**Pthreads Prime: A Producer/Consumer Simulation**

**Introduction**

Pthreads Prime is a simulation program that explores process synchronization using Pthreads. The program simulates the Producer/Consumer problem, which is a representative of operating systems. The purpose of this programming project is to write a simulation program on the Producer/Consumer problem with a prime number detector. The program is implemented using Pthreads and provides synchronization between the producer and consumer using the algorithms similar to those in Figure 5.10 and 5.11.

**Problem Description**

The Producer/Consumer problem is a classic problem in computer science, which involves two processes, the producer, and the consumer, sharing a common buffer. The producer generates items, while the consumer consumes items. The problem is to synchronize the producer and consumer processes such that the consumer process never tries to consume an item that has not been produced, and the producer process never tries to produce an item when there is no room in the buffer.

In this simulation, we use a fixed-size array of integers as a buffer. The producer process generates random numbers and inserts them into the buffer. The consumer process removes numbers from the buffer and checks if they are prime. The buffer is manipulated with two functions, **buffer\_insert\_item()** and **buffer\_remove\_item()**, which are called by the producer and consumer threads, respectively.

**Implementation Details**

The program is implemented using Pthreads, a POSIX standard for thread-based parallelism. The producer and consumer threads are created using the **pthread\_create()** function, and synchronization is provided using mutex locks and semaphores.

The program accepts command-line arguments, including the simulation length in seconds, the maximum length of time the producer and consumer threads will sleep, the number of producer threads, the number of consumer threads, and a flag to output the individual buffer snapshots for each item produced and consumed.

The program output shows the progress of the simulation, including the number of items produced and consumed, the number of times the buffer was full and empty, and the remaining items in the buffer.

**Requirements**

The program is written in C/C++ and requires a POSIX-compliant operating system with the Pthreads library.

**Usage**

1. Compile the program using a C/C++ compiler with Pthreads library support.
2. Run the program with command-line arguments specifying the simulation parameters.
3. View the program output to see the progress of the simulation and the final statistics.

**Conclusion**

Pthreads Prime is a simulation program that provides a practical implementation of the Producer/Consumer problem with a prime number detector. The program uses Pthreads for thread-based parallelism, and synchronization is provided using mutex locks and semaphores. The program output shows the progress of the simulation, including the number of items produced and consumed, the number of times the buffer was full and empty, and the remaining items in the buffer.