3	y_7
x_4	y_9
$x_5 →→ y_3$	
$x_2 →→ y_5$	
$x_5 →→ y_3$	

$$X \longrightarrow Y:$$

X functionally Determines Y.

Abhishek : LL
Vasudev : 75
Sachin : 29   98%

$$\bigcirc\!\!\!\!X \rightarrow y$$

whenever X value Repeat, Corresponding
y value Must be Same

Functional Dependency $[X \rightarrow y]$

Consider a Relational Schema R, X & y be the attribute set of Relation R & t_1 & t_2 Any Two Tuples Such that

$$X \rightarrow y$$

If $t_1 \cdot X = t_2 \cdot X$ then $t_1 \cdot y = t_2 \cdot y$ Must be Same

Note :
In $X \rightarrow y$; Whenever x value Repeat Corresponding y value Must be Same.

Type of FD's

① Trivial FD ✓ ⟶ <u>Always Valid</u>.

Imp ② Non Trivial FD

③ Semi Non Trivial FD.

$\rightarrow$ Always Valid.

① Trivial FD $[x \rightarrow y]$

$x \rightarrow y$ is Trivial FD

iff $\boxed{x \geq y}$ { Right Hand Side (R.H.S) attribute must be equal or Part of Left Hand Side (L.H.S) attribute

② Sid Sname $\rightarrow$ Sid
Sid Sname $\rightarrow$ Sname
Sid Sname $\rightarrow$ Sid Sname
AB $\rightarrow$ A
AB $\rightarrow$ B
AB $\rightarrow$ AB

② Non Trivial FD

$X \rightarrow y$ is Non Trivial FD iff

$$X \cap y = \phi \quad \&\& \quad X \rightarrow y \text{ Must Satisfy FD Definition}$$

ⓔ $A \rightarrow C$

$A \rightarrow B$

$Sid \rightarrow Roll No$

$Sid \rightarrow Mark$

$Sid \rightarrow Gender$

$Sid \rightarrow Sname$

× ③ semi Non Trivial FD

$X \rightarrow y$ is Semi

Non Trivial FD iff

$X \nrightarrow y \quad \& \quad X \cap y \neq \phi$

ⓔ

$AB \rightarrow BC$

$AB \nrightarrow BC$

$AB \cap BC = B \neq \phi$

Q Find the Non Trivial FD'S which are Satisfied by the Given Relation Instances ?

Q.1

X	Y	Z
3	3	7
3	1	7
1	3	7
1	1	7
1	3	7

$X \to Z$
$Y \to Z$
$XY \to Z$

Non Trivial FD

Trivial FD
$XYZ \to X$
$XYZ \to Y$
$XYZ \to Z$

$X \to Y$ $Y \to X$ $Z \to X$ ✓ $XY \to Z$

✓ $X \to Z$ ✓ $Y \to Z$ $Z \to Y$ $YZ \to X$

$X \to YZ$ $Y \to XZ$ $Z \to XY$ $XZ \to Y$

Q.2 Consider the following relation:

(P)(W)

A	B	C	TUPLE#
10	b1	c1	1
10	b2	c2	2
11	b4	c1	3
12	b3	c4	4
13	b1	c1	5
14	B3	c4	6

Which option Satisfied
by the Instance ?

Only
(II) Ans

① A → B
② B → C ✓
③ C → B
④ B → A
⑤ C → A

Given the extension (state), which of the following dependencies

May hold in the above relation? If the dependency cannot hold, explain why by

Specifying the tuples that cause the violation.

I. A → B, II. B → C, III. C → B, IV. B → A, V. C → A

Q.3

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

$$BC \rightarrow A$$

$A \rightarrow B$ $B \rightarrow A$ $C \rightarrow A$ $AB \rightarrow C$

$A \rightarrow C$ $B \rightarrow C$ $C \rightarrow B$ $BC \rightarrow A$ ✓

$A \rightarrow BC$ $B \rightarrow AC$ $C \rightarrow AB$ $AC \rightarrow B$

P	Q	R
6	6	7
6	7	7
7	3	4
8	3	4

$P \to R$
$Q \to R$
$PQ \to R$

$P \to Q$ $\qquad$ $Q \to P$ $\qquad$ $R \to P$ $\qquad$ $PQ \to R$ ✓

$P \to R$ ✓ $\qquad$ $Q \to R$ ✓ $\qquad$ $R \to Q$ $\qquad$ $QR \to P$

$P \to QR$ $\qquad$ $Q \to PR$ $\qquad$ $R \to PQ$ $\qquad$ $PR \to Q$

A	B	C
7	5	6
7	7	6
7	5	7
7	7	7
9	5	6

Q.6.

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

Q.7 Given the following relation instance.

X	Y	Z
4	4	4
4	7	4
7	4	7
7	4	9
4	9	9

The number of non trivial FD's are satisfied by the instance ___

Any Doubt ?