#1 Reader Writer (Writers priority implementation)

```
int writers; // # writer threads that want to enter the critical section (some or all of these may be blocked)
int writing; // Number of threads that are actually writing inside the C.S. (can only be zero or one - can you see why?)
int reading; // Number of threads that are reading inside the C.S.
int readers; // Number of threads that are or want to read

// if writing !=0 then reading must be zero (and vice versa)
```

```
reader() {
    lock(&m)
    readers ++                          (don't want reader's to read in between writers.)
    while (writer>0                     )
        cond_wait(&r_cv, &m)

    Do we need to wait for
    both 'writers' and 'writing'?

    reading++
    unlock(&m)

  // perform reading here   <- (we want these two sections to be logically exclusive.)

    lock(&m)
    reading--
    readers--
    wake up who here? (and how many)
    (wake up one writer
    if (writer>0 && reading==0)
        p_c_signal(&w_cv)

    unlock(&m)
    return result
}
```

```
writer(){
    lock(&m)
    writers++
    while (reading>0 || writing>0       )
        cond_wait(&w_cv, &m)

    writing++
    unlock(&m)

  -> // perform writing here

    lock(&m)
    writing--
    writers--
    wake up who here? (and how many)
    (wake up one writer & all readers
    if (writers) { p_c_signal(&w_cv)
    else if (readers) p_c_broadcast(&r_cv)

    unlock(&m)
}
```

DEADLOCK

#2 Deadlock Definition:

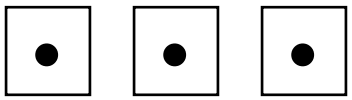
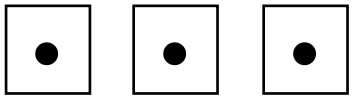
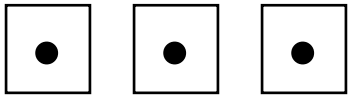
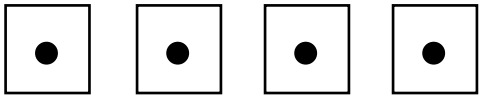
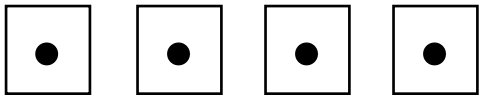
#3 Coffman Conditions

	Necessary? Y/N	Sufficient? Y/N
1		
2		
3		
4		

#4 Resource Allocation Graphs

Figure 1. Deadlock do not confuse it with dreadlocks.
Assume processes acquire locks in the order specified and release resources only when finished. Create a *resource allocation graph* to determine if and when there is deadlock.

When a process waits for a resource it will acquire an exclusive lock on resource as soon as no other process has an exclusive lock. Assume locks are fair (earliest waiting process obtains the lock).

Q1 Process 1 ("P1") requests (and obtains) Resource A and then Resource B Process 2 requests C and then B. Deadlock for P1? P2?	
Q2 P1 requests (and obtains?) A P2 requests (and obtains?) B P3 requests (and obtains?) C P2 requests (and obtains?) C P3 requests (and obtains?) A P1 requests (and obtains?) C	
Q3 P1 requests A then B P2 requests C then B P3 requests B P4 requests C then B Deadlock for P1? P2? P3? P4?	
Q4 P1 requests A then B P2 requests C, D then B P4 requests D P3 requests B P1 requests C Deadlock for P1? P2? P3? P4?	
Q5 P1 requests A and B P2 requests C and D then B P4 requests D P3 requests B P1 *releases* B (thus P2 acquires B) P1 requests C Deadlock for P1? P2? P3? P4?	

#5 What is the Banker's Algorithm?
#6 Deadlock Avoidance
#7 Linux/Windows strategy for deadlock avoidance?
#8 Acquiring resources in same rank