NAME: _____ (FIRST NAME FIRST) **SCORE**: ____

COSC 4330/6310 FINAL EXAMINATION DECEMBER 15, 2008

CLOSED BOOK. YOU CAN HAVE ONE PAGE OF NOTES. CHEATERS RISK EXPULSION FROM THE UNIVERSITY.

1. Answer in one or two sentences to the following questions (6×5 points).

a) What is the purpose of the ***dirty bit*** ?

The dirty bit associated with a given page tells whether the page contents have been modified since that page was last brought into main memory. If this is true the page must be written back to disk when it is expelled from main memory.

b) What is the difference between a ***condition.signal*** and a ***condition.notify***?

If there is a monitor procedure waiting on the condition raised by a condition.signal, that procedure gets control of the monitor while the procedure that issued the signal is suspended. There is no such thing with a condition.notify as it only takes effect when the procedure that issued the notify terminates.

c) What is the impact on ***internal fragmentation*** on the performance of virtual memory systems?

This impact is an average of half a page frame per process.

d) What is the major disadvantage of the ***LRU*** page replacement policies?

It cannot be implemented at a reasonable cost.

e) How can you prevent deadlocks by denying the ***circular wait condition***?

BY forcing all processes to acquire their resources in the same linear order.

f) Where does UNIX store ***file name***s?

In the directory entry pointing to the i-node of each file.

2. A Berkeley UNIX file system has 32-bit addresses, 15 block addresses in each i-node and 4 kilobyte blocks. How many file blocks can be accessed:

a) directly from the i-node: 12 blocks
(2 points)

b) with one level of indirection: 4K/4 = 1,024 blocks
(3 points)

c) with two levels of indirection: 4G/4K -1,024 -12 = 1M – 1,036 blocks
(5 points)

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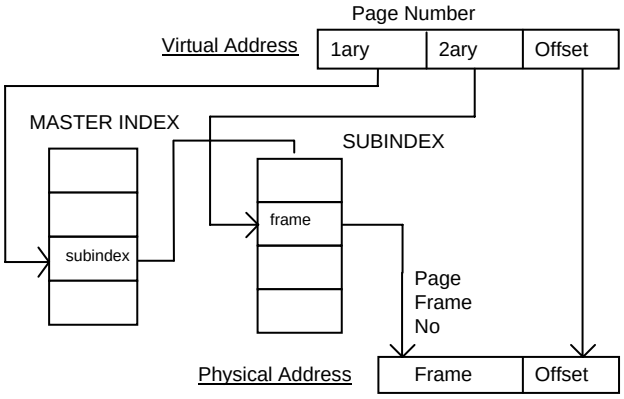
3. It has been said that the UNIX file system uses both access control lists and tickets to control access to files. What are the UNIX entities playing the role of::

(a) An ***access control list***? the nine mode bits in the i-node AKA protection bits
(5 points)

(b) A ***ticket***? the file descriptor of an opened file
(5 points)

4. Consider the following page table organization applied to a 32-bit architecture and a page size of 4KB:



a) What is the ***size of the page number field*** ? 32 – 12 = 12 **bits**
(5 points)?

b) How would you split it? The first ten bits would be an offset in the MASTER INDEX of the page table while the remaining ten bits would be an offset in the SECONDARY INDEX.

(5 points)

5. An ice-cream parlor has two employees selling ice cream and six seats for its customers. Each employee can only serve one customer at a time and each seat can only accommodate one customer at a time. Add the required semaphores to the following program skeleton to guarantee that customers will never have to wait for a chair with a melting ice-cream in their hand. (5 points per correct line for a total of 25 points)

```
semaphore employee = 2;

semaphore seats = 6;

customer (int who) {

      P(&seat); P(&employee) ;

      order_ice_cream();

      V(&employee) ;

      eat_it();

      V(&seat) ;

} // customer
```

6. How does BSD UNIX page replacement policy simulate a missing page-referenced bit? (10 points) What was the main drawback of the technique? (5 points)

The BSD page replacement policy uses a missing page-referenced bit. Each time it scans a page whose valid bit is onw, it resets valid bit to zero. It stops when it encounters a page whose valid bit is zero and it picks this page as the page to expel.

The main problem with the policy is its significant context switch overhead. Whenever a page whose valid bit has been reset to zero is referenced again an interrupt occurs and the kernel must set the valid bit back to one. Since is task is trivial, its cost is dominated by the cost of the two required context switches.