

Energy Efficiency Scheduling using Machine Learning Approach

Thesis submitted in partial fulfilment of the requirements for the award of degree of

**Master of Engineering
in
Software Engineering**

Submitted By
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Certificate

I hereby certify that the work which is being presented in the thesis entitled, "*Energy Efficiency Scheduling Using Machine Learning Approach*", in partial fulfillment of the requirements for the award of degree of Master of Engineering in *Software Engineering* submitted in Computer Science and Engineering Department of Thapar University, Patiala, is an authentic record of my own work carried out under the supervision of *Dr. V.P Singh* and refers other researcher's work which are duly listed in the reference section.

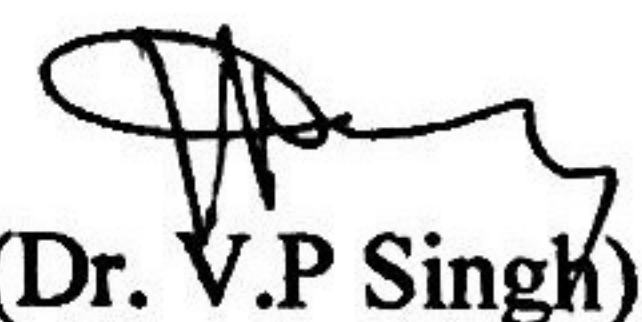
The matter presented in the thesis has not been submitted for award of any other degree of this or any other University.



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This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.



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Abstract

To ensure the efficiency of energy in data centers is very vital objective in modern cloud computing. An immense rate of electrical energy consumed by cloud computing each year which results in a lot of expense in prices. Researchers attempt to develop best possible policies within cloud for the resource management that has several parts like workload stabilization scheduling etc. Machine learning encompasses an important role in these kinds of efforts. In cloud computing, scheduling a job is an essential part for optimizing performance and managing resources. The concentration is on specialized cloud environment and effective scheduling of job in virtual machine resource and server level agreement restrictions. In practical terms, a neural network model is proposed in order to decrease the energy utilization of servers that are in data centers. Result of the proposed model illustrate that the energy utilization is less than that of linear regression models.

Table of Contents

Certificate	i
Acknowledgement.....	ii
Abstract	iii
Table of Contents.....	iv
List of Figures	vi
List of Tables.....	vii
Introduction	1
1.1. Cloud Computing.....	1
1.1.1. Characteristics	4
1.2. Characteristics of all these technologies in cloud computing.....	4
1.2.1. Grid computing.....	5
1.2.2. Virtualization	5
1.3. Cloud Service models.....	6
1.3.1. Infrastructure as a Service (IaaS).....	7
1.3.2. Platform as a Service (Paas)	7
1.3.3. Software as a service (SaaS).....	8
1.3.4. Hardware as a Service (HAAS).....	9
1.4. Deployment of cloud services	12
1.4.1. Private cloud	13
1.4.2. Public cloud	13
1.4.3. Community Cloud	13
1.4.4. Hybrid cloud	14
1.5. Why cloud services are popular.....	14
1.5.1. Issues in Cloud Computing.....	16
1.5.2. Cloud computing job scheduling strategy	16
1.6. System Model	18
1.7. Linear Regression for Machine Learning.....	20

1.7.1. Linear Regression Model Representation.....	20
1.7.2. Linear Regression Learning Model	20
1.7.3. Making Predictions with Linear Regression.....	21
1.8. Virtualization.....	22
1.8.1. Different types of hardware virtualization include	23
1.9. Cloud Entities	24
1.9.1. SLA Resource Allocator.....	25
1.9.2. Service Request Examiner and Admission Control.....	25
1.9.3. Users/Brokers	25
1.10. SCHEDULING ALGORITHMS FOR ENERGY EFFICIENCY	25
1.10.1. Methods of Decomposition.....	28
Literature Survey	30
2.1. Literature Survey	30
Proposed Methodology.....	36
3.1. Problem Formulation	36
3.2. Objectives.....	37
3.3. Research Methodology	37
3.4. Proposed Algorithm.....	38
3.5. Software Used.....	39
Results and Discussions.....	40
Conclusion and Future Work.....	46
5.1. Conclusion	46
5.2. Future Work.....	46
References	47
List of Publications.....	51
Plagiarism Report.....	52

List of Figures

Figure 1.1: IaaS, PaaS, SaaS.....	7
Figure 1.2: PaaS.....	8
Figure 1.3: SaaS.....	9
Figure 1.4: HaaS	10
Figure 1.5: Deployment Strategies	12
Figure 1.6: Full virtualization	23
Figure 1.7: Para Virtualization	24
Figure 4.1 Power Levels in Linear Regression method (5 nodes).....	40
Figure 4.2 Power Levels in Neural Network Method (5 nodes)	41
Figure 4.3 CPU usage in Linear Regression Method (5 Nodes)	42
Figure 4.4 CPU usage in Neural Network Method (5 Nodes).....	42
Figure 4.5 Overall Power consumption in linear regression	43
Figure 4.6 Overall Power consumption in Neural Network Method	44

List of Tables

Table 4.1 Comparison of Power levels of Linear regression and Neural Network Method.	41
Table 4.2 Comparison of CPU usage in linear regression and Neural Network Method.	43
Table 4.3 Power consumption values for different SLA and Working Nodes in Linear Regression	44
Table 4.4 Power consumption values for different SLA and Working Nodes in Neural Network Method.....	45

1.1. Cloud Computing

Nowadays, energy efficiency in cloud computing is a very concerning issue. Each year the data centers at cloud utilize large amount of electricity which in turn results in increase in prices. In cloud there are many elements like scheduling of tasks, workload etc, for which the researchers try to find and build up some strategy which are optimal in terms of managing the resources and the above performance is achieved by using the concept of machine learning. In the system of cloud computing, scheduling of job plays a role which is very important for managing the resources and optimizing the performances. In cloud the main concern or focus is on the scaled and faultless environment of the cloud and effective scheduling of job, considering below the resources of virtual machine (VM) and limitations of agreement on server level (SLA).

The cloud system defines the services of computer that can be out sourced which is same as the energy or power supply. The consumer don't worry about from where the energy or power is coming and how the energy is build up, the only work of consumer is to use the energy effortlessly, but they have to pay only according to the usage. The main goal of making use of cloud computing environment is that the consumer use the services of cloud basically for saving the data and utilize the power. Consumers make use of cloud environment for developing the application without worrying about how it internally works. Cloud computing layout is based on internet for computing different applications. These computing application are utilized using internet. On cloud the service provider of data centers provides the widespread of the cloud services which in turn helps in getting more profit and promotes the technology dynamically. Computing of cloud is a kind of system that is distributed in nature which consists of number of centers that are interconnected

with one another, and these data centers contains numbers of virtual machines, which is used for the job of virtualization that is accessed dynamically by using resources of cloud which depends on the agreement of service level. Most of the servers of cloud are deployed with the help of data centers, which are packed together in order to save space or utilize the space accordingly.

A cloud application depends upon server and can be utilized by sharing the resources of computing instead making use of servers that are local or gadgets that are personal in order to handle the computing applications. Cloud is known as hardware, network services which provides storage all these are joined together in order to provide the services of computing on cloud. Depending on the demand of the consumer, the services of cloud like providing software, storage for the application on cloud and infrastructure which is given to the consumer when ever requested by consumers. System computing is also known as computing which is distributed in nature on the net and provides a platform to run number of computers connected with each other at same time. By making use of cloud computing an individual is able to run end user software server on remote location and can be used in marketing in order to sold the services hosted on the cloud.

Over the internet cloud computing provides different services of computing. These computing services are managed by the third party by whom the consumer easily utilized the hardware and software provided by the servers of cloud which are present at remote location. There are many services provided by cloud such as, provide storage for data online, social site of networking, mailing, applications related to businesses which are online. When there is an internet network connection one can easily access the required information or required services anywhere from the world. Computing of cloud issues a lot of resources which are shared for example issue space to store online data, different networks, provide power for processing the computer, and applications utilized by the end user.

There are many definitions provided by different institutes, the following definition is given by the institute of U.S of cloud computing and the name of institute is national institute of standard and technology:-

Computing cloud is model which provides resources on the request of consumer, consumer have to pay for whatever it uses, provide space online to store information, pool of different resources of computing which are shared, it require less effort to understand, easily understandable by the consumer and also provide interface to interact with the server and access the resources for any part of the world. A model of cloud provides accessibility and it consists three models of cloud services, five characteristics of computing and four models of deployment.

If anyone wants to access the cloud he should have strong internet connections, which in turn implies that whenever he want to access any document or file that are placed over cloud he first need to have good internet connection, the connection will be wireless or wired or through mobile phones. The best thing regarding computing of cloud that the same file can be accessed from number of devices like computer, mobile, laptop etc; In case of businesses, cloud is very helpful as company have its own cloud where it can save its data (documents, files, images, spreadsheets etc.) which can be accessible by any person working in that company but all these things can be done if store connection to internet is available.

There are some examples of different services provided by cloud which is forward by many companies; some of them are given below:

Google : Company google provides different services to consumers on demand like maps on google, E-mail, documents or file, translating texts or file, saving data online mode etc; Google issues these services because this buys its own private cloud which helps in maintaining their private cloud.

Microsoft : Basically, Microsoft is a company which provides an office suit which provides four software's such as MS word, MS power point, MS access, MS excel. Other than these specific software Microsoft a service which is online i.e. share

point which is utilized to move the data or information and tools that are intelligent for business over cloud.

Salesforce.com This provides a platform to the consumer to develop different applications by making use of salesforce.com and vmforce.com.

1.1.1. Characteristics

Cloud computing give us many characteristics some of them are, providing services to consumer only when demanded, provide access to the network, consist of pooling feature for allotting resources and help in measuring the services. There is a service which is known as self service which is on demand that describe the request can be made by the consumer and they can also manage the resources for computing. By this a person can get the information sitting at any part of the world or by accessing any computer having internet. When this technology is compared to the computers that are conventional, a person have to be present at the same place where data is saved i.e; physical presence of the person is very important to that computer where the data is saved but this drawback is overcome by making use of cloud, so that a person can easily access the data from any place. In order to access the services provided by the cloud, it can be accessed by using internet. In context to pool of resources, implies that the any resource requested by the consumer can be access from pool. The services provided by the cloud can be large scale or can be small. According to the requirement, services are offered by the cloud to the consumer and according to the usage the consumers are charged.

1.2. Characteristics of all these technologies in cloud computing

There are certain technologies which are utilized by cloud, which in turn provides some characteristics which are given below:-

1.2.1. Grid computing

In order to get large resources for computing like supercomputing resources, a network which consists number of computers is utilized, this all is done by using grid computing. By making use of grid computing any large, small and even complex operations can be run. The network of computer may situated at different places. Folding home is one of the popular projects of grid computing. In order to execute any project on grid, it makes use of energy of computer network to run the project which are complex in nature. This home folding project is developed for understanding the diseases.

1.2.2. Virtualization

A layer or interface between the operating system and hardware is known as virtualization. Number of consumers uses machine that are virtual during the mainframes late sixties. For each and every consumer, machine that is virtual simulate the performance of operating system. Workstation Vm ware is a product inaugurated in 1999 by Vm ware, which help in running number of operating system on a computer. Hence, virtualization is very important in the technology of cloud computing. Without having the knowledge of storage consumers can easily access the servers on cloud by making use virtualization. The request of the consumer can be evaluated by making use of virtualization concept.

1.2.3. Utility Computing

It is computing which basically describe the model which is used to charge the consumer for what they use or it implies that the service requested by the consumer is on demand and it have to pay for only those services for which they requested. It is just like conventional electricity billing system, a person pays only for the services that he has used or on a monthly basis. There are number of models for billing system, some of them are discussed below:-

1.2.3.1. Billing according to the consumer count.

Suppose consider an example of google, where 100 consumer from certain organization uses google application named as gmail for mailing, where email stays on the cloud servers, then according to the usage of the consumer the bill is charged

1.2.3.2. Billing according GB per use.

Suppose consider an example of using certain site let it be jabong. If a certain organization uses jabong in order to place their information over cloud, then the billing is done according to the utilization of the disk space.

1.2.3.3. Billing is done according to utilization per hour or per day basis.

For example, in this billing system the consumer is charged and have to pay the bill according to the utilization of the cloud server that is virtual and charged per hour or per day

1.3. Cloud Service models

There are three models of services that are provided by the cloud. These three models are, first model is SAAS model, which is known as software as service, because it provides applications which are already made. Second model is PAAS, which is known as platform as service, because it provides platform needed by the consumer in order to develop application. And last model is IAAS, which is known as infrastructure as service, because it provides the infrastructure as requested by the consumer.

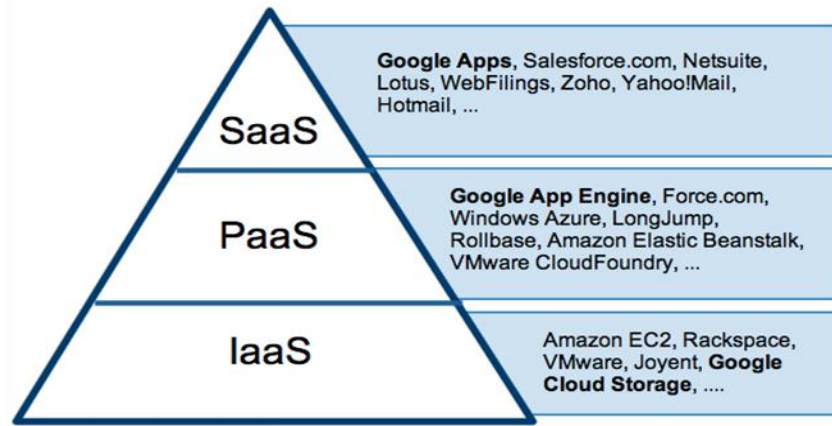


Figure 1.1: IaaS, PaaS, SaaS

1.3.1. Infrastructure as a Service (IaaS)

This is an infrastructure model of providing services to the consumer; it is used for providing the infrastructure to the consumer, whether it is physically present or can be a machine which is virtual. This service model contains hypervisors which is also known as machine which virtually exists and works like a guest on a host computer. Depending on the different requests from the consumer sides hypervisor build a pool for the requests to assign the virtual machines to the consumer and provide the respective services. This infrastructure model provides some more resources like provide firewalls to the system, provide storage too the data, balancing methods of load, provide local networks etc. In this model, when ever consumer requests for any resources the provider of cloud provides these resources respectively. It charged the consumer depending on the resources consumed by the consumer.

1.3.2. Platform as a Service (Paas)

In this model platform is provided as a service. This model of service provides a platform to the consumer which consists of languages for programming, operating systems, provide environment for executing the developed applications, databases etc. The persons who develop the applications for the

consumer according to their need can be run on the platform which is provided by the cloud for example, salesforce platform, window azure platform etc, by making use of these pre build applications any person having the technical knowledge can the develop the application for the user without paying for the platform as this is available on the cloud for free, but firstly one has to register on them. But in order to get more interesting feature one has to pay for that. By making use of platform services our requested resources and the hardware get stored automatically in order to fulfill the needs of the consumer.

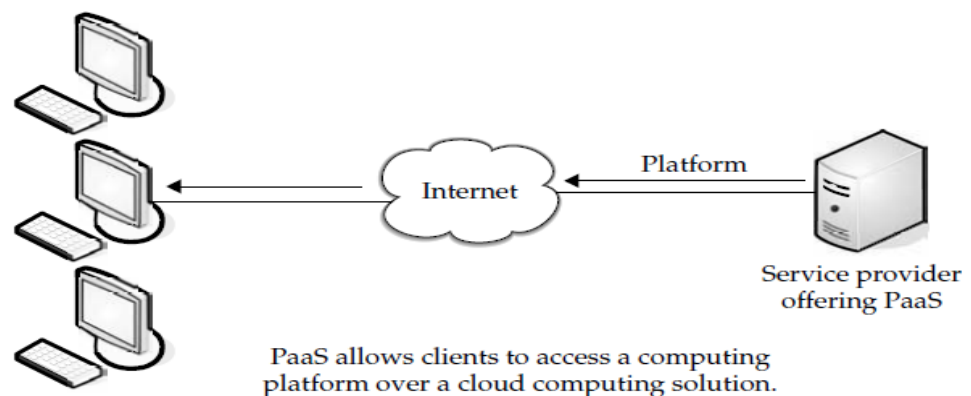


Figure 1.2: PaaS

By using this platform model of cloud only software applications are created. In these applications the consumer only utilizes the features of application without having the knowledge of how they work. These applications are only maintained by the platform developers.

1.3.3. Software as a service (SaaS)

This is one of the model provided by the cloud and known as software as service. In this model the software service enabled application is placed on the cloud in order to make it available to all the consumer from all over the world, but in order to connect to the cloud one should have strong internet connection so that they can easily access the application by sitting on place. Let us consider an example of a company, suppose a company utilizes the software service

model, so each and every member of that company make use of that application in order to access the data and to store the important data. This model is also known as pay per usage model and it is maintained by the model of infrastructure and platform. This usually applies the registration fee.

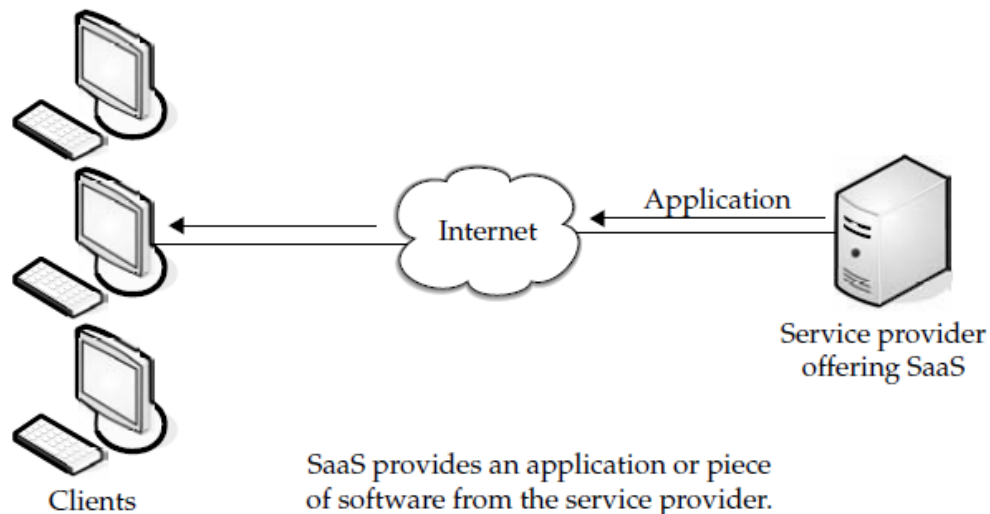


Figure 1.3: SaaS

There are some following features which are contained by Google Apps:

Gmail: This is the application of google, by using this feature of google, one can simply send, receive and even make the data save and also track the detail of the communication with her consumer.

Google Docs: This feature enables us to create, maintain and even share the document with other person through using internet, Rather than documents one can share spreadsheets of google, presentations in our company, with our group etc.

Google Talk: this feature is utilized in order to communicate with other person by enabling our internet facility. If one communicates by using sale forces then data gets saved in sales force.

1.3.4. Hardware as a Service (HAAS)

HAAS is a service provided by the cloud, it provides the hardware to the consumer. As PAAS and SAAS model, provides services to the consumer over the cloud but HAAS provide hardware to the consumer rather than services. By

making use of HAAS, one can simply place the data or information on that hardware.

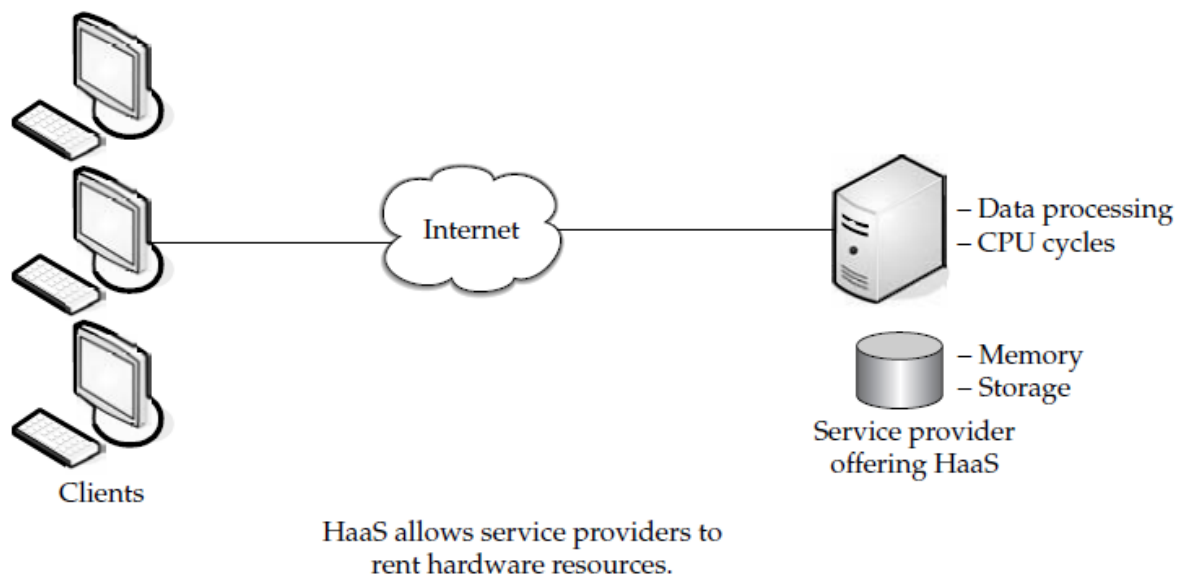


Figure 1.4: HaaS

Instead of buying the software, the server, the racks and in addition to this; pay for the space on the data centre, the servers of the cloud issues resources on rent. There are certain resources which are provided by the hardware model on rent. Following are given some resources provided by the HAAS.

- i. Space for the server on cloud
- ii. Tools regarding network
- iii. Memory
- iv. Cycles of CPU
- v. Space regarding storage

In addition to this, one can dynamically raise up the level or lay down the level of the infrastructure, depending on the resources required by the consumer.

Following are some elements included by the HAAS:-

1.3.4.1. Service level agreement

These levels of services provide an agreement or it can be said that it provides an interface between the end user and the provider of services, which in turn ensure a good performance regarding the system.

1.3.4.2. Computer hardware

In this element the resources of the hardware of the computer can be put on rent for the consumer. This rented model is already set up by the provider of the cloud services in order to get the scalability easily.

1.3.4.3. Network

This element consists of firewalls, router, and technique for balancing the load etc, all these things are consisted in the hardware

1.3.4.4. Internet connectivity

By making use of internet the consumer can easily access the hardware by sitting in their own company.

1.3.4.5. Platform virtualization environment

This is the environment which helps the consumer to run any machine which is virtual.

1.3.4.6. Utility computing billing

This element is used for computing the bill in order to charge the consumer according to their utilization of the resources provided by the cloud system

All the above classified elements are established by the organizations. But there are some more classification depending on the provided services by cloud, given below: -

- i. Storage-as-service
- ii. Database-as-service
- iii. Information-as-service
- iv. Process-as-service
- v. Application-as-service
- vi. Platform-as-service
- vii. Integration-as-service
- viii. Security-as-service
- ix. Management-as-service
- x. Testing-as--service
- xi. Infrastructure-as-a-service

1.4. Deployment of cloud services

The services of cloud are classified into mainly three types that are private, community, and public or hybrid cloud. By making use of any of this cloud one can create the services of cloud.

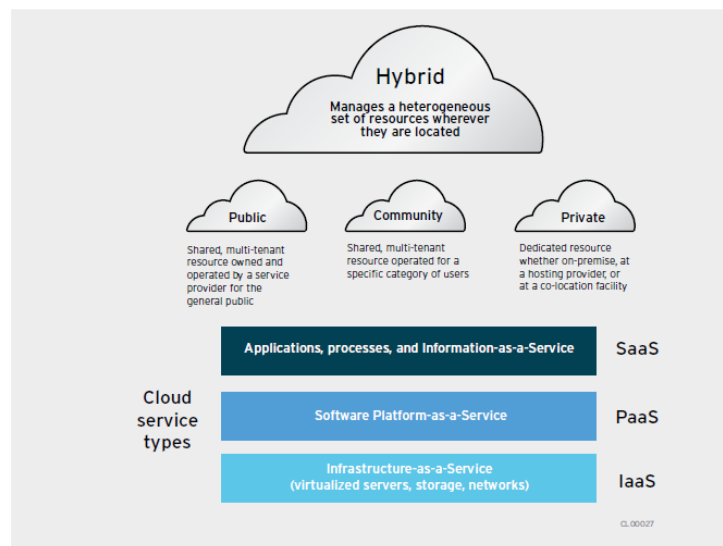


Figure 1.5: Deployment Strategies

1.4.1. Private cloud

Cloud that is private in nature is an environment which is exclusively run for only one company. These services will be provided and managed to the company either by party that is managed by the third person and it may be present in the company whether internally or may be externally. In order to virtualize the infrastructure of the company and to get the best knowledge related to cloud that is private, a person should know the level which is important and commitment of level, in order to take the decision regarding the resources allotment. By making utilization of private cloud one can easily manage company resources, but still there occurs the problem of security as this is the responsibility of the consumer to buy, manage the cloud and also build up the cloud. In this cloud only authorize user are able to get the access to the cloud, which is bought by the company.

1.4.2. Public cloud

The cloud is known as public, when the services are forwarded on the network for consumer, whenever the consumer wants to utilize the services of the cloud or the applications on the cloud for free or one can say he can access the services without paying for it. Practically, the difference among the framework of the public and the private cloud does not exists, but theoretically, there may be a difference of security depending on the different services requested by the consumer and provided by the servers. The cloud which is private can be run offline in any organization but in case of public cloud on should have internet connection in order to access the applications for free such as; amazon, jabong, google etc.

1.4.3. Community Cloud

The cloud which is known as community helps to use the similar framework among number of companies, which consider some general concerns such as

security, from some particular communities. It can be managed through internally or externally or can be managed by the third person. In context to compare the prices of this community cloud with other clouds, community cloud is cheaper than private cloud and in comparison to public cloud, it is free to use.

1.4.4. Hybrid cloud

When cloud is created by combining two or more than two cloud then it is known as hybrid cloud. By implementing this hybrid cloud, an individual is able to implement the framework of both the models and can also consider the characteristics of both models. In hybrid cloud he can make use of bursting of cloud, which is known as application, help in using both public and private cloud. Consider an example of a company making use of application of bursting cloud, in which the cloud which is private helps in the execution of application and the cloud which is public is used whenever the need for increasing the capability of computing is required. In a company by implementing cloud that is hybrid, some of the features are offered to the consumer for free but if some more features are required then they have to pay for it according to the need of the resources required by the consumer.

1.5. Why cloud services are popular

There are a lot services which are provided by the cloud as requested by the consumer, each and every services given by the cloud are very famous and important among the consumer, because some of the services of cloud are freely available so that anyone can use that services from any place or it charges less money and decrease the difficulty of maintaining the cloud and make the computer to operate well. The consumer of cloud does not need to spend the data for the technology framework, hardware can not be buy, the development can be fast, cost related to front end is less, it can easily be use. Suppose if the cloud which is dedicated to certain area, help to fetch to the services that are complex in nature rather than it is not provided by a company.

In cloud computing, efficiency of energy becomes a trendy topic in research area over previous decades. The key components of energy utilization above data centers are mainframe or servers, memory, bandwidth, storage disk and interface of the network. With all these stated features, the mainframe or server is the main component which utilizes more energy. Hence, to manage the energy utilization and its economical usage is the main goal. In cloud computing research area, the researchers are questioned to rebuild the data centers for cloud computing, add energy effectiveness to records of crucial parameters of operation which are already there in service convenience, dependableness and performance. The two most efficient ways to conserve the energy are consolidation of workload and turning additional servers. Consolidation of workload describes the method of joining the workloads from different applications and different machines. There are some provocations like requirement of less hardware; energy utilization should be less for server energy and requirement of fewer spaces which is solved by above stated approaches.

In order to conserve the energy and cooling cost of the server, the spare servers that are not in use should be turned off. The utilization of energy isn't solely decide by the hardware, but its's additionally keen about the infrastructure where the management system of resources are deployed and application's effectiveness running in the system. There is an impact of energy effectiveness on the consumers in context to prices of resource utilization that are measured by total price of ownership sustained by the providers of resources. In order to the improve the effectiveness of energy of data centers, they should be envelop in the concept of cloud computing which in turn provide control to recover the energy effectiveness on bigger scale. Consumer may merge their requirements for computation and place their applications over the cloud, rather than utilizing separate systems for computing, that is effective when compared to small systems of computing because of large scale.

1.5.1. Issues in Cloud Computing

In cloud there are many limitations, some of them are discussed below: -

1.5.1.1. Efficiency of Energy: - Now a day's computing of cloud is very famous among the consumer and it becomes very important area for every consumer. But, there is a limitation of energy because whenever an application is used by the consumer through internet it utilize more energy, therefore, to conserve the energy is the most important concern

1.5.1.2. Security: - As whenever a person uses a cloud, it in turn provides the security to every consumer which make use of cloud such as, provide every consumer with different space for storing data, transferring of data is done through encryption etc. but still there exists a problem of security because of some hackers and some companies employees who are corrupted

1.5.1.3. Reliability: - In computing there is one more important concern that is reliability, because there some customers who are not sure of making use of cloud, as thinks that if the storage is trustful or not, whether the cloud is save or not, whether it is ok to pay online.

1.5.1.4. Ownership: - There is one more issue related to ownership, in this the owner is in confusion whether the data it relate to the cloud is safe or not, whether the rights of the customers associated with it are still remain reserved or not

1.5.1.5. Data Backup: - In this issue the consumer is worried about their data which can easily be use by any other person, in order to protect their data they can make use of cloud, which provide the services to store their data and the data can be used by only the authorized consumer from any place but should have good internet connection.

1.5.2. Cloud computing job scheduling strategy

Following are some objectives regarding the strategy for scheduling the task: -

1.5.2.1. SLA limitation

Whenever a person wants to schedule the task, firstly he should sign an agreement for service level in combination with the cloud. In this limitation of agreement he must specify the server quality, time limit for the application of the cloud, consistency of the system and also the security regarding the cloud services

1.5.2.2. Load balancing

When one makes the comparison of the cloud system for computing with the conventional system for computing, he comes to know that the conventional system of computing which is distributed in nature, depends only on the time to complete the task performance and the throughput of the system. Whereas, the cloud system for computing helps in increasing the income of the services, helps in order to minimize the expenses and utilize the resources effectively. All these things in cloud system can be done by using the balancing method of load, which in turn results in good performance

1.5.2.3. Machine Learning

Machine learning may be a kind of AI which gives computer systems a flexibility to be studied while not being expressly programmed. The main focus of machine learning is on developing the programs for computers which will be modified once it's get exposed to new information. The method of machine learning is alike to data mining method. These two processes search through information to appear for patterns. Rather than withdrawing of information for human understanding, as that is the case in the application of data mining. This information is used by machine learning in order to sense the patterns in information and consequently attuned the program action. Supervised and unsupervised learning are the two types of machine learning. Supervised learning will be applied to what has been learned within the past and the unsupervised learning can be used to make assumptions from the datasets. The main key problem in cloud computing is to decrease the energy

utilization. To optimized the consumption of energy and storage over the cloud energy conscious resource allocation is used. Because the jobs consume the energy which is directly associated with the utilization of the energy, the job strengthen being employed to optimize the consumption of the energy. There are many optimal strategies for the management of resources which are attempted to develop by the researchers like, placing the virtual machines, scheduling of tasks, consolidate the workload etc. These efforts can be achieved by machine learning and gives a solution for the effectiveness of energy in the environment of cloud computing.

1.6. System Model

This model consists of four components that are described below:

1.6.1. User Request pattern

This is the first component of the system model in which the user request for the required service and this request is initially translated by the request examiner of the required service and control method of admission which interprets the essential QOS needs but it firstly decide whether the requested service request is received or refused. Generally, there are some automated systems in cloud like brokers(brokers are those system which reply from consumer sides in order to submit the request for the service from all over the world), through which end user can interact.

1.6.2. Broker

In order to achieve the professional objectives, making use of cloud computing plays a crucial role. To achieve these professional goals the consumer should know how to make use of cloud computing, thus, all the information to operate the cloud is provided by the broker. Broker performs like a module which is basically third party which provides an interface among the consumer of the cloud service and the provider who provides the requested service to the

consumer. In order to get knowledge about work processes, planning requirements and needs for managing data, the broker should work with consumer. List of suggested providers of the cloud and the contact of the seller to the consumer is presented by the broker. However, some more services can be added by the provider but only on the consumer's demand.

1.6.3. Virtual Machine

A software is known as a virtual machine if it displays the characteristics of different computer but can also execute the jobs for example, to run an application like a different computer. When a virtual machine is created or placed within same computing surrounding it is referred as guest virtual machine but if virtual machine is developed in other computing surrounding then it is referred as host virtual machine. Hardware with a specialized hypervisor is not the requirement for the virtual machine. In comparison to conventional virtual machine, now days it needs extra band width and capacity, if anyone wants their hardware to host on various machine that is running these virtual machines will be moved and assigned again and again without any difficulty.

1.6.4. Data Center

Data centre is an area under a personal building or office room where there are a number of servers which helps in accessing the internet from all over the world. Therefore, data centre is a combination of number of servers where the application required by the consumer is hosted. As data centre consists of different number of server which in turn help to access the resources only on demand. There are almost seven places where the data centre are placed and the server are placed estimated around million. If user request for a service from cloud, it is forwarded to the client through data centre. Every data centre hosted on cloud has different location over the world example countries. Whenever the client request for a service, this service request is translated by the broker and to forward the request for service to the data centre is the authority of broker.

1.7. Linear Regression for Machine Learning

In machine learning, the method which is popular and can be easily understand this method is known as regression which is linear. Machine learning can be defined as a modeling scheme which is used in order to decrease the errors or one can say that it helps in developing a model which build exact predictions.

Linear regression can be stated as linear model. Suppose that a model consider a relationship that is linear among the variables i.e; input or output/ X or Y . in other words it can also be stated that by taking the values from the input (X) as a combination, one can evaluate the output value i.e. (Y). If in this model only one variable for input is considered then it is known as regression which is simple or simple linear regression. If the model consists of number of variable for input then this scheme is known as multiple linear regression.

1.7.1. Linear Regression Model Representation

The representation of the regression model which is linear is very easy that is why this model becomes popular and attractive. This model is represented with the help of equation which is linear, which in turn combine the outcome values from the input values to the output values, but the values of input and out should be numeric in nature.

When a single scale issue is allocated to every value for the input in the equation that is linear, it is known as coefficient and denoted by B , which is Beta derived from a greek word. If anyone wants to add one more coefficient, it can be added by allotting a freedom as a degree to a line, which in turn is known as intercept.

1.7.2. Linear Regression Learning Model

In the model of regression there are four methods in order to create the model that is linear given below: -

Simple Linear Regression: When in regression there is only one input, then to evaluate the coefficients by using method of information. The conclusion

properties of the information method use means, standard deviation, correlation etc.

Ordinary Least Squares: In order to evaluate the coefficient value for the input which is more than one in number then least square method is use. This square method is used to decrease the remaining squares. This implies that one can get a line which is regression line, and to compute the space from every point of data to that line.

Gradient Descent: If someone wants to optimize the coefficient value, he should have more than two inputs to get processed which help in decreasing the bugs. All these can be done by method of gradient. By default it takes casual values for coefficient. For every combination values of input and output one will evaluate the bugs regarding the squares of sum. This will be iterated until the less number of bugs from square of sum are obtained.

Regularization: This scheme is used when there are training add on of the model that is linear and is defined as methods of regularization. This method is utilized to make the square errors less in number and also decrease the difficulty of the model

1.7.3. Making Predictions with Linear Regression

Following describe the description of the equation that is linear given below.

Here 'y' represents the load and 'x' represents height for any given problem

$$y = B0 + B1 * x1$$

or

$$\text{weight} = B0 + B1 * \text{height}$$

In the given expression 'B0' designate the coefficient of bias and 'B1' designate the column height coefficient. By using this formula better pair of values using learning scheme are achieved.

Let us consider an example, where the value of $B_0 = 0.1$ and $B_1 = 0.5$. Now, put this value into the formula and then estimate the weight but if the height is given, before solving the problem.

$$\text{weight} = 0.1 + 0.05 * 182$$

$$\text{weight} = 91.1$$

1.8. Virtualization

It is a process of divides a computer into multiple execution environment running separate operating systems. Each operating system has its own private virtual machine. Every system of operating consists of their virtual machine which is private. It may run a operating system on each virtual machine which is dissimilar in nature. Virtual Peripherals share physical hardware resources. These details are hidden from virtual machines. It also can allow efficient resource management. When most organizations get started with virtualization, they start with the servers in their data center. Server virtualization is when virtualized servers that are providing the applications that run important programs like accounting, web servers, CRM, and others to our users and our customers.

There are certain advantages of virtual machines which are discussed below: -

- i. If the hardware that are physically present is not offered, then virtualization helps to run operating systems
- ii. In virtualization, to build up new machines are easy
- iii. It helps in executing inherited systems
- iv. Virtualization helps in fixing the problem
- v. It help to reproduce the machine which are physically present
- vi. By using this concept moving machines that is virtual are easy

1.8.1. Different types of hardware virtualization include

1.8.1.1. Full Virtualization

Virtualization which is full in nature implies that it help in executing the machine on any other machine which is fully installed. In this virtual machine helps to run every software and get the result

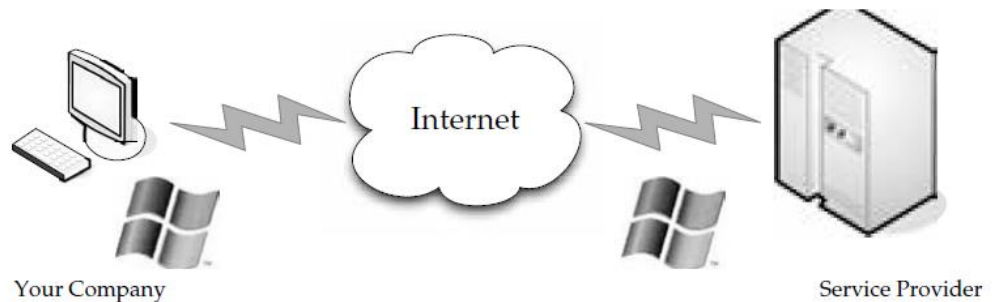


Figure 1.6: Full virtualization

When the full virtualization is deployed then the server executes the software and the outcome will be visible at the consumer end. In order to use the various services provided by the cloud, one has to relate the cloud with virtualization.

There are some purposes related to full virtualization given below: -

- a) Number of consumers will be able to share one
- b) Helps in differentiating between the
- c) A copy of one hardware run on other hardware

1.8.1.2. Para virtualization

In para virtualization numerous operating system are able to be executed on single machine but at unique time by utilizing the resources. In para the whole system is not reproduce but in full virtualization the whole system is reproduce and in para the element for managing the operating system. As in full virtualization whole system is reproduce therefore, para is better or performs better in comparison to the full virtualization.

Levels and explanation of virtual device given below: -

Started: This is the level from where the virtual machine start executing

Stopped: This is the level where virtual device stop

Suspended: It is the state where the machine which is virtual is removed from the host

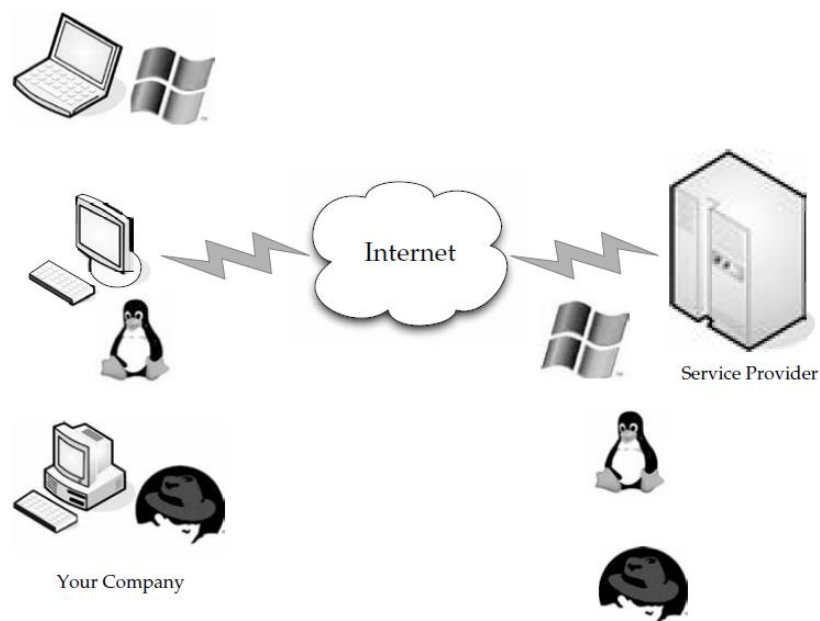


Figure 1.7: Para Virtualization

Execution of the task

- i. Firstly, the consumer forward the job to the cloud to get solved
- ii. After forwarding the job, the controller of cloud receives the job
- iii. Then controller transmit the job to the cloud data centers
- iv. There exists multiple host in the pool of virtual machine
- v. According to the need the hosts can be removed or may be configure

1.9. Cloud Entities

There are some entities of cloud which are described below: -

1.9.1. SLA Resource Allocator

Service allocator agreement is layer among the infrastructure of cloud and the consumer or broker. It is used to provide the communication among the schemes to order to manage the resources that are SLA oriented.

1.9.2. Service Request Examiner and Admission Control

The main aim of request examiner is to control the request of the consumer regarding the service and the controller method related to admission is used in order to get the knowledge regarding the services and its quality and requirements. All these decision are taken before accepting the request of the consumer. It need to update the information whenever a new information came in order to make the resources available to the consumer. Therefore, it firstly accept the request after that allot the resources accordingly.

1.9.3. Users/Brokers

There is a system which works automatically, in order to communicate with the consumer on the cloud infrastructure, which is known as schedulers or brokers. The broker in turn performs from the consumers side in order to place the request for the services, by sitting from any place of the world, if a person wants to access the cloud

1.10. SCHEDULING ALGORITHMS FOR ENERGY EFFICIENCY

Scheduling which is effective in terms of energy is very useful for balancing the environment in which the tasks or jobs related to scheduling get schedule depends on some requirement. In order to schedule the request from the Vm to those machines which are physically present, regarding particular data centre depending on the resources request and their requirement such as RAM, memory, bandwidth, all these can be done through scheduling scheme. In today's world there are number of different providers of services of cloud, which provides data centers on the cloud of different capacities and machines that are physically present. There are

number of providers of cloud such as sales force, amazon, windows azure, oracle, application of google etc.

Generally, the algorithm of scheduling work in three steps:

- i. In first level, a suitable machines that are physically present are find out for a bundle of virtual machines
- ii. In second level, an appropriate provisioning methods for machines that are physical are determined
- iii. In third level, over the machines that are physical, scheduling of jobs are performed

Following are some algorithms parameters that are effective in energy efficiency [5]:

- i. What is the percentage of the services related to time exists
- ii. Provide the feature by which one can handle the number of consumer concurrently
- iii. A benchmark in context to performance is set, according which the performance will be compare from time to time
- iv. It will notify whenever the consumer affected by any changes in the network
- v. For any problem regarding the classes get response by the help desk
- vi. Provide ease of use for dial in
- vii. Provide statistics also

The algorithm for scheduling that is effective in energy, which may be either static or dynamic. The example of scheduling scheme regarding static machine that is virtual is first come first serve scheme. The example of scheduling scheme regarding dynamic machine that is virtual is genetic scheme. If anyone wants to make use of effective scheduling in terms of energy, in order to manage and balance the load.

In respect to effective energy in balancing the load, is utilized in order to distribute the load of processing on larger scale to the processing of small scale, in order to make the performance of the system enhanced, so that one can decrease the prices

of energy. If he considers the environment which is distributed in nature, helps to distribute the processing load of the system to number of nodes in the same environment, in order to enhance the time of job responding back and the usage of the cloud resources. If he wants to balance the load or to decrease the overloading of any node, he can use of balancing the load algorithm. Load balancing is easy to implement in normal environment but if one considers the cloud infrastructure implementing the balancing technique of load is difficult, because it consists certain limitations such as, security, feasibility, through put etc. therefore, the main aim of implemented the balancing technique in cloud infrastructure in order to increase the performance and provide better responding time for the task, by issuing the whole load of the system in a manner of energy effectiveness. So that no node can be overloaded.

There are two ways in which effective energy balancing technique of load works that are: one way is cooperative way, in which for optimizing the time of responding and to attain the common aim by concurrently make the nodes working. Second way is non cooperative way, in which to increases the performance and to get better time of responding regarding the jobs that are local, by running the individual jobs separately, without depending on the other nodes, every node do their job independently. In context to the balancing of the load methods they are categorized into two types: first method for balancing load is static method. In static method does not consider the state which are used before or node behavior when the load is distributed over the nodes. Second method for balancing the load is dynamic. In dynamic method for balancing the load kept an eye on the previous state in contrast to the static method when the load of the node is distributed. This dynamic method which applied on the nodes can be distributed in nature or can be un distributed in nature. The main goal of making use of load balancing methods that are dynamic in nature is that if one considers a system consisting of numbers of nodes, then in that system any of the node met with an failure, it does not affect the whole system but the failure in turn decrease in performance. When the comparison is made with between distributed and non distributed environment, the distributed environment nodes will communicate with each other and create huge

amount of messages in contrast to environment which is non distributed. This distributed environment in which load is balance help in managing the policy for tracking the data an update the data according to it. There are four policies used by load balancing methods which are given below:

- i. Transfer policy: - It is the policy which is utilized when anyone wants to move the job to remote node from the node which is local
- ii. Selection policy: - It is the policy which is utilized when the processor want to interchange the data among themselves
- iii. Location Policy: - this policy is used in order to define the destination node to forward the data
- iv. Information Policy: - This information policy is used for managing the information of all nodes

There are number of schemes which are heuristic in nature but still there is a variation in their nature. Hence, to forward the complete classification is very difficult. Additionally, many schemes are developed in order to perform some specific task or solve some specific problem, but the there is no possibility of using the same methods for some different applications or different problems. Hence, following are some attempts are given for the categories which is not excluding and large in nature, due to which the scheme that is energy aware works.

1.10.1. Methods of Decomposition

In this method of decomposition the problem which is novel is firstly divided into number of small problems before get solved. These smaller problems are being easy to solve and get the outcome, and it always remember that the smaller problems belong to the original class of the problem. By decomposing the large problem into number of small problems, it decreases the effort and increases the time.

1.10.1.1. Inductive Methods

In these methods, firstly whole problem is considered and according to the problem some easy case is considered. After considering the generalized easy case or method which is easily evaluated, then that scheme is now applied to the whole problem.

1.10.1.2. Reduction Methods

In this method according to the optimal solution of the problem, some of the properties regarding this optimal solution are selected. After that these properties are considered as the boundary for the whole problem. The main goal of this reduction method is to control the space for the solution, by making the problem simple. But there is a limitation that the original outcome is not find out.

1.10.1.3. Constructive Methods

By the name of this method specifies that it is used for the construction or he building purpose. This method is utilized for constructing a step by step an outcome starting from start of the problem. This method runs by using the concept of iteration. As this scheme is deterministic in nature, hence, it consider the best possible out come during every iteration.

1.10.1.4. Local Search Methods

When a comparison is made of this local method of search with all the methods discussed previously, one can state that the method used for local search always start with the some solution of the problem, which is realistic in nature, which in turn help in improving the solution. In this method, one first starts with some realistic assume solution, then after moving to the next iteration this realistic solution get replaced with other better solution. The iteration will iterate until it gets the best optimal solution of the problem or that iteration will stop if it don't have any other solution to improve our realistic solution.

2.1. Literature Survey

In this chapter, results of an extensive literature research in the field of scheduling in efficiency of energy. This chapter provides the aspect of issues in computing cloud, different types of computing, virtualization etc. The review includes the experimental work undertaken from time to time along with the development of energy effective scheduling.

Craig A Lee¹ et al. [1] targeted on the promising style space for the applications that are hosted on cloud that will have the requirements that are changing which required to be supported for dynamic SLA. The elementary functions of SLA are analysed that are controlling admission, Monitoring, SLA analysis, and SLA management which is a classic involuntary cycle control. In this paper a key is proposed through which the necessities of SLA applications can be meet and manage the outpouring capacity under the surge state. By making use of any different recognized strategies the usage of above surge capacity will be managed. Researcher developed a strategy which depends on the architecture of SLA that is the elementary problem which is to be solved through the research.

Jyoti Thaman et al. [2] focus is centred on the big variety of requests that is used to access the SLA and resources which lies among services provider of the cloud and the end user. There are certain problems in environment of cloud such as quality of service, security, energy, migration of virtual machines, allocating the resources and scheduling should be attentive for community of research. According to the agreement of SLA, resources should be allocated between multiple end users. In this paper, researchers tested and invented various techniques in cloud computing for optimal scheduling.

Mehmet Demirci et al. [3] researcher focus is on the operational prices, which is complied with the concept of green computing. In this paper policies that are optimal are developed for managing the resources in cloud computing, which includes several elements like placement of virtual machine, job scheduling, workload etc.

Pedro Domingos et al. [4] this paper centred a lot of knowledge become obtainable to solve various problems. In this paper author develop an application based on machine learning which needs a significant quantity of art which is very complicated to search in books.

Soodeh Farokhi et al. [5] focus is centred on the continual change in the work load, virtual machine's size which may be alter in terms of issued resources by cloud as per work load's run time , that guarantees the good performance. An ordinarily used flexible resource method is supported by making decision which depends on capacity and usage of resources. In this paper author presented a new hybrid flexible approach which consider both performance of application and usage of resource to hold the advantages of these two methods. The presented methods are utilized in achieving the memory flexibility, but the memory which is allotted is automatically scaled at run time. Results show the high performance of the application with good stability by providing hybrid controller. It also achieves utilization of memory when the comparison is made with other controllers.

Soumya Ranjan Jena et al. [6] this paper focus is centred on the utilization of the energy by the data centre on the cloud which in turn increase the price and outflow the carbon oxide to the surrounding. An approach is developed for the usage of the CPU and the utilization of power by authorizes the migration of the machine that is virtual. In order to approve the correctness, the power effective methods like R-square and MSE (mean square error) are applied. Finally, result shows that the polynomial approach is the effective approach which utilize less power when compare to other approaches of power.

Ziqian Dong¹ et al. [7] in order to decrease the utilization of the energy by the data centre servers, the author focuses on the allocation of the jobs to the servers hosted on data centre as an issue of integer programming. Researcher stated that by making use of greedy job allocation, it restricts the service time limitation while decreasing the count of the server that are active hosted on the data centre. In this paper researcher develop the first effective job scheduling strategy for the data centre's server which in turn helps in decreasing the utilization of the energy. This proposed strategy arrange the jobs to the server that are less in count but retain reply time of the data centre considering many limitations.

Francis et al. [8] this paper provides the previous information regarding the effectiveness of the energy for the cloud, gives the cloud definition, importance of using cloud etc. in this paper author stated that judgment regarding the efficiency of energy does not only depend on the data centre of cloud but, because of communication with middle node network maintains the overall behavior of the services provided by cloud. During the communication, the networks which is used for services provided by cloud utilize more energy and this issue of consuming more energy is growing very fast. In this paper the infrastructure of the network is analyzed through energy utilization.

Zhang et al. [9] in this paper the author proposed a scheme which are light weight in nature, in order to evaluate the utilization of energy by the servers of cloud and machines that is virtual accurately. Author explores the hypervisor metrics for evaluating the performance, which in turn help in developing the model for utilization of energy. The utilization of energy by the system and requirements for SLA and methods of learning for allotting the resources and effectiveness of energy, both of them is required in order to configure the resources for cloud.

Graubner et al. [10] in this paper the author proposed an energy conserving scheme for consolidated machine which is virtual machine. Depending on the migration on live basis of virtual machine and migration for storage which is effective in energy, hardware service takes an advantage of deficiency of energy.

Dharwar et al. [11] this paper gives the outline for managing the power technology on server end hardware which in turn explain how the characteristics is extracted to place new policies for energy. This paper provides the detailed view about how will these new policies of energy help in operating the data centers of cloud effectively. It also include some of the important challenges in operating the cloud.

Ye et al. [12] the central aim of the paper is based on the strategy of migration which was live, considering number of machines that are virtual in combination with technology for reserving the resource. In this paper author firstly, explain the framework for migration that was live for number of virtual machines with reserving of resources technology. Secondly, some experiments are done so that one can get the information regarding the impact on the migration performance of virtual machines by using reserving resource method on both the machines that is whether it is source or destination machine. After simulation, results are find out using parameters like, down time, migration time in total, and performance during workload and measure overheads.

Kejiang et al. [13] in this paper author presented a data centre framework which is energy effective based on virtual machine in cloud. This paper search about the overhead performance which is cause by two technologies i.e; consolidation of server and the moving of virtual machine from one machine to another. In this paper the framework is proposed and simulated and results show that these two technologies provide less overhead by using energy effective methods.

Yamini et al. [14] in cloud computing to consolidate the job become a crucial method to simply the resource utilization which in turn improvise the effectiveness of the energy. In this paper the concentration depends on the usage of resources which is directly associated to the usage of energy. It shape it's relationship and build up the two energy aware job consolidation. These heuristic job consolidations integrated and express the outcomes of consuming the energy and its capacity is confirmed by the research. This paper analyze the conclusion of the study that has direct contact in order to reduce the bill of electricity of cloud

provider environment but it also define some feasible saving in different operative prices for example paying for the space on the floor.

Karthikeyan et al. [15] in this paper the main focus is to minimize the utilization of energy by using energy effective method which is heuristic in nature and minimize the emission of carbon by using an algorithm for effective migration virtual machine. In order to improve the services of cloud quality, in scalable infrastructure an enhanced edition of method that is auto scaling is used. Depending upon the requests load of the consumer resources are allocated accordingly and booted faster in order to match up the time of response.

Zhou et al. [16] in this paper author proposes a scheduling scheme that is dynamic is nature which is used to make contract depending on monto sampling based on improbability demands. As scheduling is inherited from the demand of consumer problem, which in turn displays that the Neural Network Method of scheduling consists of some properties which are popular. After proposing the method the simulation results are considered, which results in better efficiency.

Zhang al. [17] in this detailed study of cloud computing is presented, main concepts of computing is focused and implementation of state art is give. The main focus of the author is to offers a knowledge regarding cloud computing environment and recognizes the way which is important for research.

Berl et al. [18] in this paper a review is done on the utilization of schemes and technologies used by the environment of the network and hardware of computer for performing the operations that are energy effective. By going through the appropriate survey of literature in this field, some of the remaining main challenges which arise because of energy saving issues by extending the cloud infrastructure.

Anton et al. [19] author study and analyze the issues of utilization of the power and proposed a classification of energy effective layout for cloud system which includes the hardware, levels of data centre, system of operating and virtualization.

This paper evaluate the analysis of different works held in the cloud area and put it them in a category for future style and efforts of development.

3.1. Problem Formulation

The existing conventional algorithms have the following limitations:

- i. To decrease the energy of data centers is very important and composite task because the applications of cloud computing are escalating nowadays which in turn rise the demand for number of servers and disks that are required for fast processing within a period of time.
- ii. Green computing of cloud focuses on visualization in order to attain the processing which is effective and making use of infrastructure of the cloud, but is also used to decrease the utilization of energy. All these things are very important in order to increase the cloud's growth which is feasible.
- iii. When persistent front side of the consumer devices communicate with the data centre back side, which in turn causes the huge growth in the energy utilization.

In order to manage these problems and to drive the green computing, the resources of data centers are not organized in an energy effective way. The resources of computing of cloud are used to allocate to consumer in order to assure the quality of services and also require minimizing the utilization of energy.

There are some main challenges that have to be addressed given below:

- i. How the trade among conserving the energy and delivering of the performance is solve?
- ii. How can a person conclude that when, which and where to move the virtual machines, which in turn decrease the consumption of energy, but by maintaining the minimum overhead of moving and ensures server level of agreement?

- iii. How to build up an effective scheme which is decentralized in nature and scalable for allocating the resources?
- iv. How to build up a complete solution by making a combination of different number of policies considering different number of objectives?
- v. The key purpose of the work is to present the visual of the proposed work, research challenge in the management of the resources which are energy effective, build up policies and schemes for the virtualized data centre which are energy effective in nature, which make the computing of cloud more friendly to environment and sustainable in nature, which in turn can handle future generations like commercial, scientific and development of technology.

3.2. Objectives

Following are the objectives in order to propose the work:

- 1. To study the cloud framework for energy utilization.
- 2. To propose an efficient neural network model for energy utilization and allocating the resources of data centers.
- 3. To verify and validate the proposed model.

3.3. Research Methodology

Most of the times one has to satisfy the estimated solutions of computing, depending on the size and the existing time of CPU. In account to such situation, it may be not be possible to achieve the quality of estimated solutions. In this research methodology section, methods are described which is known as heuristic schemes, which are use to evaluate the effectiveness of energy. The above heuristic term is derived from Heuriskein which is a Greek word, which implies to determine or to find out. It can be utilized in the field which is used to illustrate some certain types of methods for solving problems. There presents a huge mixture and number of difficult problems, that came in to practice and have to be solved effectively, and

forward it for the development of effective events in order to find out the solution of the problem which is optimal. The schemes which consider the speed of solving the problem as a quality for the outcome, it is known as heuristics methods.

- i. Firstly, assemble or gather the information and limitations in order to make simulation model of the cloud
- ii. After gathering and simulating the cloud, by utilizing cloud sim tool, configure the data centers and these data centers will be further extended according to the necessity
- iii. Every data centre consist of two host in maximum
- iv. Every host in maximum consist of two virtual machine
- v. In seven separate places, these data centers can be placed
- vi. Originally, 18 illustrations are assumed
- vii. Then, according to the Neural Network Method these illustration can be allocated to the virtual machine
- viii. After setting up the setup, the location, source of the data centre, time of the state etc, is noticed
- ix. Finally, deploy our cloud model for moving of virtual machines
- x. Then, by simulating the model get the results, by using the simulator known as cloud sim

3.4. Proposed Algorithm

START

1. Enter T_n to be executed

$T_n = T_1, T_2, T_3, \dots, T_n$

Where T is the no. of jobs.

2. Implement R_h for the jobs running on the machine h .

R_h – health status of the jobs

3. Evaluate c_h for jobs where c_h is the power consumption of machine h .

4. Evaluate the soft f_n $f_{\text{soft}} = \max (100, \text{user } t_j \cdot \text{SLAF}_j, 100)$

End T_j - Strat T_j

User T_j = estimation of the user to complete the job.

Start T_j , End T_j = jobs started and finished times.

5. Set power consumption of machine as prediction process & make training sequence $P = P_1, P_2, P_3, \dots, P_n$.

6. Set jobs health status as the Response & set the targets $X = X_1, X_2, \dots, X_n$.

7. Train using neural networks and test the health status of jobs and predict the power consumption levels, loads of CPU'S and SLA timings.

8. Evaluate Performance Parameters, Power consumption using different CPU loads, SLA satisfaction levels.

9. STOP.

3.5. Software Used

This section comprises of the technologies used to implement the work described in this thesis. The work has been realized in MATLAB 9.0. MATLAB is a software suite developed by Math Works. It incorporates visualization, programming and computation in comprehensible environment. MATLAB toolbox permits applying expert knowledge in the form of rules. The fields in which MATLAB toolbox are offered are aerospace, bioinformatics, signal processing, control system, image processing, neural networks, wavelets, fuzzy logic, simulation, database and many more.

Results and Discussions

The Neural Network Method utilizes the resources and manages the resources. Therefore, prerequisite resources and migration or start or stop the virtual machine, all these things are managed by a manager that are locally available. Infrastructure as a service is used as an environment; therefore, computing environment is used in order to develop an outlook for number of resources to consumer for computing. It is also very important to estimate the method that is proposed, on large scale environment of data centers. But, it is very difficult in order to estimate the huge scale methods again and again on the real world environment, which in turn utilized to make comparison of Neural Network Methods with the other different methods but on the similar circumstances. A simulation environment is selected in order to estimate the proposed scheme. To estimate the proposed scheme firstly, the probability of proposed scheme is grouped under certain requests and secondly, makes comparison of result of proposed scheme with other methods results.

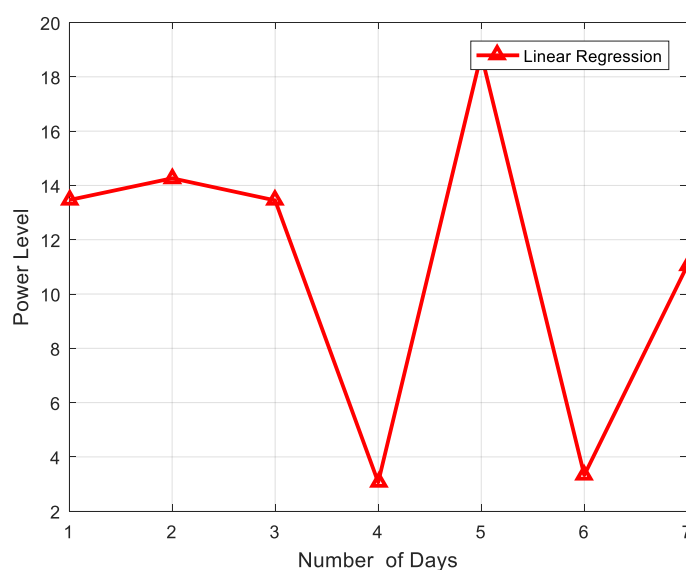


Figure 4.1 Power Levels in Linear Regression method (5 nodes)

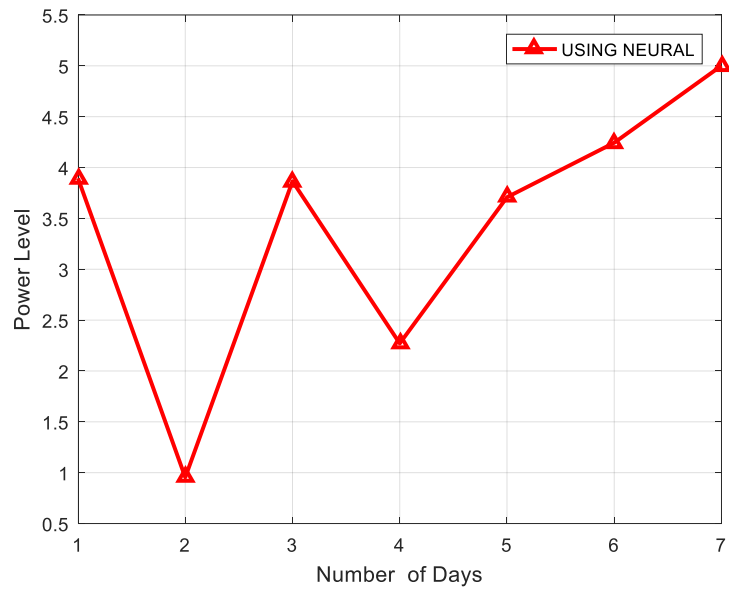


Figure 4.2 Power Levels in Neural Network Method (5 nodes)

Table 4.1 Comparison of Power levels of Linear regression and Neural Network Method.

POWER LEVELS OF 5 USER NODES IN 7 DAYS (KW)							
Linear Regression	13.46	14.26	13.44	03.06	18.82	3.32	11.05
Neural Network Method	3.89	0.95	3.86	2.27	3.70	4.24	5.00

Figure 4.1. and Figure 4.2 shows the overall power levels using linear regression and Neural Network Method respectively. From simulation the highest value for power levels in linear regression is 18.82 KW whereas the highest value for power levels in linear regression is 5.00 KW.

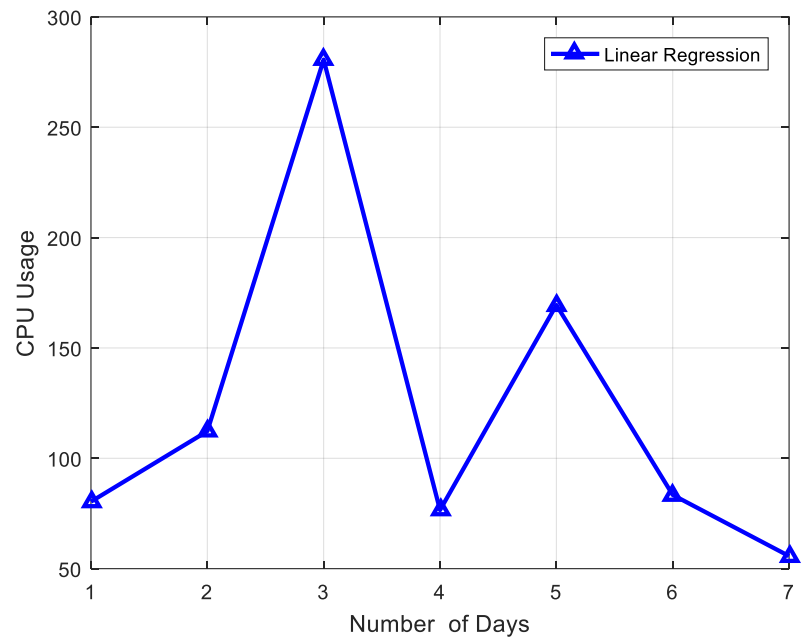


Figure4.3 CPU usage in Linear Regression Method (5 Nodes)

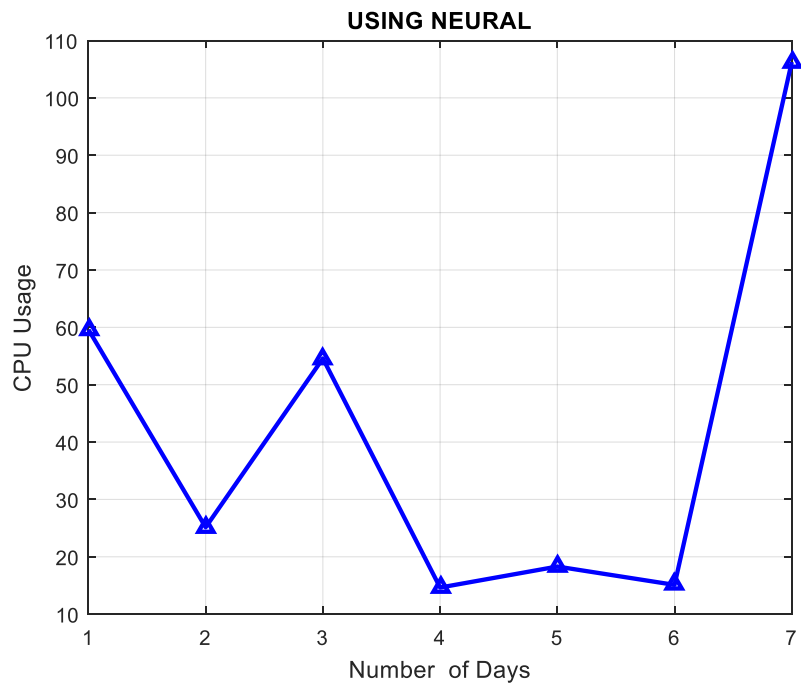


Figure 4.4 CPU usage in Neural Network Method (5 Nodes)

Table 4.2 Comparison of CPU usage in linear regression and Neural Network Method

CPU USAGE OF 5 USER NODES IN 7 DAYS (MHz)							
Linear Regression	80.36	112.26	280.59	76.55	169.45	83.41	55.70
Neural Network Method	59.60	25.14	54.57	14.64	18.29	15.10	10.24

Figure 4.3 and Figure 4.4 shows the overall CPU usage using linear regression and Neural Network Method respectively. From simulation the highest value for CPU usage using linear regression is 280.59 whereas the highest value for CPU usage using Neural Network Method is 59.60

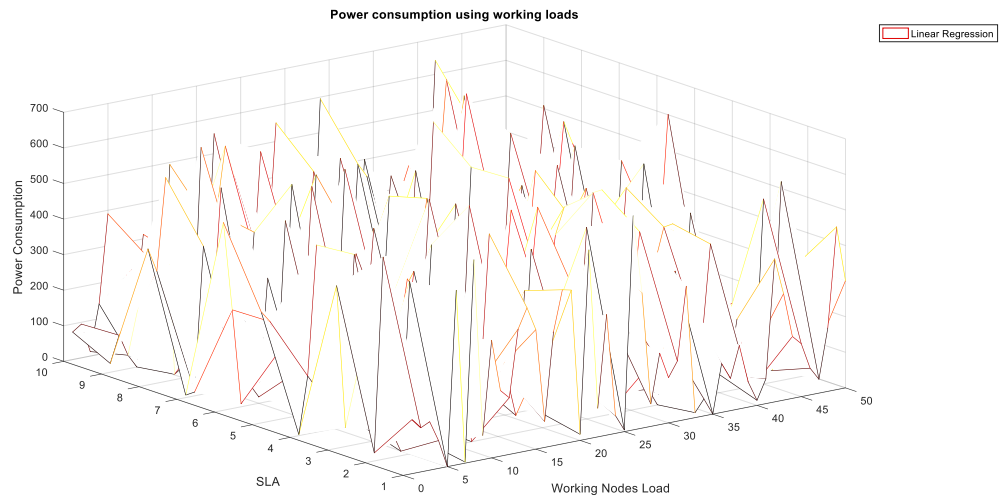


Figure 4.5 Overall Power consumption in linear regression

Table 4.3 Power consumption values for different SLA and Working Nodes in Linear Regression

SLA	Working Nodes Load	Power Consumption (KW)
1	5	269.4
1	10	566.1
2	5	43.99
2	10	364.5
3	5	269.3
3	10	330.2

Figure 4.5 and Table 4.3 display various power consumption values for different SLA and working nodes using Linear regression. The highest value for power consumption using linear regression is 566.1 KW.

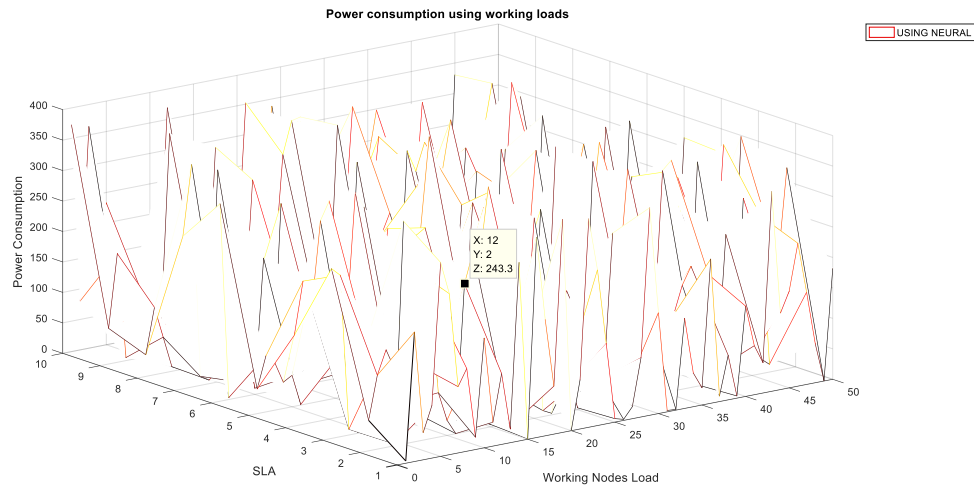


Figure 4.6 Overall Power consumption in Neural Network Method

Table 4.4 Power consumption values for different SLA and Working Nodes in Neural Network Method

SLA	Working Nodes Load	Power Consumption
1	5	62.3
1	10	365.24
2	5	5.74
2	10	124.96
3	5	146.03
3	10	174.22

Figure 4.6 and Table 4.4 display various power consumption values for different SLA and working nodes using Neural Network Method. The highest value for power consumption using Neural Network Method is 366.24 KW.

Conclusion and Future Work

5.1. Conclusion

In the proposed work a perceptive vision regarding optimization of scheduling of different tasks over the cloud environment. By considering the neural network, a theoretical perception is made in order to study the processing and the execution of different scheduling tasks and build up a scheduling task method over cloud infrastructure by making use of workloads for optimizing the utilization of energy, utilization of energy and levels of energy. Proposed work of optimized scheduling is simulated and evaluated. By considering the simulated results we concluded that the Neural Network Methods optimally uses the resources of cloud and balances the load in order to obtain a good performance by considering the limitations of resources.

5.2. Future Work

We provide an insightful view about the job scheduling optimization for cloud computing platform. In light of the proposed Neural Network, we theoretically analyze the execution process of jobs in cloud computing environment and design a job scheduling scheme using workloads learning to optimize the Power Consumption, Power Level and CPU Usage. We evaluate the proposed job scheduling optimization schemes in extensive simulations. In Future work, we find that the proposed job scheduling scheme can optimally utilize cloud resources and load balancing to obtain the Performance with resource constraint.

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- [1] Amritinder Cheema and V.P. Singh, “*Energy Efficiency Scheduling Using Machine Learning Approach*”, 3rd International Conference on Next Generation Computing Technologies (NGCT-2017). [Communicated]

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