## EXAM ON FILE SYSTEMS AND I/O – SPRING 2003 CSC 262 – OPERATING SYSTEMS **NICHOLAS R. HOWE**

1. Disk Scheduling (16 points). Consider the table below, which shows a series of requests for access to particular disk tracks, along with the time at which the request is made. Assume for simplicity that servicing each request takes exactly 5 ms, and that no request may be satisfied before the time at which it is been issued. What would be the order in which the requests are serviced under each of the following disk scheduling algorithms?

Track:	0	13	11	12	8	19
Time:	0 ms	2 ms	3 ms	6 ms	8 ms	9 ms

a. FCFS: 0, 13, 11, 12, 8, 19

b. SSTF: 0, 11, 12, 13, 8, 19

c. SCAN: 0, 11, 12, 13, 19, 8

d. F-SCAN: 0, 11, 13, 8, 12, 19

a). Give the access control list for

2. **Protection & Security** (12 points). Consider the access control matrix at right.

		File1	File2	File3	File4
e the access control list for	User1	R*W*X			RW
	User2	R	RX		R*W*X*
User2(RX); User3(R*W*X*)	User3	R*W*X*	R*W*X*	R*W*X*	R*W*X*

## b). Give the capabilities list for User2. *File1(R); File2(RX); File4(R\*W\*X\*)*

c). Which domain(s) are able to grant User2 permission to execute File1? User3

3. Vocabulary (24 points). Identify and describe the role and of the following parts of a system in one or two sentences.

a). System Bus

Carries communication between components of the computer, such as the CPU, memory, and I/O devices.

## b). RAID

File2.

Stands for Redundant Array of Independent Disks. Use of multiple drives that appear to the OS as one drive, for increased speed through parallelism and increased reliability through data duplication.

c). *i*-node

Stores important information about a file, including ownership, modification dates, security information, and pointers to disk blocks carrying the data.

d). root directory

The top-level directory on a disk or hierarchical file system. All other files and directories are descendants of the root directory.

e). cylinder (as part of a hard disk)

On a disk with a series of stacked platters, the set of sectors accessible as the disk spins without moving the comb. Physically, these form a set of stacked rings.

f). device driver

Device drivers form the second layer of a layered OS. They handle hardware-specific information from I/O devices.

4. **History** (10 points). Number the following developments in operating systems chronologically:

- <u>2</u> a). Spooling for offline printing
- <u>3</u> b). Time sharing
- <u>5</u> d). PCs get memory protection
- $\underline{4}$  e). VLSI technology leads to inexpensive microchips

5. **Ext2 File System** (16 points). The diagram below shows the data structures maintained within a block group of the Ext2 file system. Identify all the data structures that would need to be used in order to complete each of the following tasks. Assume that nothing is cached in memory, so that all information for each part must be read in from the disk. (Note: each part will typically use several of the data structures below.)

SUPER	GROUP	BLOCK	INODE	INODE	DATA
BLOCK	DESCRIPTORS	BITMAP	BITMAP	TABLE	BLOCKS

- a). Determine how much free space is available on the disk. *Super Block.*
- b). Locate a free inode and mark it used. Super Block, Group Descriptors, Inode Bitmap
- d). Check the modification date of the root directory. *Super Block, Group Descriptors, Inode Table*

d). Read the contents of the root directory of the disk. Super Block, Group Descriptors, Inode Table, Data Blocks

6. **Performance Measures** (12 points). Suppose that a processor has 10 identical jobs to do. Running alone, each will take 100  $\mu$ s (0.0001 s) and use up 10% of the CPU's resources. Calculate the mean latency, utilization, and throughput for the CPU under each of the scenarios below. (You don't need to compute latency for the individual jobs.)

a. Sequential execution, where one job starts as soon as the previous one finishes.

Latency =  $10*100 \ \mu s = 1 \ ms$ Utilization = 10%Throughput =  $10 \ jobs/ms = 10,000 \ jobs/s$ 

b. Staggered execution, where one job starts immediately, and one new job starts each 10  $\mu$ s after that until all jobs are running.

Latency = 9\*10+100 μs = 190 μs Utilization = 53% Throughput = 10 jobs/190 μs ≈53,000 jobs/s

7. **OS Structure** (10 points). Describe the role of the service layer in an OS such as Linux. Discuss its interaction with the layers immediately above and below it, contrasting its role with theirs.

The service layer must provide an intuitive, uniform interface to the user level while dealing with a potential multiplicity of devices at the driver level. For example, the Unix file system presents the user level with a single hierarchical view of all the files and directories accessible to the computer. Individual disk and tape devices are mounted at various points on this hierarchical system, and adopt its uniform hierarchy and name scheme. The service level may handle non –device-specific errors (such as "file not found") or may pass them up to the user level for handling.