| CS 4760 | **Operating Systems** | Test 3 |
|---|---|---|
| Name: | Fall 2010 | Max Pts: 48 |

**Important**: This is an open book test. You can use any books, notes, or paper but no electronic device. *Do not log into the computer during the test, or use any electronic or communications device. Switch off your cell phones*. Any calculations and rough work can be done on the back side of the test pages. If there is a syntax error in any program segment, just write it down and you will get full credit for the problem. You will lose five points for not writing your name.

1. [6 pt] What is the purpose of a translation lookaside buffer?

2. [6 pt] Why is the average search time to find a record in a file less for an indexed sequential file than for a sequential file. Is there any case where the indexed sequential file will take longer to find a record compared to the sequential file?

3. [6pt] Consider a machine with disk blocks of 4K bytes. You have a new disk of size 2TB. What is the maximum file size possible using the UFS scheme of 12 direct blocks, 1 single indirect block, 1 double indirect block, and 1 triple indirect block in the inode table?

4. [12 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 |
|---|---|---|---|---|---|
| 2 | 0 | 060 | 161 | 0 | 1 |
| 1 | 1 | 130 | 160 | 1 | 0 |
| 0 | 2 | 026 | 162 | 1 | 0 |
| 3 | 3 | 020 | 163 | 1 | 1 |

A page fault to virtual page 4 has occurred at time 164. Which page frame will have its content replaced for each of the following memory management policies?

(a) FIFO

(b) LRU

(c) OPT

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

$$4, 0, 0, 0, 2, 4, 2, 1, 0, 3, 2$$

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 would occur.

5. [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

   167, 93, 91, 81, 68, 75, 38, 12, 56

   The head is currently on cylinder 2, and is moving towards outer cylinder. 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 inwards

   (e) LOOK scheduling

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