UNIT 2

Lecture 37

Normalization GATE Questions

(2021 to 1997)

GATE Questions

Q.1 Consider the relation R(P, Q, S, T, X, Y, Z, W) with the following functional dependencies.

PQ → X, P → YX, Q → Y, Y → ZW

Consider the decomposition of the relation R into the constituent relations according to the following two decomposition schemes.

D1 : R = [(P, Q, S, T); (P, T, X); (Q,Y); (Y, Z, W)]

D2 : R = [(P, Q, S); (T, X); (Q, Y); (Y, Z, W)]

Which one of the following options is correct?

(A) D1 is a lossless decomposition, but D2 is a lossy decomposition

(B) D1 is a lossy decomposition, but D2 is a lossless decomposition

(C) Both D1 and D2 are lossless decomposition

(D) Both D1 and D2 are lossy decomposition

[GATE 2021]

GATE Questions (MSQ)

Q.2 Suppose the following functional dependencies hold on a relation U with attributes P, Q, R, S, and T :

$P \rightarrow QR$

$RS \rightarrow T$

Which of the following functional dependencies can be inferred from the above functional dependencies?

(A) $PS \rightarrow T$

(B) $R \rightarrow T$

(C) $P \rightarrow R$

(D) $PS \rightarrow Q$

[GATE 2021]

GATE Questions

Q.3 Consider a relational table R that is in 3NF, but not in BCNF. Which one of the following statements is TRUE?

(A) R has a nontrivial functional dependency X → A, where X is not a superkey and A is a prime attribute.

(B) R has a nontrivial functional dependency X → A, where X is not a superkey and A is a non-prime attribute and X is not a proper subset of any key.

(C) R has a nontrivial functional dependency X → A, where X is not a superkey and A is a non-prime attribute and X is a proper subset of some key.

(D) A cell in R holds a set instead of an atomic value.

[GATE 2020]

GATE Questions

Q.4 Let the set of functional dependencies F = {QR → S, R → P, S → Q} hold on a relation schema X = (PQRS). X is not in BCNF. Suppose X is decomposed into two schemas Y and Z, where Y = (PR) and Z = (QRS).

Consider the two statements given below.

I. Both Y and Z are in BCNF

II. Decomposition of X into Y and Z is dependency preserving and lossless

Which of the above statements is/are correct?

(A) Both I and II (B) I only (C) II only (D) Neither I nor II

[GATE 2019]

GATE Questions

Q.5 Consider the following four relational schemas. For each schema, all non-trivial functional dependencies are listed. The underlined attributes are the respective primary keys.

Schema I:

Registration (<u>rollno</u>, courses)

Field 'courses' is a set-valued attribute containing the set of courses a student has registered for.

Non-trivial functional dependency

Rollno → courses

Schema II:

Registration (<u>rollno, courseid</u>, email)

Non-trivial functional dependencies:

rollno, courseid → email

email → rollno

Schema III: Registration (<u>rollno, courseid</u>, marks, grade)

Non-trivial functional dependencies:

rollno, courseid → marks, grade

marks → grade

Schema IV: Registration (<u>rollno, courseid</u>, credit)

Non-trivial functional dependencies:

rollno, courseid → credit

courseid → credit

Which one of the relational schemas above is in 3NF but not in BCNF?

(A) Schema I (B) Schema II

(C) Schema III (D) Schema IV

[GATE 2018]

GATE Question

The following functional dependencies hold true for the relational schema R{V, W, X, Y, Z} :

V → W,

VW → X,

Y → VX,

Y → Z

Which of the following is irreducible equivalent for this set of functional dependencies?

(A)
V→W
V→X
Y→V
Y→Z

(B)
V→W
W→X
Y→V
Y→Z

(C)
V→W
V → X
Y→V
Y→X
Y →Z

(D)
V→W
W→X
Y→V
Y→X
Y→Z

[GATE 2017]

GATE Question

Which of the following is NOT a super key in a relational schema with attributes V, W, X, Y, Z and primary key VY?

(A) VXYZ

(B) VWXZ

(C) VWXY

(D) VWXYZ

[GATE 2016]

GATE Question

A database of research articles in a journal uses the following schema.

(VOLUME, NUMBER, STARTPAGE, ENDPAGE, TITLE, YEAR, PRICE)

The primary key is (VOLUME, NUMBER, STARTPAGE, ENDPAGE) and the following functional dependencies exist in the schema.

(VOLUME, NUMBER, STARTPAGE, ENDPAGE) → TITLE

(VOLUME, NUMBER) → YEAR

(VOLUME, NUMBER, STARTPAGE, ENDPAGE) → PRICE

The database is redesigned to use the following schemas.

(VOLUME, NUMBER, STARTPAGE, ENDPAGE, TITLE, PRICE) (VOLUME, NUMBER, YEAR)

Which is the weakest normal form that the new database satisfies, but the old one does not?

(A) 1NF (B) 2NF (C) 3NF (D) BCNF

[GATE 2016]

GATE Question

Consider the relation X(P, Q, R, S, T, U) with the following set of functional dependencies

F = {

{P, R} → {S, T}

{P, S, U} → {Q, R}

}

Which of the following is the trivial functional dependency in F^+, where F^+ is the closure of F?

(a) {P, R} → {S, T}

(b) {P, R} → {R, T}

(c) {P, S} → {S}

(d) {P, S, U} → {Q}

[GATE 2015]

GATE Question

Consider the relation schema R = (E, F, G, H, I, J, K, L, M, N) and the set of functional dependencies {{E, F} → {G}, {F} → {I, J}, {E, H} → {K, L}, {K} → {M}, {L} → {N}} on R. What is the key for R?

(a) {E, F}

(b) {E, F, H}

(c) {E, F, H, K, L}

(d) {E}

[GATE 2014]

GATE Question

The maximum number of super keys for the relation schema R (E, F, G, H) with E as the key is ___.

[GATE 2014]

GATE Question

A prime attribute of a relation scheme R is an attribute that appears

(A) in all candidate keys of R.

(B) in some candidate key of R.

(C) in a foreign keys of R.

(D) only in the primary key of R.

[GATE 2014]

GATE Questions

Given an instance of the STUDENTS relation as shown below :

StudentD	StudentName	StudentEmail	StudentAge	CPI
2345	Shankar	shankar@math	X	9.4
1287	Swati	swati@ee	19	9.5
7853	Shankar	shankar@cse	19	9.4
9876	Swati	swati@mech	18	9.3
8765	Ganesh	ganesh@civil	19	8.7

For (StudentName, StudentAge) to be a key for this instance, the value X should NOT be equal to_____.

[GATE 2014: 1 Mark]

GATE Question

Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. F = {CH → G, A →BC, B →CFH, E →A, F →EG} is a set of functional dependencies (FDs) so that F^+ is exactly the set of FDs that hold for R.

Q. How many candidate keys does the relation R have?

(A) 3

(B) 4

(C) 5

(D) 6

[GATE 2013]

GATE Question

Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. F = {CH → G, A →BC, B →CFH, E →A, F →EG} is a set of functional dependencies (FDs) so that F^+ is exactly the set of FDs that hold for R.

Q. The relation R is

(A) in INF, but not in 2NF

(B) in 2NF, but not in 3NF

(C) in 3NF, but not in BCNF

(D) in BCNF

[GATE 2013]

GATE Question

The following functional dependencies hold for relations

R(A, B, C)

and S(B, D, E)

B → A,

A → C

The relation R contains 200 tuples and the relation S contains 100 tuples. What is the maximum number of tuples possible in the natural join R ⋈ S?

(A) 100 (B) 200 (C) 300 (D) 2000

[GATE 2010]

GATE Question

Consider the following relational schema :

Suppliers (sid:integer, sname:string, city:string, street:string)

Parts (pid:integer, pname:string, color:string)

Catalog (sid:integer, pid:integer, cost:real)

Assume that, in the suppliers relation above, each supplier and each street within a city has a unique name, and (sname, city) forms a candidate key. No other functional dependencies are implied other than those implied by primary and candidate keys. Which one of the following is TRUE about the above schema?

(A) The schema is in BCNF

(B) The schema is in 3NF but not in BCNF

(C) The schema is in 2NF but not in 3NF

(D) The schema is not in 2NF

[GATE 2009]

GATE Question

Consider the following relational schemes for a library database :

Book (Title, Author, Catalog_ no, Publisher, Year, Price)

Collection (Title, Author, Catalog_ no)

Within the following functional dependencies :

I. Title, Author → Catalog_no

II. Catalog_no → Title, Author, Publisher, Year

III. Publisher, Title, Year → Price

Assume {Author, Title} is the key for both schemes. Which of the following statements is true?

(A) Both Book and Collection are in BCNF

(B) Both Book and Collection are in 3NF only

(C) Book is in 2NF and Collection is in 3NF

(D) Both Book and Collection are in 2NF only

[GATE 2008]

GATE Question

Which one of the following statements if FALSE?

(A) Any relation with two attributes is in BCNF

(B) A relation in which every key has only one attribute is in 2NF

(C) A prime attribute can be transitively dependent on a key in a 3NF relation.

(D) A prime attribute can be transitively dependent on a key in a BCNF relation.

[GATE 2007]

GATE Question

The following functional dependencies are given :

AB →CD, AF →D, DE → F, C → G, F → E, G →A

Which one of the following option is false?

(A) $\{CF\}^+ = \{ACDEFG\}$

(B) $\{BG\}^+ = \{ABCDG\}$

(C) $\{AF\}^+ = \{ACDEFG\}$

(D) $\{AB\}^+ = \{ABCDFG\}$

[**GATE 2006**]

GATE Questions

Which one of the following statements about normal forms is FALSE?

(A) BCNF is stricter than 3NF

(B) Lossless, dependency-preserving decomposition into 3NF is always possible

(C) Lossless, dependency-preserving decomposition into BCNF is always possible

(D) Any relation with two attributes is in BCNF

[GATE 2005]

GATE Question

Consider a relation scheme R = {A, B, C, D, E, H}on which the following functional dependencies hold : {A →B, BC →D, E →C, D →A}. Which are the candidate keys of R?

(A) AE, BE

(B) AE, BE, DE

(C) AEH, BEH, BCH

(D) AEH, BEH, DEH

[GATE 2005]

GATE Question

In a scheme with attribute A, B, C, D and E following set of functional dependencies are given

A → B

A → C

CD → E

B → D

E → A

Which of the following functional dependencies is NOT implied by the above set?

(a) CD → AC

(b) BD → CD

(c) BC → CD

(d) AC → BC

[GATE 2005]

GATE Question

The relation scheme

StudentPerformance (name, courseNo, rollNo, grade)

has the following functional dependencies :

name, courseNo → grade

rollNo, courseNo → grade

name → rollNo

rollNo → name

The highest normal form of this relation is

(A) 2NF (B) 3NF (C) BCNF (D) 4NF

[GATE 2004]

GATE Question

Consider the following functional dependencies in the database :

Date_of_birth → Age

Age → Eligibility

Name → Roll_Number

Roll_Number → Name

Course_Number → Course_Name

Course_Number → Instructor

(Roll_Number, Course_Number) → Grade

The relation (Roll_Number, Name, Date_of_birth, Age) is

(A) in second normal form but not in third normal form

(B) in third normal form but not in BCNF

(C) in BCNF

(D) in none of the above

[GATE 2003]

GATE Questions

Relation R is decomposed using a set of functional dependencies, F and relation S is decomposed using another set of functional dependencies G. One decomposition is definitely BCNF, the other is definitely 3NF, but it is not known which is which. To make a guaranteed identification, which one of the following tests should be used on the decompositions? (Assume that the closures of F and G are available).

(A) Dependency-preservation
(B) Lossless-join
(C) BCNF definition
(D) 3NF definition

[GATE 2002]

GATE Questions

Relation R with an associated set of functional dependencies, F, is decomposed into BCNF. The redundancy (arising out of functional dependencies) in the resulting set of relations is

(A) Zero

(B) More than zero but less than that of an equivalent 3NF decomposition

(C) Proportional to the size of F^+

(D) Indetermine

[GATE 2002]

GATE Questions

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 determine B and B functionally determine C.

(B) A functionally determine 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.

[GATE 2002]

GATE Questions

Consider the schema R(ABCD) and FDs A→B and C→D. Then the decomposition of R into R1(AB) and R2(CD) is

(A) Dependencies preserving and lossless join.

(B) Lossless join but not dependency preserving.

(C) Dependency preserving but not lossless join.

(D) Not dependencies preserving and not lossless join.

[GATE 2001]

GATE Questions

R(A,B,C,D) is a relation. Which of the following does not have a lossless join, dependency preserving BCNF decomposition?

(A) A → B, B → CD

(B) A → B, B → C, C →D

(C) AB → C, C → AD

(D) A→BCD

[GATE 2001]

GATE Questions

Given the following relation instance.

X Y Z

1 4 2

1 5 3

1 6 3

3 2 2

Which of the following functional dependencies are satisfied by the instance?

(A) XY -> Z and Z -> Y

(B) YZ -> X and Y -> Z

(C) YZ -> X and X -> Z

(D) XZ -> Y and Y -> X

[GATE CS 2000]

GATE Question

Let R = (A, B, C, D, E, F) be a relation scheme with the following dependencies C →F, E →A, EC →D, A →B. which of the following is the key for R?

(A) CD

(B) EC

(C) AE

(D) AC

[GATE 1999]

GATE Question

Consider the schema R = (S, T, U, V) and the dependencies

S →T,

T →U,

U → V and

V → S.

Let R = (R1 and R2) be a decomposition such that R1 ∩ R2 ≠ ø.

The decomposition is

(A) not in 2NF

(B) in 2NF but not in 3NF

(C) in 3NF but not in 2NF

(D) in both 2NF and 3NF **[GATE 1999]**

GATE Question

Which normal form is considered adequate for normal relational database design?

(A) 2 NF

(B) 5 NF

(C) 4 NF

(D) 3 NF

[GATE 1998]

GATE Question

For a database relation R(A, B, C, D), where the domains of A, B, C, D include only atomic values, only the following functional dependencies and those that can be inferred from them hold :

A → C,

B → D

This relation is

(A) in first normal form but not in second normal form

(B) in second normal form but not in third normal form

(C) in third normal form

(D) None of the above

[GATE 1997]

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