COMP 3500: Homework 2

Points Possible: 100

Note: You do not need to submit hard copies.

Goals:

- To understand the principles of deadlocks.
- To learn how to solve deadlock and starvation problems.
- To collaborate and discuss deadlock problems with your group members.

Questions:

1. [40 points]

In the code below, three processes are competing for six resources labeled A to F.

a. Using a resource allocation graph (Figures 6.5 and 6.6), show the possibility of a deadlock in this implementation.

b. Modify the order of some of the get requests to prevent the possibility of any deadlock. You cannot move requests across procedures, only change the order inside each procedure. Use a resource allocation graph to justify your answer.

```
void P0()
{
  while (true) {
    get(A);
    get(B);
    get(C);
    // critical region:
    // use A, B, C
    release(A);
    release(B);
    release(C);
  }
}
```

```
void P1()
{
  while (true) {
    get(D);
    get(E);
    get(B);
    // critical region:
    // use D, E, B
    release(D);
    release(E);
    release(B);
  }
}
```

```
void P2()
{
  while (true) {
    get(C);
    get(F);
    get(D);
    // critical region:
    // use C, F, D
    release(C);
    release(F);
    release(D);
  }
}
```

2. [20 points]

Suppose the following two processes, `foo` and `bar` are executed concurrently and share the semaphore variables `S` and `R` (each initialized to 1) and the integer variable `x` (initialized to 0).

```
void foo( ) {
    do {
      semWait(S);
      semWait(R);
      x++;
      semSignal(S);
      SemSignal(R);
    } while (1);
}
```

```
void bar( ) {
do {
    semWait(R);
    semWait(S);
    x--;
    semSignal(S;
    SemSignal(R);
} while (1);
}
```

Can the concurrent execution of these two processes result in one or both being blocked forever? If your answer is yes, please give an execution sequence in which one or both are blocked forever.

3. [20 points]
What is the difference among deadlock avoidance, detection, and prevention?

4. [20 points]
Consider a system consisting of four resources of the same type that are shared by three processes, each of which needs at most two resources. Show that the system is deadlock-free.

Submission:

- A heading at the top of your file contains your group ID, the names of your group members, and your Auburn UserIDs.
- Submit your solution as a PDF file named as ""<group_ID>_hw2.pdf" through Canvas (for example, mine might read "group06_hw2.pdf")
- Each group must submit a single PDF file that contains:
    - Group member 1's answers
    - Group member 2's answers
    - Group member 3's answers
    - Group answers after your discussion
- If three group members' answers agree with one another, you simply pick the answer with better presentation as your group answers.
- If three members' answers are different, three members have to discuss and determine whose answer is correct. The correct one should be submitted as the group answer.
- In the above two cases, your team must clarify whose answers are adopted.
- TA will only grade your group answers. However, if you (1) do not provide each member's individual answers or (2) you do not clarify whose answers are adopted, your team will **lose 20 points**. Although three group members may share different answers, the three members should have an agreement on the group answers.

Late Submission Penalty:

- Ten percent (10%) penalty per day for late submission. For example, an assignment submitted after the deadline but up to 1 day (24 hours) late can achieve a maximum of 90% of points allocated for the assignment. An assignment submitted after the deadline but up to 2 days (48 hours) late can achieve a maximum of 80% of points allocated for the assignment.
- Assignment submitted more than 3 days (72 hours) after the deadline will not be graded.

Rebuttal period:

- You will be given a period of one week (i.e., seven days) to read and respond to

the comments and grades of your homework or project assignment. The TA may use this opportunity to address any concern and question you have. The TA also may ask for additional information from you regarding your homework or project.