Cloud Computing Technology and Science

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ABSTRACT

The "Cloud" is a natural evolution of distributed computing and of the widespread adaption of virtualization and SOA. In Cloud Computing, IT-related capabilities and resources are provided as services, via the Internet and on-demand, accessible without requiring detailed knowledge of the underlying technology. By taking advantage of virtualized resources, cloud computing presents an attractive means to address the challenges while realizing the potential of ubiquitous IT services. Consequently, computational scientists are turning their attention to emerging cloud computing technology and science. As such, cloud computing has come to the picture seeking solutions for computing and IT services to be efficient and environmentally friendly. This special issue is in response to the increasing convergence of cloud computing technologies and services, while different approaches exist, challenges and opportunities are numerous in this context. The research papers selected for this special issue represent recent progresses in the field, including works on virtualization, big data intelligence, resource management, services computing architectures and modeling, as well as mobile cloud and applications. This special issue includes seven extended version of the selected papers originally presented at the 4th IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom 2012), held at Taipei, Taiwan. The papers selected for this issue not only contribute valuable insights and results but also have particular relevance to the emerging and cloud computing technologies. All of them present high quality results for tackling problems arising from the ever-growing cloud computing, heterogeneous computing as well as sustainable computing technologies. We believe that this special issue provides novel ideas and state-of-the-art techniques in the field, and stimulates future research in the emerging and cloud computing community.

Keywords: *Cloud Computing, Mobile Applications, Mobile Cloud, Resource Management, Virtualization*

CLOUD ARCHITECTURE

In virtualized environments, the customers who purchase virtual machines (VMs) from a third-party cloud would expect that their VMs run in an isolated manner. However, the performance of a VM can be negatively affected by co-resident VMs. The paper by Ziye Yang, Haifeng Fang, Yingjun Wu, Chunqi Li and H.howie Huang, entitled "Measuring the Characteristics of Hypervisor I/O Scheduling in the Cloud for Virtual Machine Performance Interference", presents a distributed I/O performance measurement system, which can help identify the characteristics of disk I/O scheduler in a hypervisor and conduct I/O based perfor-

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mance attacks. The authors conduct a number of experiments on both Xen and VMware platforms. The authors deploy their system on Amazon EC2 and successfully slow down the performance of co-resident VMs.

Along with the development of cloud computing, offloading has become an increasingly attractive way to extend the battery life and reduce execution time on mobile devices. The paper by Huaming Wu, Qiushi Wang and Katinka Wolter, entitled "Optimal Cloud-path Selection in Mobile Cloud Offloading Systems Based on QoS Criteria", explores the methods of optimal cloud-path selection for offloading in mobile cloud computing systems when taking the network bandwidth between the mobile device and cloud service and the availability of cloud service into considering. Several alternative cloud services are considered and evaluated in terms of many different criteria such as performance, bandwidth, security, financial and availability in cloud-path selection problem. The proposed architecture is proved to be an effective and synthesized way through numerical analysis.

Resource Management

Data analytics in the Cloud opens new possibilities for executing complex applications with multiple processing phases. Such applications can benefit from using MapReduce model, only requiring the end-user to define the application algorithms for input data processing and the map and reduce functions. However, this poses a need to install/configure specific frameworks such as Apache Hadoop or Elastic MapReduce in Amazon Cloud. In order to provide more flexibility in defining and adjusting the application configurations, the paper by Carlos Goncalves, Luis Assuncao and Jose C. Cunha, entitled "Flexible MapReduce Workflows for Cloud Data Analytics", describes an approach for supporting MapReduce stages as sub-workflows, termed as AWARD, which stands for Autonomic Workflow Activities Reconfigurable and Dynamic. The AWARD illustrates the feasibility of using a unified workflow framework to express the composition of different phases of a complex application. The authors have shown that one can execute a particular application phase as a sub-workflow designed as a MapReduce computation. They also showed that the proposed framework is flexible to support the execution of MapReduce workflows using similar APIs as used in Hadoop.

The Cloud computing paradigm is adopted for its several advantages like reduction of cost incurred when using a set of resources. However, despite the many proven benefits of using a Cloud infrastructure to run business processes, the lack of guidance for choosing between multiple offerings is still an open issue. The paper by Kahina Bessai, Samir Youcef, Ammar Oulamara and Claude Godart, entitled "Scheduling strategies for business process applications in Cloud environments", proposes a set of scheduling strategies for scheduling business processes on distributed Cloud resources while taking into account its elastic computing characteristic that allows users to allocate and release compute resources on-demand. Experiment results demonstrate that the proposed approaches present good performance.

Big Data Intelligence

With the advance of sensing technologies and the prevalence of GPS devices, trajectory data have been drawing much attention from the data mining community. However, trajectory data are typically large and identifying interesting patterns requires intensive analysis that cannot be manually done, where data mining techniques play an important role. The paper by Kazuhiro Seki, Ryota Jinno and Kuniaki Uehara, entitled "Parallel Distributed Trajectory Pattern Mining Using Hierarchical Grid with MapReduce", proposes a parallelizable, hierarchical grid approach with quadtree search to trajectory pattern mining so as to identify complex patterns requiring different levels of granularity. Through the evaluative experiments on real-world people flow data in the Tokyo metropolitan area, it was verified that the proposed approach was able to identify such