

## Homework 2

1. Let  $R$  be a relation with attributes  $ABCD$ . Consider

SQL conjunctive query

SELECT  $z.D$

FROM  $R \times R \times R$

WHERE  $y.C = 0$  and  $x.B = y.B$  and  $z.B = 5$   
and  $z.C = y.C$

(i) Pattern

$R$	$A$	$B$	$C$	$D$	ans	$D$
$x$	—	$b$	—	—		$d$
$y$	—	$b$	$0$	—		
$z$	—	$5$	$0$	$d$		

(ii) Minimize, satisfying FD's

$A \rightarrow D, CD \rightarrow B, C \rightarrow A$

$R$	$A$	$B$	$C$	$D$	$R$	$A$	$B$	$C$	$D$
$x$	—	$b$	—	—		—	$5$	$0$	$d$
$y$	—	$5$	$0$	$d$					
$z$	—	$5$	$0$	$d$					
					ans				$D$
									$d$

(iii) SELECT  $D$

FROM  $R$

WHERE  $B = 5$  and  $C = 0$ ;

2. Let  $R$  be a relation with attributes  $ABCDEG$  and

$F = \{E \rightarrow D, C \rightarrow B, CBE \rightarrow AG, B \rightarrow A, G \rightarrow E\}$ .

(i) Find all keys of  $R$ .

$F: E \rightarrow D$

$C \rightarrow B$

$CBE \rightarrow AG$

$B \rightarrow A$

$G \rightarrow E$

Keys:  $CE, CG$

$x C^+ = CBA$

$x CB^+ = CBA$

$\checkmark CE^+ = CBEDAG$

$\checkmark CG^+ = CBGEAD$

$\checkmark CBE^+ = CBEAGD$

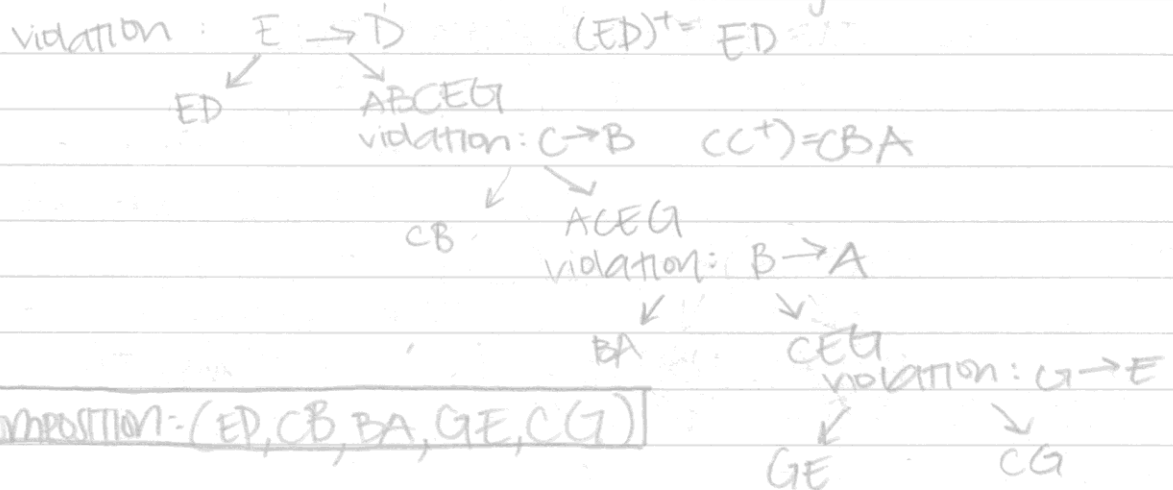
$\checkmark CBG^+ = CBAGED$

$\checkmark CEG^+ = CBEAGD$

ABCDEG

F:  $\{E \rightarrow D, C \rightarrow B, CBE \rightarrow AG, B \rightarrow A, G \rightarrow E\}$

(ii) BCNF decomposition of R with lossless join



(iii) IS DECOMPOSITION DEPENDENCY PRESERVING?

F:  $\{E \rightarrow D, C \rightarrow B, CBE \rightarrow AG, B \rightarrow A, G \rightarrow E\}$

DECOMPOSITION: ED, CB, GE, BA, CG

CBE  $\rightarrow$  AG is not preserved

(iv) 3NF with lossless & dependency preservation

1. rewrite FD w/ single attr on RHS

$E \rightarrow D, C \rightarrow B, CBE \rightarrow A, CBE \rightarrow G, B \rightarrow A, G \rightarrow E$

2. Eliminate redundant FD's

$C \rightarrow B, B \rightarrow A, G \rightarrow E, E \rightarrow D, \cancel{CBE \rightarrow A}, \cancel{CBE \rightarrow G}$

3. Eliminate redundant attr from LHS of FD's

P =  $\{CB, BA, GE, ED, CEG\}$  SUPERKEY

P has lossless join.

IS P ALSO BCNF? NO, because only one of the dependency is a candidate key and the rest are not, so they violate BCNF.