

8-Mark Questions

1. Analyze the informal design guidelines for relation schemas and explain how they improve database design quality.

Answer:

The four informal design guidelines for relation schemas are:

1. **Imparting Clear Semantics:**
Attributes in a relation should represent a single entity or relationship type. Mixing attributes of different entities leads to ambiguity.
2. **Minimizing Redundant Information:**
Redundancy leads to insertion, deletion, and modification anomalies. For example, repeating department information with each employee wastes storage and increases inconsistency risks.
3. **Reducing Null Values:**
Attributes prone to nulls should be avoided. Nulls lead to confusion in interpretation, join operations, and aggregate functions.
4. **Avoiding Spurious Tuples:**
Poorly designed schemas may generate invalid tuples when joined. Spurious tuples can be avoided by joining on primary-foreign key pairs only.

These guidelines improve database clarity, reduce anomalies, and ensure efficient and consistent data storage.

2. Differentiate between 1NF, 2NF, 3NF, BCNF, and 4NF using examples.

Answer:

- **1NF (First Normal Form):**
Ensures atomic values in each cell (no multivalued or composite attributes).
Example: A movie table with multiple genres per row violates 1NF.
- **2NF (Second Normal Form):**
Satisfies 1NF and eliminates partial dependency of non-prime attributes on part of a composite key.
Example: In a Student_Project table, student name depending only on student ID is a partial dependency.
- **3NF (Third Normal Form):**
Satisfies 2NF and eliminates transitive dependencies.
Example: Student_ID → Course_ID, Course_ID → Course_Fee; transitive dependency must be removed.
- **BCNF:**
Stronger version of 3NF. Every determinant must be a superkey.
Example: If Professor → Subject but Professor is not a superkey, decompose to BCNF.

- **4NF:**
Eliminates multivalued dependencies.
Example: If Student has multiple Courses and multiple Hobbies independently, split into two tables.

6-Mark Questions

1. Define functional dependency. Illustrate with examples and explain how it influences normalization.

Answer:

A functional dependency (FD) exists when one attribute uniquely determines another. It is denoted as $X \rightarrow Y$, where X is the determinant and Y is the dependent.

Examples:

- $SSN \rightarrow EName$
- $PNumber \rightarrow \{PName, PLocation\}$
- $\{SSN, PNumber\} \rightarrow Hours$

FDs are crucial in normalization as they help identify anomalies and guide the decomposition of relations into normal forms like 2NF, 3NF, and BCNF.

2. Explain update anomalies with examples. How can normalization help avoid them?

Answer:

Update anomalies occur when redundant data causes inconsistencies:

- **Insertion Anomaly:** Can't add a department unless an employee exists.
- **Deletion Anomaly:** Deleting the last employee of a department removes department info.
- **Modification Anomaly:** Updating department info in one tuple but not others causes inconsistency.

Normalization, especially up to 3NF, removes redundancy and separates data into related tables, avoiding these anomalies.

Would you like a set of MCQs or diagrams to support this material in a study guide?

Multiple Choice Questions (MCQs)

Q1. Which of the following anomalies can be caused by data redundancy?

- A. Insertion Anomaly
- B. Deletion Anomaly
- C. Modification Anomaly

D. All of the above

Answer: **D. All of the above**

Q2. Which of the following is **not** a goal of normalization?

- A. Reducing redundancy
- B. Improving performance of SQL joins
- C. Avoiding update anomalies
- D. Ensuring data integrity

Answer: **B. Improving performance of SQL joins**

Q3. In a relation R(A, B, C), if $A \rightarrow B$ and $B \rightarrow C$, which of the following is true?

- A. $A \rightarrow C$ (Transitive Dependency)
- B. $C \rightarrow A$
- C. A and C are independent
- D. None of the above

Answer: **A. $A \rightarrow C$**

Q4. A relation is in **2NF** if:

- A. It is in 1NF
- B. It has no partial dependencies
- C. It has no multivalued attributes
- D. Both A and B

Answer: **D. Both A and B**

Q5. Which normal form handles multivalued dependencies?

- A. 2NF
- B. 3NF
- C. BCNF
- D. 4NF

Answer: **D. 4NF**

Diagram Support

1 Spurious Tuple Generation (Incorrect Join Example)

EMP_LOCS

Emp_ID | Location

E1 | Delhi

E2 | Mumbai

EMP_PROJ1

Emp_ID | Project

E1 | P1

E2 | P2

✗ Natural Join Produces:

E1 - Delhi - P1

E1 - Delhi - P2 ← spurious

E2 - Mumbai - P1 ← spurious

E2 - Mumbai - P2

Problem: Irrelevant combinations created.

2 Functional Dependency Flowchart

SSN → EName

PNUMBER → PName, PLocation

{SSN, PNUMBER} → Hours

Shows: How primary or composite keys determine attributes.

3 Normal Forms Breakdown Table

Normal Form Condition

1NF	Atomic values only
2NF	No partial dependency
3NF	No transitive dependency
BCNF	Determinant is a super key
4NF	No multivalued dependency

Normal Form Condition

5NF No join dependency

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