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1. Review the following terms.

    Functional dependency, Holds, Trivial
    Armstrong's axioms
        Reflexive rule
        Augmentation rule
        Transitivity rule
    Additional rules
        Union rule
        Decomposition rule
        Pseudotransitivity rule
    Closure of Attribute Sets
    Decomposition, Lossless decompositions
    Third normal form (3NF)
    Boyce–Codd normal form (BCNF)

2. List all nontrivial functional dependencies satisfied by the relation of Figure 1.

A	B	C
a_1	b_1	c_1
a_1	b_1	c_2
a_2	b_1	c_1
a_2	b_1	c_3

Figure 1: Relation of Exercise 2.

3. Given the following relational schema $R = (A, B, C, D, E, F, G)$ and the following set F of functional dependencies (FDs):

$$A \rightarrow BC$$
$$E \rightarrow CGA$$
$$C \rightarrow DA$$
$$CA \rightarrow F$$
$$F \rightarrow CDGB$$
$$CD \rightarrow BF$$

1) Use Armstrongs's axioms as well as the additional rules introduced in the lecture to show that the following rule (we name it pseudo II) is correct:

$$\alpha \rightarrow \beta\gamma \wedge \beta \rightarrow \delta \Rightarrow \alpha \rightarrow \beta\delta\gamma$$

2) Please use all Armstrong's axioms, the additional rules introduced in the lecture, and the just derived rule (pseudo II) to derive the following FDs from the FDs given above:

a) $C \rightarrow D$
b) $F \rightarrow A$
c) $E \rightarrow ABCDEFG$

Please state for each step the rule you applied.

3) Compute the attribute closures $(C)^+$ and $(E)^+$ with respect to the above given set F of functional dependencies.

4. Given a relational schema $R = (A, B, C, D, E)$ and the following set F of functional dependencies (FDs):

$$A \rightarrow BC$$
$$CD \rightarrow E$$
$$B \rightarrow D$$
$$E \rightarrow A$$

1) List the candidate keys for R.
2) Is this relation in BCNF? Why or why not?
3) Suppose that we decompose the schema $R = (A, B, C, D, E)$ into

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

Is the decomposition lossless? Please explain your answer.