SYSC 4001 Assignment 3 - report
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Part 1

We analyzed the performance of the 3 CPU algorithms: Round Robin (RR), Earliest PID (EP), and the EP-RR hybrid based on 21 simulation traces as measured below:

DETAILED SCHEDULER COMPARISON

Test Case	Scheduler	Turnaround	Waiting	Response	Throughput
trace5	EP	9.00	1.00	2.00	0.1111
	RR	9.00	1.00	2.00	0.1111
	EP_RR	10.00	2.00	3.00	0.1000
trace6	EP	4.00	1.00	1.00	0.1429
	RR	4.00	1.00	1.00	0.1429
	EP_RR	5.00	2.00	2.00	0.1250
trace7	EP	1.00	0.00	0.00	0.3333
	RR	1.00	0.00	0.00	0.3333
	EP_RR	2.00	1.00	1.00	0.2500
trace8	EP	6.00	1.00	2.00	0.1111
	RR	6.00	1.00	2.00	0.1111
	EP_RR	7.00	2.00	3.00	0.1000
trace9	EP	6.00	1.00	2.00	0.1111
	RR	6.00	1.00	2.00	0.1111
	EP_RR	7.00	2.00	3.00	0.1000
trace10	EP	13.00	5.00	1.00	0.0769
	RR	9.00	1.00	0.00	0.1111

	EP_RR	14.00	6.00	2.00	0.0714
trace11	EP	2.00	0.00	0.00	0.5000
	RR	2.00	0.00	0.00	0.5000
	EP_RR	3.00	1.00	1.00	0.3333
trace12	EP	3.00	0.00	1.00	0.1667
	RR	3.00	0.00	1.00	0.1667
	EP_RR	4.00	1.00	2.00	0.1429
trace13	EP	7.00	1.00	2.00	0.1429
	RR	7.00	1.00	2.00	0.1429
	EP_RR	8.00	2.00	3.00	0.1250
trace14	EP	7.00	1.00	2.00	0.1429
	RR	7.00	1.00	2.00	0.1429
	EP_RR	8.00	2.00	3.00	0.1250
trace15	EP	7.00	1.00	2.00	0.1429
	RR	7.00	1.00	2.00	0.1429
	EP_RR	8.00	2.00	3.00	0.1250
trace16	EP	6.00	2.00	1.00	0.1667
	RR	6.00	2.00	1.00	0.1667
	EP_RR	8.00	4.00	2.00	0.1250
trace17	EP	6.00	2.00	1.00	0.1667
	RR	6.00	2.00	1.00	0.1667
	EP_RR	8.00	4.00	2.00	0.1250

trace18	EP	0.00	0.00	0.00	0.0000
	RR	0.00	0.00	0.00	0.0000
	EP_RR	1.00	1.00	1.00	1.000
trace19	EP	0.00	0.00	0.00	0.0000
	RR	0.00	0.00	0.00	0.0000
	EP_RR	1.00	1.00	1.00	1.000
trace20	EP	0.00	0.00	0.00	0.0000
	RR	0.00	0.00	0.00	0.0000
	EP_RR	1.00	1.00	1.00	1.000
trace21	EP	0.00	0.00	0.00	0.0000
	RR	0.00	0.00	0.00	0.0000
	EP_RR	1.00	1.00	1.00	1.000
trace22	EP	0.00	0.00	0.00	1.0000
	RR	0.00	0.00	0.00	1.0000
	EP_RR	1.00	1.00	1.00	0.5000
trace23	EP	37.00	19.00	3.00	0.0270
	RR	25.00	7.00	1.00	0.0400
	EP_RR	26.00	8.00	2.00	0.0385
trace24	EP	6.00	2.00	1.00	0.1667
	RR	6.00	2.00	1.00	0.1667
	EP_RR	8.00	4.00	2.00	0.1250
trace25	EP	6.00	1.00	2.00	0.1111
	RR	6.00	1.00	2.00	0.1111

	EP_RR	**7.00**	**2.00**	**3.00**	**0.1000**

OVERALL SUMMARY ACROSS ALL TESTS

Scheduler	Avg Turnaround	Avg Waiting	Avg Response	Avg Throughput
EP	6.00	2.52	1.10	0.1724
RR	5.24	1.33	0.95	0.1746
EP_RR	6.57	2.57	1.86	0.3148

Based on the CPU scheduling analysis, Round Robin (RR) outperforms both Earliest PID (EP) and the EP-RR hybrid, as shown in the calculations and the summary of the best scheduler table. It outperforms in turnaround time, waiting time, and response time. However, the EP_RR hybrid achieves the highest throughput.

Algorithm interaction with I/O bound:

1) RR performs the best due to its fair time slicing and response time

2) EP_RR performs the worst since some processes experience a delay based on their PID due to preemption

3) EP performs decently unless there are too many processes that have the same PID range

Algorithm interaction with CPU-bound processes:

1) RR performs decently due to its time slices that break long CPU bursts

2) EP_RR performs the best since it finishes many processes quickly and achieves the highest throughput

3) EP performs the worst due to not having preemption and PID starvation

Algorithm interaction with I/O and CPU bursts:

1) RR performs the best due to its low turnaround time and low waiting time

2) EP_RR performs decently since some processes experience a delay based on the process's PID

3) EP performs the worst due to too many processes arriving at the same time

Performance:

RR:
This algorithm has a great response time, meaning that jobs can have quick access to the CPU. Due to its fair time slicing, the algorithm prevents starvation and ensures all processes make progress. It can handle I/O-bound and mixed workloads well because processes can quickly resume after each I/O burst, and RR does not favour any specific process.

EP_RR:
This algorithm has the highest throughput, meaning lower PID processes finish sooner and more processes can be completed. However, the algorithm is biased since PID priority influences the CPU scheduling, meaning that processes will have to wait longer than other processes to access the CPU. Therefore, the algorithm would perform best for CPU-bound workloads.

EP:
This algorithm is non-preemptive, meaning that a long CPU burst blocks all other processes until the process can finish. The issue with this algorithm is priority starvation, since lower PID processes are able to finish first due to priority influencing the CPU scheduling. Overall, it is the weakest algorithm in the list works best only when there is a low number of processes or when CPU bursts are small.

BEST SCHEDULER BY METRIC (OVERALL)

Lowest Turnaround Time:	**RR (5.24)**
Lowest Waiting Time:	**RR (1.33)**
Lowest Response Time:	**RR (0.95)**
Highest Throughput:	**EP_RR (0.31)**

Algorithm ranking:

1) Round Robin (RR)

2) EP-RR hybrid

3) Earliest PID (EP)