COSC 4330 FINAL EXAMINATION MAY 7, 2004

THIS EXAM IS CLOSED BOOK. YOU CAN HAVE ONE PAGE OF NOTES. UH EXPELS CHEATERS.

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

a) What do you need to do to deny the ***circular wait*** condition to prevent deadlocks?

We need to force all processes to acquire all their resources in the same sequential order.

b) What is the purpose of the ***lseek(…)*** system call?

The lseek(…) system call changes the current position within a file; its main purpose is to implement random access.

c) What is the major difference between a ***monitor condition*** and a ***semaphore***?

Semaphores have a value; monitor conditions do not.

d) Enumerate the contents of a ***TLB entry***.

A TLB entry contains a page number, a page frame number and some flag bits (valid bit, dirty bit, and so on).

e) Is it likely you will ever see a virtual memory system lacking a ***page-referenced bit***?

No, a virtual memory system lacking a page-referenced bit would be unable to differentiate between "dirty" pages that need to be written back on disk when they are expelled from main memory and "clean" pages that do not.

f) Where does UNIX store the ***access control list*** of a file?

UNIX stores the access control list of a file in the file's i-node.

2. A computer has 32 bit addresses. If 19 of these 32 bits are occupied by the ***page number***, what is the ***page size***? (4 pts)

2^{13} = **8K__ bytes**

3. A computer has one gigabyte of main memory, 32 bit addresses and a page size of two kilobytes. How many page frames are there in main memory? (5 pts)

2^{19} =512K__ **page frames**

4. Consider a 64-bit UNIX file system with a block size of 16 kilobytes and 15 block addresses in each i-node. Block addresses now occupy 8 bytes and the maximum size of a file is 2^{64}. How many ***blocks*** of a given file can be accessed :

a) Using the block addresses stored in the i-node? (5 pts) _____ 12 b**locks**

b) With one level of indirection? (5 pts) _____ 16K/8 = $2^{14}/2^3$ = 2^{11} = 2048 **blocks**

c) With two levels of indirection? (5 pts) _____ 2^{11} x 2^{11} = 2^{22} = 4M **blocks**

(The 4 GB file size limit only applies to 32-bit file systems.)

5. A pizza oven has enough space inside for twelve pizzas and a small opening through which a single cook can put a pizza in the oven and remove it when it is ready. Add the required pseudocode to the following monitor to ensure the smooth operation of the oven. (8×2 pts)

```
Class oven {
      private int n_pizzas; // pizzas in oven
      private condition not_empty;
      private condition not_full;

public void synchronized put_a_pizza() {
            if (npizzas == 12)_____________________________
            __notfull.wait_____________________________
            put_a_pizza_in_the_oven();
            notempty.signal_____________________________
            _____________________________
            } // put_a_pizza()

public void synchronized remove_a_pizza() {
            if (npizzas == 0)_____________________________
            __notempty.wait_____________________________
            take_a_pizza_from_the_oven();
            notfull.signal_____________________________
            _____________________________
      } // remove_a_pizza()

oven() {
            n_pizzas = 0;
      } // constructor
} // Class oven
```

Comment: This solution is far from being perfect because users do not have to wait for a pizza to be ready before removing it from the oven.

6. Describe the VMS page replacement policy. (10 pts for an answer including a correct diagram) How does it compare with the Mach policy? (2×5 pts: there is one main advantage and one main disadvantage)

VMS allocates to each process a fixed-size partition that it manages using a FIFO policy. Pages expelled by the FIFO policy are put at the end of a large global queue from which they can be reclaimed. (*See page 108 of notes.*)

The main advantage of the VMS page replacement policy over the Mach policy is that it can accommodate real-time processes. Its main disadvantage is that it is harder to tune than the Mach policy. There is always the risk that one process will not be allocated enough main memory and that its pages will have to be constantly reclaimed from the global queue, which would result in a high number of context switches.