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CSE 414 - DATABASE
ASSIGNMENT 02

1. • $A_1 A_3 \rightarrow A_7$
→ For A_1, $A_3^+ = A_3 \not\supseteq A_7 \rightarrow A_1$ is necassary
→ For A_3, $A_1^+ = A_1 \not\supseteq A_7 \rightarrow A_3$ is necassary

• $A_4 \rightarrow A_5 A_7$
→ $A_4 \rightarrow A_5$ and $A_4 \rightarrow A_7$ are necassary.
There is one attribute (A_4).

• $A_2 A_3 \rightarrow A_4$
→ For A_2, $A_3^+ = A_3 \not\supseteq A_4 \rightarrow A_2$ is necassary
→ For A_3, $A_2^+ = A_2 \not\supseteq A_4 \rightarrow A_3$ is necassary

• $A_3 A_7 \rightarrow A_2 A_4$
→ For A_3 ($A_3 A_7 \rightarrow A_2$), $A_7^+ = A_7 \not\supseteq A_2 \rightarrow A_3$ is necassary
→ For A_7 ($A_3 A_7 \rightarrow A_2$), $A_3^+ = A_3 \supseteq A_2 \rightarrow A_7$ is necassary
→ For both A_3 and A_7 ($A_3 A_7 \rightarrow A_4$), $A_3^+ = A_3 \not\supseteq A_4$, $A_7^+ = A_7 \not\supseteq A_4$
So ~~both~~ is A_3 and A_7 are necassary.

• $A_3 A_5 \rightarrow A_1 A_7$
→ For A_3 ($A_3 A_5 \rightarrow A_1$), $A_5^+ = A_5 \not\supseteq A_1 \rightarrow A_3$ is necassary
→ For A_5 ($A_3 A_5 \rightarrow A_1$), $A_3^+ = A_3 \not\supseteq A_1 \rightarrow A_5$ is necassory

• $A_1 A_3 A_4 \rightarrow A_2$
→ For A_4 ($A_1 A_3 \rightarrow A_2$), $A_1 A_3^+ = A_1 A_3$
, ($A_1 A_3 \rightarrow A_7$) then $A_1 A_3 A_7$
($A_3 A_7 \rightarrow A_2$) then $A_1 A_3 A_7 A_2 \supseteq A_2$
A_2 is in two parts so A_4 can be removed.

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• $A_1A_3 \to A_7$

$\to A_1A_3^+ = A_1A_3 \xrightarrow{(A_1A_3 \to A_2)} A_1A_3A_2 \xrightarrow{(A_2A_3 \to A_4)} A_1A_3A_2A_4 \xrightarrow{(A_4 \to A_5)} A_1A_3A_2A_4A_5 \xrightarrow{(A_3A_5 \to A_7)} A_1A_3A_2A_4A_5A_7$

For A_7, $A_1A_3 \to A_7$ reaches, then A_7 is redundant.

• $A_3A_7 \to A_4$

$\to A_3A_7^+ = A_3A_7 \not\supseteq A_4$

FD ✓

• $A_1A_3 \to A_2$

$\to A_1A_3^+ = A_1A_3 \not\supseteq A_2$

FD ✓

• $A_3A_5 \to A_1$

$\to A_3A_5^+ = A_3A_5 \xrightarrow{(A_3A_5 \to A_7)} A_3A_5A_7 \xrightarrow{(A_3A_7 \to A_4)} A_3A_5A_7A_4$

$\not\supseteq A_1$ FD ✓

• $A_2A_3 \to A_4$

$\to A_2A_3^+ = A_2A_3 \not\supseteq A_4$

FD ✓

• $A_3A_7 \to A_2$

$\to A_3A_7^+ = A_3A_7 \xrightarrow{(A_3A_7 \to A_4)} A_3A_7A_4 \xrightarrow{(A_4 \to A_5)} A_3A_7A_4A_5 \xrightarrow{(A_2A_5 \to A_1)} A_3A_7A_4A_5A_1 \xrightarrow{(A_1A_3 \to A_2)} A_3A_7A_4A_5A_1A_2$

For A_2, $A_2A_3 \to A_2$ is redundant

• $A_3A_5 \to A_7$

$\to A_3A_5^+ = A_3A_5 \xrightarrow{(A_3A_5 \to A_1)} A_3A_5A_1 \xrightarrow{(A_1A_3 \to A_2)} A_3A_5A_1A_2 \xrightarrow{(A_2A_3 \to A_4)} A_3A_5A_1A_2A_4 \xrightarrow{(A_4 \to A_7)} A_3A_5A_1A_2A_4A_7$

$\supseteq A_7$ Then $A_3A_5 \to A_7$ is redundant

$F_c = \{ A_1A_3 \to A_2,\ A_2A_3 \to A_4,\ A_3A_5 \to A_1,\ A_4 \to A_5A_7,\ A_3A_7 \to A_4 \}$

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a) • $A_1 A_2^+ = A_1 A_2$ $\downarrow (A_1A_2 \to A_3)$

$A_1 A_2 A_3$ $\downarrow (A_2 \to A_4)$

$A_1 A_2 A_3 A_4$ $\downarrow (A_1 A_4 \to A_5)$

$A_1 A_2 A_3 A_4 A_5$

• $A_1 A_6^+ = A_1 A_6$ $\downarrow (A_1 A_6 \to A_2)$ → candidate key (all attributes derived)

$A_1 A_6 A_2$ $\downarrow (A_1 A_2 \to A_3)$

$A_1 A_6 A_2 A_3$ $\downarrow (A_2 \to A_4)$

$A_1 A_6 A_2 A_3 A_4$ $\downarrow (A_1 A_4 \to A_5)$

$A_1 A_6 A_2 A_3 A_4 A_5$

b) • Closure is impotant in determining the condidate key. And find all attributes that functionaly depend on the other attributes. Testing for superkey and computing closure of F (all possible attributes are derivered from a given set.)

$R(A_1, A_2, A_3, A_4)$ $\quad A_1^+ = \{A_1, A_2, A_3, A_4\}$

$A_1 \to A_2$ $\quad$ Every attributes depend on A_1.

$A_2 \to A_3$

$A_3 \to A_4$

* Closure is cheap test and usefull
* Then it is useful.

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3 a) In BCNF,

*A table is in BCNF if every functional dependency $X \to Y$, X is the super key of the table.

* For BCNF, the table should be in 3NF and for every functional dependicies, left hand side is super key.

superkey → {attribute set}

When all function dependencies are examined one by one, it is seen that A_1 and A_2 are superkey. Because they are located on the left hand side and others are accessible.

b) • $R_1(A_1, A_2)$: $\left.\begin{array}{l} A_1 A_2 \to A_1 \\ A_1 A_2 \to A_2 \end{array}\right\}$ A_1 is superkey so R_1 is in BCNF

• $R_2(A_1, A_3)$: $\left.\begin{array}{l} A_1 A_3 \to A_1 \\ A_1 A_3 \to A_3 \end{array}\right\}$ A_1 is superkey so R_2 is in BCNF.

• $R_3(A_1, A_4)$: $\left.\begin{array}{l} A_1 A_4 \to A_1 \\ A_1 A_4 \to A_4 \end{array}\right\}$ No function dependency. But A_1 is superkey so R_3 is in BCNF. (The definition of function dependency.)

c) If the all relations $(R_1, R_2 B_2)$ are examined:

$R_1(A_1 A_2)$: $A_1 \to A_2$ preserved
$A_2 \to A_3$ not preserved

$R_2(A_1 A_3)$: $A_1 \to A_2$ not preserved
$A_2 \to A_3$ not preserved

$R_3(A_1, A_4)$: $A_1 \to A_2$ not preserved
$A_2 \to A_3$ not preserved

* $A_2 A_3$ does not in $R_1 \cup R_2 \cup R_3$
So, not preserved. Decomposition dependency not preserved.