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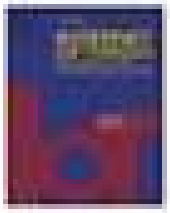

An integrated approach of ML-metaheuristics for secure service placement in fog-cloud ecosystem

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ABSTRACT

With the proliferation of the Internet of Things (IoT), a huge amount of data is being produced which requires processing. Usually, Cloud computing provides the resources for processing such requests. However, cloud has limitations in terms of latency and security. To accentuate, Fog computing came into existence to complement cloud wherein the vulnerabilities of Fog and Cloud computing adequately improves the Quality of Service (QoS). Due to inherent heterogeneity in the Cloud and Fog nodes, selecting an appropriate node becomes a complex task which requires utmost attention. Fog nodes have minimal and limited resources with a less processing capacity. To utilize the fog nodes optimally, a secure two-step service placement framework has been proposed in this work. The framework consists of the classification of services to decide on the appropriate site (Cloud/Fog) followed by the scheduling of the services on the Fog site. For classification, a machine learning based improved adaptive neuro-fuzzy inference model (ANFIS) is implemented, which predicts the suitable computing site. Further, a novel metaheuristic-based hybrid algorithm that integrates a chaotic-based grasshopper (CGOA) with genetic algorithm (GA) is applied for scheduling at the Fog site. Basic GOA suffers from several shortcomings, such as falling into local minima, slow convergence, high time complexity, etc. The concept of chaos theory and opposition-based learning is incorporated into GOA to overcome this. The performance of the proposed model has been analyzed on the Google trace data set, and its effectiveness has been studied on makespan, computational cost, and energy dissipation of the network where it yields respectively 9.3%, 4.05% and 0.75% average better results than state of art.

1. Introduction

The IoT has been gaining popularity to make the environment smarter and better. Due to innovative investment in mobile computing, billions of the physical objects/devices now connects through the Internet [1,2]. These devices produce an enormous amount of data. To process such huge data, an effective computing platform is warranted. The cloud supports IoT to retain, execute, and extrapolate knowledge from the volume of data. However, the cloud data centres are located far from the end users, exhibiting latency while accessing the cloud-based services. Such delay may often become a bottleneck for the services that require ultra-low latency [3]. Moreover, several IoT sensors offload volumes of data to the cloud through the Internet, leading to congestion. It also affects the network performance and bandwidth. Thus, offloading every service to the cloud is not beneficiary and has its own limitations [4,5].

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