KEYNOTE/PLENARY

Title:

Systems and Simulation Toolkits for Building and Evaluating Solutions for Next-Gen Cloud and Quantum Computing

Speaker:

Prof. Rajkumar Buyya

Director, Cloud Computing and Distributed Systems (CLOUDS) Lab,
The University of Melbourne, Australia

CEO, Manjrasoft Pvt Ltd, Melbourne, Australia

Abstract

The twenty-first-century digital infrastructure and applications are driven by Cloud computing and emerging Quantum computing paradigms. The Cloud computing paradigm has been transforming computing into the 5th utility wherein "computing utilities" are commoditized and delivered to consumers like traditional utilities such as water, electricity, gas, and telephony. It offers infrastructure, platform, and software as services, which are made available to consumers as subscription-oriented services on a pay-as-you-go basis over the Internet. Its use is growing exponentially with the continued development of new classes of applications such as AI-powered models (e.g., ChatGPT) and the mining of crypto currencies such as Bitcoins. To make Clouds pervasive, Cloud application platforms need to offer (1) APIs and tools for rapid creation of scalable and elastic applications and (2) a runtime system for deployment of applications on geographically distributed Data Centre infrastructures (with Quantum computing nodes) in a seamless manner.

These wide ecosystems of cloud architectures integrated with new accelerators such as Quantum processing capabilities, along with the increasing demand for energy-efficient IT technologies, require timely, repeatable, and controllable methodologies for evaluation of algorithms, applications, and policies before their implementation in cloud products. As 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 a repeatable and controllable environment free of cost, and to tune the performance bottlenecks before deploying on real Clouds and quantum processors. 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.

This keynote presentation covers (1) 21st century vision of computing and identifies various emerging IT paradigms that make it easy to realize the vision of computing utilities, (2) different approaches for evaluation of resource management and application scheduling algorithms, (3) latest CloudSim 7G toolkit supporting modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services, (4) case studies on the use of CloudSim in development and evaluation of policies for (a) management of Cloud Data Centre resource to minimise energy-consumption, (5) use of Aneka 6G software system for scheduling of applications to minimise the cost of computation, yet meeting users QoS requirements, and (6) new directions on modelling and simulation of Quantum computing systems and applications.

Biography

Dr. Rajkumar Buyya is a Redmond Barry Distinguished Professor and Director of the Quantum Cloud Computing and Distributed Systems (qCLOUDS) Laboratory at the University of Melbourne, Australia. He is also serving as the founding CEO of Manjrasoft, a spin-off company of the University, commercializing its innovations in Cloud Computing. He has authored over 850 publications and seven textbooks including "Mastering Cloud Computing" published by McGraw Hill, China Machine Press, and Morgan Kaufmann for Indian, Chinese and international markets respectively. Dr. Buyya is one of the highly cited authors in computer science and software engineering worldwide (h-index=172, g-index=384, i10-index=818, and 159,700+ citations). A bibliometric study by Stanford University and Elsevier since 2019 (for six consecutive years), Dr. Buyya is recognized as the Highest-Cited author in the Distributed Computing field worldwide. He graduated 60 PhD students who are working in world-leading research universities and high-tech companies such as Microsoft, Google, and IBM. He has been recognised as IEEE Fellow, a "Web of Science Highly Cited Researcher" for seven times since 2016, the "Best of the World" twice for research fields (in Computing Systems in 2019/2024 and Software Systems in 2021/2022/2023) as well as "Lifetime Achiever" and "Superstar of Research" in "Engineering and Computer Science" discipline twice (2019 and 2021) by the Australian Research Review.

Software technologies for Grid, Cloud, Fog, Quantum computing developed under Dr.Buyya's leadership have gained rapid acceptance and are in use at several academic institutions and commercial enterprises in 50+ countries around the world. Manjrasoft's Aneka Cloud technology developed under his leadership has received "Frost New Product Innovation Award". He served as founding Editor-in-Chief of the IEEE Transactions on Cloud Computing. He is currently serving as Editor-in-Chief of

Software: Practice and Experience, a long-standing journal in the field established in 1970. He has presented over 750 invited talks (keynotes, tutorials, and seminars) on his vision on IT Futures, Advanced Computing technologies, and Spiritual Science at international conferences and institutions in Asia, Australia, Europe, North America, and South America. He has recently been recognized as a Fellow of the Academy of Europe. For further information on Dr.Buyya, please visit his cyberhome: www.buyya.com