

Date: 10th Mar 2023

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ASSIGNMENT - 3

[A]

1. What functional dependency type is/are not present in the following dependencies

$\text{Empno} \rightarrow \text{EName, Salary, DeptNo, DName}$

$\text{DeptNo} \rightarrow \text{DName}$

$\text{EmpNo} \rightarrow \text{DName}$

Partial Functional Dependency

2. Every time attribute A appears, it is matched with the same value of attribute B, but not the same value of attribute C. Therefore, it is true that :

$$A \rightarrow B$$

3. Consider a schema $R(A, B, C, D)$ and functional dependencies $A \rightarrow B$ and $C \rightarrow D$. Then the decomposition of R into $R_1(AB)$ and $R_2(CD)$ is dependency preserving but not lossless join

4. If one attribute is determinant of second, which in turn is determinant of third, then the relation cannot be:

3 NF

5. Anomalies are avoided by splitting the offending relation into multiple relations, is also known as Decomposition

6. A _____ is an indirect functional dependency, one in which $x \rightarrow y$ only by virtue of $x \rightarrow y$ and $y \rightarrow z$.

Transitive Dependencies

7. Let $R(A, B, C, D)$ be a relation schema with the following functional dependencies:

$$A \rightarrow B, B \rightarrow C, C \rightarrow D \text{ and } D \rightarrow B$$

The decomposition of R into

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

gives a lossless join, and is depending preserving

8. A table is in BCNF if it is in 3NF and if every determinant is a Candidate key.

9. Consider the schema $R(S, T, U, V)$ and the dependencies $S \rightarrow T, T \rightarrow U, U \rightarrow V, V \rightarrow S$. Let $R = \{R_1, R_2\}$ such that $R_1 \cap R_2 = \emptyset$. Then the decomposition is:

in 2NF but not in 3NF

10. Third normal form is inadequate in situations where the relation:

None of the above.

B. b) Let us take another example to show the relationship between two FD sets. A relation $R_2(A, B, C, D)$ having two FD sets $FD1 = \{A \rightarrow B, B \rightarrow C, A \rightarrow C\}$ and $FD2 = \{A \rightarrow B, B \rightarrow C, A \rightarrow D\}$.

Checking whether all FDs of $FD1$ is present in $FD2$.

$$A \rightarrow B$$

$$(A)^+ = \{A, B, C\} \quad A \rightarrow C$$

$$B \rightarrow C$$

$$A \rightarrow C$$

$$FD2 > FD1 \text{ is true}$$

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checking whether all FDs of FD₂ are present in FD₁

$$A \rightarrow B$$

$$(A)^+ = \{A, B, C\} \quad A \rightarrow D$$

$$B \rightarrow C$$

$$A \rightarrow D$$

$$FD_2 \not\subseteq FD_1$$

In this case, FD₂ ⊇ FD₁ and FD₂ ⊈ FD₁ are not semantically equivalent.

3. Finding candidate keys and super keys of a relation using FD set. The set of attributes for example, the EMPLOYEE relation shown in Table 1 has following FD set. $\{E-ID \rightarrow E-NAME, E-ID \rightarrow E-CITY, E-ID \rightarrow E-CITY, E-ID \rightarrow E-STATE, E-CITY \rightarrow E-STATE\}$

$$FD = \{E-ID \rightarrow E-NAME\}$$

$$\{E-ID \rightarrow E-CITY\}$$

$$\{E-ID \rightarrow E-STATE\}$$

$$\{E-CITY \rightarrow E-STATE\}$$

$$(E-ID)^+ = \{E-ID, E-NAME, E-CITY, E-STATE\}$$

$$(E-NAME)^+ = \{E-NAME\}$$

$$(E-CITY)^+ = \{E-CITY, E-STATE\}$$

$$(E-ID, E-NAME)^+ = \{E-ID, E-NAME, E-CITY, E-STATE\}$$

$$(E-ID, E-CITY)^+ = \{E-ID, E-NAME, E-CITY, E-STATE\}$$

$$(E-ID, E-STATE)^+ = \{E-ID, E-NAME, E-CITY, E-STATE\}$$

$$(E-ID, E-CITY, E-STATE)^+ = \{E-ID, E-NAME, E-CITY, E-STATE\}$$

(E-ID, E-CITY, E-STATE), (E-ID, E-CITY), (E-ID, E-STATE),
(E-ID) is super key.

(E-ID) is candidate key

4. What is multivalued dependency.

Multivalued dependency occurs when two attributes in a table are independent of each other but, both depend on a third attribute.

A multivalued dependency consists of at least two attributes that are dependent on a third attribute that's why it always require at least three attributes.

C.

1. Given a relation R(P, Q, R, S, T) and Functional Dependency set FD = $\alpha PQ \rightarrow R, S \rightarrow T^y$, determine whether the given R is in 2NF? If not convert it into 2NF.

Given - R(P, Q, R, S, T)

FD - $\alpha PQ \rightarrow R, S \rightarrow T^y$

R (P, Q, R, S, T)

$(PQS)^+ = \alpha PQRST \rightarrow$ only 1 candidate key

PQR does not satisfy the definition of 2NF that non prime attribute (R) is partially dependent on part of candidate key PQS.

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$S \rightarrow T$ does not satisfy the definition of 2NF

Hence, FD - $PQ \rightarrow R$

$S \rightarrow T$ are not in 2NF

Conversion -

Decompose the Table given -

$R_1 (P, Q, R) \rightarrow$ fully FD, R_1 is in 2NF

$R_2 (S, T) \rightarrow$ fully FD, R_2 is in 2NF

$R_3 (P, Q, S) \rightarrow$ Candidate Key

2. Given a relation $R (x, y, z, w, p)$ and Functional dependency set $FD = \{x \rightarrow y, y \rightarrow p, z \rightarrow w\}$ determine whether the given R is in 3NF? If not convert it into 3NF.

$R (x, \underline{y}, z, w, p)$

$(xz)^+ = \{xyzw\}$ Hence, xz is only 1 candidate key.

Candidate key is a superkey whose no proper subset is a superkey.

$x \rightarrow y$ does not satisfy the definition of 3NF, that neither x is superkey nor y is prime attribute.

$Y \rightarrow P$ does not satisfy the definition of 3NF, that neither Y is super key nor P is a prime attribute.

$Z \rightarrow W$ satisfies the definition of 3NF, that neither Z is super key nor W is a prime attribute.

Conversion -

$R_1 (X, Y) \propto$ Using FD $X \rightarrow Y$

$R_2 (Y, P) \propto$ Using FD $Y \rightarrow P$

$R_3 (Z, W) \propto$ Using FD $Z \rightarrow W$

$R_4 (X, Z) \propto$ Using Candidate key XZ

All the decomposed tables R_1, R_2, R_3, R_4 , are in 2NF (as there is no partial dependency) as well as in 3NF.

[D]

1. Find the highest normal form of a relation

$R (A, B, C, D, E)$ with FD set $\propto B \rightarrow A, A \rightarrow C, BC \rightarrow D, AC \rightarrow BE$

$$(B)^+ = \propto B, A, C, D, E$$

$$(C)^+ = \propto C$$

$$(A)^+ = \propto A, C, B, E, D$$

B will be candidate key. B can be derived from AC using $(AC \rightarrow B, A \rightarrow E)$. A will be candidate key. So there will be two candidate keys $\propto A, B$.

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The prime attribute is those attribute which are part of candidate key $\{A, B\}$ in this example and others will be non-prime $\{C, D, E\}$ in this example.

The relation R is in 1st Normal Form as a relational DBMS does not allow multi-valued or composite attributes.

The relation is 2NF because $B \rightarrow A$ (B is a super key), $A \rightarrow C$ is in 2NF (A is a super key), $BC \rightarrow D$ is in 2NF (BC is a super key), $AC \rightarrow BE$ is in 2NF $A \& C$ ($A \& C$ is a super key).

The relation is 3NF because LHS of all FD's is super key. The relation is in BCNF as all LHS of all FD's are super keys. So the highest NF is BCNF.

Q. Explain function dependency with example?

A functional dependency is a constraint that specifies the relationship between two set of attribute where one set can accurately determine the value of other sets. It is denoted as $X \rightarrow Y$, where X is a set of attributes that is capable of determining the value of Y . The attribute set on the left side of the arrow X is called Determinant, while on right side, Y is called the dependent.

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Types of Dependency:

1. Trivial Functional Dependency:

In Trivial functional dependency, a dependent is always a subset of the determinant i.e., If $X \rightarrow Y$ and Y is the subset of X , then it is called trivial function dependency.

2. Non-Trivial Functional Dependency:

The dependent is strictly not a subset of the determinant i.e., If $X \rightarrow Y$ and Y is not a subset of X

3. Multivalued Functional Dependency:

Entities of the dependent set are not dependent on each other. i.e., If $a \rightarrow \{b, c\}$ and there exists no functional dependency b/a and

4. Transitive Functional Dependency:

Dependent is indirectly dependent on determinant. i.e., If $a \rightarrow b$ and $b \rightarrow c$, then ~~a~~ according to axiom of Transitivity, $a \rightarrow c$.