Correction to

Null values in nested relational databases

by M.A. Roth, H.F. Korth, and A. Silberschatz

M. Levene¹ and G. Loizou²

¹ Centre for Information Technology, Department of Computer Science,
University College London, Gower Street, London, WC1E 6BT, UK

² Department of Computer Science, Birkbeck College, Malet Street, London, WC1E 7HX, UK

Abstract. We show that the extended projection of a nested relation in Partitioned Normal Form (PNF) is not a precise generalization of standard projection with respect to unnesting and PNF possibility function *POSS**.

The *extended projection* of a nested relation, r , over relation scheme, R , on attributes, X^* , denoted by $\prod_{X^*}^e(r)$, is given in Definition 22 of [1] by

$$(1) \quad \prod_{X^*}^e(r) = \bigcup_{t \in \Pi_{X^*}(r)}^e(t),$$

where $\bigcup^e$ is the extended union operator of Definition 17 therein.

It was claimed in [1], Proposition 5 thereof, that the extended projection operator, $\prod_{X^*}^e$, is a precise generalization of the standard projection operator, $\prod_{X^*}$, with respect to unnesting, i.e.,

$$(2) \quad \mu^*\left(\prod_{X^*}^e(r)\right) = \prod_X(\mu^*(r)),$$

where X is the set of zero order attributes corresponding to X^* of Eq. (1).

We now proceed to show that the said Proposition 5 is, in fact, false by exhibiting a counterexample.

Lemma 1 *Extended projection is not a precise generalization of the standard projection operator with respect to unnesting, i.e., Eq. (2) is false.*

Proof. In order to prove the lemma we need to show that there exists a nested relation, r , over relation scheme, R , such that for a set of attributes, X^* , and the set of zero order attributes, X , corresponding to X^* , the following equation holds:

$$(3) \quad \mu^*\left(\prod_{X^*}^e(r)\right) \neq \prod_X(\mu^*(r)).$$

Now, let r be the nested relation, over $R=(A, B^*)$, where $B^*=(B, C^*, D^*)$, $C^*=(C)$ and $D^*=(D)$, as shown in Fig. 1. It can easily be verified that the nested relation r is in PNF, as given in Definition 1 [1]. That is, $A \rightarrow B^*$ holds in r , and also that $B \rightarrow C^*$ and $B \rightarrow D^*$ hold in the projections of the first and second tuples of r , over $\{B, C^*, D^*\}$.

A	B*		
	B	C*	D*
		C	D
a_1	b_1	c_1	d_1
a_2	b_1	c_2	d_2

Fig. 1. The nested relation, r , over R

To conclude the proof of the lemma, let $r_1 = \mu^* \left(\prod_{B^*}^e(r) \right)$ be the 1NF relation, over $\{B, C, D\}$, shown in Fig. 2, and let $r_2 = \prod_{\{B, C, D\}} (\mu^*(r))$ be the 1NF relation over $\{B, C, D\}$, shown in Fig. 3. It follows that the extended projection operator, $\prod^e$, is not a precise generalization of the standard projection operator, $\prod$, since $r_1 \neq r_2$. $\square$

B	C	D
b_1	c_1	d_1
b_1	c_1	d_2
b_1	c_2	d_1
b_1	c_2	d_2

Fig. 2. The 1NF relation, $\mu^* \left(\prod_{B^*}^e(r) \right)$, over $\{B, C, D\}$

We note that the impreciseness of the extended projection with respect to unnesting is due to the fact that the extended union operator, $\bigcup^e$, is not a precise extended operator with respect to unnesting as was shown in Fig. 5 of [1]. Furthermore, the extended union was used in the definition of the extended projection operator, and thus it is natural to question its preciseness.

B	C	D
b_1	c_1	d_1
b_1	c_2	d_2

Fig. 3. The 1NF relation, $\prod_{\{B, C, D\}} (\mu^*(r))$, over $\{B, C, D\}$

As a consequence of Lemma 1, Proposition 11 of [1], which claims that the null-extended projection operator, denoted by $\prod^{el}$, and given in Definition 28 therein, is a precise generalization of standard projection with respect to unnesting and PNF possibility function $POSS^*$, is also false. An example to illustrate this fact is shown in Figs. 4, 5 and 6, where r' is the nested relation in PNF, shown in Fig. 4, with null in r' representing a null value. Let $\mu^* \left(\prod_{B^*}^{el}(r') \right)$, over $\{B, C, D\}$, be the 1NF relation shown in Fig. 5 and let $\prod_{\{B, C, D\}} (\mu^*(r'))$, over $\{B, C, D\}$, be the 1NF relation shown in Fig. 6. Then, it can easily be verified that equation (4) holds, thus proving our claim that null-extended projection is not a precise generalization with respect to unnesting and PNF possibility function $POSS^*$. That is,

$$(4) \quad POSS^* \left(\mu^* \left(\prod_{B^*}^{el}(r') \right) \right) \prod_{\{B, C, D\}} (POSS^*(\mu^*(r'))).$$

A	B*		
	B	C*	D*
		C	D
a_1	b_1	null	d_1
a_2	b_1	c_1	null

Fig. 4. The nested relation, r' , over R

B	C	D
b_1	c_1	d_1

Fig. 5. The 1NF relation, $\mu^* \left(\prod_{B^*}^{el}(r') \right)$, over $\{B, C, D\}$

B	C	D
b_1	null	d_1
b_1	c_1	null

Fig. 6. The 1NF relation, $\prod_{\{B, C, D\}} (\mu^*(r'))$, over $\{B, C, D\}$

Finally, we observe that in order that the extended projection be precise it is necessary to define a *decomposition projection* operator, similar to the *decomposition union* of Definition 17 [1], which takes into account the multi-valued dependencies, or equivalently, the join dependency, which is produced by the nested structure over the set of projected attributes, X^* .

References

1. Roth, M.A., Korth, H.F., Silbersatz, A.: Null values in nested relational databases. Acta Inf. 26, 615–642 (1989)