Operating System Homework 14

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14.4 One problem with contiguous allocation is that the user must pre-allocate enough space for each file. If the file grows to be larger than the space allocated for it, special actions must be taken. One solution to this problem is to define a file structure consisting of an initial contiguous area of a specified size. If this area is filled, the operating system automatically defines an overflow area that is linked to the initial contiguous area. If the overflow area is filled, another overflow area is allocated. Compare this implementation of a file with the standard contiguous and linked implementations.

Answer:

This method combines the advantages of standard contiguous and linked implementations.

Comparing with contiguous standard implementation, this method solves the problem when we need to allocate new space, greatly increased flexibility without external fragmentation. The price is that we need to add a data structures to record the next address.

Comparing with contiguous linked implementation, it improves the efficiency of file accessing, especially when the file is not so large, the file can be accessed efficiently in continuous space. And we only need to record the address of the next hop for the extra block, which saves the space.

14.14 Consider a file system on a disk that has both logical and physical block sizes of 512 bytes. Assume that the information about each file is already in memory. For each of the three allocation strategies (contiguous, linked, and indexed), answer these questions:

    a. How is the logical-to-physical address mapping accomplished in this system? (For the indexed allocation, assume that a file is always less than 512 blocks long.)

    b. If we are currently at logical block 10 (the last block accessed was block 10) and want to access logical block 4, how many physical blocks must be read from the disk?

Answer:

First, we get the file physical block number and file offset number:
$$\text{block number } N = \text{logical address} / 512$$
$$\text{offset } S = \text{logical address} \% 512$$

Contiguous:

    a. physical address = file start address + $N * 512 + S$

    b. 1, directly access

Linked:

    a. Jump N times from the start block, get the block address, then add S

    b. 4, sequential access

Indexed:

    a. Find the N-th entry in the index block, then add S

    b. 2, one extra access to get address from index