CS143: Database Systems
Homework #6

1. Suppose that we decompose the schema $R(A, B, C, D, E, F)$ into (A, B, C, F) and (A, D, E). When the following set of functional dependencies hold, is the decomposition lossless?
$A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A$
Explain your answer.

2. List non-trivial functional dependencies satisfied by the following relation. You do not need to find all functional dependencies. It is enough to identify a set of functional dependencies that imply all functional dependencies that is satisfied by the relation.

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

3. Assume *Student* and *Class* entity sets that we have used in the class. The *Student* and *Class* sets are connected by Take relationship set. We now convert the Take relationship set into a table **Take(sid, dept, cnum)** using our standard translation algorithm, where sid is the key for a student and (dept, cnum) is the key for a class.
Explain how functional dependencies can be used to indicate the following:

    (a) A one-to-one relationship exists between entity sets *Student* and *Class*.

    (b) A many-to-one relationship exists between entity sets *Student* and *Class*.

4. Assume the following set of functional dependencies hold for the relation R(A, B, C, D, E):
$A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A$

    (a) Is E a key for R? Explain your answer.

    (b) Is BC a key for R? Explain your answer.

5. Assume the following set of functional dependencies hold for the relation $R(A, B, C, D, E, F)$:
$A \rightarrow BC, C \rightarrow E, B \rightarrow D$
Is it in **BCNF**? Explain your answer. If it is not, normalize it into a set of relations in **BCNF**.

6. Suppose we have a relation R(A, B, C, D) with a MVD $A \twoheadrightarrow BC$. If we know that the tuples $(a, b1, c1, d1), (a, b2, c2, d2)$ and $(a, b3, c3, d3)$ are in the current instance of R, what other tuples do we know must also be in R?

7. For relation $R(A, B, C, D, E, F)$, MVDs $A \twoheadrightarrow B$ and $AB \twoheadrightarrow C$, and FD $AB \rightarrow E$ hold. Is it in 4NF? Explain your answer. If not, normalize it into 4NF.