ANALYSIS AND TESTING OF DIFFERENT TIME QUANTUM FOR ROUND ROBIN ALGORITHM

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Abstract— One of the sufficient and necessary part of the computer resource is central processing unit, which is basics of multiprogramming. Many algorithms have been designed for achieving multiprogramming. But Round Robin algorithm is optimized multiprogramming algorithm , compared to other standards such as FCFS, SJF and Priority based algorithm. Generally we select that Multiprogramming algorithm which take minimum turnaround time and waiting time. Round Robin algorithm is a pre-emptive scheduling algorithm which switches between the processes when time quantum expires. The result of Round Robin algorithm vary according to time quantum. For example if time quantum chosen is big, then time interval between processes will be very high but if the time quantum is small, it will enhance the overhead of central processing unit. So selection of time quantum is very important in round robin algorithm. In this paper firstly i have analyzed several different type of time quantum and after analyzing them i have designed an example for testing of turnaround and waiting time of process with different time quantum. Then we have shown that which time quantum is better for which situation. This paper provides an excellent way of selection of time quantum according to the environment

Keywords— Round Robin Scheduling, Burst Time, Turnaround Time, Waiting Time, Time Quantum.

I. INTRODUCTION

Multiprocessing, multitasking operating system and real time software styles are generally depends on a basic component named as Scheduling. Central processor unit algorithm decides which of the process is to be given to CPU from the processes which are present in the ready queue [1]. Computer scheduler performs this task, Generally computer scheduler may be of three types such as long term computer scheduler , short term computer scheduler and medium term scheduler. Long term computer scheduler determines, job area unit. Long term computer scheduler executes lesser in compare to short-term computer scheduler and manages the degree of execution. Medium term computer scheduler swaps jobs between disk to memory. Short term computer scheduler selects the processes from memory that are able to execute, and allocates the central processor [2]. A lot of alternative central processor programming algorithms are being used, out of those algorithms, Round Robin is the oldest, simplest and most generally used real environment programming algorithmic program. During this paper I have got conferred comparative analysis of many alternate technique for time quantum so that i may get best result .

Performance parameters

***The various scheduling parameters*:**

Burst Time: The time period in which a process uses the C.P.U. *Arrival Time:* when a process joins the ready queue. *Throughput*: variety of processes that completed in per unit. *Turnaround Time*: Turnaround time is the time that takes process for completion. *Waiting Time*: waiting time of a process is the total time spent by the process within the ready queue. The amount of times , which processes takes to switch between processes called context switching time. The C.P.U. programming algorithms target reducing the waiting time of processes in an efficient manner.

The remaining part of this paper is organized as follows. *Section II* describe Round Robin Scheduling algorithm. In *Section III* I analyzed various type of time quantum for Round Robin Algorithm. *Section IV* gives a result about time quantum. *Section V* presents a conclusion and future work.

II. ROUND ROBIN SCHEDULING

Round Robin algorithm is same as FCFS programming but in Round Robin, pre-emption is added where pre-emption depends upon time quantum . A static or dynamic Time Quantum (TQ) may be employed during this C.P.U. scheduling. Scheduler goes to ready queue and it picks a process, waiting in ready queue and gives it to CPU according to predefined time quantum. If new process is came then it is added to the front of the queue [3]. When TQ gets terminated, the C.P.U left the process and hence the process is added to the front of the ready queue. If process gets finished with in the TQ, the process itself left the C.P.U. volitionally. During this paper I have a tendency to analyse completely different time quantum for round robin algorithm.

Round Robin Algorithm :

1. Present every process in to ready queue
2. Check if processes in the ready queue
3. compute TQ(time quantum)
4. Assign TQ to processes $P_j \leftarrow$ TQ , j++
5. If(j < amount of processes) then go to step 4
6. Compute the remaining Burst time of the every processes and jump to step 3
7. If new process is arrived : Update ready queue and attend step 3
8. Compute Average Waiting Time , Average turnaround
9. End

III. METHOD FOR TIME QUANTUM

Let say five processes P_1, P_2, P_3, P_4 and P_5 in the ready queue and its arrival time is zero. Suppose burst time of the processes are 30,42,50,85,97 respectively. Now I am going to describe different time quantum for round robin algorithm.

A. I select Time quantum (TQ) randomly then according to algorithm time quantum will vary: choose the first process from the ready queue and give the C.P.U. to it according time quantum (assume TQ= 30). If left over C.P.U burst time of the running process is fewer than 30 time quantum then assign C.P.U again to the same running process for leftover C.P.U burst time. After termination, disconnect it from the ready queue and repeat this step.

Let Time quantum =30

P_1	P_2	P_2	P_3	P_3	P_4	P_5	P_4	P_4	P_5	P_5	P_5

0 30 60 72 102 122 152 182 212 237 267 297 304

Average turnaround time=(30+72+122+237+304)/5 =153

Average waiting time = (0+30+72+152+207)/5 =92.2

B. Time quantum = (median + determinant factor) /2

Median = 1/2(X (total number of processes/2) + X(1+total number of processes/2)) if total number of process is even

X(total number of processes+1)/2 if total number of processes is odd

Determinant factor = (maximum burst_time + minimum burst_time)/2

In my example i get the time quantum=57,34

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 30 72 122 179 236 264 298 304

0 30 72 122 179 236 264 298 304

Average turnaround time = (30+72+122+264+304)/5 =158.4

Average waiting time=(0+30+72+179+207)/5=97.6

C. Time Quantum =MAXIMUM_BURST – MINIMUM_BURST

So my time quantum = 67,12,12

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_4	P_5	P_5

0 30 72 122 189 256 268 280 286 298 304

Average turnaround time = (30+72+122+286+304)/5 =162.8

Average waiting time = (0+30+72+201+207)/5 =102

D. *Time quantum = Σ Burst time i / N*

In my example i get the time quantum =61,30

P_2	P_1	P_3	P_4	P_5	P_4	P_5	P_5

0 42 72 122 183 244 268 298 304

Average turnaround time = (42+72+122+268+304)/5 =161.6

Average waiting time = (0+42+72+183+207)/5=100.8

E. *If (meanvalue > medianvalue) Time quantum = ceil (sqrt((meanvalue * max burst time) +(medianvalue * min burst time)))*

*Else If (medianvalue > meanvalue) Time quantum = ceil (sqrt((medianvalue * max burst time) +(meanvalue * min burst time)))*

Else Time quantum = meanvalue

According to above formula, time quantum =86,11

P1	P2	P3	P4	P5	P5

0 30 72 122 208 294 305

Average turnaround time=(30+72+122+208+305)/5 =147.4

Average waiting time=(0+30+72+122+208)/5=86.4

F. *Time Quantum = minimum burst time:*

So my Time quantum = 30, 12,8,35,12

P_1	P_2	P_3	P_4	P_5	P_2	P_3	P_4	P_5	P_3	P_4	P_5	P_4	P_5

0 30 60 90 120 150 162 174 186 198 206 214
222 257 304

Average turnaround time = (30+162+206+257+304)/5 =191.8

Average waiting time= (0+120+156+172+207)/5 =131

G. *Time Quantum = (AVG+MAXBT)*

According to above formula, Time quantum =79, 15,3

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 30 72 122 201 280 286 301
304

Average turnaround time=(30+72+122+286+304)/5 =162.8

Average waiting time=(0 + 30 + 72 + 201 + 207) / 5 =102

H. *Time Quantum= Arithmetic Mean and Harmonic mean*

Compute time quantum :

If (processes are not homogeneous and some processes are smaller than the others)
then
Time quantum = Harmonic_Mean of burst_times
else
If (processes are not homogeneous and some processes are larger than the others)
then
Time quantum = Arithmetic_Mean of Burst_ times
Time quantum = Arithmetic_mean:
Hence my TQ = 61,30

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 32 74 124 185 246 270 300 306

Average turnaround time = (32+74+124+270+306)/5 = 161.2
Average waiting time = (0+32+74+185+209)/ 5 =100

I. *Time Quantum = Harmonic_mean*

Hence TQ=51,40,6

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 30 72 122 173 224 258 298 304

Average turnaround time= (30+72+122+258+304)/5 =157.2
Average waiting time=(0+30+72+173+207)/5 =96.4

Now Suppose another process P_6 whose arrival time is 0 and burst time is 1 also has come According to algorithm because processes are not homogeneous and one process has burst_time 1 which is smaller than others So my time quantum will be same as Harmonic_Mean of burst_times.

TQ=6(harmonic mean), 55(arithmetic mean), 30(arithmetic mean), 6(arithmetic mean)

P_1	P_2	P_3	P_4	P_5	P_6	P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 6 12 18 24 30 31 55 91 135 190 245 269 299 305

Average turnaround time=(31+55+91+135+269+305)/6 =147.6

Average waiting time=(25+49+85+184+208+30)/6 =96.8

J. *Time Quantum = mean + Standard Deviation*

Standard Deviation = σ2= $\{(1/n)\ \Sigma\ (xi - x)^2\}^{1/2}$
According to above formula
standard deviation=0.44,0 and TQ=61,30

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 32 74 124 185 246 270 300 306

Average turnaround time = (32+74+124+270+306)/5 = 161.2
Average waiting time = (0+32+74+185+209)/5 = 100

K. *Time Quantum = (Mid + Max)/2*
Mid = (Minimum burst time + Maximum burst time)/2

According to above formula, time quantum TQ:
Time quantum =80,12, 5

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 30 72 122 202 282 287 299 304

Average turnaround time=(30+72+122+287+304)/5 =163
Average waiting time=(0+30+72+202+207)/5=102.2

L. *TQ (Time Quantum) = Eavg / E*
TQ_E (AVGTime Quantum of Even number of Processes)= total burst_time of even number of process / total even process
TQ_O(AVG Time Quantum of Odd number of Processes) = total burst_time of odd process / total odd process
if (TQ_E>=TQ_O)
Set total_TQ=TQ_E
Else
Set total_TQ=TQ_O

According to my formula time quantum
TQ=63,34

P_1	P_2	P_3	P_4	P_5	P_4	P_5

0 30 72 122 185 248 270 304

Average turnaround time=(30+72+122+270+304)/ 5 =159.6
Average waiting time=(0+30+72+185+207)/5 =98.8

M. *Time Quantum = Square root of (mean*Highest Burst):*
So my time quantum:
TQ=77, 17,3

P_1	P_2	P_3	P_4	P_5	P_4	P_5	P_5

0 32 72 122 199 276 284 301 304

Average turnaround time= (30+72+122+284+304)/ 5 =162.4
Average waiting time=(0+30+72+199+207)/5=102

N. *Time quantum = MAVG / Count*
$Medium_1$= (Lowest burst time + Highest burst time)/2
Set total_$medium_2$=0, COUNTER =0
for i=$Medium_1$ to total_process
{
Total_$medium_2$= total_$medium_2$+burst_$time_i$
COUNTER++
}

$TQn = total\_medium_2/COUNTER$

According to formula my TQ (time quantum) =91,6

P_1	P_2	P_3	P_4	P_5	P_5

0 30 72 122 207 298 304

Average turnaround time =(30+72+122+207+304)/5=147

Average waiting time= (0+30+72+122+207)/5 =86.2

IV. RESULT

After analysing my example with different time quantum i have a table which shown below. In this table i have found different average turnaround time and average waiting time according to different value of time quantum. In my table the minimum time quantum, the minimum average turnaround time and waiting time are 30, 147 and 86.2 respectively. *After analysing the paper my findings are:*

I found that the waiting time and turnaround time is minimum If time quantum = (MAVG / COUNT).

If processes are heterogeneous and some of them are smaller than others then we should select time quantum equal to Harmonic Mean of burst times.

If processes are heterogeneous and some of them are larger than others then we should select time quantum equal to Arithmetic Mean of Burst times, in this condition my time quantum (according to example) is 6 and average turnaround time , average waiting time are 147.6 and 96.8. These values are very less comparative to other average turnaround time with different time quantum. Hence i can choose different time quantum depends upon situation

Table1. Time quantum, Average_turnaround_time and Average_waiting_time

Method	TIME QUANTUM	AVERAGE TURNARRO U_ND TIME	AVERAGE_W AITING _TIME
1	30	153	92.2
2	57,34	158.4	97.6
3	67,12,12	162.8	102
4	61,30	161.6	100.8
5	86,11	147.4	86.4
6	30,12,8,35,12	191.8	131
7	79,15,3	162.8	102
8	61,30	161.2	100
9	51,40,6	157.2	96.4
9.1	6,55,30,6	147.6	96.8
10	61,30	161.2	100
11	80,12,5	163	102.2
12	63,34	159.6	98.8
13	77,17,3	162.4	102
14	91,6	*147*	*86.2*

CONCLUSION AND FUTURE WORK

In this paper , I briefly introduced different time quantum for round robin algorithm. After analyzing i got a result which briefly describes about the time quantum. In future I develop new time quantum which will be appropriate for all conditions and it can be working according to situation. So that we may get best results.

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