ARMSTRONG AXIOMS FOR FUNCTIONAL DEPENDENCIES

Functional Dependency is a crucial concept in Database Management Systems (DBMS). It helps in maintaining data integrity. Armstrong Axioms in DBMS, is a set of rules that play a fundamental role in defining and simplifying functional dependencies within a relational database.

Axioms (Primary rules)

- **Axiom of Reflexivity:** If A is a set of attributes and B is a subset of A, then A holds B. If B⊆A then A→B. This property is a trivial property.

  /*

  The Axiom of Reflexivity is the foundational principle stating that if you have a set of attributes, a functional dependency exists between that set and itself. In simpler terms, it means that any set of attributes functionally determines itself.

  Example: In a student database, if we have an attribute 'Student_ID,' it is trivially true that 'Student_ID' determines 'Student_ID.'

  */

- **Axiom of Augmentation:** If **A→B** holds and Y is the attribute set, then **AY→BY** also holds. That is adding attributes to dependencies does not change the basic dependencies. If **A→B**, then **AC→BC** for any C.

  Example:

If 'Student_ID' determines 'Student_Name,' then it also implies that 'Student_ID, Course_Code' determines 'Student_Name, Course_Code.'

- **Axiom of Transitivity:** Same as the transitive rule in algebra, if **A→B** holds and **B→C** holds, then **A→C** also holds. **A→B** is called A functionally which determines B. If **X→Y** and **Y→Z**, then **X→Z.**

Example:

If 'Student_ID' determines 'Course_Code' and 'Course_Code' determines 'Course_Name,' then 'Student_ID' determines 'Course_Name.'

Secondary Rules

These rules can be derived from the above axioms.

- **Union:** If **A→B** holds and **A→C** holds, then **A→BC** holds. If **X→Y** and **X→Z** then **X→YZ**.

  Example:

  If 'A' determines 'B' and 'A' determines 'C,' then we can derive 'A' determines 'B, C.'

- **Composition:** If **A→B** and **X→Y** hold, then **AX→BY** holds.

  Example:

  If 'A' determines 'B' and 'C' determines 'D,' we can compose these to derive 'A, C' determines 'B, D.'

- **Decomposition:** If **A→BC** holds then **A→B** and **A→C** hold. If **X→YZ** then **X→Y** and **X→Z**.

  Example:

  If 'A, B' determines 'C, D' we can decompose it into 'A' determines 'C' and 'B' determines 'D.'

- **Pseudo Transitivity:** If **A→B** holds and **BC→D** holds, then **AC→D** holds. If **X→Y** and **YZ→W** then **XZ→W**.

  Example:

  If 'A' determines 'B, C' and 'C' determines 'D,' we can use pseudo transitivity to infer that 'A' determines 'B, D.'

- **Self Determination:** It is similar to the Axiom of Reflexivity, i.e. **A→A** for any A.

  Example:

  If 'A' determines 'B,' then 'A' determines 'A.'

- **Extensivity:** Extensivity is a case of augmentation. If **AC→A,** and **A→B**, then **AC→B**. Similarly, **AC→ABC** and **ABC→BC**. This leads to **AC→BC**.

  Example:

  If 'A' determines 'B,' then 'A' determines 'B, C' (for any 'C').