

**TASK SCHEDULING IN CLOUD COMPUTING
ENVIRONMENT USING HYBRID GENETIC
ALGORITHM AND BAT ALGORITHM**

MUHAMMAD SYHRIL BIN MOHAMAD SAINAL

**FACULTY OF COMPUTING AND INFORMATICS
UNIVERSITI MALAYSIA SABAH
2022**



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ENVIRONMENT USING HYBRID GENETIC
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**THESIS SUBMITTED IN PARTIAL FULFILLMENT
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WITH HONOURS (NETWORK ENGINEERING)**

**FACULTY OF COMPUTING AND INFORMATICS
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DECLARATION

I hereby declare that this report entitled Task Scheduling in Cloud Computing Environment Using Hybrid Genetic Algorithm and Bat Algorithm is my own effort except for quotations, excerpts, equation, summaries and references, which have been duly acknowledged.



11 February 2022

.....
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ABSTRACT

Cloud computing refers to the delivery of computing services over the internet. It helps users to only pay for their usage. Cloud computing becomes one of the fastest-growing technologies since it can lower costs, higher efficiency, and scalability. Managing files and services on the local storage devices is no longer used with cloud computing that doing the same over the internet. One of the important and challenging components in cloud computing is task scheduling. Task scheduling is an organized user's task then executed with the suitable resource to perform that service efficiently. Task scheduling problem also categorized as NP-hard problem where optimization technique can be used to solve it. Nowadays, many task allocation techniques are used but the most efficient technique needs to be figured out. Meta-heuristic algorithms are mostly used to solve this problem. For example, Genetic Algorithm with Particle Swarm Optimization, Genetic Algorithm with Artificial Bee Colony Algorithms (ABC) and Genetic Algorithm with Ant Colony Optimization Algorithms. In this thesis study, hybrid Genetic Algorithm and Bat Algorithm proposed to solve the task scheduling problem. Genetic algorithm was widely used because of its accuracy and simplicity. But it will become slower in certain cases that include larger problem size. Hence, Bat Algorithm (BA) can increase efficiency and performance because it provides an efficient scheduling mechanism. BA also will minimize the execution time and deadline. This research will conduct comparison of hybrid Genetic Algorithm and Bat Algorithm (GA-BA) with Genetic Algorithm (GA) and Bat Algorithm (BA). Furthermore, CloudSim simulator will be used to evaluate the performance of this algorithm. The result of the algorithm performance will be appeared in web application system. The features of this system are displaying makespan time for each run of simulation and calculating the average of makespan for all simulations run.



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ABSTRAK

PENJADUALAN TUGAS DALAM PENGKOMPUTERAN AWAN MENGUNAKAN HIBRID GENETIK ALGORITMA DAN BAT ALGORITMA

Pengkomputeran awan adalah penyampaian perkhidmatan pengkomputeran melalui internet. Ini membantu pengguna untuk hanya membayar penggunaannya. Pengkomputeran awan adalah teknologi yang berkembang pesat kerana dapat menurunkan kos, kecekapan yang lebih tinggi, dan skala lebih luas. Menguruskan fail dan perkhidmatan pada peranti storan asal tidak lagi digunakan dengan pengkomputeran awan yang melakukan hal yang sama melalui internet. Salah satu komponen penting dan mencabar dalam pengkomputeran awan adalah penjadualan tugas. Penjadualan tugas adalah mengatur tugas pengguna kepada sumber yang sesuai untuk melaksanakan perkhidmatan tersebut dengan cekap. Masalah penjadualan tugas juga dikategorikan sebagai NP-susah di mana teknik pengoptimuman dapat digunakan untuk menyelesaikannya. Pada masa kini, banyak teknik pengagihan tugas digunakan namun teknik yang paling cekap perlu dicari. Algoritma meta-heuristik banyak digunakan untuk menyelesaikan masalah ini. Contohnya, Algoritma Genetik dengan Particle Swarm Optimization, Algoritma Genetik dengan Artificial Bee Colony (ABC) dan Algoritma Genetik dengan Ant Colony Optimization. Dalam tesis ini, Hibrid Algoritma Genetik dan Algoritma Bat (GA-BA) dicadangkan untuk menyelesaikan masalah penjadualan tugas. Algoritma genetic (GA) digunakan secara meluas kerana ketepatan dan mudah difahami. Tetapi ia lebih lambat dalam kes tertentu yang meliputi ukuran masalah yang besar. Oleh itu, Algoritma Bat (BA) meningkatkan kecekapan dan prestasi kerana menyediakan mekanisma penjadualan yang cekap. BA juga akan mengurangkan masa dan tarikh akhir pelaksanaan. Penyelidikan tesis ini akan melakukan perbandingan hibrid Genetik dan Bat Algoritma (GA-BA) dengan Algoritma Genetik (GA) dan Algoritma Bat (BA). Simulator CloudSim akan digunakan untuk menilai prestasi algoritma ini. Hasil prestasi algoritma akan dipaparkan dalam sistem aplikasi web. Fungsional adalah memaparkan makespan yang dicatatkan setiap simulasi dan mengira purata makespan daripada kesemua simulasi yang dijalankan.



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CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

This chapter describes the ideas and aspects that motivated to conduct this project called Task Scheduling in Cloud Computing Environment Using Hybrid Genetic Algorithm and Bat Algorithm which will be implemented on the CloudSim simulator. This chapter also includes introduction, problem statement, objectives, project scope, organization of project and conclusion. A problem statement was summarized to propose a solution to the problem. The solution is stated as the objectives of developing this project. Hence, the scope is covered by the functionalities provided by this project. This chapter is organized in the sequence of 1.1 Chapter Overview, 1.2 Introduction, 1.3 Problem Statement, 1.4 Objectives, 1.5 Project Scope, 1.6 organization of project and 1.7 conclusion.

1.2 Introduction

Cloud computing has become one of the most dominant technologies used in recent times. Experts come out with research that 60% workload will be running on a hosted cloud service in 2019. Cloud computing has an increasing trend over year growth since it was founded. Worldwide end-user interest in cloud computing predicts to grow 18.4% in 2021 compared to



2020. In Malaysia, usage of cloud computing was expected to increase from US\$43 million in 2013 to US\$900 million in 2020.

Task scheduling is a mechanism that is used for selecting resources to execute the task and have lower waiting and execution time. Task referred to user's queries to the different server and all the queries also achieved within the required time. Many task scheduling algorithms are used to help increase performance of the cloud and improve throughput of servers. The main component in task scheduling is to minimize cost and time.

There are many resources that are provided by the cloud including data centres, storage, firewall, network and become a platform for computation. To manage the huge number of resources, task scheduling becomes the main thing to ensure the cloud performance in optimal condition. It is the main role to improve flexibility and reliability of the cloud. Task scheduling means it chooses the most suitable resource available for the task to execute and allocate the computer machine to the task in minimum time possible.

Task scheduling also can be understood as mapping the tasks and resources according to few principles to achieve the user goal. Due to high demand of cloud computing and the needs of most suitable algorithms in task scheduling, therefore there is a need for a system that can be used to increase the performance. In this paper, hybrid genetic algorithm and bat algorithm (GA-BA), Genetic Algorithm (GA) and Bat Algorithm (BA) will be implemented for task scheduling in cloud computing environments and compared to each other focusing on makespan



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1.3 Problem statement

According to the introduction part, we already know that cloud users are increasing every day. Jamali S et al., 2016 stated that millions of users send requests to cloud resources. Scheduling these jobs is difficult for the cloud system. The paper also explains, algorithm that is widely used for task scheduling is rule-based scheduling algorithm. For example, deterministic scheduling algorithms and exhaustive algorithms. The problem with this algorithm is when it comes to the large scale of task scheduling. Thus, meta-heuristic algorithms need to be used to solve this problem. Natesan G et al., 2019 mentioned that the quality of the result or the speed of convergence can be improved when a meta-heuristic algorithm is paired with other meta-heuristic algorithms based on population or local-search-based meta-heuristic algorithms. Therefore, this paper proposed hybrid Genetic Algorithm and Bat Algorithm for task scheduling in a cloud computing environment.

Problems that are identified:

- i. Rule-based or static scheduling algorithm cannot effort large scale of task scheduling problem in cloud computing environment.
- ii. Less reference that shows hybrid meta-heuristic can perform better than non-hybrid meta heuristic algorithm.
- iii. Need of a system that can be used to evaluate multiple algorithms with parameter that user can choose.



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1.4 Project objective

The aim of this project is including:

- i. To implement the GA, BA and hybrid GA-BA algorithms for task scheduling in cloud computing using CloudSim.
- ii. To develop web-based application for executing the algorithms performance result.
- iii. To test and evaluate the makespan of the algorithms on Cloudsim simulator.

1.5 Project scope

The goal of this project is to help users to have better task scheduling in cloud computing systems. The algorithm that has been proved to enhance task scheduling in cloud computing will give benefit to Jabatan Teknologi Maklumat dan Komunikasi (JTMK) Universiti Malaysia Sabah especially to Network Administrator. It can be applied to ensure all university's system that use cloud can have better performance. This project will lead to detailed explanations on GA, BA and hybrid GA-BA. Some research will be conducted to come out with advantages of hybrid GA-BA. Furthermore, this research also proceeds by exploring previous research using GA and BA in task scheduling.

Developed web-based application systems and some calculations will be used to get experimental results that can be used to evaluate the project hypothesis. Potentiality of this project is to have better performance in terms of time execution of task scheduling in cloud computing environments that are highly demanded from users. The result of this project will be shown in a web-based application to help any developer take the result and figure out any other parameter or scenario to test the algorithm performance.



1.6 Organization of project

Chapter 1 (Introduction)

This chapter is brief about the importance of this project. It consists of problem statements that explain problems to be solved in this project. Other than that, this chapter will explain the project objective, project scope that will explain about targeted user for this project and organization of the report.

Chapter 2 (Literature Review)

This chapter will review systems that are similar to the project and does a comparison on its functions. This chapter also discusses the researched topic and reviews papers related to the researched topic. Then conclusion is made at the end of the chapter.

Chapter 3 (Methodology)

In this chapter, the development methodology used is explained. In addition, the software and hardware required for this project is listed. Phases of the project from planning phase, analysis phase, designing phase and implementation phase is be briefed in this chapter. Then the conclusion is made at the end of the chapter.

Chapter 4 (System Analysis and Design)

This chapter is discussed briefly on the system analysis such as Use Case Diagram, sequence diagram, main process and system design in term of interface designs. Conclusion will be stated at the last of the chapter.

Chapter 5 (Implementation)

There is a briefly discussion on the development of the system. The software development tools used, and the process of the implementation will be explained in detail. The explanation on how the working system tested also included in this chapter.



1.7 Conclusion

In conclusion this chapter explains the introduction of this project named Task Scheduling in Cloud Computing Environment Using Hybrid Genetic Algorithm and Bat Algorithm. Furthermore, the chapter already explained the problem that led to the idea of this project and the expected outcome of this project.



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CHAPTER 2

LITERATURE REVIEW

2.1 Chapter overview

The literature review will describe the existing system that is related to this project. It will explain about algorithms that have been used for task scheduling and performance of each algorithm. Comparison will be made to see the parameter that was used in previous research and the method that was used to evaluate the algorithm performance.

2.2 Existing system

There are several algorithms that have been used for task scheduling in cloud computing environments. Furthermore, there were some improvements that can be made to enhance the performance of task scheduling. Lots of meta-heuristic techniques were proposed by previous researchers to solve task scheduling problems. A. Al-mamari and F. A. Omara, 2015 proposed combination of Particle Swarm Optimization (PSO) and other local search strategies that are also called as Cuckoo search. They found that the algorithm can increase the utilization of resources and decrease the completion time. Cuckoo algorithm was based on the behaviour of cuckoo birds. It also has a similarity to Genetic Algorithm in that both are population-based algorithms.



According to S. Pandey, L. Wu, S. M. Guru and R. Buyya,2010 proposed that Particle Swarm Optimization (PSO) based can schedule the application to cloud recourse. It can optimize data transmission and computation cost. Results of the research prove that PSO can be helped to save cost and high quality of workload distribution onto resources. The result achieved because PSO is one of the mapping-based algorithms that need lower cost. B. Radojević and M. Žagar,2011 performed research to arrange the load balancing algorithm and deal with the defect round robin algorithm. It was one of the famous algorithms that consisted of the basics of a conversation session on the application layer, the algorithm enhances the communication time between customer and node in cloud computing. It makes the least number of communications when the approach sends a request to a node.

A.S. Kumar and M. Venkatesan,2016 came out with the research that used HybridGenetic-Particle Swarm Optimization (HGPSO) to solve task scheduling problems based on the priority of tasks. Input was taken from an on-demand queue and appropriate resources will be evaluated for the user. Z. Pooranian, M. Shojafar, J. H. Abawajy, A. Abraham,2015 proposed an algorithm that set a reduction of makespan and number of tasks that did not reach the deadline. But it is a task scheduling technique for grid computing. Therefore, there are needs to conduct research to propose an algorithm that can improve quality of service, minimize thetime execution and deadline for a given task.



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2.2.1 Task scheduling using Bat Algorithm

There are some research papers that show BA can enhance task scheduling in cloud computing environments. S. Khurana and R. K. Singh,2019 show the results of the modified BA algorithm are shown better results as compared to the other meta-heuristic algorithms-PSO and simplified BAT algorithm. The results are simulated with the help of cloudSim simulator.

M. Jaeyalakshmi and P. Kumar,2016 also introduced that bat algorithm can solve task scheduling and resource allocation problems. The result shows that BA optimized the efficiency and performance of that system tuning multibed objectives such as load balancing, execution cost., makespan, and deadline. Suresh Kumar V and Aramudhan,2014 proposed an approach for task scheduling in cloud based on the combination of BAT algorithm and Gravitational scheduling algorithm (GSA) considering deadline constraints and trust model. The algorithm is also implemented using CloudSim. The result was it efficiently reduces makespan and reduces the number of failed tasks



2.3 Comparison between existing system

Table 2.1: Comparison between existing system

	Algorithm	Parameter of evaluation	Evolution method
A. Al-maamari and F. A. Omara (2015)	Particle Swarm Optimization (PSO) and Cuckoo search	Time execution	Cloudsim 3.0.3 with 5 and 10 virtual machines. 10,20,30,40 cloudlet
S. Pandey, L. Wu, S. M. Guru and R. Buyya (2010)	Particle Swarm Optimization (PSO)	Cost for complete execution	JSwarm package
A.S. Kumar and M. Venkatesan (2016)	Hybrid Genetic-Particle Swarm Optimization (HGPSO)	Execution time, availability and throughput	Cloud simulation
Z. Pooranian, M. Shojafar, J. H. Abawajy, A. Abraham (2015)	Hybrid Particle Swarm Optimization Gravitational Emulation Local Search (PSO-GELS)	Decreases makespan and minimizes the number of tasks that miss their deadlines.	Java software running under the Win XP operating system on a 2.66 GHZ CPU with 4 GB of RAM.

