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# A systematic mapping study on soft computing techniques to cloud environment

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## Abstract

Cloud computing plays an essential role in storage and transfer of big capacity data due to a rapid increase in size and the number of organizational activities. There exist numerous studies in which diverse soft computing techniques are applied to the cloud environment. The relevant extant literature that were clustered into five main categories with respect to precedence are; task optimization, power optimization, security, service selection and cost optimization. Yet, it was discovered that there is a dearth of systematic review/mapping studies particularly on soft computing techniques in cloud environment so as to obtain exclusive insight, to identify existing gaps and future research directions. Therefore the aim of this paper is to conduct a systematic mapping study of recent literature on soft computing techniques in cloud environment. For this purpose, 163 articles were chosen as primary sources that were published within the last decade, which were classified based on study focus area, type of research, contribution facet and particularly the type of soft computing technique used. Findings revealed that task optimization takes part as the highly preferred research focus area. Secondly, most of the articles found are of validation studies. The contributions of most of the studies are concerned about methods and finally the top three soft computing techniques were detected as particle swarm optimization (PSO), genetic algorithm (GA) and hybrid systems. The results of this study confirm that applying soft computing techniques in cloud computing has gained more and more significant attention recently but there still remain challenges and gaps which calls for further investigation especially in the area of cost optimization and also artificial bee colony.

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## 1. Introduction

Recently cloud computing environment has drawn remarkable attention from organizations because of its capabilities to reduce cost, maximize productivity with high degree of flexibility in handling big data (Pueschel et al., 2009). Considering the burden of manual management in ever growing capacity of cloud data, there has always been a need to seek for more efficient autonomous and computational intelligent solutions to handle the dynamic nature of the cloud. Over the last decades, numerous soft computing techniques have been proposed and utilized for automated optimization of the cloud environment. The prevalent types of soft computing techniques which addressed mainly within the cloud computing related studies about security challenges, task optimization, service selection cost optimization and power optimization include; fuzzy logic, neural networks, genetic algorithm, swarm intelligence and hybrid systems (Esposito et al., 2015; Feller et al., 2011; Ramezani et al., 2014). Although soft computing techniques have caught the interests of many researchers over the years, yet to author's knowledge, there is currently no systematic mapping study conducted particularly to soft computing in cloud environment. A systematic mapping study not only helps to identify the extent of study in a research area, but also provides a view to pinpoint existing gaps in a particular subject area and summarizes the entire corpus of study in a subject area to encourage further development.

In the light of above, a systematic mapping study was conducted to gather, analyze and interpret existing studies that were carried out in the area of soft computing in cloud environment so as to provide an overview and highlight research gaps in the subject area.

## 2. Motivation and related surveys

Although soft computing techniques are popular and have been widely applied to cloud environments, initial attempts to locate relevant systematic mapping studies in the area of soft computing techniques in cloud environment proved to be abortive, which became the fundamental motivation to carry out this systematic study.

The only located literature survey studies were briefly summarized as follows:

A study conducted by Hormozi et al.(2012) was a survey to investigate the use of machine learning in cloud environment. Later in 2013, Tantar et al.(2013) conducted a small review in the area of computational intelligence for cloud management. Another study by Guzek et al.(2015) was a survey study with the aim of giving computational intelligence researchers an understanding of novelties in the cloud. In addition, Demirci (2015) reported on recent works focused on the use of machine learning for energy optimization in cloud computing environment. Similarly, Zhan et al.(2015) presented a report examining and comparing various evolutionary computation approaches to some areas of the cloud. A recent study by Shishira et al.(2016) was also a survey reporting on optimization algorithm for cloud environment based on three well known meta-heuristic techniques which are ant colony optimization(ACO), particle swarm optimization (PSO) and genetic algorithm (GA).In another survey study conducted by Pooman et al.(2016), some workflow scheduling metaheuristic algorithm in cloud and grids were discussed. A recent study by Masdari et al.(2016) conducted a survey to present a comparative analysis of literatures on particle swarm optimization schemes that has been proposed to the cloud environment and then provides a classification of the scheme based on the type of particle swarm optimization algorithm that was applied to the scheme.

## 3. Methodology

To ensure that reliable information is provided on the topic of soft computing techniques in cloud environments, the systematic mapping was conducted following through frameworks proposed by Petersen et al.(2008) and Kitchenham and Charters(2007).