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

COSC 3360/6310 THIRD QUIZ MAY 11, 2016

CLOSED BOOK. YOU ARE ALLOWED TO ONE PAGE OF NOTES. UH EXPELS CHEATERS.

1. A computer has 8 Gigabytes of main memory, 48-bit addresses and a page size of 4 kilobytes. (4×5 points)

a) How many ***page frames*** are there in main memory? $8G/4K = 2^{33}/2^{12} = 2^{21}$ or 2M **frames**

b) How many bits of the virtual address are taken by the ***page number***? $\log_2 4K = 12$ **bits**

c) How many bits of the virtual address are taken by the ***byte offset***? 48 – 12 = 36 **bits**

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

One half **page frame(s) per process**

2. What is the difference between the ***dirty bit*** and the ***page referenced bit***? (5 points) _____

The dirty bit indicates whether the page was modified since it was brought into main memory.

The valid bit indicates whether the page is in main memory.

3. A 32-bit FFS file system has a block size of 4 kilobytes. How many ***blocks*** of a 256 kilobyte file can be accessed:

a) Directly from the i-node? (5 points) _____ 12 **blocks**

b) With one level of indirection? (5 points) _____ 64 -12 = 52 **blocks**

c) With two levels of indirection? (5 points) _____ Zero **blocks**

(*Hint: The total of your three answers should equal to the size of the file.*)
Note: the file comprises 256/4 = 64 data blocks.

Total: _____/40

4. ***Questions with short answers:*** (6×5 points)

a) What is the major advantage of ***inverted page tables***? _____

They are small enough to fit in main memory.

_____

b) How can prevent deadlocks by eliminating ***circular waits***? _____

By requiring all processes to acquire all their resources in the same linear order.

_____

_____

c) What is the main disadvantage of the ***Global LRU*** page replacement policy? _____

Its very huge overhead.

_____

_____

d) What does the UNIX Fast File System do to fight ***internal fragmentation***? _____

It allocates block fragments to files that re smaller than the block size (and to the tail end of other files).

_____

e) What is the purpose of ***cylinder groups*** in the Unix Fast File System? _____

Cylinder groups contain both i-nodes and the data blocks of files accessed through these i-nodes, which reduces seek distances during file accesses.

Total: _____/30

f) What is the main advantage of letting the ***computer firmware*** handle ***TLB misses***? _____

Fewer context switches.

5. List the contents of a Linux directory entry. (5 points) _____

A Linux directory entry contains the name of a file or directory and the number of the associated i-node. (MORE SUCCINCTLY: a file name and an i-node number.)

6. Given the following result for the **`ls -lg Universal.pdf`** Linux command,

```
rw-r-----  1 paris    faculty    341993 May  7 18:23 Universal.pdf
```

a) Which users can modify the file **`Universal.pdf`**? (5 points)

The owner of the file: paris

b) Which users can read it? (5 points)

The owner of the file and the members of the faculty group.

Total: _____/30

7. Consider the *two-handed* ***BSD clock replacement policy*** with a ***single hand***. (3×5 points)

a) What happens when the ***first hand*** of the clock reaches a ***valid page***? _____

The page is marked invalid.

b) What happens when the ***second hand*** of the clock reaches a ***valid page***? _____

Nothing.

c) What happens when the ***second hand*** of the clock reaches a page that was ***marked invalid***? _____

The page is expelled from main memory.

Total: _____/30

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COSC 3360/6310 THIRD QUIZ MAY 11, 2016

CLOSED BOOK. YOU ARE ALLOWED TO ONE PAGE OF NOTES. UH EXPELS CHEATERS.

1. A computer has 16 Gigabytes of main memory, 48-bit addresses and a page size of 8 kilobytes. (4×5 points)

e) How many ***page frames*** are there in main memory? 16G/8K =$2^{34}/2^{13}$ = 2^{21} or 2M **frames**

f) How many bits of the virtual address are taken by the ***page number***? $\log_2$ 8K = 13 **bits**

g) How many bits of the virtual address are taken by the ***byte offset***? 48 – 13 = 35 **bits**

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

One half **page frame(s) per process**

2. What is the difference between the ***dirty bit*** and the ***page referenced bit***? (5 points) _____

The dirty bit indicates whether the page was modified since it was brought into main memory.

The valid bit indicates whether the page is in main memory.

3. A 32-bit FFS file system has a block size of 4 kilobytes. How many ***blocks*** of a 512 kilobyte file can be accessed:

a) Directly from the i-node? (5 points) _____ 12 **blocks**

b) With one level of indirection? (5 points) _____ 128 -12 = 116 **blocks**

c) With two levels of indirection? (5 points) _____ Zero **blocks**

(*Hint: The total of your three answers should equal to the size of the file.*)
Note: the file comprises 512/4 = 128 data blocks.

Total: _____/40

4. ***Questions with short answers:*** (6×5 points)

a) How can prevent deadlocks by eliminating the ***hold and wait*** condition? _____

By requiring all processes to acquire all their resources at the same time.

b) What is the main advantage of letting the ***computer firmware*** handle ***TLB misses***? _____

Fewer context switches.

c) What is the main disadvantage of the ***Global FIFO*** page replacement policy? _____

Its very poor performance. (It often expels pages that should have remained in main memory.)

d) What does the UNIX Fast File System do to guarantee the ***consistency*** of its metadata? _____

It uses blocking writes for all its metadata upodates.

Total: _____/30

e) What is the major advantage of ***inverted page tables***? _____

They are small enough to fit in main memory.

f) What is the main disadvantage of journaling file systems using ***asynchronous journal updates***? _____

Metadata updates may be lost after a system crash.

5. List the contents of a Linux directory entry. (5 points) _____

A Linux directory entry contains the name of a file or directory and the number of the associated i-node. (MORE SUCCINCTLY: a file name and an i-node number.)

6. Given the following result for the **`ls -lg Universal.pdf`** Linux command,

```
rw-rw----  1 paris    faculty    341993 May  7 18:23 Universal.pdf
```

c) Which users can modify the file **`Universal.pdf`**? (5 points)

The owner of the file (paris) and the members of the faculty group.

d) Which users can read it? (5 points)

The owner of the file (paris) and the members of the faculty group.

Total: _____/30

7. Consider the *two-handed* ***BSD clock replacement policy*** with a ***single hand***. (3×5 points)

a) What happens when the ***first hand*** of the clock reaches a ***valid page***? _____

The page is marked invalid.

b) What happens when the ***second hand*** of the clock reaches a ***valid page***? _____

Nothing.

c) What happens when the ***second hand*** of the clock reaches a page that was ***marked invalid***? _____

The page is expelled from main memory.

Total: _____/30