

**EXAM ON FILE SYSTEMS AND I/O – SPRING 2005**  
**CSC 262 – OPERATING SYSTEMS**  
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*This is a closed-book exam. You may use one double-sided 8.5x11 sheet of notes.*

*All answers to this exam should be written in your exam booklet(s). Start with the questions that you know how to do, and try not to spend too long on any one question. Show your work to be eligible for partial credit. You will have two hours and twenty minutes. Good luck!*

**1. Efficiency Measures.** (12 points) For the scenario below, compute the mean latency, mean cpu utilization, and mean throughput at the time all jobs are finished.

*Job A: Assigned @ 0 ms, finished @ 10 ms, consuming 4 ms of cpu time in all.*

*Job B: Assigned @ 4 ms, finished @ 7 ms, consuming 2 ms of cpu time in all.*

*Job C: Assigned @ 2 ms, finished @ 10 ms, consuming 3 ms of cpu time.*

**2. Disk Head Scheduling.** (10 points) Below are several questions listing two sets of scheduling algorithms. In each case, some key difference(s) separate(s) all the algorithms in one set from all the ones in the other. Explain the shortcomings of one group, and how the other group attempts to address those shortcomings.

- a. SCAN vs. LOOK
- b. F-SCAN and F-LOOK vs. SCAN and LOOK
- c. C-SCAN and C-LOOK vs. SCAN and LOOK
- d. FIFO vs. SSTF
- e. SCAN vs. SSTF

**3. RAID.** (10 points) Explain the motivation behind the technology known as the Redundant Array of Independent Disks. Cite two areas in which a RAID device may achieve better performance than an ordinary disk, and give at least one specific example explaining how such improved performance may be achieved in each area. (You may wish to use diagrams to make your answer more clear.)

4. **Protection and Security.** (12 points) A hypothetical system has three privilege domains,  $\{D_1, D_2, D_3\}$ , and five resources of interest,  $\{F_1, F_2, F_3, F_4, F_5\}$ . Below is a set of capabilities lists for three hypothetical domains, in  $(resource, rights)$  format. Convert this to an access control list describing the same security policy, using a  $(domain, rights)$  format.

$D_1: \{(F_1, rw), (F_3, rx)\}$

$D_2: \{(F_3, r), (F_4, w), (F_5, rx)\}$

$D_3: \{(F_4, r^*)\}$

5. **File System Organization.** (12 points) Shown below are the inode of a file and the first twelve data blocks of a disk on which the file is stored. The data blocks belonging to the file are labeled A through K in the diagram below. Your job is to fill in the data block pointers so that the data blocks for the file can be assembled in the proper (alphabetical) order. If necessary and appropriate, you may use additional data blocks (13+) for pointers. Assume that the inode has only two direct pointers, one single indirect, one double indirect, and zero triple indirect, and that a data block can hold exactly four pointers. Fill in unused pointers with an appropriate value.

inode	Block Number											
	1	2	3	4	5	6	7	8	9	10	11	12
	B		K	A	E	F	H	D	J	I	G	C

6. **Vocabulary.** (16 points) Identify the following terms or acronyms with a short definition (no more than one or two sentences).

- Security mechanism
- Multiprogramming
- Line printer
- MBR
- Fetch-execute cycle
- Bus (the computer-related meaning, not the vehicle)
- Asynchronous I/O
- ELF

**7. OS Organization.** (12 points) You are working on an experimental operating system. Diagnose the following symptoms, based upon what you know about the organization of a modern operating system, by explaining what level of the operating system is most likely at fault and why you think that. Be as specific as possible. [You do not need to actually propose a solution to the problem.]

a. You can see all the files on your hard drive and Zip disks. However, you can't read anything from the floppy drive. In fact, the computer doesn't even seem to know that the floppy drive is there at all. You know it isn't a hardware problem, because when you remove the floppy drive from this computer and put it into another one, it works fine.

b. Two people, both connecting to your computer remotely and running identical jobs, get very different performance. One job finishes almost immediately; the other runs very slowly, and seems to freeze up for long periods of time. You have taken steps to rule out the network connection as the source of trouble. The same thing also happens to a single user running multiple jobs at once: some finish right away, and some run very slowly.

c. Files on your system have both a character-string name and a numeric file id. For some reason, you can't get a complete listing of all the files on your hard drive. Some of them are missing when you list the names of all the files. However, you know that the files are still there and intact because you can still access them normally using the file id.

**8. Ext2 File System.** (16 points) Suppose a floppy disk is formatted with an Ext2 file system, using 2KB blocks, and 168 inodes of 128 B size. Compute the offset from the beginning of the disk for the start of the following items, showing all your work:

a. The superblock.

b. The inode bitmap.

c. The root directory inode.

d. The tenth data block (i.e., the tenth block after all the header blocks)