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Optimized task scheduling on fog computing environment using metaheuristic algorithms

Summary

Task scheduling in fog computing is tackled with the use of different kinds of algorithms in general but this paper implements a meta-heuristic based approach. Fog computing is increasingly being adopted because it reduces latency and improves performance. Compared to the cloud data centers that are resource enriched , fog nodes don't have the same luxury and hence with the additional constraint of coordinating a distributed network, task scheduling in Fog Computing is not a trivial task. Since we only have limited capacity in the system, we use meta heuristic algorithms which guarantee a solution to the optimization problem posed here. Here the main research problem was to minimize the energy used in a fog environment.

A meta heuristic algorithm called the Whale Optimization Algorithm (WOA) is used. WOA is a population based method which focuses on the bubblenet attacking method of the whales when they are hunting preys.This method is done by creating special bubbles in a spiral shape where the whales encircle the prey.

The paper has two main contributions: a) To develop task scheduling approach in fog computing environment, which needs to optimize reducing power consumption and minimizing cost and b) Develop a WOA based algorithm to solve the proposed model and evaluate the performance compared with Particle Swarm Optimization (PSO) and heuristic algorithms such as Round Robin(RR) and Shortest Job First (SJF).

The energy consumption and the Quality of Service (QoS) are the two metrics that the authors chose based on the literature review. They also review bio-inspired algorithms like Bees Life Algorithm and Evolutionary Algorithms, but before this paper WOA was never tried out for an iOT based network. For the WOA algorithm to be implemented in the fog layer first it is checked if resources accessible in the fog nodes would fulfill client requirements, if not then the resources are moved to the cloud layer. The WOA assigns tasks to VMs , this algorithm in addition turns off under utilized VMs which saves power. The two objective functions optimized are:

a. Energy: Energy Consumption + (Current Time - Last Utilization Time) * Host Power Last Utilization
b. Cost = Execution Cost + CloudSimClock* Last Utilization Time * Rate per Million instructions per second(MIPS) * Lasy Utilization * Total MIPS of the Host

The whale optimization algorithm starts with finding a set of random solutions to the problem, then at each particular iteration, the position of each search agent is updated either randomly or the best solution which is obtained in the moment. The algorithm is ended after the satisfaction of the criteria.

This paper tests out the result for 3 applications: a) DCNS fog application b) VRGameFog and c) Smart Healthcare. The paper shows that the energy and cost of WSO are less than PSO and other approaches such as RR and SJF.

Shortcomings and Proposal

The simulations have been done in an ideal setting and the practicality of realworld workload is not considered in this particular paper. Additionally the nodes can be parallelized in operation and the workload can be further reduced. Also no mathematical grounding was not provided for this being the most optimal solution so other techniques can be explored like the Chaotic Whale Optimization Algorithm.

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