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