B033040009 資工系 二年級 蔡宜勳

1. What is the difference between a hard link and a symbolic link? Give an advantage of each one.

Ans.

Hard link: 在某個目錄下的 block 多寫入一個關連資料，用以連結到目標檔案。通常磁碟空間與 inode 數目不會因此而改變。

Advantage: 比較安全，縱使某一個目錄下的關聯資料被刪除，也沒有關係，只要有任何一個目錄下存在著關連資料，那麼該檔案就不會不見。

Symbolic link: 建立一個獨立的檔案，用以連結到目標檔案。來源檔案被刪除之後，Symbolic link 檔會失效。會佔用磁碟空間與 inode。

Advantage: 用途上來説比較廣泛，比起 Hard link 來説限制較少，可以做到目錄的 link，而 Hard link 則否。

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2. A disk has 4000 cylinders, each with 8 tracks of 512 blocks. A seek takes 1 msec per cylinder moved. If no attempt is made to put the blocks of a file close to each other, two blocks that are logically consecutive (i.e., follow one another in the file) will require an average seek, which takes 5 msec. If, however, the operating system makes an attempt to cluster related blocks, the mean interblock distance can be reduced to 2 cylinders and the seek time reduced to 100 microsec. How long does it take to read a 100 block file in both cases, if the rotational latency is 10 msec and the transfer time is 20 microsec per block?

Ans.

5 msec + (10 msec + 0.02 msec) = 15.02 msec(access time per block)
15.02 msec * 100 = 1.502 sec (100 blocks access time)
(0.1 msec * 2) + (10 msec + 0.02 msec) = 10.22 msec (access time per block)
10.22 msec * 100 = 1.022 sec (100 blocks access time)

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3. Consider the following page reference string:

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 for the following replacement algorithms, assuming one, two, three, four, five, six, or seven frames? Remember all frames are initially empty, so your first unique pages will all cost one fault each.

(a) LRU replacement
(b) Optimal replacement

Ans.

Frames	1	2	3	4	5	6	7
LRU	20	18	15	10	8	7	7
Optimal	20	15	11	8	7	7	7

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4. Consider a file currently consisting of 100 blocks. Assume that the file control block (and the index block, in the case of indexed allocation) is already in memory. Calculate how many disk I/O operations are required for contiguous, linked, and indexed (single-level) allocation strategies, if, for one block, the following conditions hold. In the contiguous allocation case, assume that there is no room to grow in the beginning, but there is room to grow in the end. Assume that the block information to be added is stored in memory.

(a) The block is added at the beginning.
(b) The block is added in the middle.
(c) The block is added at the end.
(d) The block is removed from the beginning.
(e) The block is removed from the middle.

Ans.

	Contiguous	Linked	Indexed
a	201	1	1
b	101	52	1
c	1	3	1
d	198	1	0
e	98	52	0

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5. A certain computer provides its users with a virtual-memory space of 2^{32} bytes. The computer has 2^{18} bytes of physical memory. The virtual memory is implemented by paging, and the page size is 4096 bytes. A user process generates the virtual address 11123456. Explain how the system establishes the corresponding physical location. Distinguish between software and hardware operations.

Ans.
虛擬記憶體位址 11123456 用二進制表示為：
0001 0001 0001 0010 0011 0100 0101 0110
而 page 的大小是 2^{12} bytes, 所以 page table 的大小為 $2^{32} / 2^{12} = 2^{20}$ bytes
因此，最後面的 12 個 bits(0100 0101 0110)被用來當作 page 的 displacement
而其他前面的 20 個 bits(0001 0001 0001 0010 0011)則被用來當作 page table 的 displacement
最後，offset bits 連結到了由 page table 產生的實體記憶體位址，進而產生了作為結果的記憶體位址。