

Please staple pages together. CS241 Homework #3 Fall 2008. netid:_____

HOMEWORK #3

Review and application of all CS241 material to date.
Preparation for CS241 Final Exam.

Netid:_____

Last name, first name:_____

DUE DATE: Wednesday, December 3, DCL 1310 @ 10am (no late homeworks!)

INSTRUCTIONS:

- (1) Please type your homework solutions (unless otherwise mentioned). Handwritten solutions will NOT be accepted.
- (2) Homework pages must include your NetID on every page and must be stapled together when submitted.

Question	1 (10pts)	2 (25pts)	3 (20pts)	4 (25pts)	5 (25pts)	Total(105)
Score						
Grader						

QUESTION #1 (SIGNALS AND TIMERS) [10 points]

- A.** A process calls `ctime()` with an argument a , and gets as output the string:

Mon May 3 14:33:20 1976

What was the value of a ? (**3 points**)

- B.** What is the main disadvantage of `sigsuspend()` that motivates the use of `sigwait()`? Write at least three sentences on this disadvantage. (**3 points**)
- C.** Suppose you want to insert an `alarm(20)` instruction in your program, but your OS does not support the `alarm()` call. It does however support `kill()` and `fork()`. How would you achieve your wish (give the relevant code snippets)? (**4 points**)

QUESTION #2 (I/O DEVICES) [25 points]

A. Suppose a machine has a hard drive with the following characteristics:

- Rotational speed (rpm): 20,000
- Bytes per sector: 256
- Sectors per track: 800
- Tracks on the disk: 2000
- Average seek time (ms): 10

- a) What is the expected/average rotational delay for this disk? (2 points)
- b) What is the total time to read one sector on this disk? (2 points)
- c) What is the total time to read one track on this disk? (2 points)
- d) What is the transfer time for a 10KB file that is stored contiguously on a single platter? (2 points)
- e) What is the average time to access a random byte inside the file mentioned above? (2 points)

B. Answer the following questions about *programmed I/O*, *interrupt-driven I/O* and *Direct Memory Access (DMA)*:

- a) What is cycle stealing? (2 points)
- b) Which of the above three I/O mechanisms does it apply to? (2 points)
- c) Describe three conditions under which programmed I/O is preferable to interrupt-driven I/O. (HINT: think about the characteristics of a process or of the overall system) (3 points)

C. Disk requests come in to the disk driver for cylinders:

10, 22, 20, 2, 4, 38, 6, 40, 3, and 5

A seek takes 6 ms per cylinder moved. Assume the arm always begins at cylinder 1.

How much *seek time* is needed for each of the following algorithms:

1. FIFO (2 points):
2. SSTF (2 points):
3. SCAN (2 points):
4. C-SCAN (2 points):

QUESTION #3 (MEMORY MANAGEMENT) [25 points]

- A. Consider a system in which the memory has the following hole sizes in the following memory order:

1KB, 4 KB, 15 KB, 20 KB, 4 KB, 7 KB, 18 KB, 12 KB, 15 KB, 9 KB

You are given successive requests for program segments in the following order:

10 KB, 5 KB, 3 KB, 2 KB, 19 KB, 9 KB, 24 KB, 10 KB.

For each of the following algorithms, show how the holes get filled for each of the above requests. If a particular request cannot be satisfied, you can skip it (but do mention which ones cannot be satisfied):

1. First fit (**3 points**):
 2. Best fit (**3 points**):
 3. Worst fit (**3 points**):
 4. Next fit (**3 points**):
- B. The following presents an execution trace of a program fragment for a computer with 512 B pages. The program is located at address 1020, and its stack pointer is at 8192 (the stack grows toward 0).
- a) Give the page reference string generated by the program showed below. Each instruction occupies 4 B (*one word*) including immediate constants. Both instruction and data references count in the reference string. (**5 points**)

*Load word 6144 into register 0
Push register 0 onto stack
Call a procedure at 5120, stacking the return address
Subtract the immediate constant 16 from the stack pointer
Compare the actual parameter to the immediate constant 4
Jump if equal to 5152*

- b) Suppose this process allocated a total of 3 page frames in memory, and initially none of these page frames are occupied. For the above reference string, and each of the following page replacement algorithms, list where the page faults occur **and** the count of how many total page faults occur:
 - Optimal (**2 points**):
 - FIFO (**2 points**):
 - LRU(**2 points**):
- c) Suppose your machine has 32 bit addresses and uses a 2-level page table. Virtual addresses are split into: a 9 bit top-level page table field, an 11 bit second level page table field, and an offset.
 - How large are the pages? (**1 point**)
 - How many pages are there in the address space? (**1 point**)

QUESTION 4 (FILE SYSTEMS) [25 points]

- A. The starting of a free space bitmap looks like the following after the disk partition is first formatted:

1000 0000 0000 0000 (the first block is used by the root directory).

The system always searches for free blocks starting at the lowest numbered block. Show the bitmap after each of the following actions:

- a) File A with 6 blocks is written (*1 point*)
 - b) File B with 4 blocks is written (*1 point*)
 - c) File A is deleted (*1 point*)
 - d) File C with 7 blocks is written (*1 point*)
 - e) File B is deleted (*1 point*)
- B. Suppose a UNIX file system has 4 KB blocks and 8B disk addresses. What is the maximum file size if i-nodes contain 10 direct entries, and one single, double, and tripe indirect entry each? (Remember: each file has only one i-node that points to other data blocks or index tables) (*8 point*)
- C. Let us consider the following shell commands on a local i-node based file system.

```
cd /tmp
mkdir subdir
echo "hello" > subdir/file1
ln -s subdir/file1 file2
ln -s subdir/file1 file3
ln subdir/file1 file4
ln file4 file5
chmod 744 file4
touch file3
rm file5
chmod 000 subdir
```

- a) How many disk blocks were allocated in total? (*2 points*)
- b) How many disk blocks were freed in total? (*2 points*)
- c) Which command(s) incremented or decremented an existing i-node reference count? (*2 points*)
- d) Describe in words the permissions on the file 'file4' (*2 points*)
- e) Identify the last command to modify the inode of 'file3' and describe which i-node field is modified. (*2 points*)
- f) Describe the indirect effect (if any) of the 'chmod 000 .' command on the files file1, file2, file3, file4. (*2 points*)

QUESTION 5 (NETWORKING) [25 pts]

- A.** Classify each of the scenarios below as Client-Server, P2P, or Hybrid, and *explain* why you choose that answer (*You may consult the Web to answer these questions*):
- a) eBay (*1 point*):
 - b) Skype (*1 point*):
 - c) BitTorrent (*1 point*):
 - d) Telnet (*1 point*):
 - e) DNS (*1 point*):
- B.** Answer the following questions:
- a) What is the purpose of the connection-oriented server socket, which the server uses to perform an *accept()*? Explain your answer (*3 points*)
 - b) Once the *accept()* is done, does the server use this socket to communicate back to the client? Explain your answer. (*3 points*)
- C.** Given a process on host C with a UDP socket with *port* number 123. If host A and host B each send a UDP segment to host C with destination *port* number 123:
- a) Will both of these segments be directed to the same socket at host C? (*1 point*)
 - b) Can the process at host C know that these segments originated from two different hosts? Explain your answer (*2 points*)
- D.** If a system has an n-layer protocol hierarchy and at each of the layers, an h-byte header is added, what fraction of the network bandwidth is filled with headers given application generated messages of M bytes? (*5 points*)
- E.** Consider a Web browser with a cached IP address for a target URL (*i.e. you can ignore DNS lookups*). The *Round-Trip Time* (RTT) is the roundtrip time between the local host and the server containing the Web page. The Web page consists of a base HTML file and three small images. Assume the transmission times for all of the objects are negligible in comparison with the RTT. How much time elapses (in terms of RTTs) from when the user clicks on the link until the client receives the entire Web page using the following schemes:
- a) Non-persistent HTTP with no parallel connections (*2 points*):
 - b) Non-persistent HTTP with up to five parallel connections (*2 points*):
 - c) Persistent HTTP with pipelining (*2 points*):