Answer Key HW3 CS589 – Winter 2011 ①

3A. Assume schemas are $r(R)$, $s(S)$, $u(S)$.

$$r \bowtie (s \cup u) \overset{\text{expand}}{=} r \bowtie \{t1[S] \mid t1[S] \in s \text{ or } t1[S] \in u\}$$

$$\overset{\text{expand}}{=} \{t2[RS] \mid t2[R] \in r \text{ and } t2[S] \in \{t1[S] \mid t1[S] \in s \text{ or } t1[S] \in u\}\}$$

simplify

$$= \{t2[RS] \mid t2[R] \in r \text{ and } (t2[S] \in s \text{ or } t2[S] \in u)\}$$

distribute

$$= \{t2[RS] \mid (t2[R] \in r \text{ and } t2[S] \in s) \text{ or } (t2[R] \in r \text{ and } t2[S] \in u)\}^{*}$$

$$(r \bowtie s) \cup (r \bowtie u) \overset{\text{expand}}{=} \{t3[RS] \mid t3[R] \in r \text{ and } t3[S] \in s\} \cup \{t4[RS] \mid t4[R] \in r \text{ and } t3[S] \in u\}$$

$$\overset{\text{expand}}{=} \{t5[RS] \mid t5[RS] \in \{t3[RS] \mid t3[R] \in r \text{ and } t3[S] \in s\} \text{ or } t5[RS] \in \{t4[RS] \mid t4[R] \in r \text{ and } t4[S] \in u\}\}$$

$$\overset{\text{simplify}}{=} \{t5[RS] \mid (t5[R] \in r \text{ and } t5[S] \in s) \text{ or } (t5[R] \in r \text{ and } t5[S] \in u)\}$$

which can be made equal to (*) by renaming of t5 to t2.

3Ba. Consider $r(A\ B)$ and $s(B\ C)$ with $X = A$

A	B
1	2

B	C
4	3

$\Pi_{ABC}(r \bowtie s) =$

A	B	C
$\emptyset$		

$\Pi_A(r) \bowtie s =$

A	B	C
1	4	3

b. It's possible to show inequivalence here by choosing X to get different schemas on left and right, say by leaving CA out of X. But even if the schemas match there can be problems

3Bc. cont.

Consider r

A	B	C
5	b	c1
5	b	c2

let $X = B\,CA$, $Y = B$, $Z = AB$

Then $\Pi_{B\,CA}(G[B; CA = sum(A)](r)) =$

B	CA
b	10

$G[B; CA = Sum(A)](\Pi_{AB}(r)) =$

B	CA
b	5

since $\Pi_{AB}(r) =$

A	B
5	b

3Bb. Consider r

A	B
1	2

s

B	C
2	3

u

C	$\cancel{A}$
3	4

r LOJ (s LOJ u) =

A	B	C
1	2	$\perp$

(r ~~IOJ~~ s) LOJ u =

A	B	C
1	2	3

3Bd. Consider r

A	B
1	2

u

A	B
1	3

$X = A$

$\Pi_A(r - u) =$

A
1

$\Pi_A(r) - \Pi_A(u) =$

A
$\emptyset$

3C a. $X \supseteq R \cap S$

b. $X = Y \cup \{CA\}$ so schemas match

$Z \to R$ so no duplicates are eliminated

(note that $Z \supseteq YA$ is required by the expression being well formed)

3D a. Not equivalent

Let $r = s = u = \begin{array}{cc} A & B \\ \hline 1 & 2 \end{array}$

then LHS is $\begin{array}{cc} A & B \\ \hline 1 & 2 \end{array}$ RHS is $\begin{array}{cc} A & B \\ \hline 1 & 2 \\ 1 & 2 \end{array}$

b. Not equivalent. With relations from a.,

LHS is $\begin{array}{cc} A & B \\ \hline 1 & 2 \\ 1 & 2 \end{array}$ RHS is $\begin{array}{cc} A & B \\ \hline 1 & 2 \end{array}$

c. Take r as above Not equivalent

LHS is $\begin{array}{cc} A & B \\ \hline 1 & 2 \\ 1 & 2 \end{array}$ RHS is $\begin{array}{cc} A & B \\ \hline 1 & 2 \end{array}$

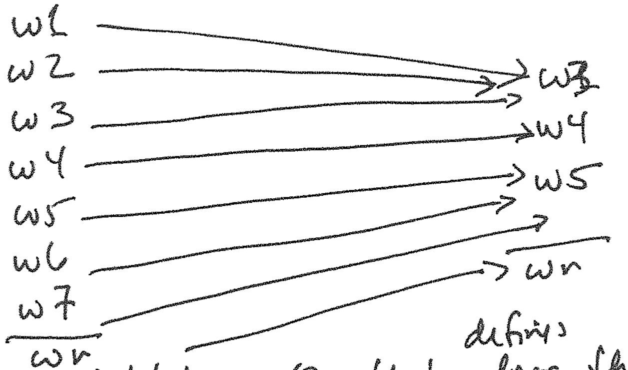
d. Holds — in both LHS and RHS, multiplicity of any tuple is the ~~multiplicity of the~~ sum of the multiplicities in the relations

e. Not equivalent Let $r = \begin{array}{cc} A & B \\ \hline 1 & 2 \\ 1 & 3 \end{array}$ and $X = A$

then LHS is $\begin{array}{c} A \\ \hline 1 \end{array}$ RHS is $\begin{array}{c} A \\ \hline 1 \\ 1 \end{array}$

f. Holds. Since join doesn't introduce duplicates, ~~there~~ if there are none in the inputs, then neither side has duplicates

3E We can map T down to 3 of its rows



The substitution Θ that ~~does~~ defines this containment mapping is

v	a1	b	c1	d1	e1	a2	c3	d2	e3	c2	e2	a3	b1	c4	a4	b2	c	d3	e
Θ(v)	5	b	c2	d1	e2	5	c2	d1	e2	c2	e2	a3	b1	c4	a4	b2	c	d3	e

v	a5	b3	d5	e4	b4
Θv	a4	b2	d3	e	b2

3F. Most people went through the minimization and attribute-removal process to get back where they started. However, you might end up with a different set of FDs

① Replace RHS with closures

A → AB

CD → ABCD

CB → ABCD

AE → ABEG

CE → ABCDEG

② Remove redundant ~~attributes~~ FDs : no change

③ Remove extraneous attributes

A → B

CD → B

CB → AD

Note the difference

AE → G

CE → D

④ ~~CE~~ Create schemas

(A B) (CD B), (CB AD), (AE → G), (CE → D)

might chose to combine these

⑤ Lossless join because CE is a key for R.