



## **Attribute Closure**

# Attribute Closure / Closure Set

$R(A,B,C,D,E)$

FD:  $\{A \rightarrow B, B \rightarrow C, C \rightarrow D, D \rightarrow E\}$

$A \rightarrow C$

$B \rightarrow D$

$C \rightarrow E$

$D \rightarrow E$

$E \rightarrow E$

$A \rightarrow A$

$B \rightarrow E$

$C \rightarrow C$

$D \rightarrow D$

$A \rightarrow D$

$B \rightarrow B$

$C \rightarrow CDE$

$D \rightarrow DE$

$A \rightarrow E$

$B \rightarrow BCDE$

$A \rightarrow ABCDE$

Set of attributes

$X^+$

Contains set of attributes  
determined by X

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

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

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

$CD^+ = \{C, D, E\}$

## Type 1 - Finding Candidate Keys

Consider relation  $R(A,B,C,D,E,F)$  with functional dependencies:

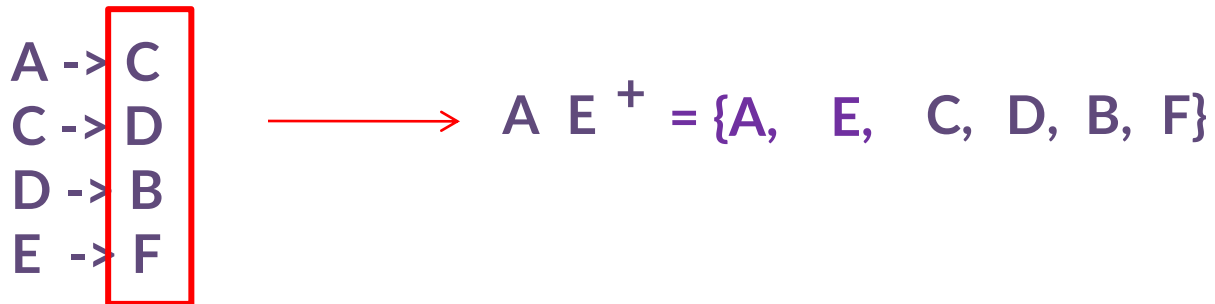
$A \rightarrow C$

$C \rightarrow D$

$D \rightarrow B$

$E \rightarrow F$

Find all the possible candidate keys?


$$\begin{array}{l} A \rightarrow C \\ C \rightarrow D \\ D \rightarrow B \\ E \rightarrow F \end{array} \longrightarrow AE^+ = \{A, E, C, D, B, F\}$$

AE is a candidate key

# Finding Candidate Keys

Consider relation  $R(A,B,C,D,E,F,G,H)$  with functional dependencies:

$CH \rightarrow G$

$A \rightarrow BC$

$B \rightarrow CFH$

$E \rightarrow A$

$F \rightarrow EG$

$\{DA, DB, DE, DF\}$  are candidate keys

Find all the possible candidate keys?

$CH \rightarrow G$   
 $A \rightarrow BC$   
 $B \rightarrow CFH$   
 $E \rightarrow A$   
 $F \rightarrow EG$



$DA^+ = \{D, A, BC, FH, EG\}$

$DB^+ = \{D, B, CFH, EG, A\}$

$DE^+ = \{D, E, A, BC, FH, EG\}$

$DF^+ = \{D, F, EG, A, BC, FH\}$

## Type 2

Let relation  $R(A,B,C,D,E,F,G,H)$  satisfy the following functional dependencies:

$A \rightarrow B$ ,  $CH \rightarrow A$ ,  $B \rightarrow E$ ,  $BD \rightarrow C$ ,  $EG \rightarrow H$ ,  $DE \rightarrow F$

Which of the following FDs is also guaranteed to be satisfied by  $R$ ?

- a.  $CGH \rightarrow BF$
- b.  $CDE \rightarrow AF$
- c.  $CEG \rightarrow AB$

$A \rightarrow B$   
 $CH \rightarrow A$   
 $B \rightarrow E$   
 $BD \rightarrow C$   
 $EG \rightarrow H$   
 $DE \rightarrow F$

- a.  $CGH^+ = \{C, G, H, A, B, E, H\}$
- b.  $CDE^+ = \{C, D, E, F\}$
- c.  $CEG^+ = \{C, E, G, H, A, B\}$

No FDs is guaranteed to be satisfied by  $R$

## Type 3

Consider relation R(A,B,C,D,E) with functional dependencies:

AB  $\rightarrow$  C, C  $\rightarrow$  D, BD  $\rightarrow$  E

Which of the following sets of attributes does **not** functionally determine E?

- a. BE
- b. ACD
- c. BC
- d. ABC

AB  $\rightarrow$  C  
C  $\rightarrow$  D  
BD  $\rightarrow$  E

- a.  $BE^+ = \{B, E\}$
- b.  $ACD^+ = \{A, C, D\}$
- c.  $BC^+ = \{B, C, D, E\}$
- d.  $ABC^+ = \{A, B, C, D, E\}$

# Attribute Closure

Refer to the below web resource to understand attribute closure

<https://www.geeksforgeeks.org/finding-attribute-closure-and-candidate-keys-using-functional-dependencies/>

<https://www.codingninjas.com/studio/library/functional-dependencies-and-attribute-closure>

**THANKS**

