Lecture 5 Review Questions

Q1. Consider the following relation and dependencies.

R(A, B, C, D, E)
FD1: A → B
FD2: C→ D

For this relation, please
(a) determine the candidate keys, and
(b) if a relation is not in BCNF then decompose it into a collection of BCNF relations.

Q2. Consider the following relation and dependencies.

R(A, B, F)
FD1: AB→ F
FD2: B→ F

For this relation, please
(a) determine the candidate keys, and
(b) if a relation is not in BCNF then decompose it into a collection of BCNF relations.

Q3. Consider the following relation and dependencies.

R(A, B, C, D, E)
FD1: D → B
FD2: CE → A

For this relation, please
(a) determine the candidate keys, and
(b) if a relation is not in BCNF then decompose it into a collection of BCNF relations.

Q4. Consider the following relation and dependencies.

R(A, B, C, D, E)
FD1: A→ E
FD2: BC→ A
FD3: DE→ B

For this relation, please
(a) determine the candidate keys, and
(b) if a relation is not in BCNF then decompose it into a collection of BCNF relations.

Q5. Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values.

- CH -> G
- A -> BC
- B -> CFH
- E -> A
- F -> EG

is a set of functional dependencies (FDs) so that F+ is exactly the set of FDs that hold for R. Determine the Candidate Keys for relation R.

Q6. Consider the following relational schema:

Suppliers (sid:integer, sname:string, city:string, street:string)
Parts (pid:integer, pname:string, color:string)
Catalog (sid:integer, pid:integer, cost:real)

Assume that, in the suppliers relation above, each supplier and each street within a city has a unique name, and (sname, city) forms a candidate key. No other functional dependencies are implied other than those implied by primary and candidate keys. Which one of the following is TRUE about the above schema?

a. The schema is in BCNF
b. The schema is in 3NF but not in BCNF
c. The schema is in 2NF but not in 3NF
d. The schema is not in 2NF

Answers

Q1: R(A,C,B,D,E). FDs: A → B, C→ D

Answer: First compute the keys for R1. The attributes A, C, E do not appear on right hand side of any functional dependency therefore they must be part of a key. So we start from {A, C, E} and find out that this set can determine all features. So the key is {A, C, E}

We have dependencies A → B and C → D so the table is not BCNF. Applying the BCNF decomposition algorithm, the non-BCNF dependency is A → B, therefore create two relations (A, C, D, E) and (A, B). The first relation is still not in BCNF since we have a non-BCNF dependency C→ D. Therefore decompose further into (A, C, E) and (C, D). Now all relations are in BCNF and the final BCNF scheme is (A, C, E), (C, D), (A, B).

Q2: R(A,B,F). FDs: AB→ F, B→ F

Answer: First compute keys for R2. Note that AB -> F is totally redundancy since we already have B-> F. A,B do not appear on right side of any dependency, so start by computing attribute set closure of {AB}. Since AB→ F, we have {AB}+ = {ABF} and therefore {AB} is the key. Since we have B → F, i.e., F is partially dependent on the key, the relation is not in BCNF. During BCNF decomposition, we have B → F as the non-BCNF relation therefore create new schema (A,B) (B,F). Both are in BCNF.

Q3: R(A,B,C,D,E). FDs: D → B, CE → A.

Answer: The key for R5 is {CDE} since we have {CDE}+ = {ABCDE}. R5 is not in BCNF and not in 3NF. Applying the BCNF decomposition, we pick D → B which is not BCNF and decompose into (D, B) and (ACDE). But (ACDE) is still not in BCNF since CE→ A is not BCNF. Therefore decompose into (D, B), (A,C,E) and (D,C,E) which is now in BCNF.

Q4: R(A,B,C,D,E). FDs: A→ E, BC→ A, DE→ B.

Answer: Since D and C do not appear on right hand side, all keys must contain C and D. The set {C,D} by itself is not a key since {C,D}+= {C,D}. However, all three element sets containing {C,D} are keys – i.e., {A,C,D} is a key, {B,C,D} is a key, and {C,D,E} is a key. So all attributes are prime attributes. Therefore the schema is in 3NF. However, the left hand side of the FDs is not a key therefore it is not in BCNF. One decomposition will start by removing A → E to form (A,E) and (A,B,C,D). But (A,B,C,D) is not in BCNF since BC is not the key. Therefore decompose further to get (A,E), (BCA) and (BCD). This is in BCNF since the only dependency in (BCD) is the trivial dependency BCD → BCD.

Q5. Relation R has eight attributes ABCDEFGH. Fields of R contain only atomic values. {CH -> G, A -> BC, B -> CFH, E -> A, F -> EG} is a set of functional dependencies (FDs) so that F+ is exactly the set of FDs that hold for R. Determine the Candidate Keys for R.

Answer: A+ is ABCEFGH which is all attributes except D.
B+ is also ABCEFGH which is all attributes except D.
E+ is also ABCEFGH which is all attributes except D.
F+ is also ABCEFGH which is all attributes except D.
So, there are total 4 candidate keys AD, BD, ED and FD.

Q6. Consider the following relational schema:

Suppliers (sid:integer, sname:string, city:string, street:string)
Parts (pid:integer, pname:string, color:string)
Catalog (sid:integer, pid:integer, cost:real)

Assume that, in the suppliers relation above, each supplier and each street within a city has a unique name, and (sname, city) forms a candidate key. No other functional dependencies are implied other than those implied by primary and candidate keys. Which one of the following is TRUE about the above schema?

Answer: The schema is in BCNF