Observations on Effect of IPC in GA Based Scheduling on Computational Grid

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ABSTRACT

Computational Grid (CG) provides a wide distributed platform for high end compute intensive applications. Inter Process Communication (IPC) affects the performance of a scheduling algorithm drastically. Genetic Algorithms (GA), a search procedure based on the evolutionary computation, is able to solve a class of complex optimization problems. This paper proposes a GA based scheduling model observing the effect of IPC on the performance of scheduling in computational grid. The proposed model studies the effects of Inter Process Communication (IPC), processing rate (μ) and arrival rate (λ). Simulation experiment, to evaluate the performance of the proposed algorithm is conducted and results reveal the effectiveness of the model.

Keywords: *Arrival Rate, Genetic Algorithms, Inter Process Communication, Makespan, Processing Rate, Scheduling*

INTRODUCTION

Computational Grid (CG) primarily processes the compute intensive jobs. It has emerged as global cyber infrastructure for next generation computing. Because next generation scientific researches are being carried out by large collaboration of researchers widely spread across the globe. Research communities are utilizing CG to share, manage and process the large computational tasks. CG is defined as a hardware and software infrastructure that provides dependable, consistent, pervasive and inexpensive access to high end computational capabilities despite the geographical distribution of both resources and the users. CG users may demand the execution of a complex job using an intelligent interface. The grid middleware searches the appropriate resources from the pool of resources of the grid for the efficient execution of the job. Depending on the execution policies and the job requirements, the job will be scheduled on suitable compute resources which execute it and furnish the result back to the user. Thus the grid users visualize the grid as an enormous source of computational power in which any job can be executed efficiently.

Scheduling on computational grid (Buyya et al., 2000; Abawajy, 2005; Foster & Kesselman, 2004) is a fundamental issue for fetching

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high end capacity to achieve better performance. The optimal usage of large number of resources becomes the main objective of such scheduling policies (Aggarwal et al., 2005). Many solutions to the problem of usage of local resources are already almost solved. The scheduling problem of widely distributed grid is still in infancy. We have proposed a grid scheduler in this work and observed the effect of IPC on the performance of scheduling. Two types of scheduler has been visualized; a local scheduler and a global scheduler. Local scheduler takes care of the scheduling inside each node of the grid whereas global scheduler optimizes the overall performance.

Genetic Algorithm (Mitchell, 2005; Goldenberg, 2005) is often used to solve the complex combinatorial optimization problem whose solution involves exploring and identifying the solution from a big search space. GA, derived from the Darwin's principle, works on the basis of natural selection and evolution. GA operators, such as crossover, mutation, etc. are applied over a randomly generated population to produce new population. Population is comprised of a set of chromosomes, which are potential solution to the problem. These chromosomes are evaluated against a fitness function derived on the basis of the optimization objective. GA uses a selection criterion to consider best population for reproduction of the new chromosomes. Solution evolves and reaches to a sub-optimal result.

Outline of the paper is as follows. After the introduction, some related work has been produced. The scheduling problem of the grid has been elaborated. GA based scheduling model is proposed. Experimental evaluation and observation has been done and finally conclusion of the work has been derived.

RELATED WORK

The scheduling problem has been discussed widely in the literature (Berman et al., 2003; Foster & Kesselman, 2004; Garey & Johnson, 1979). GA is also used very frequently for solving scheduling problems as the problem is NP-Class (Tripathi et al., 2000; Vidyarthi et al., 2009). Many other models that uses GA for solving grid scheduling problems are focused in issue minimization of makespan (Abawajy, 2005; Aggarwal et al., 2005; Buyya et al., 2000; Di Martino & Milotti, 2004; Raza & Vidyarthi, 2009b; Xhafa et al., 2007; Xhafa & Abraham, 2008).

Task scheduling for minimization of makespan in computational grid is a fundamental issue for fetching high end capacity to achieve better performance. It has been discussed (Aggarwal et al., 2005; Chang et al., 2009; Chen & Yu, 2008; Chen & Zhang, 2009; Di Martino & Mililotti, 2004; Raza & Vidyarthi, 2009a, 2009b; Xhafa et al., 2007; Xhafa & Abraham, 2008). The optimal usage of large numbers of resources becomes the main objective of such scheduling policies (Abawajy, 2005; Aggarwal et al., 2005; Xhafa, Carretero, & Abraham, 2007; Xhafa & Abraham, 2008).

Inter process communication (IPC) is discussed in literature (Kumar et al., 2003; Parhami, 2002; Quinn, 2005; Silberschatz et al., 2006; Tanenbaum, 2002a, 2002b). Communication contention in task scheduling has been discussed by Sinnen and Sousa (2005). IPC affects the time taken in job execution and thus warrants a proper grid scheduling. We have proposed a grid scheduler and observed the effect of IPC on the performance of scheduling. None of the other work observes the effect of IPC in making a scheduling decision.

THE PROBLEM

The grid is essentially a heterogeneous collection of various resources. The heterogeneity in grid introduces many challenges. These challenges include diversity in terms of local resources, dynamic nature of the local resources, creation and management of services and maintaining the Quality of Service (QoS). Since grid is inherently a parallel and distributed system (Vidyarthi et al., 2009), the key issues regarding the design of the grid e.g., data locality