HEURISTIC SCHEDULING ALGORITHM WITH FAULT TOLERANCE MECHANISM FOR CLOUD

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Abstract
A high-performance hyper-heuristic algorithm is used for scheduling the jobs on cloud computing systems to shrink the makespan. From the pool of candidate heuristics, one of the heuristic algorithms will be picked by the low-level heuristic (LLH) selection operator as the heuristic algorithm that is to be performed. Two revealing operators one for diversity revealing and one for enhancement revealing are proposed for the proposed algorithm to regulate the effectiveness to employ the low-level heuristic algorithm. To assess its performance, the proposed algorithm and numerous other scheduling algorithms are applied in the CloudSim. The basic idea of the proposed algorithm is to use the multiplicity revealing and enhancement revealing operators to balance the escalation and diversification in the search of the solutions during the convergence process.

Key word: cloud computing, scheduling, makespan, hyper heuristic algorithms (HHA), low-level heuristic (LLH).

I. INTRODUCTION

In current project presents a novel heuristic scheduling algorithm, called hyper-heuristic scheduling algorithm (HHSA), to describe the good approaches of scheduling solutions for cloud computing systems. To improve the performance criteria’s of systems for storage, computation, and analysis. Since distributed and parallel computing techniques are widely used to improve the aspects of performance using various approaches. Among all of them scheduling one of the important criteria to improve the performance.

The new era of computer and internet technologies, rules of cloud computing have been successfully used on several systems in recent years which are dealing with information. Cloud computing providing the better responsive time, scalability, flexibility.

Traditionally rule-based scheduling algorithms are not providing the appropriate for large-scale or complex scheduling problems because the results of these scheduling strategies are usually far from optimal. The extended version of heuristics combines two or more heuristics into a...
single heuristic algorithm to leverage their strengths for scheduling, called hybrid heuristic based scheduling algorithm. Different from most hybrid heuristic-based scheduling algorithms that employed only one or two heuristics, the proposed algorithm is a hyper heuristic-based algorithm (HHSA) that integrates several heuristic algorithms. The main idea of the proposed algorithm is to ascendancy the strengths of heuristic algorithms, such as genetic algorithm and ant colony optimization by combine them into a single algorithm.

Advantages:

- Hyper Heuristic Scheduling Algorithm each time it runs only one Low level Heuristic Algorithms (LLH).
- Hyper Heuristic Algorithm proposed a scheduling algorithm on cloud computing to reduce the make span.
- Use of Diversity Detection operator and Improvement Detection Operator to determine the timing to employ the LLH.

II. LITERATURE SURVEY

In this section to illustrate about different literatures and their contributions to their respective fields and how they help this paper to reach its conclusion as to choose the proposed system.

1. A particle swarm optimization based hyper-heuristic Algorithm for the classic resource constrained project scheduling problem[1].

In this (PSO) algorithm for resource constrained project scheduling problem, it has been used for the solving complex optimization problem. In this PSO algorithm works on upper level heuristic algorithms that controls the Low Level Heuristic algorithms which will operate to the solution. The main theme of the paper is to minimize the total project makespan by scheduling the activities of project.

2. Genetic algorithm-based heuristics for an open shop scheduling problem with setup, processing, and removal times separated[2].

In this Genetic Algorithm (GA) to compute the schedule that minimizes the total job tardiness. This algorithm use of Branch and bound and Elimination methods to obtain an optimum Schedule with in minimum time. The objective of the paper is minimizing the total job tardiness in the system.

3. A novel hybrid meta-heuristic algorithm for solving multi objective flexible job shop scheduling[3].

It is a Novel hybrid meta-heuristic algorithm which is a combination of simulated Annealing (SA) and Genetic Algorithm (GA), to obtain feasible scheduling that optimize all the objective functions like make span and workload of loaded machine and workload of all machines.


This paper examines the parallel-machine capacitated lot-sizing and scheduling problem with sequence dependent setup times, time windows, machine eligibility and preference constraints. The primal problem is decomposed into a lot-sizing sub problem and a set of single-machine scheduling sub problems by Lagrangian decomposition. A Lagrangian-based heuristic algorithm, which incorporates the simulated annealing algorithm aimed at searching for a better
solution during the feasibility construction stage, is proposed.

5. A hybrid artificial Bee Colony algorithm for job scheduling[5].

In this study they aim at minimizing the total weighted tardiness in JSSP. Considering the high complexity, a novel artificial bee colony (ABC) algorithm is proposed for solving the problem. A neighborhood property of the problem is discovered, and then a tree search algorithm is devised to enhance the exploitation capability of ABC.

6. A Max–Min Ant System algorithm to solve the Scheduling Problem[6].

The Software Project Scheduling Problem is a specific Project Scheduling Problem present in many industrial and academic areas. This problem consists in making the appropriate worker-task assignment in a software project so the cost and duration of the project are minimized. They present the design of a Max–Min Ant System algorithm using the Hyper-Cube framework to solve it.

7. Surveying and Analyzing Security, Privacy and Trust Issues in Cloud Computing Environment[7].

This paper primarily aims to highlight the Major security, privacy and trust issues in current existing cloud computing environments and help users recognize the tangible and intangible threats associated with their uses, which includes: (a) surveying the most relevant security, privacy and trust issues that pose threats in current existing cloud computing environments; and (b) analyzing the way that may be addressed to eliminate these potential privacy, security and trust threats, and providing a high secure, trustworthy, and dependable cloud computing environment.


Large scale distributed systems such as cloud computing applications are becoming very common. These applications come with increasing challenges on how to transfer and where to store and compute data. The first one is that it depends on a single name node to manage almost all operations of every data block in the file system. The second potential problem with HDFS is that it depends on TCP to transfer data.


In this paper, they investigate the security perspective of scientific computation in cloud computing. They investigate a cloud selection strategy to decompose the matrix multiplication problem into several tasks which will be submitted to different clouds. In particular, they propose techniques to improve the fault-tolerance and reliability of a rather general scientific computation: matrix multiplication.

10. Fault-tolerant approach in cloud computing infrastructure[10].

This paper focuses on fault tolerance in cloud computing platforms and more precisely on autonomic repair in case of faults. It discusses the implications of this splitting in the implementation of fault tolerance. In most of current approaches, fault tolerance is exclusively handled by the provider or the customer, which leads to partial or inefficient solutions.


This paper will present the security limitations in the single Cloud and the usefulness of adopting rather Multi-Clouds strategy to reduce security risks, through the
use of DepSky which is a virtual storage system that ensures better availability and high confidentiality of data.

12. Boosting adaptively of fault-tolerant scheduling for real-time tasks with service requirements on clusters[12].

In this paper they propose a service-aware and adaptive fault-tolerant scheduling algorithm using overlapping technologies (SAO) that can tolerate a node’s permanent failure at any time instant for real-time tasks with service requirements in heterogeneous clusters. SAO adopts the primary/backup model and considers the timing constraints, service requirements, and system resource utilization.


The redundancy introduced in terms of executing more versions of a task reduces the number of tasks meeting their deadlines (guarantee ratio). In this paper, they address these two issues: (i) by proposing a scheduling algorithm which supports all three fault-tolerant approaches, and (ii) by proposing guarantee ratio improving techniques such as the distance concept and task parallelization, and better algorithms for reclaiming of unused resources at run-time.


Therefore, a collection of 11 heuristics from the literature has been selected, adapted, implemented, and analyzed under one set of common assumptions. It is assumed that the heuristics derive a mapping statically (i.e., off-line). It is also assumed that a meta task (i.e., a set of independent, no communicating tasks) is being mapped and that the goal is to minimize the total execution time of the meta task.

15. Search-based QoS ranking prediction for web services in cloud environments[[15].

The main contributions of this paper are an improved similarity measurement for two ranked sequences is proposed. The measurement differs from previous Kendall rank correlation coefficient in its emphasis on relation pairs appearing contrary to the main preferences between two services, thereby filtering close neighbors. A new solution for the QoS ranking prediction problem is proposed by adopting the Particle Swarm Optimization algorithm (PSO). Corresponding operations are designed to enable PSO to find the near-optimum prediction solution, and several strategies for improving solution quality are also introduced.

16. Balancing throughput and response time in online scientific Clouds via Ant Colony Optimization[16].

The goal of this work is to study private Clouds to execute scientific experiments coming from multiple users, i.e., our work focuses on the Infrastructure as a Service (IaaS) model where custom Virtual Machines (VM) are launched in appropriate hosts available in a Cloud. Then, correctly scheduling Cloud hosts is very important and it is necessary to develop efficient scheduling strategies to appropriately allocate VMs to physical resources. [17-19]The job scheduling problem is however NP-complete, and therefore many heuristics have been developed. In this work, to describe and evaluate a Cloud scheduler based on Ant Colony Optimization (ACO). The main performance
metrics to study are the number of serviced users by the Cloud and the total number of created VMs in online (non-batch) scheduling scenarios.

17. Scheduling algorithm for real-time tasks using multi objective hybrid genetic algorithm in heterogeneous multiprocessors system[17].

In this paper, they propose a new scheduling algorithm for non preemptive tasks with a precedence relationship in a soft real-time heterogeneous multiprocessor system. In solution algorithms, the multi objective genetic algorithm (mohGA) and the simulated annealing (SA) are cooperatively used. In this method, the convergence of GA is improved by introducing the probability of SA as the criterion for acceptance of a new trial solution. However, it is hard to find the optimum solution by only applying the genetic operators.

The objective of proposed scheduling algorithm is to minimize the total tardiness and the completion time simultaneously. For these conflicting objectives, this paper combines adaptive weight approach (AWA) that utilizes some useful information from the current population to readjust weights for obtaining a search pressure toward a positive ideal point.

18. Robust scheduling for multi-objective flexible job-shop problems with random machine breakdowns[18].

This study addresses robust scheduling for a flexible job-shop scheduling problem with random machine breakdowns. Two objectives makespan and robustness. Robustness is indicated by the expected value of the relative difference between the deterministic and actual makespan. Utilizing the available information about machine breakdowns, two surrogate measures for robustness are developed. Specifically, the first suggested surrogate measure considers the probability of machine breakdowns, while the second surrogate measure considers the location of float times and machine breakdowns.[18-20]

19. A framework for ranking of cloud computing services[19].

In this work, they propose a framework and a mechanism that measure the quality and prioritize Cloud services. Such a framework can make a significant impact and will create healthy competition among Cloud providers to satisfy their Service Level Agreement (SLA) and improve their QoS.

20. A parallel bi-objective hybrid meta heuristic for energy-aware scheduling for cloud computing systems[20].

In this paper, they investigate the problem of scheduling precedence-constrained parallel applications on heterogeneous computing systems (HCSs) like cloud computing infrastructures.[21-27]

They propose a new parallel bi-objective hybrid genetic algorithm that takes into account, not only make span, but also energy consumption. They particularly focus on the island parallel model and the multistate parallel model.

TABLE 1. COMPARISONS OF ADVANTAGES AND DISADVANTAGES OF DEPLOYMENT TECHNIQUES
<table>
<thead>
<tr>
<th>S.No</th>
<th>Title and Concept</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| 1    | A particle swarm optimization based hyper-heuristic Algorithm for the classic resource constrained project scheduling problem. [Georgios, Lazaros Kotsikas, Konstantinos Anagnostopoulos, (2012)] | • Resource allocation  
• Levelling to enhance its efficiency  
• The proposed algorithm manages solution methods rather than solutions and employ simple LLH | • To develop such problem specific methods expensive and maintain |
| 2    | Genetic algorithm-based heuristics for an open shop scheduling problem with setup, processing, and removal times separated [Chinyao Low, Yuling Yeh., (2014)] | • To compute a schedule that minimize the total job tardiness  
• To obtain the optimal schedule algorithm | • Traditionally Attributes to the class of difficult tractable problem |
• Minimize the workload of most loaded machines.  
• Minimize the total workloads | • Complexity of JSP(job scheduling problem) and FJSP(flexible JSP) |
<table>
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<tr>
<th>Page</th>
<th>Title</th>
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<td>4</td>
<td>A hybrid artificial Bee Colony algorithm for job scheduling</td>
<td>Minimize the overall complexity time</td>
<td>No guarantee for optimal solution small scale instances</td>
</tr>
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<td></td>
<td>[Rui Zhang, Shiji Song, Cheng Wu, (2009)]</td>
<td></td>
<td>Total weighted tardiness is more difficult to optimize than makespan</td>
</tr>
<tr>
<td>5</td>
<td>A Max–Min Ant System algorithm to solve the Software Project Scheduling Problem</td>
<td>Minimize the cost</td>
<td>For complex instance was more difficult to find solution</td>
</tr>
<tr>
<td></td>
<td>[Broderick Crawford, Ricardo Soto, Franklin Johnson, Eric Monfroy, Fernando Paredes, (2011)]</td>
<td>Reduce the duration of the problem</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Suitable for smaller instances</td>
<td></td>
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<td>6</td>
<td>Surveying and Analyzing Security, Privacy and Trust Issues in Cloud Computing Environments</td>
<td>Applicable to large scale distributed computing</td>
<td>High speed internet</td>
</tr>
<tr>
<td></td>
<td>[Dawei Sun, Guiran Chang, Lina Sun and Xingwei Wang (2009)]</td>
<td>Flexible services</td>
<td>Need of high level of security</td>
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<td></td>
<td></td>
<td>Scalability and complexity applications</td>
<td>Vulnerabilities are Accesability, virtualization, web application</td>
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<td></td>
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<td>Storage and platform in transparent manner</td>
<td></td>
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<tr>
<td>7</td>
<td>A Scalable Distributed File</td>
<td>Full link</td>
<td>Single point of</td>
</tr>
<tr>
<td>System for Cloud computing utilization failure</td>
<td>[Debessay Fesehaye, Rahul Malik, Klara Nahrstedt, (2015)]</td>
<td>Decrease the download time</td>
<td>Depends on TCP to transfer the data</td>
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<tr>
<td>Fault-Tolerant and Reliable Computation in Cloud Computing Resource Management Short term usage of high end computing resources Reliability Cost</td>
<td>[Jing Deng, Scott C.-H. Tuang, Yungkin S. Han, and Julia H. Deng, (1997)]</td>
<td>Use of virtualization techniques. Difficulty to manage multiple layers and roles</td>
<td></td>
</tr>
<tr>
<td>Fault-tolerant approach in cloud computing infrastructure</td>
<td>[Alain Tchana, Laurent Broto, Daniel (2014)]</td>
<td>Resource that ensures better availability High confidentiality of data.</td>
<td></td>
</tr>
<tr>
<td>Boosting adaptivity of fault-tolerant scheduling for real-time tasks with service requirements on clusters</td>
<td>[Xiaomin Zhu, Chuan He, Rong Ge, Peizhong Lu (1984)]</td>
<td>Software fault-tolerance lies in it can efficiently improve the system reliability The primary copy of a real time task is faulty, the backup copy of the backup copy of a task can begin to execute even though no fault is detected in the primary copy.</td>
<td></td>
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<td>The drawback of passive backup copy scheme is that the laxity must be larger than the execution time of backup copy.</td>
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| 8 | 9 | 10 | 11 |
12 A new scheduling approach supporting different fault-tolerant techniques for real-time multiprocessor systems

- To increases the real-time system's adaptability and reconfigurability in response to failures of external events
- permits the dynamic activation of exception handling tasks;
- Back up needed

13 A hybrid Lagrangian-simulated annealing-based heuristic for the parallel-machine capacitated lot-sizing and scheduling problem with sequence-dependent setup times

- sequence-dependent setup times,
- time windows, machine eligibility, and machine preference
- independent setup time.
- high machine utilization and
- long sequence-dependent setup times

14 A Comparison of Eleven Static Heuristics for Mapping a Class

- The goal of this mapping is to
- Selecting the best heuristic
<table>
<thead>
<tr>
<th>No</th>
<th>Task Description</th>
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<td>15</td>
<td>Search-based QoS ranking prediction for their services in cloud environments. [Chengying Mao, Jifu Chen, Dave Towey, Jinfu Chen, Xiaoyuan Xie, (2007)]</td>
</tr>
<tr>
<td>16</td>
<td>Balancing throughput and response time in online scientific clouds via Ant Colony Optimization. [Elina Pacini, Cristian Ateos, Carlos Garcia Garino, (2013)]</td>
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<tr>
<td>17</td>
<td>Scheduling algorithm for real-time tasks using multiobjective hybrid genetic algorithm in heterogeneous multiprocessors system. [Myungryun Yoo, Mitsuo Gen, (2013)]</td>
</tr>
<tr>
<td>18</td>
<td>Robust scheduling for multi-objective flexible job-shop</td>
</tr>
</tbody>
</table>

- Adopting the Particle Swarm Optimization algorithm
- QoS ranking needs to find a minimum conflict solution among the active user and close, similar user
- Efficient high performance computing
- Supporting high throughput computing
- Execution time decrease
- Minimize the total tardiness and completion time
- Soft real-time resource utilization and pattern of degradation over loaded situation
- Task scheduling complex
- The workload
- The machine
problems with random machine breakdowns
[Jian, Li-ning, Ying-wu Chen(2013)]

information for each machine is utilized
breakdown locations are incorporated

| 19 | A framework for ranking of cloud computing services [Saurabh Kumar Garg, Steve Versteeg, Rajkumar Bayya,(2001)] | • Accountability—
• Agility-The organization can expand and change quickly without much expenditure
• Assurance -the service is elastic, portable, adaptable, and flexible |
• Memory optimizations |
• The first is how to measure various SMI attributes of a Cloud service
• how to rank the Cloud services |

III. CONCLUSION

The proposed algorithm uses two revealing operators on impulse to define when to variant the low-level [29-32] heuristic algorithm and a perturbation operator to fine-tune the answers gained by each low-level algorithm to more expand the scheduling effects in expressions of makespan. As far as the proposed algorithm described herein is concerned, the low-level heuristic candidate pool consists of genetic algorithm, particle swarm optimization, and ant colony optimization. [33-37] The selected enhanced hyper-heuristic algorithm will then be performed repeatedly until the termination criterion is met in computing environments. The simple indication of the
projected “enhanced hyper-heuristic” algorithm is to influence the possessions of all the low-level algorithms. The future scope is to understand the type of job failures with the intention of improving the dependability of the essential cloud infrastructure from the perspective of cloud providers.

IV. REFERENCES


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