Comparisons Of Round Robin Algorithms

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Round Robin Algorithm

- Compare standard RR with other RR and find the greatest improvement over standard RR

- Comparing 5 different RR algorithms

- RR is a pre-emptive process scheduling algorithm

- Each process gets its turn for a fixed time = Quantum Time
  - ➢Fixed
  - ➢variable (Vary based on the algorithm)

- The ready queue works like a circular queue
  - ➢All processes in this algorithm are kept in the circular queue also known as ready queue
  - ➢Each New process is added to the tail of the ready/circular queue

Parameters of Concern (Input)

Process	Arrival Time	Burst Time	Priority
P1	0	7	2
P2	0	5	1
P3	3	4	6
P4	5	4	4
P5	10	8	3
P6	13	8	5

- Arrival Time
  - The time at which a process enters the system
  - Pick a random inter-arrival time and trigger an event
    - ✓ Poisson would be ideal

- Burst Time
  - The total time taken by a process before it leaves the system
  - Pick a random burst time
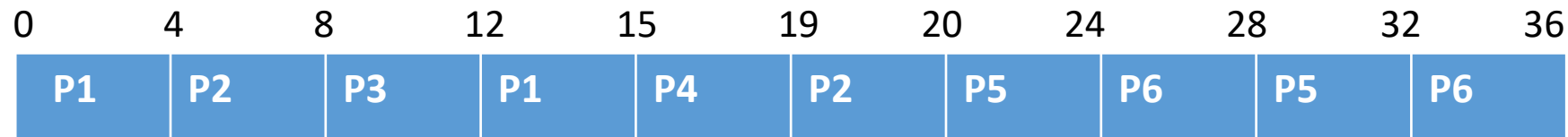   - ✓ Exponential distribution (related to inter-arrival time of poisson)

- Priority
  - Largest number corresponds to a high priority process

Parameters of Concern (Output)

- Standard Round Robin

  ➢Gantt Chart

0	4	8	12	15	19	20	24	28	32	36
P1	P2	P3	P1	P4	P2	P5	P6	P5	P6	

- Time Quantum = 4
- Number of Context Switches = 9 (Store the states of the processes)
- Average Turnaround Time = 17.17 (Time spent in the Queue)
- Average Waiting Time = 11.17 (Service Time – Arrival Time)
- Run it several times for different scenarios to find the average of all the above values.
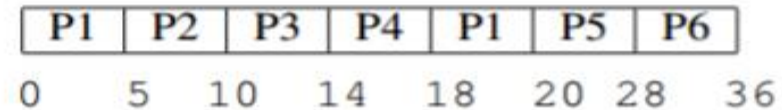
A New RR

- Focuses on calculating an ideal time quantum

TABLE I.	SIMULATED LIST OF PROCESSES		
Process	Arrival Time	Burst Time	Priority
P1	0	7	2
P2	0	5	1
P3	3	4	6
P4	5	4	4
P5	10	8	3
P6	13	8	5

AN RR
Gantt Chart

P1	P2	P3	P4	P1	P5	P6

0   5   10   14   18   20 28   36

Time Quantum calculated by algorithm
Average Turnaround Time = 15.83
Average Waiting Time = 9.83
Number of Context Switches = 6

Optimized RR

- First phase,
  - Processes are executed just like Standard RR
  - Each process runs for one time slice

- Second phase,
  - Processes are executed in order of their remaining burst time
  - Process with shorter time run before process with longer time

TABLE I.   SIMULATED LIST OF PROCESSES

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P1	0	7	2
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P4	5	4	4
P5	10	8	3
P6	13	8	5

Optimized RR

Gantt Chart

P1	P2	P2	P1	P3	P4	P5	P6

0   4   8   9   12   16   20   28   36

Time Quantum = 4 (Phase One), 8 (Phase Two)
Average Turnaround Time = 15.00
Average Waiting Time = 9.00
Number of Context Switches = 7

Priority Based RR

- First Phase,
  - Processes are executed in order of their priorities
  - Each process runs for one time slice

- Second Phase,
  - New priorities are assigned depending on the burst time
  - Process with shorter burst time have highest priority

TABLE I.   SIMULATED LIST OF PROCESSES

Process	Arrival Time	Burst Time	Priority
P1	0	7	2
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P3	3	4	6
P4	5	4	4
P5	10	8	3
P6	13	8	5

D. Priority-Based RR

Gantt Chart

P2	P1	P2	P1	P4	P3	P5	P6	P5	P6

0   4   8   9   12   16   20   24   28   32 36

Time Quantum = 4
Average Turnaround Time = 15.67
Average Waiting Time = 9.67
Number of Context Switches = 9

Adaptive RR

- Processes are sorted by their burst times, shorter process at the front of the ready queue

- Even number of processes in queue then time quantum is average of the all burst times

- If odd, equal to burst time of the middle process in the ready queue

- Any process comes in middle of the execution, then it is not scheduled in current round.

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P4	5	4	4
P5	10	8	3
P6	13	8	5

E. *Adaptive RR*

Gantt Chart

P2	P1	P3	P4	P5	P1	P6	P5

0   5   11   15   19   23 24   32   36

Time Quantum calculated by algorithm
Average Turnaround Time = 16.67
Average Waiting Time = 10.67
Number of Context Switches = 7

Efficient RR

- Combines Shortest remaining algo. and Standard RR

- Process with shortest remaining burst time is selected first.

- When new processes comes in, at end of time slice process with shortest remaining burst time is selected first.

- Long process will suffer starvation

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P5	10	8	3
P6	13	8	5

F. Efficient RR

Gantt Chart

P2	P2	P3	P4	P1	P1	P5	P5	P6

0   4   5   9   13   17   20   24   28   36

Time Quantum = 4
Average Turnaround Time = 13.33
Average Waiting Time = 7.33
Number of Context Switches = 8

Which is **BEST?**

Type	Average Turnaround Time	Average Waiting Time	Number of Context Switches
Standard Round Robin	17.17	11.17	9
AN RR	15.83	9.83	6
Optimized RR	15.0	9.0	7
Priority-Based RR	15.67	9.67	9
Adaptive RR	16.67	10.67	7
Efficient RR	13.33	7.33	8

Advance research - For reference

- Friedman statistical test

RANK SUMMARY FOR AVERAGE TURNAROUND TIME

RR Algorithm	Sum of Ranks	Mean Rank
Standard	201.5	5.04
AN	148	3.70
Adaptive	137	3.43
Efficient	68.5	1.71
Optimized	139.5	3.49
Priority-Based	142	3.55

TABLE IV.   RANK SUMMARY FOR AVERAGE WAITING TIME

RR Algorithm	Sum of Ranks	Mean Rank
Standard	193.5	4.84
AN	149	3.73
Adaptive	149.5	3.74
Efficient	66	1.65
Optimized	132.7	3.32
Priority-Based	145.5	3.64

TABLE VI.   RANK SUMMARY FOR NUMBER OF CONTEXT SWITCHES

RR Algorithm	Sum of Ranks	Mean Rank
Standard	203	5.08
AN	135	3.38
Adaptive	152	3.80
Efficient	143.5	3.59
Optimized	142.5	3.56
Priority-Based	151	3.78

TABLE III.   DIFFERENCES OF THE MEAN RANKS FOR AVERAGE TURNAROUND TIME

	Standard	AN	Adaptive	Efficient	Optimized
AN	1.338^*	x	x	x	x
Adaptive	1.613^*	0.275	x	x	x
Efficient	3.325^*	1.988^*	1.713^*	x	x
Optimized	1.550^*	0.213	0.063	1.775^*	x
Priority-Based	1.488^*	0.150	0.125	1.838^*	0.063
Critical Value	0.581				

*Value is greater than the critical value

TABLE V.   DIFFERENCES OF THE MEAN RANKS FOR AVERAGE WAITING TIME

	Standard	AN	Adaptive	Efficient	Optimized
AN	1.113^*	x	x	x	x
Adaptive	1.100^*	0.013	x	x	x
Efficient	3.188^*	2.075^*	2.088^*	x	x
Optimized	1.520^*	0.408	0.420	1.668^*	x
Priority-Based	1.200^*	0.087	0.100	1.988^*	0.320
Critical Value	0.609				

*Value is greater than the critical value

TABLE VII.   DIFFERENCES OF THE MEAN RANKS FOR NUMBER OF CONTEXT SWITCHES

	Standard	AN	Adaptive	Efficient	Optimized
AN	1.700^*	x	x	x	x
Adaptive	1.275^*	0.425	x	x	x
Efficient	1.4875^*	0.2125	0.2125	x	x
Optimized	1.513^*	0.1875	0.2375	0.025	x
Priority-Based	1.300^*	0.400	0.025	0.188	0.2125
Critical Value	0.823				

*Value is greater than the critical value

Thank you

References :

Comparisons of Improved Round Robin Algorithms by Christopher McGuire and Jeonghwa Lee