CPSC 304 Winter2, 2006-2007

Tutorial 3 - BCNF & 3NF

Partial Solutions

Feb.1, 2007

A1

(1) a. 3 candidate keys for R: (A,B), (B,C), (B,D)
b. R is in 3NF, but not in BCNF.

(2) a. 4 candidate keys for S: A, B, C, D
b. S is in BCNF

(3) i. B is the candidate key and R is not in 3NF
ii. (A, B, C), (B, C, D) are candidate keys and R is in 3NF, but not in BCNF
iii. (A, B) is the key and R is not in 3NF

A2

1) a1, a2 -> a3, a4, a5
a3, a4 -> a1, a2, a5
2) Yes, r1 is in BCNF because both {a1, a2} and {a3, a4} are the only non-trivial FDs, and both of them are superkeys.
3) Yes, r1 is in 3NF because if a relation is in BCNF, it is automatically in 3NF.

A3

(a) Minimum cover: $A_1 \rightarrow A_3$, $A_3 \rightarrow A_4$, $A_3 \rightarrow A_6$, $A_3A_5 \rightarrow A_1$, $A_3A_5 \rightarrow A_2$, $A_5A_6 \rightarrow A_3$.

(b) Only one: A_3A_5. Every candidate key must contain A_3A_5 (which don't appear in RHS of FDs), and A_3A_5 is a key.

(c) FD1, FD2 and FD4 violate BCNF.

- Start decomposing using FD4. We obtain R1 = (A_1A_2, FD4), and R2 = ($A_1A_3A_4A_5A_6$, {FD1, FD2, FD3}). R1 is in BCNF, and R2 is not in BCNF.
- For R2, FD1 and FD2 violate BCNF. Continue decomposing R2, using FD2. We obtain R3 = (A_1A_5, FD2) and R4 = ($A_3A_4A_5A_6$, {FD1, FD3}. R3 is in BCNF, and R4 is not in BCNF.
- For R4, FD1 violates BCNF. Continue decomposing R4, using FD1. We obtain R5 = (A_3A_6, FD1), and R6 = ($A_3A_4A_5$, FD3). Both R5 and R6 are in BCNF.

Thus, we obtained a dependency preserving BCNF decomposition because FD1 – FD4 have all of their attributes appearing in one of the relations (R1 – R6).

A4

1) I will focus only on the "Orders" relation and leave the other two relations for your practice.

- order_no -> isbn, cid, card_no, qty, order_date, ship_date
- cid -> card_no
- isbn, cid, order_date -> order_no (let us assume that a customer only orders the same book at most once on any particular date)

2) Normalization for "Orders" relation. Again, I will leave the other two relations for your practice.

Orders (order_no, isbn, cid, qty, order_date, ship_date)
Card (cid, card_no)

It is easy to verify that Card is in BCNF. "Orders" is in BCNF because the two functional determinants are both candidate keys.