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Review Article

Review on Different Metaheuristic Techniques for Parallel Computing

Davinderjit Kaur[1], Amit Chabbra[2]

[1,2]Department of Computer Engineering and Technology Guru Nanak Dev University Amritsar, India.

Abstract

This paper represents the parallel computing as a kind of computation in which many computations or the running of processes are carried out simultaneously as well as scheduling and resource allocation to optimize performance criteria in multi-cluster heterogeneous environments is known for NP-hard problems. Multi-cluster environments are commonly represented as a substitution to high-performance computing for solving large-scale optimization problems. The review has shown the various meta heuristic techniques which has proved their usefulness to find the optimal schedules in large-scale distributed environments. It also shows the comparison of Meta heuristic techniques which evaluates the real workload trace as well as shows the advantages and disadvantages with respect to other well-known techniques discussed in the literature.

Keywords: Parallel Computing, Multi-Clusterss, Co-Allocation, Meta-Heuristics

Introduction

Parallel Computing

Parallel computing is a type of computation in which many calculations or the execution of processes are carried out simultaneously. The term parallel computing refers to the simultaneous execution of processes. Large problems are divided into sub-problems and then these sub-tasks are executed simultaneously. Parallel computing is closely associated with concurrent computing they may be used in concert and sometimes conflated, although 2 are distinct: you'll be able to have parallelism with no concurrency (such because bit-level parallelism) and concurrency with no parallelism (such because multitasking by way of time sharing on a single-core CPU). The outcomes of such sub tasks are after that put together about completion. How much parallelism is different from dilemma in order to problem. Figure. 1 indicates your allowance associated with parallel work in order to processor.

Scheduling means to determine the order of job execution, which job will execute on which machine within the specified time period.

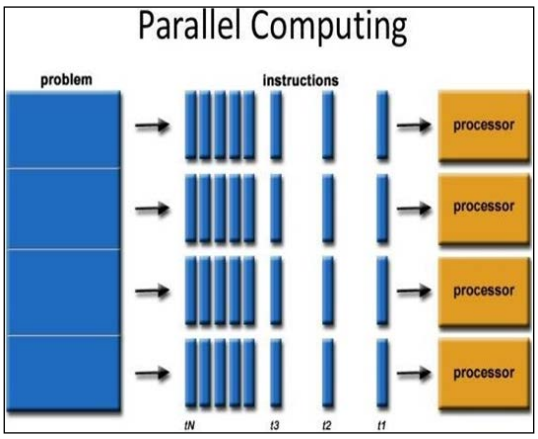

Figure 1.Allocation of parallel tasks to processors

Scheduling

It is one of the crucial step to improve the system performance. If scheduling not done properly, it can lead to degradation of system performance.

Basically, scheduling problem allows scheduling of tasks on resources subjected to certain constraints to optimize given objective function.

Corresponding Author: Davinderjit Kaur, Department of Computer Engineering and Technology Guru Nanak Dev University Amritsar, India.
E-mail Id: Davihundal93@gmail.com
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Phases of scheduling

While scheduling jobs, the scheduler performs the following steps:

- Information gathering of tasks
- Selecting resources
- Planning
- Allocating resources according to planning
- Monitoring

Multi-Clusters

Cluster is a collection of computing machines. Thus, multicluster environment consists of multiple clusters acting collectively, to treat the problems whose requirement is more than available resources. Thus, the parallel tasks are distributed across cluster boundaries.

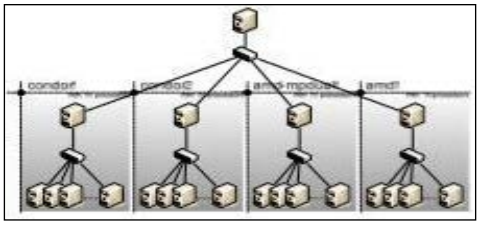

Figure 2.A Multi-Cluster environment

Co-allocation

It is the process of allocating resources from multiple providers. It is usually referred to simultaneous access of multiple resources. It can maximize the job throughput by reducing the queue waiting time. On unavailability of resources in a particular cluster, the scheduler allocate the tasks across different clusters. This kind of allocation strategy is referred to as co-allocation of jobs.

Phases of scheduling in grids

- In order to perform the scheduling process, the Grid scheduler has to follow a series of steps which could be classified into five blocks
- Preparation and information gathering on tasks, jobs or applications submitted to the Grid
- Resource selection
- Computation of the planning of tasks to selected resources
- Task allocation according to the planning (the mapping of tasks to selected resources) Monitoring of task

Meta Heuristics

Some of the scheduling problems in parallel computing belong to the category referred to as NP hard problems. For such kind of problems, it is not possible to find exact solution, so we look for an sub-optimal solution. Meta heuristics help us to solve these problems to achieve sub-optimal solutions. Some of the meta-heuristics are discussed below:

Ant Colony Optimisation

Ant colony optimization is definitely an algorithm based on the behavior of ants searching shortest path between food source and colonies. While walking to food source from colonies, the ants leave pheromones on their way. The amount of pheromone on the way keeps on increasing with the number of ants passing but decreases with pheromone evaporation.

- Usage
- Searching shortest route
- Job-shop scheduling
- Task scheduling in grids etc

Genetic Algorithm

It was introduced in 1975 by Holland. It is based on evolution process in nature. Each chromosome represents solution to problem. The initial population is randomly taken. At each step, the value of the objective function is examined by applying crossover as well as mutation operations. At each step, new offsprings are generated.

BAT algorithm

BAT algorithm seemed to be encouraged from the replicate position behavior of micro bats, along with pulse rates with emission and loudness. Bat algorithm got its start through Xin-She Yang in 2010. Just about every virtual bat travels arbitrarily by using a rate 'v' at situation (solution) 'x' by using a diverse rate or even wave length and loudness. Since it looks and finds its prey, the item alterations rate, loudness and pulse emission rate, research is definitely more intense using a neighborhood random walk. Choice of the finest remains until eventually a number of halt standards usually is met.

Firefly algorithm

This technique is actually a Meta heuristic offered by Xin-She Yang and encouraged with the pulsating behavior with fire flies. The major purpose for a firefly's flash is to work as a transmission method to draw different fireflies. Xin-She Yang created this specific firefly formula through assuming:

- Most fireflies usually are unisexual, to ensure that every firefly might be attracted to all the other fireflies.
- Attraction is actually proportional to their lighting and for any pair of fireflies, much less bright may be fascinated through and shift towards brighter one; nevertheless, this intensity decreases as the mutual range grows.
- In the case there aren't any fireflies lighter than a given firefly, it will move in random direction.

This lighting ought to be connected with objective function.

Cuckoo algorithm

It is a meta-heuristic technique proposed by Xin-she Yang

in 2009. It turned out to be motivated by the obligate generation parasitism associated with a few cuckoo species by simply laying the eggs inside nests associated with another host birds. Many host birds might indulge one on one struggle together with the intruding cuckoos. Such as, if the host bird finds this egg usually are not their own personal, it will eventually throw these unfamiliar eggs apart or perhaps get away from its nest and make a whole new nesting elsewhere.

ABC algorithm

Artificial Bee Colony (ABC) algorithm is usually a swarm cleverness based character inspired algorithm that has been designed by Karaboga regarding multi-modal in addition to multi-dimensional numeric problems. ABC attempts to design all-natural practices regarding actual honey bees with foodstuff foraging. Honey bees use quite a few systems including waggle dancing in order to perfectly identify foodstuff solutions in addition to locate new ones.

Table 1.Comparative Analysis

Name of Author	Title of paper	Technique	Advantages	Disadvantages
Gabaldon (2016)	Blacklist muti-objective genetic algorithm for energy saving in heterogeneous environments	A Genetic algorithm based on weighted blacklist	Supports multi-objective Easily distributed	Slow convergence speed. Works on local optima.
Gabaldon (2015)	Slowdown-Guided Genetic Algorithm for Job Scheduling in Federated Environments	Genetic algorithm	Works on global optima. Uses few parameters	Suffers from pre-mature convergence.
Hector Blanco(2012)	MIP model scheduling for multi-clusters	MIP-based scheduling	Inherent parallelism.	Works on local optima. Sequence of random decisions.
Alejandro Acosta(2010)	Dynamic load balancing on heterogeneous multicore/multiGPU systems	Dynamic load balancing	Automatic sub-division. Potential of coping with multimodality.	Gets struck into many local optima's. Doesn't memorize history of better solutions.
Sid Ahmed Makhlouf (2011)	Resources Co-allocation Strategies in Grid Computing	Co-allocation strategy	Fast convergence at very early stage.	In the case BA changes to exploitation phase too rapidly, that may cause stagnation after some initial stage.
Kuo Chang Huang(2010)	Processor allocation policies for reducing resource fragmentation in multi-cluster grid and cloud environments	Most-fit co-allocation policy	Fast convergence speed. Global optima	Selection of initial cuckoos
Gerald Sebi(2003)	Scheduling of parallel jobs in a heterogeneous multi-site environment	Greedy scheduling strategy	We consider the use of multiple simultaneous reservations at different sites	Doesn't memorize history of better solutions.
Shih Wei(2012)	Hybrid ABC for unrelated machines	Hybrid ABC Greedy scheduling strategy	machine-dependent setup times under due date constraints,	practical ABC algorithms useful in scheduling problems

Literature Survey

Dhananjay Thiruvady et al. (2014) within this study, your bi -objective booking problem with flexible running functions about similar related equipment can be investigated. principally encouraged because of the use in the Just-In-Time (JIT) doctrine about similar related equipment concerning bi-objective system. M.H. Fazel Zarandi et al (2014) within this study, your bi-objective booking problem with flexible running functions about similar related equipment can be investigated. principally encouraged because of the use in the Just-In-Time (JIT) doctrine about similar related equipment concerning bi-objective system, anywhere the work running functions are usually controllable. related internet achieve compression-net achieve expansion" (BPNBC-NBE) heuristic. Furthermore, your plan connected with occupations about every unit, by using power connected with running most occupations, can be determined. Sid Ahmed et.al (2011)[3] proposed that computational grids offered that computational grids have the potential intended for clearing up large scale scientific difficulties employing heterogeneous yellow sand geographically distributed resources. with Service (QoS) intended for lines customers would be the useful co-allocation connected with jobs. Because of the attractive undertake a co-allocation system that will not depend on a use of coherent international information. Pierre Delisle et. al (2004)[4] presents a parallel implementation of an ant colony optimization Met heuristic for the clear answer of a commercial arrangement issue in a metal casting center. this approach, along with Met heuristics in general, presents good quality of option, it still needs substantial computational time and resources. The code is prepared in D and the application form has been accomplished on a Silicon Artwork Source 2000 similar machine. Gerald Sabi (2003)[5] sorted out the actual arranging involving parallel jobs opportunities in the heterogeneous multi-site natural environment, nevertheless processors from distinct web pages possess distinct speeds. Starting up with a basic greedy arranging approach, many of us propose to your girlfriend and also examine quite a few enhancements applying track operated simulations. Kuo-Ching Ying et al.(2011)[6] put up with all the not related parallel machine arrangement challenge with sequence-and also machine-dependent set up periods below deadline limitations, a key subject for a number of manufacturing applications. ABC protocol is definitely analyzed through contrasting it is alternatives along with that regarding state-of-the-art algorithms on the very same standard problem set. Computational effects show that the consist of ABC protocol significantly outperforms pre-existing algorithms for the majority of problem combinations.Marcus Randall et al (2002)[7] Ant Colony Optimization is a fairly new category associated with meta-heuristic seek procedures for marketing problems. Since it is your population-based approach that will inspects several solution selections at most phase in the algorithm, there are a number associated with parallelization opportunities. several similar breaking down techniques tend to be examined. Gerald Sabi (2003)[8] most previous research on job scheduling for heterogeneous systems considers a scenario where each job or task is mapped to a single proce. Eloi Gabaldon (2016).[9] suggested that after the free sources happen to be configured, completely new possibilities occur intended for cutting down power utilization by giving ideal matching of parallel programs to free computing nodes. Eloi Gabaldon et al.(2016)[10] proposed a genetic algorithm for organizing job-packages connected with parallel jobs for source federated environments. With regards to proposition seemed to be to determine the task schedule and also offer allocation to enhance the application operation and also process throughput.

Conclusion

The scheduling of parallel jobs in a heterogeneous multi-site environment, where each site has a homogeneous cluster of processors, but processors at different sites has different speeds. Yet, the time cost of these methods makes them impractical for large-scale environments. In this paper it represents the various Meta heuristic techniques for parallel job scheduling. The review in parallel job scheduling has applied various metaheuristic techniques for scheduling of jobs but it suffers from local optima problem. Moreover convergence speed of genetic algorithm is slow so it takes more time to give final results. In future a hybridized approach of meta-heuristics will be introduced for scheduling of parallel jobs to optimize the make span and flow time of parallel jobs.

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