

Homework 4 File System, Mass-Storage, and I/O System (60pts)

File System (30pts)

1. (Exercise 11.10) The open-file table is used to maintain... (5pts)

By keeping a central open-file table, the operating system can perform the following operation that would be infeasible otherwise. Consider a file that is currently being accessed by one or more processes. If the file is deleted, then it should not be removed from the disk until all processes accessing the file have closed it. This check can be performed only if there is centralized accounting of number of processes accessing the file. On the other hand, if two processes are accessing the file, then two separate states need to be maintained to keep track of the current location of which parts of the file are being accessed by the two processes. This requires the operating system to maintain separate entries for the two processes.

2. (Exercise 11.11) What are the advantages and disadvantages of providing mandatory locks... (5pts)

Separate programs might be willing to accept concurrent access to a file without requiring the need to obtain locks and thereby guaranteeing mutual exclusion to the files. Mutual exclusion could be guaranteed by other program structures such as memory locks or other forms of synchronization. In such situations, the mandatory locks would limit the flexibility in how files could be accessed and might also increase the overheads associated with accessing files.

3. (Exercise 12.12) Consider a system where free space is kept in a free-space list...(10 pts)
- a. To recreate the free list, it would be necessary to perform garbage collection. This would involve searching the directory structure to determine the pages that are already allocated to jobs. Those remaining unallocated pages could be relinked as the free-space list.
 - b. 4 separate disk operations
 - c. The free-space list pointer could be stored on the disk.

4. (Exercise 12.16) Consider a file system that use nodes to represent files...(10pts)

64 terabytes

Mass-Storage Structure (20pts)

1. (Exercise 10.11) Suppose that a disk drive has 5,000 cylinders... (15pts)

a. The FCFS schedule is 2150, 2069, 1212, 2296, 2800, 544, 1618, 356, 1523, 4965, 3681. The total seek distance is 13,011.

b. The SSTF schedule is 2150, 3681, 356, 544, 1212, 1523, 1618, 2069, 2296, 2800, 4965. The total seek distance is 9,465.c)

c. The SCAN schedule is 2150, 544, 1212, 1523, 1618, 2069, 2296, 2800, 4965, 4999, 3681, 356. The total seek distance is 10,704.

d. The LOOK schedule is 2150, 544, 1212, 1523, 1618, 2069, 2296, 2800, 4965, 3681, 356. The total seek distance is 10,636.

e. The C-SCAN schedule is 2150, 544, 1212, 1523, 1618, 2069, 2296, 2800, 4965, 4999, 356, 3681. The total seek distance is 14,029.

f. The C-LOOK schedule is 2150, 544, 1212, 1523, 1618, 2069, 2296, 2800, 4965, 356, 3681. The total seek distance is 13,961.

2. (Exercise 10.14) Describe some advantages and disadvantages of using SSDs...(5pts)

SSD's have the advantage of being faster than magnetic disks as there are no moving parts and therefore do not have seek time or rotational latency.

I/O System (10pts)

1. (Exercise 13.14) Typically, at the completion of a device I/O...(hint: Linux kernel has a similar design. Find out why it is designed this way in Linux. 5pts)

The purpose of this strategy is to ensure that the most critical aspect of the interrupt handling code is performed first and the less critical portions of the code is delayed for the future. When a device finishes an I/O operation, the device control operations corresponding to declaring the device as no longer being busy are more important in order to issue future operations. However, the task of copying the data provided by the device to the appropriate user or kernel memory regions can be delayed for a future point when the CPU is idle.

2. (Exercise 13.15) Some DMA controller support direct virtual memory access...(hint: check the so- called IOMMU, 5pts)

Direct virtual memory access allows a device to perform a transfer from two memory-mapped devices without the intervention of the CPU or the use of main memory as a staging ground. The device simply issues memory operations to the memory-mapped addresses of a target device and the ensuing virtual address translation guarantees that the data is transferred to the appropriate device. This functionality, however, comes at the cost of having to support virtual address translation on addresses accessed by a DMA controller and requires the addition of an address-translation unit to the DMA controller. The address translation results in both hardware and software costs and might also result in coherence problems between the data structures maintained by the CPU for address translation and corresponding structures used by the DMA controller.