

1. For each of the following schema decompositions, determine whether or not it is a lossless-join decomposition.
  - (a) Schema  $R(A, B, C, D)$  with FDs  $F = \{A \rightarrow BCD, C \rightarrow D\}$  and decomposition  $\{R_1(A, B, C), R_2(C, D)\}$ .
  - (b) Schema  $R(A, B, C, D)$  with FDs  $F = \{A \rightarrow BCD, C \rightarrow D\}$  and decomposition  $\{R_1(A, C), R_2(A, B, D)\}$ .
  - (c) Schema  $R(A, B, C, D, E)$  with FDs  $F = \{AB \rightarrow C, AC \rightarrow D, E \rightarrow ABCD\}$  and decomposition  $\{R_1(A, B, C), R_2(A, B, E), R_3(A, C, D)\}$ .
  
2. Consider the schema  $R(A, B, C, D, E)$  with FDs
 
$$F = \{A \rightarrow E, AB \rightarrow D, CD \rightarrow AE, E \rightarrow B, E \rightarrow D\}.$$
 Let  $\delta = \{R_1(B, D, E), R_2(A, C, E)\}$  be a decomposition of  $R$ .
  - (a) Is  $R$  in BCNF? Explain.
  - (b) Is  $\delta$  a lossless-join decomposition? Explain.
  - (c) Is  $\delta$  in BCNF? Explain.
  - (d) If  $\delta$  is not in BCNF, find a BCNF decomposition of  $R$ .
  
3. Consider the schema  $R(A, B, C, D, E)$  with FDs
 
$$F = \{AB \rightarrow CDE, AC \rightarrow BDE, B \rightarrow C, C \rightarrow B, C \rightarrow D, B \rightarrow E\}.$$
 Find a BCNF decomposition of  $R$ .