# Assignment 3 2INCO

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## 1. Overview

There were 2 main challenges while writing this program:
1. Order threads
2. Setup buffer

## 2. Order threads

The threads are ordered by using conditional variables. All threads will block unless the value they got is the next to be placed in the buffer, the desired value. If a thread has the desired value it adds its value to the buffer and increases the value that is desired by one. After this it triggers a broadcast which wakes up all producer threads that possibly have the next desired value. This continues until the value they get is equal to the number of items or max value of item plus one.

## 3. Setup buffer

The exercise dictated that a buffer should be used to move data from multiple producer threads to a single consumer thread. To accomplish this a circular buffer was made. Both the lower bound index and the upper bound index are being tracked to see which part of the buffer is used. Whenever an item is added the item is placed on the upper bound and the value is increased by one. If an item is removed the value on the lower bound is returned and the lower bound value is also increased. Whenever the value of both the lower bound or upper bound exceeds the buffer size its value is set back to the start of the buffer using a modulo operation.

2 semaphores are also included to block the thread when an item is added while the buffer is full or when an item is removed while the buffer is empty. This ensures that busy waiting is not necessary while interaction with the buffer is not possible.

The upperbound value is only used for adding values, while the lower bound is used for removing items. The semaphores keep track of the limits of the buffer. Both adding and removing of items can be done concurrently. This result in the consumer thread only blocking when the buffer is empty. However, adding and removing can be done concurrently it is not possible to add to the buffer concurrently by multiple threads, because the upper bound value will then be used by multiple threads. However, this is not a problem because adding something to the buffer is done in the critical section of the producer thread.