COMPUTER SCIENCE



Database Management System

FD's & Normalization



WALLAH



Lecture_02

Vijay Agarwal sir





Attribute Closure

Finding Candidate keys





· RDBMS Concept

Relational Ly Arity, Carrelinality, Schema, instance

- · FD Concepts
- · Type of FD
 - 1) Trivial FD

 - 2) Non Toivial FD 3) Semil Non Toivial FD.



(8) Finding Non Trivial FD Which is Satisfied by Given Relational Instance?

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Trivial FD Advoid

$A \rightarrow A$	1
AB >1	
AB >B	
AB > AB	

A	В	С
7	5	6
7	7	6
7	5	7
7	7	7
9	5	6



$$\mathbb{R} \rightarrow \subset$$

$$C \rightarrow A$$

$$C \rightarrow \mathbb{R}$$

$$C \rightarrow AR$$



$$\mathbb{R}C \to A$$

A	В	С
2	2	4
2	3	4
3	2	4
3	3	4
3	2	4





Given the following relation instance.



Х	Y	Z
4	4	4
4	7	4
7	4	7
7	4	9
4	9	9

The number of non trivial FD's are satisfied by the instance ____

$$X \rightarrow Y$$
 $Y \rightarrow X$
 $Y \rightarrow X$
 $Y \rightarrow Z$
 $Y \rightarrow Z$
 $Y \rightarrow Z$
 $Z \rightarrow Y$
 $Z \rightarrow X$
 $X \rightarrow Y \rightarrow Z$
 $X \rightarrow Y \rightarrow Z \rightarrow Y$
 $X \rightarrow Y \rightarrow Z \rightarrow Y$



Given the following relation instance.



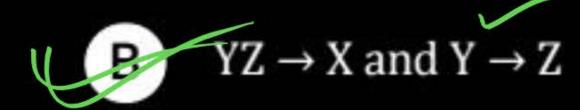
Х	Y	Z
1	4	2
1	5	3
1	6	3
3	2	2

Which of the following functional dependencies are satisfied by the instance?



 $XY \rightarrow Z$ and $Z \rightarrow Y$







 $YZ \rightarrow X$ and $X \rightarrow Z$



 $XZ \rightarrow Y$ and $Y \rightarrow X$

[2000: 2 Marks]



From the following instance of a relation scheme R (A, B, C), we can conclude that: [2002: 2 Marks]

	A	В	С
time=t1	1	1 _	\rightarrow \bigcirc 1
12	1	1 —)
+3	2 7_	3	2
ty	2]=		2





A functionally determines B and B functionally determines C



A functionally determines I and B does not functionally determines C



B does not functionally determines C



A does not functionally determines B and B does not functionally determines C

Conclude that:

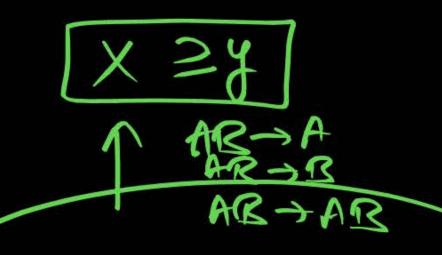
1) Rule out the FD Raged on the Table Instance



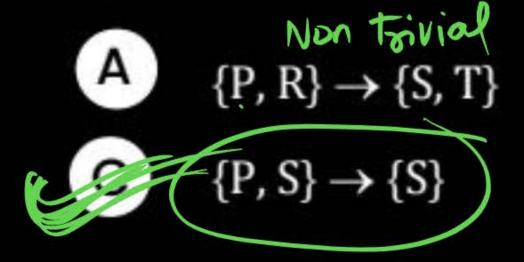
Consider the relation X(P, Q, R, S, T, U) with the following set of functional dependencies [2015: 1 Marks]

$$F = \{ \\ \{P, R\} \rightarrow \{S, T\} \\ \{P, S, U\} \rightarrow \{Q, R\} \}$$

$$\}$$



Which of the following is the trivial functional dependency in F+ is closure of F?



B
$$\{P,R\} \rightarrow \{R,T\}$$
 $\times by \ d \times ny \neq 0$

D
$$\{P, S, U\} \rightarrow \{Q\}$$

- @ CC with Enjoying, Chamles
 - (b) CC
- (C) <
- (d) Doubt.

Armstrong's Axioms/Inference Rules



- Axioms, or rules of inference, provide a simpler technique for reasoning about functional dependencies
- In the rules that follow, we use Greek letters $(\alpha, \beta, \gamma,...)$ for sets of attributes.
- We can use the following three rules to find logically implied functional dependencies.
- By applying these rules repeatedly, we can find all of F+, given F. This collection of rules called Armstrong's Axioms in honor of the person who first proposed it.
 - Reflexivity Rule: If α is a set of attributes and β ⊆ α, then α → β holds.
 - Augmentation rule: If $\alpha \to \beta$ holds and γ is a set of attributes, then $\gamma \alpha \to \gamma \beta$ holds.
 - Fransitivity Rule: If α → β holds and β → γ , then α → γ holds.

Additional Rules



- □ If $\alpha \rightarrow \beta$ holds and $\alpha \rightarrow \gamma$ holds, then $\alpha \rightarrow \beta \gamma$ holds (union)
- \square If $\alpha \rightarrow \beta \gamma$ holds, then $\alpha \rightarrow \beta$ holds and $\alpha \rightarrow \gamma$ holds (decomposition)
- \square If $\alpha \rightarrow \beta$ holds and $\gamma\beta \rightarrow \delta$ holds, then $\alpha\gamma \rightarrow \delta$ holds (Pseudo transitivity)

The above rules can be inferred from Armstrong's Axioms.

Armstrong's Axioms/Inference Rules



Inference rules that can be used to infer new dependencies from a given set of dependencies

- □ IR1 (reflexive rule) : If $X \supseteq Y$, then $X \rightarrow Y$.
- □ IR2 (augmentation rule)²: $\{X \rightarrow Y\} \mid =XZ \rightarrow YZ$.
- □ IR3 (transitive rule): $\{X \rightarrow Y, Y \rightarrow Z\} \mid = X \rightarrow Z$.
- □ IR4 (decomposition, or projective, rule): $\{X \rightarrow YZ\} = X \rightarrow Y$.
- □ IR5 (union, or additive, rule): $\{X \rightarrow Y, X \rightarrow Z\} = X \rightarrow YZ$.
- □ IR6 (pseudotransitive rule): $\{X \rightarrow Y, WY \rightarrow Z \mid |=WX \rightarrow Z.\}$

Attribute closure [X]+



Attribute closure [X]+: Let R be the Relational Schema X be the attribute set of Relation R,

Set of ALL Possible Attributes which is Logically determined by Attribute X is Called Attribute closure of X. [X].

R(ABCDEF) [A >B, B > (, C > D, D > E, E > F)

$$(A)^{+} = [ABCDEF]$$

$$(B)^{+} = [BCDEF]$$

$$(C)^{+} = [CDEF]$$

$$(D)^{+} = [DFF]$$

$$(E)^{+} = [FF]$$

$$(F)^{+} = [F]$$

Example



Let us consider a relation with attributes A, B, C, D, E, and F. Suppose that this relation has the FD's $AB \rightarrow C$, $BC \rightarrow AD$, $D \rightarrow E$, and $CF \rightarrow B$.

What is the closure of {A, B}, that is, {A, B}+?

$$F = \{Ssn \rightarrow Ename,$$



Pnumber → (Pname, Plocation),

(Ssn, Pnumber) \rightarrow Hours)

Find

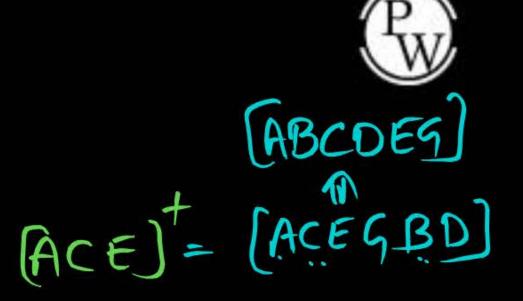
- (i) {Ssn} + = (Ssn Engme)
- (2) {Pnumber} + = (Pnumber Phame Placation)
- (3) {Ssn, Pnumber} += (Ssn Pnumber Hours Engme Prame Placation)

R (ABCDE G)

$$F: (AB \rightarrow C, BC \rightarrow AD, D \rightarrow E, E \rightarrow G, CE \rightarrow B)$$

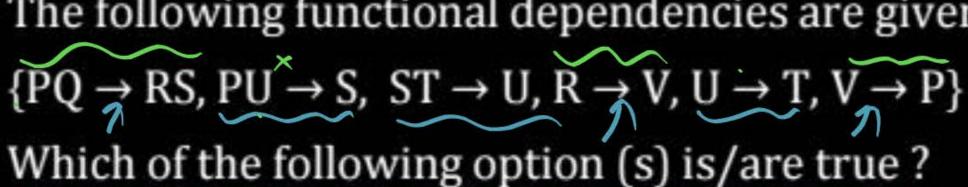
Find closure of ...

AD, D
$$\rightarrow$$
 E, E \rightarrow G, CE \rightarrow B)





The following functional dependencies are given





$$\{PU\}^+ = \{PRSTUV\} \quad \{PU\}^+ = \{PUST\}$$

$$(PQ)^{+} = \{PQRSUV\} (PQ)^{+} = (PQRSUV)$$

AM (A) 4(C).



The following functional dependencies are given:



$$AB \rightarrow CD$$
, $AF \rightarrow D$, $DE \rightarrow F$, $C \rightarrow G$, $F \rightarrow E$, $G \rightarrow A$.

Which one of the following options is false? [2006: 2 Marks]

$$A_{(i)} \{CF\}^+ = \{ACDEFG\} [CF]^+ = \{CFGEAD\} \Rightarrow \{ACDEFG\}$$

$$B(ii)$$
 {BG}+= {ABCDG} $(BG)^{\dagger}$ $(BGACD) = (ABCDG)$

$$C_{(ij)}\{AF\}^{+} = \{ACDEFG\} (AF)^{+} - (AFDE)$$

SUPERKEY: Let R be the Relational Schema LX be the attribute Set ab Relation R, It all Attributes of Relation R is determined Attribute closure of X, then X is a superkey

[x] [closuse of x] determined All Attribute of Relational Schemar, then x is a subservey.

SUPER KEY

my superset of subserkey is also superkey

ABC ABC ABCATE

AC ADF AD AF CDET Suber Suber

SUPER KEY



Any Super Set of Super Icey is also Super Icey.

SUPER KEY Assume GC.K) > Candidate Key (C.K) Minimal I Select as Primary Key Remaining C.K Alternative

(5)-A+

Except Primary Secondary key

Candidate key:

Minimal of Super key.

OR

Any Proper Subset of Suber key is also Suber key then that Proper subset is called Candidak key [2 30 on]

GR (ABODE) [AB->C,C->D, B->EA) (BRIABODE) [AB->C,C->D, B->E)

AB is suber key

Propher subset

(A) = (A)

(B) = (BEACD)

Bis Candidate 1004

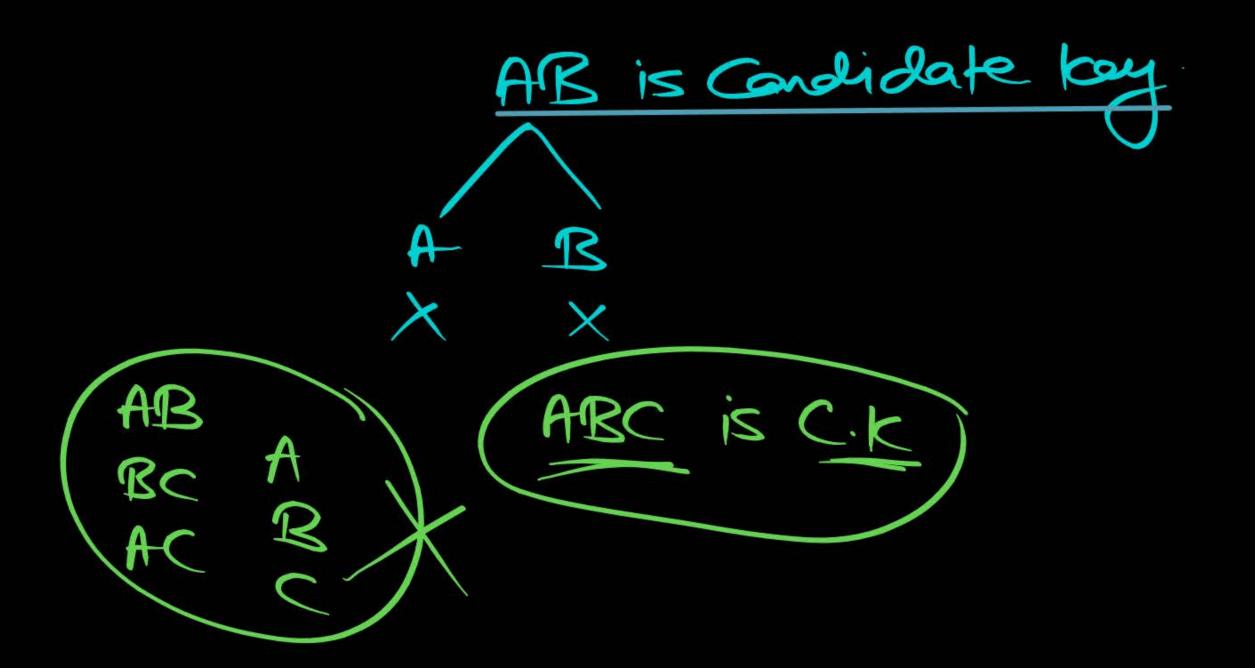
AB is suber long

Portee subset

(A) = (A)

(B) = (BE)

AB is Candidate kgy



Any Doubt?





