Tutorial 4.1

1.

[6] Two sets of functional dependencies (FD's) F and F' are equivalent if all FD's in F' follow from the ones in F, and all FD's in F follow from the ones in F'. Consider the following three sets of functional dependencies:

- $F1 = A \rightarrow C, B \rightarrow A,$
- $F2 = B \rightarrow AC$

- $F3 = AB \rightarrow C, B \rightarrow A$

(a) Are $F1$ and $F2$ equivalent? Justify your answer.

(b) Are $F1$ and $F3$ equivalent? Justify your answer.

(c) Are $F2$ and $F3$ equivalent? Justify your answer.

2.

Consider a relation $R(A, B, C)$, satisfying some functional dependency. Two instances of R are given as below:

A	B	C
2	3	1
2	2	4

A	B	C
2	2	1
3	3	2
4	2	1

Based on R's schema, enumerate all possible completely nontrivial functional dependencies (FDs) with only a single attribute on the right-hand side. Then, based on the instances above, for each FD you listed, label whether it:

H: Definitely holds in R.

NH: Definitely does not hold in R.

CD: Cannot be determined from the information given whether or not it holds in R.

3.

Consider the following relational schema for a chain store:

Sale(clerk, store, city, date, dish, size)
// a clerk sold a dish on a particular day at a given store in a city
Menu(dish, size, price)
// prices and available size for the dish

Make the following assumptions:

- Each clerk works in one store.

- Each store is in one city.

- The price of a dish is different for different sizes. The store has standardized prices: the same sized dish cannot be sold to two persons at two different prices.

1. Specify a set of completely nontrivial functional dependencies for relations Sale and Menu that encodes the assumptions described above and no additional assumptions.

2. Based on your functional dependencies in part (1), specify all minimal keys for relations Sale and Menu.

3. Are the schemas of Sale and Menu in Boyce-Codd Normal Form (BCNF) according to your answers to (1) and (2)? If not, give a decomposition into BCNF. If yes, justify your answer.

4. Now add the following assumption:

- Each city has at most one store and each store has only one clerk.

Specify additional functional dependencies to take these new assumptions into account.

5. Based on your functional dependencies for parts (1) and (4) together, specify all minimal keys for relation Sale.

6. Are the schemas of Sale and Menu in 3NF according to your answers to (1), (4) and (5)? If not, give a decomposition into 3NF. If yes, justify your answer.