**Assignment 2**

1. Consider a relation R with attributes ABCDEF. You are given the following dependencies A-> B, D -> E, AC -> E.
   1. Attribute closure of A?

{A}⁺ = {AB}

* 1. Attribute closure of C?

{C}⁺ = {C}

* 1. Attribute closure of D?

{D}⁺ = {DE}

* 1. Attribute closure of AC?

{AC}⁺ = {ABCE}

* 1. Attribute closure of ABCDEF?

{ABCDEF}⁺ = {ABCDEF}

* 1. Identify which, if any, of the above are candidate keys.

None of the above are candidate keys.

1. Consider a relation R with attributes ABCDE. You are given the following dependencies AC-> B, AC-> D, AC-> E, E -> C.
   1. List all (candidate) keys for R.

{AC, AE}

* 1. Is R in 3NF? Why or why not?

R is in 3NF because every FDs RHS attribute is a prime attribute.

* 1. Is R in BCNF? Why or why not?

R is NOT in BCNF because of the FD: E → C, in which LHS attribute E is not a super key nor a candidate key.

1. Consider a relation R with attributes ABCDE. You are given the following dependencies AB -> C, AB -> D. AB -> E.
   * 1. List all (candidate) keys for R.

{AB}

* + 1. Is R in 3NF? Why or why not?

R is in 3NF because every FDs RHS attribute is a prime attribute.

* + 1. Is R in BCNF? Why or why not?

R is in BCNF because every LHS attribute in every FD is a super key or candidate key.

For the next set of questions consider the relational schema R=(P, Q, R, S, T, U, V, W) and the set of functional dependencies FD: *Q → U* (1)

*U → V* (2)

*PQ → WST* (3)

*SU → TR*  (4)

*V T → RW*  (5)

*R → W*  (6)

1. Which of the following is a minimum cover of the FD? Mark all that qualify; if none, mark accordingly, and give your *own*. answer. SHOW THE WORK.
   1. The given FDs (Eq [1-6](#_bookmark3)), is a minimum cover already.
   2. *{Q → U, U → V, PQ → S, SU → T, SU → R, V T → R, V T → W, R → W }*
   3. *{Q → U, U → V, PQ → S, SU → T, PQ → W, V T → R, PQ → T, R → W }*
   4. *{Q → U, U → V, PQ → S, SU → T, V T → R, R → W }*
   5. *{Q → U, U → V, PQ → S, SU → T, SU → R, V T → R, PQ → T, R → W }*
   6. *None of the above.*

iv. {Q → U, U → V, PQ → S, SU → T, V T → R, R → W } is the minimal cover.

**Showing work:**

First, convert the set of functional dependencies to canonical form:

Q→U

U→ V

PQ → W

PQ → S

PQ → T

SU → T

SU → R

VT → R

VT → W

R → W

Next, check for any extraneous attributes on the LHS.

There are no extraneous attributes on the LHS of any of these FDs. This is because the possible FDs

such as P→W or Q → W can’t be obtained from the other FDs through the inference rules.

Next, check for any redundant FDs.

The redundant FDs are:

PQ → T

PQ → W

SU → R

VT → W

Therefore, the minimal cover is: {Q→U,U→V, PQ→S, SU→T, VT→R, R→W}, which corresponds to answer iv.

*Q. 14.26, 14.27 14.30*

Table

Description automatically generated with low confidence

1. i. A → B may not hold due to tuples 1 and 2  
   ii. B → C may hold  
   iii. C → B may not hold due to tuple 3  
   iv. B → A may not hold due to tuples 1 and 5  
   v. C → A may not hold due to tuples 1 and 3
2. Yes, the above relation has a potential candidate key. AB is a potential candidate key for the above relation.

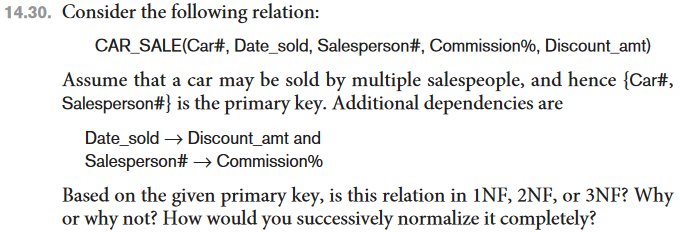
Text

Description automatically generated

No, AB is not a candidate key of this relation because the candidate key needs to contain AD since AD is not present on any of the FD's RHS.

ABD is a candidate key because: {ABD}⁺ = {ABCDE}

1. ABD determines itself
2. AB determines C
3. CD determines E
4. Therefore {ABD}⁺ = {ABCDE}
5. Thus, ABD is a candidate key



This relation is in 1NF because:

* Each column is unique.
* Each attribute is unique.
* No row has duplicate/composite values.

The relation is not in 2NF because the nonprime attribute ***Commission%*** is partially dependent on the primary key***. Commission%*** is partially dependent on ***Salesperson#*** as: ***Salesperson# → Commission%.***

It is not in 3NF because it is not in 2NF.

To normalize completely normalize the relation:

1. Make the relation satisfy the requirements of 2NF. Hence, we need to get rid of the partial dependency. To do this we must make a new relation, remove the dependent nonprime attribute of the first relation and put it in the new relation.  
     
   We should now have the following relations:  
     
   **CAR\_SALE(Car#, Date\_sold, Salesperson#, Discount\_amt)**

**NEW\_RELATION(Salesperson#, Commission%)**

1. We must get rid of the transitive dependency in the relation CAR\_SALE. The transitive dependency is ***: {Car#, Salesperson#} → Date\_sold → Discount\_amt***. To get rid of this transitivity, we must do the same thing as the previous step.   
     
   We should now have the following relations:  
     
   **CAR\_SALE(Car#, Date\_sold, Salesperson#)   
   NEW\_RELATION1(Date\_sold, Discount\_amt)  
   NEW\_RELATION2(Salesperson#, Commission%)**
2. The relation is now normalized completely