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Performance analysis on Optimal Criteria for Task Scheduling Algorithms in Cloud Environments

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Abstract: This paper focuses on the consideration of various optimization criteria forsolving task scheduling problems in cloud environments. In past, several optimization techniques have been implemented. But most of these methods are time-consuming and takes a lot of search space to obtain a solution for task scheduling. Generally, two objectives have been considered with minimization of makespan and very few are dealt with less processing cost during task scheduling. However, it is noticed that the developed algorithm comprises a number of tuning parameters which leads the mathematical complexity and takes more search space while implementation. This paper demonstrates the possible number of objectives that can be treated to solve task scheduling problems.
Keywords: cloud computing, task scheduling, optimization, makespan, and processing cost.

I. INTRODUCTION

Cloud computing provides sharing of computing resources and data storage and allows its users to access information to utilize its services over the internet and central remote servers on-demand as shown in Fig.1(Goddu & Reddi, 2019).

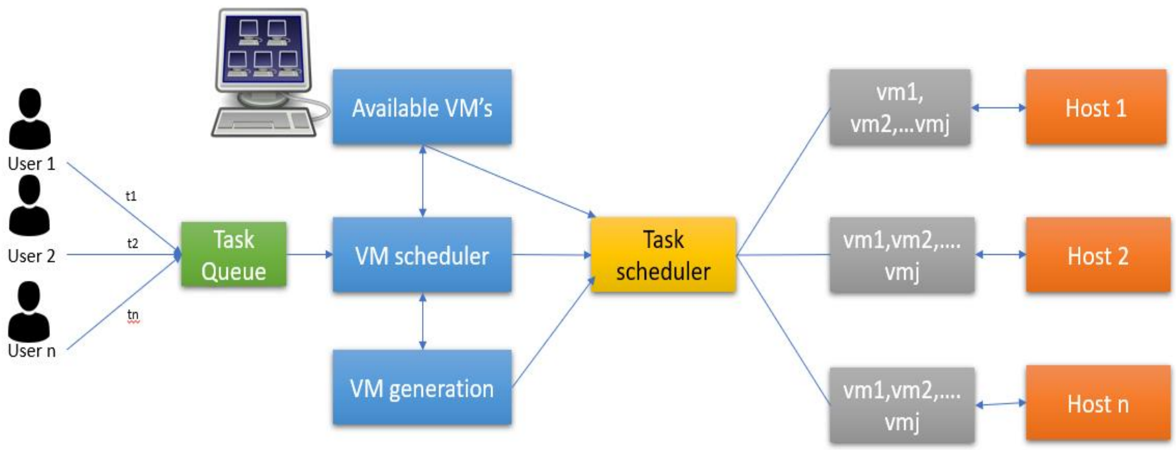

Figure 1: Cloud computing structure (Goddu & Reddi, 2019)

Scheduling of tasks plays a major role in cloud computing. Assigning jobs to particular resources at a particular time is known as scheduling. Improper scheduling may lead to the reduction of system performance. The main objective of task scheduling is to increase performance and to decrease the task completion time by developing an efficient scheduling algorithm. Based on the priority, the task is allocated to the virtual machine and then it is mapped to a suitable physical machine (Naik et al.2019; Matos et al. 2019; Arunarani et al. 2019).

Task scheduling optimization in a distributed heterogeneous computing environment is an NP-hard problem that plays a major role in optimizing cloud utilization and QOS (Xu et al. 2019; Wu et al. 2013). As cloud task scheduling is an NP-hard problem we should increase the efficient use of the shared resources to achieve optimal task scheduling. To attain optimal task scheduling, so many meta-heuristic algorithms have been developed, such as max-min (Bhoi & Ramanuj, 2013), min-min (Chen et al. 2013), Genetic Algorithm Ge

& Wei, 2010), Ant Colony Optimization (Xue et al. 2014), Particle Swarm Optimization (Zhan & Huo, 2012), etc.

However, many types of objectives have been considered during the problem solving of task scheduling in cloud environments.

II. METHODOLOGY

The present paper deals with tasks allocation to the virtual machine may be in any of the following ways:
(i) Task scheduling for minimum processing cost.
(ii) Task scheduling for less processing time.
(iii) Task scheduling for more throughput.

2.1 Type-I: Task scheduling for minimum processing cost

The total execution time depends on virtual machine processing cost which is directly proportional to this factor i.e., $C \alpha C_{vmp}$ (1)

Where C_{vmp} =total virtual machine processing cost

2.2 Type-II: Task scheduling for less processing time.

Also, Cvaries with task completion time which is indirectly proportional to this factor.

i.e., $C\alpha \frac{1}{t_{complete}}$ (2)

Where $t_{complete}$ = time requires to complete the specific assigned task

2.2 Type-III: Task scheduling for more throughput.

The system should be with more throughput means, it is directly proportional to the throughput.

$C \alpha C_{thp}$ (3)

Where C_{thp} = throughput of the system

III. USER'S CRITERIA FOR FITNESS FORMATION

Users may consider any of the parameters during the implementation. For example, from equations (1) and (2), the fine fitness function will be represented as shown in equation (4)

$$C = w_1 * C_{vmp} + w_2 * \frac{1}{t_{complete}} \quad (4)$$

Such that $w_1+w_2=1$

Where w_1& w_2 are user-defined weights which give priorities to factors of total execution time.

Case-1: If equal performance given for the both $C_{vmp}$and $t_{complete}$, then $w_1 = w_2 = 0.5$

Case-2: If $C_{vmp}$is primary and $t_{complete}$ is secondary objective , then $w_1 = 0.6$ and $w_2 = 0.4$

Case-3: If $t_{complete}$ is primary C_{vmp} and is secondary objective , then $w_1 = 0.4$ and $w_2 = 0.6$

Here $C_{vmp}$and $t_{complete}$are calculated as follows:

C_{vmp} = (virtual machine processing time) * (virtual machine processing price)

i.e., $C_{vmp} = VM_{pt} * VM_{pp}$ (6)

and $t_{complete}$ = task length/virtual machine processing speed

i.e., $t_{complete} = TL/VM_{ps}$ (7)

and $VM_{pt}(i,j) = \frac{TL(i)}{VM_{ps}(j)} * 10$

Here, $VM_{pt}(i,j)$gives the time to complete the i^{th}task by j^{th} virtual machine and this parameter value in seconds.

IV. RESULTS

Virtual Machine Processing Speed (VM_{ps}) : 250 MIPS
Virtual Machine Processing Price (VM_{pp}) : 0.02. $
Task Length -> 500MPI
Fitness value for fitness function-1: 0.5
Virtual Machine Processing Speed (VM_{ps}) : 250 MIPS
Task Length -> 1000MPI
Virtual Machine Processing Price (VM_{pp}) : 0.02. $
Throughput during execution of task : 0.1290
Fitness value for fitness function-2 : 0.419

V. CONCLUSION

In this paper, three objective functions have been addressed to solve the task scheduling problem. The task schedulers may consider one or combination of any of the objective criteria with processing cost, execution time and throughput. A case study has also been described which considers two optimal criteria one is processing time and the other is virtual machine processing cost.

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