

## Functional Dependencies:

$X \rightarrow Y \Leftrightarrow$  if two instances have the same  $x$  values their  $y$  values are the same.

$$\Leftrightarrow t_1 \in r \text{ and } t_2 \in r \quad \pi_x(t_1) = \pi_x(t_2) \Rightarrow \pi_y(t_1) = \pi_y(t_2)$$

## → Key terminology

Primary Key  $\subseteq$  Candidate Key  $\subseteq$  Super Key

one particular key  
chosen from candidate  
keys.

(minimal super key)

← set of attributes  
determining all other attributes.

→  $K$  is a candidate key for  $R$

$K \rightarrow R$  (does not require  $K$  to be minimal)

FDs are a generalisation of keys.

Armstrong's Axioms  $X, Y, Z$  sets of attributes

if  $X \subseteq Y$  then  $Y \rightarrow X$

if  $X \rightarrow Y$  then  $XZ \rightarrow YZ$

if  $X \rightarrow Y$  and  $Y \rightarrow Z$  then  $X \rightarrow Z$

$X \rightarrow Y$  and  $X \rightarrow Z \Rightarrow X \rightarrow YZ$

$X \rightarrow YZ \Rightarrow X \rightarrow Y$  and  $X \rightarrow Z$

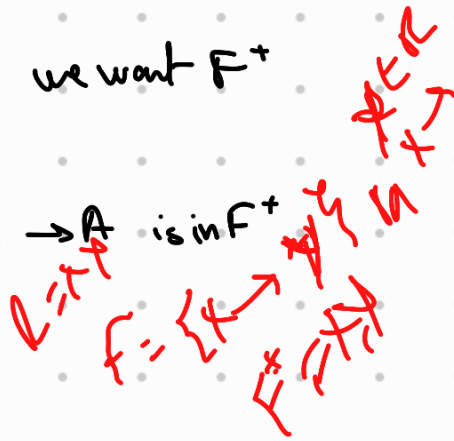
$A \rightarrow A$   
 $R = ABCDE$   
 $F = \{ \underset{0}{A} \rightarrow \underset{0}{B}, \underset{0}{CD} \rightarrow \underset{0}{E}, \underset{0}{A} \rightarrow \underset{0}{C} \}$

$F^+$  = set of all FDs deduced by  $F$

Determining closure:

for  $X \rightarrow Y$  with  $X \subset F$  we want  $F^+$

calculate  $x^+$ ? :  $\forall A$   $X \rightarrow A$  is in  $F^+$   
check if  $Y$  in  $x^+$



Exempl:  $R = \{A, B, C, D, E\}$

$F = \{B \rightarrow CD, D \rightarrow E, B \rightarrow A, E \rightarrow C, AD \rightarrow B\}$

$B^+ = \{B, A, CD, CE, C, D, E\} \checkmark$   $B \rightarrow E$  in  $F^+ \checkmark$

D: Key?

$D^+ = \{D, E, C\}$  No X

AD Key?

$AD^+ = F$  Yes  $\checkmark$

ADE Candidate Key?

No since  $AD \subset ADE$  and AD is a Key.