

Lab 3 Report

ECE254



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UWaterloo

Zahin Mohammad, Minghao Lee

**Lab 3 Stats:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **N** | **B** | **P** | **C** | **AVG Time**  Processes | **AVG Time**  Threads | **STD Time**  Processes | **STD Time**  Threads |
| 100 | 4 | 1 | 1 | 15.394694 | 18.271276 | 3.16425013 | 2.78711728 |
| 100 | 4 | 1 | 2 | 15.491816 | 16.40133 | 4.01192172 | 4.08294235 |
| 100 | 4 | 1 | 3 | 19.819686 | 15.003216 | 4.29685812 | 2.72242077 |
| 100 | 4 | 2 | 1 | 19.961146 | 17.951596 | 4.89742728 | 2.82672831 |
| 100 | 4 | 3 | 1 | 19.579208 | 18.848402 | 5.50861545 | 2.32825814 |
| 100 | 4 | 2 | 2 | 20.037968 | 17.926262 | 3.98607911 | 3.13730815 |
| 100 | 4 | 3 | 3 | 23.990856 | 17.47346 | 3.21538919 | 2.04846435 |
| 100 | 8 | 1 | 1 | 21.838822 | 16.921692 | 4.33415459 | 2.83961686 |
| 100 | 8 | 1 | 2 | 18.420256 | 16.280728 | 4.20879143 | 2.91078368 |
| 100 | 8 | 1 | 3 | 19.02039 | 16.383124 | 4.26845067 | 3.25995789 |
| 100 | 8 | 2 | 1 | 19.85311 | 17.634148 | 5.63183324 | 3.49488044 |
| 100 | 8 | 3 | 1 | 20.05484 | 19.050412 | 5.38729711 | 2.33154648 |
| 100 | 8 | 2 | 2 | 18.29362 | 16.81041 | 3.9830807 | 2.89034548 |
| 100 | 8 | 3 | 3 | 23.056076 | 17.588156 | 3.67544434 | 2.32839468 |
| 398 | 8 | 1 | 1 | 48.47887 | 38.035058 | 13.7589338 | 10.4998442 |
| 398 | 8 | 1 | 2 | 49.222884 | 38.544808 | 11.5672543 | 9.82696234 |
| 398 | 8 | 1 | 3 | 55.66906 | 39.248046 | 13.3072927 | 8.48848417 |
| 398 | 8 | 2 | 1 | 52.25754 | 44.897082 | 17.0586843 | 11.5030619 |
| 398 | 8 | 3 | 1 | 57.157522 | 43.300432 | 18.4468181 | 11.3451655 |
| 398 | 8 | 2 | 2 | 51.119446 | 40.635418 | 13.9866045 | 9.56382552 |
| 398 | 8 | 3 | 3 | 46.604294 | 43.899142 | 10.791907 | 8.64969359 |

Table of average timing and standard deviation measurement:

**Lab 3 Analysis:**

* Compare the timing results of multi-thread with shared memory and multi-

process with message queue. Discuss the advantages and disadvantages of these

two approaches to solve the same problem.

A close up of a map

Description automatically generated

A close up of a mans face

Description automatically generated

The buffer size wouldn’t affect the average time for both multi-thread and multi-process.

A close up of text on a white background

Description automatically generated

When Buffer size is 8 and producer is 1, the average time of the threads with the shared memory is much faster than the average time of the processes with the message queue. More consumers would slow the average time.

A close up of a map

Description automatically generated

When Buffer size is 8 and consumer is 1, the average time of the threads with the shared memory is much faster than the average time of the processes with the message queue. More producers would slow the average time.

A close up of a mans face

Description automatically generated

When there are three producers and three consumers, the average time of multi-thread with shared memory is much faster than the average time of multi-process with message queue.

**Advantages and disadvantages:**

**Threads with shared memory:**

Shared memory is faster than message queue for read or write operation.  But each access is treated as one normal memory access and system call is required when creating the shared memory. The data is not safe in shared memory region, which can be modified by any thread that accesses the shared memory and it’s not the data owner.

**Processes with message queue:**

The queue can make sure that every operation wouldn’t alter the queue when it processes the message in the queue successfully or fail. No conflicts need be avoided. The message queue is much easier to implement compared to shared memory. And we don’t need to worry about the detail protections. However, the access speed would be slower than shared memory by read or write, which is typically a single message.

* Compare how each variable (N/B/P/C) affects the timing of the applications

The larger number of tasks (N) would increase the average time. It would take larger time to finish all tasks.

The buffer size (B) wouldn’t affect the average time for both multi-thread and multi-process.

The larger number of producers (P) would increase the average time with the same number of consumers. Producer should wait for free space in buffer and get blocked. This can slow the program to finish all tasks.

The larger number of consumer (C) would increase the average time with the same number of producers. Consumer would wait for the specific task, which is assigned. Otherwise, the consumer is going to be blocked and wait for its assigned task. The waiting time would increase the program time.

The Average time is able to provide more accuracy for the time results. The standard deviation time represents a quantity calculated to indicate the extent of deviation for a group of the time results across 500 times.