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An Effective analysis on various task scheduling algorithms in Fog computing

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Abstract

Fog computing involved as an extension of cloud and distributed systems fog nodes allowing data to be processed closer to the edge device and reduces the latency and bandwidth, storage capacity of IoT tasks. Task scheduling in fog computing involves allocating the tasks in fog nodes based on factors such as node availability, processing power, memory, and network connectivity. In task scheduling we have various scheduling algorithms that are nature inspired and bio-inspired algorithms but still we have latency issues because it is an NP-hard problem. This paper reviews the existing task scheduling algorithms modeled by metaheuristic, nature inspired and machine learning which address the various scheduling parameters like cost, response time, energy consumption, quality of services, execution time, resource utilization, makespan, throughput but still parameters like trust, fault tolerance not addressed by many of the existing authors. Trust and fault tolerance gives an impact and task scheduling trust is necessary to tasks and assign responsibility to systems, while fault tolerance ensures that the system can continue to operate even when failures occur. A balance of trust and fault tolerance gives a quality of service and efficient task scheduling therefore this paper done analysis on parameters like trust, fault tolerance and given research directions.

Keywords: Fog computing, Task scheduling, Machine learning

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1. Introduction

In this present era IoT devices are rapidly developing day by day according to international data corporation predicts (IDC) that by 2025, 55.8 billion devices to be connected worldwide 80% of them are connected to IoT devices [1]. Every IoT device generates a large amount of data. This data was processed in a cloud. The Iot devices are sending the data to the cloud distributed systems for storing, processing, analyzing, and decides due to its high computation tasks. Cloud computing offers numerous benefits, yet there are also some disadvantages like complexity, overhead, bottlenecks, resource allocation, Dependency on cloud provider and it can't satisfy the latency issue of IoT applications [2]. Because Fog computing wasn't a replacement of cloud it was to accompaniment cloud computing. Fog as the intermediate layer of cloud and IoT applications in fog layer we have many fog nodes that are used to process the data before it is sent to the cloud. Fog computing provides the data processing, networking, analysis the data, so that cloud like services is close to the Iot application to reduce the latency period, energy competition, save bandwidth, better security for Iot applications [3]. System model of fog computing environment in between the cloud and iot layer this a three-tier architecture(cloud-fog-IoT). The first layer includes all Iot devices that generated the data this data was pre-processed to fog and cloud layer. The second layer computed the resources such as edge servers, routers, gateways, switches, and cloudlets. The fog layer, cloud layer both are responsible for the processing, receiving data, and responding to IoT applications requests are send from the Iot application layer. The third layer consists of data centers, vms this cloud layer is connected to fog layer [4].

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[21]	multi-objectives Grey Wolf Optimizer algorithm (MGWO)	MATLAB R2018b	Delay and energy consumption
[22]	Bi-objective optimization	iFogSim	Makespan and cost
[23]	Electric earthworm optimization algorithm (EEOA)	Cloud Sim	Execution time, cost, Makespan
[24]	MONWS (multi-objective normalization workflow scheduling)	Cloud Sim	Makespan and cost
[25]	(TAFFA) Trust-Aware scheduling algorithm using firefly optimization	cloud Sim	Makespan, turnaround efficiency and success

From the above Table:1 existing algorithms and authors are focused on nature inspired, bio inspired and metaheuristic algorithms they achieved a lot but still we have to optimize in task scheduling because it is a NP-hard problem. Researches are focused on machine learning based techniques in fog computing deep reinforcement learning algorithms like Q-learning, MDP, queue learning, stochastic process etc., more scope of performance in task scheduling

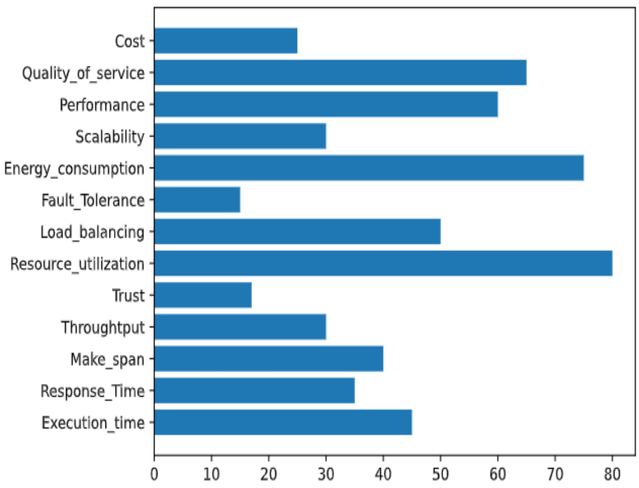

Figure 2. Parameters addressed various task scheduling algorithms

3. Research directions

Based on the literature we address, most of the scheduling algorithms are focused on quality of service, performance, scalability, energy consumption, load balancing, resource utilization, response time, and make span. While observed the fig2 trust and fault tolerance have a scope to improve. A machine learning can optimize the task scheduling process and improve the overall efficiency of the fog nodes.

3.1. Trust aware scheduling

Trust aware scheduling is necessary in fog computing environment because it supports to address privacy and security in the distributed computing environment. With fog computing, the devices close to the network edge, which means that they are more vulnerable to security threats. Trust aware scheduling helps to overcome these risks by allocating resources to trusted components of the system. In fog computing trust determines various components, such as the security mechanism in place, the reputation of the component, and the level of access it has to sensitive data. Trust-aware scheduling helps better the overall execution in fog computing systems allocating resources reduce risk of resource wastage.

3.2. Fault tolerance scheduling

It is an important aspect to check the capability of the system. In fog computing ensures reliable and efficient task execution. Task scheduling in fog computing has different approaches. One is redundancy, where multi copies of task are executed by several nodes to ensure that at least one copy is completely successful. Another approach was checkpointing, which involves periodically saving the progress of a task to persistent storage, allowing for the resumption of the task from the last checkpoint if a node fails. To detect and handle the failures' fault detection and recovery mechanism to be implemented. For instance, monitoring tools can detect when a node becomes unresponsive, and the automotive recovery process can be transferred to another available fog node.

4. Conclusion

Task scheduling is an important aspect in cloud and fog computing because it is played a particular role in the optimizing use of computing assets. Fog computing helps to reduce overhead data transport and, as a result, increases computational efficiency in cloud networks by eliminating the need to analyses and maintain large amount of data. In this paper review, recently modeled task scheduling algorithms both cloud computing and fog computing environments have been studied and various task scheduling parameters are used to compare existing algorithms. priority based scheduling, bag of tasks workload model, DAG algorithm, DVFS, salp swarm algorithm, whale optimization algorithm, electric earthworm optimization algorithms based on nature inspired bio-inspired and meta-heuristic. From fig.2 we can see that resource utilization and system performance are covered in 70 to 80 percent of discussed algorithms for improvement. But still there is a lot of work required to enhance the trust and fault tolerance. An efficient task scheduling fulfills all requirements of the cloud-fog paradigm. While we are using deep reinforcement learning in fog computing task scheduling to optimize the better resource allocation and task execution. By using a DRL agent to learn the optimal policy for allocating tasks to fog nodes based on the available resource and task requirements.

Conflict of interest

Authors declare that there are no conflicts of interest.

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