COMS4037: Databases
Tutorial: functional dependencies and normal forms

1. Give an example of a table T and a functional dependency fd such that the schema of T should, but does not, conform to fd, which gives rise to a potential

   (a) update anomaly;

   (b) insertion anomaly;

   (c) deletion anomaly.

   Explain, with reference to your particular examples of T and fd, the nature of each of the three anomalies—namely, what can go wrong in each case?

2. Suppose we have the following table stored in a database. What functional dependencies, if any, might we claim to hold for this relation?

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

3. Consider a table that holds information about students registered for a course. For each row, the table contains the following information: student number, ID number, first name, last name, age. List all the nontrivial functional dependencies that we might expect to hold for this table. List all the candidate keys for the table.

4. For the following relation schema and sets of functional dependencies, (i) List all the non-trivial functional dependencies that follow from the given functional dependencies (restrict the list to the dependencies that have a single attribute on the right-hand side of the arrow); (ii) List all the candidate keys of a relation.

   (a) $R(A, B, C, D)$ and $\{A \to B, B \to C, B \to D\}$;

   (b) $S(A, B, C, D)$ and $\{AB \to C, DE \to C, B \to D\}$.

5. Is the following purported rule for reasoning about functional dependencies valid or not? the rule is valid, proves so; otherwise, provide a counterexample.

   (a) if $AB \to DE$ and $C \to F$, then $ABC \to DEF$;

   (b) if $AB \to C$ then, $A \to C$ or $B \to C$.

6. For the following schema and sets of functional dependencies, indicate all the violation of BCNF (remember to consider the FDs that follow from the given sets of FDs, but you might restrict yourself to considering violations that involve only one attribute on the right-hand side of the arrow). Then, decompose the relation into BCNF.

   (a) if $AB \to DE$ and $C \to F$, then $ABC \to DEF$;

   (b) if $AB \to C$ then, $A \to C$ or $B \to C$.

7. What are disadvantages of BCNF? What solutions have been proposed to deal with those disadvantages? Evaluate the proposed solutions.