Some exercises on file systems

1. How do caches improve performance of the file system?

2. The open-file table is used to maintain information about files that are currently open. How the OS knows when to close an entry in this table, given that many processes may have opened the same file?

3. Assume we have an i-node with 10 direct address pointers and 1 single indirect address pointer. The address pointers are 4 bytes long, a block is 1024 bytes long. What would the largest possible file in this system?

4. Consider a 4-TB disk that uses 4-KB blocks and the free-list method. How many block addresses can be stored in one block?

5. The beginning of a free-space bitmap looks like this after the disk partition is first formatted: 1000 0000 0000 0000 (the first block is used by the root directory). The system always searches for free blocks starting at the lowest-numbered block, so after writing file A, which uses six blocks, the bitmap looks like this: 1111 1110 0000 0000. Show the bitmap after the following actions: File B is written, using five blocks, File A is deleted, File C is written, using eight blocks, File B is deleted.

6. What would happen if the bitmap or free list containing the information about free disk blocks was completely lost due to a crash? Is there any way to recover from this disaster, or is it bye-bye disk? Discuss your answers for UNIX and the FAT -16 file system separately.

7. Consider a disk that has 10 data blocks starting from block 14 through 23. Let there be 2 files on the disk: f1 and f2. The directory structure lists that the first data blocks of f1 and f2 are respectively 22 and 16. Given the FAT table entries as below, what are the data blocks allotted to f1 and f2?

   (14,18); (15,17); (16,23); (17,21); (18,20); (19,15); (20, -1); (21, -1); (22,19); (23,14).

   In the above notation, (x, y) indicates that the value stored in table entry x points to data block y.

8. A Unix file system has 1-KB blocks and 4-byte disk addresses. What is the maximum file size if i-nodes contain 10 direct entries and one single, double and triple indirect entry each?

9. How many disk operations are needed to fetch the i-node for afile with the path name /usr/ast/courses/os/handout.t? Assume that the i-node for the root directory is in memory, but nothing else along the path is in memory. Also assume that all directories fit in one disk block.