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Citizenship: Russia.
Born 30 January 1936 in Kiev, Ukraine.
Married with 2 adult daughters and 4 grandsons.

Fields of research

– database theory (see [1, 3, 4, 5, 7, 6, 9, 10, 11], [12, 13, 8, 14, 15]);

– analysis of concurrent and distributed systems (see [25, 26, 27], and also [93, 94, 96, 97]);

– programming languages and analysis (see [16, 18, 17, 19, 20, 21, 22, 23, 24], and also [30, 79, 81, 82, 83, 85, 87, 88, 89, 90, 91, 92, 95]);

– finite model theory (see [29]);

– query complexity (see [28]);

– model theory (see [33, 31, 61, 62, 63, 64, 65, 67, 68, 69, 70, 71, 72, 73, 74, 76, 77, 80]);

– commutative semigroups (see [34, 35, 52, 53, 54, 56, 59, 78, 84]);

– first-order theories (see [36, 40, 41, 42, 44, 45, 46, 47, 48, 49, 50, 51, 55, 57, 58, 60, 32, 66, 75, 86, 2]);

– multi operators groups (see [37, 38, 39, 43]).

Research activities and Research results

Database theory and programming languages and analysis

I study questions of safety of queries and programs and questions of expressivety of different languages.

We consider relational databases organized over an ordered domain with some additional relations—a typical example is the ordered domain of rational numbers together with the ternary relation + of addition. In the focus of our study are the first order (FO) queries that are invariant under order-preserving "permutations"—such queries are called order-generic. It has earlier been discovered that for several domains order-generic FO queries fail to express more than pure order queries. For example, every order-generic FO query over rational numbers with + can be rewritten without +. For several other domains, however, this is not the case.

We use the technique of special models to obtain substantially stronger results of this sort.

Firstly, we give a necessary and sufficient condition for an extended query to be equivalent to a restricted query. Secondly, this technique is developed especially for locally generic queries. Thirdly, we formulate a very general conditions on the domain—the so-called *Homogeneity Property* and *Isolation Property*—for the locally generic extended FO queries to have the same expressive power as the restricted queries. The Isolation Property is an useful special case of the Homogeneity Property. So the Homogeneity and Isolation Properties ensure collapse of locally order-generic FO queries over this domain to pure order queries. Although the Isolation and Homogeneity Properties can be directly used in classifying domains, proving these conditions for a specific domain may be a bit technical. However, fourthly, we identify a broad class of domains—the so-called *quasi o-minimal domains*—that all satisfy the Isolation Property. Examples of the quasi o-minimal domains include the following:

- all the o-minimal domains
- the integer or natural numbers with $+, <$
- the ordered real numbers with the distinguished subset of the rational numbers
- ordered unions of quasi o-minimal domains

But the Isolation Property is broader than the quasi-o-minimality and the Isolation Property is not a necessary condition for the collapse of the extended locally generic queries to pure order ones. We prove that

- for the structure $(\mathbb{R}, +, <, \mathbb{Q})$, the Homogeneity Property holds and every extended query over finite states is equivalent to a restricted query
- the theory of this structure does not have the Isolation Property

The first of the results immediately implies the analogous collapse result for any structure of the form $(A, <, E)$, where $(A, <)$ is a dense linearly ordered set without endpoints, and E is an equivalence relation on A with infinitely many classes all of which are dense.

The general setting we consider really gives some other concrete examples of collapse results. For instance, the collapse result holds for any structure of the form $(\mathbb{R}, +, <, F, f_\alpha)_{\alpha \in F}$, where F is a subfield of $\mathbb{R}$, and f_α is a name for the unary operation of multiplication by the scalar α.

It is easy to see that for the structure $(\mathbb{R}, +, \times, <, \mathbb{Q})$ the collapse result fails.

So we are really standing near a boundary.

Thus, our results cover all the known, and deep new, cases. Yet the proofs are relatively compact and straightforward.

An important difference of the presented results from a series of related papers is that we generalize all the notions to the case of finitely representable database states—as opposed to finite states—and develop a general lifting technique that, essentially, allows us to extend any result of the kind we are interested in, from finite to finitely-representable states, and thus all the results are proved for the general case of *constraint databases.*

We show that every finitely representable order database state can be represented by a finite state (of another scheme) such that these two states are uniformly FO-translatable to one another. Using this result, we show that, in particular, for any divisible ordered Abelian group, the additive group of the integer numbers, the additive semigroup of the natural numbers, and any quasi o-minimal structure, every locally generic extended query over finitely representable order database states can be translated into a restricted query. Over all rational database states, however, these two query languages differ.

These are joint results of Oleg Belegradek, Alex Stolboushkin and myself (see [9, 11, 12, 13, 15]).

The collapse result holds for $(\mathbb{N}, <, +)$. The universe is called the Presburger's arithmetics. Then, how much higher than $+$ in $(\mathbb{N}, <)$ can we go? Obviously, $+, \times$ make locally generic extended queries impossible to express as pure order ones because, for example, the query "the cardinality of P is even" is locally generic and expressible in the FO extended language but not in the restricted language. But the first-order theory of the arithmetics is undecidable, and the language is bad (is not relevant) for querying.

It was proposed

Conjecture 1. *If, in an expansion of* $(\mathbb{N}, <, +)$*, locally generic extended queries express more than restricted ones, the first order theory of the expanded domain is undecidable.*

Finally, in 2006 (see [3]), the conjecture was refuted by S.M.Dudakov.

A real big step in the direction to prove the conjecture is the excellent result of Baldwin and Benedikt. They proved the collapse result for locally generic queries over ordered domains without any independence formula.

An independence formula $\phi(\bar{x}, \bar{y})$ has the following property:

for each natural n, there are $\bar{a}_1, \ \ldots, \ \bar{a}_n$ such that for any subset I of $\{\bar{a}_1, \ldots, \bar{a}_n\}$, there is $\bar{b}_I$ such that $\{\bar{a}_i \mid \phi(\bar{a}_i, \bar{b}_I)\}$ is I.

We are considering the natural number as the domain, the addition and a unary function as the domain functions, and the usual ordering as the domain relation. So we are considering the universes $(\mathbb{N}, <, +, f^{(1)})$.

The key conditions for decidability of the first-order theories of these domains was pointed out by A.L.Semenov.

It was proved by S.M.Dudakov that in the Semenov's case, locally generic extended queries express as well as pure order ones. So the collapse result is true for any f which is interpretable in a Semenov's domain.

The proof is interesting because Oleg Belegradek, Ya'acov Peterzil, and Frank Wagner proved that $(\mathbb{Z}, <, +)$ and $(\mathbb{N}, <, +)$ have no quasi-o-minimal expansions.

It is not too easy to present an example of f such that the first-order theory of $(\mathbb{N}, <, +, f)$ is decidable and f is not interpretable in a Semenov's domain.

For example, if $f(x)$ is a polynomial of degree more than 1 from x and $[\log_2 x]$, the theory is undecidable because the multiplication is definable in the theory.

I investigate expansions of Presburger's arithmetic by a weakly monotone unary function. For the expansions, it is proposed a sufficient condition for truth of the collapse theorem. The condition holds for the Semenov's functions and for other ones proposed by the author. It is a natural way to organize a quantifier elimination for such an expansion. So, if you can organize a good quantifier elimination for such an expansion, then the collapse theorem holds for the expansion.

We proved with Alex Stolboushkin that no effective syntax for safe formulas (see [17, 19]).

A relational query is called *finite,* or sometimes *safe,* iff it yields a finite answer in every database state.

The set of finite queries of relational calculus is known to be unsolvable. However, in many cases it is possible to impose syntactical restrictions on the class of queries that guarantee finiteness and do not reduce the expressive power of the calculus.

We show that unfortunately this is not always the case, as we construct a recursive domain with decidable theory where any solvable (or enumerable, for that matter) subclass of queries either contains an infinite query, or misses a finite one. We show that although any domain can always be extended to a domain with an effective syntax for finite queries, such extensions of our domain necessarily have undecidable theories. The reason decidability of domain matters is, this property is in effect equivalent to the ability of answering queries effectively.

Using the same example, we further show undecidability of the problem of *state-finiteness,* which is, given a query and a database state, to decide upon finiteness of the query in this state.

This settles two long-standing open problems in the theory of relational databases.

Stratified Datalog with integer (gap)-order (or $Datalog^{\neg,<_z}$) is considered. A $Datalog^{\neg,<_z}$-program is said to be safe iff its bottom-up processing terminates on all valid inputs. We prove (see [18]) that safe $Datalog^{\neg,<_z}$-programs do not have effective syntax in the sense that there is no recursively enumerable set S of safe $Datalog^{\neg,<_z}$-programs such that every safe $Datalog^{\neg,<_z}$-program is equivalent to a program in S.

Analysis of concurrent and distributed systems

We studied questions of complexity for provability in the linear logic proposed by Archangelsky, Dekhtyar and myself to describe the behavior of nets with bounded types of distributed resources.

One of computer science motivations for Linear Logic is that proofs in this logic reflect the use of certain resources. However, the issue of availability of these resources is not addressed. We are attempting to fill this gap.

We further extend this approach and we introduce a new type of nets with bounded types of distributed resources and proposed a linear logic to describe its behavior. Our logic captures not only consumption of resources but their presence as well. Theorems of soundness and completeness are proved and the complexity of the provability problem is established for many cases. We propose a polynomial derivation-search algorithm for many cases.

The results have published in [25, 26, 27].

Work experience

2009 –

Professor of the Computer Science department of the Tver State University

1984 – 2009

Head of the Computer Science department of the Tver State University

1976 – 1984

Head of the Computer Science department of the Kazakh State University in Alma–Ata

1969 – 1975

Professor of the Department of Algebra and Logic of the Novosibirsk State University

1960 – 1976

Junior and Senior Researcher in the Novosibirsk Institute of Mathematics

In 1961–2011, in Novosibirsk State University, Kazakh State University, and Tver State University I taught the following courses: commutative semigroups, algebra, elementary theories, theory of algorithms, linear algebra, model theory, finite model theory, mathematical logic, discrete mathematics, mathematical foundations of computer science, linear logics, informatics, formal languages and automata, logics of programs, query complexity for languages with constraint, programming with Pascal, programming with C^{++}, programming with Dynamic HTML, programming with Prolog, database theory.

My duties included :

– theoretical research work;

– the design and implementation of a shell of an expert system; the design and implementation of shells for computer–teaching systems; design and implementation of a system for recognition of text answers;

– individual work with graduate students.

I was the Supervisor of 10 PhD:

B.I.Zilber (Oxford U., Prof., England),

O.V.Belegradek (Prof., Turkey),

E.A.Palutin (Novosibirsk U., Prof., Novosibirsk, Russia),

A.P.Stolboushkin (USA),

V.Ya. Belyaev (Russia),

D.A.Archangelsky (USA),

D.O.Daderkin (Tver U., Associative Prof.),

I.Kh.Musikaev (USA),

S.S.Magazov (Moscow, Russia),

S.A.Chikhachev (Russia).

Three of my former graduate students (Belegradek, Zilber and Palutin) have a degree of "Doctor of Phys. and Math. Sci." and are full professors. I was the Scientific Consultant of "Doctor of Phys. and Math. Sci." thesis of S.M.Dudakov.

I was invited as a research visiting professor and as a guest speaker to universities in

USA in 1990, 1993, 1994, 1995, 1996, and 1997;

Poland in 1990, 1994, and 1996;

England in 2003, 2004;

Israel in 1991 and 1995;

Australia in 1998.

I gave talks on some international scientific meetings in Canada, France, Germany, Israel, Poland, Rumania, and Russia.

I was an editor of some proceedings and collections of theoretical computer science papers.

A.Nerode and M.A.Taitslin (Eds). *Logical Foundation of Computer Science – Tver '92*, volume 620 of *LNCS*. Springer-Verlag, 1992.

A.R.Meyer and M.A.Taitslin (Eds). *Logical Foundation of Computer Science – Pereslavl–Zalessky '89*, volume 363 of *LNCS*. Springer-Verlag, 1989.

M.A.Taitslin (Ed). *Studies on model theory.* Kazakh State University, Alma–Ata, 1982. Russian.

M.A.Taitslin (Ed). *Studies on theoretical computer science.* Kazakh State University, Alma–Ata, 1981. Russian.

M.A.Taitslin (Ed). *Model theory and its applications.* Kazakh State University, Alma–Ata, 1980. Russian.

M.A.Taitslin (Ed). *Teoria nereguliarnyh krivyh v razlichnyh geometricheskih prostranstvah.* Kazakh State University, Alma–Ata, 1979. Russian.

I was an organizer of some international scientific meetings. In 1989 I was the Chair of the Program Committee of the Symposium on Logical Foundations of Computer Science (Logic at Botik'89). In 1992 I was the Chair of the Organizing Committee of the Symposium on Logical Foundations of Computer Science (Logic at Tver'92). In 1995 I was a member of the Program Committee of Logic Colloquium'95. I was a member of the program committee of the ICDT '99 (9th International Conference on Database Theory).

Grants for research:

2008 — grants of The Russian Foundation for Fundamental Research

08-01-00241 Using of finite automata and their generalizations to classify algorithmic problems (the grant holder);

2004 — 2006 — grants of The Russian Foundation for Fundamental Research

04-01-00015 Collapse and complexity results for query languages of relational and deductive databases (the grant holder);

2004 — a grant from Oxford University (UK);

2000 – 2002 — grants of The Russian Foundation for Fundamental Research

0001 00254 Extended query languages for relational and deductive databases (the grant holder);

1996 – 1998 — grants of The Russian Foundation for Fundamental Research

96-01-00086 Information logics (the grant holder);

1993 – 1995 — grants of The Russian Foundation for Fundamental Research

93-01-00490 Information logics (the grant holder);

1994 – 1997 — NSF Grant CCR 9403809 (USA);

1995 — a grant from Princeton University (USA);

1993 – 1995 — a grant of ISF (Soros) NYF000 NYF300 Linear Logics, Nonmonotonic Logics: problems of correctness, completeness, canonical proofs, proof and query complexity, model theory; connection with distributed systems and concurrency. Query complexity on finite models. (the grant holder).

Education:

1968 – "Doctor of Physics and Math. Sciences", Institute of Mathematics, Siberian branch, USSR Academy of Sciences, Novosibirsk; the Doctor degree in Russia is a post doctoral degree, comparable and superior to the habilitation in France and in Germany;

1963 – "Candidate of Physics and Math. Sciences",
Institute of Mathematics, Siberian branch, USSR Academy of Sciences,

Novosibirsk, Supervisor: Prof. Anatol I.Malcev,
Reviewers: Prof. B.A.Trakhtenbrot, Prof. A.A.Lapunov,
Reviewing institution: Steklov Mathematics Institute (Moscow); a Russian equivalent to the PhD degree;

1960 – 1962 – Institute of Mathematics, Siberian branch, USSR Academy of Sciences, Novosibirsk, Supervisor: Prof. Anatol I.Malcev, graduate student;

1955 – 1957 – Pedagogical Institute, Lugansk, Ukraine, undergraduate student;

1953 – 1955 – State University, Voronezh, undergraduate student.

Some publications

[1] M.A. Taitslin. Comparison of expressive power of some query languages for databases. In *Proceedings of the Steklov Institute of Mathematics, vol.274*, pages 297–313. Steklov Institute of Mathematics, Moscow, 2011.

[2] M.A. Taitslin. Isomorphisms and strong finite projective classes of commutative semigroups. In *Tributes, Volume 13, Proofs, Categories and Computations, Essays in Honor of Grigori Mints*, pages 243—250. College Publications, London, 2010.

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The total number of all the publications is more than 100.