COMP 3500: Introduction to Operating Systems

Project 4

Points Possible: 100 due: 11:59 pm Oct 28th, 2022

There should be no collaboration among students. A student shouldn't share any project code with any other student. Collaborations among students in any form will be treated as a serious violation of the University's academic integrity code.

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

```
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);
}
```

integer variable x (initialized to 0).
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:

- Submit your solution as a PDF file named as "<First Name>_<Last Name>_project4.pdf" through Canvas (for example, mine might read "Qi_Li_ project4.pdf")
- You must submit a single PDF file that contains your answers.

Rebuttal period:

You will be given **TWO business 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 concerns and questions you have. The TA also may ask for additional information from you regarding your homework or project.