BCNF & 3NF

E91

Sale (Customer, Store, product, price).
    A   B   C   D

Constraint: ① A customer buys from 1 store.

② a unique price for each product in a store.

Q1: FDS implied by above?

 { customer → store }. { Store, product → price}
    A → B   B, C → D

CK: {customer, product}
    A, C

Q2: Is Sale in 3NF?

NO. judge 3NF: for every X → Y in FD

    ① Y is part of key in R.

    ② X is super key of R

    ③ Y ⊆ X

A→B $\begin{cases} ① & X \\ ② & X \\ ③ & X \end{cases}$ B,C → D $\begin{cases} ① & X \\ ② & X \\ ③ & X \end{cases}$ ∴ Sale not in 3NF

Q3: Decompose sale into 3NF. R_1 (AB) R_2 (BCD)
                dependency preserving.
                but lossy!
                " B is not a super key of any table.

E92 R = (A, B, C, D, E, F, G) F = { AB → CD, C → EF, G → A, G → F, CE → F}

Q1: Candidate key?

A1: G. B.

Q2: Canonical cover?

F_c = { G → AF, C → EF. AB → CD }

Q3: 3NF decomposition
   R_1 = (G A F) R_2 = (C E F) R_3 = ($\underline{AB}$ CD) R_4 = ($\underline{GB}$)

E93 $R(ABCD)$. ~~FD (BC, DA)~~ , $F_D = \{B \to C, D \to A\}$

3NF: $R_1(BC)$ $R_2(DA)$. $R_3(BD)$ CK: BD.

E94 $R(ABCD)$ $F_D = \{ABC \to D, D \to A\}$

CK: ABC, BCD.

3NF: ABCD already in 3NF

Q1: Does ABCD contain redundancy?

Yes. ∵ $D \to A$ is not a candidate key.

Q2: can u decompose R in a way that preserves FDS and contains no redundancy?

No. ∵ $ABC \to D$ involves all attr, decompose R will lose the dependency.

E95 $R(ABCDE)$. $FD \{A \to BC, C \to D\}$

$R_1(ABC) + R_2(ADE)$

Q1: lossless join?   Yes. ∵ common attr A is key for R_1.

Q2: Is dep preserving? Ⓞ. No. $C \to D$ is lost.

Q3: Is BCNF?
CK: (A,E) R_1 Ⓞ X ∵ A is super key for ABC.
                        ∵ C not super key of ADE.
                    R_2 X

Q4: give a BCNF. ~~dependency preserving~~ decomposition,
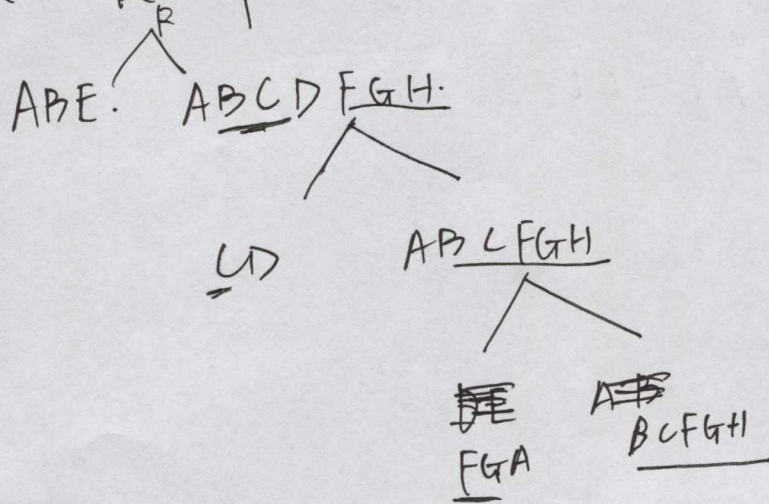 $R_1(ABC)$ ~~R₂(ADE)~~
        $R_2(CD)$
        $R_3(AE)$

Eg6   R(A B C D E F G H)   FD = (AB→E, C→D, D→E, FG→A)

Q1: Ckey?

A1:   BCFGH

Q2:   Decompose into BCNF:

ABE.   ABCD FGH.

     C→D   ABCFGH   ⟹   ABE. CD. FGA BCFGH

           DE   ABE
           FGA   BCFGH

Q3: Is dep preserving?   no.   lose D→E.

Eg7   R(ABCDE)   FD = (ABC→D, AB→D, A →D)

Q1: To 3NF ; To BCNF ;   ⇕ A→D

Ck: ABCE.

A: 3NF : (AD), (ABCE)

BCNF : AD. ABCE

Q2: Is BCNF decomposition dep preserving?

    Yes. ∵   BCNF = 3NF   ∴   dep preserving

Eg8 $R = (ABCDE)$, $FD = (A \rightarrow B, B \rightarrow E, E \rightarrow A)$

Q1: To 3NF. & BCNF

~~ABC~~ C-key: ACD. BCD. ECD.

3NF: R(ABCDE)

BCNF: AB ~~ACDE~~ AE CDE.

Q2: Is dep preserving?

Yes Ⓞ