EXAM ON FILE SYSTEMS AND I/O – SPRING 2007
CSC 262 – OPERATING SYSTEMS
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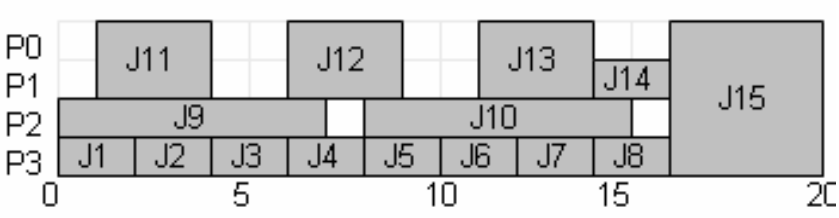
This is a closed-book exam. You may use one double-sided 8.5x11 sheet of notes.

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 one hour and fifty minutes. Good luck!

1. **Efficiency Measures**. (12 points) Consider the diagram below, representing the jobs run over a 20-minute span on a hypothetical computer with four CPUs.



a.) Compute the overall throughput of the 4-processor ensemble.

b.) Compute the mean utilization of each processor (rows P0-P3) during this period, and the overall utilization of the 4-processor ensemble.

c.) If J15 was assigned at t = 13, what is its latency?

2. **Disk Head Scheduling**. (12 points) Consider the following group of disk scheduling algorithms: FCFS/FIFO, LIFO, Priority, SSTF, SCAN, LOOK, C-SCAN.

a.) Which ones can allow a request to wait indefinitely during times of heavy disk utilization?

b. Which ones attempt to optimize overall disk performance by making some effort to handle nearby track requests together?

c. Which one might be expected to have the lowest mean response time, averaged over all requests?

3. **OS History**. (12 points) What two important OS developments occurred as computers began to be used by multiple users at once? Explain briefly why their development was vital to successful sharing of a single computer.

4. **Disk Hardware**. (12 points) Over time, design of so-called "Winchester" hard disk drives has tended towards ever-smaller platter radius and faster rotation speeds. Explain why this trend makes sense from a performance standpoint. Next, explain the contrary factors that prevent platters from shrinking too far or spin rates from becoming too fast.

5. **Units**. (8 points) Give the exact number of **bits** represented by each of the following abbreviated quantities. (You may give an exact decimal representation, or express your answer in terms of its factors, e.g., 2^8*10^3.)

a.) 1 B
b.) 8 KiB
c.) 10 Gb
d.) 16384 Mib

6. **Directories**. (16 points) Shown below is a representation of the contents of a directory file on an ext2 file system. Answer the questions that follow by carefully interpreting the file's contents.

37				12	1	2	.				18				12	2	2	.	.		
44				16	5	2	a	u	s	e	r				115				36		5	1
s	t	u	f	f				99				20		12	1	a	n	d	m	o	r	e	s
t	u	f	f	42			24		12	2	a	n	o	t	h	e	r	t	h	i	n	g

a.) What entries would be listed as the result of an `ls` command on this directory?

b.) Indicate the type (file, directory, etc.) of each of the entries you listed above.

c.) What is the inode number of this directory file?

d.) Which former entry has been deleted?

7. **Device Drivers**. (16 points) Using the Minix driver we studied in class as your example, match the following list of driver calls to the operations that they perform.

I. Initialization	A. Query device for physical characteristics (#sectors, etc.)
II. Mounting	B. Seek specific track
III. Data Transfer	C. Unlock/eject media
IV. Unmounting	D. Register data structure with API function mapping
	E. Install interrupt handler
	F. Read device data from BIOS
	G. Assign minor device number/partition
	H. Wake up sleeping user process

8. **Security and Protection**. (12 points) Consider the following capabilities associated with three protection domains:

> Domain W can write to files of class I and II.
> Domain R can read files of classes I and II, and can also execute files of class I.
> Domain Z can read, write, and execute files of class III.

Now consider three users. User A has access to domains R and Z. User B has access to domains W and R. User C has access to domain R only. Write an access control list for files of each of the three types specifying permissible actions for the three **users**, reflecting the policy given above. (In other words, your answer should represent the same access policy, but without making any reference to the three domains.)