

Operating Systems 211

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Tutorial - File Systems

1. Explain what it means to “defragment a file system”? Are there file systems that do not require defragmentation? How can a file system reduce the amount of fragmentation?
2. Consider a file system that maintains a unique inode for each file in the system. Each inode includes 8 direct pointers, a single indirect pointer, and a double indirect pointer. The file system block size is 1024 (2^{10}) bytes, and a block pointer occupies 4 bytes.

How many disk operations will be required if a process reads data from the Nth block of a file? Assume that the file is already open, the buffer cache is empty, and each disk operation reads a single file block. Your answer should be given in terms of N.

3. Consider a file system that uses inodes with single-indirect and double-indirect blocks and a block size of 1024 (2^{10}) bytes. If the block size of the file system is doubled, by approximately what factor does the maximum possible file size increase? Your answer should be an integer.
4. Consider a hierarchical file system in which free disk space is kept in a free block bitmap.
 - a. Suppose that the stored free block bitmap is lost. Can the OS reconstruct the lost information? If so, describe how.
 - b. Suggest a scheme to protect the free block bitmap against such accidental loss.
5. Consider a file system with an inode organisation. Suppose that, for a given file, the file system has filled up all the blocks stemming from the doubly indirect pointers. Assume that the inode and free block bitmap are both completely in memory, but there is no buffer cache.

How many disk accesses will it take to write one more byte to the file?