Midterm Examination CS 265 Spring 2016 Name: _____

I will not use notes, other exams, or any source other than my own brain on this exam: _____(please sign)

1. (5 pts) Consider the relational schema, R = [A B C D E F G] with applicable FDs

A, B → C, D
A, E → G
F → A
A → F

Key(s):

Give *all* keys for this relational schema. Be clear.

2. (5 pts) Consider the relational schema, R = [A B C] with applicable FDs

A → B B → A
B → C C → B
C → A A → C

Give TWO minimal set of FDs consistent with those given. Do not take any short cuts in presenting your answers. Be clear.

First Minimal Set

Second Minimal Set

3. (5 pts) Consider the relational schema, R = [A B C D E F G H I J] with applicable FDs

A, F → C, I

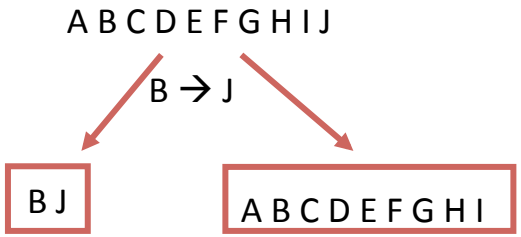
B, E → G, H

B → J

B, C, E → D

C → A, F

Reflect on the task of decomposing relation R into a **set of BCNF relations**. For example, I might use B → J as the first step to decompose R:



Circle the FD(s) in the list above that would NOT be used as the first step to decompose R using the decomposition procedure described in class. Beside each circled FD, give a brief explanation of why you would not use that FD to decompose the relation R.

4a. Consider the relation R with 7 attributes, R = [A B C D E F]. You are given the following functional dependencies:

$$Q = \{A \rightarrow B, \quad CD \rightarrow E, \quad CF \rightarrow AB\}.$$

Give a minimal set of FDs equivalent to Q. If Q is already a minimal set, then say so. BE CLEAR!

4b. Consider the relational schema [A B C D E F G] with Functional Dependencies

$$AB \rightarrow CD,$$
$$D \rightarrow EF,$$
$$CF \rightarrow G,$$
$$FG \rightarrow A$$

Give *all* minimal keys for this relational schema .

5. Consider the relation P with 5 attributes, R = [A B C D E]. You are given the following functional dependencies: Q = { A → B, B → C }. Circle **all true statements**.

(a) [A B] is in BCNF

(b) [B C] is in BCNF

(c) [A D E] is in BCNF

(d) [A C D E] is in BCNF

(e) [A B D E] is in BCNF

(f) [A B C D E] is in BCNF

(g) [A B], [A C D E] is a dependency preserving decomposition

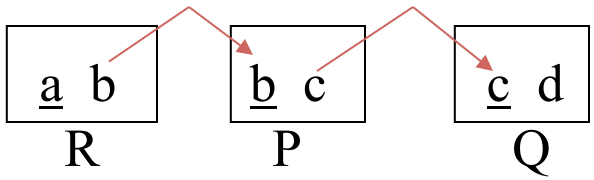
(h) [A B D E], [B C] is a dependency preserving decomposition

(i) [A B], [A D E], [B C] is a dependency preserving decomposition

(j) {A → B, B → C} is a minimal set of FDs

(k) [A B], [C D E] is a lossless decomposition

6. A colleague brings you three table definitions, summarized by these relational schema (R, P, Q), with '<u>a</u>' as a primary key for table R, '<u>b</u>' the primary key for table P, and '<u>c</u>' the primary key for table Q. '<u>b</u>' is a foreign key from R to P, and '<u>c</u>' is a foreign key from P to Q.



In addition to the table definitions, your colleague gives you this assertion, intended to enforce the FD Q.d → R.a.

```
CREATE ASSERTION AsPerD
CHECK (NOT EXISTS (SELECT *
                   FROM (SELECT COUNT (DISTINCT R.a) AS cnt
                         FROM R, P, Q
                         WHERE R.b = P.b AND P.c = Q.c
                         GROUP BY Q.d, R.a) AS Temp
                   WHERE Temp.cnt > 1))
```

(a) Ignoring for the moment that your colleague requires a course in DB design, you recognize that the assertion is incorrect, but that you can correct it by making ONE simple STRIKETHROUGH. Put a line through that part of the assertion definition so that the corrected version properly enforces the FD, d → a.

(b) After you explain your fix, your colleague leaves, and you replace your colleague's three tables and one (corrected) assertion by ONE table definition that enforces all the constraints encoded in the original three tables and one assertion. Give the definition for this one table as a CREATE TABLE statement. List all attributes, and show other constraints, but do not worry about the types of the attributes.