CS 377: Database Systems

Homework #3

Due: Wednesday, March 30, 2016 IN CLASS

1. **Functional Dependencies via Question 14.26** (10 + 8 points):
   Consider the following relation:

Tuple #	A	B	C
1	10	b1	c1
2	10	b2	c2
3	11	b4	c1
4	12	b3	c4
5	13	b1	c1
6	14	b3	c4

   (a) Given the above database content, which of the following functional dependencies **may hold** in the above relation. If the functional dependency is invalid, explain why by specifying the tuples that cause the violation.
      i. A $\rightarrow$ B
      ii. B $\rightarrow$ C
      iii. C $\rightarrow$ B
      iv. B $\rightarrow$ A
      v. C $\rightarrow$ A

   (b) Does the above relation have a potential candidate key that does not include all attributes in the relation? If it does, what is it? If it does not, why not?

2. **Closures adapted from Question 14.27** (6 + 6 + 6 points):
   Consider a relation:

   `R(A, B, C, D, E)`

   with the following dependencies:

   - A, B $\rightarrow$ C
   - C, D $\rightarrow$ E
   - D, E $\rightarrow$ B

   (a) Compute the closure $\{A, B\}^+$
   (b) Compute the closure $\{C, D\}^+$
   (c) Compute the closure $\{D, E\}^+$

3. **Keys and BCNF Normalization via Question 14.24** (10 + 15 points):
   Consider the relation:

`R(A, B, C, D, E, F, G, H, I, J)`

and the following dependencies:

- A, B → C
- A → D, E
- B → F
- F → G, H
- D → I, J

(a) What is the key(s) in R?

(b) Decompose R losslessly into BCNF and identify the keys for each new relation.

4. **BCNF** (10 + 7 + 15 + 7 points):

Consider the following relation:

`R(A, B, C, D, E, F, G, H)`

and the following dependencies:

- B → C, D
- B, F → H
- C → A, G
- C, E, H → F
- C, H → B

(a) What are the key(s) of the relation?

(b) Which of these functional dependencies violate BCNF?

(c) Decompose the relation to obtain a lossless decomposition of R that are in BCNF. Make sure it is clear what the keys are for each relation.

(d) Is the resulting decomposition functional dependency-preserving? Explain why it does or does not.