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Cloud System Enhancement using improved Workflow Task Ranking System

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Abstract:
There is not even iota of doubt that cloud computing has reached at its peak importance as compare to grid and parallel computing. In cloud systems, two types of algorithms can be imposed. These are heuristics and meta- heuristics. Heuristics algorithms like HEFT are applicable for the purpose of ranking of tasks but for better optimization, meta-heuristics algorithms like GA-PSO, hybrid optimization algorithms are more useful. Diverse systems use Scientific Workflows. Collections of multiple computational tasks are included in the workflow and scheduling of cloud computing science workflows is a demanding research area. A workflow-scheduling algorithm works in two stages. First, take input workflow tasks and rank the tasks based on parameters like makespan, cost and deadline constraints. During second stage, apply scheduling algorithm on ranked tasks and then schedule the tasks to cloud resources. In this paper, an improved workflow tasks ranking algorithm has been implemented. The findings after simulation show that our ranking algorithm has provided better results in terms of cost, time and deadline constraint over existing approaches.

Keywords*: Cloud Computing, heuristics and meta- heuristics approaches, HEFT, GA-PSO, Scheduling algorithm.*

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INTRODUCTION

In Today's world, a system with heterogeneous group of machines is known as Heterogeneous computing system. Grid computing, Parallel Computing, Cluster computing, and cloud computing [1] are examples of heterogeneous computing systems. Tasks scheduling [2] is one of the main aspect that requires a smooth task assignment to cloud resources. Cloud computing is a new platform which provides customers with on-demand resources such as infrastructure, platform, software. As three service models are available in cloud- SaaS, PaaS and IaaS [3]. In IaaS, the users do not need to purchase own physical hardware and physical data centers. Virtual infrastructure is available to user and cost is paid as per its use. Now the question is how actually an application should be scheduled to IaaS for better optimization. In this concern, many issues can be scanned e.g. makespan, time, deadline constraints, tasks to VM mapping and many other. [4.1]. It is true that cloud computing provides a live access to all kinds of resources with minimum expenditure as it provides a shared pool of online available resources logically placed into network, storage etc. categories and these can be accessed as per need from an individual to a big association [4]. It is also true that a cloud is a sea of services as per choice of users. Agility, elasticity and most important cost and time are the features of cloud systems. Efficiency as well as performance of a cloud has become a challenge for which better optimization from all angles is mandatory [5] [6] [7]. In last years, cloud computing has become very admired due to its significant cost decline. Within the cloud environment, consumers do not need to pay for the network for various computing services, so they can access computers anywhere in the world. These cloud features are at the bottom of high scalability and multi-tenancy. Cloud environment is updating day by day to ease the life of its consumers. Yet, there are some major issues [2] like time, cost,

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maximum resource utilization, less energy consumption, charges as per consumption, healing of lost data, portability of data and tasks, Quality of Services, data transfer into virtual setups, ranking of tasks, security, reliability, productivity, real time monitoring, dependency of cloud consumers on cloud service providers, etcetera. All these issues are still challenges for cloud service providers. Several companies have begun developing cloud-based systems with challenging advantages, which a cloud provides. Infrastructure of cloud [8] [9]. However, use of cloud for managing various services is not as easy as we think. Such process needs proper system for allocating input tasks to cloud resources. As per customer point of view, cost and time are highly efficient parameters since services are delivered on demand. Cloud device users are simply using those tools to execute their applications. Cloud users use those resources to run their apps. While meeting the deadline, scheduling of taks to cloud VMs with optimized TET and TET is a challenge for researchers. [10]

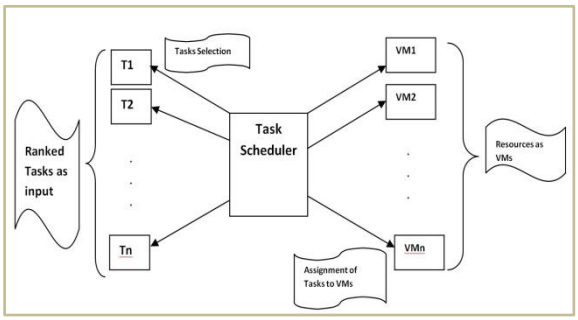

Fig. 1. Workflow Tasks Scheduling to VMs

Figure 1 depicts tasks scheduling to cloud resources and importance of task scheduler. The work in this research is how to rank inputs tasks so that mapping to VMs should provide optimal results. In cloud computing, Workflows are used for a variedseries of scientific applications [11]. A theoretical workflow refers to the exiting dependencies between the tasks. It is also true that the workflow is described in myriad cases as a DAG i.e. directed acyclic graph where the nodes represent tasks, and the edges denote the task dependencies. These can be simple or complex depending upon number of tasks in workflow. Pegasus a popular project which describes various common useful scientific workflow with million billion of tasks [4.1] [4.2] Five types of scientific workflows are depicted in figure 2 have been taken as input workflows for further work.

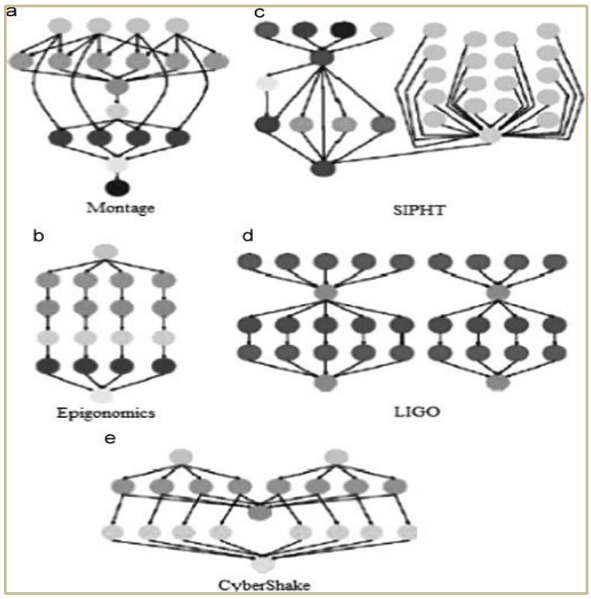

Fig. 2. Five different types of Scientific Workflows

Workflow scheduling under deadline constraints is like a fast medium for easy and efficient management of cloud environment with big data. Moreover, parameters like makespan, cost, response time and energy are highly restricted to execute a cloud in efficient way. As the cloud facility is well equipped, the customer only has to pay for the length of the instance used even though he / she has only used a partial fraction of it and the scheduling algorithm has to be selected to allow its full use. It is also directly linked with customer demands satisfaction. Now the major attraction is towards research in optimizing cloud resources. Since the user has to pay for the time span of the used services even though he / she has used just a partial fraction of it, the scheduling algorithm has to make its full usage. Cloud computing experiences many challenges that need to be undertaken. A Task Ranking algorithm is implemented for ranking various tasks of input workflow on the basis of tasks dependency and computation time. Heterogeneous deadline based ranking algorithm will be implemented. In this study, a Stride towards Optimal Solution has been provided. In a Cloud System, there

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are myriad factors, which are responsible for making a cloud system as most satisfactory. For this, task Ranking and task scheduling has become vital need for making a cloud to meet all requirements.

I. RELATEDWORK

If we talk about work done for scheduling and task mapping to cloud instances, then we can start reviewing already work done on the basis of single objective or multi-objective scheduling algorithm. In [5], various static and dynamic algorithms are defined in detail. Cost, budget and deadline are QoS parameters and all should be satisfied. Direct dealing with tasks assignment to cloud resources cannot be considered fully optimized and it is true that no algorithm can achieve all targets (QoS) achievement simultaneously. Workflow is one of the commonly used model for marking IaaS cloud-based science applications such as Amazon EC2 and other cloud providers[5–7]. So, in current study, it has been accepted that rather than directly schedule the tasks to VMs, one more stage preceding it must be added. Heuristic approach of ranking tasks of input workflow is one of the ways to make scheduling better. Workflow scheduling with already ranked tasks enhances optimization with better utilization of cloud resources. Heuristic algorithms like HEFT, fuzzy HEFT are useful for ranking tasks of input scientific workflows [8]. HEFT is mono-objective workflow scheduling problem. It does not work upon more than one quality parameter at one time. In [8] [9] [10], it has been concluded thatoptimization based on multi-objectivesis the utmost common approach used to minimize TEC and TET simultaneously. The Rank hybrid scheduling algorithm first uses the HEFT ranking algorithm to compute the rank of each task[11]. The researchers Durillo et al. [12] familiarizeda multi-objective technique called MOHEFT (multi-objective heterogeneous earliest-finish-time)procedurewhich is one of the best algorithm for scheduling workflows in Amazon EC2. Apart from this, it is an extension to the well-known list heuristic HEFT [13]. The section showing results and graphs in this study is impossible with only ranked tasks. So, scheduling of tasks to cloud resources using meta – heuristic algorithms makes optimum use of cloud instances.
One more improved version of HEFT is known as FDHEFT [8] which can be divided into two major phases. Both steps are task prioritizing process selection and process selection of cloud resources. The scheduling priorities of all tasks in the workflow are allocated during the task-prioritizing process, and then the best option for each task in the scheduling list is decided in the cloud option selection process. It is planning of a multi-objective workflow. It applied sort method using fuzzy dominance to HEFT and use fuzzy dominance to compute the relative fitness of solutions. There is one issue, which has been overcome in the proposed research work. The issue with Fuzzy HEFT is its static threshold value. Alkhanak et al. [14] proposed a cost based optimization approach forscheduling in scientific workflow in cloud-based applications. The proposed approach employs the four algorithms based onmeta-heuristics and on the population. The strategy allows the service providers to reduce costs and time. Compared with baseline methods, the cost and time of the execution was reduced. Rimal, et al. [15] Cloud chains the Multi-tenancy characteristic and provides the scalability and other benefits to the other users. Resource organization is an important task in the multi-tenant cloud computing which is done by using the scheduling process. In this work, cloud based workflow scheduling rule is planned for efficient computing in cloud. This strategy reduces cost of execution as well as workflow completion timeand also properly utilize the resources. The proposed research results fit current methods and algorithms. The recreational outcome of the proposed solution indicates more successful outcomes than the current approach. Work in [16] reduced time and expense, and implemented a gravitational search algorithm for workflow scheduling in the cloud world. Workflow enhancements minimize costs, and makepan. For workflow scheduling two GSA and HEFT algorithms are hybridised. The performance assessment is conducted on the basis of two metrics, which are the monetary cost ratio and the duration ratio of the schedule. The justification of result is

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also tested by ANOVA test and it shows that the proposed approach does better. Ghose, Manojit, et al. [17] have given the scheduling approach in cloud environment which is highly energy efficient. In this approach, for different kinds of scientific workflows, six different scheduling plans are proposed.These plans consider both the static as well as dynamic consumption of energy by the nodes. The complete process is divided into two parts. One is a non-splittable allocation of VMs on a single host, and the second allocation is issplittable on multiple hosts. The work done with the proposed approaches to scheduling is matched with existing work. The findings reflect a 70 per cent drop in average energy. Li Liu, et al. [18] proposed thealgorithm named genetic algorithm. It is for the purpose of workflow scheduling in cloud computing by considering deadline-constrained. In this study, work has been done on four different types of workflows called epigenomics, montage, inspiral and cybershake. Both TET (Total Evaluation Time) and TEC (Total Evaluation Cost) were evaluated in user's defined deadline constraints. A penalty function as well as penalty rule in CGA is proposed which is CGA2 and it works without any parameter. Also it has worked to overcome prematurity. Apart from this, focus on crossover and mutation probability was also prior concern. Performance is evaluated by task ranking system. DAG (Direct Acyclic Graph) is useful to denote various workflows. Anubhav, et al.[19] implemented a gravitational search algorithm to do workflow scheduling in cloud world. Workflow enhancements minimize costs, and makepan. Two algorithms for workflow scheduling are hybridized to GSA and HEFT in this phase. The performance assessment is conducted on the basis of two metrics, which are the monetary cost ratio and the duration ratio of the schedule. The validation of result is also tested by ANOVA test and it shows that the proposed approach outperforms. Garg et al.[20] used the Genetic Algorithm to formulate the scheduling problem in cloud. The proposed research is performed to reduce the time and expense of conducting the tasks computations. This work is done on the cloudSim simulator and it maximizes the resource utilization. The performance evaluation is done on the different parameters and performs well. Bölöni, et al. [21] proposed The definition of calculation scheduling was proposed by Bölöni, et al.[21] and used to measure two forms of cost-cost estimation and financial expense. It also predicts the performance gain known as the knowledge value. This complete research is focused on the real-estate assetchance analytics method. Thealgorithm used for scheduling used in this work is called scheduling algorithm based on volume. [22] proposed BAT system for scheduling the workflow in cloud computing which helps to handle the large size of data. The scheduling process decides that which task is executed first and which is last according to their requirement of the resources. It manages the resources according to the task size and execution time. Compared to the particle swarm optimization algorithm and Cat swarm optimization algorithm, the outcome of the proposed algorithm is. The proposed algorithm would converge better than the current algorithms. Vinothina et al. [23] suggested ACO, i.e. Ant Colony optimisation algorithm for cloud computing workflow scheduling. For heterogeneous distributed systems this model is presented. The service level agreements are used for monitoring the service providers' quality of service. The problem of workflow scheduling is solved by using parameters cost, makespan and resource utilization. The ACO algorithms reduce the cost and makespan and enhance the resource utilization. E. Alkhanak et al. [24] have proposed SWFS, whichis calledcost optimization of Scientific Workflow Scheduling in both cloud and Grid systems. In addition, service providers and service consumers are directly related to this research. Both parameters and aspects are important in this work. a detailed study of QoS constraints with monetary and temporal cost parameters is defined. A detailed chart of several qualitative cost optimization approaches are surveyed with name and type of tool used, number and type of resources and type of SWFA (Scientific Workflow Application). ThiagoGenez, et al. [25] have worked with selection of CPU frequency configuration for resources carefully to reduce the total makespan. It is combination of PSO and HEFT schedulers to make it better in case of time. A fitness

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function without any parameter value is imposed to measure performance of various particles. Less is fitness value, better is solution. So, particles of swarm are moved towards less fitness value regionthe workflows with different sizes are accepted for simulation. Cybershake, SIPHT and LIGO are the workflows on which experiments are performed. The work in [16] reduced time and cost And implemented a gravitational workflow scheduling search algorithm into the cloud world. Workflow enhancements minimize costs, and makepan. Two algorithms for the workflow scheduling are hybridized GSA and HEFT. The performance assessment is conducted on the basis of two metrics, which are the monetary cost ratio and the duration ratio of the schedule.The justification of result is also tested by ANOVA test and it shows that the proposed approach does better.

III. IMPLEMENTATIONOFDISTRIBUTED HEFT RANKING METHOD

If ranking is better, it improves cloud optimization. If optimization is better then automatically time and cost is improved. The concern is which ranking algorithm can effectively improve it. We accessed HEFT improvement as well as of Fuzzy HEFT. Then we viewed the improvement given by distributed HEFT ranking system which gave better results interms of TEC and TET. Based on figure, the implementation of the proposed algorithm has been explained in following steps.

Step 1: We have collected the tasks from input workflows (SIPHT, MONTAGE, CYBERSHAKE, LIGO and GNOME) using HEFT method for experimental purpose.

Step 2: Thereafter, we have calculated level wise distribution score value of each task based on correlation of three parameters: deadline, computation time and budget. High score value is based on nearest deadline.

Step 3: Then, tested existing HEFT based ranking techniques on VMs to evaluate their Total Execution Time) which is TET and Total Execution Cost i.e. TEC.

Step 4: From experimental analysis, we have found that the distributed HEFT ranking methodology is more efficient as compared to fuzzy HEFT and HEFT based ranking techniques.

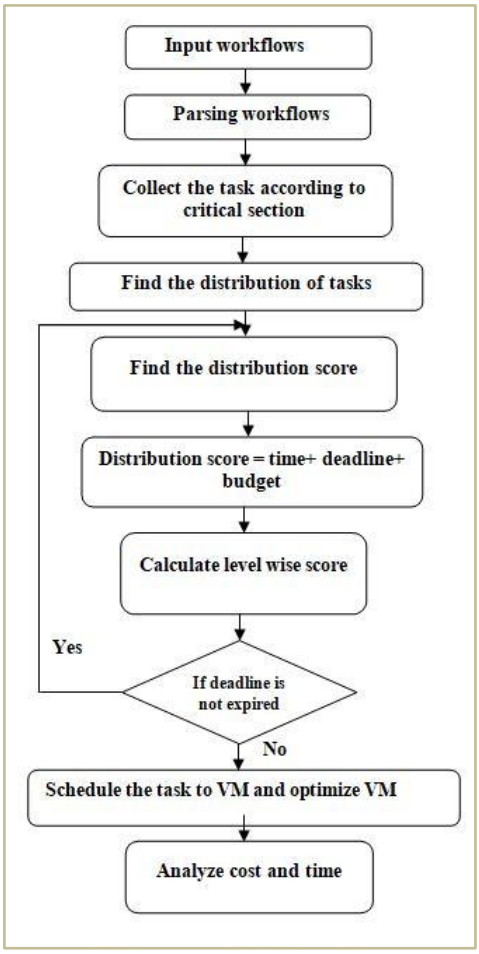

Fig 4: Distributed HEFT Ranking

IV. EVALUATION, RESULT AND DISCUSSION

Our workflow-scheduling scheme based on TEC and TET is validated via simulation experiments. It's built on real-world workflows. Total five scientific workflows have been taken as input from pegasus. Each segment discusses the experimental configurations and explores the effects of the simulation. A new ranking algorithm has been generated which gave better results than HEFT and

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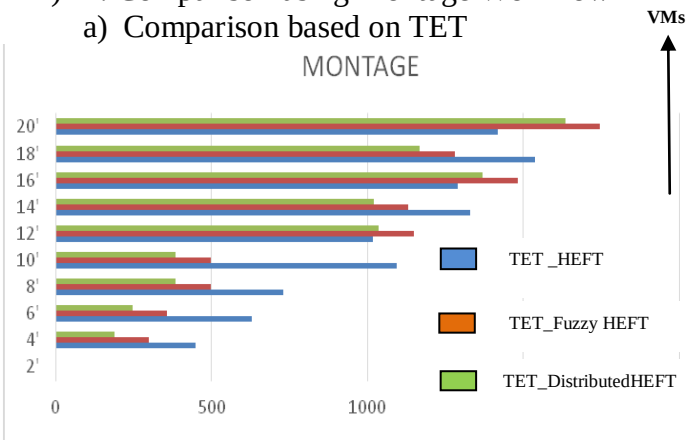
fuzzy HEFT ranking system. Based on TEC and TET, input scientific workflows are validated. The simulation experiments have been implemented on cloudSim simulator. To access comparative results, ranked tasks with HETt, Fuzzy HEFT and distributed HEFT methodology have been scheduled on cloud resources.

Comparison of proposed ranking method with methods already in use:
Proposed method- Distributed HEFT
Existing method for comparison- Fuzzy_HEFT and HEFT.

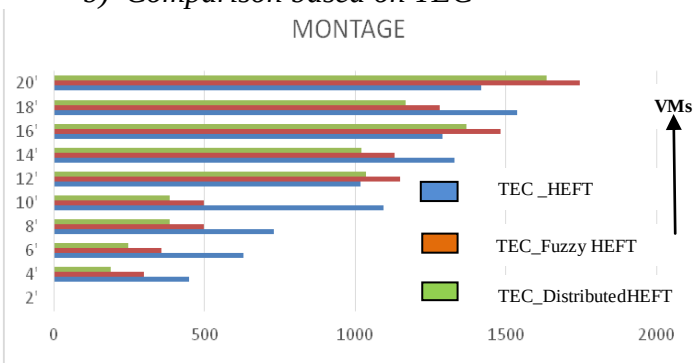
1) The experimental research shows positive results for the suggested method. Comparing the schedule time, efficiency and schedule length with other well-known task scheduling algorithms shows the success of proposed heuristic.

2) A. Comparison using Montage Workflow

a) Comparison based on TET



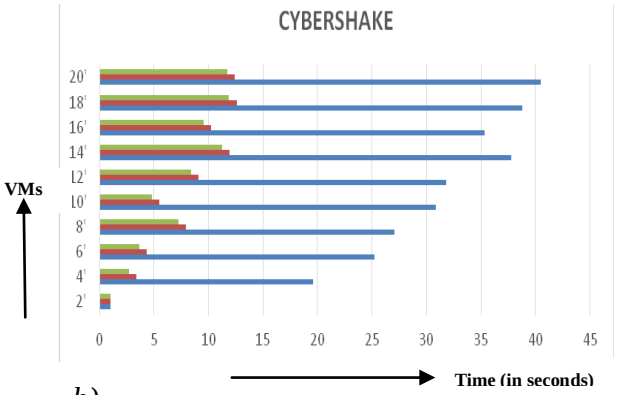
b) Comparison based on TEC



Color indication in above Graphs:
Blue color expressing HEFT algorithm,
Orange color Fuzzy HEFT
Green Color Distributed HEFT.

3) B. Comparison using Cybershake Workflow

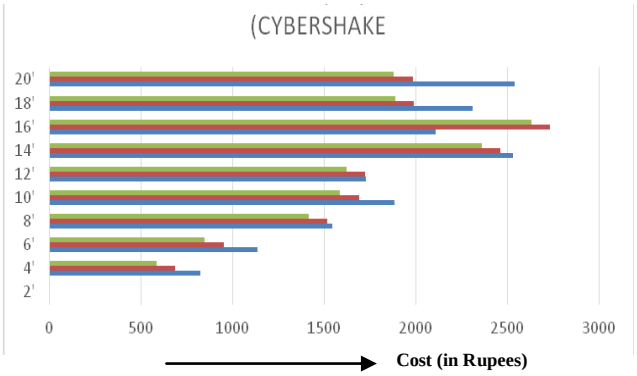
a) Comparison based on TET



b)

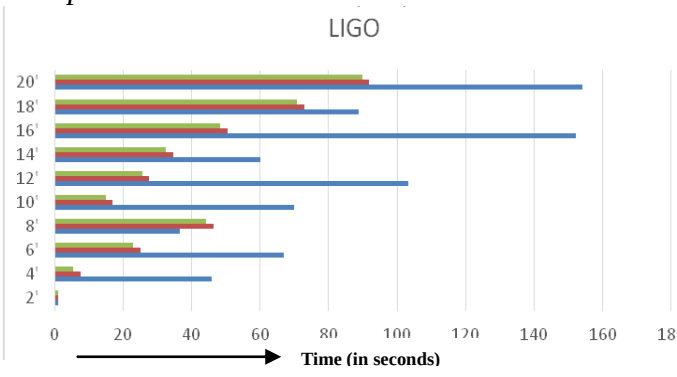
c) Comparison based on TEC

d)



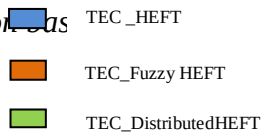
Comparison using LIGO Workflow

e) Comparison based on TET



f)

g) Comparison bas



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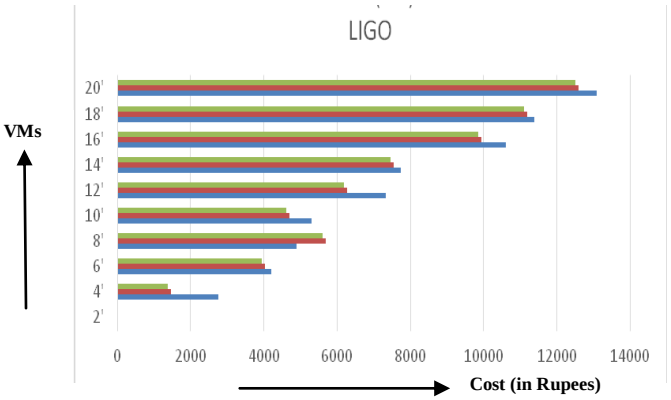
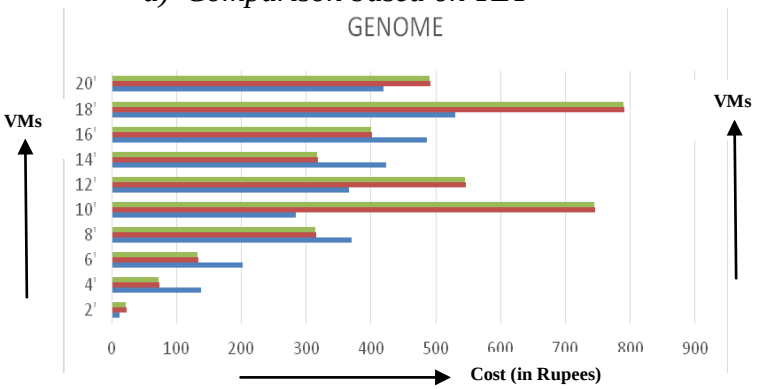
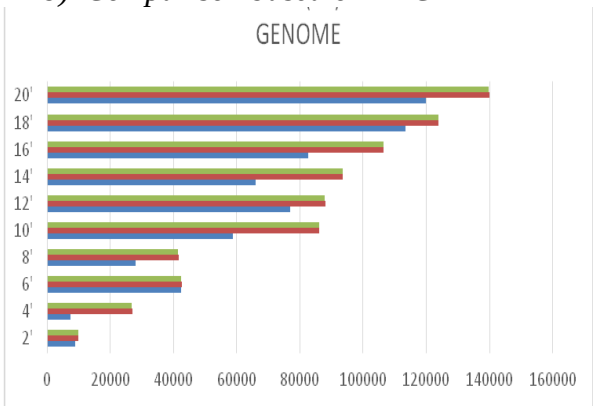


4) *D. Comparison using GENOME Workflow*

a) Comparison based on TET



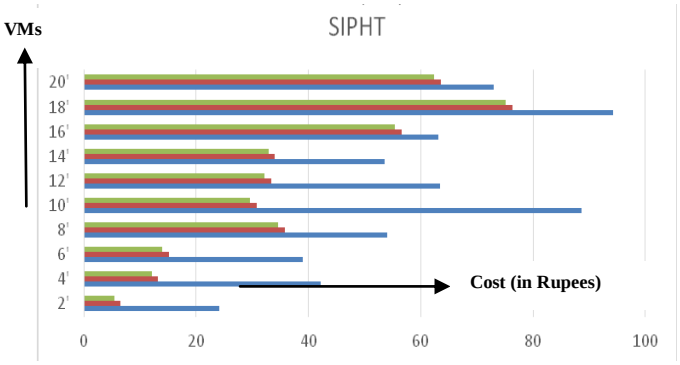
b) Comparison based on TEC



5) *E. Comparison using SIPHT Workflow*

a) Comparison based on TET

b)



c) Comparison based on TET

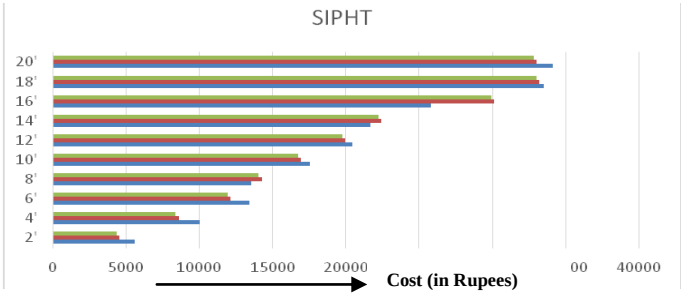


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Table 2. Comparison of proposed Ranking method using Montage workflow based on TET and TEC parameters

ENSEMBLE	HEFT		FUZZY_HEFT		Distributed HEFT	
SIZE	TET	TEC	TET	TEC	TET	TEC
2'	1	1	1	1	1	1
4'	16.09	448.3718	2.73	300.958	1.93	189.958
6'	18.69	629.3048	2.82	357.9556	2.02	246.9556
8'	21.95	731.9887	5	497.4608	4.2	386.4608
10'	26.47	1094.207	5.8	497.4608		386.4608
12'	28.89	1018.366	7.84	1148.339		1037.339
14'	32.15	1330.824	8.61	1132.746		1021.746
16'	33.2	1289.644	10.52	1481.906		1370.906
18'	36.07	1539.399	9.66	1279.957	8.86	1168.957
20'	37.3	1419.877	12.4	5	11.6	1635.794
				7.04		
				7.81		
				9.72		

v. CONCLUSIONS

We have proposed a ranking algorithm for the scientific workflows that is highly effective for ranking tasks of input workflows. The proposed ranking algorithm is advance to existing fuzzy HEFT algorithm. It minimized total execution time which is represented with TET in above graphs and total execution cost represented as TEC in above results based graphs. For getting these results, mapping of tasks to VM resources has been done. The proposed algorithm named distributed HEFT has provided better ranking system and so has minimized TEC and TET while scheduling tasks to VMs. In future, we aim at providing enhanced scheduling
algorithm to provide better results.

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