
AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Computer Engineering and Systems

# Green Cloud Computing: Datacenters Power Management Policies and Algorithms

A Thesis submitted in partial fulfillment of the requirements of the degree of

Master of Science in Electrical Engineering

(Computer Engineering and Systems)

By

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Bachelor of Science in Electrical Engineering

(Computer Engineering and Systems)

Faculty of Engineering, Ain Shams, 2007

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**Cairo - Egypt**
**2015**

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Date: 10 August 2015

# STATEMENT

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain Shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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# ABSTRACT

Cloud computing is offering utility oriented IT services to users worldwide. Based on a pay per use model, it provides a variety of computing resources, enterprise applications while enabling their hosting. It provides services through a three layered architecture and different cloud types.

The proliferation of cloud computing has resulted in the establishment of large-scale data centers around the world containing thousands of computing nodes. Those nodes consume huge amounts of energy, contributing to high operational costs and carbon footprints to the environment. Energy consumption is not only determined by hardware efficiency, but it also depends on the resource management system deployed on the infrastructure and the efficiency of applications running in the system.

This study is to introduce algorithms and policies that reduce power consumption in cloud data centers through improving the utilization of computing resources using fuzzy logic. The thesis starts with introducing cloud computing and its impact on the environment and clearing out the green cloud computing origin, concepts and methodologies.

Next, it discusses approaches and directions for similar work, and demonstrates the working environment definitions, structures and techniques. It represents the design and implementation of Fuzzy based algorithms and policies for dynamic resource management in cloud data centers.

Finally, the thesis compares the presented policies with existing approaches showing that the introduced models improves power efficiency in cloud datacenter with around 40 % than other policies.

Key words: Cloud Computing, Green cloud, Virtual machines, Consolidation, Allocation, Selection, Migration, Utilization, Fuzzy Logic, CloudSim.

# SUMMARY

This thesis demonstrates the importance of enhancing power aware resource allocation policies and algorithms of datacenters in cloud computing environment.

**Chapter One:** It starts with defining Cloud computing and presenting its importance and why it is needed. Then it presents the thesis objectives and outline.

**Chapter Two:** It begins with an introduction about cloud computing origin. Then it passes over cloud computing evolution stages through years till our current status. Also it represents some technologies that contributed in its existence and proliferation. It presents some principles about cloud computing environment. Finally it addresses some cloud computing challenges.

**Chapter Three:** This chapter represents Green computing concept. Then, through relating the concept with cloud computing, the chapter clears green cloud computing concept. As being a green approach, some of Power management techniques are cleared out. Then they are related to the cloud environment through cloud datacenter resource management approaches.

**Chapter Four:** In this chapter, different power management techniques are demonstrated. It focused on cloud environment performance metrics.

**Chapter Five:** This chapter presents a brief introduction about fuzzy logic environment. It demonstrates a fuzzy logic based power aware resource management models. Those models apply different techniques in VM placement, VM Selection and migration stages while detecting over utilized and underutilize host.

**Chapter Six:** In this chapter fuzzy based algorithms are implemented and simulated. It starts with representing used simulator, its features and architecture. Then a simulation for the introduced models is made. Finally, the simulations results are analyzed and evaluated.

**Chapter Seven:** The thesis ends by extracting conclusions and stating future work that might be done based on this work.

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