Volume: 05, Issue: 04, Pages:1968-1973 (2014) ISSN : 0975-0290

CPU Scheduling Algorithms: A Survey

Imran Qureshi
Department of Computer Science, COMSATS Institute of Information Technology, Wah Cant Pakistan.
Email: imarwat11@gmail.com

ABSTRACT

Scheduling is the fundamental function of operating system. For scheduling, resources of system shared among processes which are going to be executed. CPU scheduling is a technique by which processes are allocating to the CPU for a specific time quantum. In this paper the review of different scheduling algorithms are perform with different parameters, such as running time, burst time and waiting times etc. The reviews algorithms are first come first serve, Shortest Job First, Round Robin, and Priority scheduling algorithm.

Keywords – **Burst Time, CPU Scheduling, Operating System, Round Robin, Scheduling Algorithms.**

Date of Submission: January 23, 2014 Date of Acceptance: March 05,2014

INTRODUCTION

Operating system support wireless communication. As we know that wireless communication occurs in number of applications and traditionally in wireless network portable devices such as laptop's and cell phones are connected to a single access point where each device deal rigid pond of data speed [1, 2]. But current and future mobile devices are able to provide high bandwidth to users and we know that information is playing vital role in today world so that distributed virtual disk storage system (DVDSS) is fully reliable system for storage of information [3, 4]. Operating system also support and manages parallel and distributed computing and these two technologies plays an important role in today scheduling [5]. Wireless network is more flexible than wired network and wireless mesh network is a wireless network model which attracts current industry [6, 7]. We know that computer is dependent on both hardware and software and lot of advancements have done in this field [8]. CPU scheduling means process assigned to CPU for a particular time of interval. We know that scheduling avoids starvation of each job within CPU also assigning of processes to CPU done by scheduler as in [9, 10] and [11].

Advanced operating systems have the multitasking environments capabilities which also depend upon the scheduling algorithms, so core component of computer is CPU and Round Robin is the one of the effective algorithm among other scheduling algorithms and broadly applied in scheduling of CPU. In multitasking and multiprocessing the strategy by which the jobs or processes are assigning to the CPU is known as scheduling. Its main objective is to utilize the maximum, throughput and also minimize the waiting time, response time as in [12].Scheduling also used in real time application such as routing of data in networking and in the all type traffic control system like airways, roadways, railways. Scheduling is the strategy by which jobs or processes are given access to the system resources. By that the system load are manage efficiently or quality of service are achieve as in [13].

There are many types of algorithms for scheduling the CPU jobs. Each of these algorithms have different in efficiency and depend upon the environment. Following are some measurement for good scheduling algorithms.

Maximize the CPU utilization.

- Maximize the efficiency.
- Maximize the response time.
- Maximize the throughput.

There are two basic types of scheduling algorithms, pre-emptive and the non-preemptive algorithms.

Some properties of non-preemptive scheduling algorithms are mentioned below. Short process are wait for the longer process but the overall process handling is fair. The scheduling discipline is preemptive if a process has given to the CPU can take away when high priority jobs arrive. In pre-emptive algorithm when the high priority process come it automatically takes the CPU, and non-preemptive algorithms works on FCFS (first come first serve) rule even though eminent priority job comes in execution time as in [14]. Scheduling is the core function of operation system and operation of scheduling is to deal system resources among multiple processes. The main resource of computer is the CPU. So that programming of CPU is primal operation of design phase and have significant role in field of computer sciences as in [15]. To improve the speed and utilization of the CPU for that purpose several processes are kept in memory at a time means we use Schering concept as in [16]. According to [17, 18, 19] the CPU scheduling play an important role when they switching among more than one processes. In order to maximize the CPU utilization the operating system allows several processes to run all times. Scheduling is the core function of any operating system, since all the resources of computer is schedule before use as in [20]. In [21] the architecture of grid for scheduling are discussed which generate a list of resources and then select a suitable set. Scheduling algorithm is the important part of operating system invention. Scheduler decides among processes which process is first to executed by the CPU.

Resource Sharing: The web server and FTP server are the applications that partition the resources such as CPU, the bandwidth of the network and space between the connections can benefit the overall resource allocation. The second is the physical resource partitioning such as practical machine as in [22, 23]. According to [24] scheduler assigned by the operating system to CPU, disk and port of network. Unique features of the auxiliary scheduler are to get the hierarchical partitioning in multiprocessor environment as in [25, 26] and [27, 28]. The adaptive scheduling policies for multimedia and workload are discussed in [29], which present flexible scheduling. The system engineering

Volume: 05, Issue: 04, Pages:1968-1973 (2014) ISSN : 0975-0290

approach to CPU scheduling for mobile multimedia system are discussed in [30]. According to [31] the virtual CPU scheduling in the quest operation system are describes which have the three main goals predictability, safety and the software execution. There are many factors that affect the efficiency of disk I/O schedulers like workloads file system and its execution enhanced near changing scheduler parameters as in [32]. According to [33] apriority based algorithm are proposed which calculates the time quantum of individual jobs and changed after each process. This algorithm adopted the dynamic quantum idea. According to [34, 35] have study the use of load-balancing model to overcome diligence performance time in different types of system environment and this will assumed that the resource performance will never occurred with slowly.

2. SCHEDULER

First is the long term Scheduler determines which processes will go first to the ready queue that type of decision will take by the long term scheduler. In this decision the dispatcher authorized or delayed the processes. Second is the mid-term in this type of Scheduler some processes or jobs are removed from the RAM and placed them on the secondary memory, such as hard disk. In operating system these terms are known as swapping out and swapping in of the process. And third is the short term in this type of scheduler decides which process will be in ready queue, in memory to be executed. This type of scheduler is much frequent making decision then the long-term and the mid-term scheduler. This scheduler can be pre-emptive and non-preemptive as.

3. SCHEDULING ALGORITHMS

The core algorithms for scheduling and their characteristics are describes in this section.

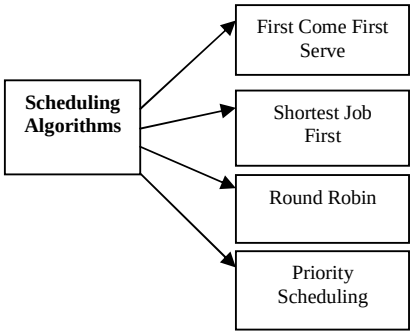

Figure1. Different Scheduling Algorithms

3.1 First Come First Serve

The merest techniques that permit the first job arrive to execute first. This access is called first-come, first serve (FCFS) scheduling algorithm. In this approach the late coming processes are waiting in a queue form, the processes are inserted into the tail of the queue and when they are submitted as in [36]. The processes are taken from the head of the queue when a process finishes its running. The efficiency of the first-come first-serve is discussed in [37].This Scheduling technique has poor performance, longer waiting time and low throughout as discussed in [38]. A comprehensive study of Cup scheduling are perform in [39], it also discuss the importance of Cup scheduling algorithms.

3.2 Shortest Job First

In this approach low execution time jobs are assigned to CPU. In this technique the scheduler kept the jobs in a queue such that the head of queue has the shortest jobs and the tail has the longest jobs. In SJF the average waiting time is minimized because it process the little jobs before it take the prominent ones as in [40]. In this algorithm the jobs with prominent execution time will never be executed. According [41] to the scheduling technique is describes which is based on this technique. In [42] a task is divided into two mandatory and optimal portions, the optimal part is schedule using shortest job first.

3.3 Round Robin

The round Robin scheduling algorithm assigns the time slice or quantum for each process. The ready process are kept in queue and new jobs are infixed into the tail of the queue as in [43, 44].In this algorithm the CPU efficiency will low when set the time slice too short, and too long time will cause poor response time. As in [45, 46] and [47, 48] Round Robin is the old, simple algorithm and especially designs for the time sharing system. It is the effective and good responsive but the waiting time and turnaround time are wicked because of the determined time amount nature. The scheduler gives a determined time slice to each job and repeats them in cycle. It is just like to the FCFS but pre-emption is performing to switch them among the processes as in [49, 50]. In Round Robin scheduling the equality is given to each process, process gets equal time of the CPU because of time quantum, so it is better than other scheduling algorithms and it gives low turnaround time, waiting time. In [51] the new dynamic quantum scheduling algorithm is proposed. In [52, 53, 54] a new round robin algorithm are presented which decrease context switching and provides better waiting time, turnaround time then RR scheduling algorithm.

3.4 Priority Scheduling

The operation system assigns fixed priority to each process. The low priority is interrupted when the high priority processes are arrived. The high priority processes have a smaller waiting time and the starvation can happen to the low priority processes as in [55]. The priority queuing scheduling algorithm can provides. According to [56] the improved priority scheduling algorithm are presented it also discussed in static and dynamic scheduling algorithm the lower priority process are postponed. It also describes the longest pre-empted process in ready queue and on it micro scheduling model in ready queue is built up. In [57, 58] a priority scheduling algorithm are describes, the process are schedule based on their antecedence rate and allocate to processor equating with the subsisting programming algorithm based on its duration and resource employment.

Volume: 05, Issue: 04, Pages:1968-1973 (2014) ISSN : 0975-0290

References	Algorithm	Dataset	Performance
[10]	conservatives scheduling policy	5 scheduling approaches, one step scheduling, predicted mean interval scheduling. .conservative scheduling, history mean scheduling, .history conservative scheduling.	This scheduling policy able to achieve efficient execution of data-parallel applications even in heterogeneous and dynamic environments.
[11]	scheduling algorithm based on time dynamic quantum	Four processes in four different cases with random burst.	Improve the efficiency of round robin by changing the idea of fixed time quantum to dynamic calculated automatically without the interference of user.
[12]	shortest remaining burst round robin scheduling algorithm	5 processes with burst time in increasing, decreasing and random order respectively	Performing better than the static algorithm in terms of average waiting time, average turnaround time and number of context switches.
[13]	finding time quantum of round robin cup scheduling	5processess with burst time & arrival time	performance of time quantum of round robin cup scheduling policy is higher than that of round robin
[14]	an improved round robin scheduling algorithm for cup scheduling	four processes with arrival time and burst time	This algorithm is superior to present round robin algorithm but not working for time sharing system.
[15]	A cup scheduling algorithm simulator.	-	this uses graphical animation concepts of various scheduling algorithms for a single cup ,configured easily by the user, allows the user to test and increase his understanding and concepts
[16]	Disk scheduling revisited technique.	-	First, substantial performance improvement greater utilization of disk bandwidth is achievable by viewing most of main memory as a large write buffer.
[28]	Self-learning disk scheduling schemes.	Five workload system file systems, disk systems, and user preferences.	It outperforms disk schedulers by as much as 15.8 precent while consuming less than 3 percent-5 precent of cup time.
[55]	Shortest Remaining Burst Round Robin algorithm	Five processes	performing better than the static RR algorithm in terms of average waiting time, average turnaround

Volume: 05, Issue: 04, Pages:1968-1973 (2014) ISSN : 0975-0290

			time and number of context switches

Table no. 1 performance result of different algorithms

The above table is about the performance result of different algorithms which are discussed in this respective paper and about some other algorithms relevant to the discussed scheduling algorithms in terms of data set and performance.

4. CONCLUSION

Different scheduling algorithms are reviews in this paper are according to their CPU overhead, throughput, turnaround time and response time. The FCFS have low throughput, low turnaround time, high turnaround time and low response time. SJF have the Medium CPU overhead, high throughput, medium turnaround and medium response time. RR has the high CPU overhead, medium throughput, medium turnaround time and high response time. Priority Scheduling have the medium CPU overhead, low throughput, high turnaround time and high response time.

REFERENCES

[1]. Khan, Bilal Ahmad, Muhammad Sharif, Mudassar Raza, Tariq Umer, Khalid Hussain, and Aman Ullah Khan. An Approach for Surveillance Using Wireless Sensor Networks (WSN). *Journal of Information & Communication Technology Vol. 1*, No. 2, (Fall 2007) 35-42.

[2]. Ahsen, Faraz, Khalid Hussain, Nyla Khadam, Muhammad Sharif, and Noor Zaman. Identification of a Lossy Channel in Wireless Mesh Network using Conservation of flow. *Journal of Information & Communication Technology Vol. 1*, No. 2, (Fall 2007) 60-70.

[3]. Haider, Waqas, Muhammad Sharif, Mudassar Raza, Abdul Wahab, Jamal Hussain, Izhar Ahmed Khan, and Umar Zia. The Realization of Personalized E-Learning platform based on 3G Mobile phone and NGN control frame work for SIP based IP Networks. *Research Journal of Recent Sciences Research Journal of Recent Sciences ISSN 2277-2502.Vol.* ***2*****(2),** 85-89, February (2013).

[4]. Sharif, Muhammad, Nasir Mehmod Butt, Mudassar Raza, and Muhammad Arshad. Distributed Virtual Disk Storage System. *Control Theory and Informatics* 2, no. 1 (2012): 17-23.

[5]. Sharif, Muhammad, and Aman Ullah Khan. Benchmarking of PVM and LAM/MPI Using OSCAR, Rocks and Knoppix Clustering Tools. *World Academy of Science, Engineering and Technology International Journal of Computer, Information Science and Engineering Vol:1* No:3, 2007.

[6]. Muhammad Sharif, Aisha Azeem, Mudassar Raza Waqas Haider. A Novel Wormhole Detection Technique for Wireless Ad Hoc Networks. *Int. J. Advanced Networking and Applications Volume: 03*, Issue: 05, Pages: 1298-1301 (2012).

[7]. Sharif, Muhammad, Maryum Murtaza, Waqas Haider, and Mudassar Raza. Priority Based Congestion Control Routing in Wireless Mesh Network. *Int. J. Advanced Networking and Applications 1147 Volume: 03*; Issue: 03; Pages:1147-1151 (2011).

[8]. Irum, Isma, Mudassar Raza, Muhammad Sharif, Ming Zhang, Huyuan Zhang, Suli Cui, Lingyan Jia et al. File Systems for Various Operating Systems: A Review. *Research Journal of Applied Sciences 4*(17): 2934-2947 (2012).

[9]. Silberchatz, Abraham, Peter Galvin, and Greg Gagne. *Operating Systems Concepts With Java.* (2004).

[10]. Lingyun Yang Jennifer M. Schopf Ian Foster. Conservative Scheduling: Using Predicted Variance to Improve Schedulin Decisions in Dynamic Environments. *Proceedings of the ACM/IEEE SC2003 Conference* (SC) 1-58113-695-1/03 $ 17.00 © 2003 ACM.

[11]. Abbas Noon, Ali Kalakech and Seifedine Kadry.A New Round Robin Based Scheduling Algorithm for Operating Systems: Dynamic Quantum Using the Mean Average. Vol. 8, Issue 3, No. 1, May 2011.

[12]. Rakesh Mohanty, H. S. Behera, Khusbu Patwari, Monisha Dash, Design and Performance Evaluation of a New Proposed Shortest Remaining Burst Round Robin (SRBRR) Scheduling Algorithm, *In Proceedings of International Symposium on Computer Engineering & Technology (ISCET),* Vol 17, 2010.

[13]. Samih M. Mostafa, S. Z. Rida, Safwat H. Hamad, Finding Time Quantum Of Round Robin Cpu Scheduling Algorithm In General Computing Systems Using Integer Programming, *International Journal of Research and Reviews in Applied Sciences IJRRAS), Vol 5*, Issue 1, 2010.

[14]. Rakesh Kumar Yadav, Abhishek K Mishra, Navin Prakash and Himanshu Sharma. An Improved Round Robin Scheduling Algorithm for CPU scheduling. Vol. 02, No. 04, 2010, 1064-1066.

[15]. Sukanya Suranauwarat. A CPU Scheduling Algorithm Simulator.1-4244-1084-3/07/$25.00 ©2007 IEEE October 10 – 13, Milwaukee, WI *37th ASEE/IEEE Frontiers in Education Conference.*

[16]. Seltzer, Margo, Peter Chen, and John Ousterhout. Disk scheduling revisited. *In Proceedings of the Winter 1990 USENIX Technical Conference*, pp. 313-323. 1990.

[17]. Silberchatz, Galvin and Gagne, 2003 .*Operating Systems Concepts*, (6th edn), (John Wiley and Sons).

Volume: 05, Issue: 04, Pages:1968-1973 (2014) ISSN : 0975-0290

[18]. Abraham Silberschatz, Peter Baer Galvin, Greg Gangne; *Operating System Concepts*, (edition-6), (2002, John Wiley and Sons, INC).

[19]. Singh Rawat,Dr. Lakshmi Rajamani. Experiments with CPU Scheduling Algorithm on a Computational Grid.*IEEE International Advance Computing Conference (IACC)* Patiala, India, 6-7 March 2009.

[20]. Sindhu M Rajkamal R Vigneshwaran P .An Optimum Multilevel CPU Scheduling Algorithm.*2010 International Conference on Advances in Computer Engineering.*

[21]. Jennifer M. Schopf. *A General Architecture for Scheduling on the Grid.* (Argonne National Laboratory preprint), ANL/MCS-P1000-1002.

[22]. P. Barham, B. Dragovic, K. Fraser, S. Hand, T. Harris, A. Ho, R. Neugebauer, I. Pratt, and A. Warfield, Xen and the Art of Virtualization, *Proc. 19th ACM Symp. Operating Systems Principles (SOSP)*, Oct. 2003.

[23]. C.A. Waldspurger, Memory Resource Management in VMware ESX Server, *Proc. Fifth Usenix Symp. Operating System Design and Implementation (OSDI)*, Dec. 2002.

[24]. K. Duda and D. Cheriton, Borrowed Virtual Time (BVT) Scheduling: Supporting Latency-Sensitive Threads in a General- Purpose Scheduler, *Proc. 17th ACM Symp. Operating Systems Principles (SOSP*), pp. 261-276, Dec. 1999.

[25]. S.J. Golestani, A Self-Clocked Fair Queueing Scheme for High- Speed Applications, *Proc. IEEE INFOCOM*, pp. 636-646, Apr. 1994.

[26]. J. Nieh and M.S. Lam, The Design, Implementation and Evaluation of SMART: A Scheduler for Multimedia Applications, *Proc. 16th ACM Symp. Operating Systems Principles (SOS),* pp. 184-197, Dec. 1997.

[27]. Rau, Melissa A., and Evgenia Smirni. Adaptive CPU scheduling policies for mixed multimedia and best-effort workloads. *In Modeling, Analysis and Simulation of Computer and Telecommunication Systems. Proceedings. 7th International Symposium on, IEEE, 1999*, pp. 252-261.

[28]. Al-Muhsen, Abbas A., and Radu F. Babiceanu. Systems engineering approach to CPU scheduling for mobile multimedia systems. *In Systems Conference (SysCon),IEEE International, . IEEE, 2011*. pp. 239-243.

[29]. Matthew Danish, Ye Li and Richard West .Virtual-CPU Scheduling in the Quest Operating System. *2011 17th IEEE Real-Time and Embedded Technology and Applications Symposium.*

[30]. Gallager, R.G. Conflict Resolution in Random Access Broadcast Networks, *in Proc. of AFOSR Workshop on Comm. Theory and Appl*., Sept. 1978, pp. 74-76.

[31]. Yu Zhang,Bharat Bhargava. Self-Learning Disk Scheduling. *ieee transactions on knowledge and data engineering*, vol 21, no. 1, January 2009.

[32]. Rakesh Mohanty, H. S. Beheram Khusbu Patwarim Monisha Dash, M. Lakshmi Prasanna , Priority Based Dynamic Round Robin (PBDRR) Algorithm with Intelligent Time Slice for Soft Real Time Systems, *(IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 2*, No.2, February 2011.

[33]. Berman, F., Wolski, R., Figueira, S., Schopf, J. and Shao, G. *Application-Level Scheduling on Distributed Heterogeneous Networks*. (Supercomputing, 1996).

[34]. Dail, H.J. *A Modular Framework for Adaptive Scheduling in Grid Application Development Environments.* Computer Science, University of California, California, San Diego, 2001.

[35]. K. Govil, D. Teodosiu, Y. Huang, and M. Rosenblum, Cellular Disco: Resource Management Using Virtual Clusters on Shared- Memory Multiprocessors, *ACM Trans. Computer Systems, vol. 18,* no. 3, pp. 229-262.

[36]. Saleem, U., and Muhammad Younus Javed. Simulation of CPU scheduling algorithms. *In TENCON. Proceedings*, vol. 2, pp. 562-567. IEEE, 2000.

[37]. Beck, L. L., *System Software*, (Addison Wesley1990), (2"d Edition), 1990, pp. 322-324.

[38]. Jyotirmay Patel, A.K.Solanki. CPU Scheduling: A Comparative Study. *.Proceedings of the 5th National Conference, INDIACom, Computing For Nation Development*, March 10-11, 2011 Bharti Vidyapeeth's Institute of Computer Applications and Management, New Delhi.

[39]. Milenkovic, M., *Operating System Concepts and Design*, (McGraw Hill, International Edition, 1992), pp.65-76.

[40]. Lupetti, Simone, and Dmitrii Zagorodnov. Data popularity and shortest-job-first scheduling of network transfers.*In Digital Telecommunications. ICDT. International Conference on*, pp. 26-26. IEEE, 2006.

[41]. Radhakrishna Naik,RR.Manthalkar, Mukta Dhopeshwarkar. modified iuf scheduling algorithm for real time system. *2010 3rd International Conference on Emerging Trends in Engineering and Technology*, Goa, India November 19-November 21 ISBN: 978-0-7695-4246-1.

Volume: 05, Issue: 04, Pages:1968-1973 (2014) ISSN : 0975-0290

[42]. Silberschatz, A., Peterson, J. L., and Galvin, P.B., *Operating System Concepts*, (Addison Wesley 1991), (3" Edition), pp. 108-118.

[43]. Sun Huajin', Gao Deyuan, Zhang Shengbing, Wang Danghui. Design Fast Round Robin Scheduler in FPGA, 0-7803-7547-5/021/$17.00 *@ 2002 IEEE*.

[44]. Rami J. Matarneh, Self-Adjustment Time Quantum in Round Robin Algorithm Depending on Burst Time of the Now Running Processes, *American Journal of Applied Sciences, Vol 6*, No. 10, 2009.

[45]. Q., GUO and Y., Liu, the effect of scheduling discipline on cpu-mem load sharing sys-tem, *4th International Conference on Wireless Communications, Networking and Mobile Computing*. WiCOM. 2008.

[46]. A., Bashir, M.N. Doja and R., Biswas, Improving the Performance of Round Robin Scheduling Using Fuzzy Logic, *In proceedings of the International Conference on Advanced Computing and Communication Technologies for High Performance Applications sponsored by IEEE & CSI*(Cochin, India, September 24-26, 2008).

[47]. A., Bashir, M.N. Doja and R., Biswas, Conceptual Improvement of Priority Based CPU Scheduling Algorithm Using Fuzzy Logic, *International Journal of Fuzzy Systems and Rough Systems (IJFSRS) (Vol. 1*, No. 1, Ja-nu.-June 2008.

[48]. A., Bashir, M.N. Doja and R., Biswas, Finding Time Quantum of Round Robin CPU Scheduling Algorithm Using Fuzzy Logic, *The International Conference on Computer and Electrical Engineering, ICCEE* 2008.

[49]. Rakesh Mohanty, H. S. Behera, Debashree Nayak, A New Proposed Dynamic Quantum with Re-Adjusted Round Robin Scheduling Algorithm and Its Performance Analysis, *Int rnational Journal of Computer Applications (0975 – 8887), Volume 5*– No.5, August 2010.

[50]. Tarek Helmy,Abdelkader Dekdouk, Burst Round Robin as a Proportional-Share Scheduling Algorithm, *In Proceedings of The fourth IEEE-GCC Conference on Towards Techno- Industrial Innovatons*, pp. 424-428, Bahrain, 2007.

[51]. H.S.Behera,R.Mohanty,Debashree Nayak. A New Proposed Dynamic Quantum with Re-Adjusted Round Robin Scheduling Algorithm and Its Performance Analysis. *International Journal of Computer Applications (0975 – 8887) Volume 5*– No.5, August 2010.

[52]. Sunita Mohan. Mixed Scheduling (A New Scheduling Policy). *Proceedings of Insight*,25-26 November 2009.

[53]. Helmy, T. and A. Dekdouk, 2007. Burst Round Robin as a Proportional-share Scheduling Algorithm, *IEEEGCC*, http://eprints Kfupm.edu. sa/1462/.

[54]. Md. Mamunur Rashid and Md. Nasim Adhtar; A New Multilevel CPU Scheduling Algorithm, *Journals of Applied Sciences 6* (9): 2036- 2039, 2009.

[55]. Prof. Rakesh Mohanty, Prof. H. S. Behera. Design and Performance Evaluation of a New Proposed Shortest Remaining Burst Round Robin (SRBRR) Scheduling Algorithm.

[56]. Xiaoying Wang; Hai Zhao; Wenbo Zhang; Zhenyu Yin, Preemptive Behavior Analysis and Improvement of Priority Scheduling Algorithms, *Parallel and Distributed Processing Symposium, 2005. Proceedings. 19th IEEE International* , vol., no., pp.130a,130a, 04-08 April, doi: 10.1109/IPDPS.2005.358.

[57]. Weifeng Sun; Yudan Zhu; Zhiyuan Su; Dong Jiao; Mingchu Li, A Priority-Based Task Scheduling Algorithm in Grid, Parallel Architectures, Algorithms and Programming (PAAP), *2010 Third International Symposium on* , vol., no., pp.311,315,18-20 , doi: 10.1109/PAAP.2010.24.

[58]. Tianchi Ma and Rajkumar Buyya, Critical-Path and Priority based Algorithms for Scheduling Workflows with Parameter Sweep Tasks on Global Grids. *Proceedings of the 17th International Symposium on Computer Architecture and High Performance Computing IEEE* (SBAC-PAD) 1550-6533/05 $20.00 © 2005.

Authors Biography

Imran Qureshi is a student of MS (Computer Science) at COMSATS Institute of Information Technology, Wah Campus, Pakistan. He has completed his Bachelor degree from Islamia College, University of Peshawar in 2011. His areas of interest are Image Processing, Biomedical Image Analysis, Pattern Recognition and Operating System.