NAME: _____ **(FIRST NAME FIRST)** **TOTAL:** ___

COSC 4330/6310 FINAL JULY 24, 2013

This exam is **closed book**. You can have **one** page of notes. UH expels cheaters.

1. A PC has 4 GB of memory, 32-bit addresses and 4 KB pages. (4×5 points)

a) How many bits of the virtual address are taken by the byte offset? 12 **bits**

b) How many bits of the virtual address are taken by the page number? 32- 12 =20 **bits**

c) How many page frames are there in main memory?

4GB/4KB = 1M = 2^{20} **page frames**

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

4KB/2 = 2KB = 2,048 **bytes per code or data segment**

2. The Windows page replacement policy allocates a specific number of page frames to each process. Under which conditions is this number decreased? (5 points)

When the memory is tight. _____

_____

3. A 32-bit Berkeley UNIX file system has a block size of 8 kilobytes. How many ***blocks***—***not bytes***—of a given file can be accessed :

a) Using the block addresses stored in the i-node? (5 points) 12 **blocks**

b) With one level of indirection? (5 points) 8K/4 = 2K **blocks**

c) With two levels of indirection? (5 points) 4G/8K – 2K – 12 = 510K - 12 **blocks**

Detail your computations here for possible partial credit:

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

a) List the contents of a ***UNIX directory entry***.

A UNIX directory entry contains a file name and an i-node number.

b) Why is the cost of many system calls equal to ***two context switches***?

Because these system calls involve trivial requests to the kernel and the cost of the transfers of control to and from the kernel dominates.

c) How does a ***TLB entry*** differ from a regular ***page table entry***?

It contains a page number in addition to a page frame number and various bits.

d) What is the major advantage of ***tickets*** over ***access control lists***?

They can be validated much faster as the system does not have to check the identity of the entity presenting the ticket.

e) What does the Berkeley Fast File System to reduce ***internal fragmentation***?

Each block can be partitioned into block fragments that can be allocated individually.

f) How does Berkeley UNIX simulate the ***page referenced bit***?

Clearing the page referenced bit of a page frame is replaced by marking this page INVALID. Setting the page referenced bit is replaced by marking this page VALID.

5. Given a memory size of **two** page frames, enumerate the pages that would be ***expelled*** from main memory while processing the reference string

1 1 0 1 1 0 1 0 2 0

a) under a ***LRU*** policy (5 points): page 1 (when page 2 is fetched into main memory)

b) under a ***FIFO*** policy (5 points): page 1 (when page 2 is fetched into main memory)

6. How should the type of files stored in a disk partition affect your choice of a block size for that partition? (2×5 points)

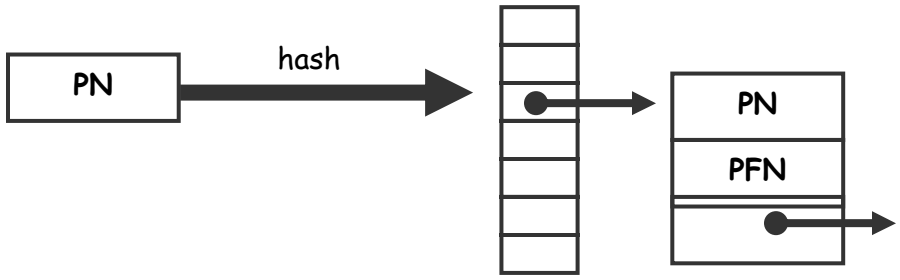
- **Large block sizes are better when** the partition contains very large files, _____

_____

- **Small block sizes are better when** the partition contains many very small files. _____ ___

_____

7. How would you implement ***inverted page tables***? (10 points for an answer with a correct diagram**)**



PN = page number
PFN = page frame number
There is one page table entry per page frame in main memory.

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