

CSCI 3753: Operating Systems

Fall 2017 Problem Set Two

Due Date and Time: Tuesday, October 17, 2017 in class

- Write your answers in the space provided. DO NOT use extra space.
- Submit a **hardcopy** of your solutions at the beginning of the lecture on Tuesday, October 17. Submissions via emails or any other means will not be accepted.
- No extensions will be given except at the instructor's discretion in documented cases of extreme hardship or emergencies.

Problem 1. [10 Points] Is the swap() function below thread-safe or not? Explain your reasoning.

```
int temp;
```

```
void swap(int *y, int *z)
{
    int local;

    local = temp;
    temp = *y;
    *y = *z;
    *z = temp;
    temp = local;
}
```

Problem 2. [20 Points] Using TS() instruction, provide an implementation of semaphores.

Problem 3. [35 Points] You have just been hired by Greenpeace to help the environment. Because unscrupulous commercial interests have dangerously lowered the whale population, whales are having synchronization problems in finding a mate. The trick is that in order to have children, *three* whales are needed, one male, one female, and one to play matchmaker --- literally, to push the other two whales together (*I am not making this up!*). Your job is to write three functions: *Male* (), *Female* (), and *Matchmaker* (). A male whale calls *Male* (), which waits until there is a waiting female and a matchmaker. A female whale calls *Female* (), which must wait until there is a waiting male and a matchmaker. Similarly, a matchmaker calls *Matchmaker* (), which must wait until there is a waiting male and a female. Once all three types of whales are present, all three return with one of them printing a message “A calf is born”. Use semaphores to implement the required synchronization.

Problem 4. [35 Points] Unisex bathroom problem: CU wants to show off how politically correct it is by applying the U.S. Supreme Court's "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.