International Journal of Technology Research and Management
ISSN (Online): 2348-9006
Vol 7 Issue 4 April 2020

Resource Allocation in Cloud using Edge Cover Based Graph Coloring Algorithm

Neelema Rai[1], Dr. Deepika Pathak[2]
Asst. Prof. M.K.H.S Gujarati Girls College, Indore (M.P)-452001 ,India[1]
Computer Science Department, Dr. A.P.J. Abdul Kalam University, Indore (M.P.) – 452016, India[2]
neelemachoukse21@gmail.com[1], deepikapathak23@gmail.com[2]

Abstract: *In presents scenario cloud computing is most suitable and used IT service solution. Cloud service model provide various services on the basis of pay per use, which is a cost effective and easily available solution for different IT resource requirement like data storage, computing power, network services, working platforms and software. From the cloud management point of view, it is required to provide maximum services with minimum resources. To achieve this objective cloud should have a powerfully cloud resource allocation strategy. This paper presented a cloud resource allocation algorithm based on graph coloring algorithm. This paper also suggested an edge cover based graph coloring algorithm for cloud resource allocation. Implementation prospective and experimental result with analysis is also discussed in this paper.*

Keywords: *Resource allocation, cloud computing, graph coloring algorithm, edge cover.*

1. INTRODUCTION

Now a day's cloud services are used by most of the IT resource users. Cloud computing provide services in three different form, Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Commonly these services are known as cloud service model [1]. Through this cloud service model services to the customers are provided in the form of public, private, community and hybrid cloud [2]. Every organization and individual wants to use this cutting edge technology for their business and personal use. Cloud computing is an internet based technology. Cloud provides all services to the end user through the internet. All activity of cloud customers are performs on web portal, which is an interface between customer and cloud resources. Most of the activities of cloud is automated and managed by software like security [3], authentication [4], memory management, storage management and resource allocation [5].

Providing services through cloud computing is growing business. Providing maximum services in minimum resources is one of the key requirement and challenge of any service oriented business. So that to achieve this target cloud computing uses some resource allocation strategies [6] and scheduling algorithms [7].

This paper proposed a resource allocation technique for cloud, which is based on graph coloring concepts. Graph coloring problem is a NP-hard problem. The idea behind graph coloring is that coloring vertices of any connected graph in such a way that no two adjacent vertices get the same color. There are certain types of graph coloring like vertex coloring [8], edge coloring [9], face/map coloring, total coloring, list coloring, path coloring etc. There are many real word problems which can be solved by graph coloring approach like time table scheduling [10], frequency assignment to radio stations [11], air traffic flow management [12], CPU register allocation [13] and many more. Due to the high problem solving capabilities graph coloring attracted many researchers for development of new algorithms and efficient approaches. There are numerous algorithms available for solving graph coloring problem like Modified Cuckoo Optimization Algorithm [14], Memetic Algorithm for Graph Coloring [15], ant base graph coloring algorithm [16] and Bee's behavior based algorithm [17].

2. RELATED WORK

As cloud computing is an emerging technology. There are various research activities going on in different areas of cloud computing. Technological researchers have also proposed and applied many techniques for resource allocation in cloud. Jiyani (2010) proposed an adaptive resource allocation technique for preemtable jobs [18]. A Bee behavior based algorithm was proposed by Preadeep and Kavinya (2012) [19]. On the basis of best fit distribution of resource in cloud, Gouda et al proposed a priority based Bin-Picking algorithm in 2013[20]. A multi cloud resource allocation algorithm based on Markov Decision Process was proposed by Oddi et al in 2013 [21]. In the year of 2015 a dynamic resource allocation technique was introduced by Saraswati et al [22]. This algorithm is based on priority of jobs in cloud. An evolutionary algorithm was used by Robin et al (2017) for load sharing among virtual machine of cloud to increase the resource utilization and to reduce the response time [23].

3. PROBLEM IDENTIFICATION

Use of cloud computing is increasing day by day. In this situation users/customers of every cloud are also increasing. Now it is challenge for any cloud service provider, that they should provide fast services to the customer. Resource utilization is also important i.e. providing maximum services with minimum resources. So development of such an algorithm which can schedule customer request for any resource in such a manner that maximum request can be fulfilled by cloud with minimum available resources is a challenging task for cloud service provider. Incoming requests can be concurrent so the cloud has to take care the concurrency of requests also.

4. PROPOSED SOLUTION

It has been already discussed in previous sections, that there are many techniques and scheduling algorithms used by cloud environments. This paper is presenting a novel technique to assign cloud resources to the requested customers. Proposed technique is based on graph coloring approach to solve the resource allocation problem in cloud computing.

To understand the proposed technique let's take an example. Here table 1 shows the list of requests received by cloud for a particular resource. Table 1 also shows the request arrival time and resource occupancy duration. Figure 1 shows the Gantt chart of requests. In this example total numbers of requests are 11, for a particular resource. Now it is required to calculate the minimum number resource instance to fulfill all requests. Requests must be fulfilling in such a way that no collision occurs in resource allocation.

Table 1: Cloud Client Request Arrival time and Occupancy Duration

S.No.	Request	Arrival Time	Occupancy Duration (in Time Cycle)
1	Req 1	3	3
2	Req 2	0	2
3	Req 3	1	4
4	Req 4	4	3
5	Req 5	5	3
6	Req 6	3	5
7	Req 7	2	7
8	Req 8	0	3
9	Req 9	1	4
10	Req 10	3	6
11	Req 11	5	5

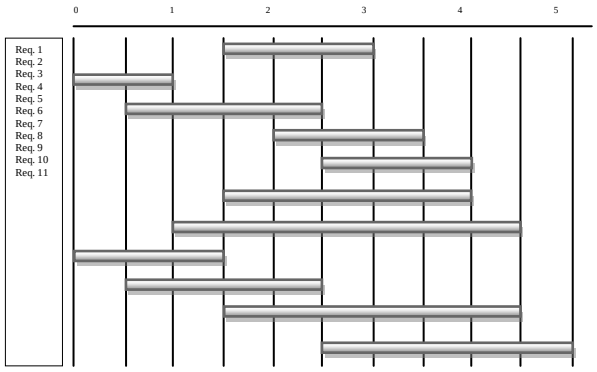

Figure 1: Gantt Chart of Occupancy Duration

Table 2 shows the list of edges generated form table 1. Table 2 represents the graph, in which all the requests are represented in the form of vertices. Edge between two vertices depends on their collision, i.e. if there is any time collision between two requests, there must be an edge between these two requests vertices. Like in this example request number 1 and 3 is colliding at time interval 3 to 5, so there must be an edge between vertices 1 and 3. Similarly for all other vertices, by the result of these operations table 2 is formed. Figure 2 shows the graphical representation of table 2. After preparing the graph, now it's time to color the

vertices graph. To color the vertices of graph one can use any well know graph coloring algorithm. But in this paper an Edge cover based graph coloring algorithm (ECGCA) [24] is used.

Table 2: Edge List

Edge Number	Edge (Vi-Vj)
1	1-3
2	1-4
3	1-5
4	1-6
5	1-7
6	1-9
7	1-10
8	1-11
9	2-3
10	2-8
11	2-9
12	3-4
13	3-6
14	3-7
15	3-8
16	3-9
17	3-10
18	4-5
19	4-6
20	4-7
21	4-9
22	4-10
23	4-11
24	5-6
25	5-7
26	5-10
27	5-11
28	6-7
29	6-9
30	6-10
31	6-11
32	7-8
33	7-9
34	7-10
35	7-11
36	8-9
37	9-10
38	10-11

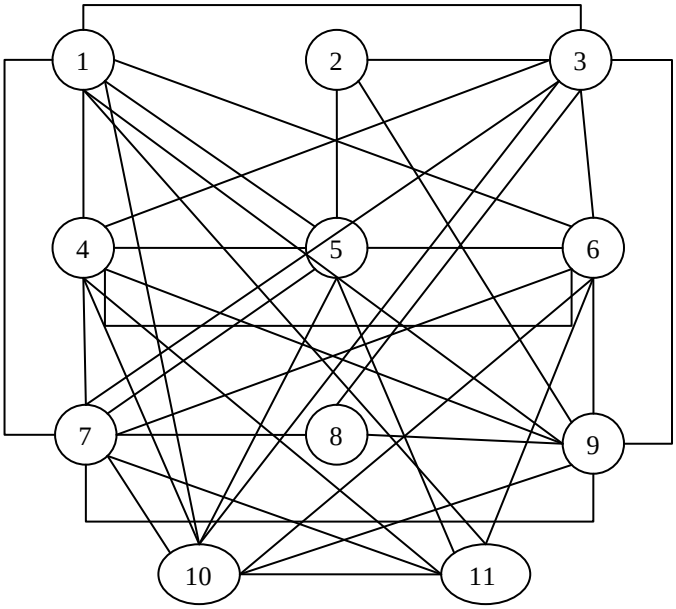

Figure 2: Graph Generated from Requests

By executing the graph data through ECGCA it is found that, minimum 7 resource instances are required to fulfill the requirement 11 requests. Table 3 shows the resource allocation generated by the algorithm.

Table 3: Resource Allocated to Different Requests

S.No.	**Resource Instance**	**Requests**
1	Instance 1	Req. 1 and Req. 2
2	Instance 2	Req. 3 and Req. 5
3	Instance 3	Req. 4 and Req. 8
4	Instance 4	Req. 6
5	Instance 5	Req. 7
6	Instance 6	Req. 9 and Req. 11
7	Instance 7	Req. 10

5. PROPOSED ALGORITHM

Proposed resource allocation algorithm is divided into following steps:

Step1: Calculate request arrival time and resource occupancy duration

Whenever any new request receive form client for resource. It is considered as arrival time of request. For proposed algorithm arrival time of requests are required. Resources are occupied by client for time duration, this time duration is known as occupancy time. So it must be known the occupancy time of all requests.

Step 2: Designing of graph

In this step, a graph has to be design in such a way that all requests are considered as vertices of graph. There must be edges between two vertices if two requests occupancy time clashes.

Step 3: Coloring vertices of graph

In this step, all vertices of graph are colored in such a way that no two adjacent vertices colored with the same color. For that a proper graph coloring algorithm has to be used so that graph can be colored with minimum colors.

Step 4: Resource allocation

After coloring all vertices of graph, Resource can be allocated to all client requests in such a way that, single resource must be allotted to requests which has the same color in graph.

6. ALGORITHM USED FOR GRAPH COLORING

There are various graph coloring algorithms available to solve the graph coloring problem. But for this implementation an edge cover based graph coloring algorithm (ECGCA) [24] is used. ECGCA is fast and efficient graph coloring algorithm. ECGCA algorithm is based on Edge cover technique to find independent set in graph. After finding independent sets, each independent set is colored with the same color. So that each connected vertex get different color in graph. ECGCA required data in the form of edge list format. So that before applying ECGCA all requests data need be covert into edge list. Figure 3 shows the format of edge list. This edge list is store in a text file and this text file is input for the ECGCA. After process this data algorithm generates output as given in figure 4. Output contains information about resource instance allotment to requests.

7. CONCLUSION

Graph coloring approach is an effective resource allocation technique for cloud resources. This approach increases the resource utilization by scheduling resources through graph coloring algorithm. Dynamic resource allocation is also possible thorough graph coloring algorithm. On the other hand if cloud is able to full fill more requests' of cloud clients. Edge cover based graph coloring algorithm is efficient to execute problem data in finite time. So this algorithm is used in proposed implementation. But if we want to increase resource utilization, in that case we can use another graph coloring algorithm.

REFERENCES

[1] Eeva Savolainen ,"Cloud Service Models", Seminar – Cloud Computing and Web Services, Computer Science Department, University of Helsinki, pp. 1-15, 2012.

[2] Sumit Goyal, "Public vs Private vs Hybrid vs Community - Cloud Computing: A Critical Review", International Journal of Computer Network and Information Security, Volume 6, Issue 3, pp. 20-29, 2014.

[3] Dimitrios Zissis and Dimitrios Lekkas, "Addressing cloud computing security issues", Future Generation Computer Systems (elsevier), Volume 28, Issue 3, pp. 583-592, March 2012.

[4] Amlan Jyoti Choudhury,Pardeep Kumar and Mangal Sain, "A Strong User Authentication Framework for Cloud Computing", In Proc. Services Computing Conference (APSCC), Dec 2011.

[5] Sudeepa R, Dr. H S Guruprasad, "Resource Allocation in Cloud Computing", International Journal of Modern Communication Technologies & Research, Volume-2, Issue-4, pp.19-21, April 2014.

[6] V. Vinothina, Dr. R. Sridaran, Dr. Padmavathi Ganapathi, "A Survey on Resource Allocation Strategies in Cloud Computing", International Journal of Advanced Computer Science and Applications, 3(6), 2012, pp. 97-104.

[7] M.Gokilavani, S.Selvi, C.Udhayakumar, "A Survey on Resource Allocation and Task Scheduling Algorithms in Cloud Environment", International Journal of Engineering and Innovative Technology, Volume 3, Issue 4, 174-179, 2013.

[8] Enrico Malaguti,Michele Monaci, Paolo Toth, "A Metaheuristic Approach for the Vertex Coloring Problem", Informs Journal of computing, Volume20, Issue 2, pp. 302-316, 2008.

[9] D. de WERRA, "Investigations on an edge coloring problem", Discrete Mathematics (elsevier), Volume 1, Issue 2,pp. 167-179, 1971

[10] Hussin B., Basari A. S. H., Shibghatullah A. S. and Asmai S. A., Exam Timetabling Using Graph Colouring Approach, In Proc. IEEE Conference on Open Systems, Langkawi, 25-28 September (2011), p.139-144.

[11] Ahmed S., "Applications of Graph Coloring in Modern Computer Science", International Journal of Computer and Information Techology, 3(2), 1-7, (2012).

[12] Barnier N. and Brisset P., "Graph Coloring for Air Traffic Flow Management", Annals of Operations Research, 130 (1-4), 163–178, August (2004).

[13] Briggs P., "Register allocation via graph coloring", PhD thesis, Rice University, (1992).

[14] Mahmoudia S., Lotfi S., "Modified Cuckoo Optimization Algorithm (MCOA) to Solve Graph Coloring Problem", Applied Soft Computing, 33, 48-64 (2015).

[15] Lü Z. and Hao J. K., "A Memetic Algorithm for Graph Coloring", European Journal of Operational Research, 203, 241–250, (2010)

[16] Bui T. N., Nguyen T. H., Patel C. M. and Phan K. T., "An Ant-Based Algorithm for Coloring Graphs", Discrete Applied Mathematics, 156 (2), 190-200, January (2016),

[17] Faraji M. and Javadi H. H. S. "Proposing a New Algorithm Based on Bees Behavior for Solving Graph Coloring", International Journal Contemp. Math. Sciences, 6 (1), 41 - 49, (2011).

[18] Jiyani, "Adaptive resource allocation for preemptable jobs in cloud systems" (IEEE, 2010), pp.31-36.

[19] Pradeep.R, Kavinya.R, "Resource Scheduling in Cloud Using Bee Algorithm for Heterogeneous environment", IOSR Journal of Computer Engineering, Volume 2, Issue 4, PP 15-16, 2012.

[20] K C Gouda, Radhika T V, Akshatha M, " Priority based resource allocation model for cloud computing", International Journal of Science, Engineering and Technology Research, Volume 2, Issue 1, 2015-2019, January 2013.

[21] G. Oddi, M. Panfili, A. Pietrabissa "A Resource Allocation Algorithm of Multi-cloud Resources Based on Markov Decision Process",In Proc IEEE 5th International Conference on Cloud Computing Technology and Science (CloudCom), 2013.

[22] Saraswathi AT, Kalaashri.Y.RA, Dr.S.Padmavathi,"Dynamic Resource Allocation Scheme in Cloud Computing", Science Direct-Procedia Computer Science 47, pp. 30 – 36, (2015).

[23] Robin Khunger, Pawan Luthra, Bindu Bala,"EA Based Approach for Resource Allocation in Cloud Computing", International Journal of Engineering Development and Research, Volume 5, Issue 2,pp.309-314, 2017.

[24] Harish Patidar, Dr. Prasun Chakrabarti, " A Novel Edge Cover based Graph Coloring Algorithm", International Journal of Advanced Computer Science and Applications, Vol. 8, No. 5, pp. 279-286, 2017