Operating Systems Laboratory

Lab 4

Scheduling Schemes

Shortest Job First (SJF)

The first scheduling we have implemented is the shortest first job. This policy is non-preemptive in nature. This policy schedules the process with the shortest bust time to minimize the overall waiting time for the processes. But due to the fact that it is non-preemptive, some large jobs can come first and block away the smaller jobs in the queue.

Round Robin (RR)

This is the second scheduling algorithm that we have implemented. This is a preemptive scheduling algorithm. Each of the processes is assigned a fixed amount of time slices to execute after which another process replaces it. This is a fair scheduling algorithm.

Expected Job Characteristics

Shortest Job First (SJF)

1. Low waiting time.
2. Optimal for average turnaround time.
3. Turnaround time for some processes is high, which can lead to starvation.

Round Robin (RR)

1. Low response time.
2. High throughput.
3. No starvation.
4. Equal time sharing.

Observations

Process Data 1 (SJF)

Process	Waiting Time	Turnaround Time	Penalty Ratio
0	4097	803	1.23478
1	4579	871	1.2349
2	1893	370	1.24294
3	1454	349	1.31584
4	308	106	1.52475
5	102	97	20.4
6	2631	1214	1.85674
Average	544.286	2152	4.11699

Average Throughput: 0.00479452

Process Data 2 (SJF)

Process	Waiting Time	Turnaround Time	Penalty Ratio
0	5	0	1
1	146	121	5.84
2	1148	320	1.38647
3	213	78	1.57778
4	2305	472	1.2575
5	441	148	1.50512
6	3878	597	1.18196

7	210	77	1.57895
8	391	192	1.96482
9	438	147	1.50515
10	441	148	1.50512
11	336	116	1.52727
12	339	117	1.52703
13	294	103	1.53927
14	303	106	1.53807
15	174	68	1.5913
16	180	67	1.59292
17	183	68	1.5913
Average	163.444	634.722	1.73417

Average Throughput: 0.0174757

Process Data 3 (SJF)

Process	Waiting Time	Turnaround Time	Penalty Ratio
0	6939	560	1.08779
1	4938	1778	1.56266
2	9435	806	1.09341
3	4231	1507	1.55323
4	4755	322	1.07464
5	6226	1687	1.37167
6	5457	590	1.08779

7	6	0	1
8	42	22	2.1
9	1636	1536	16.36
10	19	9	1.9
11	11651	714	1.06528
Average	794.25	4611.25	2.60732

Average Throughput: 0.00544959

Process Data 1 (RR)

Process	Waiting Time	Turnaround Time	Penalty Ratio
0	1009	1430	3.396675
1	1010	1352	3.953216
2	952	1244	4.260274
3	764	966	4.782178
4	47	61	4.357143
5	26	32	5.333333
6	806	1012	4.912621
Average	576	761	3.874430

Average Throughput: 0.033447

Process Data 2 (RR)

Process	Waiting Time	Turnaround Time	Penalty Ratio
0	3	8	1.600000

1	5	19	1.357143
2	503	705	3.490099
3	82	96	6.857143
4	589	881	3.017123
5	81	95	6.785714
6	592	934	2.730994
7	128	142	10.142858
8	206	244	6.421052
9	104	118	8.428572
10	114	128	9.142858
11	117	131	9.357142
12	108	122	8.714286
13	122	136	9.714286
14	115	129	9.214286
15	135	149	10.642858
16	118	132	9.428572
17	122	136	9.714286
Average	170	226	6.671541

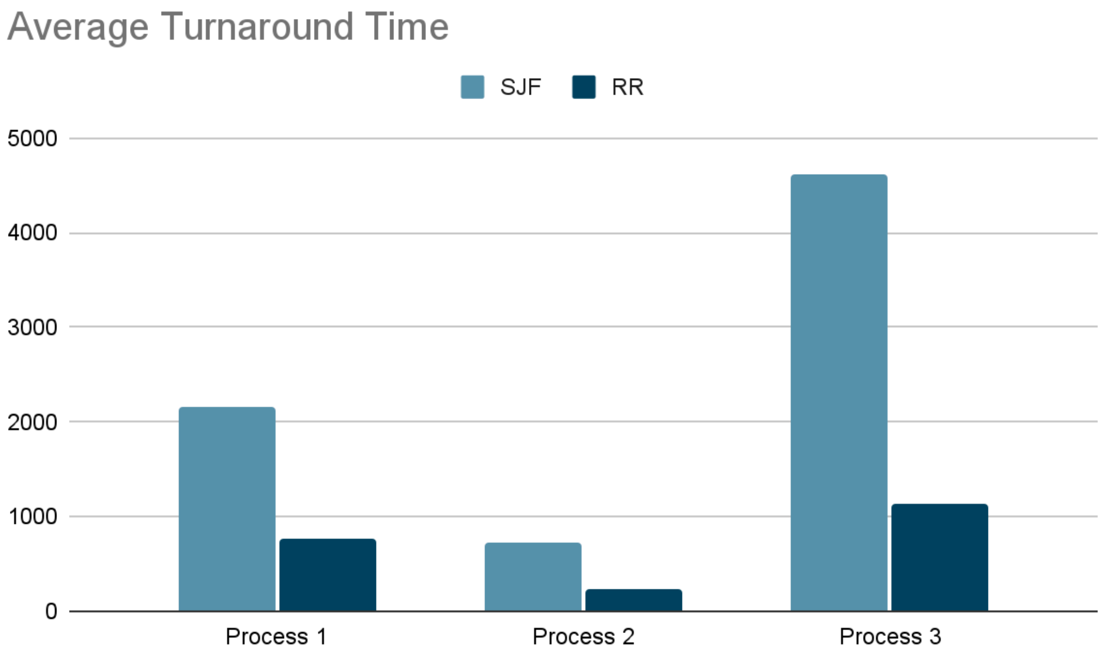
Average Throughput: 0.012356

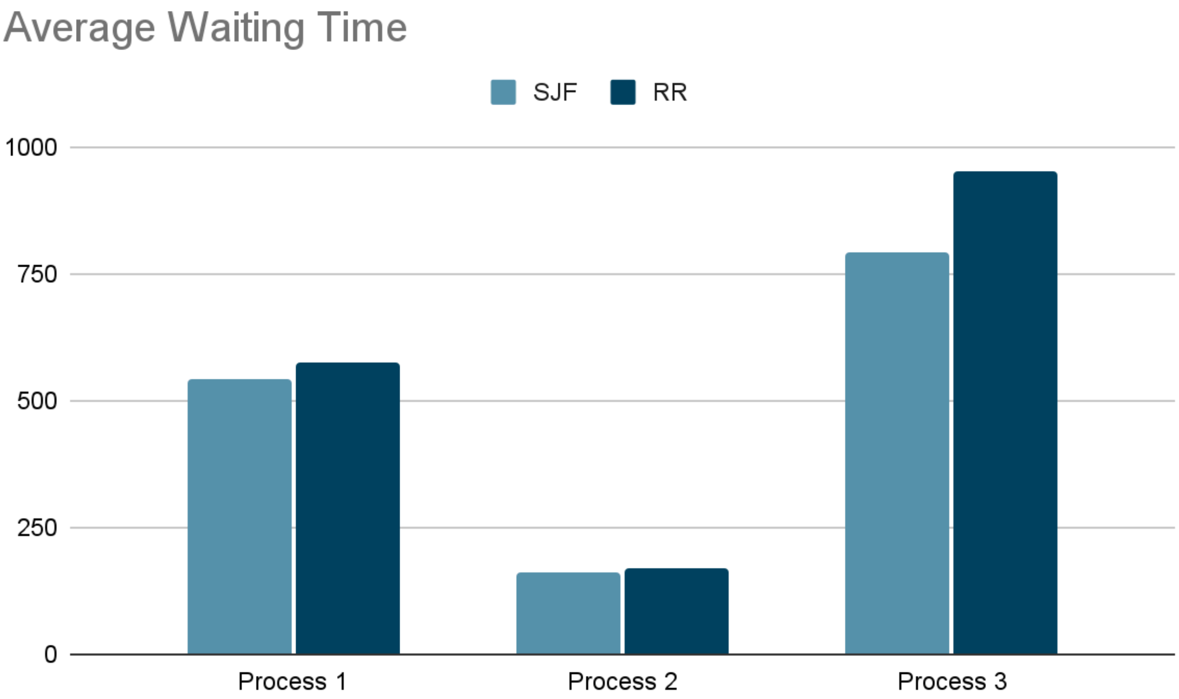
Process Data 3 (RR)

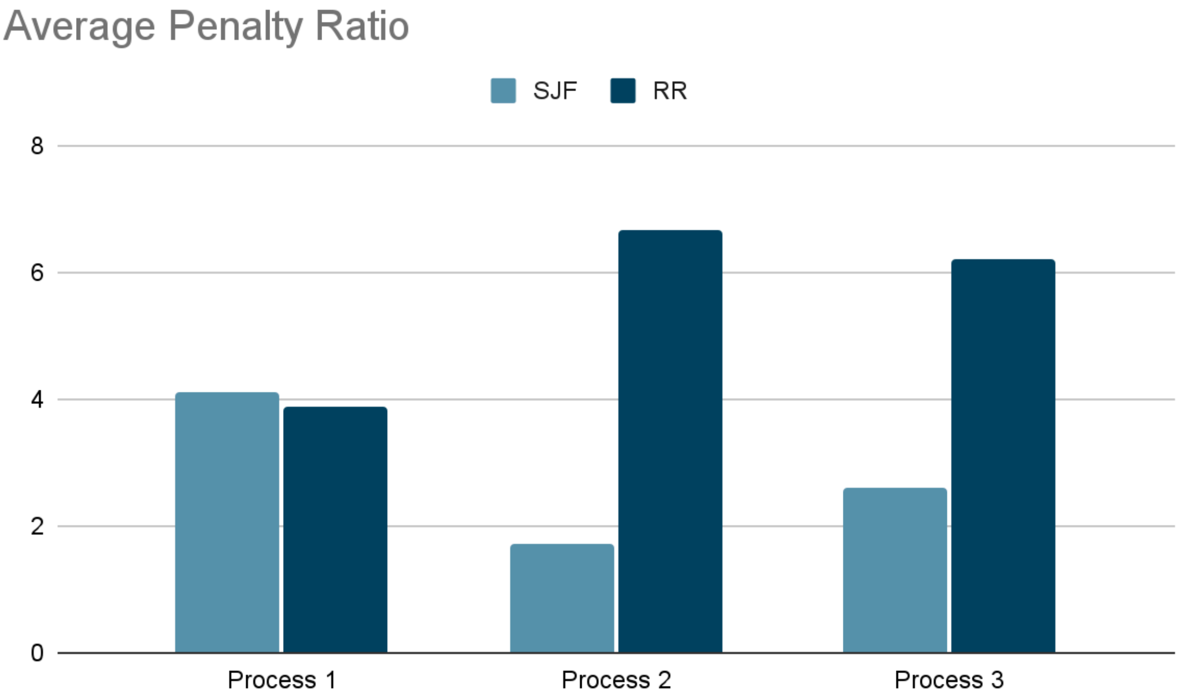
Process	Waiting Time	Turnaround Time	Penalty Ratio
0	1252	1480	6.491228

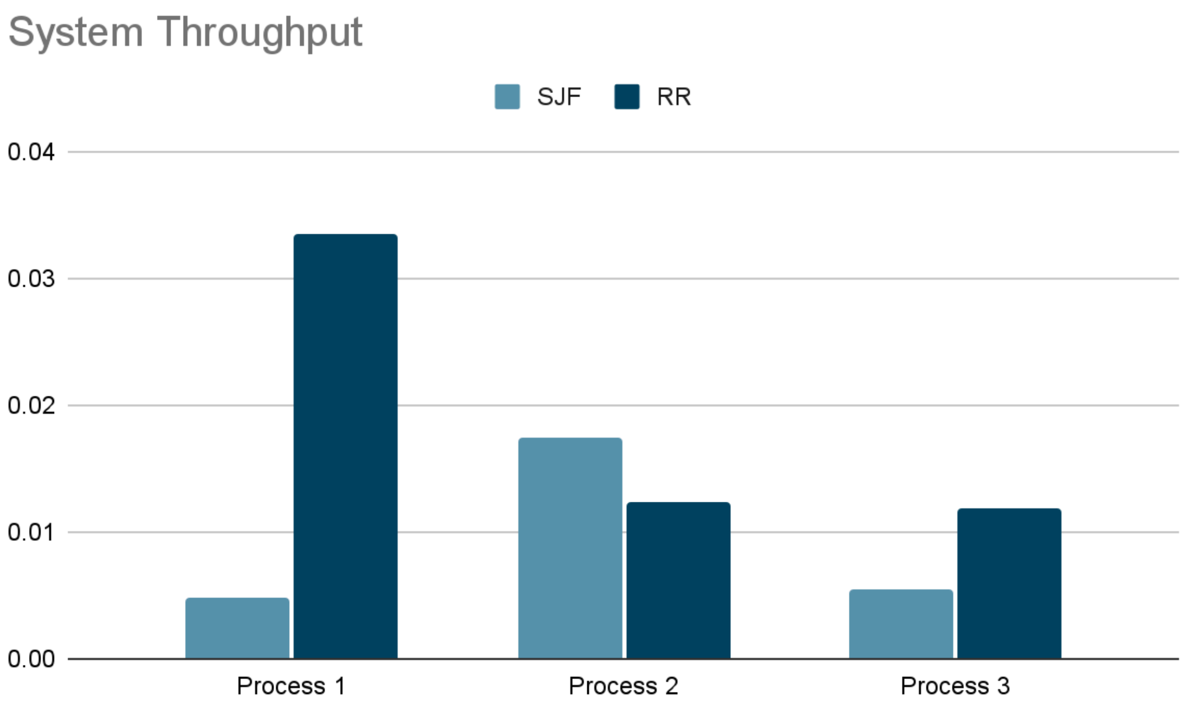
1	1631	1926	6.528813
2	1558	1863	6.108197
3	1196	1365	8.076923
4	966	1136	6.682353
5	1687	2070	5.404700
6	1409	1646	6.945148
7	58	65	9.285714
8	116	177	2.901639
9	805	906	8.970297
10	70	80	8.000000
11	1635	2025	5.192307
Average	952	1133	6.199025

Average Throughput: 0.011813




Average Waiting Time
SJF
RR
1000
750
500
250
0
Process 1
Process 2
Process 3


Average Penalty Ratio
SJF
RR
8
6
4
2
0
Process 1
Process 2
Process 3


System Throughput
SJF
RR
0.04
0.03
0.02
0.01
0.00
Process 1
Process 2
Process 3

Test Processes

Shortest Job First (SJF)

A process test data that suits this scheme

```
0 100 -1
0 5 -1
```

SJF algorithm is best for these kind of processes. SJF will provide very low turnaround time and very optimal performance as the shorter job will get scheduled first.

A process test data that does not suit this scheme

```
0 300 -1
4 10 -1
5 5 -1
10 10 -1
```

In this scheme, the SJF algorithms will starve the small jobs that came after the first big job. This will lead to very high turn-around time for the small processes.

Round Robin (RR)

A process test data that suits this scheme

```
1 2 2 2 2 -1
1 2 2 2 2 -1
1 3 3 3 3 -1
```

In this scheme, the round-robin algorithms provide every job with an equal time slice, and all the jobs have time uniformly distributed so the jobs do not get stuck. Each process will finish smoothly.

A process test data that does not suit this scheme

```
1 100 -1
2 10 -1
3 13 -1
4 12 -1
5 17 -1
6 30 -1
7 50 -1
8 16 -1
9 19 -1
```

In this scheme, the Turnaround time will skyrocket if we try to optimize the responsiveness, and if we try to reduce the turnaround time, then the responsiveness will reduce.

Also, if too many processes arrive, the cost of context switching might significantly impact the system's performance.

Analysis

Shortest Job First (SJF)

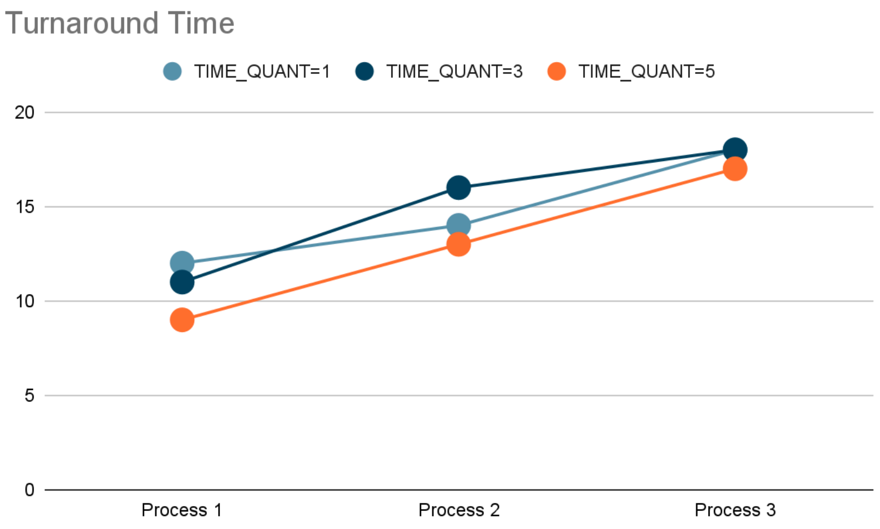
We can see the when we run SJF in the given test cases, the waiting time for the processes is quite low as the scheduler tried to schedule the shortest job first. Due to it being non-preemptive, it schedules some high burst job first, making the turnaround time of other processes higher.

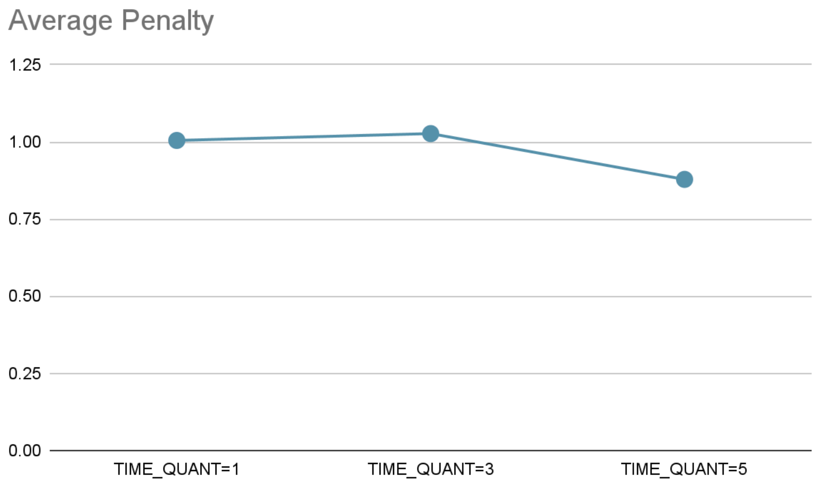
Round Robin (RR)

We can see that when we run the RR on the given test cases, it reduces the turn around time for process by a big margin when compared to SJF. Since this scheduling algorithm is preemptive in nature, it lead to higher penalty ratio as some processes get preempted in middle of their bust and get replaced by another process. If we assume the code of context switch to be very high, this policy will give very low system throughput for small quantum (or time slice). But here the quantum was optimum, which lead to high system throughput.

A process test data that suits this scheme

```
1 2 2 2 2 -1
1 2 2 2 2 -1
1 3 3 3 3 -1
```



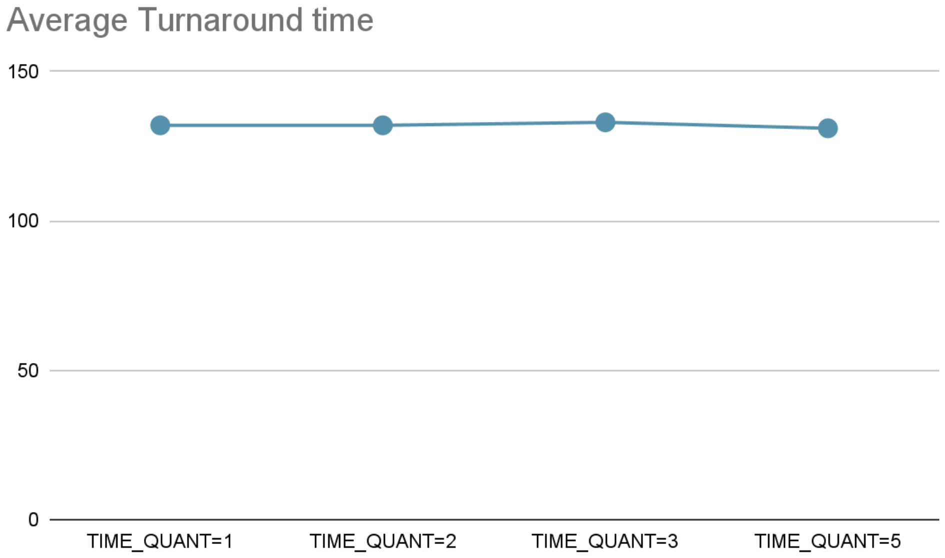


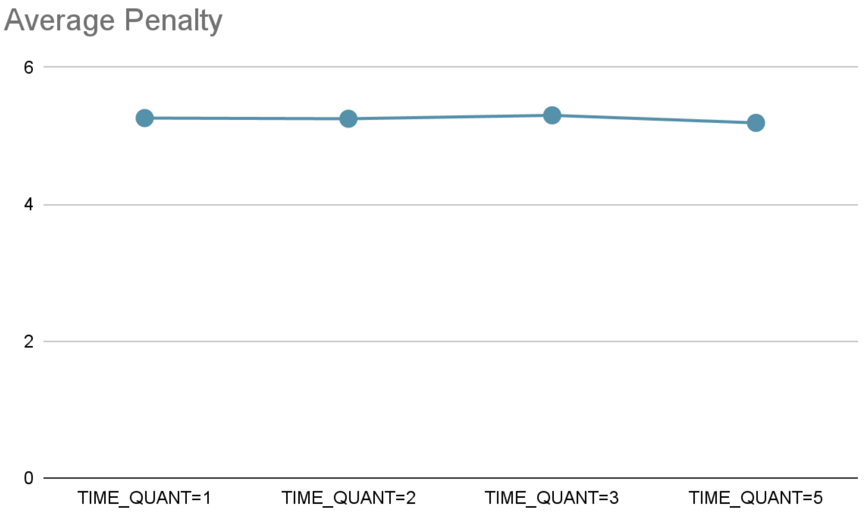
The graphs exhibit a penalty of less than 1 and a turnaround time of less than 20.

A process test data that does not suit this scheme

```
1 100 -1
2 10 -1
3 13 -1
4 12 -1
5 17 -1
6 30 -1
7 50 -1
```

```
8 16 -1
9 19 -1
```





The graphs show high penalties and high turnaround times.