CS414 MIDTERM

Name: **Net Id:**

This exam is closed book. It has 9 questions, and 30 points. You have 50 minutes to answer all questions. Show your work for partial credit.

1. Answer TRUE or FALSE (**1 for a correct answer, -0.5 for an incorrect answer**) **[10]**

   a. Monitors avoid deadlocks.

   b. Ethernet ensures that a packet is always delivered to the destination.

   c. UDP is an end-to-end protocol.

   d. Microkernels differ from other OS models in that they try to modularize all the components of the kernel

   e. Multiple processes can share the same program code.

   f. The many-to-one threading model usually gives more parallelism compared to the many-to-many model.

   g. Pooling of threads helps reduce the context switch overhead.

   h. The average waiting time under FCFS scheduling depends on the arrival order of processes.

   i. Round-robin scheduling has better turnaround and response time than SJF scheduling.

   j. FCFS is the best scheduling strategy for the Producer Consumer problem.

2. In 1966, *Communications of the ACM* published this incorrect solution to the **two process** mutual exclusion problem.

```
Shared: boolean blocked[2];
        int turn;

Init: blocked[0] = false;
      blocked[1] = false;
      turn = 0;
```

```
P(i) {
    while(true) {
        blocked[i] = true;
        while(turn != i) {
            while(blocked[1-i]) ;
             turn = i;
         }
         /* critical section */
         blocked[i] = false;
    }
}
```

Assuming load/stores are atomic operations show a counterexample that demonstrates that this solution is incorrect. **[4]**

3. Consider a modified definition of semaphore operations P() and V():

```
P(S) {
    if(S.value > 0) {
        S.value--;
    } else {
        Add process in S.list;
        Block();
    }
}
```

```
V(S) {
    if(∃ blocked processes on S) {
        remove process from S.List;
        put process in ready list;
    } else {
        S.value++;
    }
}
```

Are these definitions functionally equivalent to their blocking definitions discussed in class? **[4]**

4. A restaurant, *Deadlock Free Eatery*, aims to prevent deadlocks when serving its patrons. As a first-step to achieve its goal, *Deadlock Free Eatery*, has introduced the following rule: all patrons are served their maximum resource demands all at once. So, if a patron will require 3 bowls during their meal, they are all served all at once. Similarly, if she requires 4 forks during the course of the meal (2 initially, 2 for dessert!), she is given all at once. Does this condition avoid deadlocks? **[2]**

5. Let's compare round-robin scheduling vs. first come first served scheduling. Describe an application that works with round robin scheduling but crashes a system with FCFS. **[2]**

6. The MAC layer, such as Ethernet or IEEE 802.11, has a retransmission mechanism to increase the reliability of packet delivery. If the source and destination are on the same LAN, comment on the importance of TCP's acknowledgement mechanism. **[2]**

7. Why is there a limit to the length of the cable in the Ethernet network? **[1]**

8. Why do browsers make connections to a fixed port (here 80) of the web server? **[1]**

9. Solve the following synchronization problem using monitors: There are three changing rooms in *Kool & Funky Apparel*, which have an interesting rule for trying out clothes. Either all three changing rooms are occupied by women, or all of them are occupied by men. A combination of men and women is not possible. People are served in the order in which they arrive. So, if women are trying out clothes, and a woman arrives, then she is given the opportunity to try out her dress if there is a changing room available. Else she waits for a woman to come out of the changing room before she can enter. However, if a man arrives at the head of the queue, and if there are women in the changing rooms, he will wait for all the changing rooms to be vacant before he can enter. The same holds for the reverse case, when men are in the changing rooms. Write procedures
woman_waiting_to_try
woman_finished_trying
man_waiting_to_try
man_finished_trying
that are executed by a customer before and after trying the garment. Your code should ensure the following:
    a. Correctness: Men and women should not be in the changing rooms together.
    b. Deadlocks should not occur:
    c. Fairness. Women should not get preference over men, and vice versa.
    d. Starvation: People at the head of the queue should not starve for their turn.
    e. Efficiency: Changing rooms should be used whenever possible. **[4]**