Database Systems Laboratory

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Information systems in transportation, health-care and public utility services depend on large scale data management systems. Research activity in Database Systems is focused on broadening their range of applicability. It is also focused on improving the performance of domain specific applications.

Large applications for Services use database systems as a basic part for web data resources. This year the laboratory organized an International workshop with many invited distinguished researchers during 23-25 March 2015. The proceedings have been published for the 10th workshop on "Databases in Networked Information System (DNIS)" by Springer-Verllag in the Lecture Notes in Computer Science series (LNCS) in Volume 8999. The delivered lecture and manuscripts are being utilized to develop the state-of-the-art lectures on current research problems. These created a focused view on new research problems. many current aspects of web related research activity were discussed at the workshop. In addition to DNIS 2014 workshop, the laboratory organized an International conference jointly with Depertment of Computer Science, at Delhi University. The conference invited many distinguished researchers during 16 - 18 December 2014. The proceedings have been published for the conference (3rd BDA 2014) by Springer-Verllag in the Lecture Notes in Computer Science series (LNCS). The delivered lecture created a focused view on new research problems.

Most of the advances in techniques concentrate on capturing more meaning within data. A number of researchers are actively developing improved data management strategies using Business Intelligence and data. This provides a challenging area for study. The domains of activity include :

- developing new user interfaces and query languages for skilled and semi-skilled users in health-care;

- developing infrastructures for computing facilities for cloud computing;
- supporting mobile computing applications, and
- designing new data models and asynchronous computation models for transaction and services.

In addition to complexity in features such as multiple attributed data, many new types of raw data are emerging that need to be captured by DBMSs for information extraction. Many research efforts are being made to make suitable Object-Relational architectures for spatial databases.

The Database Systems Laboratory has research activity concentrating on data modeling as well as transaction processing activity.

Data Modeling for Spatial Objects

Information Processing Systems of future will be a combination of integrated components. There will be components for intelligent problem solving, or decision making, components for specialized data processing and components for shared information management. The applications will utilize a shared base of information. Some examples are - business automation, industrial automation, computer-aided design and manufacture, and cartography.

Work-flow and Web Services

Traditional approaches to transaction management introduce elements of unpredictable delays during transaction processing. Thus, making these not suitable for adoption in new application environments. The techniques for time-critical transactions are applicable to Mobile databases and multimedia databases.

Healthcare Studies

The goal of this research is to study the Standardized Electronic Health Records (EHRs) databases. It is a temporal computational system with the ability to process large volume of information. Such system will prove useful in various areas of information technology such as online healthcare agencies. The modeling considers the complementary points of view:

1. EHRs data mining approach to address the epidemic studies,

2. An approach that involves the user in the modeling process.

3. Query Language with reference to user skills

Prototype systems to access dynamic contents through web based information systems are in progress. These emulate mobile e-commerce activity in banking and Geographic Information Systems, for test and studies. The test protypes have been evolved based on research on new easy-to-use search and also new query language interfaces.

Refereed Journal Papers

[bhalla-01:2014] A. Madaan and S. Bhalla. Usability Measures for Large Scale Adoption of the Standardized Electronic Health Record Databases. *Journal of Information Processing (JIP)*, 22(3):508–526, 2014.

With the adoption of Standardized Electronic Health Records (EHRs) databases, recent research studies consider - standardization and interoperability. At the same time the need for querying (the archival data) is becoming important. The complex and dynamic nature of these databases give rise to several usability challenges. This study aims to reduce the gap between the designed application flow and user work-flows (anticipated by them) within the system. Moreover, in the case of standardized EHRs databases, there is a need to reduce the dependency on post-release user-feedbacks and surveys. This will facilitate the task of system redesign (and re-engineering). We assume that socio-technical features of the users and their usage-patterns over the standardized EHRs databases are correlated. Therefore, we propose the application of user-centric design and automated usability support for the standardized EHRs databases. It provides an insight for improving the system on a continuous basis.

[w-chu-01:2014] Yamin Li and Wanming Chu. Total exchange routing on hierarchical dual-nets. *International Journal of Big Data Intelligence*, 1(4):230–243, 2014.

The hierarchical dual-net (HDN) is a newly proposed interconnection network for building extra large scale supercomputers. The HDN is constructed based on a symmetric product graph (called base network), such as three-dimensional torus and n -dimensional hypercubes. A k -level hierarchical dual-net, HDN(B , k , S), is obtained by applying k -time dual constructions on the base network B. S defines a supernode set that adjusts the scale of the system. The node degree of HDN(B , k , S) is d 0 + k , where d 0 is the node degree of the base network. The HDN is node and edge symmetric and can contain huge number of nodes with small node-degree and short diameter. The total exchange, or all-to-all personalised communication, is one of the most dense communication patterns and is at the heart of numerous applications and programming models in parallel computing. In this paper, we show that the total exchange routing can be done on HDN efficiently and extra large scale HDNs can be implemented easily.

[yutaka-01:2014] Yutaka Watanobe and Nikolay Mirenkov. Hybrid intelligence as-

pects of programming in *AIDA. *Future Generation Computer Systems*, 37:417–428, 7 2014.

Programming in algorithmic pictures (a-pictures) is an approach where pictures and moving pictures are used as super-characters for representing features of computational algorithms and data structures. Within this approach some data space structures are traversed by fronts of computation and/or some units of activity are traversed by flows of data. There are compound a-pictures to define algorithmic steps (called Algorithmic CyberFrames) and generic a-pictures to define the contents of compound pictures. Compound a-pictures are assembled into special series to represent some algorithmic features. The series are assembled into an Algorithmic CyberFilm. The generic/compound a-pictures and their series are developed and acquired in special galleries of an open type where supportive pictures of embedded clarity annotations are also included. In this paper, *AIDA (Star-AIDA) modeling/programming language (AIDA stands for Animation and Images to Develop Algorithms) and its Filmification modeling (F-modeling) environment are briefly considered and examples of programs in a-pictures are provided. A special attention is paid to *AIDA programs as special information resources which perception, comprehension and cognition depend on interaction with, at least, a few different but mutually supplementing features of a-pictures. A scheme of data/knowledge acquisition based on clusters of different views and how this acquisition is oriented to enhancing user's ability within works on developing application models, corresponding algorithms and programs are presented.

Refereed Proceeding Papers

[bhalla-02:2014] H. Suzuki, E. Suzuki, W. Chu, J. Terazono, and S. Bhalla. Exploring Kaguya Moon Mission Sensor Data by Locating Geographic Entities. In S. Srinivasa and S. Mehta, editors, *3rd International Conference on Big Data Analytics*, pages 169–173, Germany, December 2014. Lecture Notes in Computer Science Series, Springer Verlag.

The Kaguya Lunar probe generated 88 data products using various instruments, during its long mission. These products are based on location and time. These include, Carbon dioxide readings, altitude, images, temperature, and so on. The raw data has been published and is available for download in the raw form. A location name based search facility has been proposed and

implemented for exploration and visualization of scientific data for the data products

[w-chu-02:2014] Yilang Wu and Wanming Chu. Query Languages for Domain Specific Information from PTF Astronomical Repository. In Subhash Bhalla Editor Wanming Chu, Shinji Kikuchi, editor, *10th International Workshop on Databases in Networked Information Systems*, pages 237–243, Germany, March 2015. Lecture Notes in Computer Science Series, Springer verlag.

The increasing availability of vast amount of astronomical repositories on the cloud has enhanced the importance of query lan- guage for the domain-specific information. The widely used keyword- based search engines (such as Google or Yahoo), fail to suffice for the needs of skilled/semi-skilled users due to irrelevant returns. The domain specific astronomy query tools (such as Astro-query, CDS Portal, or XML) provide a single entry point to search and access multiple astronomical repositories, however these lack easy query composition tools in unit-step or multi-stages query. Based on the previous research studies on domain- specific query language tools, we aim to implement a query language for obtaining the domain-specific information from the astronomical repos- itories (such as PTF data).

[yutaka-02:2014] Yutaka Watanobe, Nikolay Mirenkov, and Haruo Terasaka. Information resources of *AIDA programs. In *The IEEE Symposium on Visual Languages and Human-Centric Computing*, pages 137–140, 2014.

Programming in pictures is an approach whereby pictures and moving pictures are used as super-characters to represent features of computational algorithms and data structures, as well as to explain models and application methods involved. *AIDA is a language supporting programming in pictures. In this paper, a fluid dynamics problem is considered and an example of a *AIDA program for fluid flow simulation is provided. The program is presented as a set of information resources oriented not only to the executable code generation, but also to an explanation of the problem and its application algorithm. Various features of the *AIDA program are discussed and some comparisons with a Fortran equivalent are performed.

[yutaka-03:2014] Yutaka Watanobe, Nikolay Mirenkov, and Mirai Watanabe. Applying *AIDA programs as educational materials. In *The 13 th Inter-*

national Conference on Intelligent Software Methodologies, Tools and Techniques, pages 783–798, 2014.

*AIDA is a language supporting programming in pictures. Programming in pictures is an approach whereby pictures and animation are used as super-characters for representing features of computational algorithms and data structures, as well as for explaining models and application methods involved. In this paper, some features of *AIDA programs are discussed and how these features can be applied for educational goals oriented to users with little programming experience. Special attention is paid to algorithmic dynamics explanations based on animations and to template programs supporting the implementation of this dynamics.

[yutaka-04:2014] Yutaka Watanobe and Nikolay Mirenkov. *AIDA: A Language of Big Information Resources. In *10th International Workshop-Databases in Networked Information Systems*, pages 112 – 121, 2015.

Some features of *AIDA language and its environment are provided to show a way for possible preparing well-organized information resources which are based on integrated-data architecture supporting searching, understanding and immediate re-use of the resources needed. A project of big information resources of the above mentioned type is presented and relations of users and resource unit owners within Global Knowledge Market are briefly considered. Some ideas behind knowledge and experience transfer with permanent re-evaluating resource unit values and examples of the resource types are also provided.

Books

[bhalla-03:2014] A. Madaan, S. Kikuchi, and S. Bhalla. *Databases in Networked Information Systems*, volume 8999 of *Lecture Notes in Computer Science*. Springer-Verlag, Germany, March 2015.

[yutaka-05:2014] Yutaka Watanobe. *Introduction to Programming in C/C++ through Online Judge System: Online Programming Challenge*. Mainavi, 6 2014.

[yutaka-06:2014] Yutaka Watanobe, Ozy, and Takuya Akiba. *Algorithms and Data Structures for Programming Contests*. Mainavi, 2014.

Chapters in Book

[bhalla-04:2014] Pulkit Mehndiratta, Hemjyotasna Parashar, Shelly Sachdeva, and Subhash Bhalla. *Standardized Multimedia Data in Health-Care Applications*, pages 325–344. Cloud Computing and Digital Media: Fundamentals, Techniques, and Applications. CRC Press, Florida, 2014.

Grants

[yutaka-07:2014] Yutaka Watanobe. Online Judge System based on Programming Languages of the Next Generation, 2014.

Academic Activities

[yutaka-08:2014] Yutaka Watanobe, 2014.

Program Committee and Reviewer of The 13th International Conference on Intelligent Software Methodologies, Tools, and Techniques

[yutaka-09:2014] Yutaka Watanobe, 2 2015.

Reviewer of Knowledge-Based Systems

[yutaka-10:2014] Yutaka Watanobe, 2014.

Reviewer of The 2nd FTRA International Conference on Ubiquitous Computing Application and Wireless Sensor Network

[yutaka-11:2014] Yutaka Watanobe, 2014.

Reviewer of The 4th FTRA International Conference on Advanced IT, engineering and Management

[yutaka-12:2014] Yutaka Watanobe, 2 2015.

Reviewer of Human-centric Computing and Information Sciences

[yutaka-13:2014] Yutaka Watanobe, 2 2015.

Reviewer of SMC Magazine

Ph.D and Others Theses

Summary of Achievement

[w-chu-03:2014] Saki Osawa. Search Timetable Information for Public Transport Bus Service, University of Aizu, 2014.

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