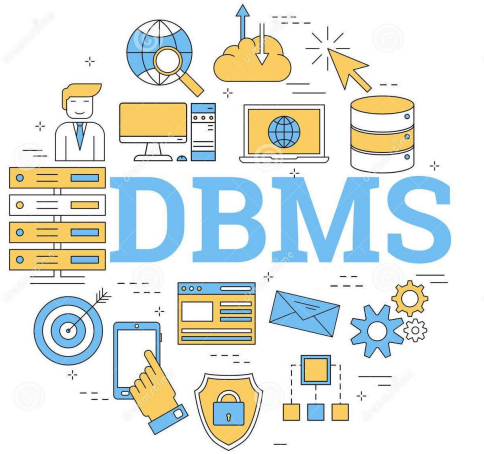
Unit III – Database Design

Dependencies and Normal forms - Functional Dependencies, Armstrong's axioms for FD's, **closure of a set of FD's**, minimal covers-Non- loss decomposition-First,Second,Third Normal Forms, Dependency Preservation-Boyce/Codd Normal Form-Multivalued Dependencies and Fourth Normal Form- Join Dependencies and Fifth Normal Form



Closure of a set of FD's

- The Closure Of Functional Dependency means the complete set of all possible attributes that can be functionally derived from given functional dependency using the inference rules known as Armstrong's Rules.
- If "F" is a functional dependency then closure of functional dependency can be denoted using "$\{F\}^+$".

Closure of a set of FD's

- **Step-1 : Add the attributes which are present on Left Hand Side in the original functional dependency.**
- **Step-2 : Now, add the attributes present on the Right Hand Side of the functional dependency.**
- **Step-3 : With the help of attributes present on Right Hand Side, check the other attributes that can be derived from the other given functional dependencies. Repeat this process until all the possible attributes which can be derived are added in the closure.**

Super key and candidate Key

- Super key – Set of all attributes whose closure contains all attributes of given relation
- Candidate Key –minimal set of attributes whose attribute closure is set of all attributes of relation

Example 1

Consider a relation R(A,B,C,D,E) having below mentioned functional dependencies.

1. FD1 : A →B
2. FD2 : B →C
3. FD2 : C →D
4. FD3 : D →E

1. $\{A\}^+ = \{A, B, C, D, E\}$
2. $\{B\}^+ = \{B, C, D, E\}$
3. $\{C\}^+ = \{C, D, E\}$
4. $\{D\}^+ = \{D, E\}$
5. $\{E\}^+ = \{E\}$

1. $\{AD\}^+ = \{A, D, B, C, E\}$
2. $\{CD\}^+ = \{C, D, E\}$

Example 2

Consider the table student_details having (Roll_No, Name,Marks, Location) as the attributes and having two functional dependencies. calculate the closure of all the attributes present in the relation

1. FD1 : Roll_No → Name, Marks
2. FD2 : Name → Marks, Location

$\{Roll\_no\}^+ = \{Roll\_No, Marks, Name, Location\}$

$\{Name\}^+ = \{Name, Marks, Location\}$

$\{Marks\}^+ = \{Marks\}$

$\{Location\}^+ = \{ Location\}$

Example 3

Consider a relation R(A,B,C,D,E) having below mentioned functional dependencies.

1. **FD1 : A →BC**
2. **FD2 : C →B**
3. **FD3 : D →E**
4. **FD4 : E →D**

1. $\{A\}^+ = \{A, B, C\}$
2. $\{B\}^+ = \{B\}$
3. $\{C\}^+ = \{B, C\}$
4. $\{D\}^+ = \{D, E\}$
5. $\{E\}^+ = \{E\}$

Example 4

Consider a relation R(A,B,C,D,E) having below mentioned functional dependencies. Calculate the candidate key.

1. **FD1 : A →BC**
2. **FD2 : C →B**
3. **FD3 : D →E**
4. **FD4 : E →D**

1. $\{A\}^+ = \{A, B, C\}$
2. $\{B\}^+ = \{B\}$
3. $\{C\}^+ = \{B, C\}$
4. $\{D\}^+ = \{D, E\}$
5. $\{E\}^+ = \{E\}$

A single attribute is unable to determine all the attribute.

Here, we need to combine two or more attributes to determine the candidate keys.

$\{A, D\}^+ = \{A, B, C, D, E\}$

$\{A, E\}^+ = \{A, B, C, D, E\}$

Assessment

1. Give R(X, Y, Z, W) and Set of Functional Dependency FD = { X → Y, Y → Z, Z → X}. To calculate the candidate key and no. of candidate key in above relation R using a given set of FDs.
2. Give R(X, Y, Z, W) and Set of Functional Dependency FD = { XY → ZW, W → X}. The question is to calculate the candidate key and no. of candidate key in above relation R using a given set of FDs.
3. Give R(P, Q, R, S, T, U) and Set of Functional Dependency FD = { PQ → R, R → S, Q → PT}. The question is to calculate the candidate key and no. of candidate key in above relation R using a given set of FDs.
4. Give R(A, B, C, D) and Set of Functional Dependency FD = { AB → CD, C → A, D → B}. The question is to calculate the candidate key and no. of candidate key in above relation R using a given set of FDs.

Assessment Solution

Question Number	Candidate Key
1	WX, WY, WZ.
2	Y X, Y W.
3	QU
4	AB, AD, BC, and CD


Thank You!