CMPS111 Homework #2
Fall 2008

Out: Oct 28
Due: Nov 4, 11:59pm

Please read the general homework page for guidelines and submission information. Homework must be submitted online.
All work on this homework must be your own. Please read (and follow!) the academic honesty policy for this class.

1. In class, we discussed the readers/writers synchronization problem. We noted that a writer might "starve" if a continuous stream of readers kept arriving, never releasing the system to the writer. Modify the code for the readers/writers problem so that writers cannot starve. In particular, a writer should go before all readers that arrive after the writer arrives. The system must otherwise work the same way it does currently. You may assume that semaphores keep waiting processes in a FIFO (simple FCFS queue).

2. On a distant planet, there are three genders. They must share a single bathroom with infinite capacity; unfortunately, only members of a single gender may be in the bathroom at any given time (the aliens are *very* concerned about privacy). As a result, the bathroom is in one of the following states:

- Empty
- In use by gender 1
- In use by gender 2
- In use by gender 3

A single alien executes the following "code" to use the bathroom:

```
EnterBathroom(my_gender);
DoMyBusiness();
LeaveBathroom(my_gender);
```

Write the code for `EnterBathroom(int gender)` and `LeaveBathroom(int gender)` so that an alien sleeps when waiting for the bathroom. You may use any semaphores or counters you might need to solve the problem. Does your solution generalize to *n* genders?

3. Bank of America processes millions of transactions per day, each of which transfers money from one account to another account. Accounts are identified by (unique) 12 digit numbers. During a transaction, both debit account *D* (the one from which the money is coming) and credit account *C* (the one to which the money is going) must be locked by the process doing the transaction. In order to run faster, BofA does many transactions in parallel (one transaction per process). If a process needs a lock that is not available, the process waits for the lock to become available. There is a very real possibility for deadlock here because many accounts have hundreds or thousands of transactions per day (businesses), and there's a chance of a cycle in the lock graph. How could BofA fix things so that deadlock is impossible? It is *not* acceptable to release a lock on an account without completing a transaction (so you can't use two phase locking); in other words, solutions that lock one account and release it if the second account is already locked are not allowed.

4. Consider the following snapshot of a system:

Process	Allocation				Max			
	A	B	C	D	A	B	C	D
P0	0	0	1	0	6	7	3	0
P1	1	0	0	2	2	0	0	2
P2	3	6	0	2	5	6	0	2
P3	5	3	1	4	6	3	3	6
P4	1	0	0	4	6	6	2	6

Currently, the available resources are: 3-A, 5-B, 1-C, and 0-D. Answer the following questions, assuming you're using the banker's algorithm to manage resources and avoid deadlock:

a. How many of each resource are there in the system?
b. What is the content of the Need matrix?
c. Is the system currently in a safe state? Explain.
d. If process P2 requests an additional 2 units of B, can this request be granted immediately? Explain.

5. From the book: #5.7

6. From the book: #5.11

7. A local area network is used as follows:
The user issues a system call to write data packets to the network. On machine 1, the OS then copies the data to a kernel buffer. Then it copies the data to the network controller board. When all bytes are safely inside the controller, they are sent over the network at a rate of 10 megabits/sec (Mbps). On machine 2, the receiving network controller buffers each bit until 1 full packet is received. Each bit is stored 1μs after it is received. When the last bit arrives, the destination CPU is interrupted, and the kernel copies the newly arrived packet to a kernel buffer to inspect it. Once the kernel has figured out which user the packet is for, the kernel copies the data to user space. Assume each interrupt takes 1ms to process, packets are 1024 bytes, copying a byte takes 1μs, and 1 complete packet of data starts inside the user process' buffer on machine 1. How long does it take for 1 packet sent by a user on machine 1 to completely transfer to a user on machine 2?

8. Disk requests come to the disk driver for cylinders in this order: 10, 20, 22, 2, 40, 6, 38, and 21. A seek takes 6ms per cylinder moved. If the disk arm is currently at cyliner 20, how much seek time is needed for the following:
a. First come, first served (FCFS)?
b. Closest cylinder next?
c. Elevator algorithm (initially moving upward)?

9. From the book: #5.25

10. From the book: #5.27