CS 377: Database Systems

Homework #3

Due: Friday, March 31, 2017 at 11:59 PM on Gradescope

1. **Functional Dependencies** (10 + 4 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 & Keys** (10 + 3 points): Consider a relation:

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R(A, B, C, D, E)
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   with the following dependencies:

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

   (a) Compute the closures of all the functional dependencies.

(b) List all the candidate keys for R.

3. **Dynamite Database - BCNF Normalization** (5 + 5 + 15): Youre designing a database for an online gaming service named Dynamite. The database should hold customer information, game information and sales. Consider the game sales relation with a schema and functional dependencies as follows:

   `R(saleID, saleTime, gameTitle, gamePublisher, publisherCutPercent, quantity, price,customerID, address, creditCardNo)`

   - gameTitle → price
   - gameTitle → gamePublisher
   - gamePublisher → publisherCutPercent
   - customerID → address
   - customerID → creditCardNo
   - saleID → saleTime, gameTitle, quantity, price, customerID

   (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.

4. **3NF & BCNF** (10 + 8 + 10 + 15 + 5 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 3NF? What about BCNF?
   (c) Decompose the relation to obtain a lossless decomposition of R that are in 3NF. Make sure it is clear what the keys are for each relation.
   (d) 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.
   (e) Is the resulting decomposition functional dependency-preserving? Explain why it does or does not.