COSC 4330 FINAL EXAMINATION MAY 7, 2001

Closed book. You can have one page of notes. Cheaters risk expulsion from UH.

- 1. Answer in one or two sentences to the following questions (6×5 points).
 - a) What is the sole *file attribute* of a UNIX file that is *not* stored in the file i-node?

The file name.

b) Give an example of a *capability*—or *ticket*—in the UNIX file system.

The file descriptor.

c) What is the major disadvantage of the FIFO page replacement policy?

It often expels the wrong page .

d) What is the major disadvantage of selecting a *large block size* for a file system?

Excessive internal fragmentation, especially if there are many small files.

e) What is the major reason to have *memory protection* in a *uniprogramming system*?

To prevent user processes from damaging the kernel.

f) Can we deny the *hold-and wait* condition in message passing systems? Include a short justification of your answer.

No, it would require each process that will receive messages to receive all of them when it starts and none of them after that.

- 2. The block size of a Berkeley UNIX file system is *4 kilobytes*. How many *file blocks* can be accessed:
 - a) directly from the i-node: ______ 12 *blocks* (2 points)
 - b) with one level of indirection: $4096/4 = 1,024 = 2^{10}$ blocks (3 points)
 - c) with two levels of indirection: _____ $4G/4K 2^{10} 12 = 2^{20} 1K 12$ *blocks* (5 points)

(Recall that the maximum size of a UNIX file is 2^{32} bytes.)

- 3. A virtual memory system has 256 Megabytes of main memory, a virtual address space of 4 Gigabytes and a page size of 4096 bytes. Each page table entry occupies 4 bytes. (4×5 points)
 - a) How many bits of the virtual address will remain *unchanged* by the address translation process?

b) What is the maximum size of a page table? $2^{20} \times 4 = 2^{22} _ bytes$ c) How many page frames are there in main memory? $2^{28}/2^{12} = 2^{16} _ page frames$

d) On the average, how much memory is lost to *internal fragmentation*?

__half a page or 2,048___ bytes per process

__12__*bits*

4. Consider the function:

```
void exchange(int *pa, int *pb){
    (*pa) += 3; (*pb) -= 3;
} // exchange
```

and assume the following calling sequence:

int alpha = 10; void exchange(&alpha, &alpha)

What will be the value of alpha *after the call* assuming that:

- a) the call was a regular procedure call ? $alpha = __10_(5 \text{ points})$
- b) the call was a *remote procedure call*? *alpha* = ____7_(5 points)
- 5. What is the main disadvantage of letting the OS handle TLB misses? (5 points)

It will increase the cost of handling TLB misses for they will now require a system call.

6. What are the main advantage and the main disadvantage of *atomic transactions* ? (2×5 points)

They implement the all-or nothing semantics but are slow.

7. Describe in some detail a *two-level page table organization* (10 points minus 4 points if there is no drawing) and explain why it works better when the page size is *4 kilobytes*. (5 points).

The page table is divided into a master index that always remains in main memory and subindexes that can be expelled.



(only one of the four subindexes is represented)

This two-level organization is especially suited for a page size of 4 kilobytes and 32 bits virtual addresses. We can then allocate:

- 10 bits of the address for the first level,
- 10 bits for the second level, and
- 12 bits for the offset.

This means that the master index and all the subindexes will have 2¹⁰ entries. Since each entry occupies four bytes, they will occupy exactly *one page*.