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Comparision of different Round Robin Scheduling Algorithm using Dynamic Time Quantum

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Abstract—Performance of computer system is heavily depends on the scheduling of the processes. The concept of scheduling helps in selection of the process for execution. There are many scheduling techniques available like First-Come-First-Serve (FCFS), Shortest Job First (SJF), Priority, Round Robin (RR) etc. Output of these scheduling technique is depends on mainly three parameter, one is average waiting time, average turnaround time and number of context switch. It also depends on the context switching of the processes. In this paper, we focus on the RR scheduling techniques. There are two types of RR scheduling technique, one is RR with static quantum and other is RR with dynamic quantum. In this paper we compare the result of different RR algorithm techniques those having dynamic quantum and we show that even-odd RR scheduling is the best scheduling technique compare to simple RR, average-max RR and average mid-max RR.

Keywords**-** Scheduling, Waiting Time, Turnaround Time, Dynamic Quantum, Context Switch.

I. INTRODUCTION

Operating system is a collection of program and utilities. It is a program that controls execution of application programmed and act as an interface between the user of a computer and computer hardware [9]. Operating system control and coordinate use of hardware among various users and hardware. It is resource allocators which manage resources. Operating system provides different types of services such as a program execution, I/O operation, file system manipulation, communication and error detection [7]. In operating system there are many processes executed at the same time so we need to schedule the processes. This scheduling is called Central Processing Unit (CPU) scheduling. CPU scheduling is heart of any computer system since it contains decision of giving resources between possible processes [1]. CPU scheduling decision may take place when process switches from running to waiting state, running to ready state, waiting to ready state and process terminates. Process is a smallest work unit of a program which requires a set of resources for its execution that are allocated to it by the CPU. When multiple process available in the ready state at that time it is necessary to decide which process is execute next, it is done by the "scheduler". The CPU scheduling can be defined as the art of determining which processes run on the CPU when there are multiple processes are available. When processes enter the system they are put into a job pool. This job pool refers to the job queue [5]. The processes that are residing in main memory and are ready and waiting to execute are kept on a list is called ready queue [5]. Device queue refers to the when a process assign to the CPU, it executes or while waiting for some I/O devices for completing particular I/O event [5]. CPU use many parameters in scheduling such as,

A. CPU Utilization

It is refers to a computer's usage of processing resources or the amount of work handled by a CPU. It is varies depending on the amount and type of managed computing tasks.

B. Throughput

It refers to the amount of work completed in a unit of time. The number of processes the system can execute in a period of time.

C. Waiting Time

The average period of time a Process spends waiting. Waiting time may be expressed as turnaround time less the actual execution time. Waiting time is the sums of periods spend waiting in the ready queue.

D. Turnaround Time

The total time between arrival of a process and process completion.it may simply deal with the total time it takes for a program to provide the required output to the user after the program is started.

E. Response Time

It is amount of time taken between requests was submitted and the first response is produced [8].

F. Fairness

Avoid The Process from starvation. all the processes must be given equal opportunity to execute.

G. Priority

It gives preferential treatment to Processes with higher priorities.

There are many different scheduling techniques are available in operating system such as FCFS, SJF, priority, RR etc. The performance of each scheduling technique is depends on above mentioned parameters. Now a day's round robin algorithm is widely used.

RR is a pre-emptive scheduling Algorithm. It is designed especially for time sharing systems. In this RR technique, a small unit of time called Time Quantum (TQ) or time slice is assigned to each process [1]. When the TQ expired, the CPU is switched to another process. Generally in RR technique the performance depends upon the size of fixed or static TQ [2]. If TQ is too large then RR algorithm approximate to FCFS. If the TQ is too small then there will be many contexts switching between the processes. Overall performance of the system depends on choice of an optimal time quantum, so that context switching can be reduced [4].

In this paper we discussed on different round robin strategies in which dynamic time quantum is used. Dynamic quantum generally calculated using burst time of the processes. But it is not compulsory, it's depends on the strategy. In this paper we discussed on Average-Max round robin, Average Mid-Max round robin and Even-Odd round robin techniques.

In next section we discussed on above mentioned techniques in details. Section III contains the mathematical calculation of these RR techniques. Comparison and result analysis included in section IV. Conclusion is specified in the last section.

II. BACKGROUND WORK

Round Robin scheduling algorithm works with static and dynamic time quantum. In this section we discussed different RR strategies those having dynamic time quantum:

A. Average Max Round Robin Strategy

In average max round robin technique, time quantum is mean of the summation of the average and the maximum burst time [3]. Apply this time quantum to each process available in ready queue.

$$\text{time quantum} = (\text{avgbt} + \text{maxbt})/2 \qquad (1)$$

Where *avgbt* is the average of burst time of all processes, *maxbt* is the maximum burst time of processes.

B. Average Mid Max Round Robin Strategy

In this strategy, Time Quantum is the Average of the summation of mid and max process [2]. Apply this time quantum applies to each process.

$$\text{mid} = (\text{minbt} + \text{maxbt})/2 \qquad (2)$$

$$\text{time quantum} = (\text{mid} + \text{maxbt})/2 \qquad (3)$$

Where *minbt* is the minimum burst time of the processes, *maxbt* is the maximum burst time of processes, mid is the average of *minbt* and *maxbt*.

C. Even Odd Round Robin Strategy

In this strategy we calculate two time quantum's TQ1 and TQ2. Where TQ1 is the average burst time of all the processes at even places in the ready queue and TQ2 is the average burst time of all the processes at odd places in the ready queue [6]. Then we compare the two time quantum's, to get the greater Time Quantum. Take greater time as a time quantum and apply to the each process.

$$\text{if tq1} > \text{tq2 then tq} = \text{tq1 else tq} = \text{tq2} \qquad (4)$$

Where *tq1* is the average of even place process's burst time and *tq2* is the average of odd place process's burst time.

III. MATHEMATICAL CALCULATION

In CPU scheduling the number of processes and CPU Burst Time (BT) are accepted as input and Average Turnaround Time (ATT), Average Waiting Time (AWT) and number of Context Switch (CS) are produced as output.

Let's consider four processes(P1,P2,P3,P4) with arrival time=0 and burst time(8,40,72,84) as shown in the Table I.

Table I. PROCESS WITH BURST TIME

Process	Arrival time	Burst time
P1	0	8
P2	0	40
P3	0	72
P4	0	84

Now first we calculate the time quantum using Simple RR strategy. Here we assume fixed Time Quantum (TQ) = 20 shown in Figure 1.

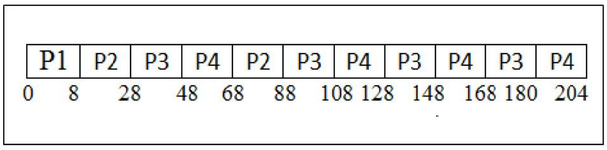

Figure 1. Gantt chart of RR Scheduling.

Now for Average Max round robin: in first iteration

Time Quantum (TQ) = (avgbt + maxbt)/2 = (51 + 84) / 2 = 67.5 ≈ 68

Then apply this TQ to all processes. In second iteration remaining burst time of p1, p2, p3 and p4 are 0, 0, 4, 16 respectively. So,

Time Quantum (TQ) = (avgbt + maxbt)/2 = (10 + 16) / 2 = 13

Then apply this TQ to all processes. In third iteration remaining burst time of p1, p2, p3, p4 are 0,0,0,3 respectively. And then process p4 was completed shown in Figure. 2.

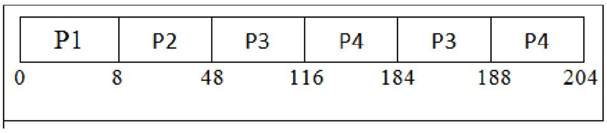

Figure 2. Gantt chart of AMRR Scheduling

Now for Average Mid max round robin: in first iteration

mid = (minbt + maxbt) / 2 = (8+84)/2 = 46

Time Quantum (TQ) = (mid + maxbt) / 2 = (46 + 84) / 2 = 65

Then apply this TQ to all processes. In second iteration remaining burst time of p1, p2, p3 and p4 are 0, 0, 7,19 respectively. So,

mid = (minbt + maxbt) / 2 = (7+19)/2 = 13

Time Quantum (TQ) = (mid + maxbt) / 2 = (13 + 19) / 2 = 16

Then apply this TQ to all processes. In third iteration remaining burst time of p1, p2, p3, p4 are 0,0,0,3 respectively. And then process p4 was completed shown in Fig. 3.

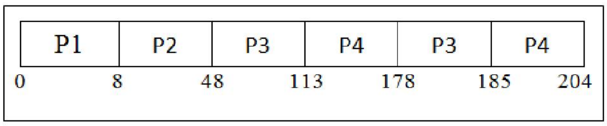

Figure 3. Gantt chart of AMMRR Scheduling.

Now for Even-Odd Round Robin:

tq1 = average of even place process burst time = 62 & tq2 = average of odd place process burst time = 40

If tq1 > tq2 then tq = tq1 else tq = tq2, So tq = 62.

Then apply this TQ to all processes. In second iteration remaining burst time of p1, p2, p3 and p4 are 0, 0, 10, and 22 respectively. So, tq1 = average of even place process burst time = 22 & tq2 = average of odd place process burst time = 10

If tq1 > tq2 then tq = tq1 else tq = tq2, So tq = 22.

Then apply this TQ to all processes. So process p3 and p4 was completed shown in Figure 4.

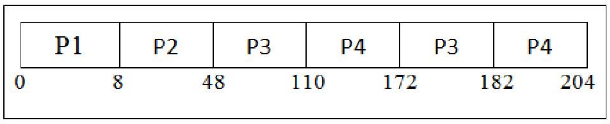

Figure 4. Gantt chart of EVEN-ODD Scheduling

IV. COMPARISION & RESULT ANALYSIS

Even-Odd RR algorithms have minimum Average Turnaround Time 59.5 and minimum Average Waiting Time 59.25. So Even-Odd RR is best round robin technique than simple RR, Average-Max RR and Average Mid-Max RR.

Table II. COMPARISON OF RR, AMRR,AMMRR AND EVEN-ODD

Paper	Time Quantum	ATT	AWT	CS
RR	20	120	69	10
AMRR	68,13,3	112	61	5
AMMRR	65,16,3	111.25	60.25	5
EVEN-ODD	62,22	59.5	59.25	5

Even-Odd RR algorithms have minimum Average Turnaround Time 59.5 and minimum Average Waiting Time 59.25. So Even-Odd RR is best round robin technique than simple RR, Average-Max RR and Average Mid-Max RR.

V. CONCLUSION

In this paper, we compare simple round robin algorithm with different round robin technique those having dynamic time quantum. We also apply mathematical calculation for the same. In this paper we show that Even-Odd RR algorithm give better performance than all other RR scheduling strategy. As well as we can reduce Average Turnaround Time (ATT), Average Waiting Time (AWT) and number of Context Switch (CS) using the Even-Odd RR scheduling.

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