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Study of Various Heuristic Approaches in Cloud Computing

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Abstract- Cloud computing is the most recent arrival to the world of IT infrastructure. Also, Cloud Computing is one of the most emerging areas in the field of research and development. It allows companies to maximize the utilization of their resources and consequently raise their performance. The main benefit of Cloud Computing is the significant rise in the efficiency of executing their various business plans. It provides large applications with powerful computing parameters like scalability, adaptability, reliability, etc. This paper includes the study of various existing heuristic approaches used to improve different parameters. In cloud computing, there are large numbers of problems while you are going for scheduling requests from users. However in practice there is only need of solving the issue of efficiently even if not optimal.

Keywords **-** Cloud Computing, Heuristic, Load Balancing

I. INTRODUCTION

One of the most emerging technologies in the world is Cloud Computing, which has various features like adaptability, scalability, etc. Distributed computing environment has become cost effective and popular choice to get high performance and to solve large-scale computation problems. Unlike previous supercomputers, a cloud or cluster or grid system is used as multipurpose computing platform to execute diverse high performance parallel applications. It is the delivery of various resources as a service rather than as a product, whereby shared resources, like software, and information are provided to other systems as a utility over a network (typically the Internet). The term Cloud acts as a network, that can provide services over network, i.e., on either public or private networks, such as WAN, LAN or VPN. Also, we are able to simply see that numerous applications like email, net conferencing, client relationship management (CRM), all run in cloud.

Cloud Computing refers to manipulate, configure, and access the on-line applications. It offers varied services like on-line knowledge storage, infrastructure and application. It acts because the high utility software system, that has the power to vary the IT software system trade and to create the software system even additional enticing. it's dynamical the approach that IT corporations wont to obtain and style hardware. the net services ar increasing day by day, that makes load reconciliation a giant analysis topic. The physical property of running resources while not paying a premium for large-scale, is unexampled within the history of IT trade.

A. Characteristics of Cloud Computing

The Cloud could be a variety of parallel and distributed system together with the cluster of inter-connected and virtualized computers that are scheduled dynamically and highlighted as a lot of unified computing resources supported SLA established through conciliation between the service supplier and customers [14]. The assorted characteristics of Cloud Computing include on-demand self service, broad network access, resource pooling and measured service.

- On-demand self service, which suggests that customers (usually organizations) will send request and manage their own computing resources.
- Broad network access, that enables services to be offered over the web or personal networks.
- Pooled resources, that customer draw from a pool of computing resources, typically in remote information centers.
- Climbable services; and use of a service is measured and customers are beaked consequently.

B. Deployment Models

a) **Private Cloud**: Private cloud is a type of cloud computing that delivers similar advantages to public cloud, together with measurable and self-service, however through a proprietary style. It is for a single organization. It is desirable for those businesses which are with dynamic or unpredictable computing and wants the need of direct management over environments. This cloud gives some similar basic advantages of public cloud. These embody self-service and scalability; also multi-tenancy and the power to the virtual machines; dynamical computing resources that are on-demand; and creating multiple same machines for advanced computing jobs, such as huge knowledge. Chargeback tools track computing usage, and business units pay just for the resources they use. Additionally, it offer hosted services to a restricted variety of individuals behind a firewall, thus it reduces the security considerations some organizations have around cloud. It conjointly offers various companies direct management over their data.

b) **Public Cloud**: A public cloud is one which is based on some standards of cloud computing model, in which a service provider provides resources, like applications and storage that are available to the public over the Internet. Its services are sometimes free or offered on a pay-per-usage model. The term

"public cloud" is raised to differentiate between the existing standard model and the private cloud, which is the desired network or data center that uses cloud computing technologies, like virtualization. It is managed by the organization it serves. Examples of public clouds include Amazon Elastic Compute Cloud (EC2), IBM's Blue Cloud, Sun Cloud, Google AppEngine and Windows Azure Services Platform.

c) **Hybrid Cloud**: A third model, the hybrid cloud, is maintained by both internal and external providers. It is a cloud environment that uses a combination of above mentioned on-premises, private cloud and third-party, public cloud services with orchestration between the platforms. By permitting workloads to transfer between private and public clouds as computing needs and costs change, hybrid cloud gives businesses having more flexibility and more data deployment options. It is especially valuable for extremely changeable or dynamic workloads. Its flexibility and scalability deletes the need for an organization to create large capital expenditures to accommodate short-run spikes in demand. The provider supplies compute resources, and the organization only pays for those resources which it consumes. Private cloud workloads should access and interact with providers, so it requires application program interface compatibility and fixed network connectivity. For this kind of cloud, there are various potential connectivity issues, SLA breaches and alternative possible cloud service disruptions. To mitigate the risks, organizations build hybrid workloads which interoperate with multiple providers. However, it complicates workload design and testing.

C. Service Models of Cloud Computing

Cloud providers provide various services [14], which are shown below:

a) **Infrastructure as a service (IaaS)**: In this, the cloud user patches and maintains the OS and also the application software. This capability that is provided to the customer is to provision various things like processing, storage, networks, and other fundamental computing resources where the customer is able to deploy and execute arbitrary software. The consumer cannot manage or control the cloud infrastructure but has great control over all resources, such as operating systems, storage, and applications, which are deployed on it; and possibly restricted control of select (security) networking elements (e.g., host firewalls).

b) **Platform as a service (PaaS)**: In this, the capability which is provided to the customer is to deploy onto the cloud infrastructure which is consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The customer cannot manage or control the underlying cloud infrastructure consisting of network, servers, operating systems, or storage, but can control over the deployed applications and probably configuration settings for the application-hosting setting environment.

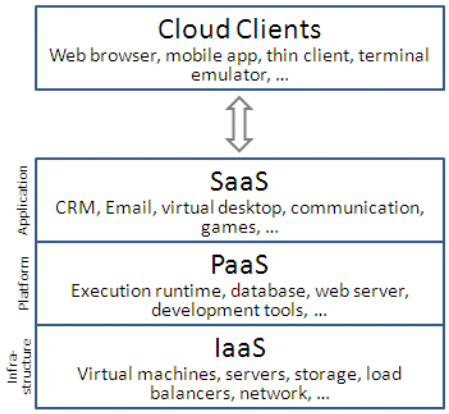

Fig.1 - Cloud Service Models

c) **Software as a service (SaaS)**: In this, the capability provided to the customer is to use the provider's applications executing on a cloud infrastructure. The applications are accessible from numerous client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure consisting of network, servers, OS, storage, or maybe even individual application capabilities, with the probable exception of restricted user-specific application configuration settings.

D. Benefits of Cloud Computing

Cloud computing offers lots of advantages:

- *Cost*
- *Performance*
- *Freedom from up gradation and maintenance*
- *Scalability*
- *Speedy Implementation*
- *Green*
- *Mobility*
- *Maximized Storage Capacity*

E. The Pros and Cons of Cloud Computing

Any serious analysis of cloud computing must address the advantages and disadvantages offered by this burgeoning technology. What's good—and what's bad—about cloud computing? Let's take a look.

A. Cloud Computing: Advantages: There are many advantages offered by cloud computing and are as follows:

- **Flexibility**: Services, which are cloud-based, are unique for businesses to grow with rapidly changing demands. If one wants to increase demand, it's easy to increase the cloud capacity, by drawing on the remote servers. Similarly, if one wants to reduce it again, the flexibility is involved into the service. So, the level of agility provides a real advantage to businesses using cloud computing over competitors.
- **Disaster recovery**: Various businesses of different sizes must be taking care of disaster recovery, but it is more ideal than the reality for smaller businesses that lack the required cash and expertise. Cloud helps

more organizations to raise that trend. Small-scale businesses are doubly as likely as larger ones to implement the backup and then recovery solutions which save time, roll up third-party expertise, and also avoid large investment as the deal.

- **Automatic software updates**: One of the benefit of cloud computing is that the servers are outside the premises where it is not visible. Providers take care of them and check out for updates made to the software– including security updates – so that one don't have to think about time consumption and maintaining the system, leaving one independent to focus on the important things to raise his business.
- **Free Capital-expenditure**: Cloud computing reduces the cost of hardware. One uses "pay as you go" concept and enjoys a subscription-based model which is a kind of cash flow. Also, the ease of setting up and management of IT project looks very friendlier, that is not easier to adopt cloud.
- **Increased collaboration**: When groups usually access, change and share documents at anytime, from anywhere, they are easily able to work together, and in better way. Cloud-based workflow, along-with file sharing apps helps them to update them in real time and provides full accessibility of their collaborations.
- **Work from anywhere**: If one has an internet connection, one can be at work anytime and with serious cloud services providing the mobile apps, one is not restricted to devices one has in their hand. Businesses provide more flexible working area to employees so that they can enjoy working over the cloud without decreasing productivity. One author reported in his work that 42% of all of workers swapped a part of their pay for the beneficial to telecommunication. On average they would take a 6% pay cut out.
- **Document control**: The more people work on documents, more is the requirement for document control. Employees used to send files as email on which they have to work on by a single user. Usually sooner, one ends up with a large number of conflicting file contents. Even the small-scale companies become more global with the rise in scope for complication. When one uses cloud, all of their files are centrally stored so that everyone sees it accurately. More visibility means more improved collaboration, which finally means better work. If one is still dependent on the old ways, it could take more time to try something, which is more streamlined.
- **Security**: Laptops, which are lost, is much bigger business problem and more than the reduction in an expensive kit, that is the loss of the sensitive data present inside it. Cloud gives more security when this, such situation happens. As data is stored in the cloud, one can access it without knowing what happens to the machine and one can even remotely loss data from lost laptops which can move into the wrong hands.
- **Competitiveness**: Using the cloud gives access to enterprise-class technology, for all. It also allows small-scale businesses to act faster than large-scale, established competitors. Pay-as-you-go concept of services and cloud business applications means that small businesses can be run with the large-scale of workers, and disrupt the market.
- **Environmentally friendly**: As the above points speak about the advantages of cloud computing in business, it is not the selfish task to move to the cloud. When cloud needs to be changed, the server capacity increases and reduces as per the need and demand. So one can only use the cloud for energy efficiency. This is done at Salesforce.com, where all try their best to generate sustainable solutions along-with minimal environmental impact.

B. **Cloud Computing Disadvantages**: There are a variety of reasons for not adopting cloud computing for some particular needs as discussed below:

- **Network connection**: The concept of cloud assumes that the consumer has reliable network connection. If there are various issues of network connectivity, it becomes a problem to access the cloud. Performance of the cloud applications additionally depends on the performance of network at consumers' side. Uploading and downloading speeds are slower than that of a local server.
- **Control of data security**: In a public cloud, the client has no control over security of his/ her own data. The clients' data can be prone to hacking or phishing attacks. Since the servers are interconnected over the cloud it is simple for malware to spread.
- **Additional costs**: Although cloud computing offers cost benefits, it has hidden or extra costs as well. Clients are charged extra for data transfer or other services. Initial offerings are priced higher, till economies of scale work out for the service provider.
- **Peripherals**: Peripheral devices like printers or scanners might not work with cloud. Many of them require software to be installed locally. Networked peripherals have lesser problems.
- **Integration**: Internal applications with those on cloud can be complex to be integrated and in some cases not viable.
- **Generic**: Public cloud offerings are terribly generic and offer multi-tenancy service that may not be comfortable to all organizations. Implementing an in-house cloud is difficult to be implemented and is burdensome on resources if the organization is small.

Cloud service providers are repeatedly evolving solutions to reduce the hurdles mentioned above. Some enterprises see clear benefits in adopting the cloud technology and are adopting it without any condition while some enterprises are moving some non-critical applications to check the waters. Some others are waiting how the technology is evolving before deciding.

II. RELATED WORK

In [1], an algorithm was implemented, that kept the minimum migration time. They achieved migrations of VMs on the basis of overloading that occurred in physical servers in cloud data centers through their modified best fit decreasing algorithm, which provided relatively less performance degradation due to VM migrations. The SLA violation was also compared to other techniques and resulted that the cloud provider incurred less cost from VM migrations. Host

selection and VM reallocation was quicker than the existing algorithms. Maintenance of physical servers could be efficiently achieved through their algorithm, which is efficient consolidation of VMs.

In [2], the proposed scheduling algorithm mainly focused on efficiency of cost, which used two heuristic methods, out of which first method mapped the tasks to VMs that are the cost-efficient, based on the concept of Pareto dominance dynamically and the other is the complement to the first, in which the monetary costs of noncritical tasks have been reduced. The algorithm is cost-effective while improving makespan as good as the best known task-scheduling algorithm.

In [3], a heuristic algorithm for the multi-site computation offloading problem is proposed and evaluated for solving the weighted single-objective optimization problem. The combinatorial optimization problem with three objectives is considered: (1) to reduce the energy consumption of the mobile device to minimum; (2) the computation time has to be minimum; (3) which further reduces the total cost of the computation incurred by cloud computing. This multi-objective optimization problem had been implemented into a weighted single-objective optimization technique. The experimental results showed that the good quality solutions in a reasonable time for those test problems can be produced by the heuristic algorithm.

In [4], the multi-attribute combinatorial exchange approach is not scalable in the number of participants but fits both the domains-specific and the economic requirements. The conceptualization, implementation, and evaluation of a scalable market mechanism that is suitable for the needs of large-scale computing infrastructures are the main objectives. A generic representation of the allocation problem based on the multi-attribute combinatorial exchange approach, which is suitable for greedy optimization methods, is proposed. Three greedy approaches differing in the computational complexity are customized to the problem representation.

In [5], authors planned a completely unique superior hyper-heuristic formula for programming on cloud computing systems to cut back the makespan. This algorithm is applied to both sequence dependent and independent scheduling problems. The two operators, which are diversity detection and improvement detection operators, are employed in the algorithm to determine the timing. These two are employed dynamically to determine a low level heuristic that used to find better solution. Authors examined the above method with several scheduling algorithms to evaluate the performance of this method and results proved that proposed algorithm can significantly decrease the makespan of task scheduling, when it is compared to other scheduling algorithms.

In [6], authors proposed a hybrid HSGA and the solution achieved through this proposed algorithm is obtained that it reduced the running time of tasks, whereas it supports the load balancing and reliability with various parameters. Also it improved the makespan of application in about by 19.14 %, load balancing in about by 10.38 % and speedup ratio in about by 18.22 % at least.

In [7], they obtained the solution based on existing heuristic approaches, in which they scheduled requests, which are made by users. They simulated the results and seen the effectiveness of the approach of the revenue generation.

In [8], the authors proposed a new heuristic algorithm for scheduling tasks of tasks (meta-task) in heterogeneous computing. It improved the performance with respect to makespan and effective utilization of resources in which the idle time of the machine is reduced by using the benchmark simulation model for distributed heterogeneous computing systems. Their performance seen that the proposed algorithm improved the resource utilization rate and reduced makespan, when compared to other known algorithms.

In [9], the proposed method in which scheduling was performed based on hybrid PSO with CS algorithm given better results in terms of average schedule length and ratio of successful execution. The length of average schedule of proposed HPSOCS has performed better by 0.93% than PSO, when number of task is 100 and by 3.03% than PSO, when number of task is 900. The average schedule length is increased when the number of tasks increases. Also the ratio of successful execution of proposed HPSOCS performed better by 3.5% than PSO at number of task was 100 and by 1.24% than PSO at number of task was 900. The ratio of successful execution reduced when the number of tasks increased.

In [10], here Cuckoo Genetic Optimization Algorithm (CGOA) is proposed that was achieved from cuckoo optimization algorithm (COA) and genetic algorithm (GA) for task scheduling in grid computing. This CGOA is implemented on parallel dealing out for effective scheduling of multiple tasks with less schedule length and load balance. Here transmission time and number of job set are evaluated with the help of job-processor relationship. The results showed that the proposed algorithm is capable in improving complexity, load balancing and utilizing the resources.

[11] showed an efficient fine-tuned high –level heuristic for a job scheduling problem to reduce the comprehensive make span time of given collection. The intensification and diversity operators is proposed on longing to make out when the low-level heuristic algorithm is variant and to a conditional revealing operator to shine up the outcome gained by each low-level algorithm to enhance the scheduling possessions by improving makespan.

In [12], a Hyper-Heuristic Approach (HHA) was developed to optimize the process price of SWFAs during a cloud surroundings. Moreover, to show intelligence choose a LLH, a brand new prioritization strategy was projected supported process price collectively of the performance criteria.. Furthermore, the capabilities of the proposed model were enhanced by devising a prioritization strategy for the selection of low-level heuristics. This dynamic selection performed better than the randomly applied mechanism, which was based on previously achieved performance certainly.

In [13], heuristic algorithm reducing a high-performance makespan was presented to find better solutions for scheduling in cloud systems. This algorithm has used two operators: one is to automatically determine when to change the low-level heuristic algorithm and other is the perturbation operator to analyze the results obtained by candidate pool algorithm, which further improved the scheduling by reducing makespan. The simulation resulted in proving that proposed algorithm was faster than the other heuristic algorithms and computational cost was also low.

III. CONCLUSION

In this paper, we have studied various heuristic approaches, which are used for scheduling purpose. There are various different algorithms like Min-Min, Max-Min, etc., which are implemented in the above research papers and various parameters are calculated based on which the results were found.

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