

CSC 447: Parallel Programming for Multicore and Cluster Systems

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Lab 3

Consumer-Producer Problem

Due: March 17, 2022

The producer–consumer problem is a common implementation pattern for cooperating threads. The problem is defined as follows:

1. The producer and consumer run concurrently, and share a common buffer;
2. The consumer does consume an item that has not yet been produced;
3. The common data buffer is bounded. Thus, the consumer process must wait if the buffer is empty, and the producer process must wait if the buffer is full.

The starter code that is provided include C code for the above-described consumer-producer problem. The producers place integers into the queue starting at 0 and ending at some predefined maximum while the consumers remove one integer at a time from the queue, reporting each as it is consumed. Each consumer exits after the predefined maximum total removals by all consumers.

The starter solution has race conditions and uses busy waiting. Modify the code so that:

- 1) It models a networking system where producers and consumers correspond to routers;
- 2) Messages are created randomly using the Mersenne Twister;¹
- 3) Assume there is a many-to-many relationship among the producers and consumers. That is, the producers can randomly produce a message that is randomly addressed to any consumer;
- 4) it uses condition variables. The producer and consumer should not spin until the condition they are waiting on is met but should actually block their own execution. They should be signaled to wake up when that condition is satisfied. The code has initialized all the mutexes and condition variables you should need;
- 5) Consumers cannot be producers or vice versa.

Start your simulation using one producer and one consumer. Repeat this exercise for n producers and 1 consumer, and then for n consumer and m producers. Time your simulation time and plot the results. Please complete your report and submit to Google Classroom.

¹ <http://www.math.sci.hiroshima-u.ac.jp/m-mat/MT/VERSIONS/C-LANG/c-lang.html>