Lossless Join Example discussed in class

Let R = ABCDE, R1 = AD, R2 = AB, R3 = BE, R4 = CDE, and R5 = AE. Let the functional dependencies be: A -> C, B -> C, C -> D, DE -> C, CE -> A
Apply algorithm 7.2 from class handout to test if the decomposition of R into {R1,..,R5} is a lossless join decomposition.

The initial table looks as follows:

	A	B	C	D	E
R1(AD)	**a1**	b12	b13	**a4**	b15
R2(AB)	**a1**	**a2**	b23	b24	b25
R3(BE)	b31	**a2**	b33	b34	**a5**
R4(CDE)	b41	b42	**a3**	**a4**	**a5**
R5(AE)	**a1**	b52	b53	b54	**a5**

Apply FD A -> C to the initial table to modify the violating dependencies. Rows 1, 2, 5 will need to change the values for the RHS attribute C – equate b13, b23, b53 to b13 (you might very well have picked b23 or b53 to equate all three). We won't change the rows 3 & 4 yet because their symbols b31, b41 are different from a1.

A	B	C	D	E
a1	b12	~~b13~~ **b13**	a4	b15
a1	a2	~~b23~~ **b13**	b24	b25
b31	a2	b33	b34	a5
b41	b42	a3	a4	a5
a1	b52	~~b53~~ **b13**	b54	a5

Apply B -> C next to equate b33 with b13

A	B	C	D	E
a1	b12	~~b13~~ b13	a4	b15
a1	**a2**	~~b23~~ **b13**	b24	b25
b31	**a2**	~~b33~~ **b13**	b34	a5
b41	b42	a3	a4	a5
a1	b52	~~b53~~ b13	b54	a5

Next, use C -> D to equate a4, b24, b34, and b54

A	B	C	D	E
a1	b12	~~b13~~ **b13**	**a4**	b15
a1	a2	~~b23~~ **b13**	~~b24~~ **a4**	b25
b31	a2	~~b33~~ **b13**	~~b34~~ **a4**	a5
b41	b42	a3	a4	a5
a1	b52	~~b53~~ **b13**	~~b54~~ **a4**	a5

DE -> C helps us to equate b13 (all occurrences) with a3. The following table shows the corresponding changes.

A	B	C	D	E
a1	b12	~~b13~~ ~~b13~~ **a3**	a4	b15
a1	a2	~~b23~~ ~~b13~~ **a3**	~~b24~~ a4	b25
b31	a2	~~b33~~ ~~b13~~ **a3**	~~b34~~ **a4**	**a5**
b41	b42	**a3**	**a4**	**a5**
a1	b52	~~b53~~ ~~b13~~ **a3**	~~b54~~ **a4**	**a5**

Apply CE -> A to the table above to equate b31, b41, and a1.

A	B	C	D	E
a1	b12	~~b13~~ ~~b13~~ a3	a4	b15
a1	a2	~~b23~~ ~~b13~~ a3	~~b24~~ a4	b25
~~b31~~ **a1**	**a2**	~~b33~~ ~~b13~~ **a3**	~~b34~~ **a4**	**a5**
~~b41~~ **a1**	b42	**a3**	a4	**a5**
a1	b52	~~b53~~ ~~b13~~ **a3**	~~b54~~ a4	**a5**

The middle row in the table above is all a's, and the decomposition has a lossless join.

What happens if we apply FDs in a different order?

Try any FD with the same symbols (a or b) on the LHS attribute in at least two rows. We have two choices: A -> B or B -> C. We tried A -> B in the previous test. Try B -> C here.

A	B	C	D	E
a1	b12	b13	**a4**	b15
a1	**a2**	~~b23~~ b23	b24	b25
b31	**a2**	~~b33~~ b23	b34	**a5**
b41	b42	**a3**	**a4**	**a5**
a1	b52	b53	b54	**a5**

Apply A -> C after that to get the following table. Notice I chose b23 to equate b13, b23, and b53.

A	B	C	D	E
a1	b12	~~b13~~ b23	**a4**	b15
a1	**a2**	~~b23~~ b23	b24	b25
b31	**a2**	~~b33~~ b23	b34	**a5**
b41	b42	**a3**	**a4**	**a5**
a1	b52	~~b53~~ b23	b54	**a5**

The table shown above is the similar to the one we got before after applying A -> C and B-> C to the initial table. To the current table we apply C -> D as before because we have the same symbol b23 in rows 1, 2, 3, and 5.