Tutorial 3
Functional Dependencies & Normalisation

Classroom Exercise

1. A medical clinic database schema contains the following:

   APPOINTMENT (patient-id, patient-name, doctor-id, doctor-name, appointment-date, appointment-time, clinic-room-no)

   Show, with suitable examples, the insertion anomalies that the schema is liable to encounter.

2. Consider the relation ADDRESS having attributes Street, City, State and Zip. Assume that for any given zipcode, there is just one city and state. Also, for any given street, city, and state, there is just one zipcode.

   (a) Infer all possible functional dependencies (FDs) for this relation.
   (b) Which are possible minimal keys?

3. Prove the following properties using Armstrong's axioms or reject it by counterexample relations.

   (a) $A \rightarrow B \Rightarrow AC \rightarrow B$
   (b) $A \rightarrow C$ and $AB \rightarrow C \Rightarrow B \rightarrow C$

4. Consider a relation R(A, B, C, D) with the following FDs: $B \rightarrow C$, $D \rightarrow B$

   (a) Find the key(s) of R.
   (b) Is this relation in BCNF? Why or why not? If it is not, decompose R into a collection of relations that are in BCNF.

5. Prove that every two-attribute relationis in BCNF.

Critical Thinking Exercise

6. Consider a relation R(A,B,C,D,E) and FD's $AB \rightarrow C$, $DE \rightarrow C$, and $B \rightarrow D$. Is this relation in BCNF? Why or why not? If it's not, decompose the relation into collections of relations that are in BCNF.

7. Consider a relation R(A,B,C,D,E) and FD's $A \rightarrow B$, $A \rightarrow C$, $BC \rightarrow A$, and $D \rightarrow E$. Is this relation in BCNF or 3NF or neither? If it's not in BCNF, decompose the relation into collections of relations that are in BCNF. Show each step of the decomposition process.