MANIPAL UNIVERSITY
JAIPUR

Faculty of Engineering
School of Information Technology
B.Tech IT
IV Semester
Second Sessional Examination: 2022-23
IT2203-Relational Database Management Systems
(CLOSED BOOK)

Duration: 1 Hour **Max. Marks: 20**

Instructions:

- Answer all questions.
- Missing data, if any, may be assumed suitably.
- Calculator is not allowed.

1 a) Explain different types of anomalies present in the database with an example. [2+3]

Anomalies

1- Update Anomaly: Let say we have 10 columns in a table out of which 2 are called employee Name and employee address. Now if one employee changes it's location then we would have to update the table. But the problem is, if the table is not normalized one employee can have multiple entries and while updating all of those entries one of them might get missed.

2- Insertion Anomaly: Let's say we have a table that has 4 columns. Student ID, Student Name, Student Address and Student Grades. Now when a new student enroll in school, even though first three attributes can be filled but 4th attribute will have NULL value because he doesn't have any marks yet.

3- Deletion Anomaly: This anomaly indicates unnecessary deletion of important information from the table. Let's say we have student's information and courses they have taken as follows (student ID,Student Name, Course, address). If any student leaves the school then the entry related to that student will be deleted. However, that deletion will also delete the course information even though course depends upon the school and not the student.

b) Suppose that we decompose the schema R = (A, B, C, D, E) into R1 = (A, B, C) and R2 = (A, D, E) Show that this decomposition is a lossless join decomposition if the following set F of functional dependencies holds: A -> BC CD -> E B -> D E -> A

Solution: A decomposition {R1, R2} is a lossless-join decomposition if $R1 \cap R2 \rightarrow R1$ or $R1 \cap R2 \rightarrow R2$. Let R1 = (A, B, C), R2 = (A, D, E), and $R1 \cap R2 = A$. Since A is a candidate key $\{A\}^+ = A = ABC = ABCD = ABCDE$ Therefore $R1 \cap R2 \rightarrow R1$.

2. A) A relation **R (P, Q, R, S)** having two functional dependencies A and B:
The set A has -{$P \rightarrow Q, Q \rightarrow R, PQ \rightarrow S$}
The set B has {$P \rightarrow Q, Q \rightarrow R, P \rightarrow R, P \rightarrow S$}

Check whether the two sets of Functional dependencies are Equivalent or not?

Solution :

b)A relation given as R(A, B,C), where the FD is $\{A \rightarrow B, B \rightarrow C\}$

Decomposition of R is R1 (A ,C) and R2 (B,C)

Does this decomposition preserve the given dependencies or not. Justify with proper explanation.

Solution:

In R1 following dependencies hold: $F1 = \{A \rightarrow A, A \rightarrow C, C \rightarrow C, C \rightarrow A\}$

In R2 following dependencies hold: $F2 = \{B \rightarrow B, B \rightarrow C, C \rightarrow C, C \rightarrow B\}$

The non-trivial FDs hold on R1 and R2 as $\{A \rightarrow C, B \rightarrow C\}$

$A \rightarrow B$ *cannot be derived hence the above doesnot preseve the dependency*

3.Find minimal cover of set of functional dependencies example, Solved exercise - how to find minimal cover of F? Easy steps to find minimal cover of FDs, What is minimal cover?

Question:

6. Find the minimal cover of the set of functional dependencies given; {A → C, AB → C, C → DI, CD → I, EC → AB, EI → C}

Solution:

Let us apply these properties to F = {A → C, AB → C, C → DI, CD → I, EC → AB, EI → C}

1. Right Hand Side (RHS) of all FDs should be single attribute. So we write F as F1, as follows;
F1 = {A → C, AB → C, C → D, C → I, CD → I, EC → A, EC → B, EI → C}

C→DI EC→AB

2. Remove extraneous attributes.

Extraneous attribute is a redundant attribute on the LHS of the functional dependency. In the set of FDs, AB → C, CD → I, EC → A, EC → B, and EI → C have more than one attribute in the LHS. Hence, we check one of these LHS attributes are extraneous or not.

To check, we need to find the closure of each attribute on the LHS; [apply the closure finding algorithm – refer here]

(i) A+ = ACDI
(ii) B+ = B
(iii) C+ = CDI
(iv) D+ = D
(v) E+ = E
(vi) I+ = I

From (i), the closure of A included the attribute C. So, B is extraneous in AB → C, and B can be removed.

From (iii), the closure of C included the attribute I. So, D is extraneous in CD → I, and D can be removed.

No more extraneous attributes are found. Hence, we write F1 as F2 after removing extraneous attributes from F1 as follows;

F2 = {A → C, C → D, C → I, EC → A, EC → B, EI → C}

Q4: Given R (A, B, C, D, E, F, G, H, I, J) and set of functional dependencies, F = {AB → C, A → DE, B→F, F→GH, D → IJ}. Find the highest normal form. Convert the relation up to BCNF by proper decomposition.

Sol: Given R (A, B, C, D, E, F, G, H, I, J) with FD Set F = {AB → C, A → DE, B→F, F→GH, D → IJ}.

Candidate Keys= {AB}

Check for 2NF:

F = {AB → C, A → DE, B → F, F → GH, D → IJ}.

2NF:	Full	Partial	Partial	Full	Full

Decomposition into 2NF :

R1 {A, B, C} R2 {A, D, E, I, J} R3 {B, F, G, H}

F1= {AB → C} F2={ A → DE, D → IJ} F3={ B→F, F→GH}

CK ={AB} CK= {A} CK={B}

R1, R2 and R3 are in 2NF as there is no partial dependency.

Now, check for 3NF:

R1 {A, B, C} R2 {A, D, E, I, J} R3 {B, F, G, H}

CK ={AB} CK= {A} CK={B}

F1= {AB → C} F2={ A → DE, D → IJ} F3={ B→F, F→GH}

3NF: yes yes, no yes, no

Decomposition into 3NF:

R1 {A, B, C} R21 {A, D, E} R22(D, I, J) R31(B, F) R32(F, G, H)

F1= {AB → C} F21= {A → DE} F22={D → IJ} F31={B→F} F32={F→GH}

CK ={AB} CK={A} CK={D} CK={B} CK={F}

Since all the FDs have super key on LHS, it's BCNF also.

$\{P \to Q,\ Q \to R,\ PQ \to S\}$

$B = \{P \to Q,\ Q \to R,\ P \to R,\ P \to S\}$

Check if A covers B or $A \supseteq B$
and if B covers A or $B \supseteq A$
If both above conditions are true
then $A \equiv B$

$\Rightarrow$ B is checked first ($A \supseteq B$)

$P^+ = \{P, Q, R, S\}$

Here, $P \to Q$
$Q \to R$
$P \to R$
$P \to S$
is covered in B

$Q^+ = \{Q, R\}$

$Q \to R$ is covered in B

So, A covers B

$\Rightarrow$ Check B covers A

$P^+ = \{P, Q, R, S\}$

$P \to Q$
$Q \to R$
$P \to S$
covered in A

$Q^+ = \{Q, R\}$
$Q \to R$
covered in A

So, B covers A