Review of Scheduling Algorithm Followed in Parallel Environment

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ABSTRACT: The jobs can be simple or complex in nature. The processing of jobs through single processor system consume more time. In order to resolve the problem parallel systems can be resolved. The parallel system involve group of processors that could be same or distinct in nature. The same type of processors within the parallel system is known as array environment and distinct processor within the system is known as federated system. The purpose of this paper is to present the comparison of such system along with performance evaluation of each technique utilized in it.

KEYWORDS: Job, Single Processor, Multiprocessor, Array, Federated, distinct processor.

I. INTRODUCTION

The job presented to the system can be simple or complex in nature. The simple job which is not modular not required to be subdivided and distributed. The job which is complex needed to be divided into modules. These jobs which are complex may have to be processed by the use of multiprocessor environment. Such environment is known as multiprocessor environment. [1]The complexity of job hence specifies the requirement of amount of processor required to yield the output within specified interval of time. The description of parallel system is better understood by the use of Flynn's classification.
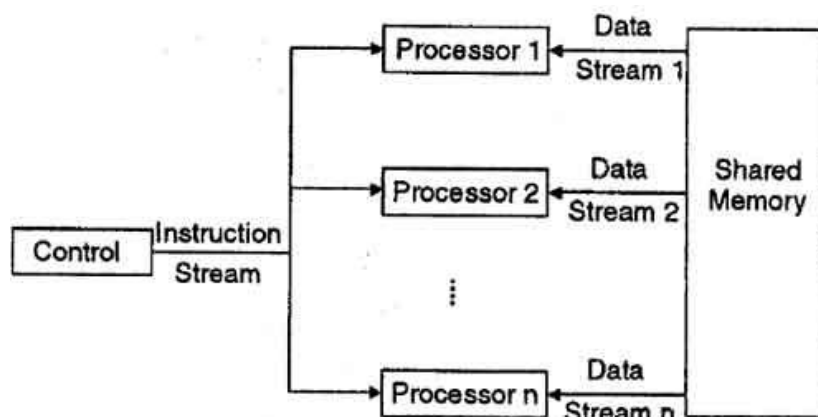

Figure 1: Showing Parallel System

Job allocation in parallel system is complex. Legion of techniques are devised by researcher. Genetic algorithm is one such technique which can be used to optimally allocate job to server within the cluster. Combination of distinct servers is termed as Cluster. Clusters when combine together Grid is formed. Genetic algorithm is search technique used to seek actual or approximate solution to given problem. The optimality of Gas depends greatly on size of population. The smaller problems if utilizes genetic algorithm than performance degrades. Genetic algorithm is considerable useful for larger problems. In case Genetic algorithm is applied higher cost of evaluation is encountered. So a modification to existing GAs has to be made to obtain better results. The problems which can be solved through the use of Genetic

algorithm are generally distributed. The algorithms handling complex problems require GAs design and simulation strategies. [2]

II. JOB SCHEDULING WITHIN PARALLEL SYSTEMS

The critical part of parallel system is mechanism of distributing jobs within the parallel systems. Legions of algorithms utilized for this purpose. The algorithms which take part in the parallel system are described in this section.

A. FIFO JOB SCHEDULING

In this job scheduling algorithm job is distributed to the processor within the system on the first come first serve basis. This algorithm may or may not yield optimal solutions. [3]The allocated processor release the job when the job burst time finishes. This algorithm is strictly non primitive in nature. It is hence rarely utilized in the parallel environment.

B. TIME SHARING

In this scheduling time is shared among multiple jobs. The time sharing system utilizes time quantum. The processor is switched among the processors based on time quantum. The process continues until all the jobs finish execution. The time sharing system involves states such as waiting, active and ready. The time scheduling on parallel system can be implemented using local scheduling. The processing node has processors associated with them. Threads ready to be executed are placed within first come first serve buffer.[4] When the processor is available thread is fetched from the queue and executed. The rime sharing environment generally adopt pipeline concept for executing instructions concurrently within uniprocessor systems.

C. ANT COLONY OPTIMIZATION

This algorithm is considered one of the best algorithms in order to schedule the resources and allocate jobs to the processors. The characteristics of ants are followed in this case. The ants communicate with each other and let the information spread to detect optimal path. The base of parallel ant colony is implemented using parallel construction phase. In parallel ant colony algorithm multiple colonies are built simultaneously. The output of all the colonies is compared with each other. The output generated by colonies is checked for optimality. [4]
The only problem with the ACO is the convergence of ant colony algorithm is slow. The distance covered using this algorithm is less. In order to resolve the problem honey bee algorithm can be utilized.

D. HONEY BEE ALGORITHM

This algorithm utilizes better features of Ant Colonies algorithm along with high distance capabilities. The Honey bee algorithm utilizes optimal path finding along with distance coverage. It utilizes the foraging system associated with honey bees to find the path out of available alternatives. This algorithm converges much faster as compared to existing ant colony algorithm.[5]

E. GANG SCHEDULING

This scheduling produces optimal result as compared to all other parallel scheduling algorithms. This algorithm is primitive in nature. Hence deadlock never occurs within the system. The tasks that form a job are grouped together and then scheduled in this approach. The job priority is also considered in this case. the job with highest priority is executed at first place in this case. in the early system this approach produces optimal results. But nowadays more advanced algorithms exists which produces better result as compared to this algorithm. [6]

F. GENETIC ALGORITHM FOR PARALLEL SCHEDULING

The genetic algorithm has phases associated with it. The algorithm continues until optimal result is obtained. The phases associated with genetic algorithms are initialization, mutation crossover etc. The genetic algorithm goes through the generations and in case of complex problems consumes large amount of time. so for smaller problems genetic algorithm is not preferred. The genetic algorithm terminates when solution reaches satisfactory level. The prescribed tolerance hence plays critical part in terminating genetic algorithm. [7]–[9]

III. RELATED WORK

The work is conducted by researcher in the field of parallel system to devise algorithm for optimal performance. This section studies the work done by different researchers in the field of parallel computing.

Genetic algorithm merged with parallel computing gives optimal performance in terms job scheduling. The energy consumption is minimized as the phases of Genetic algorithm are performed. The studied paper explain deoxyribonucleic acid(DNA) using genetic algorithm. The calculations which are performed on DNA are complex and more time consuming. The genetic algorithm along with its phases is applied over the DNA to enhance performance of existing DNA studied. The convergence rate is also become faster. The optimal result is obtained well within time. [10]

The approach using ant colony and honey bee algorithm can be used in order to enhance job scheduling performance. The ant colony algorithm utilizes to select path which is optimal in nature. The ant colony algorithm however is distance dependent. In order to resolve the problem honey bee algorithm is utilized. Honey bee may not always give optimal path but speed is enhanced considerable. The honey bee algorithm is not distance dependent. Parallel ant colony algorithm is need of the hour in which multiple process can be executed at the same time. [1], [4], [5]

Parallel evolutionary model is also proposed by researchers. This model is formed by combining the features of cellular automata and evolutionary model. In this model each distinct gnome is assigned a unique cell in cellular automata. Reinforcement is utilized in order to alter the contents of the cell to obtain optimal result. This model reduce the time consumption and enhance performance of exiting algorithm with which genetic algorithm. [11]

The performance of system without and with genetic algorithm is analyzed and observed that system with genetic algorithms performance is sufficiently enhanced. Next section describes comparison table of various techniques utilized in parallel system.

IV. COMPARISON OF PARALLEL COMPUTING ALGORITHM

S.NO	TECHNIQUE	PARAMETERS OF SCHEDULING	FACTS DISCOVERED	METHODOLOGY
1	FIRST COME FIRST SERVE[12]	TIME OF SUBMISSION, PROCESSING TIME, FINISH TIME	UTILIZATION OF RESOURCES IS LOW	MATLAB, NS2,CTC SP2
2	BACKFILLING ALGORITHM[13]	JOB BURST TIME	SHORTEST JOB MOVE AHEAD OF OTHER JOBS	SIMULATION IS EVENT BASED
3	CONSERVATIVE BACKFILLING ALGORITHM[14]	ARRIVAL TIME, PROCESSING TIME, FINISH TIME	RESOURCE UTILIZATION IS IMPROVED	SIMULATION IS EVENT BASED
4	GANG SCHEDULING[6], [15]	AVERAGE TIME INTERVALS ARE CONSIDERED	IMPROVED AVERAGE WATING AND TURNAROUND TIME	SIMULATION IS DISCRETE IN NATURE
5	GENETIC ALGORITHM[7], [16]–[18]	CHROMOSOMES	BEST FOR LARGE AND COMPLEX PROBLEMS	MATLAB, PYTHON
6	ANT COLONY[4],	BURST TIME,	BEST FOR	MATLAB

	[19]	NUMBER OF JOBS,DISTANCE	OPTIMAL PATH SEARCH, LOW DISTANCE HANDLING	
7	HONEY BEE[20], [21]	BURST TIME, NUMBER OF JOBS, DISTANCE	BEST FOR HIGH DISTANCES	MATLAB
8	AMBF[22]	FRONT AND BACK END VIRTUAL MACHINES	REQUIRED KEEPING TRACK OF BACKFILLING JOBS	TRACE DRIVEN SIMULATION
9	PAIRED GANG SCHEDULING[23]	BURST TIME, NUMBER OF JOBS	IMPROVE UTILIZATION OF RESOURCES	IMPLEMENTED IN CLUSTER BASED ENVIRONMENT
10	BUDDY ALLOCATION MECHANISM[22]	JOBS ARE PARTITIONED	IMPROVE UTILIZATION OF RESOURCES	CLOUDSIM

Table 1: Showing comparison of various techniques implemented in Parallel System

V. CONCLUSION

The proposed system conducts the review of various algorithm utilized in the parallel system. The objective of work is to discover algorithm which can be utilized in almost every situation. The comparison table is also presented showing performance of each algorithm. The comparison shows that single algorithm is not enough to be utilized in simulative environment hence algorithms have to be merged to obtain best possible solution. Hence in the future for enhanced performance multiple algorithms has to be merged in order to form hybrid algorithm.

REFERENCES

[1]   R. Singh, "Task Scheduling in Parallel Systems using Genetic Algorithm," vol. 108, no. 16, pp. 34–40, 2014.
[2]   A. Munawar and M. Wahib, "A Survey : Genetic Algorithms and the Fast Evolving World of Parallel Computing," pp. 897–902, 2008.
[3]   I. J. I. Systems, M. S. Garshasbi, M. Effatparvar, and A. Branch, "High Performance Scheduling in Parallel Heterogeneous Multiprocessor Systems Using Evolutionary Algorithms," no. October, pp. 89–95, 2013.
[4]   P. Delisle and P. Delisle, "Parallel Ant Colony Optimization : Algorithmic Parallel Ant Optimization : Algorithmic Models Models and Colony Hardware Implementations and Hardware Implementations."
[5]   B. Yuce, M. S. Packianather, E. Mastrocinque, D. T. Pham, A. Lambiase, and T. Parade, "Honey Bees Inspired Optimization Method: The Bees Algorithm," pp. 646–662, 2013.
[6]   F. A. B. Silva, E. P. Lopes, E. P. L. Aude, F. Mendes, T. C. Júlio, H. Serdeira, M. Martins, and W. Cirne, "Response Time Analysis of Gang Scheduling for Real Time Systems."
[7]   E. Gabaldon, J. L. Lerida, F. Guirado, and J. Planes, "Multi-criteria genetic algorithm applied to scheduling in multi-cluster environments," *J. Simul.*, vol. 9, no. 4, pp. 287–295, 2015.
[8]   W. Abdulal, A. Jabas, S. Ramachandram, and O. Al Jadaan, "Task Scheduling in Grid Environment Using Simulated Annealing and Genetic Algorithm," 2012.
[9]   S. G. Ahmad, C. S. Liew, E. U. Munir, T. F. Ang, and S. U. Khan, "A hybrid genetic algorithm for optimization of scheduling workflow applications in heterogeneous computing systems," *J. Parallel Distrib. Comput.*, vol. 87, pp. 80–90, 2016.
[10]   S. Mengyu, Y. A. O. S. Ä, and R. E. N. Yuxin, "TSINGHUA SCIENCE AND TECHNOLOGY Optimization Method for Turbine Airfoil Designing Using Genetic Algorithms , CFD and Parallel Computing 1 Turbomachinery Aerodynamic Design Process Camber-line Generator," vol. 5, no. 4, pp. 419–423, 2000.
[11]   X. Wang, "Parallel Model of Evolutionary Computing Based on Genetic Algorithm," pp. 277–280, 2010.
[12]   V. Hamscher, U. Schwiegelshohn, A. Streit, R. Yahyapour, R. Buyya, and M. Baker, "Evaluation of Job-Scheduling Strategies for Grid Computing," *Grid Comput.*, vol. 1971, pp. 191–202, 2000.
[13]   F. Xhafa and A. Abraham, "Meta-heuristics for grid scheduling problems," ... *Sched. Distrib. Comput.* ..., pp. 1–37, 2008.
[14]   A. Mishra, S. Mishra, and D. S. Kushwaha, "An Improved Backfilling Algorithm : SJF-BF," vol. 05, no. 01, 2011.
[15]   L. R. Dror G. Feitelson, D. G. Feitelson, and L. Rudolph, "Parallel Job Scheduling: Issues and Approaches," *Jsspp*, vol. 949, pp. 1–18,

1995.

[16]   K. Deb, A. Pratap, S. Agarwal, and T. Meyarivan, "A fast and elitist multiobjective genetic algorithm: NSGA-II," *IEEE Trans. Evol. Comput.*, vol. 6, no. 2, pp. 182–197, Apr. 2002.

[17]   R. Nedunchezhian and P.Vivekanandan, "a Fast Genetic Algorithm for Mining Classification Rules in," *Soft Comput.*, vol. 1, no. 1, pp. 10–20, 2010.

[18]   J. Carretero, F. Xhafa, and A. Abraham, "Genetic Algorithm Based Schedulers for Grid Computing Systems," *Int. J. Innov. Comput. Inf. Control*, vol. 3, no. 6, pp. 1–19, 2007.

[19]   D. Maruthanayagam and R. UmaRani, "Enhanced Ant Colony Algorithm for Grid Scheduling," *Int. J. Comput. Technol. Appl.*, vol. 1, no. 1, pp. 43–53, 2010.

[20]   M. Wang and W. Zeng, "A comparison of four popular heuristics for task scheduling problem in computational grid," *2010 6th Int. Conf. Wirel. Commun. Netw. Mob. Comput. WiCOM 2010*, pp. 3–6, 2010.

[21]   S. Sharma, A. Chhabra, and S. Sharma, "Comparative Analysis of Scheduling Algorithms for Grid Computing," pp. 349–354, 2015.

[22]   A. Kousalya and R. Radhakrishnan, "A Comparative Study of Parallel Job Scheduling Algorithms in Cloud Computing," vol. 6, no. 3, pp. 2687–2690, 2015.

[23]   H. D. Karatza, "SCHEDULING GANGS IN A DISTRIBUTED SYSTEM," vol. 7, no. 1, pp. 15–22, 2000.