COSC 4330 FINAL EXAMINATION DECEMBER 10, 2004

This exam is **closed book**. You can have **one page** of notes. UH expels cheaters.

1. Advantages and disadvantages: (4×5 points)

a) What is the major disadvantage of letting the kernel handle *TLB misses*?

Each TLB miss will require two context switches.

b) What is the major advantage of *sequential file allocation*?

It speeds up file accesses.

c) What is the major advantage of using *notify* operations instead of *signal* operations in your monitor procedures?

You can put notify calls inside critical sections.

d) What is the major disadvantage of the *VMS page replacement policy* over the *Mach page replacement policy*?

It is difficult to know ahead of times how many pages should be allocated to each process.

2. A computer system uses the Clock page replacement policy to manage its virtual memory. Assuming that the hand of the clock points to page frame 36 and that page frames 36 to 40 have the following values for their valid bits and page-referenced bits

Frame	Valid bit	PR bit
36	1	1
37	1	1
38	1	0
39	1	1
40	1	1

a) Which page will the Clock policy expels if a page fault occurs and the memory is full? (4 points)

The page located in frame <u>38</u> will be expelled.

b) Which of the above page frames will remain in main memory and keep their page-referenced bit *unchanged*? (6 points)

Pages _39 and 40_ will remain in main memory and keep their page-referenced bit unchanged.

- 3. Consider a file whose access control bits are 0640. Which system users can
 - a) Modify the file? (5 points) _____ The owner of the file ____
 - b) Read the file? (5 points) The owner of the file and the members of the file group ____

- **4.** A 32-bit Berkeley UNIX file system has a block size of 16 kilobytes. How many *blocks* of a given file can be accessed :
 - a) Using the block addresses stored in the i-node? (2 points) _____ 12___ blocks
 - b) With one level of indirection? (4 points) _____ 16K/4 = 4K or 4,096____ blocks
 - c) With two levels of indirection? (4 points) _____ 4G/16K 4K 12 = 256K- 4K -12___ blocks
- 5. A computer system has 32-bit addresses and a page size of 8 kilobytes.
 - a) What is the maximum number of pages a program can have? _____ 4G/8K= 512K __ pages
 - b) How many bits of the virtual address will remain unchanged during the address translation process?

__Its last 13_ bits

6. A computer system has 64 bit addresses but restricts the size of its process address spaces to 8 Terabytes, that is, 2⁴³ bytes. Assuming a page size of 8 kilobytes, describe the best three-level page table organization for this system. (10 points for answer giving the correct sizes of all indexes)

Since process address spaces are limited to 2⁴³ bytes, the 64-43 = 21 most significant bits of virtual addresses will always be equal to zero. Hence, we only have to deal with the 43 least significant bits of these addresses. Of these 43 bits, 13 bits will be occupied by the byte offset. As a result, our page numbers will be 30-bit long.

< 21 MSB >	<30 remaining bits >	< 13 LSB >
Always zero	Page number	Byte offset

A three-level page table, would partition the page number into three groups of bits., say, three groups of ten bits each:

< 21 MSB >	< 10 bits >	< 10 bits >	< 10 bits >	< 13 LSB>
Always zero	Level 1	Level 2	Level 3	Byte offset

Since 10 bits of the page number are assigned to each level, indexes at all three levels will contain 2¹⁰ addresses. Observing that 64-bit addresses occupy 8 bytes, we conclude that all indexes will occupy exactly 8 kB, that is exactly the size of a page.

7. An electronics store has all shoppers waiting in a single waiting line for one of their twenty check-out clerks. After they complete their purchases, the shoppers must wait again to have their bags inspected by one of the two inspectors standing at the door. Add the proper semaphore calls to represent this behavior (20 points).

8. What is wrong with the following solution to the mutual exclusion problem? (10 points)

```
//Global array
shared int wait[2] = {0, 1};
void enter_region(int pid) { // pid must be 0 or 1
    while (wait[pid]); // busy wait
} // enter_region
void leave_region(int pid) {
    wait[pid] = 1; wait[1 - pid] = 0;
} // leave_region
```

____ It denies mutual exclusion.

_X It denies access to the critical section.

This happens when _____ A process tries to access the critical section twice in a row____