Spring 2025 CS 692 Systems Capstone Exam

Please read the following instructions before you start the exam. Please avoid asking a question that is addressed below:

1) You can write your answers on **both sides** of the paper. If you run out of space on the first page, continue your answer on the back of the page.

2) You may use the last paper sheet (front and back) as scratch paper. It is also marked as scratch paper. Please note that the instructor will NOT grade the scratch paper. The scratch sheet stays with the exam. Please do not detach it.

3) Do NOT detach the exam sheets. If at any point the papers got detached, raise your hand and request for them to be stapled immediately.

4) You are NOT allowed to use Calculator.

5) You are NOT allowed to have your cell phone, e-watch, or other electronic devices nearby (on the desk or inside your pocket). They should be turned off and stay inside your bag /backpack which will be placed in the front/back of the room.

6) Exam duration: 3:00 to 4:30 pm.

Choose two of the three questions. Please indicate the questions you have completed for grading below. If they are not indicated, we will assume that the first two questions that you attempted are to be graded.

- ❑ Question #1
- ❑ Question #2
- ❑ Question #3

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1) Consider the code below that attempts to solve the two (2) process mutual exclusion problem. There are three (3) Processes A, B, and C. The below variables are initialized before the processes begin:

```
int p = 1;      //global variable initialized once before Processes A,B,C
int lock = 0; // global variable initialized once before Processes A,B,C
```

Process A

```
while (true) {
    while (p!= 1);
        lock = 1;
        // critical section
        lock = 0;
        // non critical section
}
```

Process B

```
while (true){
    while (p != 2);
        lock = 1;
        //critical section
        lock = 0;
        //noncritical section
}
```

Process C

```
while (true) {
    while (lock ==1);
        if (p ==1)
            p = 2;
        else
            p = 1;
}
```

Answer each question below and give a description of steps or explanation that validates your answers.

a) (7pts) Does the code guarantee mutual exclusion?
b) (6pts) Can deadlock occur?
c) (7pts) Is indefinite postponement possible?

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Question 2 parts a through e (20 points total)

2a) (3pts) Name three (3) services that an Operating System provides.

2b) (6pts) What are the possible states of a process? Draw a diagram and label transitions.

2c) (2pts) Fill in the blank: A _____ process is a process that has terminated, but whose parent has not yet called wait().

2d) (3pts) Define what is meant by the term race condition. What is a solution mechanism to solve race conditions?

2e) (6pts) Assume for the following that competition synchronization is NOT enabled. The variable **count** is initialized to the value **2** before the processes begin. What are the four possible values of the variable count after the A and B processes finish?

Process A: count = count + 1; Process B: count = count * 2;

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Question 3 parts a through e (20 points total)

3a) (8pts) Given the resources (A, B, C, D) for processes P0, P1, P2, P3, P4 and available equal to <3,3,2,2> (A,B,C,D, respectively). Is the system in a safe state? If more than one process can be chosen, the **higher** numbered process will have precedence. Please show all work.

	Allocated	Max	Need
P0	<2,0,0,1>	<7,5,3,4>	
P1	<1,1,1,1>	<3,2,2,2>	
P2	<3,0,1,2>	<9,0,2,4>	
P3	<1,1,1,1>	<2,2,2,3>	
P4	<1,2,1,0>	<4,3,3,2>	

3b) (4pts) If P3 makes a request of <1,1,2,2> will it be allowed? Why or why not. Show all work.

QUESTION CONTINUES ON FOLLOWING PAGE…

3c) (2pts) What is the Banker's Algorithm used for?

3d) (4pts) List and describe the four necessary conditions of deadlock.

3e) (2pts) In the Banker's Algorithm, what is the meaning of a "safe state?"

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Scratch paper