Code 004.655

THE CLOSURE OF TABLE ALGEBRA OF INFINITE TABLES WITH RESPECT TO OPERATIONS OF MULTISET TABLE ALGEBRA

Glushko Iryna

Nizhyn Mykola Gogol State University

Abstract

This article is a continuation of the works devoted to the actual problem of the development of the theoretical basis of the table databases. The question of the relationship between table algebra of infinite tables and multiset table algebra is considered. The question arises, is whether table algebra of infinite tables a subalgebra of multiset table algebra. This paper is devoted to this issue. Applying the theorem-plural and logical-algebraic methods found that this is not the case. The table algebra of infinite tables does not form subalgebra of multiset table algebra, since it is not closed in relation to some signature operations of multiset table algebra. These operations are determined.

Анотація

Дана робота є продовженням робіт, присвячених актуальній проблемі розробки теоретичної основи табличних баз даних, в якості якої виступають табличні алгебри. Досліджується питання про те, чи є таблична алгебра нескінченних таблиць підалгеброю мультимножинної табличної алгебри. Застосовуючи теоретико-множинні та логіко-алгебраїчні методи, встановлено, що таблична алгебра нескінченних таблиць не утворює підалгебру мультимножинної табличної алгебри, бо не є замкненою відносно деяких операцій сигнатури мультимножинної табличної алгебри. У роботі встановлено, що це за операції.

Introduction

This article is a continuation of the works devoted to the actual problem of the development of the theoretical basis of the table databases. The purpose of this work is to determine is whether table algebra of infinite tables a subalgebra of multiset table algebra.

Table algebra of infinite

Table algebra of infinite tables generalizes table algebra which was suggested by Redko V., Brona J., Buy D., Poliakov S. in monograph [1]. First of all any set of tuples, in particular infinite, is understand under relation, because, as a rule, mathematical statements about standard properties of specification of relation operations remain true for infinite relations. Secondly every table correlated to a certain scheme. A table is pair, where the first component is an arbitrary set and the second component is a scheme of the table.

Let $\boldsymbol{A}$ be the set of attributes and $\boldsymbol{D}$ be the universal domain. Under the table algebra of infinite tables is understood algebra $\langle \boldsymbol{T}, \Omega_{P,\Xi} \rangle$, where $\boldsymbol{T}$ is the set of all tables, $\Omega_{P,\Xi} = \{\bigcup_R, \bigcap_R, \setminus_R, \sigma_{p,R}, \pi_{X,R}, \underset{R_1,R_2}{\otimes}, \div_{R_2}^{R_1}, Rt_{\xi,R}, \sim_R\}$ is a signature, $p \in P, \xi \in \Xi$, $X, R, R_1, R_2 \subseteq \boldsymbol{A}$, P, Ξ are the sets of parameters.

An arbitrary finite set of attributes $R \subseteq \boldsymbol{A}$ is called scheme. The tuple of scheme R is the nominal set on pair R, $\boldsymbol{D}$. The projection of this nominal set for the first component is equal to R.

A table of scheme R ($R \subseteq \boldsymbol{A}$) is pair $\langle t, R \rangle$, where t is a set (in particular infinite) of tuples of fixed scheme R. The operations of signature $\Omega_{P,\Xi}$ are defined in [2].

Multiset table algebra

Multiset table algebra is multisets analog of the table algebra. In this case, the concept of the table is specified, using concept of the multisets (or bags).

Under multiset table algebra is understood algebra $\langle \Psi, \Omega_{P,\Xi} \rangle$, where Ψ is the set of all tables, $\Omega_{P,\Xi} = \{\bigcup_{All}^{\Psi,R}, \bigcap_{All}^{\Psi,R}, \setminus_{All}^{\Psi,R}, \sigma_{p,R}, \pi_{X,R}, \underset{R_1,R_2}{\otimes}, Rt_{\xi,R}, \sim_R\}_{X,R,R_1,R_2 \subseteq \boldsymbol{A}}^{p \in P, \xi \in \Xi}$ is a signature, P, Ξ are the sets of parameters. The operations of signature $\Omega_{P,\Xi}$ are defined in [2, 3].

The table is pair $\langle \psi, R \rangle$, where the first component ψ is an arbitrary multiset, basis of which $\Theta(\psi)$ is the set of tuples of the same scheme and the second component R is a scheme of the table. A certain scheme is also ascribed to every table and table can be infinite.

About relationship between table algebra of infinite tables and multiset table algebra

1-multisets are multisets whose range of values is the empty set or single-element set {1}. These multisets are the analogues of ordinary sets. Considering this fact the question arises, is whether table algebra of infinite tables a subalgebra of multiset table algebra. This paper is devoted to this issue. Applying the theorem-plural and logical-algebraic methods found that this is not the case. The table algebra of infinite tables does not form subalgebra of multiset table algebra, since it is not closed with respect to the union, projection and active complement.

Let's check it out at union operation. Bases of 1-multisets t_1^1 and t_2^1 are designated as $\Theta(t_1^1)$, $\Theta(t_2^1)$ accordingly. So $\langle t_1^1, R \rangle \bigcup_{All}^{R} \langle t_2^1, R \rangle = \langle t_1^1 \bigcup_{All} t_2^1, R \rangle$, where $\langle t_1^1, R \rangle$, $\langle t_2^1, R \rangle \in T(R)$, $T(R)$ is a set of all table on scheme R.

Basis of multiset $t_1^1 \bigcup_{All} t_2^1$ of the resulting table is equal to union of bases of multisets of input tables:

$$\Theta(t_1^1 \bigcup_{All} t_2^1) = \Theta(t_1^1) \bigcup \Theta(t_2^1).$$

Duplicate tuples, which appear after implementation of operation, are not removed from the result. The number of duplicates is given by the following formula:

$$Occ(s, t_1^1 \bigcup_{All} t_2^1) = \begin{cases} 1, \textit{if } \ s \in \Theta(t_1^1) \setminus \Theta(t_2^1) \ \textit{or} \ s \in \Theta(t_2^1) \setminus \Theta(t_1^1), \\ 2, \textit{if } \ s \in \Theta(t_1^1) \bigcap \Theta(t_2^1); \end{cases}$$

where $s \in \Theta(t_1^1) \bigcup \Theta(t_2^1)$. As a result $t_1^1 \bigcup_{All} t_2^1$ is a multiset and it is not a 1- multiset.

Consequently, the set of all table of table algebra of infinite tables is not closed with respect to the union $\bigcup_{All}^{R}$. Similarly, we can show that the set of all table of table algebra of infinite tables is not closed with respect to the projection and active complement.

References:

1. Реляційні бази даних: табличні алгебри та SQL-подібні мови / В.Н. Редько, Ю.Й. Брона, Д.Б. Буй, С.А. Поляков. – Київ: Видавничий дім "Академперіодика", 2001. – 198 с. – ISBN 966-8002-00-8.

2. Буй Д.Б. Числення на розширення сигнатур табличних алгебр: монографія / Д.Б. Буй, І.М. Глушко. – Ніжин: НДУ ім. М. Гоголя, 2016. – 151 с. – ISBN 978-617-527-145-2.

3. Buy D.B. Extended of Table Algebrs: Multiset Table Algebra / D.B. Buy, I.M. Glushko // Modern scientific research and their practical application. – 2013. – Vol.J11309. – С. 41-49.

4. Glushko I. Формальна семантика агрегатних операцій мультимножинної табличної алгебри (A formal semantics of aggregate operations of multiset table algebra) / I. Glushko // Proceedings of the 9th International Conference of Programming. – Kyiv, Ukraine, May 20-22, 2014. – P.166-173.