



Research Article

RESOURCE SCHEDULING OF BAG-OF-TASKS WORKFLOWS ON CLOUD ENVIRONMENTS

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ARTICLE INFO

Article History:

Received 21st, August 2015
Received in revised form
16th, September 2015
Accepted 25th, October 2015
Published online 30th, November 2015

Keywords:

Cloud Computing (CC), Multi Objective Resource Scheduling (MORS), Con-Current Bags of Task (CBoTs), Heterogeneous Workflow Optimization (HWO), Game Theory.

ABSTRACT

During 21st century of Engineering and Technology, Internet-based service and performance computation is playing a significant role in cyber world and physical world. It was perceived that computing paradigm meet the challenges of everyday needs of human community. The present scenario demands cloud computing, the latest computing paradigm basically steps on form of demand computing, pay-as-you-use on-demand basis. In this paper, we addresses Multi-objective Resource scheduling(MORS) and optimizing resources employing with Game Theory in order to achieve high resource utilization and users meet their work performance need with Low cost as well as Low Convergence Rate. Then we present cloud Environment in order to allocate resources by using Multi-Objective Resource Scheduling (MORS) for employed game theory. Cloud computing is the largest and latest distributed-paradigm where it has a tremendous impact & opportunities on the distributing systems of cloud computing techniques in order to solve large scale scientific problems. Hence, Game Theory Based Multi-objective Resource scheduling as well as the rules of elasticity in heterogenic of the computing resources has to be discussed in this proposed thesis. By taking two variables such as an independent variable and dependent variable, the first variable contains the Bags-of- Tasks (BoTs) of various resources and the second variable also analysing about the mode of work flow with a hedonistic sprit. However, we are trying to our level best to justify the invited article which has to be represented a generic model of heuristic scheduling algorithms with multi-objectives of Game-theory and cloud computing in order to scheduling its problems in the present scenario of the real world optimization, characterized by a number of Con-current Bags-Of -Tasks (CBoTs) i.e. Homogeneous which are the main sources of bottle neck and open great potential for Heterogeneous Workflow Optimization (HWO).

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INTRODUCTION

At present Era Cloud Computing (CC) become very popular in the field of computing paradigm especially it has emerged a promising approach in Modern sector of Information Technology. Thus most of Companies has adopting Cloud Computing Environment for Software, Platform, and Infrastructure Development by which it can facilitate massive capacities of Intra-infrastructure investment in Business for getting optimum benefit in Micro-Small-Medium Enterprises (MSME) (Duan *et al.*, 2014). Where the Cloud Computing has refers a particular benefit to small and medium Enterprises or Business. Where as an Entrepreneur wish to complete outsource the avail data regarding the infrastructure development. In the titled article, "Game Theory Based Multi-Objective Resource Scheduling of Bag-of-Tasks Workflows in Cloud Environment" has caught the attention not only the IT industry but academia as well.

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In this study we have analysed the entire research work in to some categorized way i.e. (A) "Bag-of-Task (BoT)" which contains many independent Tasks. (B) "Work Flows". Where, the tasks are interconnected though dependencies. Hence fourth this thesis has addresses the above said title which scheduling problems of large scale applications inspired .from real world, characterized by a huge number of Con-current Bags of Task (CBoT) (Rodrigo *et al.*, 2010) that are the main sources of this research work and it has the bottle necks with opening a great potential for Heterogeneous Workflow Optimization (HWO) (Xin Xu and Huiqun Yu, 2014). Finally, The multiple scheduling problems are formulated as a new sequential of co-operative games and purposes a communication through scheduling optimization of Multi-objective Resource Scheduling (MORS) (Mark *et al.*, 2012) and its algorithm that optimizes many user objectives such as minimize the execution time, economic cost (e.g., time, cost) while fulfilling other constraints, as per the system prospective provides a system-level efficiency and quality of service (QoS) (Raj Kumar Buyya, 2009) to all users.

Henceforth, we have been interested to do our research work on this proposed area, where most of the hybrid heuristic-based scheduling algorithms that to be employed many heuristics models. Thus, the basic idea of this thesis has proposed a number of algorithms such as Simulated Annealing (SA), Genetic Algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), and Hyper-Heuristic Scheduling Algorithm (HHSA) (Ardagna *et al.*, 2007). The major advantages of our Game Theory Based Multi-objective Resource Scheduling as compared to other heuristics algorithms are its faster convergence as well as low cost to determine the search directions, movements, storage requirements regarding the problem formulation and easy to customize new objectives. The rest of the paper is structured as follows: Section 2 depicts the overview and related work of Cloud Computing. Section 3 depicts the overview and related work of Cloud Computing. Section 4 we provide the problem definition and motivation. Section 5 depicts the Probabilistic approach based Resource scheduling. Section 6 concludes the paper.

Literature Review

In literature review, we have taken two variables like independent variable and dependent variable with followed by number of constraints where independent variables consist the concurrent Bag of Tasks (CBoTs) (Domain based resource management by Dongwan Shin and Hakan Akkan, ?) consists of many independent tasks such as machines of two companies like TATA and Ashok Leyland Ltd. here the machines are independently operated by a fixed time schedule specific date and allocated of resources such as the expert skills of pilots technical knowledge with budget.

Work Flows

In this article, we have decided to take many heterogeneous work assignments or jobs for evaluation of work performance of three pilots in homogeneous power of machines (2000 Hertz Power) where the pilot shows their expert skill of by operating machines technically but we have cross over and mutation of machines work performance on various job assignments in order to testing the heterogeneous work flow (Daniel, 2011) performance. If the assigned work is heterogeneous the performance of machines in heterogeneous work are not optimum but if there the constraints are favourable then it has accelerate the work flow for a maximum optimization.

Multi-Objective Scheduling

Multi-objective scheduling (Di, 2013) minimizes the expected execution time and cost of application in real world problems simultaneously optimize multiple objectives such as minimize the make span, cost money, distance, storage etc. are often conflicting because it deals with non-dominated solution or pareto-optimal solution. That means one objective shows up gradation result where as other one shows degradation result. Instead of getting a single optimal solution with respect to one another. One objective, multi-objective aim is to getting the pareto-optimal solution. In case of Single objective, one attempt to obtain the best solution whereas in case of multi-objective, one cannot identify a single Solution that simultaneously optimizes each objective. Finally when attempting to improve one objective, other objective suffer as a result.

Models of Cloud Computing System

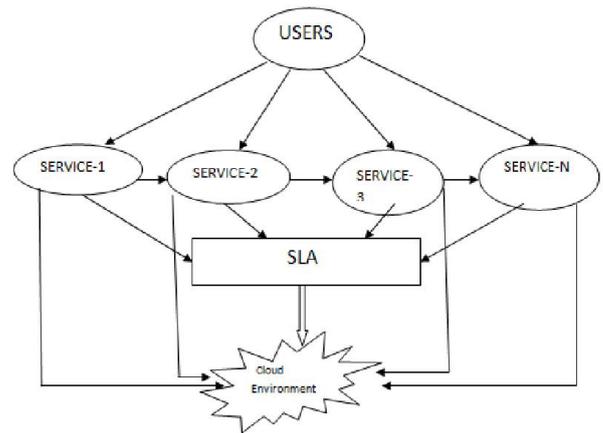


Figure 1. Models of Cloud Computing System

Conceptual frame work of Pareto Theory

We have considered a maximization problem and its experimental solution. Let a, b has two probable decision vectors (solutions) from the conceptual frame work of this experiment. Solution a dominate b (also written as, a f b) if and only if the following conditions are fulfilled:

- (i) $f_i(a) \geq f_i(b); \forall i = 1, 2, n;$
- (ii) $\exists j \in \{1, 2, \dots, n\}: f_j(a) > f_j(b)$ (i)

In connection with the above solution where we have taken, 'a' feasible vector 'a' is fluctuate in optimal if no feasible vector b can increase some criterion without causing a simultaneous decrease in at least one other criterion. Where, Multi objective evolutionary algorithms can yield a whole set of potential solutions, which are all optimal in some sense. The main challenge in a multi objective optimization environment is to minimize the distance of the generated solutions to the Pareto set and to maximize the fluctuated of the developed Pareto set. A good Pareto set may be obtained by appropriate guiding of the search process through careful design of reproduction operators and fitness assignment strategies. To obtain diversification special care has to be taken in the selection process. Therefore, a special care has to be taken in order to prevent a non- problematic loss of economical cost and slow convergence rate of work performance.

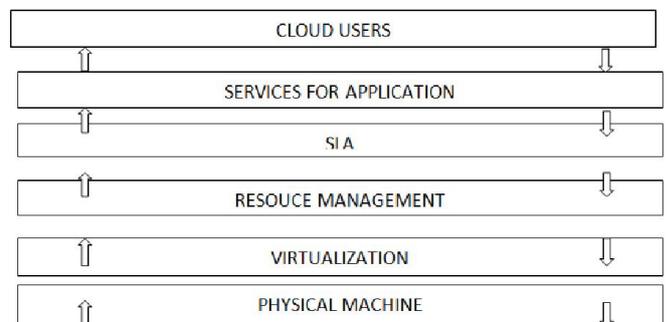


Figure 2. Layered Architecture

Genetic Mode of Operation & its Representational Solution

By the research work, we have proposed to use multi objective approach where, the solutions have represented as a string of equal length to the number of jobs.

The values corresponding to each position i.e. in the string represent the machine to which job that was allocated to the players (pilots).

For example, we have 10 jobs and 3 machines. Then a chromosome and the job Scheduling can be represented as follows:

1	2	3	2	1	1	3	2	1	3
Machine 1		Job1	Job1			Job1			Job9
Machine 2		Job 2	Job4			Job8			
Machine 3		Job 3	Job 7			Job.7			

Mutation and crossover were used as operators of the Machines where, Binary tournament selection was used in the implementation. The Pareto dominance concept is used in order to compare two experimental solutions. The one which dominates is preferred. In case of Non- Dominance, the solution whose jobs allocation between machines is uniform is preferred. This means, there will not be failure machines as well as overloaded machines. The evolution process is similar to the evolution scheme of a standard genetic algorithm for multi objective resource scheduling optimization.

Scope of the work

Motivation

- To maintain the flexibility in between the variability by which it ensure resource –intensive process shall be well utilized.
- It focuses & enables to construct IT infrastructure in various sector.
- It enables quick scale of IT operation in new computing resources.
- It focuses and consumes economical benefits to the service provider as well as the consumer by implementing IT cloud computing in various variables.
- It improves cloud computing techniques more scientifically to use for enhancing inherited resiliency.
- It is highly automated to implement in IT structure with high quality of service provide to the customer.
- To reduce the high computational cost due to their slow convergence rate for the effective utilization of global resource information

Objectives

The main Objectives of the thesis, it has designed in a new way of algorithm for scheduling a set of multi-objectives of game theory application which will be analyzed with consists of a large number of Principles (Existing algorithm which aren't scale) in an environment modelled. In this research work our algorithm aims at number of objectives and its functions which are related with this title that.

- To be testing the generic performance of cloud computing system on multi-objective resource scheduling.
- To be compared the main advantages and disadvantages of evolutionary algorithm whether they high computational cost due to their slowly convergence rate (Yazir *et al.*, 2010).

- To know about the hybrid cloud Multi scheduling algorithm (HCMISA) impact on game theory.
- To be observed the consumer's perception style towards the products consumption and its elasticity.
- To facilitate the work flow sprit among the minds of employees in order to enhancing their work performance from lower stage to higher stage.
- To justify the role of Cloud -Sims and Hadoop in multi-objective resource scheduling as subject to the game theory practice.
- To study the significance of the taken variables with comparison total quality management (TQM).

Models

As the models of game theory based multi-objective resource scheduling of resource allocation as concerned, we have already discussed and described in the abstract section about various models how to be applied in order to know the performance of system administration of an organization for a better communication and choice of location. Where, allocation of resources for an operational function of workflows of cloud computing environment by assignment of the number of tasks work flow performance provided by the service providers like Google and Amazon in order to facilitates the cloud services of an organization for selecting a suitable location for creating a good cloud computing environment. Here ,we have decided to allocate time as the factor of communication and place as the factor of location for mobilizing the availed resources with communication of service, and location of task i.e. make span , minimizing cost, time, performance and other constraints in order to justify the validity of resource allocation and its scheduling. Here, we have taken number of models for the real application of the real world of cloud computing Environment.

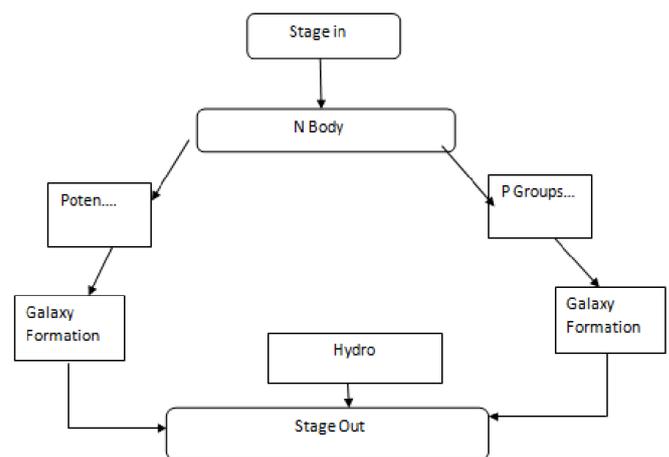


Figure 3. Real-world Application Model

Work flow Application Model

Primarily, we are concentrating on the large- scale workflows characterized by a high number of homogeneous parallel (independent) tasks of two service providers such as Google and Amazon where, we have taken bag- of -tasks as an independent variables in order to test the performance of cloud services are to be observed through the less execution of time with low cost that interconnected through control and data flow dependencies.

Problem Definition

Let $W=(BS, DD)$ where BS stands for Bag-of-Tasks(BoTs) and DD denotes the work flow application model as DAG, where $BS= \cup_{k=1}^K T_K$ is the set of constraints (K) i.e. Heterogeneous of Bag of Tasks and $DD= (T_s < d, |T_d \{T_s, T_d\} \subset BS)$ where the set of work flow dependencies data are related with the performance due to its dependencies on number of constraints, therefore we call T_s the predecessor of T_d and write: $T_s=Pred(T_d)$. We define a Bag of Tasks(BoTs)is an independent variable by taking machines of two companies with equal power as a homogeneous which is functioned or operated as parallel form sequential task i.e. 1 2 3 and descending order 3 2 1 and crossover 3 1 2, 1 3 2, 2 1 3 with completely mutation and random order. Therefore, the sequential task $T_k=\cup_{j=1}^{K_k} T_{kj}$, $k \in (1, 2 \dots K)$. That have the same type of task can be concurrently executed where K_k is the cardinality of Bag of Tasks (BoTs).

related to time as limit (24 hours per day) on each S sites. In connection with we expect that the availability of time in order to observe the work performances of machines as related with bag of task (BoTs). Hence forth, we decide to implement algorithm principle as well as matrix formula for smooth calculation of time factor in order to deliver the expected proper execution of time (PET) of task in each BoTs $K \in 1, K$ on each S site $\tau s, i \in [1, S]$. In addition to that other related constraints like cost, pilot expert, make span, performance, plays vital role in order to enhancing work performance of machine besides that communication also a vital factor for assembling the recourses in order to execute properly. Hence forth, the performance of machines in heterogeneous assignments related with BoTs. For testing cloud computing environment of work performance we have applied many application in many cases where as multi-objective resource scheduling and game theory are the most important factor for consideration for example for large scale

Table 1. Amazon Cloud versus Google Cloud (Prices as of December 1, 2012)

Service Provider	Virtual Cores	Memory (GB)	Compute Unit	HDD (GB)	\$ Per Hours	\$ Per Unit Per Hours
Google	1	3.75	2.75	420	0.145	0.053
Amazon	1	3.75	2	410	0.160	0.080
Google	2	7.5	5.5	870	0.290	0.053
Amazon	2	7.5	4	850	0.320	0.080
Google	4	15	11	1770	0.580	0.053
Amazon	4	15	8	1690	0.640	0.080
Google	8	30	22	3540	1.160	0.053
Amazon	8	30	20	850	0.900	0.069
Amazon	8	34.2	13	1690	0.660	0.033

Where T_s = Time schedule and T_d =Time Deviation.

Problem Formulation

As predicated to problem formulation we have analyzed a number of application in the definition paragraph i.e. problem definition where the task is completely independent (Service Provider) but ignoring about the service operating time which consists of number of task that can be categorized into K in different job activities(BoTs) and a cloud environment consists of S sites. Therefore the make span of an application is $A_i, i \in (1, n)$ is the maximum completion time of its BoTs.

application it is necessary to use multi objective resource scheduling and BoTs for smooth function of machine beyond this or overlap, resulting in the execution time determined as highly convergence as well as expensive therefore we may define the execution time(E_{ki}) (24 hours per day is maximum and 8 hours per day is minimum) is necessary for computation time C_{ki} and workflow performance Wp_{ki} as follows:

$$E_{ki} = \begin{cases} C_{ki} & C_{ki} \geq Wp_{ki} \\ C_{ki} + (Wp_{ki} - C_{ki}) = Wp_{ki} & C_{ki} < Wp_{ki} \end{cases} \tag{2}$$

Where Wp_{ki} can be expressed as

$$Wp_{ki} = \frac{D_{ki}}{M_{ki}}, \tag{3}$$

Where D_{ki} = data size of the task M_{ki} = Service allocated to BoTs on site S_i .

Hence, the objective of multi-objective scheduling problem is to find a solution that assigns all tasks to the Cloud Service (Through Service Provider) of two Service Provider Companies such as Google and Amazon ,in order to test the work flow performance of services for low convergence rate of workflow with optimizing performance. Thus we expect that the minimization of cost expenses for the resource allocation and hopes for an optimization of work performance of Services. Henceforth, the make span and the economic cost of all applications $F(s)$ are minimized and the workflow activities are optimized and fulfilled.

Based on the above analysis, we can find that for data-intensive applications, the expected execution time E_{ki} is determined by either computation time or workflow performance.

Game Theoretic Solution

$$\begin{aligned} & \text{Minimize}_s F(s) = (P(s), E(s)), \\ & \text{S.t. } V(s) \leq \tau s, i \in [1, S], \\ & M(s) \leq \tau s, i \in [1, S], \\ & s \in F(s), \end{aligned} \tag{1}$$

As the multi objective scheduling of resource allocation as concerned we have taken the number of constraints for problem formulation and its solution in order to obtaining the research objectives or goals .Thus, we are decided to take Game Theory as the one factor of constraints to justify the role of Bag-of-Tasks (BoTs) on the process of Game Theory by which a problem can be easily formulated with playing a cooperative game among the application of Cloud services and efficiency of service providers which can theoretically generate the optimum solution of its application which is hard to achieve due to facing

Where s is a solution and $F(s)$ is the feasible solution and $F(s)$ is the image of s , The performance of service provider $P(s)$, Economic cost of objective $E(s)$, Variation of Time $V(s)$, and Variation Cost (Tk_i), $\tau s, i \in [1, S]$ is the recorded data for evaluation of work flow performance (W_i) and consumption of time (T_i) for testing and observing different work activities

number of problems at different levels of work assignment again this problem is seems highly complexity to do the performance effectively at different hedonistic condition such as System failure, failure of WEB links (Network failure) Untrained Service Operator (USO), inefficiency of data transmission, lack of technical knowledge of service agents, fatigues' of the Service Agent(FSA) and required budget or cost etc.

Therefore, we observed that the problems can be further formulated and addresses as sequential for playing the co-operative game. While we playing it we require to redefine of five parameters like Cloud Service Provider, Expert of Service Operator (Agent), Service planning and strategies, specification of time and required budget.

Cloud Service Provider

The first parameter we have taken two different service provider companies Google & Amazon, in order to observe their work performance followed by game theory application of operational efficiency of service provider and their attempts to minimize the execution of time (E_{ki}) and cost (Tk_i) of one Bag-of-Tasks on the basis of total number of tasks (Sk_i) and its processing rate of work flow performance (βWp_{ki}) on each site S_i . For a better work performance and clarity of work we have assumed and taken a manager and three pilots for application of their efficiency on the real field of work environment in order to handle and execution of one by one Bag-of-Tasks through the application of game theory by use of Algorithm method. Therefore, the objectives of service Provider and each Service Operators (Agent) are to minimize the execution of time and economic cost of its BoT while function of the constraints of work assignment and expressed as:

Expert skill of Service Operator (ESO)

The second parameter, we have taken the Expertization of Service Operator (ESO) where the Service Operator's expert skill plays an important role for adequate service providing to the cloud users. Here, the expert skill refers to the quality or skill of an operator whose are timely done their assigned task perfectly and efficiently by which they able to provide the services to their clients in timely and accurately.

Service planning and Strategies

In the parameter, we have taken an account in to consideration that service planning & strategy of cloud service provider, where planning means, thoughts or ideas (Generic) of a service operator how will be execute in a systematic way or process. Here, the Service Operators (SO) is going to prepare some of plans, game plans (Strategic) in order to execute the plans, prepared by them previously for the purpose of providing a well and adequate service facility to their esteemed service users... This plans are to be execute through the game theoretic way of playing, by which the planning and strategies are to be optimum success as per their expectation

Specification of Time

In the fourth parameter we have taken specific time 16 hours per day to each pilot as a constraint which can be redefined.

Required Budget

As per the constraint it needs a specific budget and its allocation with mobilization of funds in order to meet the requirements of the assigned work as well as the project title. To further compare the quality of the GMO solution against the absolute optimum, we consider a small-sized problem consisting of two sites with three and two homogeneous processors each and two BoTs containing five tasks each.

We use in our simulation both consistent matrices and inconsistent matrices, outlined in Table 2: consistent represents that, if a site A executes a task faster and more expensive than site B, then A executes all tasks faster and more expensive than B, while inconsistent characterizes the situation when the site A might be faster and more expensive than B for some tasks and slower and less expensive for some other constraints. However others algorithms require more scheduling time to execute for such type of large problems.

Table 2. Comparisons with other algorithm

Processor	T1	T2	GMO	G-Min-Min	G-Max-Min
S1:P1	15	9	9, 9	9, 15	15, 9
S1:P2	15	9	9, 9	9, 15	15, 9
S1:P3	10	8	10, 10	8, 10	10, 8
S2:P1	10	8	10, 10	8, 10	10, 8
S2:P2	10	8	10, 9	8, 10	8, 10
Make span			19	23	23

Rationality of Game Theory in Cloud Computing Services in probabilistic Mode of Play

As per the availed data from the field, we developed an experiment on the work performance of three JCB machines such 1, 2, 3, with randomly mutation rather than chronological set. This game has played by three experienced Pilots and it does not beyond three pilot games because if do empirical theories you have remain closed the data, most games (Machines of JCB) played by three pilots not more than four and five pilot piloting machines (JCB) experimental. The parameter space is enormous; one is hesitant to generalize beyond the three pilots. Thus the virtualized three pilots operating machines is only for Zero" normalized games for games which have minimum time needs with maximum work performance and minimizes the economic cost. We think every thing changes if the pilot has positive effort & coalitions. We had already played more than 200 games of JCB Machines piloting.

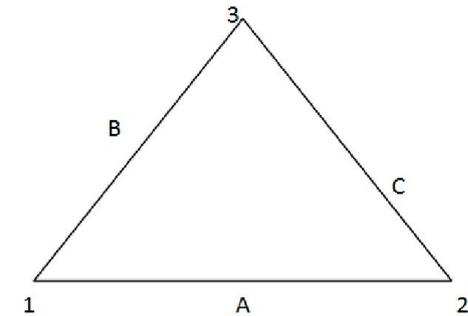
Normative & Descriptive Theory of Probability

By implementing the descriptive theory, we aimed at bounded rational behaviour of pilots, by observing from their field experiments of (Piloting JCB's) & emerged. Theorizing has no longer based on the idea of fully rationally, but rather than the stipulated time and budget. Thus we, show you a comparison for a very simple job of assignment i.e.

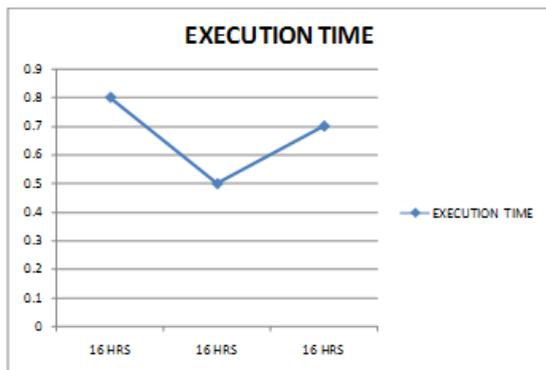
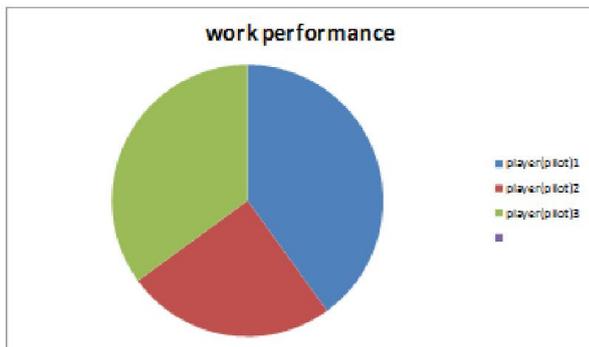
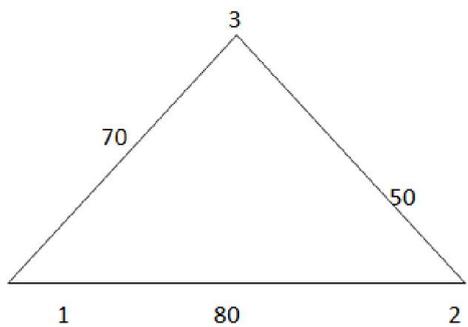
The Normative & descriptive Theory of Probability

In this experiment of this game theory, we want to consider all work performance of three pilots by using a quota game, without Grand coalition and minimum payoff for one pilot's coalition.

Let us, see the triangle 1.of above where you can look at the three players (Pilots) like 1,2,3, where, 1 and 2 together done the job 'A' and 1, and 3 together done the job 'B' and 3, and 2 together done the job 'C'. Thus, B & C is greater than 'A'. In this way the pilots just did their assigned jobs.



NB: In this diagram represents $A > B > C = 0$
 $A+B > C, B+C > A$



[Work performance of Three Pilots by Execution of Time]

An example of fully symmetric 3 pilot's quota games without grand coalition and three minimums cost pay of to one pilot coalition .The obtained values are all together than or equal to "zero" and then 'B' plus 'C' is greater than 'A'.

This is a kind of triangular equation, we are experimented 200 games, where, pilots get 80.70 and 50 respectively games.

Results of Semiotic Model by using pie chart

This semiotic models of pie chart focuses about the work flow performance of three JCB machines operating by the three pilots in different time as per the stipulated time (16) hours per day.

Solution by using Quota Theory

In order to solute, this problem, earlier we have taken game theory of algorithm, and here, we have taken three quotas of assignment of piloting such as $q_1, q_2,$ and q_3 in order to define the concepts of minimizing cost of expenditure and time as well as maximizing work flow of performance of pilots (over JCB machines) by the way the three pilots i.e. 1, 2, and 3, with the property of that quotas of two pilots. Sum the value of their coalition. So the sum of q_1, q_2 is sum of 'A' q_1 and q_1 and q_3 is the sum of 'B' q_2 and q_3 is the sum up 'C'. 'A' in order to testing the prevails pilot 1 can offer more two pilot '3' than pilot'2', here, only quota agreements avoid this kind of discrepancies and imbalanced in between them.

Table 3. Comparison with quota theory

Quotas/Assignments	Equal division of cost Bounds
$q_1+q_2=A$	$1 > 2 > 3$ (order of strength)
$q_2+q_3=B$	Lower bound S_1, S_2 and S_3 for payment.
$q_2+q_3=C$	in to '2'pilots coalitions
Example: $q_1=50$ $q_2=30$ $q_3=20$	Stronger member can claim equal share $S_1=A/2, S_2 =C/2$
	Upper bounds for 1and 2 in (1,2) $H1= A-S_2, H2= a- S_1$ 3's competitive bound $S_3=Max.S=40, s_2=25, s_3=10$
Circular definition	An algorithm definition has proved.

Research Findings

In this research work, we got the following findings for the future course of research work of young researcher i.e.

- To facilitate and empowered the probabilistic theory of problem solution on cloud computing environment instead of algorithm way of problem solution .because the physical concept of work assignment is very much clear than the cloud service.
- To make balanced by using various method of cloud computing techniques if the discrepancies or imbalanced are occurs.
- To minimise the stipulated time of work assignment with work flow maximization in order to minimizes the cost of expenditure.
- To observe the discrepancies in between the variables of resource allocation, resource mobilization, transformation and make transparency in the work.

Game Theory Based Resource Scheduling Algorithm

A preliminary Experiment

Once upon a time two companies of service provider named as Google and Amazon whose wants to provide the service

facilities to the clients in order to share their interest for a topic (web net browsing, JAVA , yoga, cloud environment whatever) in a nice corporate office premises in India Two senior researchers of a well-known Institute wants to gather some colleagues and young researchers to disseminate the most recent scientific results on scheduling theory in a school of Engineering in the frame of the proposed Research of the title "Game Theory Based Multi-Objective Resource Scheduling of Bag-of-Tasks Workflows on Cloud Environment" The duration is 7days.

They first selected some good speaker from the corporate sector in pairs (topic, speaker). Some of them are more popular than others (good topic with good speaker, but also bad topic with good speaker, etc.). As they have to pay for the equipments for the whole week, they must determine the best repartition of talks for attracting the maximum number of participants. Available time slots are not evenly distributed in the week (it is better to deliver a talk Wednesday morning before the banquet instead of Monday early morning when many participants are not still arrived or Friday afternoon when most people already left.

User as an Organizational Point of view

In the conference the participants are participated from various corporate, education industries and, software companies etc. They are very busy people, thus, they want to come the minimum time and attend the maximum of good talks. The participants want to maximize the number of good pairs (topic, speaker) (they have played for!). The organizers want to maximize the number of participants in each session of lecture of the key note speaker

Bi-Criterion Problem

This is a typical bi-criteria assignment problem. It is easy to find a good solution for each criterion; however, it is not always satisfactory for the other... Multi-objective optimization is a rather new topic which motivates a lot of people. Optimizing one objective has been widely studied for many combinatorial problems including scheduling. Scheduling is a problem that has many variants. The most popular objective is the makespan which is informally defined as the time of the last finishing task (completion time) of an application represented by a precedence task graph.

Basic Framework of Traditional scheduling

Application a weighted DAG $G = (V, E)$

- V = set of tasks (indexed from 1 to n)
- E = dependency relations
- p_i = computational cost of task i (execution time)
- $c(i, j)$ = communication cost (data sent from task i to j)

Platform Set of m processors (identical, uniform, dedicated,) Schedule

- $\sigma(i)$ = date to start the execution of task
- $i \pi(i)$ = processor assigned to it

Traditional scheduling Constraints

Data dependencies If $(i, j) \in E$ then if $\pi(i) = \pi(j)$ then $\sigma(i) + p_i \leq \sigma(j)$ if $\pi(i) \neq \pi(j)$ then $\sigma(i) + p_i + c(i, j) \leq \sigma(j)$
Resource constraints $\pi(i) = \pi(j) \Rightarrow (\sigma(i), \sigma(i) + p_i) \cap (\sigma(j), \sigma(j) + p_j) = \emptyset$

Traditional Scheduling Objective Function

Completion time of task i : $C_i = \sigma(i) + p_i$
Makespan or total execution time (the most studied one) $C_{\max}(\sigma) = \max_{i \in V} (C_i)$

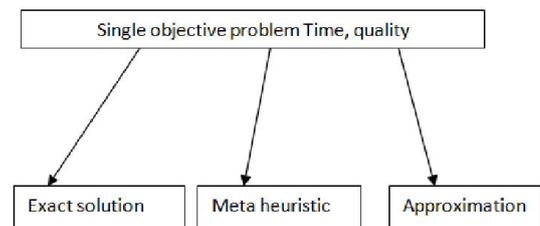
Other classical objectives

- Sum of completion times (min sum)
- With arrival times: maximum flow or sum flow
- Stretch Tardiness
- Fairness

Single objective problem

Scheduling Problem

Determine σ : when and where the computational units (tasks) will be executed. Diagram of solving the single objective problem. This Describes about various possible ways for solving the problems of single objectives criteria such as time, quality etc



Thorium

Minimizing the makespan (basic problem) is NP-Hard Solutions may be obtained by exact methods, purely heuristic methods, or approximation methods. Problems are classified by approximation classes (FPTAS, PTAS, APX). Well-established techniques since years. We focus on ρ -approximation algorithms. In particular, dual-approximation today, there is an increasing interest in considering a big variety of criteria. Taking into account the diversity of points of view is a recent challenge. In the jungle of criteria, the tendency is to imagine his own criteria which would not be considered usually.

Philosophical discussion

Make clear first that that multi-objective problem is an optimization problem, and not really a decision one. The central problem here is the trade-off between all feasible solutions. There are a lot of "good" solutions.

Property

The only reasonable answer is to give all the good solutions. Determining one of them is external to the optimization. Good solutions are Pareto optimal solutions.

Definition

A solution is Pareto optimal if no solution is as good as it is for all the objectives and is better for at least one objective.

Complexity Activity –One

The theoretical framework on multi-objectives in recent, and thus, the domain lacks of concepts, tools, etc. For instance, how to define the complexity classes in multi-objective optimization?

Theoretical Frame work

The theoretical framework on multi-objectives in recent, and thus, the domain lacks of concepts, tools, etc... For instance, how to define the complexity classes in multi-objective optimization?

Complexity Activity –Two

Two easy single objective problems can lead to a hard bi-objective problem: Let consider two sets of independent jobs J_1 and J_2 to schedule on 1 machine. The single objective problem is to minimize the min sum over each set J_i ($i = 1, 2$). The solution is easy by SPT (Shortest Processing Time) list algorithm. Two easy single objective problems can lead to a hard bi-objective problem: Let consider two sets of independent jobs J_1 and J_2 to schedule on 1 machine. The single objective problem is to minimize the min sum over each set J_i ($i = 1, 2$). The solution is easy by SPT (Shortest Processing Time) list algorithm. The bi-objective problem is to minimize the min sum on both sets. The idea of the proof is to show that the decision of the problem is NP-hard (given a pair of values, deciding if there is at least one point which is better than this pair). Remark that we can easily check if a given solution of the bi-objective problem is optimal (by SPT).

Activity Complexity: Three

What is the size of the optimum of an optimization problem?

Single objective problems

Usually, only one value of the solution

Multi-objective problems

Exponential number of solutions (or even infinite number of solutions). Sometimes, there are only a few solutions... It is linked to the cardinality of the Pareto curve. For instance, the cardinality of the curve on the previous example is exponential. Remark that even if the cardinal of the curve is polynomial, the problem can be hard.

An overview of Existing Approach of Multi Objective scheduling of game theory

- Just observe
- Aggregation (linear or convex) of objectives. How to do it? Remark that we implicitly take position while aggregating. The solution is Pareto optimal but we obtain only those on the convex hull (and not all these points).
- Change some objectives into constraints. Popular in Linear Programming.

- Hierarchy between objectives: give them different priorities
- True multi-objective analysis: find approximation.

Acknowledgement

It gives us immense pleasure to share some thing with the intellectual minds of the world .where we are highly thankful to them if this article gives them satisfaction as they desire to digest their related problems of research work of the current scenario of research work in the field of cloud computing environment. In connection with firstly, we express our tribute and gratitude to the Almighty, Who bless us to think about the assigned research work of cloud computing environment, by the blessings of “God” we able to write something. Secondly we express our highly thankful to the dignitaries who are encouraged and motivated to complete the research work.ie our parents, teachers, friends, relatives, colleagues and our lovely students because of their inspirations are highly motivated to a great extent in order to complete this article.

Conclusion

In conclusion, we may conclude that, “Game Theory Based Multi-Objective Resource Scheduling of Bag-of-Tasks Workflows on Cloud Environment” is an excellent version of research work, where many eminent researchers has presented their article regarding the said article before us on the basis of problematic solution by using algorithm. But in this research work ,we first time introduced and used the concept of game theory of multi objective scheduling of bags-of –tasks work flows on cloud computing environment and its problematic solution by using the probabilistic method in order to observe the discrepancies in between the assigned variable of bags-of tasks, and the workflows of cloud computing environment for the purpose of optimization of workflow with minimizing the allocated time. After the cross over, mutation, comparison, and testing with its authenticity we came to conclude, probabilistic way of game theory has a highly impactful than the algorithm based of computation.

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