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Assignment 3
Task 1
Consider the relation schema R(A, B, C, D, E, F) and the following three

FDs: **FD1**: {A} → {B,C} **FD2**: {C} → {A,D} **FD3**: {D,E} → {F}

Use the Armstrong rules to derive each of the following two FDs. In both cases, describe the derivation process step by step (i.e., which rule did you apply to which FDs).

a) {C} → {B}

FD4: {C} -> {A} (Decomposition FD2)
FD5: {A} -> {B} (Decomposition FD1)
FD6: {C} -> {B} (Transitivity FD4 & FD5) **Q.E.D.**

b) {A,E} → {F}

FD4: {A} -> {C} (Decomposition FD1)
FD5: {C} -> {D} (Decomposition FD2)
FD6: {A} -> {D} (Transitivity FD4 & FD5)
FD7: {A,E} -> {F} (Pseudo-transitivity FD6 & FD3) **Q.E.D.**

Task 2
For the aforementioned relation schema with its functional dependencies,

FDs: **FD1**: {A} → {B,C} **FD2**: {C} → {A,D} **FD3**: {D,E} → {F}

compute the attribute closure X+ for each of the following two sets of attributes.

a) X = { A }

The attribute closure of X = {A} with FD1-FD3 is {A,B,C,D}

b) X = { C, E }

The attribute closure of X = {C, E} with FD1-FD3 is {A,B,C,D,E,F}

Task 3
Consider the relation schema R(A, B, C, D, E, F) with the following

FDs **FD1**: {A,B} → {C,D,E,F} **FD2**: {E} → {F} **FD3**: {D} → {B}

a) Determine the candidate key(s) for R.

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Our keys are {A,B} and {A,D} because AB+ and AD+ reaches the whole relation in a minimal way

b) Note that R is not in BCNF. Which FD(s) violate the BCNF condition?

FD2 and FD3 violates BCNF due to candidate key not being on the left side

c) Decompose R into a set of BCNF relations, and describe the process step by step (don't forget to determine the FDs and the candidate key(s) for all of the relation schemas along the way)

Step 1: Our candidate keys are AD and AB.

Step 2: FD2 and FD3 are non-BCNF (see b)).

FD2 is non BCNF, we will decompose this first

Step 3: E+ = {EF}

We will decompose this into two relations:

R1 = {ABCDE} FD1 and FD3 belongs to this relation -> FD3 is non-BCNF -> decompose R1 again
R2 = {EF} FD2 belongs to this relation. FD2 is BCNF so this is fine!

Step 4: D+ = {DB}

We will decompose this into two relations:

R1 = {ACDE} FD1 belongs to this. FD1 is BCNF so this is fine
R2 = {DB} FD3 belongs to this. FD3 is BCNF so this is fine

Answer:
Output: [{EF}, {ACDE}, {DB}]

Task 4
FD1: {A,B,C} → {D,E} **FD2:** {B,C,D} → {A,E} **FD3:** {C} → {D}

a)
Find candidate key.
- E isn't on the left side -> doesn't exist in the candidate key.
- B and C is only on the left side -> must exist in candidate key
- BC+ reaches the whole relation

Candidate key: BC

Check which relations is non-BCNF to show that R is not in BCNF

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Answer: FD3 is non-BCNF -> R is not BCNF

b)

Step 1: Candidate keys are BC

Step 2: FD3 is non-BCNF. We will decompose this

Step 3: D+ = CD

Decompose into two relations:
R1 = {ABCE} FD1 and FD2 belongs to this. Both are BCNF so this is fine
R2 = {CD} FD3 belongs to this. Is BCNF so this is fine

Answer: Output = [{ABCE}, {CD}]