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Improved PSO Scheduling Research Using Virtualization and Internet-Cloud Computing

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Abstract

Industry, health care, academic, development and manufacturing, as well as the private sector, are all experiencing scheduling issues these days. This paper provides an overview of the scheduling problems that particle swarm optimization can solve. It can be seen from a study of various author papers that particle swarm optimization provides better results in terms of time, productivity, and a balanced workload, among other things.

In recent years, cloud computing has exploded in popularity in the fields of computing, science, and business. Virtualization through the internet has opened up new possibilities for developing software and providing different services to end users. Since the user must pay for resource use based on time, task scheduling is critical in cloud computing. It helps to spread the load equally among system resources by optimising utilisation and reducing task execution time. In a cloud computing system, solving the scheduling problem for user requests is impossible. In order to reduce to polynomial complexity, this problem is normally solved using heuristic methods. The goal of this paper is to (1) reduce the system's total cost and (2) meet users' QOS (Quality of Service) requirements.

Keywords: *Cloud computing and virtualization, QOS (Quality of Service), Particle Swarm Optimization*

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INTRODUCTION

Particle Swarm Optimization

Particle Swarm Optimization (PSO) is a swarm-based intelligence algorithm that is inspired by animal social activity, such as a flock of birds looking for food or a school of fish defending them from a predator. In PSO, a particle is like a bird or a fish flying through a search (problem) space. Each particle's movement is synchronised by a velocity that has both magnitude and direction. The location of each particle in a problem space is influenced by its best position and the position of the best particle at any given time. The performance of a particle is measured by a fitness value, which is problem specific. The PSO algorithm is similar to other evolutionary algorithms. In PSO, the population is the number of particles in a problem space. Particles are initialized randomly. Each particle will have a fitness value, which will be evaluated by a fitness function to be optimized in each generation. Each particle knows its best position p be stand the best position so far among the entire group of particles g best. The p best of a particle is the best result (fitness value) so far reached by the particle, whereas g best is the best particle in terms of fitness in an entire population. In each generation the velocity and the position of particles will be updated, respectively. PSO algorithm provides a mapping of all the tasks to a set of given resources based on the model described in Section.

Particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. PSO optimizes a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity. Each particle's movement is influenced by its local best known position but, is also guided toward the best known positions in the search-space, which are updated as better positions are found by other particles. This is expected to move the swarm toward the best solutions Companies building embedded real-time systems are driven by a profit motive. To succeed, they aim to meet the needs and desires of their customers by providing systems that are more capable, more flexible, and more effective than those of their competitors, and by bringing these systems to market earlier. This desire for technological progress has resulted in a rapid increase in both software complexity and the

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processing demands placed on the underlying hardware.

Scheduling is the general concept used in many areas, and the problems related to scheduling are difficult to solve because of some factors like high search space, constrained and dynamic nature and variations in the problem depending on areas and applications .Scheduling is the process of allocating or distributing work or workloads and tasks to processor, humans or machines to complete within the time constraint. To solving the optimization problem, there are various traditional techniques are available but sometimes that are fail to solve the problems containing large no. of parameters and non-linear objective functions. To find the solution on these problems researchers introduced some modern optimization techniques and they become popular day by day. Some popular evolutionary techniques are, Genetic algorithm based on the principle of natural selection and the survival of the fittest. Simulated annealing is probabilistic iterative based method used in applied mathematics. Ant colony optimization is probabilistic Meta –heuristic algorithm inspired by behavior of ants searching for optimal path. Particle swarm optimization is based on the Particle swarm optimization is a non-traditional, modern optimization method. It is population based, it is inspired by the natural behavior of animals or insects e.g., bird flocking, fish schooling. It is introduced by Dr. Kennedy and Dr. Eberhart in 1995. PSO was developed to solve non-linear optimization problems, but nowadays this algorithm has been used in many areas, real-world application problems.

PROBLEM IN SCHEDULING

A. Scheduling Problem

Scheduling problem is how to allocate tasks with limited resources to achieve some pre-set goals. The "task", "machine", "resources" in scheduling problem are abstract concepts. However, they actually represent extremely wide range of practical objects. During the past few decades, People have done a lot of research on the scheduling problem that has received wide attention from applied mathematics, operations research, engineering and other fields. The linear computation, dynamic programming and decision analysis in operations research have been widely used to study scheduling problem using PSO.

B. Scheduling Problem in the Cloud

The goal of cloud computing scheduling is to achieve the optimal scheduling

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submitted by the user, It should try to improve the overall throughput of cloud computing systems with Specific objectives include the optimal make span, quality of service, load balance, economic principles and so on.

OBJECTIVE OF PAPER

1. The objective of the paper is to ensure that every computing resource is distributed efficiently and equitably and at the end to improve resource utility. In traditional computing environments of distributed computing, grid and parallel computing, a set of scheduling strategies have been proposed and identified effectively.

2. To establish an efficient load balanced model which would be proposed to ensure cloud computing could be used efficiently & effectively which is a fundamental goal of the service providers.

3. The objective of the task scheduling is to achieve high system throughput, improve the load balance and reduce the completion period while ensuing in the same time meeting the job requirement with available virtualized resources.

LITERATURE REVIEW

Kennedy and Eberhart (2009) have discussed a workflow scheduling strategy using Particle Swarm Optimization (PSO). PSO, an applied soft computing method developed [6], is one of the most advance evolutionary algorithms driven from nature. PSO approximates an optimal solution by iteratively improving a group of candidate solutions, Called particles. Each particle is modified iteratively by the best information from both the individual and the entire group. By collecting the cumulative intelligence of whole group, the group is expected to move toward the most optimal solutions. PSO works well on most global optimal problems. In addition it is simple, effective, and of low computational cost.

In this paper, we present a particle swarm optimization (PSO) based heuristic to schedule applications to cloud resources that takes into account both computation cost and data transmission cost. We experiment with a workflow application by varying its computation and communication costs. We compare the cost savings when using PSO

This paper describes a procedure that uses particle swarm optimization (PSO) combined with the Lagrangian Relaxation

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(LR) framework to solve a power-generator scheduling problem known as the unit commitment problem (UCP). The UCP consists of determining the schedule and production amount of generating units within a power system subject to operating constraints. The LR framework is applied to relax coupling constraints of the optimization problem.

Parameter Sweep Experiments (PSEs) allow scientists to perform simulations by running the same code with different input data, which results in many CPU-intensive jobs and thus computing environments such as Clouds must be used. Our goal 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 scheduling strategies to appropriately allocate VMs to physical resources. Here, scheduling is however challenging due to its inherent NP-completeness. We describe and evaluate a Cloud scheduler based on Particle Swarm Optimization (PSO).

Scheduling problems are multi-constrained and NP-Hard problems. This paper deals with the faculty assignment problem. Objective of this paper is to assign the faculty to exam halls. This problem is tested on real world dataset from Rajarambapu institute of technology. This paper attempts to solve the problem by using particle swarm optimization algorithm and its variation and analysis of both approaches are shown.

FLEXIBLE JOB SHOP SCHEDULING PROBLEM

Flexible job shop scheduling is an expansion of job shop scheduling problem. FJSP means that machine can act upon any task from existing set of machines. FJSP is a little bit complex as compared to JSP because given a set of machines required to determine the assignment of an operation. Essentially, it is used in flexible manufacturing system (FMS).It becomes effortful to get the optimal schedule in a given period of time as increasing number of jobs.

The FJSP problem divided into two sub-problems, they are:

1. ***Assignment Problem***- Assignment problem assigns a machine from a set of available machines.

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2. ***Sequence Problem***. Sequence problem means to identify an array of all operations on each machine.

Brandimarte was the initiator for using Breakdown Avenue for FJSP. He used dispatching rules to solve the modular problem of routing. Wu and Xia developed an effortlessly accoutered solution to solve multi-objective flexible JSSP. It is the amalgamation of PSO and SA. PSO is used to accredit operations to the specific machine and simulated annealing provides a range of operation on the machine. PSO provides an elucidation when the search process is hybrid for SA.

A. Optimal make span

Makespan is a very important and common goal in task scheduling. Users usually hope that their tasks can be completed as soon as possible. Optimal makespan is the common goal of both cloud provider and clients.

B. Quality of service

Scheduling system must guarantee the QoS specified by the users. On the one side, it needs to improve the efficiency of resources based on application characteristics in order to ensure the efficiency and accuracy of customers. On the other side, it should select and redirect resources dynamically based on users' status changes to meet the user's economy and satisfaction. So the goal is not only to protect users but also helpful for the long-term sustainable development of cloud computing.

C. Load balancing

Since the number of computers in the cloud computing platform is very large. In additional, the complex composition and different heterogeneous cloud computing platform make load balancing in current could challenge.

D. Economic principles

Economic is a key factoring in scheduling of cloud computing because of ultra large scale and pay-per-use business model. Market driven cloud users and providers can have mutual benefits from an efficient scheduling system.

Since cloud services require great amount of control and manage resources, a good workflow scheduling is important to manage jobs and tasks. Workflow scheduling plays a key role in the workflow management system. Figure 1 illustrates the cloud workflow scheduling. After submitting workflow by a client, a broker or scheduler is used to run the scheduling algorithm so that the system

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can start to make decision. In cloud-based infrastructure, the physical machines are virtualized into unified resources called virtual machines (VMs). The scheduler decides which resources.

E. Swarm Intelligence

The concept of swarm intelligence stems from observing the behaviors of social groups of organisms bees, ants, geese, fish and other species. Strictly, swarm intelligence is an artificial intelligence model inspired by groups of organisms in nature. These kinds of intelligent patterns need relative number of intelligent individuals to achieve certain types of problem solving capabilities. As intelligent individuals, in generally, without the feedback information from community, the way it is in the solution space travel is Intelligent individuals can reflect an overall optimization features from entire intelligent group. Swarm intelligence should follow five rules: Proximity Principle, Quality Principle, Principle of Diverse Response, Stability Principle and Adaptability Principle. Following these five rules does not mean that each individual is quite complicated. The fact is precisely the opposite. The core of swarm intelligence is a group consists of a large amount of simple individuals that can achieve more complex functions through simple cooperation between each other.

APPLICATION OF PSO IN SCHEDULING

A. Task scheduling in grid computing

In paper author propose an algorithm called Particle Swarm Optimization for scheduling tasks in Workflow Applications. In this paper author consider both computation cost and data transmission cost. Here author uses two optimization components

Scheduling heuristic – scheduling heuristics calculates the computational cost of all tasks on the resources.

PSO steps for task-allocation – after calculating the computational cost PSO is computed for all available tasks and these available tasks are assigns to resources according to the solution provided by the PSO. These steps are repeated until all the tasks in the workflow are scheduled. Here, this heuristics algorithm is used to minimize the total cost of execution of tasks. In this paper results of PSO algorithm are compared with the "Best Resource Selection" (BRS) heuristic algorithm. By the results it has been seen that PSO algorithm is at least three times cost saving.

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B. Task Scheduling in Cloud Computing

In paper author represents particle swarm optimization to scheduling tasks in grid computing. In that algorithm each particle shows the possible Solution. This approach has aim to get the schedule in minimum time. Here performance of PSO algorithm is compared with the Genetic algorithm and simulated results show that the PSO algorithm gives best results than GA. To solving the problem of task scheduling by using PSO algorithm, author uses the small position value (SPV) rule in the PSO algorithm which is borrowed from the random key representation. Here this approach is used to generate an optimal schedule so the task completed in a minimum time and utilize the resources in an efficient way.

C. Task Scheduling in Cloud Computing Environment

In paper author propose two new algorithms for scheduling of tasks in cloud computing environments. Task scheduling is the most important thing in the cloud computing because the user has to pay for resource using on the basis of time, which acts to distribute the load evenly among the system resources by maximizing utilization and reducing task execution Time.

D. Automated timetable generator

There are two objectives in that, First provide a detailed introduction to the topic of timetabling, Particle Swarm Optimization their method and their variations. The second objective is to apply them to the Course Timetabling problem. Author considers four main factors in course timetable problem, i.e. teacher, course, timeslot and classroom. These parameters are already set for this problem. In this approach inertia weight factor is used to find the solution on university course timetabling problem and it is conclude that PSO is better technique to solve the problems like timetabling.

E. Timetable Scheduling

In paper author states that PSO has good contribution to solve the discrete problems like timetabling problem. Every particle of this method would be self-changed, so particles can take the best positions for the solution and that increases the chance of particles to find a better solution. The rest of the evolutionary approach is iterating many times until it gets optimal timetable. An experimental result shows that PSO gives better solutions on discrete problems of timetabling and there is fewer clashes happened for timetable scheduling.

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F. Grid scheduling

In paper author adopted a heuristic based particle swarm optimization technique to solve the task scheduling problem in grid environment. By the paper PSO algorithm has better ability of global searching and it applied in many areas. For better performance PSO algorithm is modifying by inertia factor, it produces the optimized results. Inertia parameter is provided with the velocity that controls on the movement of particle and forces to reach the particle at best position of its neighbor. The experimental results show that the modified particle swarm optimization algorithm is able to get the better schedule.

G. Job-shop scheduling

In paper author proposed improved particle swarm optimization to perform research on flexible job-shop scheduling. Here author describes the traditional and flexible job shop scheduling problem. In traditional job shop problem each task or procedure is assigned to single machine and in flexible job-shop scheduling problem each task or procedure is assigned to several machines. Byintroducing the dynamic non-linear factor 'W' in basic PSO algorithm, velocity updating equation is changed. A large number of simulation results shows that this improved PSO algorithm has good feasibility and effectiveness in job-shop scheduling problem than basic PSO algorithm.

H. Dynamic Task Scheduling

In paper author propose a method for solving the Task Assignment Problem called Hybrid Particle Swarm Optimization (HPSO). The proposed algorithm is mainly used for dynamic task scheduling. The objective of the proposed algorithm is to schedule the tasks dynamically in a heterogeneous environment. The simulated experimental results show that the Hybrid PSO is effective other variants of PSO. The PSO results of HPSO are also compared with the Genetic Algorithm which is another popular heuristic technique. The results show that the PSO and its variants perform better than the GA.

J. The Performance Evaluation

Cloudsim3.0.3 is an open source simulator which has been developed by Grid bus project team and the grid Laboratory of the University of Melbourne in Australia. The Cloud simulation can run on Linux and Windows systems. Cloud Sim has been used to implement the proposed MDAPSO task scheduling algorithm. Also, a comparative study has been done to evaluate the performance of the proposed DAPSO, and MDAPSO algorithms with

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respect to the PSOCS algorithm [20], and the original PSO algorithm. This simulation mainly validates the advantage of the make span and the resource utilization among these scheduling algorithms in the Cloud Computing environment.

SCHEDULING PROCESS BASED ON PARTICLE SWARM OPTIMIZATION

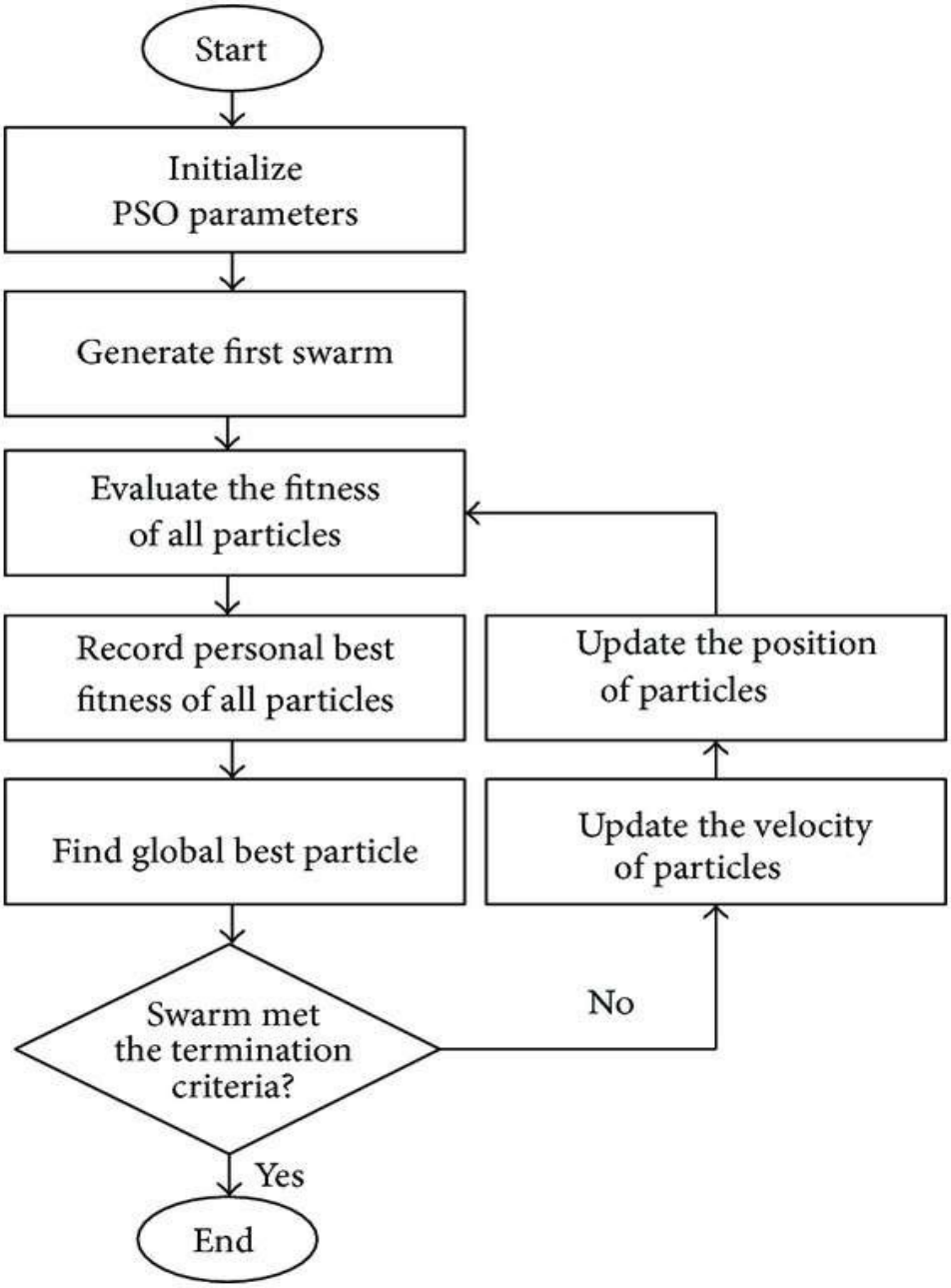


Fig1: Flow process chart of PSO

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CONCLUSION

Particle swarm optimization is a heuristic worldwide optimization technique for unraveling scheduling problems like (Job Shop Scheduling Problem and Flexible Job Shop Scheduling Problem).This review paper shows the different solutions of these problems by implementing PSO using various variants to optimize solutions. Here we have presented the concept of PSO and work carried out on PSO by different researchers.

Particle swarm optimization is a global heuristic optimization algorithm, which is a part of swarm intelligence. It is inspired by natural behavior of bird flocking and fish spooling. Because of many advantages of PSO, including its simplicity and easy implementation, utilization of few parameters this algorithm can be used widely in the many fields. It can be also used to solve the discrete problems and the many real world engineering problems. By comparing with other optimization algorithms, it can be seen that the PSO method is very simple, can be easily completed and it needs few parameters. By comparing the results of PSO with other evolutionary algorithms it can be seen that PSO outperforms over other algorithms. By literature on scheduling used by PSO it is proved that, PSO gives better results than other evolutionary approach in terms of time, efficiency.

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