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Activity Based Cost Scheduling Using Priority Approach in Cloud Computing

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ABSTRACT

Since cost is the most effective factor in cloud computing, so in this paper, an approach is being proposed based on cost applied on datacenters using basic approach of ABC (Activity-based Cost) scheduling algorithm. The proposed approach works in two phases. In the first phase, we categorized three datacenters' based on cost. Tasks were assigned to datacenters based on cost. In the second phase, three different priority queues were implemented and tasks were assigned to VMs' according to their priorities.

Keywords: Activity Based Cost approach, Cloud Computing, Datacenter, Datacenter Based Approach, Scheduling Algorithm

I. INTRODUCTION

Before cloud computing, resources were used in a limited way and the cost of hardware and their maintenance were also high. When cloud computing came in existence, cost of maintaining resources became less. That's why researchers are taking more attention in this field. Cloud computing's on-demand network access, resource pooling, elasticity, and computing resources availability, e.g., networks, servers, and storage had made it so popular. Every organization is thinking of using these services. As cost is the most impacting factor for an organization, researchers started paying more attention in cost effective scheduling algorithms. ABC is one of the cost effective approaches used in cloud computing.

II. RELATED WORK

Cost is the most considerable part of an organization not only in recent years, but also since when organization came into existence. To reduce, cost Gary Cokins introduced Activity Based Cost approach in management and named "ABC/M" in 1988 [1]. Further, in 1993, it was also implemented by Yair M. Babad et. al. by grouping the activities into single drive to calculate or trace the cost of product or service [2]. This was the starting age of ABC algorithm. Carsten Homburg (2001) proposed algorithm based on ABC [3]. He suggested that with the existing cost drivers (cost of activities that are interconnected or that affect the other activities), a new combination of cost driver should be replaced. With this approach, system complexity with ABC will be same but cost allocation will be accurate.

When cloud computing technology came in existence, researchers also tried to implement ABC approach in scheduling. For this, QI CAO et. al. (2009) implement optimized ABC algorithm [4]. The proposed algorithm used priority in ABC that is calculated on the basis of task cost, individual resource cost and earned profit from individual tasks. Requested tasks were consigned to VMs according to defined priorities. Instead of using three queues, Shachee Parikh et. al. (2010) used double level priority queues in ABC approach of scheduling [5]. In their proposed methodology, all tasks were sorted according to their processing power and provide the resources according to tasks' turnaround time. Priority in ABC was used by Mrs. S.

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Selvarani et. al. (2010) in a different way [6]. Their proposed work was based on new arriving tasks. New tasks were arranged into priority queues according to their size and priority. Ashutosh Ingole et. al. (2011) suggested another cost effective algorithm based on ABC [7]. In their proposed algorithm, firstly highest priority tasks were allotted to the resources and then medium & low priority tasks were shifted and consigned to the resources according to their priorities. Except, ABC approach in cloud computing Zhi Yang et. al. (2011) proposed another cost effective scheduling algorithm [8]. In their proposed algorithm maximum profit was achieved through ordering supplier's need. First supplier's tasks with the highest profit were assigned resources before second highest profit tasks. The process was continued until all needs got the resources.

III. ABC (ACTIVITY BASED COST) APPROACH

Activity based cost approach is used not only for finding the cost of resource, but also performance cost [4] [6] [7]. Activity based approach means each activity is different and cost occurring from these activities should be different. In this approach, cost is measured in terms of CPU, memory and time required while fulfilling the individual request. After calculating the cost, priority is calculated of the individual task and divide these tasks into three categories HIGH, MID, and LOW. The following equation calculates individual task's priority [4] [6] [7]:

$$L_k = \Sigma_{i=0}^{n} R_{i,k} * C_{i,k} / P_k \quad (1)$$

Here n is the no. of resources. Other parameters are explained below:

1) $R_{i,k}$: The i^{th} individual use of resources by the k^{th} task.
2) $C_{i,k}$: The cost of the i^{th} individual use of resources by the k^{th} task.
3) P_k: The profit earned from the k^{th} task.
4) L_k: The priority level of the k^{th} task.

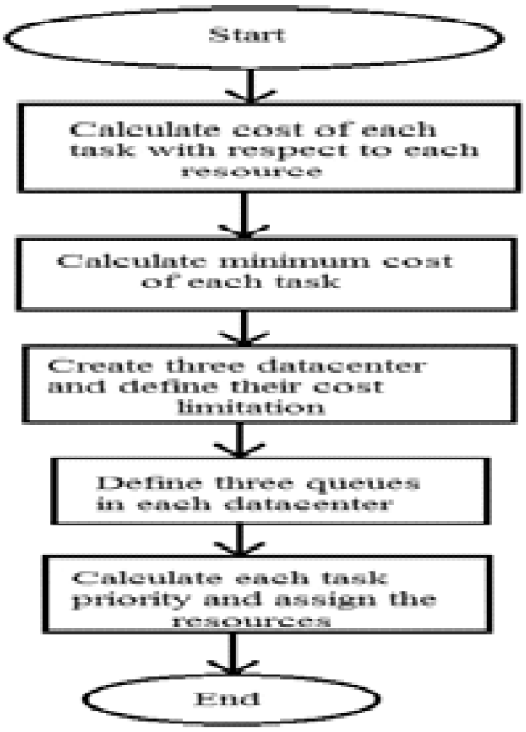

Figure 1: Datacenter Based ABC algorithm

IV. PROPOSED WORK

Earlier researches were performed at the single datacenter, which causes slow execution speed. All tasks priorities were calculated and divided into different categories according to their priorities. After categorizing, tasks are grouped in three different queues (LOW, MID, HIGH) and are assigned resources simultaneously for the fast execution. In this paper, a new approach is proposed in two phases, based on priority. In the first phase, datacenters were distributed based on their cost. Service provider divides three datacenters and assigns the tasks as per the cost requirement. In the second phase, basic ABC algorithm has been applied on individual host based on task's priority using equation (1). Flowchart of proposed algorithm is as under:

4.1. Proposed Algorithm

r = resource size, t = task size

1) Calculate ETM (Execution Time Matrix) of each task with respect to each resource by using $\Sigma_{i=0}^{t} \Sigma_{j=0}^{r}$ t.length / r.mips.
2) Calculate CM (Cost Matrix) of each task with respect to resource by using $\Sigma_{i=0}{}^{t} \Sigma_{j=0}{}^{r}$ etm[i][j] * r.mips.
3) Find out minimum cost of each task w.r.t. resource.
4) Catagorise datacenters according to cost.
5) Calculate priority of each task in each datacenter by using task.priority = cost/profit
6) Assign VMs according to their cost and priority.

In proposed approach, the execution time of tasks is calculated based on their MIPS.

4.2. Experimental parameters

For this proposed work, following configuration has been taken in cloudsim simulator:

Table 1
Datacenter configuration

Datacenter	
No. of host per datacenter	3
P.E. (Process Element) per datacenter / Speed	3 / 21000 MIPS
RAM	10192 MB
Storage	1000000 MB
Bandwidth (BW)	10000 MIPS
Scheduling policy	Timeshared

Table 2
VM Configuration for high cost datacenter

VM Configuration (High Cost Datacenter)	
No. of VM	3
No. of P.E. (process element) per VM	1
Storage size	10000 MB
RAM	4096 MB
Bandwidth (BW)	1000 MIPS
Virtual Machine Manager (VMM)	Xen
MIPS	21000(high priority) 20000(mid priority) 19000(low priority)

Table 3
VM Configuration for medium cost datacenter

Vm Configuration (Medium Cost Datacenter)	
No. of VM	3
No. of P.E.(process element) per VM	1
Storage size	10000 MB
RAM	4096 MB
Bandwidth (BW)	1000 MIPS
Virtual Machine Manager (VMM)	Xen
MIPS	18000(high priority) 17000(mid priority) 16000(low priority)

Table 4
VM Configuration for low cost datacenter

Vm Configuration (Low Cost Datacenter)	
No. of VM	3
No. of P.E.(process element) per VM	1
Storage size	10000 MB
RAM	4096 MB
Bandwidth (BW)	1000 MIPS
Virtual Machine Manager (VMM)	Xen
MIPS	15000(high priority) 14000(mid priority) 13000(low priority)

4.3. Result and Analysis

After implementing proposed algorithm, tasks were divided among three datacenters' based on cost and then tasks were provided resource or VMs based their priorities. Three VMs with different MIPS were implemented on each datacenter. Our result shows less execution time as compared to basic ABC scheduling policy. Table 5 shows execution time taken by various tasks on basic ABC scheduling and proposed algorithm:

Table 5
Comparison of ABC scheduling & Datacenter Based ABC approach

	Datacenter Based ABC Approach				Basic ABC Approach			
No. of cloudlets	H	M	L	A	H	M	L	A
25	2.73	4.77	4.1	3.23	3.14	14.34	36.03	1.7
50	8.09	9.61	7.71	4.6	37.64	30.25	73.03	53.45
100	25.85	29.92	27.69	12.03	49.96	85.77	99.47	88.48
150	38.6	43.51	40.86	19.96	102.67	125.65	140.87	130.64
200	43.27	43.79	45.42	21.52	132.43	176.41	184.67	178.38

Table 5 shows execution time taken by various tasks using ABC approach and using proposed algorithm. In the above table, variables H, M, L, A show time taken by high, mid, low and all (high, mid and low) queues to execute all tasks.

Graph representation of above results:

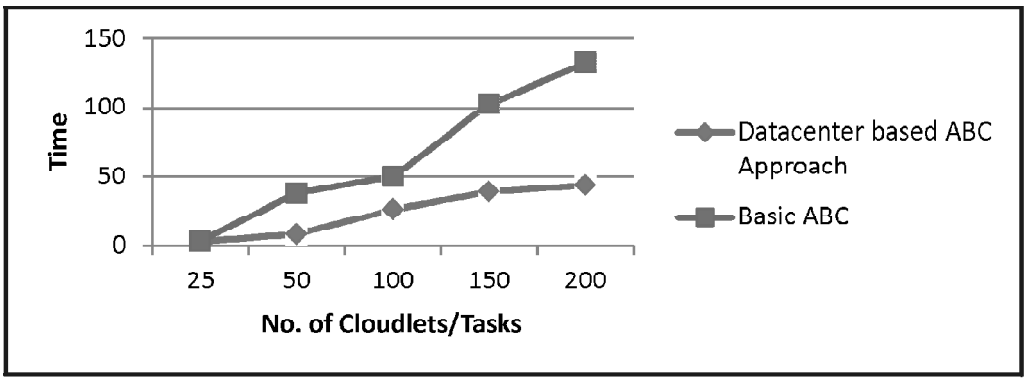

Figure 2: Execution of all tasks in High Priority Queue.

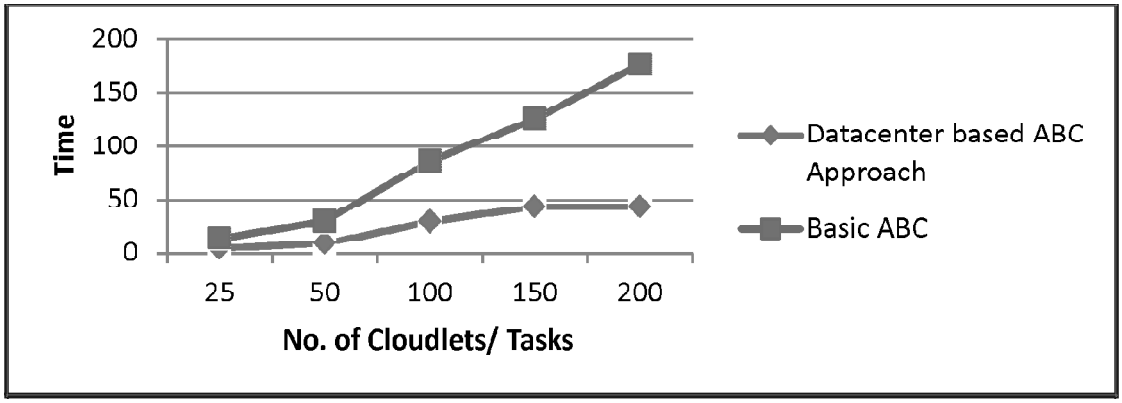

Figure 3: Execution of all tasks in Medium Priority Queue

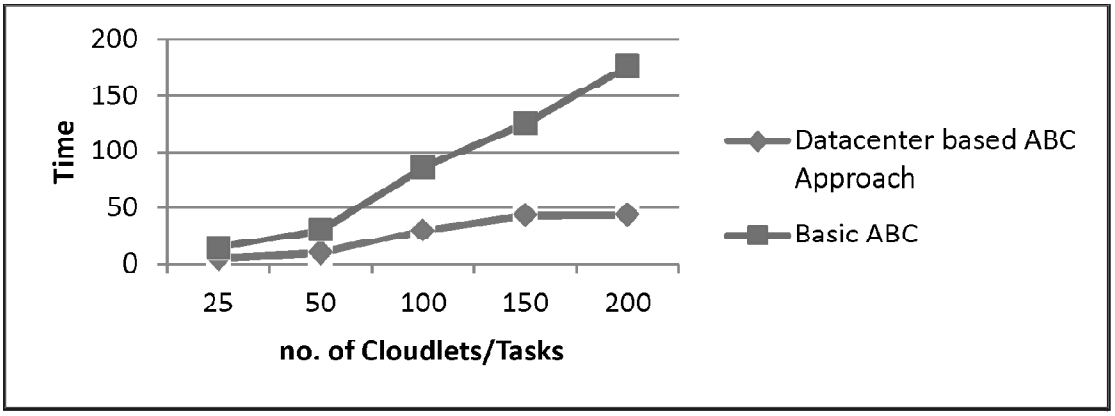

Figure 4: Execution of all the tasks in Low Priority Queue

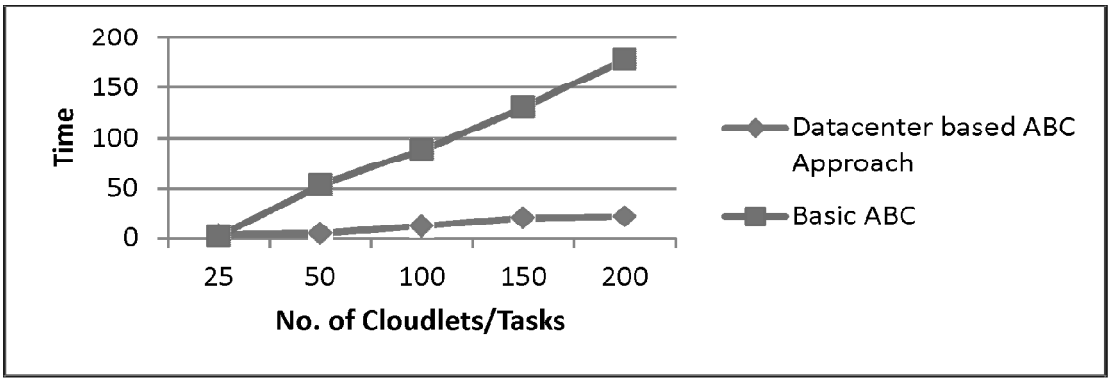

Figure 5: Execution of all the tasks in all queues

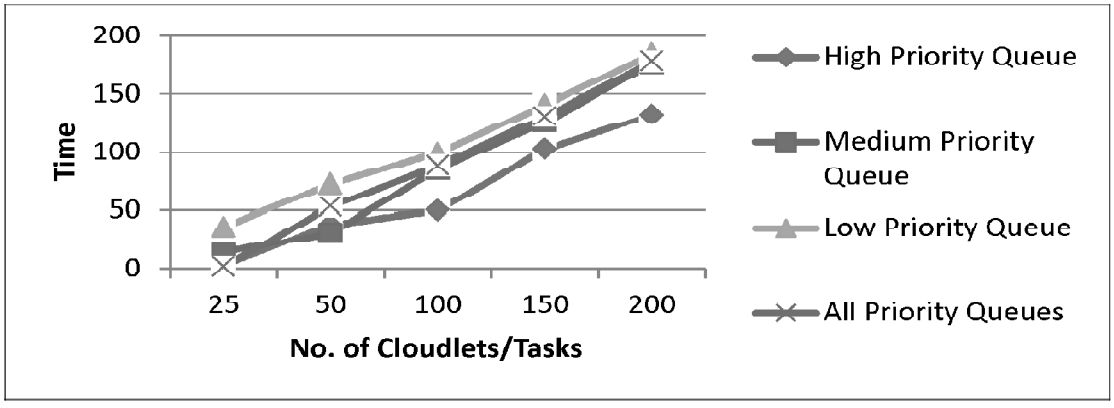

Figure 6: Basic ABC algorithm

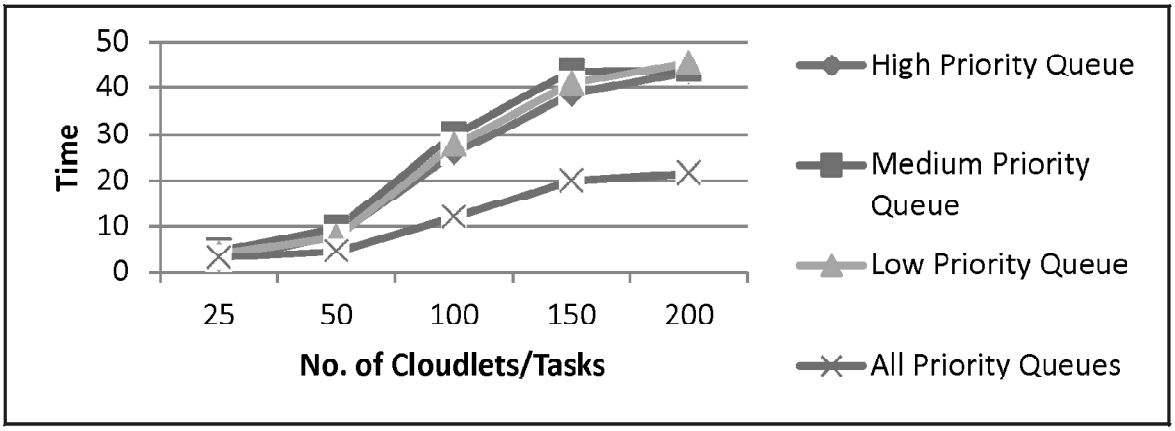

Figure 7: Datacenter Based ABC algorithm (Proposed)

Fig. 6 shows the execution of tasks by Basic ABC algorithm and fig. 7 shows the execution of various tasks by proposed algorithms. Graphs and tables discussed above show that proposed algorithm executes tasks according to cost in less time as compared to basic ABC approach.

4.4. Output screenshot

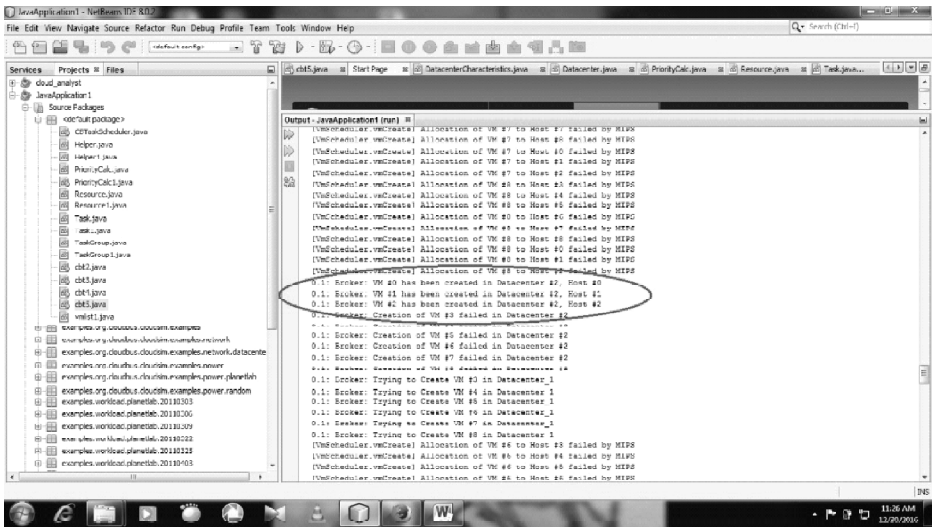

Figure 8: Creation of VMs in high-cost datacenter

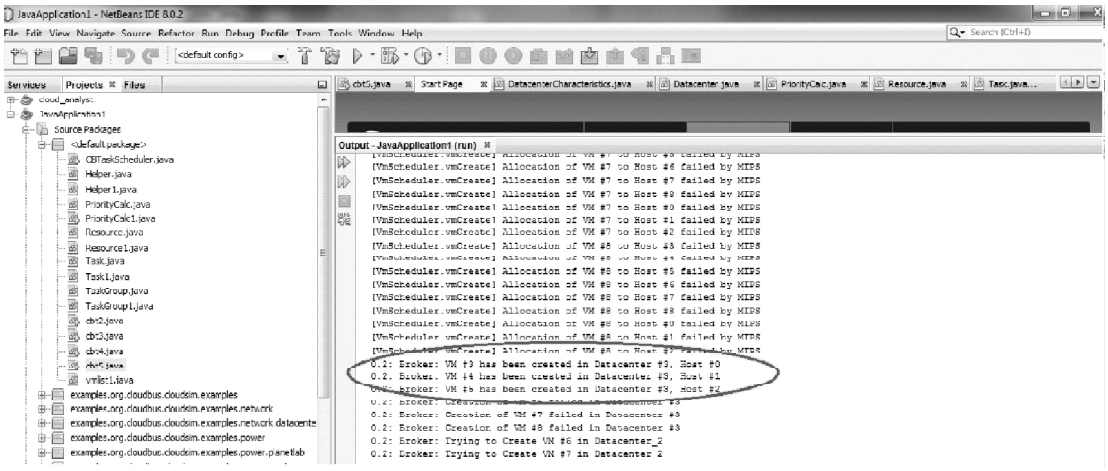

Figure 9: Creation of VMs in medium-cost datacenter

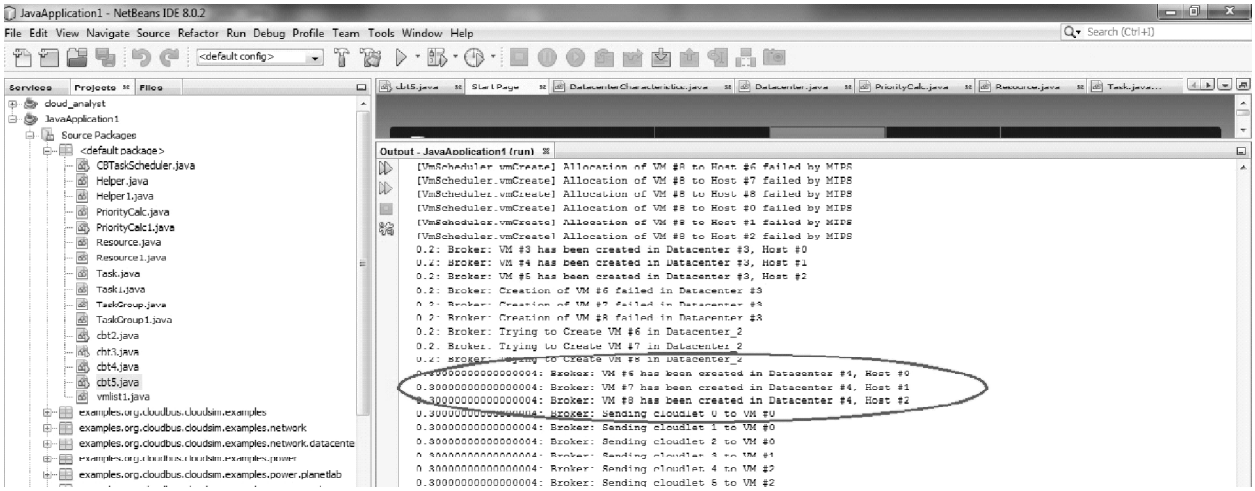

Figure 10: Creation of VMs in low-cost datacenter

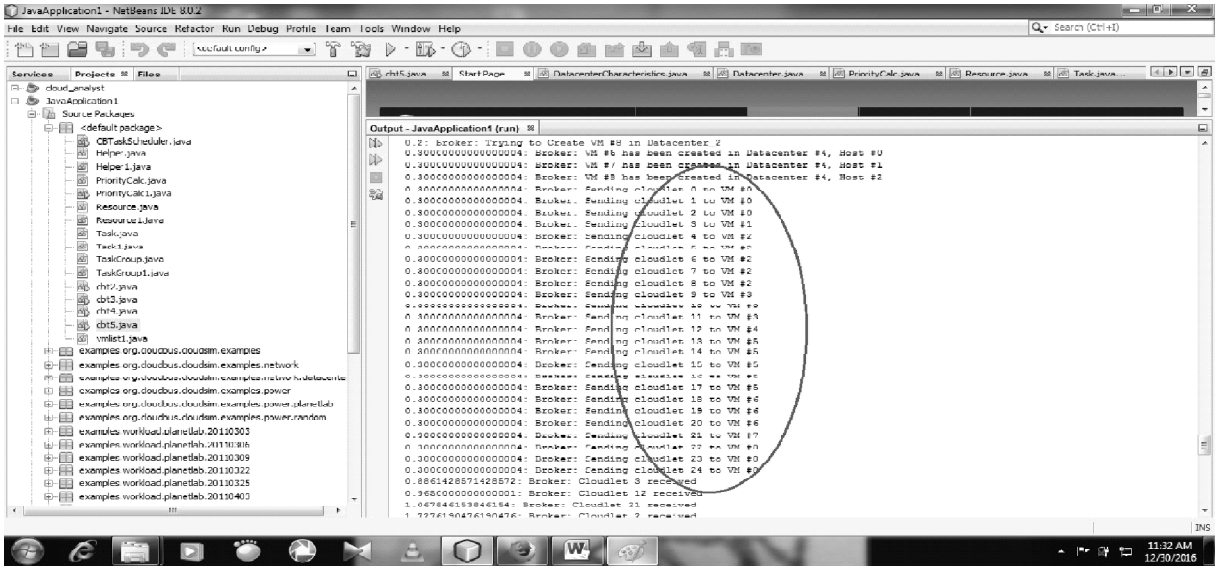

Figure 11: Sending tasks or cloudlets to the particular VMs

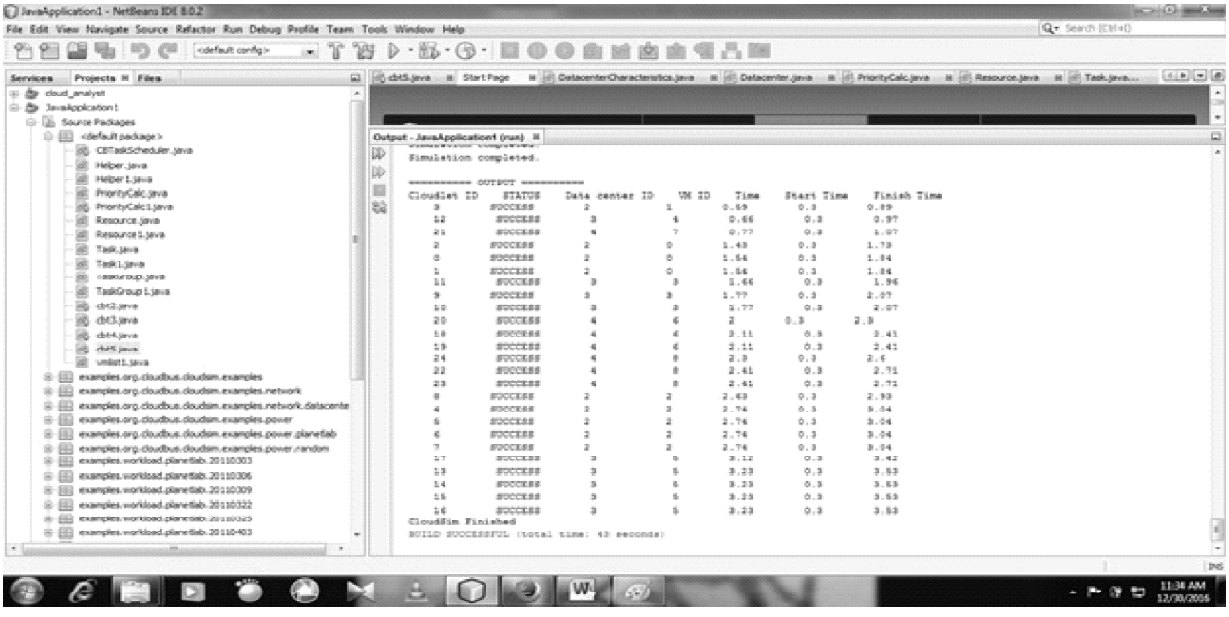

Figure 12: The result, if all tasks are executed by the low priority queue

Figures 8, 9,10,11,12 shown above show the flow of proposed approach. Fig. 8, 9, 10 shows the creation of VMs in different datacenters. Fig. 11 shows the binding to VMS to the clouds and finally fig. 12 shows the execution of tasks.

V. CONCLUSION AND FUTURE WORK

In this paper, a basic framework for scheduling in cloud computing based on cost has been proposed. Cloud was divided into three categories of datacenters based on cost. Tasks with high cost were assigned with high processing power units in the first datacenter, while the medium cost tasks were assigned to the medium processing power unit. In the last, tasks with low cost were assigned to the third datacenter with the low processing power unit. This paper calculates the expected cost of the tasks submitted and accordingly the task is sent to the datacenter. Proposed approach is based on the expected cost of tasks before their execution. The results of the proposed approach are found to be better as compared to basic ABC approach i.e. the time taken for completion of a task is less as compared to ABC. In future, the scheduling policies which will prove beneficial in terms of cost/profit to both service provider as well as client.

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