

**Cloud Computing and Distributed Systems Laboratory
and the Cloudbus Project**



Annual Report - 2012



Department of Computing and Information Systems

Melbourne School of Engineering

The University of Melbourne, Australia

1. Director's Message



I am pleased to report on the key activities and outcomes of **Cloud Computing and Distributed Systems (CLOUDS) Laboratory** at the University of Melbourne, Australia during the academic year 2012, which has been another extraordinary year in terms of research quality and international recognition of its members. The Lab has consolidated its position as one of the world-leaders in developing innovative solutions for Cloud Computing. The highlights of research activities and outcomes in 2012 are:

- The Lab successfully carried out two ARC research projects; one of them was carried out with Computer Associates as an ARC Linkage Project partner.
- Members of CLOUDS Lab have authored 32 publications, which include 15 journal papers, and 12 conference papers.
- The Lab's flagship Cloudbus Project has released "open source" CloudSim 3.0 Toolkit, which is used by several researchers in academia and industries around the world.
- Members have presented over 30 invited talks that include 9 keynotes delivered at international conferences held in India, Australia, and China.
- The Lab successfully hosted research activities of over 20 scholars: 15 PhD students, 4 Research Fellows (2 at PostDoc level and 2 Software Engineers), and couple of Masters/honours students.
- Lab members have been recognised for their outstanding contribution to the field of distributed computing by awards such as "*Hind Rattan (Jewel of India) Award*" and "Best Prototype Award".
- The Lab housed several (short and long term) international visitors (academic and PhD students) from France, China, Canada, Netherlands, and Belgium.
- The Lab attracted two ARC grants in the area of Cloud computing. One of them is "*Future Fellowship*" from 2012-2016.
- The Lab Director has been appointed as the foundation Editor-In-Chief of IEEE Transactions on Cloud Computing.
- Members of the Lab have led community efforts by (a) involving in the organisation of conferences (e.g., CCGrid 2012 in Ottawa, Canada), (b) served on the Steering Committee of 5 international conferences and (c) served as the Chair of the Advisory Board of the IEEE Technical Committee on Scalable Computing.

The Lab is always looking for talented, motivated, and dedicated "young" students and researchers to join its team. Please feel free to contact me with your ideas!

Sincerely Yours,



Professor Rajkumar Buyya, PhD
Director, Cloud Computing and Distributed Systems (CLOUDS) Laboratory
Department of Computing and Information Systems
The University of Melbourne, Australia
Web: www.cloudbus.org

2. The Team

Director:

- Professor Rajkumar Buyya

Research Staff:

- Dr. Rodrigo N. Calheiros
- Dr. Saurabh Garg
- Mr. Dileban Karunamoorthy
- Mr. Enayat M. Moghaddam

PhD Students

- Mr. Michael Mattess
- Mr. William Voorsluys
- Mr. Mohsen Amini
- Mr. Anton Beloglazov
- Mr. Amir Vahid
- Ms. Linlin Wu
- Mr. Adel Toosi
- Mr. Sivaram Yoganathan
- Mr. Deepak Poola
- Mr. Mohammed Alrokayan
- Ms. Atefeh Khosravi
- Mr. Nikolay Grozev
- Ms. Sareh Fotuhi
- Mr. Yaser Mansouri
- Mr. Roland Padilla
- Ms. Maria Rodriguez

Collaborators

- Colleagues holding research grants with the Director
 - International Visitors
 - Many collaborators involved in extending and using the Cloudbus software.
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3. Competitive Grants Funded Projects and Programs - Active

Australian Research Council (ARC)

- R. Buyya, Megha: Utility Oriented Federation of Cloud Computing Environments for Scaling of Application Services, Discovery Project, ARC, 2010-2012. Amount: \$280,000.
- R. Buyya, Service Level Agreement (SLA) oriented Resource Allocation for Data Centers and Cloud Computing Systems, Linkage Project, Australian Research Council (ARC), Australia and CA (Computer Associates), Australia, 2009/2010-2011/2012. Amount: \$273,000 (ARC: \$195,000 and CA: \$78,000).
- R. Buyya, Dynamic resource provisioning for autonomic management of cloud computing environments, Future Fellowship, ARC, 2012-2016. Amount: \$786,168.
- M. Palaniswami and R. Buyya, Creating a Smart City Through Internet of Things, Linkage Project, ARC, 2012-2014. Amount: \$350,000.
- M. Palaniswami, P. Mendis, M. Taylor, E. Chung, P. Pathirana, R. Buyya, C. Leckie, M. Duckham, and D. Nandagopal, Internet of Things Testbed for Creating a Smart City, Infrastructure, Equipment and Facilities (LIEF), ARC, 2012. Amount: \$270,000.

Industry and Melbourne University Grants

- R. Buyya and Aneka Team, "Scaling e-Science Applications using Azure Public Cloud", Academic Research Grant—Equipment Access, Microsoft, Seattle, USA, 2010-2013. Amount Equivalent: Approx. US\$180,000.
 - R. N. Calheiros, "Autonomic and cost-effective workflow execution in Cloud computing environments", Early Career Researcher Grant, The University of Melbourne, 2012. Amount: \$39,499.
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4. Publications

- The Lab publication record since its inception in 2002 highlighted in the Table below:

Year Publication Type	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Books/Proceedings Edited	1	1	1	1	5	4	3	5	2	3	2
Journal Papers	6	1	4	5	6	4	10	13	8	9	15
Book Chapters	1	0	0	4	4	2	4	11	3	13	3
Conference Papers	4	7	9	16	15	24	22	27	15	14	12
Magazine/Other Articles	0	0	1	2	4	2	0	1	2	1	0
<i>Total</i>	12	9	15	28	34	36	39	57	30	40	32

Book Chapters

1. Suraj Pandey and Rajkumar Buyya, A Survey of Scheduling and Management Techniques for Data-Intensive Application Workflows, Data Intensive Distributed Computing: Challenges and Solutions for Large-Scale Information Management, 156-176pp, T. Kosar (ed), ISBN13: 9781615209712, IGI Global, USA, January 2012.
2. Mukaddim Pathan, James Broberg, and Rajkumar Buyya, On the Performance of Content Delivery Clouds, Next Generation Content Delivery Infrastructures: Emerging Paradigms and Technologies, 29-45pp, G. Fortino and C. Palau (eds.), ISBN: 978-1-4666-1794-0, IGI Global, USA, May 2012.
3. Saurabh Garg and Rajkumar Buyya, Green Cloud Computing and Environmental Sustainability, Harnessing Green IT: Principles and Practices, 315-340pp, S. Murugesan and G. Gangadharan (eds), ISBN: 978-1-1199-7005-7, Wiley Press, UK, November 2012.

Proceedings Edited

4. Pavan Balaji, Rajkumar Buyya, Shikharesh Majumdar, and Suraj Pandey, Proceedings of the 12th IEEE/ACM International Symposium on Cluster, Cloud, and Grid Computing (CCGrid 2012, May 13-16, 2012, Ottawa, Canada), ISBN 978-0-7695-4691-9, IEEE CS Press, Los Alamitos, CA, USA.
5. Rajiv Ranjan, Rajkumar Buyya and Anirban Basu, Proceedings of the International Conference on Advances in Cloud Computing (ACC 2012), Computer Society of India, July 26-28, 2012, Bangalore, India.

Journal Papers

6. Christian Vecchiola, Rodrigo N. Calheiros, Dileban Karunamoorthy, and Rajkumar Buyya, Deadline-Driven Provisioning of Resources for Scientific Applications in Hybrid Clouds with Aneka, Future Generation Computer Systems, Volume 28, No. 1, Pages: 58-65, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, January 2012.
7. Suraj Pandey, William Voorsluys, Sheng Niu, Ahsan Khandoker, and Rajkumar Buyya, An Autonomic Cloud Environment for Hosting ECG Data Analysis Services, Future Generation Computer Systems, Volume 28, No. 1, Pages: 147-154, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, January 2012.

8. Mohsen Amini Salehi, Bahman Javadi, Rajkumar Buyya, QoS and Preemption aware Scheduling in Federated and Virtualized Grid Computing Environments, *Journal of Parallel and Distributed Computing (JPDC)*, Volume 72, Number 2, Pages: 231-245, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, February 2012.
9. GuoFu Feng, WenZhong Li, SangLu Lu, DaoXu Chen and Rajkumar Buyya, The Optimization of Replica Distribution in the Unstructured Overlays, *Science China Information Sciences*, Volume 55, Number 3, Pages: 714-722, ISSN: 1674-733X, Science China Press and Springer-Verlag, March 2012.
10. Amir Vahid Dastjerdi, Sayed Gholam Hassan Tabatabaei, and Rajkumar Buyya, A Dependency-aware Ontology-based Approach for Deploying Service Level Agreement Monitoring Services in Cloud, *Software: Practice and Experience*, Volume 42, Number 4, Pages: 501-518, ISSN: 0038-0644, Wiley Press, New York, USA, April 2012.
11. Anton Beloglazov, Jemal Abawajy, and Rajkumar Buyya, Energy-Aware Resource Allocation Heuristics for Efficient Management of Data Centers for Cloud Computing, *Future Generation Computer Systems*, Volume 28, No. 5, Pages: 755-768, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, May 2012.
12. Rodrigo N. Calheiros, Christian Vecchiola, Dileban Karunamoorthy, and Rajkumar Buyya, The Aneka Platform and QoS-Driven Resource Provisioning for Elastic Applications on Hybrid Clouds, *Future Generation Computer Systems*, Volume 28, No. 6, Pages: 861-870, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, June 2012.
13. Vincent C. Emeakaroha, Marco A. S. Netto, Rodrigo N. Calheiros, Ivona Brandic, Rajkumar Buyya, and Cesar A. F. De Rose, Towards Autonomic Detection of SLA Violations in Cloud Infrastructures, *Future Generation Computer Systems*, Volume 28, No. 7, Pages: 1017-1029, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, July 2012.
14. Rajiv Ranjan, Aaron Harwood and Rajkumar Buyya, Coordinated Load Management in Peer-to-Peer Coupled Federated Grid Systems, *Journal of Supercomputing*, Volume 61, No. 2, Pages: 292-316, ISSN: 0920-8542, Springer, Netherlands, August 2012.
15. Marco A. S. Netto and Rajkumar Buyya, Coordinated Rescheduling of Bag-of-Tasks for Executions on Multiple Resource Providers, *Concurrency and Computation: Practice and Experience*, Volume 24, No. 12, Pages: 1362-1376, ISSN: 1532-0626, Wiley Press, New York, USA, August 25, 2012.
16. Linlin Wu, Saurabh Kumar Garg, and Rajkumar Buyya, SLA-based Admission Control for a Software-as-a-Service Provider in Cloud Computing Environments, *Journal of Computer and System Sciences*, Volume 78, No. 5, Pages: 1280-1299, ISSN 0022-0000, Elsevier Science, Amsterdam, The Netherlands, September 2012.
17. Anton Beloglazov and Rajkumar Buyya, Optimal Online Deterministic Algorithms and Adaptive Heuristics for Energy and Performance Efficient Dynamic Consolidation of Virtual Machines in Cloud Data Centers, *Concurrency and Computation: Practice and Experience*, Volume 24, No. 13, Pages: 1397-1420, ISSN: 1532-0626, Wiley Press, New York, USA, September 10, 2012.
18. Rodrigo N. Calheiros, Adel Nadjaran Toosi, Christian Vecchiola and Rajkumar Buyya, A Coordinator for Scaling Elastic Applications Across Multiple Clouds, *Future Generation Computer Systems*, Volume 28, No. 8, Pages: 1350-1362, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, October 2012.
19. Bahman Javadi, Jemal Abawajy and Rajkumar Buyya, Failure-aware Resource Provisioning for Hybrid Cloud Infrastructure, *Journal of Parallel and Distributed Computing (JPDC)*, Volume 72, No. 10, Pages: 1318-1331, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, October 2012.
20. Suraj Pandey and Rajkumar Buyya, Scheduling Workflow Applications Based on Multi-source Parallel Data Retrieval in Distributed Computing Networks, *The Computer Journal*, Volume 55, No. 11, Pages: 1288-1308, ISSN 0010-4620, Oxford University Press, UK, November 2012.

Conference Papers

21. William Voorsluys and Rajkumar Buyya, Reliable Provisioning of Spot Instances for Compute-intensive Applications, Proceedings of the 26th IEEE International Conference on Advanced Information Networking and Applications (AINA 2012, IEEE CS Press, USA), Fukuoka, Japan, March 26-29, 2012.
22. Mohsen Amini Salehi, Bahman Javadi, and Rajkumar Buyya, Preemption-aware Admission Control in a Virtualized Grid Federation, Proceedings of the 26th IEEE International Conference on Advanced Information Networking and Applications (AINA 2012, IEEE CS Press, USA), Fukuoka, Japan, March 26-29, 2012. [**Nominated for Best Paper Award**].
23. Amir Vahid Dastjerdi and Rajkumar Buyya, An Autonomous Reliability-Aware Negotiation Strategy for Cloud Computing Environments, Proceedings of the 12th IEEE/ACM International Symposium on Cluster, Cloud, and Grid Computing (CCGrid 2012, IEEE CS Press, USA), Ottawa, Canada, May 13-16, 2012.
24. Bhanu Sharma, Ruppa Thulasiram, Parimala Thulasiraman, Saurabh Garg and Rajkumar Buyya, Pricing Cloud Compute Commodities: A Novel Financial Economic Model, Proceedings of the 12th IEEE/ACM International Symposium on Cluster, Cloud, and Grid Computing (CCGrid 2012, IEEE CS Press, USA), Ottawa, Canada, May 13-16, 2012.
25. Bahman Javadi, Parimala Thulasiraman, and Rajkumar Buyya, Cloud Resource Provisioning to Extend the Capacity of Local Resources in the Presence of Failures, Proceedings of the 14th International Conference on High Performance and Communications (HPCC 2012, IEEE CS Press, USA), Liverpool, UK, June 25-27, 2012.
26. Mohsen Amini Salehi, Radha Krishna Pisipati, Krishnamurthy Sai Deepak, and Rajkumar Buyya, Preemption-aware Energy Management in Virtualized DataCenters, Proceedings of the 5th International Conference on Cloud Computing (IEEE Cloud 2012, IEEE CS Press, USA), Hawaii, USA, June 24-29 2012.
27. Saurabh Kumar Garg, Bhanu Sharma, Rodrigues N. Calheiros, Ruppa K. Thulasiram, Parimala Thulasiraman, and Rajkumar Buyya, Financial Application as a Software Service on Cloud, Proceedings of the 5th International Conference on Contemporary Computing (IC3-2012, Springer, Germany), Noida, India, August 6-8, 2012.
28. Guofu Feng, Saurabh Kumar Garg, Rajkumar Buyya and Wenzhong Li, Revenue Maximization Using Adaptive Resource Provisioning in Cloud Computing Environments, Proceedings of the 13th IEEE/ACM International Conference on Grid Computing (Grid 2012, IEEE CS Press, Los Alamitos, CA, USA), Beijing, China, September 20-23, 2012.
29. Adel Nadjaran Toosi, Ruppa Thulasiram and Rajkumar Buyya, Financial Option Market Model for Federated Cloud Environments, Proceedings of the 5th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2012, IEEE CS Press, USA), Chicago, USA, November 5-8, 2012.
30. Rodrigo N. Calheiros and Rajkumar Buyya, Cost-effective Provisioning and Scheduling of Deadline-constrained Applications in Hybrid Clouds, Proceedings of the 13th International Conference on Web Information System Engineering (WISE 2012), Paphos, Cyprus, November 28-30, 2012.
31. Rajkumar Buyya, Rodrigo N. Calheiros, and Xiaorong Li, Autonomic Cloud Computing: Open Challenges and Architectural Elements, Proceedings of the Third International Conference of Emerging Applications of Information Technology (EAIT 2012, IEEE Press, USA), Kolkata, India, November 29-December 01, 2012. - **Keynote Paper**.
32. Xiaorong Li, Rodrigo N. Calheiros, Sifei Lu, Long Wang, Henry Palit, Qin Zheng, and Rajkumar Buyya, Design and Development of an Adaptive Workflow-Enabled Spatial-Temporal Analytics Framework, Proceedings of the ICPADS 2012 IEEE International Workshop on Scalable Computing for Big Data Analytics (SC-BDA, IEEE Press, USA), Singapore, Dec 17-19, 2012. [**Best prototype awards**].

5. Invited Presentations and Outreach

By the Lab Director:

Keynote Talks at International Conferences

1. Market-Oriented Cloud Computing and the Aneka Platform, International Conference on Recent Advances in Computing and Software Systems (RACSS 2012), April 25-27, 2012, Chennai, India.
2. Market-Oriented Cloud Computing and the Aneka Platform, Enterprise Computing Conference (ECC 2012), May 15-16, 2012, Canberra, Australia.
3. Market-Oriented and Energy-Efficient Cloud Computing, International Conference on Advances in Cloud Computing (ACC 2012), July 26-28, 2012 Bangalore, India.
4. Cloud Services and Software Engineering: Challenges and Solutions, Improving Systems and Software Engineering Conference (ISSEC 2012), August 15-16, 2012, Melbourne, Australia.
5. Market-Oriented Cloud Computing: Research Opportunities and Challenges, 6th International Conference on Network and System Security (NSS 2012) and Co-located IDCS 2012 ICKDE 2012 Conferences, Nov. 21-23, 2012, Wu Yi Shan, Fujian, China.
6. Cloud Computing: The Driver of the Next Big Wave of Innovations, The 7th International Conference on Frontier of Computer Science and Technology (FCST 2012), November 21-23, 2012, Suzhou, China.
7. Cloud Computing: Research Opportunities and Challenges, 2012 Third International Conference on Emerging Applications of Information Technology (EAIT 2012), November 29-December 01, 2012, Kolkata, India.
8. Cloud Computing: The Driver of the Next Big Wave of Innovations Delivering Ubiquitous Solutions, Fourth International Conference on Advanced Computing (ICoAC 2012), Dec. 13-15, 2012, Chennai, India.
9. Cloud Computing, International Conference on Recent Trends in Information Technology and Computer Science (ICRTITCS 2012), Dec. 17-18, 2012, Mumbai, India.

National Conferences

1. Platforms for Market-Oriented Cloud Computing, 2012 Second International Workshop on Cloud Computing and Future Internet, Tsinghua University, Beijing, China, July 9-10, 2012.
2. Emerging Opportunities in Cloud Computing, Government and Industry Forum on Cloud Computing, Nanjing, China, July 12, 2012.
3. Market-Oriented Cloud Computing, International Workshop on Cloud Computing, Shenzhen Institutes of Advanced Technology, Shenzhen, China, July 16, 2012.
4. Cloud Computing with Aneka, Workshop on Cloud Computing and Internet of Things, NITK Surathkal, Mangalore, India, July 23-25, 2012.
5. Cloud Computing with Aneka, National Workshop on Cloud Computing and High Performance Computing (CCHPC), Thapar University, Patialla, India, Dec. 5-7, 2012.
6. Cloud Computing: The Next Revolution in Information Technology, Teachers Training Workshop on Recent Advances in Computer Science, Jadavpur University, Kolkata, India, Nov. 28, 2012.
7. Cloud Computing with Aneka, National Workshop on Cloud Computing, Kurnool, India, Dec. 9, 2012.
8. Cloud Computing with Aneka, National Workshop on Cloud Computing, JNTU, Hyderabad, India, Dec. 11, 2012.
9. Cloud Computing with Aneka, National Workshop on Cloud Computing, Andhra University, Visakhapatnam, India, Dec. 13, 2012.

Seminars - in Cloud Computing area:

1. Hyderabad Central University (HCU), Hyderabad, India, Jan. 3, 2012.
2. Institute for Development & Research in Banking Technology (IDRBT), Hyderabad, India, Jan. 5, 2012.
3. A-STAR Institute of High Performance Computing (iHPC), Singapore, Jan. 30, 2012.
4. A*STAR Institute of High Performance Computing (iHPC), Singapore, Feb. 2, 2012.
5. Universiti Tunku Abdul Rahman (UTAR), Kuala Lumpur, Malaysia, April 23, 2012.
6. Anna University, Chennai, India, April 25, 2012.
7. Hindustan University, Chennai, India, April 27, 2012.
8. Sathyabama University, Chennai, India, April 27, 2012.
9. Renmin University, Beijing, China, July 18, 2012.
10. University of Science and Technology Beijing (UTSB), Beijing, China, July 19, 2012.
11. Siddaganga Institute of Technology (SIT), Tumkur, India, July 24, 2012.
12. Accenture, Bangalore, India, July 25, 2012.
13. Malaviya National Institute of Technology (MNIT), Jaipur, India, Dec. 3, 2012.
14. Indian Institute of Technology, Bombay, India, Dec. 18, 2012.

Conference Tutorials

1. Introduction to Cloud Computing and the Aneka Platform, International Conference on Advances in Cloud Computing (ACC 2012), July 26-28, 2012 Bangalore, India.
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6. Selected Community Services

By the Lab Director:

IEEE Computer Society

1. Chair of Advisory Board, IEEE Technical Committee on Scalable Computing

Journal Editorials

1. Editorial Board Member, *Future Generation Computer Systems (FGCS)* -- The International Journal of Grid Computing: Theory, Methods and Applications, ISSN: 0167-739X, Elsevier Press, Amsterdam, The Netherlands.
2. Editorial Board Member, *International Journal of Parallel, Emergent and Distributed Systems (IJPEDS)*, ISSN: 1744-5760, Taylor & Francis Group, UK.
3. Editorial Board Member, *Multiagent and Grid Systems: An International Journal*, ISSN: 1574-1702, IOS Press, Amsterdam, The Netherlands, 2005 onwards.
4. Editorial Board Member, *Software: Practice and Experience*, ISSN: 0038-0644, Wiley Press, New York, USA, 2009-to date.

Conference Steering Committee

1. Chair, CCGrid conference series: IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid): CCGrid 2001, Brisbane, Australia; CCGrid 2002, Berlin, Germany; CCGrid 2003, Tokyo, Japan; CCGrid 2004 in Chicago, USA; CCGrid 2005, UK; CCGrid 2006, Singapore; CCGrid 2007, Brazil; CCGrid 2008, Lyon, France; CCGrid 2009, Shanghai, China; CCGrid 2010, Melbourne, Australia; CCGrid 2011, Newport Beach, USA, and CCGrid 2012, Ottawa, Canada.
2. Co-Chair, International Conference on e-Science(e-Science) series, 2005- to date.
3. Member, IEEE International Conference on Cluster Computing (ClusterXY), 1999-to date.
4. Member, International Symposium on Computer Architecture and High Performance Computing, 2005-to date.
5. Member, IEEE/ACM International Conference on Grid Computing (GRIDxy), 2000-2012.
6. Chair, IEEE/ACM International Conference on Utility and Cloud Computing (UCCxy), 2010-to date.

Technical Program Committee Memberships

1. 35th Australasian Computer Science Conference (ACSC 2012), January 30 - February 2, 2012, Melbourne, Australia.
2. 26th IEEE International Conference on Advanced Information Networking and Applications (AINA 2012), March 26-29, 2012, Fukuoka, Japan.
3. 11th IEEE/ACM International Conference on Ubiquitous Computing and Communications (IUCC 2012), June 25-27, 2012, Liverpool, UK.
4. 21st International Conference on Computer Communications and Networks (ICCCN 2012), July 30 - August 2, 2012, Munich, Germany.
5. 9th International Conference on Autonomic Computing (ICAC 2012), Sept. 17-21, 2012, San Jose, California, USA.
6. The 9th International Conference on Economics of Grids, Clouds, Systems, and Services (GECON 2012), November 27-28, 2012, Berlin, Germany.

7. 13th ACM/IFIP/USENIX International Middleware Conference, December 3-7, 2012, Montreal, Quebec, Canada.

Community Information Sources

- Maintained a Grid Computing Information Centre at: <http://www.gridcomputing.com>, whose newsletter mailing list has over 2500 members. This website is often ranked as #2 source for grid computing by Google search engine.
- Maintained a Cluster Computing Information Centre at: <http://www.buyya.com/cluster>
- Co-Moderator for Computing Research Repository (CoRR, <http://arxiv.org/corr/>)'s subject on "Distributed, Parallel, and Cluster Computing".

By Other Members:

Chairs and Memberships.

1. Mohammed Alokayan, Cyber Chair, 2nd IEEE/ACM International Conference on Utility and Cloud computing (UCC 2012) November 5-8, 2012, Chicago, USA.

Technical Program Committee Memberships

1. Rodrigo N. Calheiros, 27th Symposium On Applied Computing (ACM SAC 2012) – Operating Systems Track, March 26-30, 2012, Trento, Italy.
2. Rodrigo N. Calheiros, 1st International Conference on Smart Grids and Green IT Systems (SMARTGREENS 2012), April 19-20, 2012, Porto, Portugal.
3. Saurabh Kumar Garg, 5th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2012), November 5-8, 2012, Chicago, USA.

7. International Visitors

1. A/Prof. Abdullah Bin Gani, University of Malaya, Malaysia, Oct 2011-Jun 2012.
 2. A/Prof. Thierry Monteil, University of Toulouse, France, Jul 2012.
 3. Dr. Kurt Vanmechelen, University of Antwerp, Belgium, Aug-Sep 2012.
 4. Prof. Noel De Palma, University Joseph Fourier, France, Aug 2012.
 5. Ms. Ling Ding, Heifei University of Technology, China, Oct 2012-Oct 2014.
 6. A/Prof. Lu Liu, University of Science and Technology Beijing, China, Nov 2012-Oct 2013.
 7. Prof. Ivan Stojmenovic, University of Ottawa, Canada, Nov 2012.
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8. Continuing Members Profile and Activities

Member Self Profile: Rodrigo N. Calheiros

I joined the CLOUDS Lab as a Research Fellow in June 2010, after being a research visitor between 2008 and 2009.

During 2012, I was Assistant Lecturer for two subjects: Cloud and Grid Computing (Sem. 1) and distributed Systems (Sem. 2).

During 2012, I also held an “Early Career Research Grant” from the University of Melbourne. This grant allowed me to spend part of my time doing research in the area of execution of scientific workflows in Clouds. This also gave me the opportunity to collaborate with colleagues at the iHPC institute, Singapore. This included participation in the SCALE 2012 challenge (held together with CCGrid 2012 in Canada) and a joint paper that was awarded “Best Workshop Awards” in the SC-BDA workshop in Singapore. Overall, the ECR Grant generated positive outcome, and future works derived from this research can be explored by PhD students in 2013.



My other duties are related to the InterCloud project, where I've been researching coordinated provisioning and scheduling of BoT applications in hybrid Clouds (via Cloud bursting). This work was presented in the WISE 2012 conference in Cyprus.

I'm also one of the original designers and developers of CloudSim. Therefore, I'm still collaborating in the support for the tool whenever users from these tools contact us. I've been also involved in collaborations with researchers from University of Toulouse (France), University of Manitoba (Canada), University of Ceara (Brazil), and CSIRO (Australia).

Other activities I was involved in 2012 were competitive grant proposals writing, program committees memberships, and supervision of Master students (minor thesis).

Member Self Profile: Enayat M. Moghaddam

My service as a research assistant has commenced in mid-2012. During my Master program on Distributed Systems, I was vigorously following the ongoing activities in CLOUDS Lab; and after being graduated, I officially joined the group.

During this short period, I mostly was involved in the design and implementation of a dynamic VM provisioning system which is a collaboration project with CSIRO.

Automatic Aneka infrastructure deployment and configuration, and adding support for variety of public Cloud providers are still in progress.



Member Self Profile: Dr. Saurabh Kumar Garg

Until 2012 I worked as Research Fellow under the supervision of Dr. Rajkumar Buyya in Cloud Computing and Distributed System (CLOUDS) Laboratory of The University of Melbourne. I completed my 5-year Integrated Master of Technology in Mathematics and Computing from the Indian Institute of Technology (IIT) Delhi, India, in 2006. After completing my post graduate degree, I joined the IBM Indian Research Laboratory Delhi, where I worked in the area of High Performance Computing. I designed and optimized the FFT and Random Access benchmarks for Blue Gene/L, which is the fastest supercomputer from IBM. Here in Melbourne University, I have been awarded with various scholarships such as MIFRS and MIRS for my PhD candidature.

In CLOUDS Laboratory, I conducted research in various research areas of Cloud computing such as utility and market principles in Grid and Cloud computing, SLA-based resource allocation, carbon- and energy-aware Scheduling, resource provisioning algorithms for SaaS, meta-scheduling etc. I developed my expertise in simulation modelling particularly in Grid Simulation Toolkits such as GridSim, CloudSim and Gridbus Broker. Currently I am working in IBM Research Australia.



Member Self Profile: Dileban Karunamoorthy

I joined CLOUDS Lab in August 2009 in the capacity of a Research Fellow contributing primarily to the on-going research and development of a platform for building cloud applications. Aneka, one of the flagship projects in the research group, is an infrastructure for developing cloud-based applications capable of utilizing resources on the desktop, clusters, and on-demand resources from infrastructure-as-a-service providers.

Prior to pursuing a Masters in Distributed Computing (MEDC) at the University of Melbourne in July 2008, I was employed at IFS R&D, an ERP software vendor, since 2000. In the fall of 2008, after finishing my first semester at University of Melbourne, I began working as a part-time Research Assistant with the CLOUDS Lab group. In August 2009 after completing my degree, I joined the group as a full-time Research Fellow until May 2012, when I assumed a new role at IBM Research.



Member Self Profile: William Voorsluys

I joined CloudsLab in February 2008, when I started my PhD studies in the University of Melbourne.

In the past few years, before coming to Melbourne, I've been involved with aspects of grid and cloud computing, virtualization technologies and load balancing in distributed systems. This interest started back in the year 2000 during my undergraduate studies, when I developed load-balancing algorithms for heterogeneous clusters. Later, in my master's research in the University of Sao Paulo, I've studied memory-related metrics that allow a precise evaluation of a system's memory-usage, with the objective of aiding cluster load balancing policies to make better decisions.



From 2005 to 2008 I have worked as a researcher in the OurGrid project, a Brazilian grid computing initiative, which is dedicated to research and development of a peer-to-peer grid computing solution.

My PhD research aims at creating a provisioning and allocation mechanism for virtualised data centres. A key feature of my research is the concept of workload mobility. I'm taking advantage of live migration and replication of virtual machines to achieve load balancing and fault tolerance capabilities.

More specifically, my research involves devising a mechanism that uses detailed information about resource utilization in each virtual machine to intelligently consolidate and redistribute the workload in a data center. I'm also working on fault tolerant policies to allow executing high performance computing application on variable pricing cloud resource (spot market).

Member Self Profile: Anton Beloglazov

My name is Anton Beloglazov, I am from Novosibirsk, Russian Federation. I am a graduating PhD candidate under the supervision of Prof. Rajkumar Buyya at the Cloud Computing and Distributed Systems (CLOUDS) Laboratory within the Department of Computer Science and Software Engineering, The University of Melbourne, Australia. I have joined the CLOUDS Lab in 2009 to pursue my PhD studies funded by Endeavour International Postgraduate Research Scholarship and Melbourne International Research Scholarship. Prior to my PhD, I have graduated from Novosibirsk State Technical University in 2006 with Bachelor's degree followed by Master's degree in 2008 in Computer Science and Engineering.



My PhD research topic is "Energy-Efficient Management of Virtual Machines in Data Centers for Cloud Computing". My work is focused on the development of novel techniques, models, algorithms, and software for dynamic consolidation of virtual machines in Cloud data centers to improve the utilization of physical resources and reduce energy consumption under quality of service constraints. I have contributed to the development of CloudSim, an open-source Java framework for modeling and simulation of Cloud computing infrastructures and services: <http://www.cloudbus.org/cloudsim/>. I have also designed and implemented OpenStack Neat, a manager for distributed dynamic consolidation of virtual machines in OpenStack Clouds: <http://openstack-neat.org/>

In 2012, my research work has resulted in the following publications:

1. Anton Beloglazov and Rajkumar Buyya, "Managing Overloaded Hosts for Dynamic Consolidation of Virtual Machines in Cloud Data Centers Under Quality of Service Constraints", IEEE Transactions on Parallel and Distributed Systems (TPDS), IEEE CS Press, USA, 2012 (in press, accepted on August 2, 2012).
2. Anton Beloglazov, Sareh Fotuhi Piraghaj, Mohammed Alrokayan, and Rajkumar Buyya, "Deploying OpenStack on CentOS Using the KVM Hypervisor and GlusterFS Distributed File System", Technical Report CLOUDS-TR-2012-3, Cloud Computing and Distributed Systems Laboratory, The University of Melbourne, August 14, 2012.
3. Anton Beloglazov and Rajkumar Buyya, "OpenStack Neat: A Framework for Dynamic Consolidation of Virtual Machines in OpenStack Clouds – A Blueprint", Technical Report CLOUDS-TR-2012-4, Cloud Computing and Distributed Systems Laboratory, The University of Melbourne, August 14, 2012.

For the full list of publications and details of my work, please visit my web-page: <http://beloglazov.info/>

Member Self Profile: Amir Vahid Dastjerdi

I am a fourth year PhD student, and conducting my research on “QoS-aware and ontology-based Service Deployment in multiple Cloud environments” under supervision of Prof. Rajkumar Buyya. My thesis presents a toolkit which simplifies cross-Cloud deployment and facilitates service discovery, composition, and negotiation. The toolkit uses ontology-based matchmaking for discovery to achieve semantic interoperability, multi-objective evolutionary algorithms and fuzzy logic inference system for composition



optimization to handle user vague preferences, and a time-dependent strategy which considers resource utilization during negotiation and concedes accordingly for SLA negotiation. My publication in year 2012 comes below.

Conference papers:

1. Amir Vahid Dastjerdi and Rajkumar Buyya, An Autonomous Reliability-aware Negotiation Strategy for Cloud Computing Environment, Proceedings of the 12th IEEE/ACM International Symposium on Cluster Computing and the Grid (CCGrid 2012), Ottawa, Canada, May 13-16, 2012. (Ranked A)

Journal papers:

2. Amir Vahid Dastjerdi, Sayed Gholam Hassan Tabatabaei, Rajkumar Buyya. Dependency-aware Ontology-based Approach for Deploying SLA Monitoring Services in Cloud, Journal of Software: Practice and Experience, Volume 42, Issue 4, pp. 501-518. (Ranked A)
3. Amir Vahid Dastjerdi, Yoganathan Sivaram, and Rajkumar Buyya, Multi-objective and Ontology-based Cloud Service Composition Under Fuzzy Preferences of Users in Clouds, Journal of Software: Practice and Experience, 2012, in review. (Ranked A)
4. Amir Vahid Dastjerdi, Saurabh Kumar Garg and Rajkumar Buyya, QoS-aware Service Deployment across Multiple Clouds, Journal of Automated Software Engineering, 2012, in review. (Ranked A)

Member Self Profile: Michael Mattess

I joined the CLOUDS lab at the beginning of 2008, when I commenced my masters by research at The University of Melbourne under the supervision of Professor Rajkumar Buyya. With this I returned to the department where I completed my undergraduate studies. During this Bachelor of Computer Science (with Honours) I investigated file systems and storage layer aspects of email systems.

Between the bachelor degree and commencing my masters I worked as a Software Engineer. In this role I develop an embedded system for the healthcare sector, which allowed for the integration of multiple systems found in hospitals. I also worked, amongst other things, on an IP based TV system.



For the most part of 2009 I was on leave-of-absence from my masters and worked as a consultant performing a diverse range of tasks, from building a virtualization cluster to reverse engineering legacy systems to writing a data migration application.

During 2010 I continued my research work, which is centered on the problems of offloading some processing of tasks to commercial cloud providers when the local infrastructure is overloaded. In late 2009 Amazon introduced 'Spot Instances', which have a varying, market driven price. Spot Instances were incorporated into my work, which was presented¹ at the HPCC 2010 conference. This work was then further extended and additional workloads were investigated.

At the end of 2010 I also converted from masters by research degree to a PhD. In 2011 I entered the third year of the PhD as a confirmed candidate. In 2012 I joined Google Australia, initially for an internship and later as a Software Engineer.

Member Self Profile: Mohsen Amini Salehi

I am Mohsen Amini Salehi, I have completed my PhD in CLOUDS laboratory, at University of Melbourne, in 2012. Currently I am a postdoctoral fellow at Colorado State University. My main research interests are resource provisioning in large-scale distributed systems such as InterCloud.



In 2004, when I was still an undergraduate, I started to get interest on research management and scheduling. In that year, I joined a new research centre on high performance computing (Simorgh), in Computer center of Ferdowsi University. During the period of 2003-2005, I worked with resource management and load balancing in Grid computing under supervision of Dr. Hossein Deldari. In that period, I developed tools and authored research papers. In 2005, I moved back to Azad University of Mashhad as a lecturer. Since 2005 up to 2008 I was teaching in Azad University of Mashhad in Operating System Concepts and Computer Networks. As a researcher I was working on Text Summarization Systems during that period and I could get a research grant on that area.

In 2008, I joined CLOUDS Lab, at the University of Melbourne, Australia, to pursue my PhD under supervision of Dr. Rajkumar Buyya. My research has been focused on resource provisioning in InterGrid, which extends my background in Master degree. However, different from my previous research, at this time I am considering environments which support lease-based resource provisioning. My thesis is on preemption-based resource provisioning in resource sharing environments such as InterGrid.

My research is on resolving the contention to access resources in InterGrid platform. More specifically, we consider two major types of user requests namely, Local users' requests and External users' requests. This research has resulted in several outcomes. Earlier in 2011, we published a paper in Australian Computer Science Week 2011 (ACSW '11) Conference in Perth, Australia. Another part of this research that focuses on a scheduling policy in InterGrid Gateway (IGG) level published in ICA3PP 1'1, conference and Journal of Parallel and Distributed Computing (JPDC).

2012 was a prosperous career year for our research group. As a member of this group, I could publish a paper on admission control policies in each cluster of InterGrid in AINA 2012 conference that was nominated for the best paper award. I spent 3 months of 2012 at Infosys Ltd where I worked on the impact of preemption on energy efficiency in Haizea Cloud scheduler. The research paper resulted from this research was published in IEEE Cloud 2012 conference, in Hawaii. Infosys Ltd has filed a patent based on the outcome of my research in this area. Additionally, I received the best intern award from the company in 2012. The most recent paper that got accepted in Concurrency and Computation: Practice and Experience (CCPE) journal in 2012 was on measuring the overhead of Virtual Machine preemption that I expect to have a significant impact in the research area.

For the list of publications and details about my past and current work, please visit my webpage:

<http://www.engr.colostate.edu/~amini>

Member Self Profile: Linlin Wu

Linlin Wu is a PhD candidate under the supervision of Professor Rajkumar Buyya in the CLOUDS Laboratory at the University of Melbourne, Australia. She received Master of Information Technology from the University of Melbourne and then worked for CA (Computer Associates Pty Ltd) as Quality Assurance Engineer. Then she joined National Australia Bank (NAB) as a Knowledge Optimization Officer. Here in Melbourne University, she has been awarded with APA scholarship supporting PhD studies. She received the Best Paper Award from AINA 2010 conference for her first publication. Her current re-search interests including: Service Level Agreement, QoS measurement, Resource Allocation, and Market-oriented Cloud computing. She is the Vice Chair of IEEE committee at the University of Melbourne organizing industry and social activities for IEEE members.



Member Self Profile: Adel Toosi

I started my PhD studies under supervision of Dr. Rajkumar Buyya in the Department of Computer Science and Software engineering at the University of Melbourne in July 2010. I received my B.Sc. degree in 2003 and M.Sc. degree in 2006 both in Computer Software Engineering from Ferdowsi University of Mashhad, Iran. Throughout my master degree, I mainly focused on the areas of network security, especially intrusion detection systems, and soft computing system such as fuzzy systems and genetic algorithms.



Before coming to Melbourne, I was working in Azad University of Mashhad as a lecturer, where I was responsible for teaching courses like Internet Engineering, Formal Languages and Automata Theory. During that time, I found various aspects of distributed systems fascinating so I decided to continue my education in this area. Finally, I joined the CLOUDS Lab to pursue my PhD studies. My PhD studies are funded by Melbourne International Research Scholarship (MIRS) and Melbourne International Fee Remission Scholarship (MIFRS).

Currently, I am third year PhD student and my thesis confirmed by the committee on the subject of "Resource Provisioning Policies for Federated Cloud Computing Environments". I study different aspects of Cloud Federation particularly economic and market oriented issues in my thesis. So far, I was able to publish my research outcome as follows:

1. Adel Nadjaran Toosi, Rупpa K. Thulasiram, and Rajkumar Buyya. 2012. Financial Option Market Model for Federated Cloud Environments. In proceedings of the 5th IEEE/ACM International Conference on Utility and Cloud Computing (UCC'12), Chicago, Illinois, USA, pp. 3-12.
2. Adel Nadjaran Toosi, Rodrigo N. Calheiros, Rупpa K. Thulasiram, Rajkumar Buyya. "Resource Provisioning Policies to Increase IaaS Provider's Profit in a Federated Cloud Environment", In proceedings of IEEE 13th International Conference on High Performance Computing and Communications (HPCC'11), Sept. 2011, Banff, Canada, pp. 279 -287.
3. Rodrigo N. Calheiros, Adel Nadjaran Toosi, Christian Vecchiola, Rajkumar Buyya "A Coordinator for Scaling Elastic Applications Across Multiple Clouds", Future Generation Computer Systems, Volume 28, No. 8, Pages: 1350-1362, ISSN: 0167-739X, Elsevier Science, Amsterdam, The Netherlands, October 2012.

For detail information about my current research and past publications, please visit my homepage: <http://www.csse.unimelb.edu.au/~adeln>

Member Self Profile: Yoganathan Sivaram

I started my PhD studies under the supervision of Prof. Rajkumar Buyya in the Department of Computing and Information Systems at the University of Melbourne in March 2011. I received my B.Eng degree in Software Engineering in 2003 and Master of Applied Science degree in 2008 from RMIT University in Melbourne, Australia. My focus during my Masters degree is related to Internet Computing and Application Security.



Before starting my PhD studies, I worked in the industry for over 10 years as developer, technical leader, and development manager specialised in Software as a Service (SaaS) based applications. During this time I have gained valuable 'hands-on' experience in resolving challenges faced in developing and deploying SaaS applications which complements my research interests and experience.

Currently I am working on Dynamic Scalable deployment and management of web applications in Cloud Platforms. This work particularly addresses the challenges and exploits the opportunities presented by the Cloud computing platform in order to efficiently and effectively deploys applications.

Member Self Profile: Deepak C Poola

I joined CLOUDS Lab in July 2011 as a PhD Student under the supervision of Prof Rajkumar Buyya and Prof Rao Kotagiri. My research focus is on Robust and Fault-Tolerant scheduling for scientific workflows in Cloud Computing environments. This involves failure modelling of workflows, reliability engineering of workflows and performance studies of Clouds. My research interests includes Cloud Computing, Workflows, Scheduling Algorithms, Reliability engineering, Failure modelling and Streaming Applications.

Prior to Joining CLOUDS Lab, I was working as an Application Developer in J P Morgan Chase, India. I have worked in Java, Spring, Struts, UNIX and web services as a part of my job profile. I have been in J P Morgan for two years from 2009 to 2011.

I have also worked as an Intern in Citrix R&D, Bangalore from Jan 2009 to Jun 2009. During which I worked on the implementation to WBXML parser for their home product Net scalar. Citrix gave me exposure and knowledge of working in a networking company.

I am a proud Alumina of BITS-Pilani, India. I have completed my M.E Computer Science from BITS-Pilani. Prior to which I completed my graduation in B.E Computer science from VISVESWARAIAH TECHNOLOGICAL UNIVERSITY, Karnataka.

Apart from this I nourish interests in Poetry, Philosophy and Sports.



Member Self Profile: Atefeh Khosravi

I joined CLOUDS Lab in March 2012 to pursue my PhD studies under the supervision of Prof. Rajkumar Buyya at the University of Melbourne. Before entering the University of Melbourne, I received my M.Sc. degree of Computer Engineering in 2011 and my B.Sc. degree of Information Technology Engineering in 2008, both from the Amirkabir University of Technology.

Prior to starting my PhD studies and during my master, I have worked as a researcher and consultant on Iran National IP/MPLS Core Network project at Iran Telecommunication Research Center (ITRC).

My PhD research is on energy-aware resource management across distributed Cloud datacenters. It is mainly focused on the development of policies and algorithms for placement of virtual machines by considering datacenters energy resources, carbon footprint, power consumption, and network distance, while meeting the required quality of service for Cloud users.

During 2012, I have worked with Gridbus Broker and connected it to Microsoft Azure to be able to lease resources from this Cloud provider. Moreover, I have collaborated with Telstra and CEET (Center for Energy-Efficient Telecommunications), the University of Melbourne, as a vocational placement on Data Modeling for NABERS (National Australian Built Environment Rating System) for Datacenters project.



Member Self Profile: Mohammed Alrokayan

I joined CLOUDS Lab in 2011 during my Master study. I was researching Aneka Cloud Platform and developing Cloud Web Portal (CWP) as part of my Master Thesis at the lab. CWP has been implemented and designed as a SaaS for Aneka middleware to manage and monitor cloud infrastructure.

By the end of 2011 I have graduated from The University of Melbourne with First Class Honours degree in Master of Information Technology. Then, in early 2012 I become a PhD student at The University of Melbourne.

Also, I'm a faculty member at the College of Computer and Information Science (CCIS), King Saud University (KSU), Riyadh, Saudi Arabia since 2007. I taught Distrusted Systems and Information Security for B.Sc. students.

Back in 2006 I have been working in a Cloud Operating System called "Swooj". Part of Swooj was my B.Sc. graduation project, which was a Cloud Operating System that combines three concepts: Thin Clients, Remote Desktop Services and Web 2.0. Swooj won the first rank in Mawhiba contest (Gulf region wide) and the second rank in AEC's best graduate project contest (Saudi Arabia wide).

My vision is: Moving people from consumption to productivity and sharing the experience and knowledge with others. As a result, my goal is to contribute establishing one of the top institute/organization in information technology in the world.

For more information on my current and past projects please visit my website: <http://alrokayan.com>

My 2012 publications are:

- Mohammed Alrokayan and Rajkumar Buyya, A Web Portal for Management of Aneka-Based MultiCloud Environments, Proceedings of the 11th Australasian Symposium on Parallel and Distributed Computing (AusPDC 2013), Adelaide, South Australia, January-February 2013.
- Anton Beloglazov, Sareh Fotuhi Piraghaj, Mohammed Alrokayan, and Rajkumar Buyya, Deploying OpenStack on CentOS Using the KVM Hypervisor and GlusterFS Distributed File System, Technical Report CLOUDS-TR-2012-3, Cloud Computing and Distributed Systems Laboratory, The University of Melbourne, August 14, 2012.



Member Self Profile: Sareh Fotuhi Piraghaj

I have joined CLOUDS Lab at the beginning of 2012. Currently, I am conducting my research on 'Autonomic Energy Efficient Resource Management in Cloud data centres'. During my research I participated in deploying OpenStack on the available hardware using the KVM Hypervisor. This results in a technical report¹ as a step by step installation guide for OpenStack.

During my master's degree in Iran University of Science and Technology, I have been working on image processing techniques on Synthetic Aperture Radar images which results in a number of publications.

My experiences before joining The University of Melbourne are as follows:

- Tutor, Teaching mathematics and physics for high school students, 2007-2012
- Teacher, Teaching mathematics and physics
- Counsellor, Ghalamchi Institute, 2008(for six months)
- University Lecturer (Digital Systems and Designs)
- Programmer (Working on Image Processing and Tracking techniques)
- Laboratory teacher



¹ Deploying open-stack on CentOS using the KVM hypervisor and GlusterFS distributed system, Tech. Rep., Technical Report CLOUDS-TR-2012-3, Cloud Computing and Distributed Systems Laboratory, The University of Melbourne, 2012

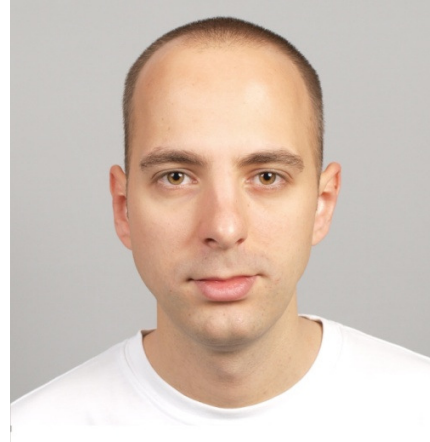
Member Self Profile: Nikolay Grozev

I joined CloudsLab in March 2012, when I enrolled as a PhD student at the University of Melbourne under the supervision of Prof. Rajkumar Buyya.

Previously I have graduated from the University of Sofia "St. Kliment Ohridski" with a bachelor's degree in Informatics and a master's degree in Software Engineering. I have also specialised at the Mälardalen University, Sweden, where I worked on my master's thesis. My professional experience includes working as a Software Engineer at various companies participating in projects ranging from large scale enterprise systems to research products.

In my PhD research I investigate how to architect 3-tier applications so that they can utilise multiple Cloud data centres. This will allow for building applications which are more resilient to data centre outages and provide end users worldwide with high Quality of Experience (QoE) by minimising network latency. Moreover, it will allow for building cost efficient systems that are legislation compliant in multiple regulatory regions.

A complementary direction in my research is the modelling and simulation of interactive distributed systems. I research analytical performance models and simulation environments that facilitate quick performance analysis and evaluation of provisioning and scheduling approaches for such applications.



Member Self Profile: Maria Alejandra Rodriguez

My name is Maria Alejandra Rodriguez and I am from Bogota, Colombia. I came to Melbourne on February 2010 to start my master's degree, Master of Engineering in Distributed Computing, at the University of Melbourne. I completed the degree on December 2011 with first class honours. On October 2012 I decided to pursue my PhD and joined the Cloud Computing and Distributed Systems (CLOUDS) Laboratory at The University of Melbourne where I am currently a PhD candidate under the supervision of Prof. Rajkumar Buyya.



Before coming to Australia, I finished my Bachelor's degree in Computing and Systems Engineering at Los Andes University in Bogota, Colombia. I worked as a software engineer in a small company for over two years and then head to Bangalore, India to work for Tata Consultancy Services, an Indian multinational. As much as I enjoyed and learnt from my years in the industry, I've always had a passion for learning and studying and hence decided to go 'back to school' after spending a year as a developer in India.

Because I've mostly done coursework studies, I am slowly plunging into the world of research and learning its ways. During my master's research project, I investigated the execution of scientific workflows on distributed environments, specifically on grids and clouds. I am now expanding on this topic and my knowledge of Cloud Computing. I am researching resource provisioning and scheduling algorithms of large scale scientific workflows on distributed environments and, in the short term, I aim to propose a heuristic that targets IaaS Clouds and its pricing model while taking advantage of some of their more promising characteristics: elasticity, heterogeneity and auto-scaling.

My personal interests include travelling and getting to know different cultures. I'm also a big promoter of my country; unfortunately it has suffered from negative publicity over the years and people are afraid of visiting. I enjoy Bikram yoga, scuba diving and I love animals, especially dogs. I'm passionate about ballet; I believe it is a beautiful and graceful art that helps in the development of essential qualities like hard work, discipline and teamwork.

Member Self Profile: Roland Padilla

Roland Padilla is uniquely positioned as an information systems (IS) practitioner-academic. As an IS professional he had worked for global organisations representing systems integration (SI), information technology (IT) consulting, and business process outsourcing (BPO). Most recently, he is recognised by the Australian Computer Society (ACS) as a senior ACS certified professional or MACS (Snr) CP, someone in professional practice for at least 10 years and has been in a senior ICT management position for at least 5 years.



He rose from the ranks as a PABX (Private Automatic Branch Exchange) Engineer involved in patching cables to a General Manager responsible for global operations. Roland has demonstrated success and proven an ability to lead people and manage numerous functions, consisting data networking from CISCO Systems (Engineer), IT systems integration from FUJITSU (Manager), resource management from Headstrong (Manager), IT service management from Netmarks (General Manager), and project management from NEC (Team Leader). These senior leadership and management functions from multi-national corporations provided an opportunity to engage in diverse industry segments, comprising telecommunications, semiconductor, automotive, banking, government, and utilities. Additionally, Roland has demonstrated global experiences, having undertaken projects, collaborations, and skills trainings in several countries such as Japan, US, Philippines, Hong Kong, Singapore, and UK.

Apart from real world and broad industry perspectives, Roland is deepening his viewpoint within the academic world. In 2010, he earned his master's degree in IS, and obtained a First-Class Honours (H1) or High Distinction (HD) equivalent. He had the honour and privilege to deliver the valedictory address on Graduation Day. Less than a month after, he joined CISCO Systems in Sydney, and won 1st Place in its Asia-Pacific and Japan internship competition. Currently, Roland is undertaking a PhD -- exploring how to measure the value of service in business-to-business cloud computing. Economies are increasingly dominated by the service sector. More than ever, research is needed to address approaches that measure and optimise service. His research journey examines service value within an interdisciplinary context, and focuses on the effective use of computing and information technologies by organisations. His thesis seeks to address the essential research question of how service value, as a higher-order formative measure, is investigated within the context of cloud computing. The research project argues that a reliable conceptualisation of the service value construct is of critical relevance in the optimisation and measurement of the cloud computing phenomena.

In transitioning from Masters to PhD, Roland was awarded an Australian Postgraduate Award (APA), a scholarship awarded to local students with exceptional research potential and proven academic excellence. This scholarship supports him via fee remission and living allowance throughout this worthwhile intellectual journey. Apart from this scholarly pursuit, Roland is occupied as a Convenor of the cloud computing special interest group (SIG) of the ACS, and as a reserve member of the Department of Defence in Australia.

For more information, please visit <http://linkedin.com/in/rolandpadilla>

Member Self Profile: Jing Ding

I'm Jing Ding, from Anhui Province of China. From October 2012, I became a visiting student supervised by Rajkumar Buyya in Cloud Computing and Distributed Systems (CLOUD) Laboratory at University of Melbourne. My visit is sponsored by Chinese Scholarship Council (CSC).

I am a second year PhD student at Hefei University of Technology in China. Before I came to University of Melbourne, I participated in projects on Cloud Computing, exploring decision making process and information service system architecture in Cloud Computing environment.

My current research focuses on Cloud services, in order to provide better infrastructure, platform and software services in Cloud Computing environment.

I wish to have vibrant and enjoyable study life in Melbourne.



9. Selected Projects/Programs

Cloudbus: A Toolkit for Market-Oriented Cloud Computing

Web: <http://www.cloudbus.org/>

The Cloud Computing and Distributed Systems (CLOUDS) Laboratory is a software research and innovation group at the University of Melbourne, Australia. The Lab is actively engaged in design and development of next-generation computing systems and applications that aggregate by dynamically leasing services of distributed resources depending on their availability, capability, performance, cost, and users' QoS requirements. The lab is working towards realising this vision through its two flagship projects: Gridbus and Cloudbus.

The Cloudbus project, an initiative that started in 2008 by the CLOUDS lab at the University of Melbourne, facilitates the realization of the above vision. The project developed innovative solutions for market-oriented Cloud computing. The current innovative developments include: (i) Aneka, a platform for developing and managing Cloud computing applications from market-oriented perspective; (ii) InterCloud, a framework for internetworking of Cloud service providers, dynamically creating federated computing environments, and scaling of distributed applications; (iii) CloudSim, a simulation framework that allows researchers to control every aspect of a Cloud environment: algorithms, platforms, and infrastructure; and (iv) Workflow Engine, a management platform that facilitates the creation, deployment and monitoring of complex applications modeled in a systematic and orderly manner in Cloud computing environments.

The Cloudbus project

The Cloudbus project is engaged in the creation of open-source specifications, architecture and a reference Cloud toolkit implementation of market-oriented cloud computing. Some of our technologies serve as foundation for industrial solutions offered by Manjrasoft to its customers worldwide.

The research probes include:

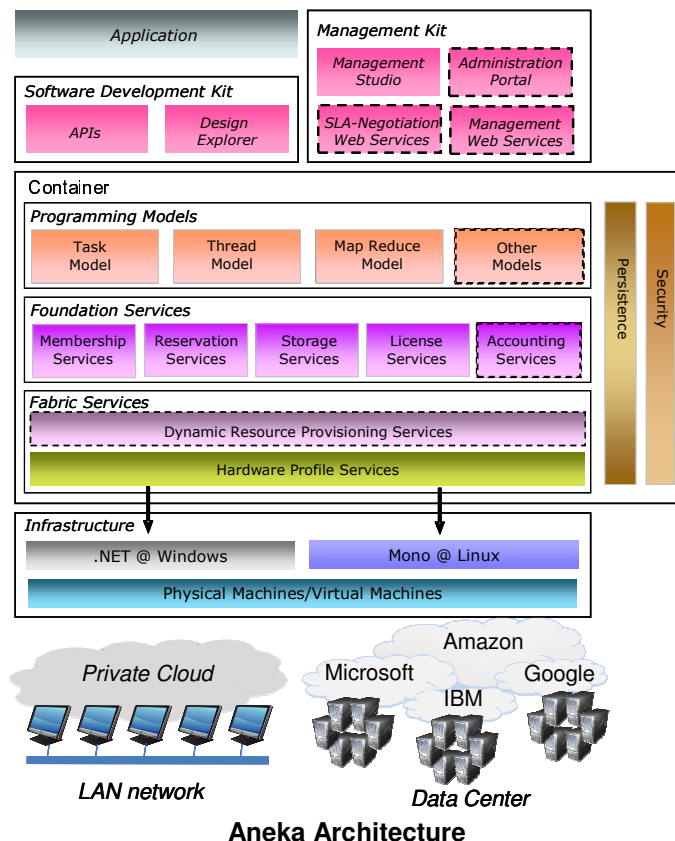
- Market Oriented Cloud Architecture
- Enterprise Cloud Application Platform (Aneka)
- Cloud Service Broker
- Cloud Workflows and Scheduling
- Service Level Agreements & Resource Allocation Systems (Libra).
- Energy-Efficient Data Centers and Clouds
- Cloud Simulation Toolkit (CloudSim).
- Application Development Environments
- Application Targets include: ECG Monitoring and Analysis, Data Mining and Business Analytics, Brain Imaging (Dartmouth Medical School), and Geophysics (*Intrepid*).
- Open SensorWeb Architecture
- InterCloud – Peering and Federation of Clouds
- Content Delivery Networks

Aneka: .NET-based Cloud Computing

Web: <http://www.manjrsoft.com>

ANEKA provides a set of services that make construction and development of Clouds and their applications as easy as possible without sacrificing flexibility, scalability, reliability and extensibility. It is now commercialized through Manjrsoft, a startup company of the University of Melbourne. The key features supported by ANEKA are:

- A configurable and flexible execution platform (container) enabling -
 - Pluggable services;
 - Security implementations - multiple authentication / authorization mechanisms such as role-based security and Windows domain-based authentication;
 - Multiple persistence options including RDBMS, SQL Express, MySQL and flat files;
- SDK (Software Development Kit) supporting multiple programming models including –
 - Object oriented thread model,
 - Task model for legacy applications
 - Map Reduce model for data-intensive applications
 - Custom tools such as Design Explorer for parameter sweep studies
- Easy to use management tool for SLA and QoS negotiation and resource allocation.



QoS-Oriented Cloud Workflow Engine

Web: <http://www.cloudbus.org/workflow>

The emerging e-Research paradigm enables researchers from different disciplines and organisations to engage in collaborative scientific investigation. They need to share geographically distributed resources owned by different organisations. e-Research applications need to negotiate with resource providers for guarantees on access time, duration and level of quality of service (QoS). To meet QoS requirements of e-Research application workflows, this project aims to develop Grid technologies that support (a) QoS-based scheduling of e-Research application workflows on distributed resources, (b) mechanisms for formulating, negotiating and establishing service level agreements (SLA) with resource providers and (c) SLA-based allocation and management of resources. Specifically, the project aims to:

- Define an architectural framework and principles for the development of QoS-based workflow management and SLA-based resource allocation systems,
- Develop QoS-based algorithms for scheduling e-Research workflow applications,
- Develop SLA-based negotiation protocols and resource allocation algorithms,
- Implement a prototype system by incorporating the algorithms and policies developed above, and
- Develop real world demonstrators in various scientific domains such as life sciences.

Key Reference: [1] Jia Yu and Rajkumar Buyya, Scheduling Scientific Workflow Applications with Deadline and Budget Constraints using Genetic Algorithms, *Scientific Programming Journal*, Volume 14, Issue 3-4, ISSN: 1058-9244, IOS Press, Amsterdam, The Netherlands, Nov. 2006.

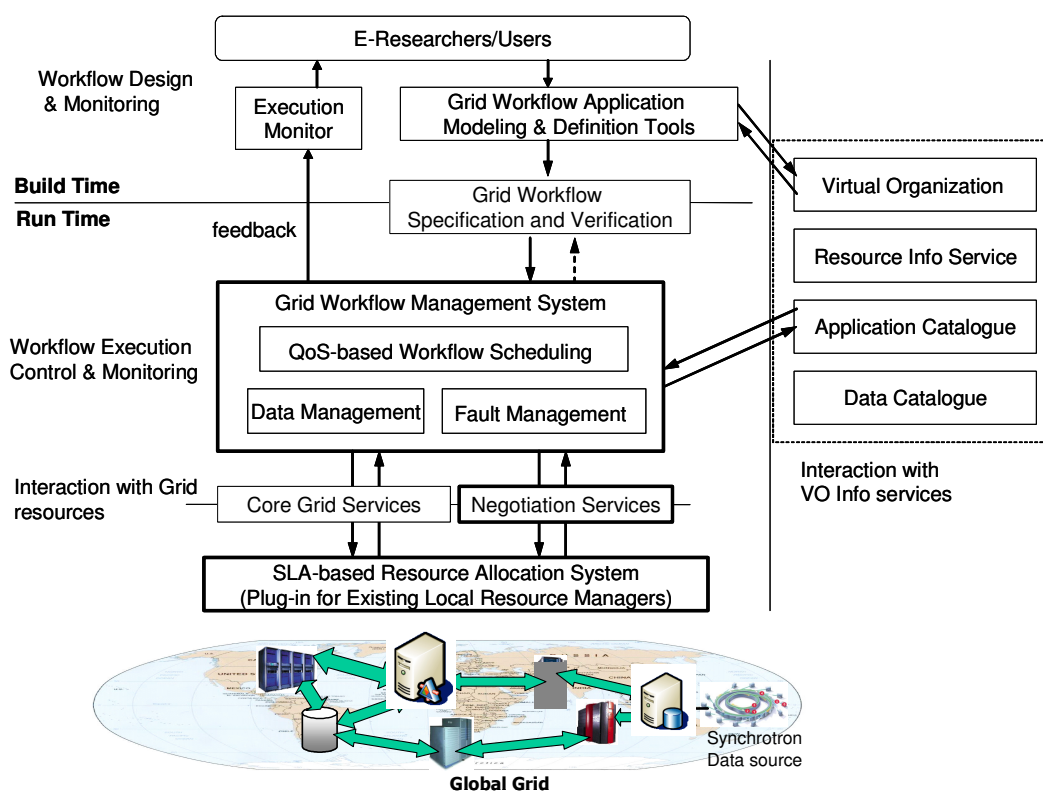


Fig. 1: Architecture of QoS-based workflow management and resource allocation system.

The Green Cloud Project: Innovative Solutions for Energy-Efficient Cloud Computing

Web: <http://www.cloudbus.org/greencloud>

Traditionally, high-performance computing (HPC) community has focused on performance (speed). Since early 2000, several companies have started building Data Centers inspired by commodity HPC (cluster computing) systems-architecture for hosting/powering industrial applications including search engines such as Google. At the same time microprocessor vendors have not only doubled the number of transistors (and speed) every 18-24 months, but they have also doubled the power densities. That is, the tremendous increase in computer performance has come with an even greater increase in power usage. As a result operational cost of HPC systems including industrial Data Centre is rapidly growing. This is reflected from a statement by CEO of Google (Eric Schmit): "what matter most to Google is not speed but power, because data centers can consume as much electricity as a city."

The aim of Green Cloud Project is to develop high-end computing systems such as Clusters, Data Centers, and Clouds that allocate resources to applications hosting Internet services (e-Services) to meet not only users' quality of service requirements, but also minimise consumption of electric power. That is to, to improve power management and consumption by dynamically managing and configuring power-aware ability of system devices, such as processors, disks, and communication links.

Selected Publications:

- Anton Beloglazov, Rajkumar Buyya, Young Choon Lee, and Albert Zomaya, [A Taxonomy and Survey of Energy-Efficient Data Centers and Cloud Computing Systems](#), Advances in Computers, Volume 82, 47-111pp, M. Zelkowitz (editor), ISBN: 978-0-12-385512-1, Elsevier, Amsterdam, The Netherlands, March 2011.
- Saurabh Kumar Garg, Chee Shin Yeo, Arun Anandasivam, and Rajkumar Buyya, [Environment-Conscious Scheduling of HPC Applications on Distributed Cloud-oriented Data Centers](#), Journal of Parallel and Distributed Computing (JPDC), Volume 71, Number 6, Pages: 732-749, ISSN: 0743-7315, Elsevier Press, Amsterdam, The Netherlands, June 2011.
- Saurabh Kumar Garg, Chee Shin Yeo, and Rajkumar Buyya, [Green Cloud Framework For Improving Carbon Efficiency of Clouds](#), Proceedings of the 17th International European Conference on Parallel and Distributed Computing (EuroPar 2011, LNCS, Springer, Germany), Bordeaux, France, August 29-September 2, 2011.
- Kyong Hoon Kim, Anton Beloglazov, and Rajkumar Buyya, [Power-aware Provisioning of Virtual Machines for Real-time Cloud Services](#), Concurrency and Computation: Practice and Experience, Volume 23, Number 13, Pages: 1491-1505, ISSN: 1532-0626, Wiley Press, New York, USA, September 10, 2011.

CloudSim: A Framework for Modeling and Simulation of Cloud Computing Infrastructures and Services

Web: <http://www.cloudbus.org/cloudsim>

Recently, cloud computing emerged as the leading technology for delivering reliable, secure, fault-tolerant, sustainable, and scalable computational services, which are presented as Software, Infrastructure, or Platform as services (SaaS, IaaS, PaaS). Moreover, these services may be offered in private data centers (private clouds), may be commercially offered for clients (public clouds), or yet it is possible that both public and private clouds are combined in hybrid clouds.

These already wide ecosystem of cloud architectures, along with the increasing demand for energy-efficient IT technologies, demand timely, repeatable, and controllable methodologies for evaluation of algorithms, applications, and policies before actual development of cloud products. Because utilization of real testbeds limits the experiments to the scale of the testbed and makes the reproduction of results an extremely difficult undertaking, alternative approaches for testing and experimentation leverage development of new Cloud technologies.

A suitable alternative is the utilization of simulations tools, which open the possibility of evaluating the hypothesis prior to software development in an environment where one can reproduce tests. Specifically in the case of Cloud computing, where access to the infrastructure incurs payments in real currency, simulation-based approaches offer significant benefits, as it allows Cloud customers to test their services in repeatable and controllable environment free of cost, and to tune the performance bottlenecks before deploying on real Clouds. At the provider side, simulation environments allow evaluation of different kinds of resource leasing scenarios under varying load and pricing distributions. Such studies could aid the providers in optimizing the resource access cost with focus on improving profits. In the absence of such simulation platforms, Cloud customers and providers have to rely either on theoretical and imprecise evaluations, or on try-and-error approaches that lead to inefficient service performance and revenue generation.

The primary objective of this project is to provide a generalized and extensible simulation framework that enables seamless modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services. By using CloudSim, researchers and industry-based developers can focus on specific system design issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.

CloudSim is powered by jProfiler.

Main reference: Rodrigo N. Calheiros, Rajiv Ranjan, Anton Beloglazov, Cesar A. F. De Rose, and Rajkumar Buyya, CloudSim: A Toolkit for Modeling and Simulation of Cloud Computing Environments and Evaluation of Resource Provisioning Algorithms, Software: Practice and Experience (SPE), Volume 41, Number 1, Pages: 23-50, ISSN: 0038-0644, Wiley Press, New York, USA, January, 2011.

10. Software Releases

CloudSim Toolkit 3.0: A Framework For Modeling And Simulation Of Cloud Computing Infrastructures And Services

The Cloudbus Project at The University of Melbourne, Australia is proud to announce the release of the new version of its Cloud simulation software, the CloudSim.

One year has passed since last version of CloudSim was released. Cloud computing now is mainstream, and has been heavily adopted by different industries. It is also omnipresent in conferences and journals from diverse fields such as high performance computing, grid computing, distributed systems, operating systems, software engineering, databases and so on. CloudSim has been present in publications in all the above fields.

To help in further developments in the field of Cloud computing regardless the main area of application, new features and improvements were added to CloudSim 3.0. Having the project hosted in Google code allowed us to have an enhanced feedback from users, via issue tracking and group discussion. Based on this feedback, we could identify bugs, concepts that were being misinterpreted by users and features of little significance and complexity. In response to this feedback, we fixed all the identified bugs, clarified confusing aspects of the tool, and removed features that were proven to be unpopular with users and just were making the APIs confusing.

This version of CloudSim brings enhanced modelling of power-aware and energy efficient Cloud computing, and also a new package allowing modelling of internal data center topologies and message-passing applications.

We encourage the community to keep collaborating with us by notifying us about any identified bugs, providing feedback on new features you would like to have in future versions of the toolkit, and also developing your own extension packages, which we will be happy to promote on the project's homepage. We will also be happy to list on our homepage scientific peer-reviewed papers, whose results were obtained with CloudSim.

As in its previous version, all components developed as part of the CloudSim Toolkit are open source released under the LGPL license to encourage innovation and pass full freedom to our users.

We would like to thank all the support we have received from users all around the world. Your contribution in finding and reporting bugs, proposing (and developing) new features, and even in using CloudSim has been paramount in the success of the project.

To download the CloudSim software, please visit the Cloudbus Project web site at <http://www.cloudbus.org/cloudsim/>

The CloudSim Team Melbourne, January 2012

Aneka 3.0: A Software Technology to Simplify .NET-based Enterprise Clouds

Manjrasoft Pty Ltd, Australia

Aneka is a Cloud Application Development Platform (CAP) for developing and running compute and data intensive applications. As a platform it provides users with both a runtime environment for executing applications developed using any of the three supported programming models, and a set of APIs and tools that allow you to build new applications or run existing legacy code.

The Aneka 3.0 distribution comes with the following features:

- Application Catalogue Service
 - Implemented Platform independent management protocol
 - Central software repository for software installation and update
 - Implemented Node gateway to control the node services
- Reservation Integration
 - Integrated Reservation services into Aneka codebase
 - Integrated the existing Allocation services into Aneka codebase
- Enterprise QoS
 - Added Cost-Optimization Job Scheduling
 - Added Time-Optimization Job Scheduling
 - Added User Modules into Design Explorer enabling selection of QoS
- Cloud Deployment
 - Full support for Amazon EC2 (static deployment and dynamic deployment)
 - Full support for Xen Virtualization
 - Static deployment via Xen VM: Dynamic deployment via Xen API
 - Full support for GoGrid (static deployment and dynamic deployment)
- Logging Service
 - Added logging service that manage the log information in each node
 - Added logging management GUI to view the log information
- Dynamic Resource Provisioning Scheduling
 - Added intelligent algorithm to dynamic provisioning service to auto scale the resources based on QoS
- Reporting Service
 - Provided service capability to report its own properties to the Aneka container
 - Implemented the Reporting service that handles queries related to various reporting activities including billing, metering, and usage
 - Enhanced GUI to provide statistics for various reporting activities
 - Configuration Utilities: Implemented customizable configuration facilities that will be used when configuring various Aneka services

Download:

<http://www.manjrasoft.com>

11. Moments with Visitors, Colleagues and International Hosts



Prof. Buyya receiving "Hind Rattan (Jewel of India) Award" during the 31st International Congress of Non Resident Indians, The NRI Welfare Society of India, New Delhi, India, Jan 2012.



David Alan Grier (2012 President-Elect, 2013 President of the IEEE Computer Society) visit to Melbourne University and CLOUDS Lab.



IV Ventures Chair Professors and researchers from Tsinghua University, China during the workshop on Internet of Things and Cloud Computing, Beijing, China.



During inauguration of International Conference on Advances in Cloud Computing in Bangalore. Organized by the Computer Society of India.