CS 4760	**Operating Systems**	Test 3
Name:	Fall 2021	Max Pts: 64

Important: This is an open book test. You can use any books, notes, or paper. If there is a syntax error in any program segment, just write it down and you will get full credit for the problem. The test is 75 minutes long.

1. [6 pt] I have read permissions for a certain directory on `opsys` which is a Linux machine. However, when I try to `cd` into the directory, I get a message `Permission denied`. What could be wrong?

2. [6 pt] What is the purpose of translation lookaside buffer?

3. [6 pt] What is the cause of a bus error? What is the cause of a segmentation fault?

4. [10 pt] Consider a simple paging system with the following parameters: 2^{32} bytes of physical memory, page size of 2^{10} bytes, and 2^{16} bytes of logical address space.

   (a) How many bits are in a logical address?

   (b) How many bytes are in a frame?

   (c) How many bits in the physical address specify the frame?

   (d) How many entries are in the page table?

   (e) How many bits are in each page table entry? Assume each page table entry contains a valid/invalid bit and a dirty bit.

5. [6 pt] Why do we have memory fragmentation problem in C?

6. [6 pt] What is the role of kernel for block-special devices? Why is this role essential?

7. [6 pt] What is the advantage of using magic number compared to filename extension to recognize a file content type? What is the advantage of using filename extension compared to magic number for the same?

8. [15 pt] A process has four page frames allocated to it. (All the following numbers are decimal, and everything is numbered starting from zero). The time of last loading of a page into each page frame, the time of last access to the page in each page frame, the virtual page number in each page frame, and the reference (R) and modify (M) bits for each page frame are as shown (the times are in clock ticks and the process start at time 0 to the event not the number of ticks since the event to the present).

Virtual page no.	Page frame	Time loaded	Time referenced	R bit	M bit
0	8	21	22	1	0
1	9	9	19	0	0
2	2	0	11	1	1
3	4	3	15	1	1

   A page fault to virtual page 4 has occurred at time 25. Which page frame will have its content replaced for the following memory management policies?

   (a) FIFO

   (b) LRU

(c) OPT (Look at the reference string in the next part to answer this part).

(d) Given the aforementioned state of memory just before the page fault, consider the following virtual reference string:

9, 5, 6, 4, 7, 6, 0, 7, 1, 6

How many page faults will occur if the working set policy with LRU were used with a window size of 4 instead of a fixed allocation? Show when each page fault will occur.

9. [18 pt] Consider a disk with 256 cylinders, indexed from 0 to 255, with 0 being the innermost and 255 being the outermost cylinder. The system receives disk requests on the following tracks in the specified order

170, 97, 10, 16, 235, 160, 18, 145, 61, 45

The head is currently on cylinder 99, and is moving towards inner cylinder (cylinder 0). Give the total number of tracks traversed for the given requests using each of the following algorithms.

(a) FCFS scheduling

(b) SSTF scheduling

(c) SCAN scheduling

(d) C-SCAN scheduling, servicing requests as head moves outwards

(e) LOOK scheduling

(f) C-LOOK scheduling, servicing requests as head moves outwards