Analysis Existing Load Balancing Algorithms in Cloud Computing

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Abstract

Cloud computing technology is one of the assistive technologies that are developed on a daily basis. Cloud computing technology faces many challenges and difficulties to develop and improve the technology's work, and one of the most important challenges facing cloud computing technology is balancing the burdens in the dynamic work environment in cloud computing. The algorithms of load balancing in cloud computing are one of the important tools to improve the performance of cloud computing technology, and it is important to distribute tasks between the nodes in the cloud computing system, the increased burden on a node in the cloud computing system will lead to poor performance in the system, so it is important to use an efficient algorithm to improve performance. There are many researchers interested in this field who have contributed to improving the work performance of the cloud computing system, and in this research we presented an analytical study of burden allocation algorithms to improve work performance and task allocation in cloud computing. There are many algorithms used in cloud computing and each algorithm has advantages and disadvantages. In this paper, we analyzed cloud computing burden distribution algorithms. Through the analysis, we find that the PSO algorithm is better than other algorithms in terms of performance and efficiency in the process of distributing tasks in cloud computing.

Keywords— Load balancing; cloud computing; Checkpoint; Scheduling; PSO

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خلاصة:

تقنية الحوسبة السحابية تعتبر من أحد التقنيات المساعدة والمتطورة بشكل يومي. تقنية الحوسبة السحابية تواجه تحديات ومصاعب كثيرة لتطوير وتحسين عمل التقنية، ومن أحد اهم التحديات التي تواجه تقنية الحوسبة السحابية هي موازنة الأعباء في بيئة العمل الديناميكية في الحوسبة السحابية. خوارزميات موازنة الاعباء في الحوسبة السحابية هي أحد الأدوات المهمة لتحسين أداء عمل تقنية الحوسبة السحابية وهي مهمه لتوزيع المهام بين العقد المتواجدة في نظام الحوسبة السحابية، تزايد الأعباء على عقدة ما في نظام الحوسبة السحابية سيؤدي الى أداء سيئ في النظام، لذا من المهم استعمال خوارزمية كفؤة لتحسين الأداء هناك العديد من الباحثين المهتمين بهذا المجال والذين ساهموا في تحسين أداء عمل نظام الحوسبة السحابية، وفي هذا البحث قدمنا دراسة تحليلية لخوارزميات توزيع الأعباء لتحسين أداء العمل وتوزيع المهام في الحوسبة السحابية هناك العديد من الخوارزميات المستخدمة في الحوسبة السحابية وكل خوارزمية لها مميزات وعيوب، حللنا في هذه الورقة العلمية خوارزميات توزيع اعباء الحوسبة السحابية. ومن خلال التحليل نجد ان خوارزمية PSO أفضل من الخوارزميات الأخرى من حيث الأداء والكفاءة في عملية توزيع المهام في الحوسبة السحابية..

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Introduction

Currently, information technology has tended to develop technologies to meet user demands with the lowest cost and multiple sources. This led to the development of multiple technologies, including cloud computing.[1] Cloud computing is one of the most substantial technologies that witness rapid development in use, and with the widespread use of the Internet, cloud computing technology is used as a major turning point in the business and public life economy, as many international organizations and companies use cloud
computing technology. Cloud computing technology provides users with a set of various services that provide each user with the required needs by sharing resources, available infrastructure and different devices (networks, services storage devices, servers and
and application services, security and programming).[2] In this technology, these services are provided as a helping service and many auxiliary services to facilitate the users' business, and many features and services are accommodated and can be canceled according to the user's desire.[3] Cloud computing technology is concerned with providing customer requirements and distributing them over the Internet to use computers available resources and services, the user does not know the arrangement of services that are delivered to the system and the user may use all available services so that for all systems and resource management in cloud computing systems.[4] Cloud computing technology develops previous models used previously such as network computers' use, distributed software services. Cloud computing technology has many services that the user can request and use such as networks, servers, data storage, software applications, and other computer usage services.[5] Cloud computing technology has three basic layers and each layer has a set of tasks and services: (Software as a service (SaaS), Platform as a service (PaaS), Infrastructure as a service (IaaS))

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1- Software as a service (SaaS):

This layer deals with the various programs and applications that the user needs and the user can upload applications and tools that are appropriate to the work environment such as the systems for the work of the organization or the company, Internet browsers ... etc.

2- Platform as a service (PaaS):

It specializes with developers as it provides them with a special environment for using programming languages and utilities such as Google App, Microsoft Azure, IBM Smart Cloud, Amazon.

3- Infrastructure as a Service (IaaS):

Dealing with infrastructure and sources of use of computers is reserved according to the needs of the customer's work environment such as processors, storage capacities, and other needs.

Cloud Models:

Public Cloud: available for every organization.
Private Cloud: available only for a particular organization or company.
Hybrid Cloud: this hybrid clouds are a hybrid between two or more different clouds such as private or public.

It is possible to reach the best performance by maintaining a budget of business burdens in the cloud computing resources, and one of the biggest challenges facing researchers is the process of distributing users' tasks to the various resources appropriate to conduct business while maintaining a balanced workload, and the balanced distribution of business in the cloud computing is one of the most difficult problems that aim to improve business performance in cloud computing technology.[6] The dynamic load balancing algorithm does not depend on the previous state or the behavior of the previous system, it depends on the current behavior of the system.[7] To improve response time in cloud computing systems, we use dynamic algorithms to make assignments of tasks in nodes loaded to other nodes less loaded. Types of Load balancing algorithms: 1) Sender Initiated, 2) Receiver Initiated,3) Symmetri

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Analysis of Existing load balancing algorithm in cloud computing

Cloud computing technology One of the modern technologies used and aids to accomplish human tasks, there are many users from organizations and large companies for this technology.[8] Several algorithms have been used to improve the performance of cloud computing systems such as Ant Colony Optimization, First Come First Serve, Round Robin, Min-Min Algorithms, to improve and accelerate performance to complete tasks in less time.[9]

Classification of Load Balancing Algorithms

• *Static Load Balanced Algorithm is used in a small environment that* is suitable for internet speed and neglected delays.

• Dynamic Load Balanced Algorithm focuses on reducing task completion time in large distributed environments.
The difference between types of load balancing:
Static:
It is based on the system's information and its previous behaviors and does not depend on the current system information, it is not possible to control the transfer of information from one node to another node.[10]
Type of Load Balancing algorithms is static and dynamic.[11]

- Static Algorithms:
  - Round Robin Algorithms:

Concerned with data processing, give each task a specific time to complete the task, and if the time has passed and the task has not been completed, waiting for the task queue for the additional time unless you finish processing the task.

  - Min-Min Algorithms:

Focus to completing all the tasks with less time for each contract. Any task completed with less time is chosen for the assigned node. This process is repeated until all tasks are completed and selected

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- Max-Min Algorithm:

This algorithm works against the Min-Min Algorithms and it is concerned with completing tasks in a high time, a time is specified for each task selected.

- Dynmic:

It depends on the current information of the system and distributes the charges between the contract.[10]

Dynamic Algorithms:

- Particle Swarm Optimization Algorithm "PSO":

It takes the closest and least-carrying portion of the set of random nodes that are found, each node has storage capacity, the least-load nodes are known using the function fitness function, the function fitness function, calculating the storage capacity of this node according to the user's desire if he wants to find the maximum value, maximum cost, or The minimum value.

- Nears Search Algorithm:

It is one of the predictive algorithms and it does not need complicated mathematical equations. It searches for a group of the nearest nodes using probabilities.

- Honey Bee Algorithm:

This algorithm works to balance across the disparate nodes in cloud computing technology, whereby the current node calculates whether it is the least-load, balanced-loads, or the most-load, the tasks are transferred from the loaded nodes to the least-loaded nodes.

- Ants -Colony Algorithm (AC)

This algorithm forms a network when the request begins to begin its move forward to search in all the nodes one by one. It records the data of the visited nodes, whether it is the lowest load or the most pregnancy if it encountered a loaded node due to the previous node with the least load.

- Tabu Search(TS)

Used to solve the compatibility problem, it moves to the best neighbor node, but it does not concern itself with performing tasks efficiently or efficiently in the system.

- Red-Black Tree(RB)

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Organizes the lowest load node with the times the nodes are used in the cloud computing environment with a tree method.

- Cat Swarm Optimization(CSO)

It is one of the algorithms for improving crowd intelligence. Cats' behavior is used to track or locate the situation and determines the next site move according to the speed used, while determining the new average speed

Name of Algorithm	***Static Environment Algorithms***	***Dynamic Environment Algorithms***	***Advantages***	***Disadvantages***
Round Robin Algorithms	✓	✗	*Priority based load distribution*	*Larger time to take, Short Quantum time*
Min-Min Algorithms	✓	✗	*Less Completion time.*	*Can't predict tasks variation*
Max-Min Algorithm	✓	✗	*Medium Completion time.*	*Larger time to take for completion.*
Particle Swarm Optimization Algorithm "*PSO*"	✗	✓	*it can distinguish loads for each node due to the user's desire, either the great value or the minimum value.*	*It can't distinguish the adjacent nodes.*
Nears search	✗	✓	*Adjacent nodes can be predicted.*	*The burden ratio for each node cannot be determined.*

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Honeybee Foraging algorithm	✗	✓	*Minimum Response time with increased throughput.*	*Couldn't work with high priority tasks.*
ants - Colony algorithm (AC)	✗	✓	*Independent tasks to execute with minimum make span.*	*Larger time to execute, No clarity between larger ants.*
Tabu Search	✗	✓	*solve the compatibility problem, it moves to the best neighbor node*	*it does not concern itself with performing tasks efficiently or efficiently in the system.*
(RB)Red-Black Tree	✗	✓	*it's arranges the lowest pregnancy contract*	*delay for responding to user requests in the server during distributed processing in cloud computing*
CSO	✗	✓	*ability to specify the locations to move to, have speed with the ability to set a new speed*	*Cannot determine the load between each node*

Table 1 **Type of Load Balancing Algorithm(LBA)**

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Among the problems that are encountered in the workload balancing technology is the scheduling the tasks received from users, as users of cloud computing technology are increasing significantly.[12] so the use of cloud computing resources requires effective management that avoids the distribution of unbalanced workloads between data centers and physical devices that provides the user with an integrated work environment, there is another challenge facing researchers is the difficulty arranging or scheduling devices to be used in terms of determining priority in selection.[13] In general, the burden distribution in the cloud computing depending on the actual condition of the devices in the same The moment or the previous situation of the actual devices for each of the data center, the device is determined with the least burden or the most burdensome devices, this burden appears in the case of minor use of the actual devices and excessive use which leads to an impact on the overall performance so the task scheduling well help in the good distribution of the devices.[14] To improve distribution performance, there are several solutions offered by researchers, as followed: Jinhua Hu: Scheduling a strategy in balancing burdens using the genetic algorithm, the strategy solves the problem of unbalanced loads and high-cost transfers with conventional algorithms, and results have shown that this method can perceive load balancing and use reasonable sources.[15] The researcher Radha G. Dobale * Use the style of the node that is where Ada tasks to balance loads, this method eliminates struggling to balance loads contract, reducing the cost of the required movements while reducing spending on technology is possible.[5] The researcher, Mohammad Riyaz Belgaum, used the checkpoint technology based on the immediate scheduling of load balancing, this strategy solves the problem of unbalanced loads, and to accomplish the different services needed.[16] The researcher Bappaditya Jana researcher, use MPSO with two algorithms Max-Min and PSO, results were tested at the time of scheduling and the average percentage of successful completion of the completed tasks is relatively better in the molecular crowd optimization algorithm. The researcher used the CLOUDSIM emulator in a virtual environment to specify the requests of users in the cloud computing service, where the researcher used algorithms (Max-Min scheduling and Minimum Execution time scheduling algorithm with Particle Swarm Optimization

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algorithm).[17] The researcher Muhammad Atif Tahir has proposed a hybrid algorithm (K-NN and Tabu Search (TS)). This hybrid algorithm selects the best feature and weight to improve the classification process. Using the technology (TS / K-NN), the results were more accurate in the choices of the selected group of categories, as some classes such as (Balance, Vehicle, and Iris.) are no longer used. This technique is also used in biomedicine.[18] The researcher Fahimeh Ramezani · Jie Lu · Use Task Based (TBSLBPSO) Technology System Load Balancing method using Particle Swarm Optimization The researcher mentioned some problems (1) it prepares dirty memory that will accrue after pre-copy in online VM migration, (2) it utilizes a large amount of memory in both primary physical machine (PM) and new host PM, (3) it needs to pause the primary VM thus causing VM down time, (4) it carries the risk of losing recent customer activities in online VM migration, and (5) it is cost- and time-consuming. It contributed to improve the load-balancing system in transferring tasks from dummy loaded devices to other fake devices with less load, improving scheduling of multiple tasks and the transfer process from loaded devices and reducing the time of transferring tasks and implementing them.[19] The researcher Chih-Yi Chiu contributed to solve the problem of information loss during the research using a model based on learning the relationships between the contract using the (KNN) nearest neighbor algorithm to calculate the distances between the nodes before the distance-based classification process. A classification is arranged according to the distances between the contract and the expected probability can be used to quantify retrieved data and to estimate the possibilities of distribution between the contract for the given inquiries.[12] The researcher Yongfei Zhu in improving load balancing and reducing response time, using a Hybrid algorithm (RB-PSO) ((RB) Red / Black Tree Algorithm and PSO Algorithm) for Improving Load Balancing Speed.[20] The researcher Danlami Gabi proposed an Orthogonal Taguchi Based-Cat Swarm Optimization (OTB-CSO) hybrid algorithm to solve the problem of completing tasks in the central database The researcher contributed to improve the speed of completion of tasks in a dynamic cloud calculator environment.[13] In this research, the researcher Sreelakshmi used the PSO algorithm to optimize scheduling expected tasks, to contribute solving the

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problem of reducing time to minimize the cost of communication and accomplish tasks within the *time specified for each task.[14]*

Year	Journal	Author	Title of Paper	Techniques	Contribution
2007	ELSEVIER	Muhammad Atif Tahir a	Simultaneous feature selection and feature weighting using Hybrid Tabu Search/K-nearest neighbor classifier	Hybrid Tabu Search/K-nearest neighbor classifier	Contribute to a significant improvement in the performance in classification accuracy.
2010	IEEE	Jinhua Hu	A Scheduling Strategy on Load Balancing of Virtual Machine Resources in Cloud Computing Environment	scheduling strategy on load balancing	Strategy solves the problem of load imbalance and high migration cost by traditional algorithms after scheduling.
2013	Springer	Fahimeh Ramezani · Jie Lu ·	Task-Based System Load Balancing in Cloud Computing Using Particle Swarm Optimization	Task based System Load balancing method using Particle Swarm Optimization (TBSLBPSO)	reduces the time taken for the load balancing process
2015	International Journal of Advanced Research in Computer Science and Software Engineering	Radha G. Dobale*	Review of Load Balancing for Distributed Systems in Cloud	manner in which nodes perform their load balancing tasks	Contribute to solves and strives to balance the loads of nodes and reduce the demanded movement cost

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2016	SPRINGER	Yongfei Zhu	A Novel Load Balancing Algorithm Based on Improved Particle Swarm Optimization in Cloud Computing Environment	Red / Black Tree with PSO Algorithm (RB-PSO)	reducing response time
2017	International Journal of Electrical & Computer Engineering	Danlami Gabi	Solving Task Scheduling Problem in Cloud Computing Environment Using Orthogonal Taguchi-Cat Algorithm	Orthogonal Taguchi Based-Cat Swarm Optimization (OTB-CSO)	contributed improving the speed of completion of tasks in a dynamic cloud calculator environment
2018	SPRINGER	Mohammad Riyaz Belgaum	Cloud Service Ranking Using Checkpoint-Based Load Balancing in Real-Time Scheduling of Cloud Computing	checkpoint-based load balancing in real-time scheduling	This strategy contributes to solve the problem of load imbalance and in order to attain ranking, different services are needed to be invoked in the cloud, which is time-consuming and wastage of services invocation.

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2019	SPRINGER	Bappaditya Jana	A Task Scheduling Technique Based on Particle Swarm Optimization Algorithm in Cloud Environment	Modified Particle Swarm Optimization (MPSO) technique	Detraction contributes to average scheduling time and ratio of successful execution is comparatively better in Particle Swarm Optimization algorithm.
2019	IEEE	S.Sindhu	Multi-Objective PSO Based Task Scheduling-A Load Balancing Approach in Cloud	PSO algorithm	Optimize scheduling expected tasks.
2019	IEEE	Chiu	Learning to index for nearest neighbor search	model based on learning using the (KNN) nearest neighbor	contributed to solve the problem of information loss during the research

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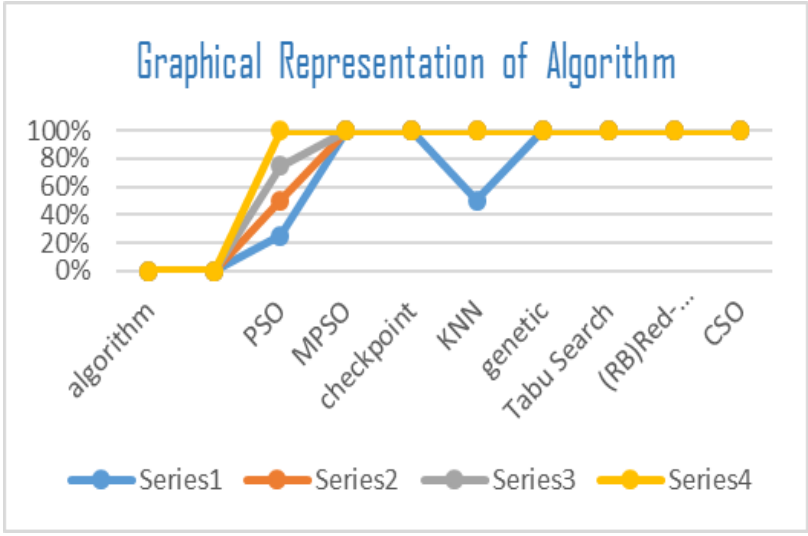
Tabel2. ***Survey of Existing Literature Surve***

algorithm	number of algorithms			
PSO	1	1	1	1
MPSO	1			
checkpoint	1			
KNN	1	1		
genetic	1			
Tabu Search	1			
(RB)Red-Black Tree	1			
CSO	1			

Tabel3. ***Survey of Existing Algorithms Survey***

We made a comparison of the algorithms most used in the scientific papers on which the analytical study was based on this paper. fig.1 mentions the algorithms and the number of their use in previous studies for this research .



.***Fig 1.*** ***Graphical Representation of Algorithm***

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Performance Comparison

To use Cloud Computing we focus on balancing loads.

Throughput(TP):

The total number of tasks performed is called productivity. Completion of tasks is required for better performance in the business environment.

Fault Tolerant(FT):

The ability of the algorithm to perform tasks correctly even in cases of failure on any node of the system.

Migration Time(MT):

Transferring tasks from one location to another in the system is considered immigration time.

Response Time(RT):

The lower time in a distributed system to negate a specific task.

Resource Utilization(RU):

The percentage of using system resources in cloud computing.

Scalability(S):

Load balancing algorithms and the number of processors or machines to accomplish in the system.

Performance(P):

It is the effect of load balancing that optimally improves system performance.

Types of Algorithm	Performance	Response Time	Scalability	Resource Utilization	Throughput	Fault Tolerance	Process Migration
PSO	✓	✓	✓	✗	✓	✓	✓
MPSO	✓	✓	✓	✗	✓	✓	✓
checkpoint	✓	✗	✓	✗	✓	✓	✓
KNN	✓	✓	✓	✗	✓	✗	✗
genetic	✓	✓	✗	✗	✓	✓	✗
Tabu Search	✗	✓	✗	✓	✗	✓	✓
(RB)Red-Black Tree	✓	✗	✓	✗	✗	✓	✓
CSO	✓	✓	✓	✓	✗	✓	✓

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Table 4. ***Survey of Load Balancing Algorithms and their performance.***

Conclusion

Load balancing is important for improving business performance in cloud computing technology. Dynamic load balancing algorithms are important for distributing loads between multiple nodes regularly because the increased loads on the node will lead to poor performance in the system. It is important to use an efficient algorithm for efficient load balancing. In this research we presented an analytical study to contribute to improving task performance in cloud computing. We found from previous studies and analyzes of the burden distribution algorithms present in cloud computing that there are algorithms that have advantages and disadvantages. Through the analysis, we found that the PSO algorithm is better than other algorithms in terms of performance and efficiency in the process of assigning tasks in cloud computing.

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