Chuong Vu
~~Database~~ I
HW 6

2/2

8.1

A decomposition $\{R_1, R_2\}$ is a lossless-join decomposition if
$R_1 \cap R_2 \rightarrow R_1$ or $R_1 \cap R_2 \rightarrow R_2$

Let $R_1 = (A, B, C)$,
$R_2 = (A, D, E)$
and $R_1 \cap R_2 = A$.

Since A is a candinate key, therefore $R_1 \cap R_2 \rightarrow R_1$

8.6 Compute closure of the following set F for relation schema $r(A, B, C, D, E)$

$A \rightarrow BC$
$CD \rightarrow E$
$B \rightarrow D$
$E \rightarrow A$

Start with A

$\{A\}^+ = \{A, B, C, D, E\}$ ← A a candidate key
$\{B\}^+ = \{B, D\}$
$\{C\}^+ = \{C\}$
$\{D\}^+ = \{D\}$
$\{E\}^+ = \{A, B, C, D, E\}$ ← E is a candidate key.
$\{BC\}^+ = \{B, C, D\} = \{B, C, D, E\} = \{A, B, C, D, E\}$ ← candidate key
$\{BD\}^+ = \{B, D\}$
$\{CD\}^+ = \{C, D, E\} = \{A, B, C, D, E\}$ ← candidate key.

We don't have to compute and FD of the form A*, BC*, CD*, E* because they will return α and α is any subset of $\{A, B, C, D, E\}$

⇒ The candidate key is $\boxed{A, E, BC, CD.}$

8.20

Find canonical convor of R

$A \to B$

$A \to C$

$CD \to E$

$B \to D$

$E \to A$

+ Assume $A \to B$ doesn't exist, $(A)^+ = \{A\ C\}$, B is not in the attributes of A, so $A \to B$ is not reduectant.

+ Assume $A \to C$ doesn't exist, $(A)^+ = \{A\ B\ D\}$, C is not in the attributes of A, so $A \to C$ is not rediatant.

+ Assume $CD \to E$ does'nt exist, $(CD)^+ = \{C\ D\}$, E is not in the attributes of (CD), so $CD \to E$ is not reductant.

+ Assume $B \to D$ doesn't exist, $(B)^+ = \{B\}$, D is not in the attribute of B, so $B \to D$ is not reductand.

+ Assume $E \to A$ doesnt exist, $(E)^+ = \{E\}$, A is not in the attributes of E, so $E \to A$ is not reductant.

$\Rightarrow$ Canonical cover R' is $\{A \to B,$
$A \to C$
$CD \to E$
$B \to D$
$E \to A\}$

$\Rightarrow R' = \{(A, B, C), (C, D, E), (B, D), (E, A)\}$

$\Rightarrow$ R' is 3NF (third normal form)

-4/ usin

8

Using Chase Test

	A	B	C	D	E
$r_1(A, B, C)$	a	b	c	d_1	e_1
$r_2(C, D, E)$	a_2	b_2	c	d	e

FD: A → BC

CD → E

B → D

E → A

Based on the functional dependencies, we can't remove any subscript. So the decomposition above is not a lossless.

8.29

a) $(B)^+ = \{D, A, B, C, E\}$

b) Prove using Armstrong's axioms that AF is a supper key.

A → BCD (given)

ABCDE → ABCDE (Augmentation)

A → ABCDE (Transitivity)

AF → ABCDEF (Augmontation)

c) Find the canonical conver of F

A → B

A → C

A → D

BC → D

BC → E

B → D

D → A

* A → B ⇒ $(A)^+ = \{A, C, D\}$ ✓
* A → C ⇒ $(A)^+ = \{A, B, D\}$ ✓
* A → D ⇒ $(A)^+ = \{A, B, C, D, E\}$ → is reductant
* BC → D → $(BC)^+ = \{B, C, E, D, A\}$ → is Reductand
* BC → E → $(BC)^+ = \{B, C, D, A\}$ ✓

$B \to D \Rightarrow (B)^+ = \{B\}$ ✓

$D \to A \to (D)^+ = \{D\}$ ✓

$\Rightarrow$ The canonical cover is: $\{A \to B$
$A \to C$
$BC \to E$
$B \to D$
$D \to A\}$

We minize the number of relation

$\Rightarrow$ $A \to BC$
$BC \to E$] minim
$B \to D$
$D \to A$

From the FD above, we see that $(B)^+ = \{D, A, B, C, E\}$. So from B, we can also determine E.

$\rightarrow$ $BC \to E$ and $B \to D$ we can make $B \to DE$

$\Rightarrow$ The final canonical conver is: $\{A \to BC$
$B \to DE$
$D \to A\}$

d) Find the 3NF based on c).
From c, we can break the canonical conver into it own relation.

$r_1(A, B, C)$
$r_2(B, D, E)$
$r_3(D, A)$

Since the relations above doesn't have F attribute from the original relation schema. So, we need to add another relation with a super key.

$r_4(A, F)$

e) Find

Find BCNF.

We know that AF is superkey of relation r. Also, based on the FD, we can have the decomposing.

$r_1 (A, B, C, D)$
$r_2 (A, E, F)$

However, from the original FD, we known that from A, we can get to F (A → E) without the needed of F. So this will violate the BCNF. We decomposing the r_2 into (A, E) and (A, F)

→ Finally, we have the BCNF as follow:

$r_1 (A, B, C, D)$
$r_2 (A, E)$
$r_3 (A, F)$

f) From the canonical conver, we can't get the BCNF as from e.
From d, we can get BCNF as $\{ r_1 (A, B, C), r_2 (B, D, E), r_3 (D, A), r_4 (A, F) \}$. So this different from e.

However, if we can infer the canonical conver back to the original FD, then based on e, we can decomposition it to BCNF same as above.