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Homework #6

1. $R(A, B, C, D, E, F)$, $R_1(A, B, C, F)$, $R_2(A, D, E)$
$A \to BC$ $\{A\}^+ = \{A, B, C, D, E\}$
$CD \to E$ Since $A \to DE$, R_1, R_2 are valid lossless decompositions
$B \to D$ of R.
$E \to A$

2. $C \to AB$, $A \to B$.

3. Student (sid, name, addr), Class (dept, cnum, title, unit)
Take (sid, dept, cnum).
sid $\to$ name, addr. dept, cnum $\to$ title unit.
a. One to one: FD is injective, so every student has 1 class + every class has one student: sid $\to$ dept, cnum, dept, cnum $\to$ sid.
b. Many to one: Many students can take one class.
sid $\to$ dept, cnum.

4. $A \to BC$, $CD \to E$, $B \to D$, $E \to A$.
a. $\{E\}^+ = \{E, A, B, C, D\}$.
Thus, $\{E\}^+ = R$, and E is minimal, so E is a key of R.

b. $\{BC\}^+ = \{B, C, D, E, A\}$. $\{B\}^+ = \{B, D\}$, $\{C\}^+ = \{C\}$.
So BC is minimal, + $\{BC\}^+ = R$. Thus BC is a key of R.

5. $\{A\}^+ = \{A, B, C, E, D\}$. $\cancel{R_1(A, B, C, D, E)}$, $R_2(A, F) \to$ BCNF
$\{C\}^+ = \{C, E\}$ $R_3(C, E) \to$ BCNF
$\{B\}^+ = \{B, D\}$ $\cancel{R_4(C, A, B, D)}$.
$R_5(B, D)$, $R_6(B, A, C) \to$ BCNF

R_2, R_3, R_5, R_6 are in BCNF.

6. $R(A, B, C, D)$. $A \twoheadrightarrow BC$.

$a\ b_1\ c_1\ d_1$	$a\ b_2\ c_2\ d_3$
$a\ b_2\ c_2\ d_2$	$a\ b_3\ c_3\ d_1$
$a\ b_3\ c_3\ d_3$	$a\ b_3\ c_3\ d_2$
$a\ b_1\ c_1\ d_2$	
$a\ b_1\ c_1\ d_3$	
$a\ b_2\ c_2\ d_1$	

7. $AB \to E$, $AB \twoheadrightarrow C$, $A \twoheadrightarrow B$. $\cancel{R(A,B,C,D,E,F)}$

$\{AB\}^+ = \{A, B, E\}$ $\cancel{R_1(A,B,E)}$. $R_2(A, C, D, F) \to$ BCNF, 4NF

$\{A\}^+ = \{A, B\}$ $R_3(A, B)$, $R_4(A, E) \to$ 4NF

$R_2(A, C, D, F) \cup R_3(A, B) \cup R_4(A, E) = R$