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Task Scheduling Heuristic in Grid Computing

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Abstract: Task scheduling is heart of any grid application which guides resource allocation in grid. Heuristic task scheduling strategies have been used for optimal task scheduling. Heuristic techniques have been widely used by the researchers to solve resource allocation problem in grid computing. In this paper, we classify heuristic task scheduling strategies in grid on the basis of their characteristics. We identified different types of heuristics such as population based heuristic, economic heuristic, meta heuristic, simple heuristic, and hybrid heuristic.

Keywords: Task Scheduling; Simple Heuristic; Economic Heuristic; Iterative Heuristic.

1. INTRODUCTION

Optimal or near optimal resource allocation for task scheduling is complex undertaking in grid computing. Task scheduling strategies have been widely used by researches to solve resource allocation problem in grid computing. Heuristic task scheduling strategies help to search optimal task scheduling in grid computing. Heuristics do not try to optimize i.e. find the best solution, but rather satisfied i.e. find good-enough solution. [1] proposed that all heuristics rely on effort reduction by one or more of the following: a) examining fewer cues, b) reducing the effort of retrieving cue values, c) simplifying the weighting of cues, d) integrating less information, and e) examining fewer alternatives.

Importance of heuristics task scheduling strategies:-

- Find perfect resource match for task.
- Incorporate intelligence to give optimal solution.
- Reduce uncertainty.
- Provide smart choices.
- Utilize fewer resources.
- Save formulation time.
- Reduce computational time.
- Produce acceptable solution.
- Find solution in reasonable time.
- Gives better judgments.

2. HEURISTIC CLASSIFICATION

It is reported in literature that grid task scheduling is NP complete problem [2]. Various heuristic have been proposed in literature for grid scheduling which we broadly classified into five types. They are i) Economic Heuristic [3, 4, 5, 6], ii) Population Based Heuristic [7, 8, 9] iii) Meta-Heuristic [10, 2, 11, 12, 13, 15-19], iv) Simple Heuristic [20-23] and, v) Hybrid Heuristic [24-28]. Fig. 1 shows the proposed classification of heuristics for task scheduling in grid. Based on approach used to arrive at the solution we categorized heuristic into three types:-

1) Iterative Heuristic: - It designates a computational method that optimizes a problem by iteratively trying to improve a candidate solution. There are two types of iterative heuristics.

- Population Based Heuristic:- It is computational method that optimizes problem by taking population of individuals. This heuristic calculates the fitness of each individual and based on their fitness individual are takes out .The new population is used for next iteration of algorithm. When satisfactory fitness level is reached then algorithm stops [29]. We have identified two of population based heuristic: Genetic algorithm (GA) [7, 9], Memetic algorithm (MA) [8].
- Meta Heuristic: - Meta heuristics make few or no assumptions about the problem being optimized and can search very large spaces of candidate solutions. Meta heuristics are used for combinatorial optimization in which an optimal solution is sought over a discrete search-space [30]. We distinguished four meta-heuristics viz. Simulated Annealing (SA) [13], Tabu Search (TS)

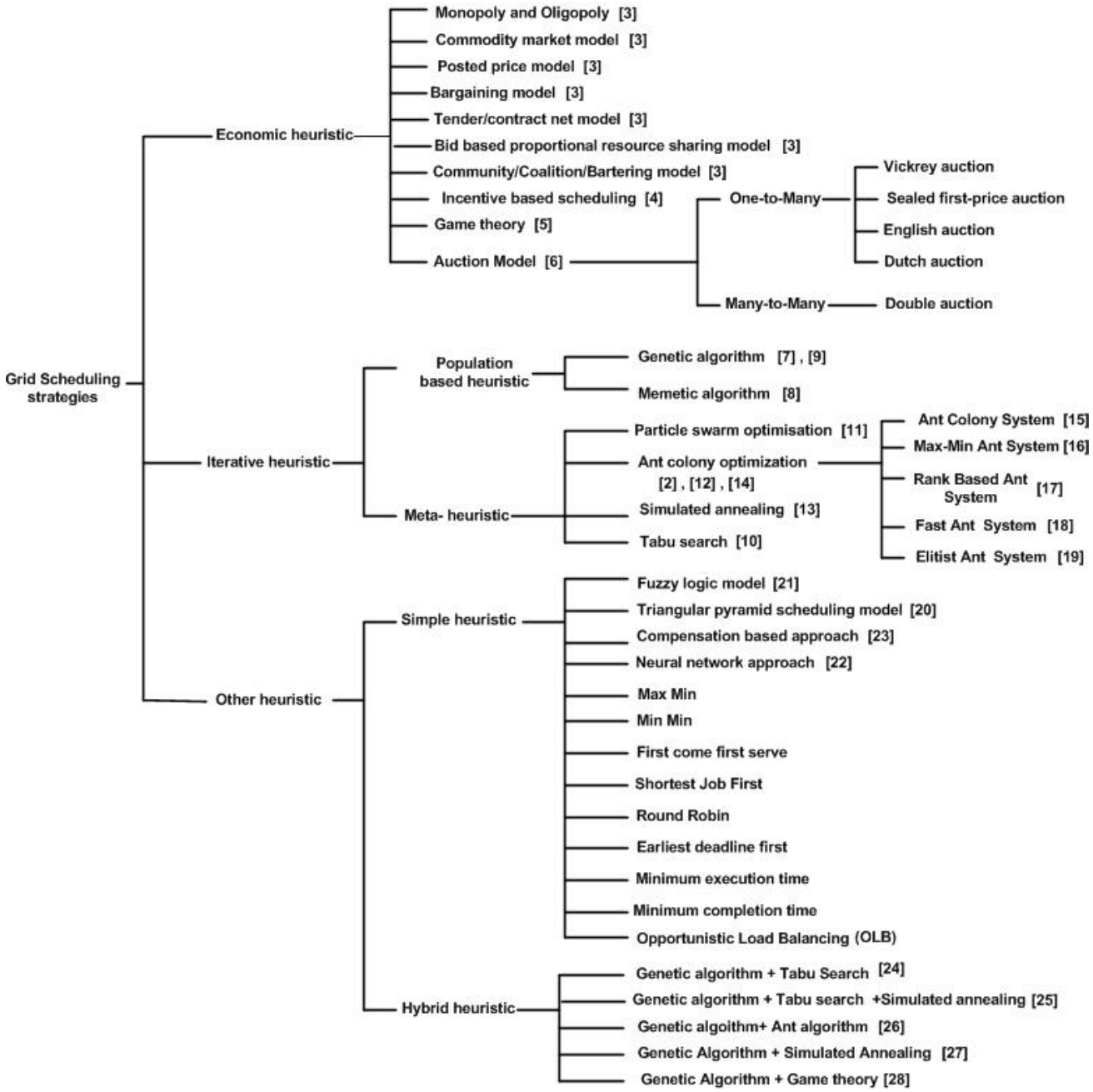

Fig. 1 Classification of Heuristic for Task Scheduling in Grid

[10], Particle Swarm optimization (PSO) [11] and Ant Colony Optimization (ACO) [2, 12].

2) Economic Based Heuristic: - In competitive market, there is always scarcity of resources. Economic heuristic deals with matching tasks to available resources provider and consumer get sufficient incentive to stay and play in competitive market. [3] introduced various economic approaches such as commodity market model, posted price model, bargaining model, tendering/contract-net model, auction model, bid-based, proportional resource sharing model, and community/coalition/bartering model for grid resource allocations while Incentive based Scheduling [4], Game Theory [5] and Auction Model [6] are other models used for task scheduling.

3) Other Heuristic: -

Hybrid heuristic:- Hybrid heuristic optimize the problem by combining two or more heuristic for scheduling tasks in grid. We identified various heuristic such as GA+TS [24], GA+TS+SA [25], GA+Ant Algorithm [26], GA+SA [27], and GA+ Game Theory [28] for task scheduling.

- Simple Heuristic:- Simple heuristic differs from cognitive science and economics. Traditional heuristics have limited knowledge and limited reasons to make scheduling choice. But sometimes task scheduling requires more plausible notion to solve scheduling problem. It provides fast and frugal way for decision making. It provides smart choices Min, Min-min, First Come First Serve (FCFS), Shortest Job First (SJF), Round Robin

(RR), Earliest Deadline First (EDF), Minimum Execution Time (MET), Minimum Completion Time (MCT), and Opportunistic Load Balancing (OLB).

3. COMPARISON OF SIMPLE HEURISTIC

In this section, we compare simple heuristics viz. Max-Min, Min-Min and FCFS.

3.1 Simulation Model

A scheduling algorithm can be classified into clairvoyant or non-clairvoyant, with regard to knowledge about characteristics of tasks. A clairvoyant scheduling algorithm may use information of tasks characteristics such as service demand, whereas a non-clairvoyant algorithm assumes nothing about the characteristics of the tasks [42]. We assume that tasks service demands are known to the scheduler. We developed a simulation application using Matlab 7.11. Each simulation experiment ends when 1000 tasks execution gets completed. To evaluate performance, we have considered following three types of tasks: a) I/O intensive tasks b) Data intensive tasks c) Computational intensive tasks. We consider site which consist nine nodes for computation. We dedicate three nodes to each type of task. First of all, incoming task type is determined and is allocated to appropriate node i.e. I/O task is assigned to I/O specific node, data task is assigned to data specific node and computational resource requirement task is assigned to computation specific node.

3.2 Makespan Result

Makespan result is shown in Fig. 2. From comparison, it is observed that scheduling tasks using Max-Min heuristic gives less makespan as compared Min-Min and FCFS heuristics.

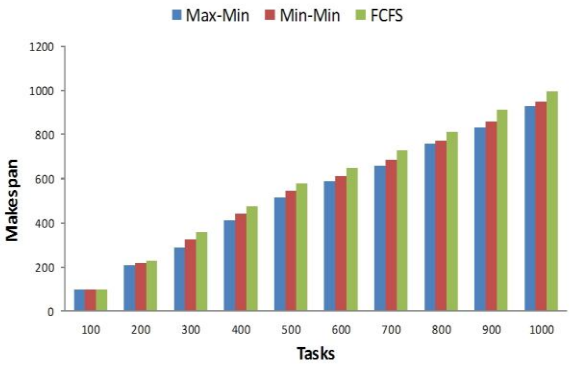

Fig. 2 Makespan Comparison

4. CONCLUSION

In this paper, we presented classification of heuristics for task scheduling. Since simple heuristic has no bounds, we compare various simple heuristics viz. Max- Min, Min-Min and FCFS. The experimental results clearly revealed that Max-Min gives better results for minimizing makepan. The result indicates that Max-Min heuristic for task scheduling is a suitable selection.

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