CS 692 Systems Capstone Exam, Spring 2024

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 as you answer the questions on the front pages, continue your answer on the back of the page. Please do not ask the instructor whether you can write on the back side of the paper. The answer is YES YOU CAN.

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 instructor. 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 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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Question 1) Scheduling

Using the table below, show how the processes would be scheduled using the CPU scheduling algorithms listed below the table. Please show your work with a **Gantt chart** for **a, b**, and **c**.

	Arrival (secs)	Burst	Priority
P1	0	7	2
P2	3	3	3
P3	5	2	1
P4	7	5	3
P5	9	2	2

a) (5pts) **Round Robin** with time quantum of **2** seconds

b) (5pts) **Pre-emptive Shortest job first**

c) (5pts) **Pre-emptive priority** – if there are any ties, the lower numbered process goes first.

d) (3pts) List one **disadvantage** of the **Pre-emptive Shortest Job First** scheduling algorithm.

e) (2pts) Please write the **formula** for **process wait time**.

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Question 2 Dining Philosophers - shared resources

2. a) (5pts) Assume that process synchronization is NOT enabled. Given that the current value of **total = 2**, what are the four (4) possible values of **total** after the **X** and **Y** processes execute? Explain under which conditions these values can occur. The X and Y processes are below:

Process X: total = total + 2; **Process Y: total = total * 3;**

b) (5pts) In terms of the critical section problem and multiple processes, what is meant by the two terms: "**bounded waiting"** and **"progress?**"

c) (5pts) Consider the **incorrect** solution to the Dining Philosophers problem below where philosophers are either thinking or eating. There are five (5) philosophers i where i = 0,1,2,3,4. There are five (5) semaphores fork(i) which are initialized to 1. Show a sequence of events where **deadlock** can occur.

```
while(true){
      think;
      wait(mutex);
      wait(fork[i];
      signal(mutex);
      wait(mutex);
      wait fork[i + 1) % 5];
      signal(mutex);
           eat;
      signal(fork[i]);
      signal(fork[(i + 1) % 5];
}
```

d) (5pts) Show how you would you fix the code above so that it is correct.

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Question 3 Memory

a) (4pts) Translation Lookaside Buffer (TLB) with the following details: TLB access time **90ns**, memory access time **180ns**, hit ratio of **95%**.

b) (4pts) Given the memory allocation methods **First Fit** and **Best Fit**, list one advantage and one disadvantage of each.

c) (12pts) Given dynamic memory partitioning and four (4) memory partitions of sizes 500K, 200K, 800K, and 300K each and processes of size 250K, 180K, 450K, 200K, 100K, 260K each arriving in that order, show which partition is selected for each process and give the list of remaining partitions for the **First Fit, Best Fit,** and **Worst Fit** algorithms. State if any process request cannot be fulfilled.

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Scratch Page- This page (front and back) will not be graded.

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