Adam Gincel

CS492

Homework 1

Performance Analysis

*I pledge my honor that I have abided by the Stevens Honor System.*

**Test 1**: 5 Producers, 5 Consumers, 100 products, Queue Size 50, First Come First Serve, Seed 1

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 0.017935 seconds / 0.000017 seconds / 0.042696 seconds  Average/Min/Max Product Wait Time: 0.017915 seconds / 0.000011 seconds / 0.042694 seconds  Total time spent: 2.098297 seconds.  Producer Throughput: 2869.113863 products per minute  Consumer Throughput: 2859.558407 products per minute | Average/Min/Max Product Turnaround: 0.003107 seconds / 0.000030 seconds / 0.008145 seconds  Average/Min/Max Product Wait Time: 0.003086 seconds / 0.000017 seconds / 0.008143 seconds  Total time spent: 2.049135 seconds.  Producer Throughput: 2928.707822 products per minute  Consumer Throughput: 2928.153392 products per minute | Average/Min/Max Product Turnaround: 0.004927 seconds / 0.000061 seconds / 0.008538 seconds  Average/Min/Max Product Wait Time: 0.004907 seconds / 0.000056 seconds / 0.008502 seconds  Total time spent: 2.050217 seconds.  Producer Throughput: 2938.815548 products per minute  Consumer Throughput: 2926.591079 products per minute |

**Test 2**: 50 Producers, 50 Consumers, 1000 products, Queue Size 500, First Come First Serve, Seed 1

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 0.003748 seconds / 0.000387 seconds / 0.006914 seconds  Average/Min/Max Product Wait Time: 0.003727 seconds / 0.000379 seconds / 0.006892 seconds  Total time spent: 2.022871 seconds.  Producer Throughput: 29682.559752 products per minute  Consumer Throughput: 29670.244861 products per minute | Average/Min/Max Product Turnaround: 0.006622 seconds / 0.001407 seconds / 0.040700 seconds  Average/Min/Max Product Wait Time: 0.006599 seconds / 0.001403 seconds / 0.040685 seconds  Total time spent: 2.078831 seconds.  Producer Throughput: 29446.320816 products per minute  Consumer Throughput: 28870.623688 products per minute | Average/Min/Max Product Turnaround: 0.044299 seconds / 0.001565 seconds / 0.100695 seconds  Average/Min/Max Product Wait Time: 0.044276 seconds / 0.001521 seconds / 0.100660 seconds  Total time spent: 2.131288 seconds.  Producer Throughput: 28194.695560 products per minute  Consumer Throughput: 28158.122964 products per minute |

Multiplying values by 10 yields consistent results; took roughly the same amount of time and throughput was multiplied by 10.

**Test 3**: 10 Producers, 3 consumers, 150 products, Queue Size 50, First Come First Serve, Seed 3

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 1.271753 seconds / 0.000524 seconds / 1.703311 seconds  Average/Min/Max Product Wait Time: 1.271730 seconds / 0.000514 seconds / 1.703305 seconds  Total time spent: 5.010868 seconds.  Producer Throughput: 2494.913247 products per minute  Consumer Throughput: 1796.158367 products per minute | Average/Min/Max Product Turnaround: 1.273658 seconds / 0.007803 seconds / 1.701988 seconds  Average/Min/Max Product Wait Time: 1.273634 seconds / 0.007793 seconds / 1.701949 seconds  Total time spent: 5.094727 seconds.  Producer Throughput: 2447.542449 products per minute  Consumer Throughput: 1766.544808 products per minute | Average/Min/Max Product Turnaround: 1.274857 seconds / 0.000331 seconds / 1.725881 seconds  Average/Min/Max Product Wait Time: 1.274833 seconds / 0.000305 seconds / 1.725860 seconds  Total time spent: 5.063269 seconds.  Producer Throughput: 2474.016614 products per minute  Consumer Throughput: 1777.525970 products per minute |

With more producers than consumers, we can see that Consumer throughput is lower, and we can see this took longer than either earlier trial because of the increased wait times.

**Test 4**: 3 Producers, 10 consumers, 150 products, Queue Size 50, First Come First Serve, Seed 3

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 0.000096 seconds / 0.000037 seconds / 0.000548 seconds  Average/Min/Max Product Wait Time: 0.000071 seconds / 0.000022 seconds / 0.000296 seconds  Total time spent: 5.111791 seconds.  Producer Throughput: 1795.454243 products per minute  Consumer Throughput: 1760.692554 products per minute | Average/Min/Max Product Turnaround: 0.000246 seconds / 0.000023 seconds / 0.008031 seconds  Average/Min/Max Product Wait Time: 0.000220 seconds / 0.000015 seconds / 0.007998 seconds  Total time spent: 5.147929 seconds.  Producer Throughput: 1753.708137 products per minute  Consumer Throughput: 1749.499360 products per minute | Average/Min/Max Product Turnaround: 0.000500 seconds / 0.000024 seconds / 0.008358 seconds  Average/Min/Max Product Wait Time: 0.000475 seconds / 0.000020 seconds / 0.008343 seconds  Total time spent: 5.146006 seconds.  Producer Throughput: 1754.375000 products per minute  Consumer Throughput: 1748.969892 products per minute |

With more consumers than producers, we notice that each product has a very short turnaround and wait time, as they are consumed as soon as they are created.

**Test 5**: 5 Producers, 5 Consumers, 100 products, Queue Size 50, Round Robin, Quantum 350, Seed 1

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 0.781816 seconds / 0.000245 seconds / 1.603262 seconds  Average/Min/Max Product Wait Time: 0.781792 seconds / 0.000220 seconds / 1.603225 seconds  Total time spent: 3.608772 seconds.  Producer Throughput: 2992.056359 products per minute  Consumer Throughput: 1662.693841 products per minute | Average/Min/Max Product Turnaround: 0.766367 seconds / 0.000039 seconds / 1.600764 seconds  Average/Min/Max Product Wait Time: 0.766346 seconds / 0.000034 seconds / 1.600762 seconds  Total time spent: 3.619625 seconds.  Producer Throughput: 2873.473892 products per minute  Consumer Throughput: 1657.682976 products per minute | Average/Min/Max Product Turnaround: 0.781993 seconds / 0.000152 seconds / 1.604032 seconds  Average/Min/Max Product Wait Time: 0.781972 seconds / 0.000126 seconds / 1.603994 seconds  Total time spent: 3.642469 seconds.  Producer Throughput: 2947.632367 products per minute  Consumer Throughput: 1647.257009 products per minute |

Using the same numbers as Test 1 except using Round Robin with a quantum of 350, we see that Consumer throughput is lower than Producer throughput simply because each consumer has to take more time to consume any individual quantum. Raising this quantum to a value greater than 1024 would make it operate identically to first come first serve.

**Test 6:** 5 Producers, 5 Consumers, 100 products, Queue Size 50, Round Robin, Quantum 35, Seed 1

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 9.701937 seconds / 0.200424 seconds / 13.720121 seconds  Average/Min/Max Product Wait Time: 9.701900 seconds / 0.200395 seconds / 13.720087 seconds  Total time spent: 27.040465 seconds.  Producer Throughput: 413.195765 products per minute  Consumer Throughput: 221.890725 products per minute | Average/Min/Max Product Turnaround: 9.694392 seconds / 0.200371 seconds / 13.721811 seconds  Average/Min/Max Product Wait Time: 9.694363 seconds / 0.200339 seconds / 13.721742 seconds  Total time spent: 27.060201 seconds.  Producer Throughput: 412.324543 products per minute  Consumer Throughput: 221.728139 products per minute | Average/Min/Max Product Turnaround: 9.713898 seconds / 0.200510 seconds / 13.748695 seconds  Average/Min/Max Product Wait Time: 9.713869 seconds / 0.200485 seconds / 13.748634 seconds  Total time spent: 27.194327 seconds.  Producer Throughput: 411.232454 products per minute  Consumer Throughput: 220.634673 products per minute |

With a quantum of 1/10 of the previous one, we can see that both throughputs go significantly down, as the Producers have to wait longer for the queue to fill up and the Consumers are taking much longer to consume.

**Test 7**: 5 Producers, 5 Consumers, 100 products, Queue Size 0 (unlimited), Round Robin, Quantum 35, Seed 1

|  |  |  |
| --- | --- | --- |
| Average/Min/Max Product Turnaround: 12.421700 seconds / 0.200758 seconds / 25.036181 seconds  Average/Min/Max Product Wait Time: 12.421663 seconds / 0.200721 seconds / 25.036121 seconds  Total time spent: 27.041876 seconds.  Producer Throughput: 2991.850402 products per minute  Consumer Throughput: 221.879723 products per minute | Average/Min/Max Product Turnaround: 12.414643 seconds / 0.200264 seconds / 25.000826 seconds  Average/Min/Max Product Wait Time: 12.414613 seconds / 0.200241 seconds / 25.000774 seconds  Total time spent: 27.045132 seconds.  Producer Throughput: 2929.498767 products per minute  Consumer Throughput: 221.852221 products per minute | Average/Min/Max Product Turnaround: 12.404243 seconds / 0.200423 seconds / 24.964514 seconds  Average/Min/Max Product Wait Time: 12.404214 seconds / 0.200391 seconds / 24.964463 seconds  Total time spent: 27.060943 seconds.  Producer Throughput: 2861.380463 products per minute  Consumer Throughput: 221.722190 products per minute |

By making the Queue Size unlimited, we can see our Producer Throughput shoot up, as the producers are no longer limited by the slow consumers. The consumer throughput stays basically the same, and the execution time is basically identical, which proves the consumers were the bottleneck.

**Test 8**: 500 Producers, 100 Consumers, 200000 products, Queue Size 10000, First Come First Serve, Seed 1

Average/Min/Max Product Turnaround: 9.842459 seconds / 0.037945 seconds / 11.689640 seconds

Average/Min/Max Product Wait Time: 9.842437 seconds / 0.037908 seconds / 11.689624 seconds

Total time spent: 203.204392 seconds.

Producer Throughput: 61988.274178 products per minute

Consumer Throughput: 59053.891679 products per minute

A large test to make sure the program could handle large loads. Interesting to note that Consumer and Producer throughputs were very similar despite the disparity between the number of producers and consumers.