International Journal of Information Processing, 9(4), 89-99, 2015
ISSN : 0973-8215
IK International Publishing House Pvt. Ltd., New Delhi, India

K-means Min-Min Scheduling Algorithm for Heterogeneous Grids or Clouds

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Cloud computing is delivering on-demand services to the customers in the form of Infrastructure as a Service (IaaS), platform as a service and software as a service. IaaS serves the customer demands (or tasks) by deploying the Virtual Machines (VMs) in the datacenter. However, efficient mapping of tasks to the VMs/grids/clouds plays a crucial role in obtaining minimum makespan. Therefore, task scheduling is one of the most challenging issues in both grid and cloud computing systems. The mapping of the tasks to the grid or cloud resources is a well-known NP-complete problem for which various heuristic approaches are proposed in the literature. In this paper, we propose a new task scheduling algorithm, called Grid (or Cloud) K-means Min-Min Scheduling (GKMS (or CKMS)) algorithm which uses traditional K-means algorithm followed by the well-known Min-Min algorithm. The performance of the proposed scheduling algorithm is evaluated by means of two performance metrics such as makespan and average grid/cloud utilization. The proposed algorithm is compared with the well-known Min-Min, Max-Min, Cloud Min-Min Scheduling (CMMS), Cloud MAX-Min Scheduling (CMAXMS) and Cloud Normalized Min-Min Max-Min (CNXM) algorithms as per their applicability. The experimental results on the benchmark dataset clearly show the efficacy of the proposed algorithm over the existing algorithms in terms of makespan and average grid/cloud utilization.

Keywords : Average Cloud Utilization, Cloud Computing, Grid Computing, K-means Algorithm, Makespan, Multi-cloud.

1. INTRODUCTION

Cloud computing is a new and proficient technique in the field of Information and Communications Technology (ICT). It is an extension of parallel, distributed and grid computing. The services in the cloud can be delivered to the customer in the form of three services, namely infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS). These services are available to users in a pay-per-use basis [1]. Therefore, cloud computing has drawn intensive interest in various fields such as healthcare, agriculture and smart grid [2]. This technology is provided by the following cloud service providers (CSPs): Microsoft Azure [3], Amazon Elastic Compute Cloud (EC2) [4], Google App Engine (GAE) [5] and IBM Cloud [6] to distribute tasks across the various resources hosted by the datacenters. The task assignment to the grid or cloud resources are a well-known NP-Complete problem as it aims to minimize the overall execution time (*i.e.*, makespan) [7-10]. Hence, several efforts have been made to find a near optimal solution. However, the problem in multi-cloud heterogeneous environment is very challenging and not well covered in the current research [2].

In this paper, we address the problem for heterogeneous grids or clouds and propose a new task scheduling algorithm, called Grid (or Cloud) K-means Min-Min Scheduling (GKMS (or CKMS)) algorithm. This algorithm comprises of two phases, namely clustering and

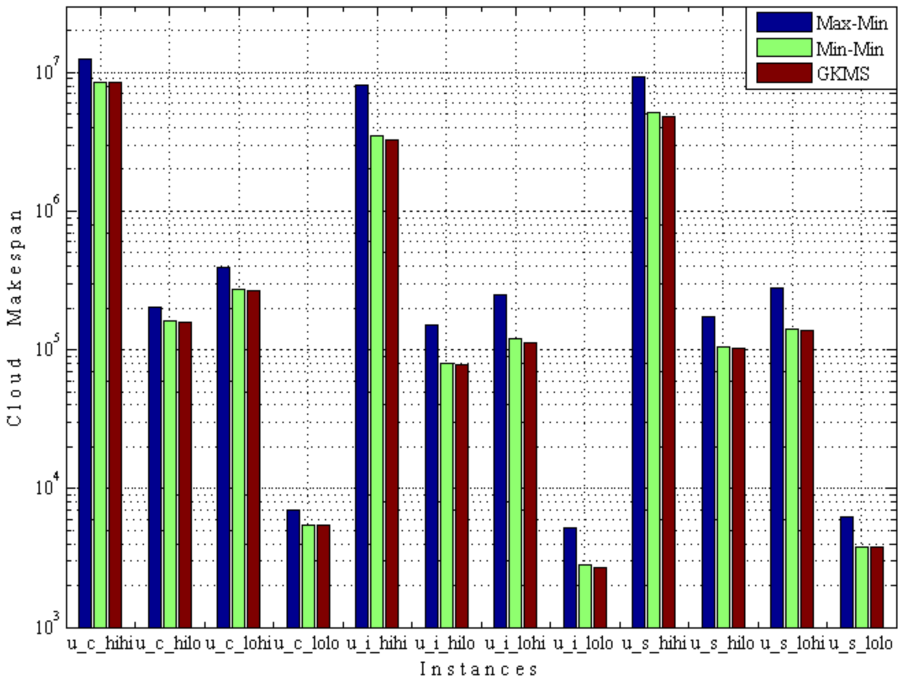

Figure 1. Graphical Comparison of Makespan for Max-Min, Min-Min and GKMS using 512 × 16 Benchmark Dataset

7. CONCLUSIONS

Scheduling in heterogeneous computing environments is a well-known NP-complete problem. We have presented a task scheduling algorithm for heterogeneous grid and cloud system. The proposed algorithm uses traditional K-means clustering technique to minimize the makespan and maximize the resource utilization. It was tested and compared with existing algorithms using 512 × 12 benchmark dataset. The comparison is based on task heterogeneity, machine or cloud heterogeneity and type of consistency (*i.e.*, consistent, inconsistent and semi-consistent). The comparison result clearly shows the efficacy of the proposed algorithm in terms of makespan and resource utilization. The future work will be the implementation of the proposed algorithm in real cloud environment and cost analysis of the proposed algorithm.

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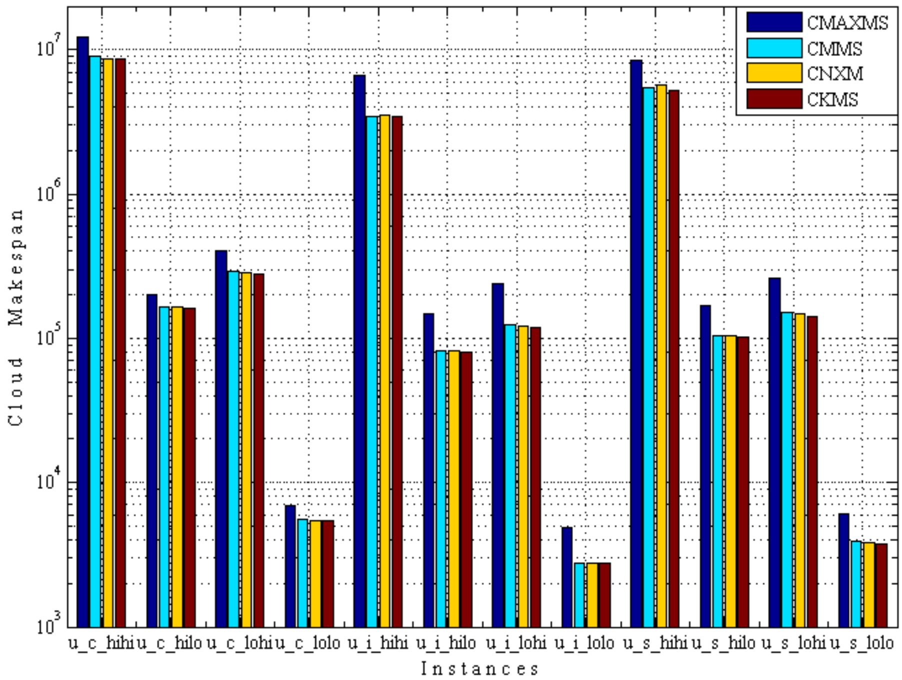

Figure 2. Graphical Comparison of Makespan for CMAXMS, CMMS and CNXM using 512 × 16 Benchmark Dataset

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