# SYSTEMS EXAM Spring 2022 90 minutes

Check which problems you are submitting:



## How many pages total?

Please do not write on the back of any pages.

(print name)

(signature)

(NetId)

### 1. (20pts Total) Critical Section

- a) (4pts) List the **three** (3) standard goals of the **mutual exclusion** problem when there are two processes.
- b) (8pts) Using the code below, state one goal that is **NOT** satisfied and provide an execution sequence that violates the goal.
- c) (8pts) Using the code below, select one goal that **IS** satisfied and give a brief explanation that justifies why the goal is met for all possible execution sequences.

Assume a common variable: lock = false; and assume the existence of an atomic (non-interruptible) test\_and\_set function that returns the value of its Boolean argument and sets the argument to true.

//Process 1	Process 2
while (true) {	while (true) {
while(test_and_set(lock));	while(test_and_set(lock));
Critical section;	Critical section;
lock = false;	lock = false;
Noncritical section;	Noncritical section;
}	}

### 2. (20pts Total) Paging

Given the page reference string: 0 1 3 5 0 1 2 4 5 3 5 1

a) (10pts) Assume memory has 8 pages and there are 4 page frames. Using the **second chance page replacement (clock) algorithm**, fill in the table below. Show the marker bits as they change and indicate if a page fault will occur.

pages	0	1	3	5	0	1	2	4	5	3	5	1
Frame 0												
Frame 1												
Frame 2												
Frame 3												

b) (10pts) Assume memory has 8 pages and there are 4 page frames. We have a page reference string of 2,6,5,7 to fill the first 4 frames. Complete the tables below by adding three more page references that will result in LRU having fewer page faults than FIFO.

LKU							
pages	2	6	5	7	?	?	?
Frame 0	2	2	2	2			
Frame 1		6	6	6			
Frame 2			5	5			
Frame 3				7			

LRU

FI	FO
	гυ

pages	2	6	5	7	?	?	?	
Frame 0	2	2	2	2				
Frame 1		6	6	6				
Frame 2			5	5				
Frame 3				7				

#### 3. (20 pts Total) Mixed – Short answer

- a) (2pts) Name **two** (2) mechanisms that an applications programmer can use to ensure correct process **synchronization** when manipulating shared data?
- b) (2pts) Name a hardware solution to the critical section problem.
- c) (4pts) Define "**short-term scheduler**" and "**long-term scheduler**." Specifically, where do processes go when using each of these?
- d) (4 pts) What is a **context-switch** and **name five (5) elements** of a process context switch.

- e) (4pts) What would be the **implementation** of a **block** and **wait semaphore** and how is the **value** of any semaphore modified?
- f) (4pts) A computer system has a 36-bit virtual address space with a page size of 8K, and 4 bytes per page table entry. How many pages are in the virtual address space? What is the maximum size of addressable physical memory in this system?