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成绩： _____

学院：智能工程学院　　课程：数据库原理　　周次：第 16 周

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1 题一

1.1 题目

Consider the following relation $r(A, B, C, D, E, F)$ with the set of functional dependencies

$$F = \{$$
$$A \to BCD$$
$$BC \to DE$$
$$B \to D$$
$$D \to A\}$$

(a) Compute B^+

(b) Prove that AF is a superkey

(c) Compute a canonical cover of F_c

(d) Give a 3NF decomposition of r

(e) Give a BCNF decomposition of r

1.2 解答

(a) $B \to BD$ (third dependency)

$BD \to ABD$ (fourth dependency)

$ABD \to ABCD$ (first dependency)

$ABCD \to ABCDE$ (second dependency)

Thus, $B^+ = ABCDE$

(b) Using Armstrong's axioms

$A \to BCD$ (Given)

$A \to ABCD$ (Augmentation with A)

$BC \to DE$ (Given)

$ABCD \to ABCDE$ (Augmentation with ABCD)

$A \to ABCDE$ (Transitivity)

$AF \to ABCDEF$ (Augmentation with F)

(c) Because of dep. 3, we can observe that D is superfluous in deps. 1 and 2. We acquire the new set of rules by removing these two.

$$A \to BC$$

$$BC \to E$$

$$B \to D$$

$$D \to A$$

Now observe that B^+ equals $ABCDE$, and from this set, the FD $B \to E$ can be derived. As a result, in the third dependence, the property C is superfluous. We can achieve the final canonical cover by removing this characteristic and merging it with the third FD:

$$A \to BC$$

$$B \to DE$$

$$D \to A$$

There are no unnecessary attributes in any of the FDs here.

(d) We see that there is no FD in the canonical cover such that the set of attributes is a subset of

any other FD in the canonical cover. Thus, each each FD gives rise to its own relation, giving

$$r_1(A, B, C)$$
$$r_2(B, D, E)$$
$$r_3(D, A)$$

Now the attribute F is not dependent on any attribute. Thus, it must be a part of every superkey. Also, none of the relations in the above schema have F, and hence, none of them have a superkey. Thus, we need to add a new relation with a superkey.

$$r_4(A, F)$$

(e) We start with

$$r(A, B, C, D, E, F)$$

We see that the relation is not in BCNF because of the first FD. Hence, we decompose it accordingly to get

$$r_1(A, B, C, D)\ r_2(A, E, F)$$

Now we notice that $A \to E$ is an FD in F^+, and causes r_2 to violate BCNF. Once again, decomposing r_2 gives

$$r_1(A, B, C, D)\ r_2(A, F)\ r_3(A, E)$$

This schema is now in BCNF.