CSci 144 Introduction to Operating Systems
Quiz 3, October 17, 2016

1. (0.4 points) What are the four necessary conditions of deadlock?

   (i) __Limited Resources_____

   (ii) ___No Preemption_____

   (iii) ___Hold while waiting_____

   (iv) ____Circular Waiting_____

2. (0.6 point) Please fill in the missing part of the following pseudo code for bounded buffer problem, assuming Mesa Semantics for condition variable.

```
get() {
    lock.acquire();

    while (front == tail) {
        empty.wait(&lock);
    }
    item = buf[front % MAX];
    front++;
    full.signal(&lock);
    lock.release();
    return item;
}
```

```
put(item) {
    lock.acquire();
    while ((tail – front) == MAX) {
        _full.wait(&lock)__;
    }
    buf[tail % MAX] = item;
    tail++;
    _empty.signal(&lock)__;
    lock.release();
}
```

Initially: front = tail = 0; MAX is buffer capacity and empty/full are condition variables

3. (0.4 point) Suppose there are two threads A and B. Both threads need to acquire lock1 and lock2 before moving forward. Write the pseudo code (**just the lock variable part**) that prevents deadlock from happening.

Thread A	**Thread B**
Lock1.acquire(); Lock2.acquire(); ….. Lock2.release(); Lock1.release();	Lock1.acquire(); Lock2.acquire(); ….. Lock2.release(); Lock1.release();

4. (0.6 point) Consider a communal dining philosopher problem where *m* chopsticks are placed in middle of a table for *n* philosophers, each can take one chopstick at a time.

   (a) What is the minimum *m* to prevent deadlock? Why?

   m>=n+1 to prevent deadlock.
   Justification: in this case, at least one philosopher will have 2 chopsticks and therefore be able to continue and eventually release more chopsticks to the table, leading to a better situation for resource sharing.

   (b) If each philosopher is required to take-all-or-none, i.e., either taking two chopsticks at a time or not taking none, what is the minimum *m* to prevent deadlock? Why?

   m=2
   Justification: 2 chopsticks at least so that at least one philosopher can continue and eventually release those chopsticks to the table, allowing more philosophers to continue.