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# King Fahd University of Petroleum and Minerals

Information and Computer Science Department

ICS 431: Operating System

## FINAL EXAM

**DO NOT OPEN UNTIL INSTRUCTED TO DO SO!!!!**

**Write clearly, precisely, and briefly!!**

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<b>ID:</b>							
<b>Name:</b>							

<b>Grades</b>		
<b>Section</b>	<b>Max</b>	<b>Scored</b>
<b>A</b>	<b>10</b>	
<b>B</b>	<b>15</b>	
<b>C</b>	<b>13</b>	
<b>D</b>	<b>11</b>	
<b>E</b>	<b>12</b>	
<b>F</b>	<b>14</b>	
<b>G</b>	<b>11</b>	
<b>H</b>	<b>14</b>	
<b>TOTAL</b>	<b>100</b>	

A. Answer all of the following TRUE/FALSE questions. Circle your answer in the following table. [10 pts]

1	2	3	4	5	6	7	8	9	10
T	T	T	T	T	T	T	T	T	T
F	F	F	F	F	F	F	F	F	F

1. In a single user operating system none of the short, medium, or long term schedulers are needed.
2. In many-to-many user to kernel threads, thread library is not really needed.
3. Average waiting time in preemptive SJF is shorter than non- preemptive SJF.
4. A cycle in a **wait-for graph** means deadlock.
5. None of the **first-fit**, **best-fit**, and **worst-fit** memory allocation schemes result in internal fragmentation.
6. When the CPU utilization is low, increasing the degree of multiprogramming will always improve CPU utilization.
7. Deadlock avoidance provides more concurrency than prevention.
8. A sufficient condition for deadlock is the existence of a circular wait condition.
9. On average, SJF gives less waiting time than both RR and FCFS.
10. Suppose that 3 processes share 4 resource units which can be reserved and released only one at a time. If each process needs a maximum of 2 units, then deadlock can never occur.

**B. Memory Management****[15 pts]**

1) Consider a paging system with the page table stored in memory. If a memory reference takes 100 nanoseconds,

a) How long does a paged memory reference take? **[5 pts]**

b) If we add associative registers, and 95 percent of all page-table references are found in the associative registers, what is the effective memory reference time? (Assume that finding a page-table entry in the associative registers takes zero time, if the entry is there.)

**[5 pts]**

2) Compare paging with segmentation with respect to the amount of memory required by the address translation structures in order to convert virtual addresses to physical addresses. **[5 pts]**

**C. Virtual Memory****[13 pts]**

1. Consider a demand-paging system with the following time-measured utilization. **[8 pts]**

CPU utilization	5%
Paging disk	98%
Other I/O devices	5%

For each of the following, say whether it will (or is likely to) improve CPU utilization. Explain your answers.

- a. Install faster CPU.
- b. Decrease the degree of multiprogramming
- c. Install more main memory
- d. Installing a faster disk, or multiple controllers with multiple hard disk.

2. Consider the following page-reference string: **[5 pts]**

1,2,3,4,2,1,5,6,2,1,2,3,7,6,3,2,1,2,3,6

How many page faults would occur if LRU page replacement algorithm is used? Assume 4 frames.

**D. Storage Management****[11 pts]**

1. Explain why RAID 5 is more efficient than RAID 4 for Database applications. **[5 pts]**

2. Suppose that a disk drive has 3000 cylinders, numbered 0 to 2999. The drive is currently serving a request at cylinder 144, and the previous request was at cylinder 140. The queue of pending requests in FIFO order, is

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130.

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk scheduling algorithms? **[6 pts]**

i. SSTF

ii. C-LOOK

**E. File Systems****[12 pts]**

1. What are the two tables that are maintained by the OS to manage open files? Explain the use of each table. **[5 pts]**

2. Consider a system where free space is kept in a free-space list.

- a. Suppose that the pointer to the free-space list is lost. Can the system reconstruct the free-space list? Explain your answer. **[4 pts]**

- b. Suggest a scheme to ensure that the pointer is never lost as a result of memory failure. **[3 pts]**

**F. Protection****[14 pts]**

- a.** Briefly explain 2 ways of implementing access-matrix and show the advantages and disadvantages of each one of them. **[6 pts]**

- b.** In the access-matrix what is the use of each of the following operations: **[ 8 pts]**

i. Switch

ii. Copy

iii. Own

iv. Control.

**G. Security****[11 pts]**

**a.** Briefly explain how the private and public encryption keys are used. **[4 pts]**

**b.** Write a program that can cause denial of service. **[7 pts]**



**H. Distributed Systems****[14 pts]**

- a. Assume P1 and P2 are two processes running in a distributed environment where deadlocks are prevented using time-stamped deadlock prevention scheme. Also assume P1 has higher priority than P2. What will happen when P1 requests a resource held by P2, if **[6 pts]**

i. Wait-die scheme is used?

ii. Wound-wait scheme is used?

- b. Assume P1, P2, P3, and P4 are 4 processes running in a distributed environment where deadlocks are handled using deadlock detection algorithm. Assume initially all of the 4 processes are active and the priority of  $P1 > P2 > P3 > P4$ . If the centralized approach is used to detect deadlocks and the Bully algorithm is used to select a coordinator, what will happen if: **[8 pts]**

i. P3 finds out that the coordinator is no longer active. Show all the steps of selecting the coordinator, and who will be the coordinator.

ii. P1 was inactive but now it is activated