**Homework #5**

Name:王思正 Student ID: 4108056004 Assigned Date: 2021-12-07

1. For each of the following relation schemas and dependencies
   1. 𝑅(𝐴, 𝐵, 𝐶, 𝐷) with MVD’s 𝐴 ↠ 𝐵 and 𝐴 ↠ 𝐶. (10%)
   2. 𝑅(𝐴, 𝐵, 𝐶, 𝐷) with MVD’s 𝐴 ↠ 𝐵 and 𝐵 ↠ 𝐶𝐷. (10%) do the following:
      1. Find all the 4NF violations.
      2. Decompose the relations into a collection of relation schemas in 4NF.

(i) (a) not 4NF since A is not the super key

(b) not 4NF since B is not the super key

(ii)

(a)AB, ACD

(b)AB, ACD

1. Consider a relation with schema 𝑅(𝐴, 𝐵, 𝐶, 𝐷) and FD’s 𝐴𝐵 → 𝐶, 𝐶 → 𝐷, and 𝐷 → 𝐴.
   1. What are all the nontrivial FD’s that follow from the given FD’s? You should restrict yourself to FD’s with single attributes on the right side. (10%)
   2. What are all the candidate keys of 𝑅? (10%)
   3. What are all the super-keys for 𝑅 that are not candidate keys? (10%)

(a) 𝐴𝐵 → 𝐶, 𝐶 → 𝐷, 𝐷 → 𝐴, 𝐶 → A, 𝐴𝐵 → D, 𝐵 → A, 𝐵D → A, 𝐵C → A, CD → A

, BCD → A , 𝐴𝐵C → D, ABD → C

(b) AB, BD, BC

(c) ABC, ABD, BCD, ABCD

1. For each of the following relation schemas and sets of FD’s:
   1. 𝑅(𝐴, 𝐵, 𝐶, 𝐷) with FD’s 𝐴𝐵 → 𝐶, 𝐶 → 𝐷, and 𝐷 → 𝐴. (10%)
   2. 𝑅(𝐴, 𝐵, 𝐶, 𝐷) with FD’s 𝐵 → 𝐶 and 𝐵 → 𝐷. (10%)
   3. 𝑅(𝐴, 𝐵, 𝐶, 𝐷) with FD’s 𝐴𝐵 → 𝐶, 𝐵𝐶 → 𝐷, 𝐶𝐷 → 𝐴, and 𝐴𝐷 → 𝐵. (10%)
   4. 𝑅(𝐴, 𝐵, 𝐶, 𝐷) with FD’s 𝐴 → 𝐵, 𝐵 → 𝐶, 𝐶 → 𝐷, and 𝐷 → 𝐴. (10%)
   5. 𝑅(𝐴, 𝐵, 𝐶, 𝐷, 𝐸) with FD’s 𝐴𝐵 → 𝐶, 𝐷𝐸 → 𝐶, and 𝐵 → 𝐷. (10%)

do the following:

* + 1. Indicate all the BCNF violations. Do not forget to consider FD’s that are not in the given set, but follow from them. However, it is not necessary to give violations that have more than one attribute on the right side.
    2. Decompose the relations, as necessary, into collections of relations that are in BCNF.

(i)

(a) given: 𝐴𝐵 → 𝐶, 𝐶 → 𝐷, and 𝐷 → 𝐴

derived FDs: C→A, C→D, D→A, AB→D, AB→ C, AC→D, BC→A, BC→D, BD→A, BD→C, CD→A, ABC→D, ABD→C, BCD→A

Keys:

AB, BC, and BD

BCNF violations:

C→A, C→D, D→A, AC→D, CD→A.

(b) given: 𝐵 → 𝐶 and 𝐵 → 𝐷

derived FDs: B→C, B→D, AB→C, AB→D, BC→D, BD→C, ABC→D,ABD→C

Keys:

AB

BCNF violations:

B→C, B→D, BC→D and BD→C

(c) given: 𝐴𝐵 → 𝐶, 𝐵𝐶 → 𝐷, 𝐶𝐷 → 𝐴, and 𝐴𝐷 → 𝐵

derived FDs: AB→C, BC→D, CD→A, AD→B, AB→D, AD→C, BC→A, CD→B, ABC→D, ABD→C, ACD→B and BCD→A

keys:

AB, AD, BC, and CD

BCNF violations:

None

(d) given: 𝐴 → 𝐵, 𝐵 → 𝐶, 𝐶 → 𝐷, and 𝐷 → 𝐴

derived FDs: 𝐴 → 𝐵, 𝐵 → 𝐶, 𝐶 → 𝐷, 𝐷 → 𝐴, 𝐴 → C, 𝐴 → D, B → D, B → A, 𝐶 → A, 𝐶 → B, 𝐷 → B, 𝐷 → C, B𝐶 → A, 𝐶D → A, B𝐶D → A, 𝐶D → B, AD → B, A𝐶D → B, AB → C, BD → C, ABD → C, AB → D, AC → D, ABC → D

keys:

A, B, C, D

BCNF violations:

none

(e)given: 𝐴𝐵 → 𝐶, 𝐷𝐸 → 𝐶, and 𝐵 → 𝐷

derived FDs: 𝐴𝐵 → D, 𝐴𝐵DE → 𝐶, 𝐵E → 𝐶, A𝐵E → 𝐶

keys:

ABE

BCNF violations:

𝐴𝐵 → 𝐶, 𝐷𝐸 → 𝐶, 𝐵 → 𝐷, 𝐵E → 𝐶, 𝐴𝐵 → D

(ii)

(a) BC, AD, and CD

(b) AB and BCD

(c) don’t need to decompose

(d) don’t need to decompose

(e) ABD, CDE

1