

show that a well-established general matrix multiply-and-add operation should be extended through the theory of algebraic semirings, to allow for unification of solvers for a large class of computational problems (within the scope of the discussed Algebraic Path Problem). We will also demonstrate that extended and generalized matrix multiply-and-add operation can be used not only for computing of the linear and multi-linear transforms but also for matrix data manipulations, such as reordering of matrix rows/columns, matrix rotation, transposition, etc. This data manipulation is an integral part of a large class of matrix algorithms, regardless of parallelism.

Visualization of polyhedral solution sets

I.A. Sharaya

The series IntLinInc of program packages is presented. These packages are intended to visualize various solution sets to interval systems of linear relations as well as the solution sets to point (i.e. noninterval) systems of relations with linear and absolute value operators. Algorithms are based on the Boundary Intervals Method proposed by the author. The package series IntLinInc is free software. Its codes are open and available from <http://interval.ict.nsc.ru/Programming> and <http://interval.ict.nsc.ru/sharaya>.

Equality-based alias calculus for iterative programs with dynamic memory

N.V. Shilov, A.K. Vorontsov

A very important research problem in program analysis is study of methods to determine whether two arbitrary address expressions can in program execution become aliased, that is to say, denote references to the same object in the dynamic memory. We study combination two different approaches to this problem: Alias Calculus (by Bertand Meyer) and Separation Logic (by John C. Reynolds). We define alias transformer *after* that computes alias distribution for programs written in language used in Separation Logic. This language comprises variable declarations, direct and indirect assignments, dereferencing, memory allocation and deallocation, sequential composition, while-loop and if-then-else conditional operator.

Theorem: Hoar triple $\{D\} \alpha \{aft(D, \alpha)\}$ is true for any program α and for any alias distribution [.

A method for solving mass figure-in-covering problems for arbitrary coverings using GPU

I.N. Skopin, D.Y. Tribis

Results of numerical experiments in solving mass problems of determining membership of a set of various figures in a set of arbitrary shapes covering a domain or intersecting with each other in a space of arbitrary dimension are discussed. The problems are solved using geometrical techniques on graphics processors.

The proposed solution can outperform the fastest classical algorithms by a factor from 6 to 700 in terms of speed. As an example, the construction of grids for computations within a geophysical model of the Earth is used. Such problems are typical for all the numerical computations involving geometric modeling where coverings or triangulations are used or rendering problems are solved.

Using distributed column indexes for query execution over very large databases

L.B. Sokolinsky, E.V. Ivanova

The special index structures called distributed column indexes are presented. These indexes are used for parallel processing of extremely large datasets. Column index of attribute B of relation R is a table that consists of two columns. First column is the inner primary key which is pointing the tuples in R, second column contains values of attribute B for corresponding tuples. Index is ordered by B and partitioned across computing nodes by domain-interval fragmentation. If two attributes belong to one domain, the elements of their column indexes having equal attribute values are placed on the same node. Distributed column indexes are compressed and stored in the main memory of cluster system. The relational operator is executed in parallel in all processor nodes as a set of parallel agents. Each agent processes the separate fragments of the column indexes by using Intel Xeon Phi coprocessor and generates partial resulting script. Each such

resulting script includes all inner primary key values which are needed to construct resulting tuples. The partial resulting scripts are merged in the master node. Then DBMS constructs resulting relation using merged resulting script. This technology allows to eliminate data exchange during parallel execution of relational operators.

Technology of knowledge portal development oriented to experts in a subject domain

Yu. A. Zagorulko

Recently, a great amount of scientific knowledge and information resources relating to various areas of knowledge has been accumulated in the Internet. However, the access to these resources is rather complicated as they are disembodied and ill-structured, or distributed over various Internet catalogues and sites. To solve this problem we have suggested the ontology-based architecture and technology of development of knowledge portals which provide systematization and integration of knowledge and information resources related to the modeled area of knowledge, as well as the content-based access to them. The methodology of ontology building, the main principle of which is to build the ontology of the knowledge portal by means of completion and evolution of the basic domain-independent ontologies was suggested. Based on this methodology, the technology of knowledge portal development oriented to experts in a subject domain was developed. It was successfully applied for creation of the scientific knowledge Internet portals on archeology and computational linguistics as well as an electronic Russian-English thesaurus on computational linguistics.