Database Systems - Homework 3 - Functional Dependencies & Normal Forms

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1 Scheme Analysis

1.1

X is not in $BCNF$.
Proof.
From transitivity and reflexivity, $CG \to H$.
Note CG is not a superkey in R_3 since D is not implied by any FD since it only appears as the left operand.
Thus $CG \to D$ is not satisfied and $R_3 \notin BCNF \Rightarrow X \notin BCNF$.

1.2

No.
Proof.

- e only appears as the right operand.
- e is not prime.
- Any properkey does not contain e.
- c is not a superkey in R_2.
- $c \to e$ violates the properties of $3NF$.

1.3

By running the algorithm seen in class we get to:

A	B	C	D	E	H	G
	b	c	d			
		c		e	h	
		c	d		h	g

$\Longrightarrow_{C \to E}$

A	B	C	D	E	H	G
	b	c	d	**e**		
		c		e	h	
		c	d	**e**	h	g

And thus no more steps can be deduces and via the correctness of the algorithm - the decomposition does not preserve information.

1.4

Let

$$R := \{(a_1, b, c, d, e, g_1, a_1), (a_2, b, c, d, e, g_2, a_2)\}$$

Note that $R \models F$, additionally $(a_2, b, c, d, e, g_1, a_2) \in R_1 \bowtie R_2 \bowtie R_3$, thus the decomposition does not preserve information.

1.5

First we apply the confusing algorithm seen in the tutorial:

- $Z_F := \{A, H\}$
- On inspecting R_1:
  $\{A, H\} \cup (\{A, H\} \cap (\{A, H\} \cap \{B, C, D\})^+ \cap \{B, C, D\}) = \{A, H\}$
- On inspecting R_2:
  $B \notin R_2 \Rightarrow B \notin Z_F$
- On inspecting R_3:
  $B \notin R_3 \Rightarrow B \notin Z_F$

Thus $B \notin Z_F \Rightarrow$ Dependencies are not preserved.

2 Scheme Analysis

3 Scheme Analysis

4 Vatiations on Armstrong's Axioms

4.1

Yes. Since this system has less of freedom than the armstrong system, any proof generated by the reduced system is also a proof in the armstrong system.
In particular - our system is satisfied by the correctness of the armstrong system.

5 MongoDB