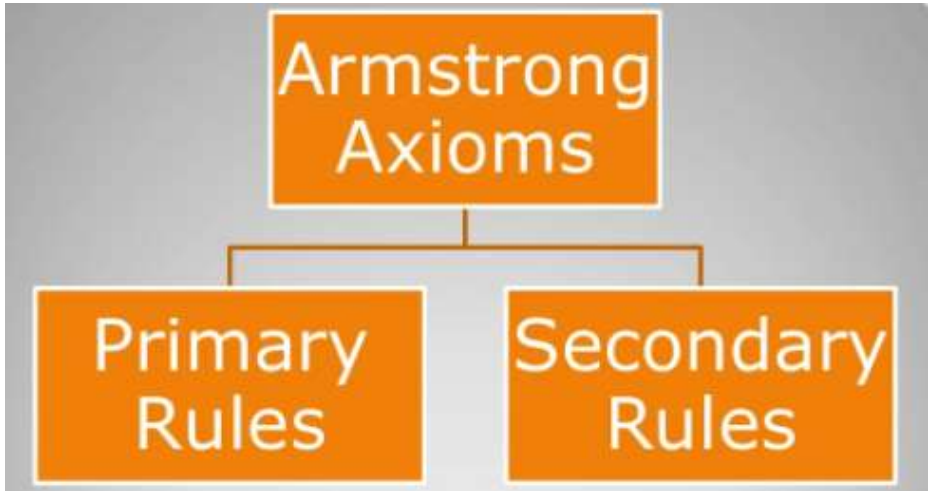
GLA UNIVERSITY MATHURA
Recognised by UGC Under Section 2(f)
Accredited with A Grade by NAAC
12-B Status from UGC

Database Management System (BCSC–1003)

Topic: Armstrong Axioms (Inference Rules)



Mr.Prateek Kumar Soni

Assistant Professor, Dept. of CEA, GLA University, Mathura.

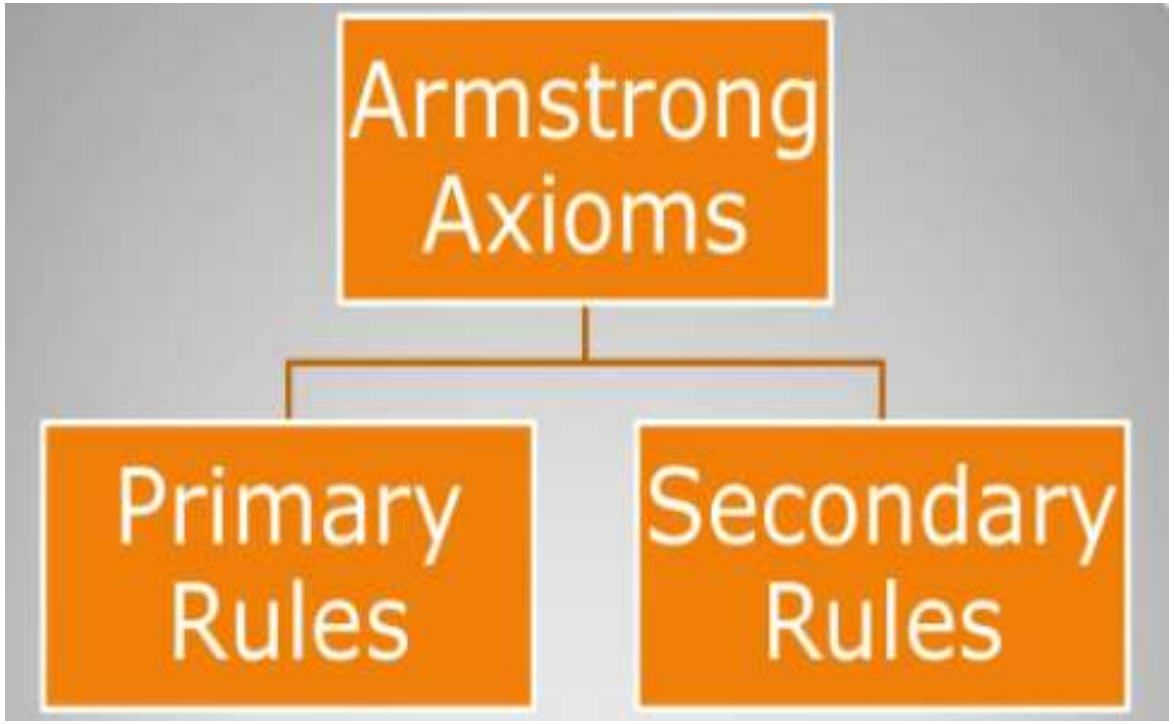
Armstrong Axioms (Inference Rule) in Functional Dependecy in DBMS

Introduction to Axioms Rules:

- Armstrong's Axioms is a set of rules.
- It provides a simple technique for reasoning about functional dependencies.
- William W. Armstrong developed it in 1974.
- It is used to infer all the functional dependencies on a relational database.

Armstrong Axioms (Inference Rule)

Armstrong Axioms can be classified as:



Armstrong Axioms (Inference Rule)

Consider a relation **STUDENT**

RNo	Name	Marks	Dept	Course
1	A	78	CS	C1
2	B	60	EE	C1
3	A	78	CS	C2
4	B	60	EE	C3
5	C	80	IT	C2

Primary Rules

Rule 1. Reflexivity

- $\{A \rightarrow A\}$ and,
- If A is a set of attributes and B is a subset of A, then A holds B. $\{A \rightarrow B\}$. This is trivial property.

Example:

RNo → RNo (✓)

(RNo, Name) → Name (✓)

Primary Rules

Rule 2. Augmentation

- If A → B holds and Y is attribute set, then AY → BY also holds.
- That means adding attributes in dependencies, does not change the basic dependencies.
- If A → B, then AC → BC for any C.

Example:

If RNo → Name (✓)

then {RNo, Marks} → {Name, Marks} (✓)

Primary Rules

Rule 3. Transitivity

- If A holds B and B holds C, then A holds C.
- It means if $\{A \rightarrow B\}$ and $\{B \rightarrow C\}$, then $\{A \rightarrow C\}$.
- A holds B $\{A \rightarrow B\}$ means that A functionally determines B.

Example:

If Name → Marks (✓) and Marks → Dept (✓)

then Name → Dept (✓)

Secondary Rules

Rule 1. Union

- If $\{A \rightarrow B\}$ and $\{A \rightarrow C\}$, then $\{A \rightarrow BC\}$

Example:

If RNo → Name (✓) and RNo → Marks (✓)

then RNo → Name, Marks (✓)

Secondary Rules

Rule 2. Decomposition or Splitting property

- If {A → BC} then {A → B} and {A → C}
- *But if AB → C then we can't split the LHS as A → C and B → C*

Example:

If (RNo → Name, Marks) (✓)

Then (RNo → Name) (✓) and (RNo → Marks) (✓)

Secondary Rules

Rule 3. Pseudo Transitivity

- If{A → B} and {BC → D}, then {AC → D}

Example:

RNo → Name (✓) and (Name, Marks) → Dept (✓)

then (RNo, Marks) → Dept (✓)

Secondary Rules

Rule 4. Composition

- If X → Y and A → B then XA → YB

Example:

RNo → Name (✓) and Marks → Dept (✓)

then (RNo, Marks) → (Name, Dept) (✓)

Example

Question: Consider relation E = (P, Q, R, S, T, U) having set of following Functional Dependencies (FD).

$P \rightarrow Q$ $P \rightarrow R$ $QR \rightarrow S$

$Q \rightarrow T$ $QR \rightarrow U$ $PR \rightarrow U$

Calculate some members of Axioms are as follows:

1. $P \rightarrow T$
2. $PR \rightarrow S$
3. $QR \rightarrow SU$
4. $PR \rightarrow SU$

Example

Solution:

1. $P \rightarrow T$

In the above FD set, $P \rightarrow Q$ and $Q \rightarrow T$

So, Using Transitive Rule: If $\{A \rightarrow B\}$ and $\{B \rightarrow C\}$, then $\{A \rightarrow C\}$

$\therefore$ If $P \rightarrow Q$ and $Q \rightarrow T$, then $P \rightarrow T$.

$P \rightarrow T$

Example

2. PR → S

In the above FD set, P → Q

As, QR → S

So, Using Pseudo Transitivity Rule: If{A → B} and {BC → D}, then {AC → D}

∴ If P → Q and QR → S, then PR → S.

PR → S

Example

3. QR → SU

In above FD set, QR → S and QR → U

So, Using Union Rule: If{A → B} and {A → C}, then {A → BC}

∴ If QR → S and QR → U, then QR → SU.

QR → SU

Example

4. PR → SU

So, Using Union Rule: If{A → B} and {A → C}, then {A → BC}

∴ If PR → S and PR → U, then PR → SU.

PR → SU

References

- Korth, Silbertz and Sudarshan (1998), “Database Concepts”, 4th Edition, TMH.
- Elmasri and Navathe (2010), “Fundamentals of Database Systems”, 5th Edition, Addision Wesley.
- Date C J,” An Introduction to Database Systems”, 8th Edition, Addision Wesley.
- M. Tamer Oezsu, Patrick Valduriez (2011). “Principles of Distributed Database Systems”, 2nd Edition, Prentice Hall.


Thank
you