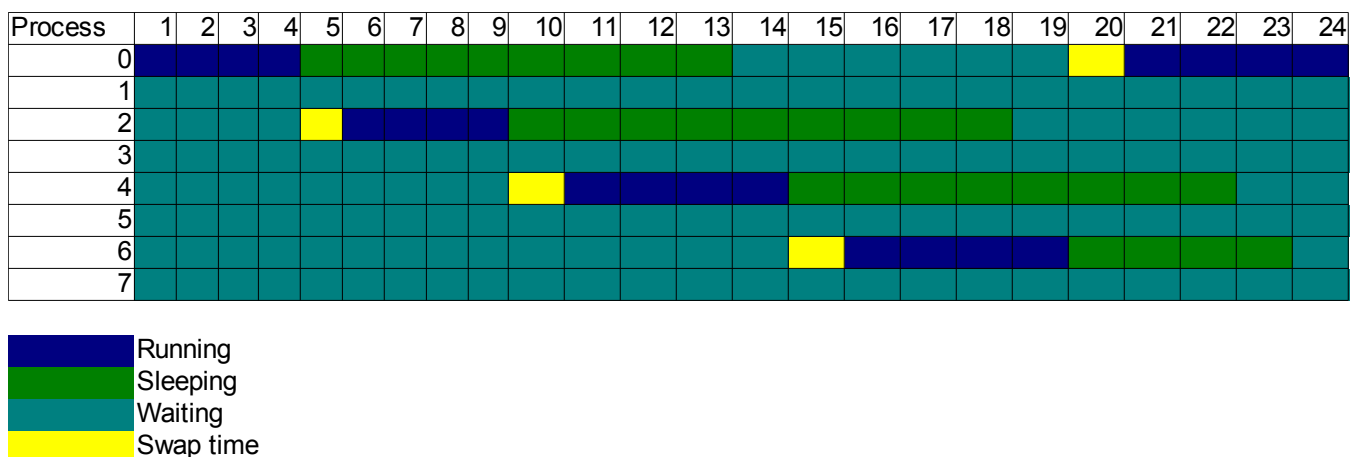


1)

The first thing to realize is that the short processes will starve the longer ones, at least until the time they spend on disk is great enough that larger processes get picked because they are the only ones in the queue.

For example, if we have the disk access time of 9ms, only the three smallest processes will get to run. It would look like this:



We can see that by 20ms, the first process is back and back on the processor.

So, with a 9ms sleep time, each process will eventually either starve or get a response time of approximately 10ms (Process 0 begins what will become a regular schedule, with 6ms of waiting then 4ms of executing).

At 21ms, there will be enough of a gap between when the first process goes to the disk and it's last friend (same burst time) gets on disk. It's only a 1ms window ($4 * 4 = 16$ ms, 4ms of switching), but it's enough to get on the processor. Eventually, all the second-shortest processes will get a chance.

For the longest process, 7, we will need a really long sleep time. We need all other processes to be on the disk. To do that, the disk speed will have to equal the sum of all the process run times plus one, and the context switching time ($4*4 + 3*6 + 7*1 + 1$), so 42 ms.

The CPU utilization, in all cases, will be almost 100%. The only detriment is the context switching. There is never a moment when the CPU doesn't have something to work on.

You could calculate the utilization by summing the number of context switches per cycle, divided by the length of the cycle. For 9ms, it would be about 80% (4 switches for every 24 ms). For 9, it would go higher.

2)

Results for Highest response ratio next Queue with hdd speed of 9

Response time for PID(0)	31.702628
Response time for PID(1)	31.538462
Response time for PID(2)	29.706777
Response time for PID(3)	31.545788
Response time for PID(4)	33.706777
Response time for PID(5)	31.538462
Response time for PID(6)	21.598616
Slowdown for PID(7)	4.725852
CPU Utilization	0.8633767795

Results for Highest response ratio next Queue with hdd speed of 19

Response time for PID(0)	8.884488
Response time for PID(1)	50
Response time for PID(2)	12.884488
Response time for PID(3)	48
Response time for PID(4)	12.084488
Response time for PID(5)	17.605611
Response time for PID(6)	12.884488
Slowdown for PID(7)	2.448639
CPU Utilization	0.8947013731

Results for Highest response ratio next Queue with hdd speed of 39

Response time for PID(0)	4.095952
Response time for PID(1)	22.099025
Response time for PID(2)	8.099025
Response time for PID(3)	28.099025
Response time for PID(4)	12.099025
Response time for PID(5)	28.993994
Response time for PID(6)	16.099025
Slowdown for PID(7)	1.952762
CPU Utilization	0.7839898272

3)

As we increase the time processes spend on the disk, the response time for the processes rapidly decreases. This is because we have fewer processes in the queue, and therefore the ones there get time more frequently. The CPU utilization. Does not change drastically, because we will always have to context switch between at least on process and the scheduler.

Results for Round Robin Queue (quanta 4) with hdd speed of 9

Response time for PID(0)	23.946869
Response time for PID(1)	43.32925
Response time for PID(2)	23.085389
Response time for PID(3)	43.332312
Response time for PID(4)	23.941176

Response time for PID(5)	43.389571
Response time for PID(6)	23.05793
Slowdown for PID(7)	6.207435
CPU Utilization	0.7830049475
Results for Round Robin Queue (quanta 4) with hdd speed of 19	
Response time for PID(0)	16.320082
Response time for PID(1)	31.641481
Response time for PID(2)	14.994903
Response time for PID(3)	31.626667
Response time for PID(4)	16.346939
Response time for PID(5)	31.668148
Response time for PID(6)	15.014286
Slowdown for PID(7)	5.698165
CPU Utilization	0.7823721436
Results for Round Robin Queue (quanta 4) with hdd speed of 39	
Response time for PID(0)	13.501433
Response time for PID(1)	25.52415
Response time for PID(2)	13.577586
Response time for PID(3)	25.569024
Response time for PID(4)	13.529412
Response time for PID(5)	25.185185
Response time for PID(6)	13.599138
Slowdown for PID(7)	3.572846
CPU Utilization	0.7177274787

Bonus

For better CPU utilization, the higher quanta was better. This is because there is less context switching going, and the processes are spending more time on the processor.

For better (lower) response time, the smaller quanta helped. This is because each process got onto the processor more often, and even though it wasn't for as long, it would (theoretically) have an opportunity to respond to any events that it needed to.

To get the lowest slowdown, the higher quanta was better. This is because the computation had more time on the processor to itself, and didn't have to switch out as often.

Results for Round Robin Queue (quanta 2) with hdd speed of 9	
Response time for PID(0)	25.457447
Response time for PID(1)	36.934272
Response time for PID(2)	25.457447
Response time for PID(3)	36.943662
Response time for PID(4)	25.468085
Response time for PID(5)	37.044706
Response time for PID(6)	25.516874
Slowdown for PID(7)	9.375

CPU Utilization	0.6666666667
Results for Round Robin Queue (quanta 2) with hdd speed of 19	
Response time for PID(0)	18.794574
Response time for PID(1)	27.619048
Response time for PID(2)	18.827184
Response time for PID(3)	27.647619
Response time for PID(4)	18.831068
Response time for PID(5)	27.72315
Response time for PID(6)	18.846602
Slowdown for PID(7)	7.324219
CPU Utilization	0.6666666667
Results for Round Robin Queue (quanta 2) with hdd speed of 39	
Response time for PID(0)	16.260989
Response time for PID(1)	22.501458
Response time for PID(2)	16.277473
Response time for PID(3)	22.524781
Response time for PID(4)	16.293956
Response time for PID(5)	22.536443
Response time for PID(6)	16.304945
Slowdown for PID(7)	4.210938
CPU Utilization	0.6184291899
Results for Round Robin Queue (quanta 7) with hdd speed of 9	
Response time for PID(0)	32.302876
Response time for PID(1)	33.377327
Response time for PID(2)	32.455161
Response time for PID(3)	33.376481
Response time for PID(4)	32.457699
Response time for PID(5)	29.721423
Response time for PID(6)	33.260796
Slowdown for PID(7)	5.36658
CPU Utilization	0.8382479013
Results for Round Robin Queue (quanta 7) with hdd speed of 19	
Response time for PID(0)	24.080961
Response time for PID(1)	25.883452
Response time for PID(2)	24.089858
Response time for PID(3)	25.897687
Response time for PID(4)	25.721282
Response time for PID(5)	25.920748
Response time for PID(6)	25.721282
Slowdown for PID(7)	4.365513
CPU Utilization	0.8402147514
Results for Round Robin Queue (quanta 7) with hdd speed of 39	
Response time for PID(0)	22.505631
Response time for PID(1)	19.013528
Response time for PID(2)	19.482456
Response time for PID(3)	19.26743
Response time for PID(4)	20.415385
Response time for PID(5)	19.898958
Response time for PID(6)	19.734375

Slowdown for PID(7)
CPU Utilization

3.244913
0.7661254199