BIRZEIT UNIVERSITY
Electrical and Computer Engineering Department

ENCS339 Operating Systems Spring 2022/2023

Assignment I

Shared Memory

Task:

Implement a solution to the bounded buffer producer-consumer problem using shared memory and fork/exec functions in C programming language. The producer should fork a consumer process and use exec() to replace the child process with the suitable consumer code.

Problem Description:

The bounded buffer producer-consumer problem involves a shared circular buffer where producers add items to the buffer and consumers remove items from the buffer. The buffer has a fixed capacity and the producers and consumers must coordinate to ensure that the buffer does not overflow (i.e., the producers must wait when the buffer is full) or underflow (i.e., the consumers must wait when the buffer is empty).

In this version of the problem, shared memory is used to store the circular buffer and the synchronization objects. However, semaphore or mutex should not be used to solve the synchronization problem.

Requirements:

1. Implement a circular buffer with a fixed size N (e.g., N=10) using shared memory.
2. Implement a producer function that adds items to the buffer.
3. Implement a main function that creates a consumer process using fork() and starts it using exec() with the suitable consumer code.
4. Ensure that the producers wait when the buffer is full and the consumers wait when the buffer is empty.
5. Ensure that the producers and consumers do not access the buffer at the same time (i.e., mutual exclusion).
6. Ensure that the shared memory is properly initialized and cleaned up.
7. Test your solution with multiple producers and consumers and verify that it works correctly.
8. Implement a consumer code (separate C program) (to be copied to the child that you created you step 3) that removes items from the buffer.
9. Make your program pause/resume the producer when you hit the “p” key and pause/resume the consumer when you hit the “c” key.

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Deliverables:

1. Submit a C source code file containing your solution.
2. Submit a short report explaining your solution and any challenges you faced while implementing it.
3. Submit a set of test cases that you used to verify your solution.
4. Submit a video demo of your solution in action, showing multiple producers and consumers working correctly.
5. Be ready for discussion any time.

Due date:

The deadline is strict. This assignment is due Saturday May 6th 23:59.

Teamwork:

Find ONE partner to work with you. In the report, clearly state the roles for both of you.

Plagiarism:

Plagiarism is strictly prohibited. If a team has cloned others' work, the team will gain ZERO.