EXERCISE #1

The following is the solution for “Producer & Consumer Problem” we built on February 15th (the one that prevents the race condition and spin-waits).

**Problem: CFQ (Circular Fifo Queue)**

**BASE SOLUTION: “SOLUTION #2”**

```c
void producer (void)
{
int new_item;         // a place holder for a new item
for (i = 0; i < NUM_REPEAT; i++)
{
new_item = rand(); // generate a piece of data
wait(EMPTY);
shm->CFQ[shm->Tail] = new_item; // insert the new item
shm->Tail = (shm->Tail + 1) % N; // update the tail pointer
wait();
shm->empty = shm->empty - 1; // empty slots is decreased by one
signal();
signal(FULL);
}
}

void consumer (void)
{
int new_item;         // a place holder for a new item
for (i = 0; i < NUM_REPEAT; i++)
{
wait(FULL); // wait for some data
new_item = shm->CFQ[shm->Top]; // remove the first item in the CFQ
shm->Top = (shm->Top + 1) % N; // update the top pointer
wait();
shm->empty = shm->empty + 1 // empty slots is decreased by one
signal();
signal(EMPTY);
}

do_something(new_item);
}
```

**Shared memory (“shm”)**

- **SEMAPHOR S = 1;** // binary semaphore
- **SEMAPHOR EMPTY = N;** // counting semaphore
- **SEMAPHOR FULL = 0;** // counting semaphore

Assuming that we have only one producer and one consumer,

**Question #1:** Is it possible to eliminate “S” (mutex) semaphore?

(a) If yes, explain “how” and why is it OK?

(b) If no, explain why not?
**Question #2:** If it is possible to eliminate “S” (mutex) semaphore, is there any merit (advantage) in eliminating the semaphore?

(a) If yes, explain “why” (or “how is it an advantage”).

(b) If not, explain why not.

**EXERCISE #2**

For the same solution for the solution for “Producer & Consumer Problem” (shown for EXERCISE #1):

Assuming that we have more than one producer and more than one consumer,

**Question #1:** Is it possible to eliminate “S” (mutex) semaphore?

(c) If yes, explain “how” and why is it OK?

(d) If no, explain why not?

**Question #2:** If it is possible to eliminate “S” (mutex) semaphore, is there any merit (advantage) in eliminating the semaphore?

(c) If yes, explain “why” (or “how is it an advantage”).

(d) If not, explain why not.