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USCS3P01:USCS303-Operating System (OS) Practical-03

Practical – 03: RR Scheduling Algorithm

Practical Date: 27-07-2021

Practical Aim: Implement RR scheduling algorithm in Java.

- Round-robin (RR) scheduling algorithm is mainly designed for time-sharing systems.
- This algorithm is similar to FCFS scheduling, but in Round robin (RR) scheduling, preemption is added which enables the system to switch between processes.
- Round-robin (RR) scheduling algorithm is mainly designed for time-sharing systems.
- This algorithm is similar to FCFS scheduling, but in Round robin (RR) scheduling, preemption is added which enables the system to switch between processes.
- Round-robin scheduling algorithm is used to schedule process fairly each job a time slot or quantum and the interrupting the job if it is not completed by then the job come after the other job which is arrived in the quantum time that makes these scheduling fairly.

Algorithm:

Step 1: Input the number of processes and time quanta or time slice required to be scheduled using RR, burst time for the process.

Step 2: Choose the first process in the ready queue, set a interrupt it after time quantum and dispatches it. Check if any other process request has arrived. If a process request arrives during the quantum time in which another process is executing, then add the new process to the Ready queue.

Step 3: After the quantum time has passed, check for any processes in the Ready queue. If the ready queue is empty then continue the current process. If the queue not empty and the current process is not complete, then add the current process to the end of the ready queue.

Step 4: Take the first process from the Ready queue ar executing it. Calculate the Turn Around Time and Waiting T each process using RR.

Step 5: Repeat all steps above from Step 2 to Step 4.

Step 6: If the process is complete and the ready queue is empty then the task is complete.

Step 7: Calculate the Average Waiting Time and Average Turn Around Time.

Step 8: Stop.

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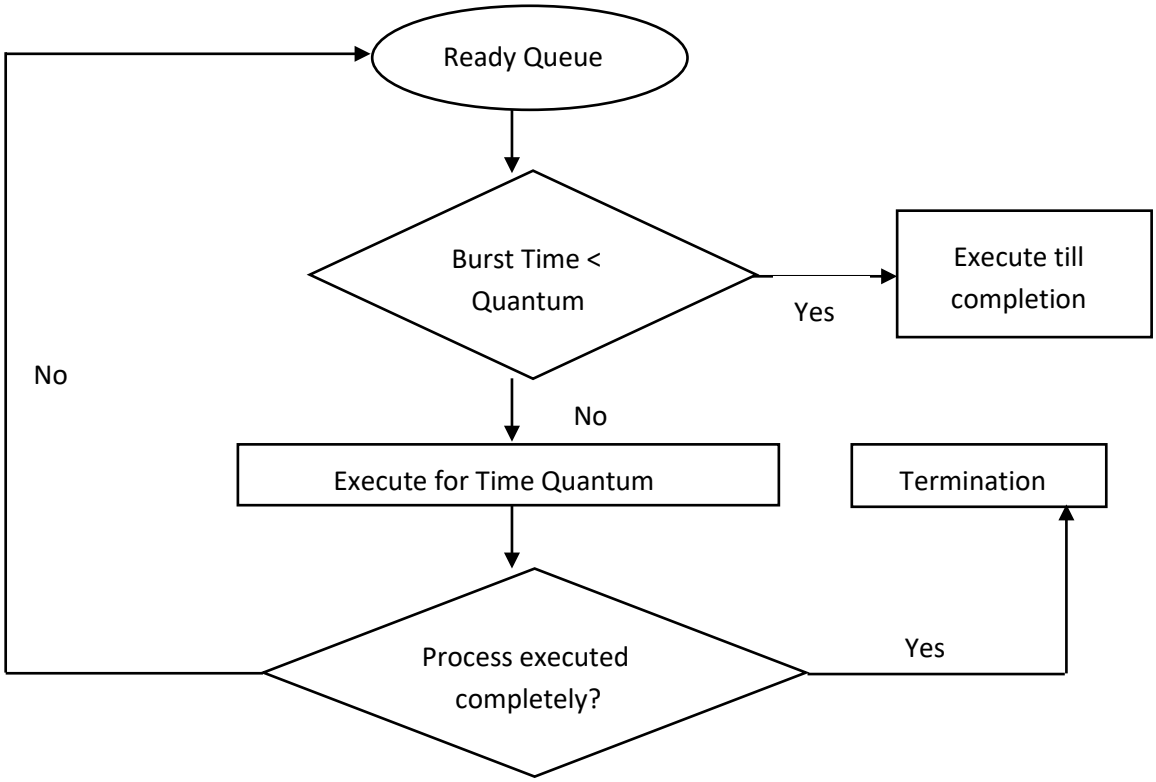
Flowchart



Solved Examples :

Example 1:

Consider the following example containing three processes arriving at time t = 0 ms.

Process ID	Burst Time
P0	24
P1	3
P2	3

Step 1: Consider the time quanta / time slice - 4 ms. Step 2: Following shows the scheduling and execution of processes.

Step 2.1: PO process arrives at 0 with 24 ms as the burst time which is greaterthan time quanta - 4 ms. So PO executes for 4 ms and goes in waiting queue.

System Time	:	0
Process Scheduled	:	P0
Remaining Time	:	24 – 4 = 20
Waiting Time	:	0 + 0 = 0
Turn Around Time		0 + 4 = 4

Step 2.2: Next P1 process executes for 3 ms which is greater than quanta time. So P1 executes and gets terminated.

System Time	:	0
Process Scheduled	:	P0 , P1
Remaining Time	:	3 – 4 = -1 =0
Waiting Time	:	4 – 0 = 4
Turn Around Time		4 + 3 = 7

Step 2.3: Next P2 process executes for 3 ms which is greater than quanta time. So P2 executes and gets terminated.

System Time	:	7
Process Scheduled	:	P0 , P1 , P2
Remaining Time	:	3 – 4 = -1 =0
Waiting Time	:	7– 0 = 7
Turn Around Time		7 + 3 = 10

Step 2.4: Now PO turns comes again and it's the only process for execution so for 4 ms of quanta it gets executed.

System Time	:	10
Process Scheduled	:	P0 , P1 , P2 , P0
Remaining Time	:	20 – 4 = 16
Waiting Time	:	0
Turn Around Time		10+ 4 = 14

Step 2.5: Again, PO continues to execute for next 4 ms. Waiting for PO will be zero.

System Time	:	7
Process Scheduled	:	P0 , P1 , P2 , P0 , P0
Remaining Time	:	16 – 4 = 12

Waiting Time	:	0
Turn Around Time		14 + 4 = 18

Step 2.6: PO continues to execute for next 4 ms.

System Time	:	7
Process Scheduled	:	P0 , P1 , P2 , P0 , P0 , P0
Finish Time	:	12 – 4 = 12
Turn Around Time	:	18 + 4 = 22

Step 2.7: PO continues to execute for next 4 ms.

System Time	:	7
Process Scheduled	:	P0 , P1 , P2 , P0 , P0 , P0 , P0
Finish Time	:	8 – 4 = 4
Turn Around Time	:	22 + 4 = 26

Step 2.8: PO continues to execute for next 4 ms.

System Time	:	7
Process Scheduled	:	P0 , P1 , P2 , P0 , P0 , P0 , P0 , P0
Finish Time	:	4 – 4 = 0
Turn Around Time	:	26 + 4 = 30

Step 3: Calculate Average Waiting Time and Average Turn Around Time.

Average Waiting Time	=	(6 + 4 + 7) / 3
	=	17 / 3
	=	5.666667

Average Turn Around Time	=	(30 + 7 + 10) / 3
	=	47 / 3
	=	16

Step 4: After scheduling of all provided processes:

Process ID	Burst Time	Turn Around Time (Completion Time - Arrival Time)	Waiting Time (Turn Around Time – Burst Time)
P0	24	30 – 0 = 30	30 – 24 = 6
P1	3	4 + 3 = 7	7 – 3 = 4
P2	3	7 + 3 = 10	10 – 3 = 7
Average		15.666667	5.666667

Gnatt Chart :

Process ID	Burst Time	Turn Around Time (Completion Time - Arrival Time)	Waiting Time (Turn Around Time – Burst Time)
P0	24	30 – 0 = 30	30 – 24 = 6
P1	3	4 + 3 = 7	7 – 3 = 4
P2	3	7 + 3 = 10	10 – 3 = 7
Average		15.666667	5.666667

P0	P1	P2	P0	P0	P0	P0	P0
0 1 2 3 4	5 6 7	8 9 10	11 12 13 14	15 16 17 18	19 20 21 22	23 24 25 26	27 28 29 30

Example 2:

Consider the following example containing three processes arrive at same time having time slice as 1ms

Solution:

Process ID	Burst Time	Turn Around Time (Completion Time - Arrival Time)	Waiting Time (Turn Around Time – Burst Time)
P0	2	4 – 0 = 4	4 – 2 = 2
P1	1	2 - 0 = 2	2 – 1 = 1
P2	6	9 – 0 = 9	9 – 6 = 3
Average		5.000000	2.000000

Process ID	Burst Time
P0	2
P1	1
P2	6

P0	P1	P2	P0	P2	P2	P2	P2	P2	P2
0	1	2	3	4	5	6	7	8	9

Example 3:

Consider the following example containing three processes arrive at same time having same time. Time Quanta = 3

Solution:

Process ID	Burst Time	Turn Around Time (Completion Time - Arrival Time)	Waiting Time (Turn Around Time – Burst Time)
P0	7	24 – 0 = 24	24 – 7 =17
P1	3	6 – 0 = 6	6 – 3 =3
P2	2	8 – 0 = 8	8 – 2 = 6
P3	10	30 – 0 =30	30 – 10 =20
P4	8	29 – 0 =29	29 – 8 =21
Average		19.4000000	13.4000000

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Process ID	Burst Time
P0	7
P1	3
P2	2
P3	10
P4	8

P0	P1	P2	P3	P4	P0	P3	P4	P0	P3	P4	P3
0	3	6	8	11	14	17	20	23	24	29	30

Batch: B1 Name: Yash Anand Parab

Implementation:

```
//Name: Yash Parab
// Batch: B1
// PRN: 2020016400922513
// Date: 27 July,2021
// Prac-03:RR Scheduling Algorithm

import java.util.Scanner;
class P3_RR_YP
{
		public static void main(String args[])
		{
	Scanner input = new Scanner(System.in);	int i, j, k, q,
sum = 0;
		 System.out.print("Enter number of process: ");
	int n = input.nextInt();
	int burstTime[] = new int[n];
	int waitingTime[] = new int[n];
	int turnAroundTime[] = new int[n];
	int a[] = new int[n];
		System.out.println("Enter Burst Time of each process: ");
		for (i = 0; i < n; i++)
		{
			System.out.print("Enter Burst Time for Process - P" + (i) +" : ");
			burstTime[i] = input.nextInt();
			a[i] = burstTime[i];
		}
	System.out.print("Enter Time quantum: ");
	q=input.nextInt();
	for (i = 0; i<n; i++)
		waitingTime[i] = 0;
	int timer = 0; // Current time
// Keep traversing processes in round robin manner until all of them are not done.
	do
	{
		for (i = 0; i<n; i++)
		{
// If burst time of a process is greater than 0 then only need to process further

		if (burstTime[i] > q)
```

```
                    {
// Increase the value of ti.e. shows how much time a process has been processed
                        timer += q;
// Decrease the burst time of current process by quantum
                        burstTime[i] -= q;
        for (j = 0; j<n; j++)
                        {
                         if ((j!= i) && (burstTime[j] != 0))
        waitingTime[j] += q;
                        }
                    } // if ends
// If burst time is smaller than or equal to quantum. Last cycle for this process
                    else
                    {
// Increase the value of t i.e. shows how much time a process has been processed
                        timer += burstTime[i];
                        for (j = 0; j<n; j++)
                        {
                                if ((j != i) && (burstTime[j] != 0))
                                waitingTime[j] += burstTime[i];
                        }
// As the process gets fully executed make its remaining burst time = 0
                    burstTime[i] = 0;
                    } // else ends
            }       sum = 0;
        for (k = 0; k<n; k++)           sum += burstTime[k];
        } while (sum != 0);
// calculating turnaround time by adding waiting Time + burst Time
        for (i = 0; i<n; i++)
        turnAroundTime[i] = waitingTime[i] + a[i];
        float total = 0;
        for (int x : waitingTime)
        {
        total += x;
        }
        float averageWaitingTime = total / n;
        total = 0;
        for (int y : turnAroundTime)
        {
                total += y;
        }
```

```
        float averageTurnAroundTime = total / n;
// print on console the order of processes scheduled using Round-robin Algorithm
        System.out.println("RR Algorithm: ");
        System.out.format("%20s %20s %20s %20s\n","Processld","BurstTime","Waiting
Time","TurnAroundTime");
        for (i = 0; i<n; i++)
        {
        System.out.format("%20s %20d %20d %20d\n","P"+(i),a[i],
waitingTime[i],turnAroundTime[i]);
        }
        System.out.format("%40s %20f
%20f\n","Average",averageWaitingTime,averageTurnAroundTime);
       }
}
```

Input :

```
C:\USCSP301_USCSP303_OS_B1\Prac_03_YashParab_27_07_2021>java P3_RR_YP
Enter number of process: 3
Enter Burst Time of each process:
Enter Burst Time for Process - P0 : 24
Enter Burst Time for Process - P1 : 3
Enter Burst Time for Process - P2 : 3
Enter Time quantum: 4
```

Output :

```
RR Algorithm:
           Processld            BurstTime         Waiting Time       TurnAroundTime
                  P0                   24                    6                   30
                  P1                    3                    4                    7
                  P2                    3                    7                   10
                             Average             5.666667            15.666667
```

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Sample output 01

```
C:\USCSP301_USCSP303_OS_B1\Prac_03_YashParab_27_07_2021>javac P3_RR_YP.java

C:\USCSP301_USCSP303_OS_B1\Prac_03_YashParab_27_07_2021>java P3_RR_YP
Enter number of process: 3
Enter Burst Time of each process:
Enter Burst Time for Process - P0 : 24
Enter Burst Time for Process - P1 : 3
Enter Burst Time for Process - P2 : 3
Enter Time quantum: 4
RR Algorithm:
          Processld            BurstTime         Waiting Time       TurnAroundTime
                P0                   24                    6                   30
                P1                    3                    4                    7
                P2                    3                    7                   10
                                  Average             5.666667            15.666667
```

Sample output 02

```
C:\USCSP301_USCSP303_OS_B1\Prac_03_YashParab_27_07_2021>java P3_RR_YP
Enter number of process: 3
Enter Burst Time of each process:
Enter Burst Time for Process - P0 : 2
Enter Burst Time for Process - P1 : 1
Enter Burst Time for Process - P2 : 6
Enter Time quantum: 1
RR Algorithm:
          Processld            BurstTime         Waiting Time       TurnAroundTime
                P0                    2                    2                    4
                P1                    1                    1                    2
                P2                    6                    3                    9
                                  Average             2.000000            5.000000
```

Sample output 03

```
C:\USCSP301_USCSP303_OS_B1\Prac_03_YashParab_27_07_2021>java P3_RR_YP
Enter number of process: 5
Enter Burst Time of each process:
Enter Burst Time for Process - P0 : 7
Enter Burst Time for Process - P1 : 3
Enter Burst Time for Process - P2 : 2
Enter Burst Time for Process - P3 : 10
Enter Burst Time for Process - P4 : 8
Enter Time quantum: 3
RR Algorithm:
          Processld            BurstTime         Waiting Time       TurnAroundTime
                P0                    7                   17                   24
                P1                    3                    3                    6
                P2                    2                    6                    8
                P3                   10                   20                   30
                P4                    8                   21                   29
                                  Average            13.400000           19.400000
```

Batch: B1 Name: Yash Anand Parab