CSC343 Worksheet 13 Solution

July 5, 2020

1. a)

A	B	C	D	E
a	b	c	d_1	e_1
a_1	b	c	d	e_2
a	b_1	c	d_2	e

Step 1 ($B \rightarrow E$):

A	B	C	D	E
a	b	c	d_1	e_1
a_1	b	c	d	e_1
a	b_1	c	d_2	e

Step 2 ($CE \rightarrow A$):

A	B	C	D	E
a	b	c	d_1	e_1
a	b	c	d	e_1
a	b_1	c	d_2	e

So in this case, an example of an instance of R that is not lossless is:

Title	Studio Name	President	Year	President Address
Toy Story	Pixar	Steve Jobs	2000	123 ABC Street
Star Wars	Fox	Lachlan Murdoch	1977	Hollywood
Return of the Jedi	Fox	Lachlan Murdoch	1983	Hollywood

- $S_1 = \{A, B, C\}$

Title	Studio Name	President
Toy Story	Pixar	Steve Jobs
Star Wars	Fox	Lachlan Murdoch
Return of the Jedi	Fox	Lachlan Murdoch

- $S_2 = \{C, D, E\}$

President	Year	President Address
Steve Jobs	2000	123 ABC Street
Lachlan Murdoch	1977	Hollywood
Lachlan Murdoch	1983	Hollywood

- $S_3 = \{C, E, A\}$

Title	President	President Address
Toy Story	Steve Jobs	123 ABC Street
Star Wars	Lachlan Murdoch	Hollywood
Return of the Jedi	Lachlan Murdoch	Hollywood

- $S_1 \bowtie S_2$

Title	Studio Name	President	Year	President Address
Toy Story	Pixar	Steve Jobs	2000	123 ABC Street
Star Wars	Fox	Lachlan Murdoch	1977	Hollywood
Star Wars	Fox	Lachlan Murdoch	1983	Hollywood
Return of the Jedi	Fox	Lachlan Murdoch	1977	Hollywood
Return of the Jedi	Fox	Lachlan Murdoch	1983	Hollywood

- $S_1 \bowtie S_2 \bowtie S_3$

Title	Studio Name	President	Year	President Address
Toy Story	Pixar	Steve Jobs	2000	123 ABC Street
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Star Wars	Fox	Lachlan Murdoch	1983	Hollywood
Return of the Jedi	Fox	Lachlan Murdoch	1977	Hollywood
Return of the Jedi	Fox	Lachlan Murdoch	1983	Hollywood

Notes:

- Decomposition: The good bad and ugly
  1) **Elimination of Anomalies** by decomposition as in Section 3
  2) **Recoverability of Information** Can we recover the original relation from the tuples in its decomposition?
  3) **Preservation of Dependences (lossless join):** Can we be sure that after reconstructing the original relation from the decompositions, the original FD's satisfy?

  BCNF: $\rightarrow$ satisfies 1) and 2) Not good. NONO
- The Chase Test for Lossless Join
  - Tests whether the decomposition is lossless

  Input:
  - A relation R

- A decomposition of R
- A set of functional dependencies

Output:

- Whether the decomposition is loseless or not
- $\Pi_{S_1}(R) \bowtie \Pi_{S_2}(R) \bowtie \cdots \Pi_{S_i}(R) = R$

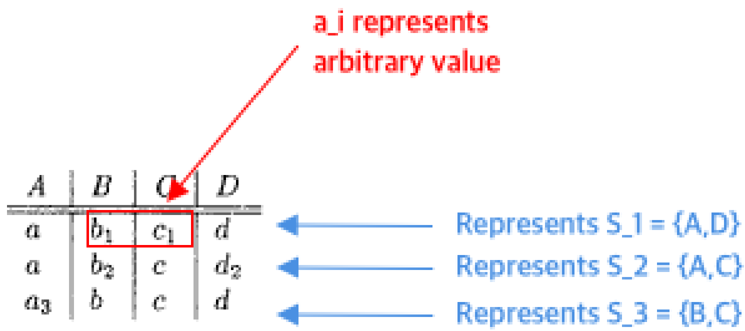
Three things to remember:

1. The natural join is associate and commutative
2. Any tuple t in R is surely in $\pi_{S_1}(R) \bowtie \pi_{S_2}(R) \bowtie \cdots \bowtie \pi_{S_k}(R)$.
3. We have to check to see any tuple in the $\pi_{S_1}(R) \bowtie \pi_{S_2}(R) \bowtie \cdots \bowtie \pi_{S_k}(R)$.

Example:

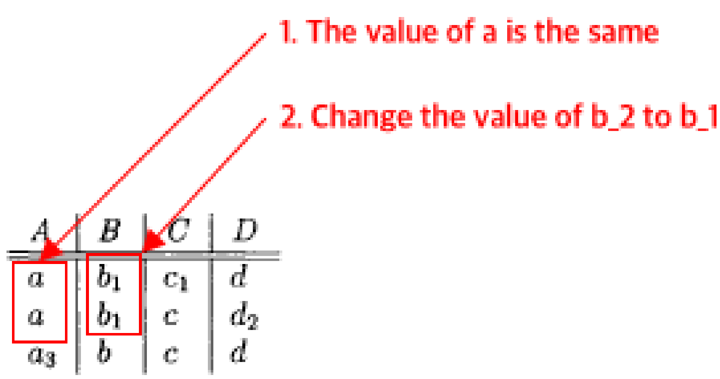
$S_1 = \{A, D\}$, $S_2 = \{B, C\}$, $S_3 = \{A, C\}$

$A \to B$, $B \to C$, $CD \to A$



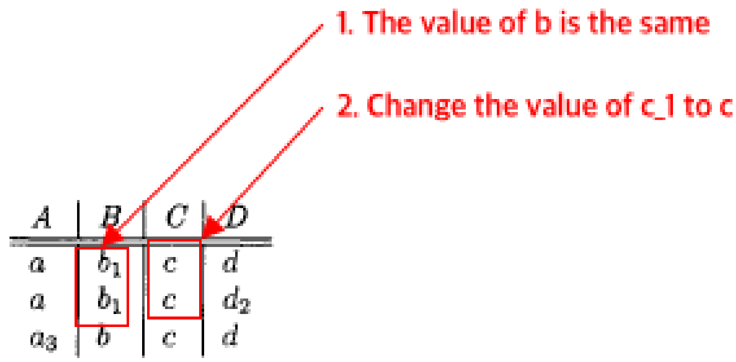
Step 1: $A \to B$

Set the value b with the same value of a to be the same. (e.g. $b_2 \to b_1$)



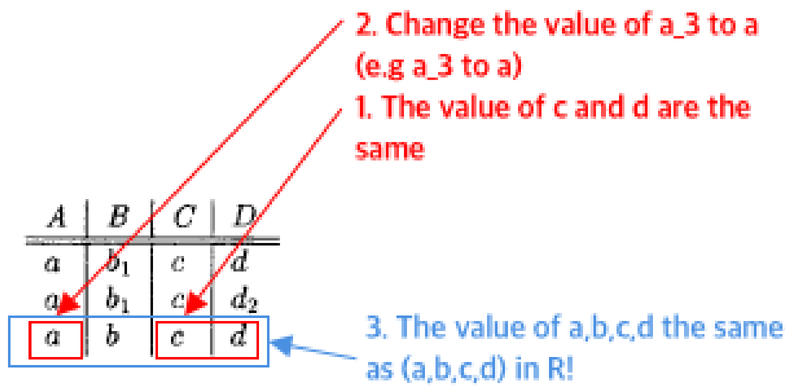
Step 2: $B \to C$

Set the value c with the same value of b to be the same. (e.g. $b_2 \to b_1$)



Step 3: $CD \to A$

Set the value a with the same value of c and d to be the same. (e.g. $a_3 \to a$)



So, we can conclude the join is lossless.

b)

A	B	C	D	E
a	b	c	d_1	e_1
a_1	b	c	d	e_2
a	b_1	c	d_2	e

Step 1 ($AC \to E$)**:**

A	B	C	D	E
a	b	c	d_1	e
a_1	b	c	d	e_2
a	b_1	c	d_2	e

Step 2 ($BC \to D$)**:**

A	B	C	D	E
a	b	c	d	e
a_1	b	c	d	e_2
a	b_1	c	d_2	e

a, b, c, d, e exists. So by the Chast test, the decomposition of $R(A, B, C, D, E) : AC \to E, BC \to D$ into $\{A, B, C\}$, $\{B, C, D\}$, $\{A, C, E\}$ is lossless.

c)

A	B	C	D	E
a	b	c	d_1	e_1
a_1	b	c	d	e_2
a	b_1	c	d_2	e

Step 1 ($A \to D$):

A	B	C	D	E
a	b	c	d_1	e_1
a_1	b	c	d	e_2
a	b_1	c	d_1	e

Step 2 ($D \to E$):

A	B	C	D	E
a	b	c	d_1	e
a_1	b	c	d	e_2
a	b_1	c	d_1	e

Step 2 ($B \to D$):

A	B	C	D	E
a	b	c	d	e
a_1	b	c	d	e_2
a	b_1	c	d	e

a, b, c, d, e exists. So by the Chast test, the decomposition of $R(A, B, C, D, E) : A \to D, D \to E, B \to D$ into $\{A, B, C\}$, $\{B, C, D\}$, $\{A, C, E\}$ is lossless.