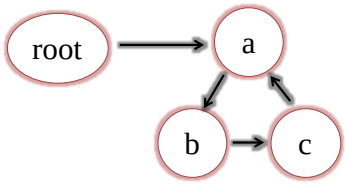
# 長庚大學109學年度第二學期作業系統實務期中測驗(總分107)

<<請依題號順序作答，跳號作答不予計分，跳號作答不予計分，跳號作答不予計分>>

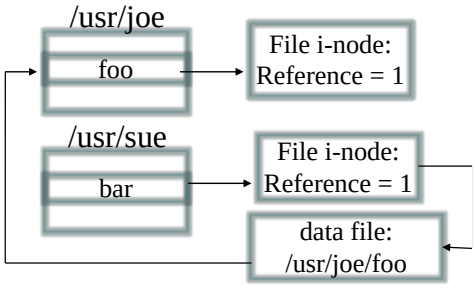
系級: 姓名: 學號:

1. (10%) Directory designs are an important issue in file systems. (a) What is the difference between Tree-Structured Directories and Acyclic-Graph Directories? If we extend the Acyclic-Graph Directory design to General Graph Directories, we might have some file and directory structure as the following figure. (b) What is the problem if we remove "/root/a"?




Answer: (a) Based on a tree structure, Acyclic-Graph Directories further allows the sharing of files without having any cycle in the directory structure.
(b) There is a self-referencing cycle among directories a, b and c. Thus, even though there is no path for accessing a, b or c, directories a, b and c are still not removed.

2. (15%) (a) How many i-nodes will be used if we create a file and create 2 hard links to the file? (b) How many i-nodes will be used if we create a file and create 4 symbolic links to the file? (c) For the following figure, can we access /usr/joe/foo after removing /usr/sue/bar? The reasons have to be provided to support your answers.




Answer: (a) 1 i-node. Creating the file uses an i-node, and the 2 hard links share the i-node.
(b) 5 i-nodes. Creating the file uses an i-node, and the 4 symbolic links use another 4 i-nodes.
(c) Yes, the symbolic link is removed, but the original file still exists.

3. (10%) There are three basic methods of file allocation, i.e., Contiguous Allocation, Linked Allocation, and Indexed Allocation. (a) Please answer that the FAT file system is developed on which type of allocation? (b) How does FAT do to reduce the cost of random reads and writes?

Answer: (a) Basically, FAT is a kind of linked allocation.
(b) FAT separates the pointers of linked lists and the data in two different areas. The pointers are collected in the file allocation table for quickly finding out all pointers of a linked list.

4. (10%) For free space manage management of file systems, please explain (a) the Bit Map approach and (b) the Linked List approach with the Counting method.

Answer: (a) There is an array in which each bit indicates the state (free or occupied) of a block.
(b) The first block of a sequence of free blocks will keep the number of the free blocks in the sequence and the pointer to the first block of the next sequence of free blocks.

5. (12%) Considering the disk scheduling, let a disk drive consist of 100 cylinders, from cylinder 0 to cylinder 99. Assume that the read-write head is now at cylinder 20 and moving toward cylinder 99. Now, there are multiple read/write requests (to be served) in the disk I/O queue, and no more request will arrive. The queued requests are at the following cylinders: 2, 15, 16, 21, 25, 68, 74, 89. Please illustrate the scheduling results of (a) the SSTF scheduling, (b) the SCAN scheduling, and (c) the C-LOOK scheduling.

Answer: SSTF: 21, 25, 16, 15, 2, 68, 74, 89
SCAN: 21, 25, 68, 74, 89, (99), 16, 15, 2
C-LOOK: 21, 25, 68, 74, 89, 2, 15, 16

6. (10%) We have RAID 0+1 and RAID 1+0, and RAID 1+0 is more popular than RAID 0+1. (a) Please explain the mechanisms of RAID 0+1 and RAID 1+0. (b)Why is RAID 1+0 better? You can provide a figure or an example to show that RAID 1+0 indeed outperforms RAID 0+1.

Answer: (a) RAID 0+1 does the data striping first and then does the data mirroring. RAID 1+0 does the data mirroring first and then does the data striping.
(b) When a hard disk fails, in RAID 1+0, only the bad hard disk should be offline. But in RAID 0+1, all hard disks in the data striping group of the bad hard disk should be offline.

7. (10%) There four type of device registers which can be accessed by the host to control the device: data-in registers, data-out registers, status registers, and control registers. Please explain the usage of (a) status registers and (b) control registers.

Answer: (a) The status register contains bits which indicate device states.
(b) The control register is written by the host to send commands.

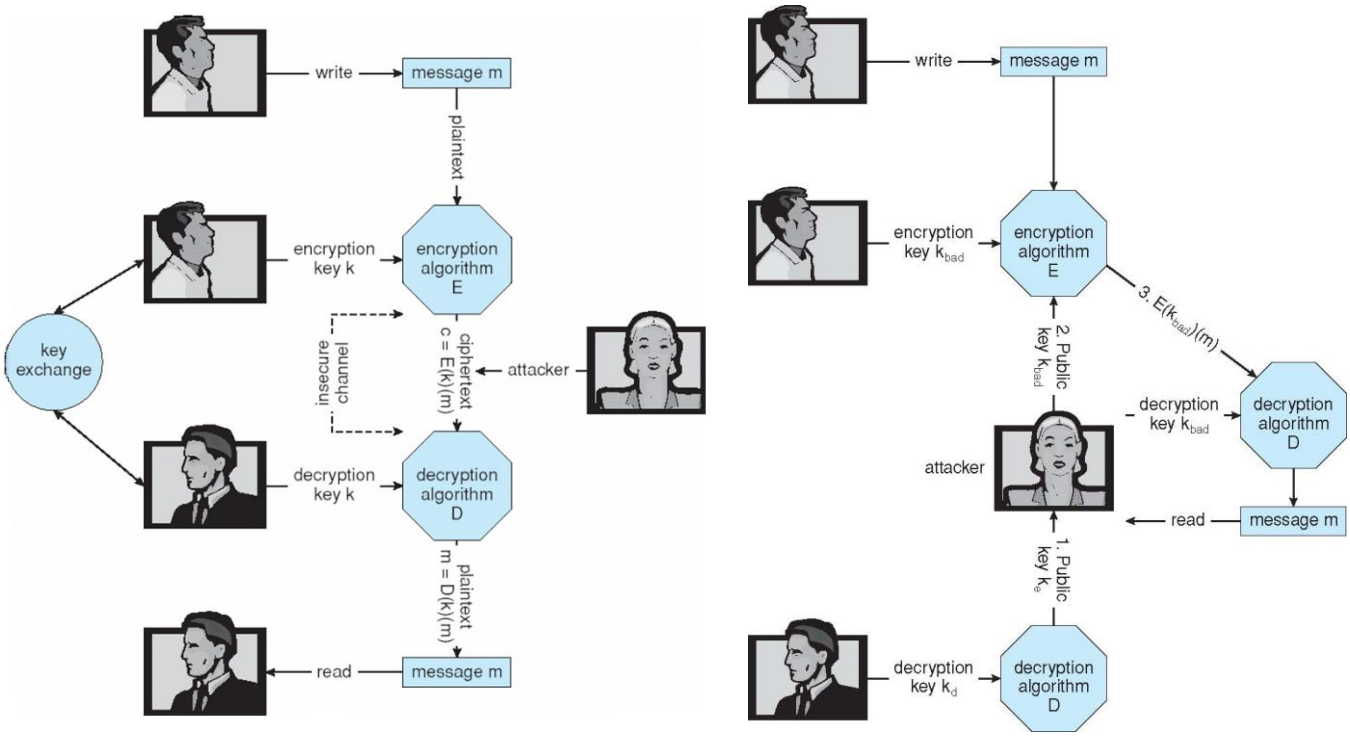
8. (8%) Direct Memory Access (DMA) is an I/O technique to improve the performance for massive data input/output. Compared with programmed I/O, please explain the advantage of DMA.

Answer: DMA is used to avoid programmed I/O (one or few bytes at a time) for large data movement so as to bypasses CPU to transfer data directly between I/O device and memory. Therefore, CPU is available for other computing jobs.

9. (12%) For system protection, to implement the access matrix, we have several different approaches. Please explain (a) Access list for objects, (b) Capability list for domains, and (c) Lock-key approach.

Answer: (a) Access list for objects: For each object, keep a linked list to describe the privilege of each domain for using this object.
(b) Capability list for domains: For each domain, keep a linked list to describe the privilege of this domain for using each object.
(c) Lock-key approach: Each object has a list of unique bit patterns, called locks. Each domain has a list of unique bit patterns called keys. A process in a domain can access an object if the domain has a key that matches one of the locks.

10. (10%) There are several security violation methods. (a) Please explain the man-in-the-middle attack. Even though we have public and private keys, we still might suffer from the man-in-the-middle attack. (b) Please explain the scenario of the man-in-the-middle attack with asymmetric encryption.




Answer: (a) Man-in-the-middle attack: an intruder sits in data flow, masquerading as sender to receiver and vice versa

(b) The intruder can block the package for sending the original public key and replace it by a fake one. When the client uses the fake public key for sending confidential content, the intruder can decrypt it and read the confidential content.