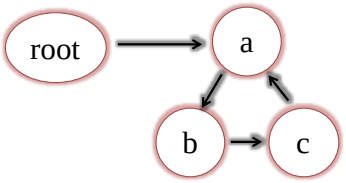
長庚大學106學年度第二學期作業系統實務期中測驗(總分106)

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 allow 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. (10%) (a) How many i-nodes will be used if we create a file and create 3 hard links to the file? (b) How many i-nodes will be used if we create a file and create 5 symbolic links to the file? The reasons have to be provided to support your answers.

Answer: (a) 1 i-node. Creating the file uses an i-node, and the 3 hard links share the i-node.
(b) 6 i-nodes. Creating the file uses an i-node, and the 5 symbolic links use another 5 i-nodes.

3. (12%) When we want to put a file into a hard disk, we have to develop allocation methods to assign each part of the file to some block of the hard disk. Please explain the three allocation methods (a) Contiguous Allocation, (b) Linked Allocation, and (c) Indexed Allocation.

Answer: (a) Contiguous Allocation – each file occupies set of contiguous blocks
(b) Linked Allocation – each file has a linked list of blocks, and the file is stored in the blocks
(c) Indexed Allocation – each file has its index block(s) which has pointers to the data blocks

4. (10%) To manage the free space of a file system, we can use Bit Map or Linked List solutions. If we directly use a linked list to manage all free space, it could be quite time-consuming to find a large continue space for storing a new file. Therefore, we have Grouping approach and Counting approach to improve the performance of the Linked List solution. Please explain (a) the Grouping approach and (b) the Counting approach for the Linked List solution.

Answer: (a) Grouping approach – Modify the linked list to store address of next n-1 free blocks in the first free block, plus a pointer to next block that contains free-block-pointers
(b) Counting approach – Modify linked list to store the number of continuous free blocks in first free block, plus a pointer to next block that keep a number of following free blocks

5. (12%) For disk scheduling, let a hard disk consist of 100 cylinders, from cylinder 0 to cylinder 99. Assume that the read-write head is now at cylinder 10 and moving toward cylinder 99. Now, there are multiple read/write requests (to be served) in the disk I/O queue, and no other request will further arrive. The queued requests are at the following cylinders: 30, 25, 34, 97, 7, 11, 68, 2. Please illustrate the scheduling results of the (a) SSTF scheduling, (b) SCAN scheduling, and (c) C-LOOK scheduling. (Note that: If the read-write head has to visit cylinder 0 or 99, you have to illustrate that in your answer.)

Answer: (a) SSTF: 11 → 7 → 2 → 25 → 30 → 34 → 68 → 97
(b) SCAN: 11 → 25 → 30 → 34 → 68 → 97 → (99) → 7 → 2
(c) C-LOOK: 11 → 25 → 30 → 34 → 68 → 97 → 2 → 7

6. (12%) We have RAID 0+1 and RAID 1+0, and RAID 1+0 is more popular than RAID 0+1. (a) What is RAID 0? (hint: RAID 0 is for better performance) (b) What is RAID 1? (hint: RAID 1 is for better reliability) (c) Why is RAID 1+0 better than RAID 0+1?

Answer: (a) Striping: It partitions a file into several parts and saves them in several disks so as to fully utilize all disks for improving the file read/write throughput.
(b) Mirroring: It keeps a duplicate of each disk so that whenever a disk fail, there is another disk having the same data.
(c) 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. (8%) There are four types of device registers which can be accessed by the host, and the device registers should be carefully managed by device drivers. Please explain the purpose for using (a) data-in register, (b) data-out register, (c) status register, and (d) control register.

Answer: (a) The data-in register is read by the host to get input
(b) The data-out register is written by the host to send output
(c) The status register contains bits which indicate device states
(d) The control register is written by the host to send command

8. (12%) Please carefully explain the concepts of (a) Buffering, (b) Caching, and (c) Spooling.

Answer: (a) Buffering: Buffering is to store data in some intermediate devices, such as DRAM, while the data are transferring between devices. It can be used to cope with some problems of the device speed mismatch and the device transfer size mismatch.
(b) Caching: A cache is a region of fast memory that holds copies of data. The difference between a buffer and a cache is that a buffer may hold the only existing copy of a data item, whereas a cache, by definition, holds a copy on faster storage of an item that resides elsewhere.
(c) Spooling: A spool is a buffer that holds multiple outputs for a device, such as a printer, that cannot accept interleaved data streams.

9. (8%) To implement the access matrix for system protection, there are four methods: global tables, access lists for objects, capability lists for domains, and lock-key schemes. Please explain the lock-key implementation.

Answer: Each object has a list of unique bit patterns, called locks. Each domain consists of 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. (12%) Assume that there are a public key K_e and a private key K_d, where K_e and K_d are a pair. E() and D() are the encryption and decryption functions, respectively. $E(K_e, X)$ is the encryption result of any data X by using function E() with the key K_e, and $D(K_d, Y)$ is the decryption result of any ciphertext Y by using function D() with the key K_d. Now, let Emily have key K_e, and David have key K_d.
    (a) If Emily wants to send private data Q to David, what should they do?
    (b) For symmetric encryption, we can use the same key for encryption and decryption. That is, if we have a key K_s for symmetric encryption, we can use function $E(K_s, X)$ to encrypt data X and use $D(K_s, Y)$ to decrypt ciphertext Y. Now, the question is as follows: David has private data R and wants to send data R to Emily. Thus, Emily first creates a symmetric key K_{iss}. What should they do to properly pass key K_{iss} to David and protect the data transfer from David to Emily?

Answer: (a) 1. Emily sends the encryption result $E(K_e, Q)$ to David.
2. David then gets the decryption result $D(K_d, E(K_e, Q)) \rightarrow Q$.
(b) 1. Emily sends the encryption result $E(K_e, K_{iss})$ of K_{iss} to David.
2. David then gets the decryption result $D(K_d, E(K_e, K_{iss})) \rightarrow K_{iss}$.
3. David sends the encryption result $E(K_{iss}, R)$ of R to Emily.
4. Emily then gets the decryption result $D(K_{iss}, E(K_{iss}, R)) \rightarrow R$.