*RECITATION: 104*
*NUMBER OF HOURS TO COMPLETE: 4 hours*

1. *(10 pt) Describe and explain each of the following (use examples):*

   (a) *The concept of interleaving instructions of two threads*

   (b) *Each of the requirements for deadlock (give examples). Explain why the first three are necessary but not sufficient for deadlock.*

2. *(10 pt) Compare and contrast the following (make sure to define each of the items):*

   (a) *Mode switch vs process switch*

   (b) *Semaphore vs conditional variable*

3. *(20 pt) Given the code below answer the following questions (explain your reasoning):*

```
[xleftmargin=5mm]
int temp;
void swap(int *y, int *z) {
int local;
local = temp;
temp = *y;
*y = *z;
*z = temp;
temp = local;
}
```

   (a) *Is the function thread safe?*
       Thread safe

   (b) *Is the function reentrant?*
       Reentrant is specific to one thread.

4. *(30 pt) Barrier Synchronization: A **barrier** is a tool for synchronizing the activity of a number of threads. When a thread reaches a **barrier point**, it cannot proceed until other threads have reached this point as well. When the last thread reaches the barrier point, all threads are released and can resume concurrent execution. You have a number of threads processing data and each piece of data takes a different amount of time to process. When a thread has completed its processing, it will ask for more work. However, the data requires that 4 workers all start together on the next 4 pieces*

*of data. This means we want to gather 4 threads before having them begin processing. Please provide a solution (pseudocode), explain how it works, show that it is starvation free and deadlock free.*

5. *(30 pt) CU wants to show off how politically correct it is by applying the U.S. Supreme Courts Separate but equal is inherently unequal doctrine to gender, ending its long-standing practice of gender-segregated bathrooms on campus. However, as a concession to tradition, it decrees that when a woman is in the bathroom, other women may enter, but no men, and vice versa. Also, due to fire code, at most N (N ¿ 1) individuals may use the bathroom at any time. Your task is to write two functions:* `man_use_bathroom()` *and* `woman_use_bathroom()`*. Provide a monitor-based solution that manages access to the bathroom. Your solution should be fair, starvation free and deadlock free.*