Proceedings in
Informatics and Information Technologies

IIT.SRC 2012
Student Research Conference

Mária Bieliková (Ed.)

IIT.SRC 2012:
Student Research Conference

8th Student Research Conference
in Informatics and Information Technologies
Bratislava, April 25, 2012
Proceedings

SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA
Faculty of Informatics and Information Technologies

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IIT.SRC 2012
Student Research Conference

Editor

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Cover Designer: Peter Kaminský

Published by:
Nakladateľstvo STU
Vazovova 5, Bratislava, Slovakia

Vol. 1, ISBN 978-80-227-3689-3
Vol. 2, ISBN 978-80-227-3690-9

Preface

Research has been one of the main priorities of the university education since its very beginning. It is the case also for our university – the Slovak University of Technology in Bratislava and its faculty – the Faculty of Informatics and Information Technologies. Close connection of research and education leads very naturally to a participation of students in research. This holds not only the students of doctoral study, where research is a substantial part of their study and one of their principal activities. A participation of students in research is "going down" to students of master, even bachelor study.

Universities of technology have a long tradition of students participating in a skilled labour where they have to apply their theoretical knowledge. The best of these results were usually presented at various students' competitions or exhibitions. There were also combined with student research works. Our university has a long tradition in such competition named ŠVOČ (abbreviation of the Student Scientific and Technical Activity). Eight years ago our faculty, FIIT STU, decided to transform former ŠVOČ into the Student Research Conference covering topics of Informatics and Information Technologies (IIT.SRC). Participants are students of all three levels of the study – bachelor (Bc.), master (Ing.) and doctoral (PhD.) study. The conference adopted a form of reviewing as at any other scientific conference, and presenting internally the papers in a form of internal Proceedings, which in most cases means a first step towards later publishing the results on national or international established conferences or journals.

IIT.SRC 2012 attracted 92 student papers from which 79 were accepted (18 bachelor, 41 master, 20 doctoral). The number of papers is rather stable. This year we have noticed an increase in bachelor category comparing to IIT.SRC 2011.

IIT.SRC 2012 was organized in five sections with papers in two categories – full papers and extended abstracts:

- Intelligent Information Processing,
- Web Technologies and Science,
- Software Engineering and Computer Science,
- Computer Systems, Computer Networks and Security,
- User Interaction, Computer Graphics, Image Processing.

The conference was opened by Keith G. Jeffery followed by a keynote titled The Challenges in ICT: Debunking the Hype. Keith is currently Director International Relations at STFC (Science and Technology Facilities Council). He previously had strategic and operational responsibility for ICT with 360,000 users, 1100 servers and 140 staff. His research interests include distributed computing with special emphasize to cloud computing, security and green computing.

Besides the 79 papers presented at the conference and included in these Proceedings several accompanying events were organized. The RoboCup Exhibition is organised as a part of IIT.SRC from 2005. RoboCup is an attractive project with free participation, designed to support education and research in artificial intelligence, robotics and information technologies. Through several years, our students achieved interesting results, which were presented during the conference. RoboCup exhibition presented both the way the RoboCup simulated league is played and also the progress of current students' research in this field. Three years ago a new RoboCup league – three-dimensional (3D) robotic simulation was added. The extension of the simulation to the third dimension shows the continuous progress in RoboCup and in our students' skills.

This year we organized for the fourth time as part IIT.SRC a showcase of TP-Cup projects. TP-Cup is a competition of master students' teams aimed at excellence in development information technologies solutions within two semester long team project module. The competition has four stages. 12 teams managed to achieve this stage and presented their projects during the TP-Cup showcase. Extended abstracts of their projects are included in these proceedings.

Accompanying events included for fifth time also our programming contest. It follows a long tradition at the Slovak University of Technology in Bratislava and our faculty in organizing programming contests, especially the ACM International Collegiate Programming Contest like competitions. This year we have organized for the first time the final round of the ProFIIT programming contest for high school students in parallel with IIT.SRC. Our aim was to show our potential future students exciting research opportunities awaiting them at our university.

We continued this year with FIITApixel exhibition. FIITApixel brings together both students and staff of the Faculty as well as its potential students and alumni in an effort to create, share and judge pictures. It is organized as an ongoing event, where anyone can contribute pictures. The IIT.SRC FIITApixel exhibition presented the best pictures of this year contest.

As a part of IIT.SRC we organized again this year an exhibition of three games with a purpose. Games with a purpose represent a way of harnessing the power of the human brain for producing useful artefacts or solving computational problems through computer gaming. They are interesting not only for the research opportunity itself but also for research promotion and popularization.

Nokia Lab has presented its activities at its presentation spot via several interesting applications whose development has been supported by the FIIT STU Nokia Lab.

New accompanying event this year was Junior IIT.SRC. Junior IIT.SRC provides a room for presenting inventive high school student projects within the topics of the conference. This year, three submissions were selected, first two dealing with an actual topic of electronic parliamentary elections (presenting either the potential platform and result analysis apparatus), the third presenting a smart portal for delivery of IT news and updates, focused on young audience.

IIT.SRC 2012 was the result of considerable effort by a number of people. It is our pleasure to express our thanks to:

- the IIT.SRC 2012 Programme Committee who devoted effort to reviewing papers,
- the IIT.SRC 2012 Organising Committee for a smooth preparation of the event,
- the students – authors of the papers, for contributing good papers reporting their research and their supervisors for bringing the students to research community.

Special thanks go to:

- Anton Andrejko together with Katarína Mršková who did an excellent job in the completion of the proceedings,
- Zuzana Marušincová and the whole organizing committee for effective support of all activities and in making the conference happen.

Finally we highly appreciate the financial support of our sponsors which helped the organizers to provide excellent environment for presentation of the results of student research and valuable awards.

Bratislava, April 2012

Pavel Čičák and Mária Bieliková

Conference Organisation

The 8th Student Research Conference in Informatics and Information Technologies (IIT.SRC), held on April 25, 2012 in Bratislava, was organised by the Slovak University of Technology (and, in particular, its Faculty of Informatics and Information Technologies) in Bratislava.

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The Challenges in ICT: Debunking the Hype

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Abstract. ICT has – in the last 50 years – changed the world of business, learning and leisure more than any other technology or influence. Imagine if we took computers out of the world. It would take every man, woman and child in UK working 24/7/365 to manage the banking transactions. Transport would stop. Communications would stop. TV and radio would stop. Financial services would stop. Hospitals could not operate effectively. Manufacturing would stop. Retail would stop. Even your car, fridge, washing machine, home TV, central heating system would stop. The management of ICT and gaining the best cost-benefit (by hiding complexity using autonomic techniques) is a perpetual challenge. The newest concept is Cloud Computing. It follows (and to some extent incorporates) many previous concepts such as Grid computing, Cluster Computing, Distributed Computing, Client-Server computing, Service-oriented architecture, Model-driven software development and many more. We shall explore what Cloud computing is and what it means for us all in the context of the modern ICT environment. We shall also consider whether or not it provides a solution to the major underlying challenges in ICT. We shall also look forward to what is coming next.

1 Introduction

Since using computing for my Geology PhD in the 1960s I have been fascinated by the potential of ICT for research, business, management, learning and entertainment. I have been fortunate to have been involved in the earliest relational database systems, distributed systems, logic-based systems, systems development methods, the first WWW server outside CERN, various WWW standards, the standard for international research information (CERIF), mobile computing, open access to research results, the original e-Science concept, Grids and Clouds. This provides a special perspective on ICT (or particularly ICST where the S stands for science).

1.1 The Pervasiveness of ICT

ICT is everywhere. It is found not only in laptops and smartphones but in cars, planes, process plant, refrigerators, washing machines and TVs. It is part of the fabric of life, but in parts of Africa, Asia and South America there is not a sustainable power supply. Storage densities have improved in 20 years by 10**18, processor speeds by 10**15 but broadband by only 10**4. Large scale businesses communicate at Gb/s speed, the average mobile connection is <200Kb/s.

IIT.SRC 2012, Bratislava, April 25, 2012, pp. xv–xviii.

1.2 A Short History of ICT

In the 1960s an end-user described the requirement to an analyst who designs a system for programming by a programmer and when run the results are handed back to the end-user and – if necessary – explained by the analyst. Now an end-user expects to use 'off the shelf' software products to achieve their objectives. With vastly increasing data production, the trend is to move the software to the data rather than the data to the software (and computing resource). This has distributed system architectural implications realised through Grid computing. However, businesses still struggle to reconcile their management processes with the demands and capabilities of purchased software systems, to reduce ICT costs and increase productivity and to achieve on-demand scalable ICT resources. Paradoxically, this has led to ICT centralisation in in-house clusters and Cloud computing.

2 Cloud Computing

2.1 Characteristics

Many consider Cloud computing to be just marketing hype. Indeed, in the Gartner hypecycle graph, 2011 is the year when the Cloud hype is unsustainable and we move for some time into disillusionment with the technology. Cloud Computing is, in fact, a combination of pre-existing technologies together with a managed business model. The major types of Cloud offerings are determine by their customer base: private (in-house), hybrid and public (outsourced). The next discriminant is the offering; IaaS: infrastructure as a service for system architects, PaaS: platform as a service for systems developers and SaaS: software as a service for end-users.

The technologies utilised are in general shared across both the above discriminations and include cluster computing (from datacentres) and autonomic computing (from Grids). It is no accident that the major public cloud offerings are from large companies that needed to invest heavily in ICT to support infrequent peak demands in their core business leaving expensive capital investment idle for much of the time. Cloud Computing opened a way to make money on this idle capital investment without risking its availability for in-house requirements.

The business model offered to end-user customers is 'pay as you go' thus reducing capital expenditure and investment and increasing operational expenditure. This is attractive both to users of a public cloud and to users of a private cloud – in both cases encouraging a stronger management of ICT expenditure.

A further claimed advantage of Cloud computing is its environmental ('green') credentials. A centralised datacentre is more energy-efficient than multiple distributed departmental centres especially if the capacity switched on at any time is managed autonomically. There are also opportunities for utilising the heat generated in associated buildings.

2.2 Problems

Cloud computing has its problems. The Cloud centre is potentially vulnerable to disablement by intended or unintended actions. Shipping data to the centre may be impractical because of available bandwidth or legal issues concerning privacy and security. Despite the promise of autonomicity, there remain problems with horizontal and vertical scaling. The design of software services to take advantage of the elastic scalability (by dynamic re-composition based on metadata) has not yet been achieved and the attendant systems development methods have not been provided.

Additionally there are a host of challenges in ICST that need to be addressed – and have needed to be addressed for many years. These challenges are present in the Cloud environment as in any other although with subtly changed / emphasised characteristics.

3 Challenges

3.1 Metadata

Metadata describes objects so they can be used. However, what is metadata to one application is data to another: a library catalogue card is metadata pointing to the book on the shelf but data for a librarian counting the number of books on a given subject. As ICT become increasingly autonomic, the autonomic managers rely upon metadata to describe the data to be processed, the software services to do the processing and the computing resources desired or available. Packaged services are advertised via metadata to end-users. Unfortunately existing metadata standards either do not exist or are woefully inadequate for the requirements.

3.2 Management of State

The representation accurately within the ICT system of the state of the real world is a key objective. As things change in the real world so they should also in the system (observation) and conversely, as things change in the system they should change in the real world (control). Database technology has developed appropriate transactions to maintain database state. However, as the volume and rapidity of changes increases the system may not be able to react quickly enough, particularly with streamed data and particularly if it is multimedia. In a distributed system things become more complex and if the global state is represented by multiple local states the integrity of the global state is fragile or even unsustainable.

3.3 Data Representativity

Objects in the real world have great complexity, subtlety and usually dynamism. Representations in computer systems consist of a representative encoding (character set, media type), a syntax (structure) and semantics (meaning). It is common for the same object in the real world to have in different ICT systems – with increasing probability - different encoding, syntax and semantics. This has two important aspects for ICT: (a) the real-world object may not be represented faithfully in the ICT system; (b) interoperation of ICT systems representing the same or similar objects becomes complex

3.4 Data Quality, Veracity and Permanency

Data quality relates to the accuracy and precision of the way the ICT system represents the real-world object. Usually this can only be verified by comparison with the real world object, or by ensuring the entity/attribute values stored in the ICT system conform to metadata constraints. Permanency (and related considerations of provenance which also gives some guarantee of quality) depends on an appropriate digital preservation strategy. This will include media conversion rewriting (to ensure the data is readable) and maintenance of the associated metadata and – if necessary – software or software specifications.

3.5 Trust, Security and Privacy

Privacy concerns the management of data stored and used concerning an individual person. Most countries have legislation which balances freedom of access to information with the privacy rights of the individual. Security concerns assurance of data availability for those authorised to access it and prevention of availability for others. Trust relies on security and privacy and concerns the representation of an organisation, product, service or resource within an ICT system such that e-business transactions can be performed.

3.6 Management of Service Levels and Quality of Service

In general an end user neither knows nor cares where and how the ICT system provides the required information or computation. The concern is the time to obtain results and the quality of those results. This is managed by SLAs (service level agreements) and QoS (quality of service) guarantees – usually related to payments for improved service. In a virtualised environment such as a cluster, Grid or Cloud the management of resource availability (supply-side) against SLAs and QoS (demand-side) is critical to success.

3.7 Systems Design, Development, Maintenance and Decommissioning

Systems development methods have developed slowly and their origins in the 1960s are evident. The world is changing; the problem is now much less to develop new software but to (re-)use existing software components. The problem is to find a systems development method which allows for such automated composition based on declared requirements and then provides an execution environment appropriately distributed and autonomic allowing dynamic re-composition to exploit the available resources optimally to satisfy SLA and QoS constraints. Such an environment implies software modules with metadata describing their characteristics in sufficient detail for automated composition and execution, and equally such metadata for data, services and resources.

4 Conclusion

So, is Cloud Computing just hype? The answer is complex. For some offerings it certainly is – either rebranded well-known offerings or novel offerings claiming to be Cloud-based even if they are not. However, there is emerging some experience of the use of private (in-house) Cloud computing with derived benefits in management of resources. There is also experience of successful utilisation of public Cloud services, either for exceptional, one-off peak demands that would be too expensive to resource in-house by capital purchases or for experimenting with new software in an environment separated from the in-house ICT production facility. Of course public Clouds can also be used for office functions and for social networking – but with some loss of privacy and potential targeted advertising.

The real challenge is to provide seamless elasticity from private to public Clouds so that appropriate ICT tasks can be offloaded to the scalable and pay-as-you-go resources. This could also encourage the use of public clouds as a marketplace for inter-company trading. However, for this to become a reality the challenges outlined above need to be solved.

There is plenty of advanced R&D yet to be done.