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114/120

Midterm Examination
CSE 350

This examination has 6 problems. You may use your textbook or your notes to derive solutions. READ EACH PROBLEM CAREFULLY.

The root directory ROOT and file allocation table FAT will be needed for problems 1, 2 and 3. ROOT and FAT are tables defined as follows. The ROOT table has 6 entries and the FAT has 16 entries. The first column of the ROOT is the file name and the second column indicates the first block of the file. The only column of the FAT is the link field which indicates the next block in the file. In the FAT, a 0 indicates the entry is the last block in the file. The first free block in the free list is given in FAT[0].

| | | |
|---|---|---|
| 1 | F1 | 8 |
| 2 | F2 | 6 |
| 3 | F3 | 7 |
| 4 | | |
| 5 | | |
| 6 | | |

ROOT

| | |
|---|---|
| 0 | 16 |
| 1 | 0 |
| 2 | 0 |
| 3 | 4 |
| 4 | 5 |
| 5 | 0 |
| 6 | 0 |
| 7 | 3 |
| 8 | 9 |
| 9 | 11 |
| 10 | 0 |
| 11 | 12 |
| 12 | 0 |
| 13 | 0 |
| 14 | 13 |
| 15 | 14 |
| 16 | 15 |

FAT

DIAGRAM 1

| A. | B. | C. | D. | E. |
|---|---|---|---|---|
| 15 | 14 | 3 | 7 | 3 |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 |
| 4 | 4 | 14 | 14 | 14 |
| 5 | 5 | 5 | 5 | 15 |
| 0 | 0 | 0 | 0 | 0 |
| 16 | 16 | 16 | 16 | 16 |
| 3 | 3 | 4 | 3 | 0 |
| 9 | 9 | 9 | 9 | 9 |
| 11 | 11 | 11 | 11 | 11 |
| 0 | 0 | 0 | 0 | 0 |
| 12 | 12 | 12 | 12 | 12 |
| 0 | 15 | 15 | 15 | 15 |
| 0 | 0 | 0 | 0 | 0 |
| 13 | 13 | 13 | 13 | 13 |
| 14 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 7 |

FAT (Problem 2)

DIAGRAM 2

| | | |
|---|---|---|
| 1 | F1 | 8 |
| 2 | F2 | 6 |
| 3 | F3 | 4 |

ROOT (Problem 2)

1. {20 points}
Consider the ROOT and FAT given in DIAGRAM 1.
A. List the blocks in the free list.
B. List the blocks in files F1, F2, and F3.
C. List the bad (unused) blocks in the file system.

A: 16,15,14,13 C: 10
B: F1 - 8,9,11,12
F2 - 6
F3 - 7,3,4,5 20

2. {20 points}
Recall the functions Addblock(F,B)and Delblock(F,I) which belong to the FileSys class. Addblock accepts a file name F and a block of characters B, and adds the block to the end of the file F returning the block number and updating the ROOT and FAT. Delblock accepts a file name F and a block number I and removes that block from the file and adds it to the front of the empty list.

Indicate the changes that will be made to the ROOT and FAT in the example given in DIAGRAM 1 on page 1 after the following procedures are executed. Indicate the changes in DIAGRAM 2.

A. Addblock(F2,B)
B. Addblock(F1,B)
C. Delblock(F3,3)
D. Delblock(F3,7)
E. Addblock(F2,B)

20

3. {20 points}
The functions Firstblock(F), Nextblock(F,I) and Rmfile(F) are also members of the FileSys class. Firstblock(F) returns the number of the first block in the file F (returns -1 if the file does not exist and returns 0 if the file has no blocks). Nextblock accepts a file name F and a block number I and returns the block number of the block that follows I in the file F. It returns 0 if I is the last block in the file and -1 if I does not belong to the file. Rmfile(F) removes the empty file F from the filesystem.

See attached

Use Firstblock, Nextblock, Rmfile and Delblock to write a function :

int delete(FileSys& filesystem, string file) 20

which accepts a file name "file" and deletes the file. That is, the function deletes every block in the file leaving the file empty. It then removes the empty file. Note that your function may not directly access or modify the FAT or ROOT. It must use Firstblock, Nextblock, etc.

4. {20 points}
A. How many 65536 (2^16) byte blocks will be needed to store an MS-DOS FAT for a filesystem with 1073741824 (2^30) blocks and 32 bit block addresses?
B. System VI UNIX system uses 1024 byte blocks and 4 byte (32 bit) block addresses. Each i-node holds 10 block addresses for data blocks, one single-indirect block address, one double-indirect block address and one triple indirect block address. What is the maximum size of a file in terms of the number of blocks?

A: 65,536 blocks needed
B: $6.873 \times 10^{10}$ ? X -6 68 billion blocks.

14

5. {20 points}
A SCSI disk drive has 65536 cylinders, 4096 sectors/track,
12 heads (surfaces), 512 bytes/block and spins at 10,000 RPM.

A. How many storage blocks are located on a single cylinder? 49,152 storage blocks
B. What is the total storage capacity in bytes? $1.65 \times 10^{12} \approx$ 1.6 tera bytes
C. What is the maximum data transfer rate expressed in terms of bytes/second? $\approx$ 349 mb/s
D. What is the maximum rotational delay? .006 seconds.

20

6. {20 points}
A. Use the entropy function to compute the necessary number of binary digits required to encode the message eieiooeieioodada (assuming a codeword for each individual character).
B. Design a binary Huffman Code to compress the message eieiooeieioodada.
C. How many binary digits are needed to compress the message using your code?

(A)

a - $\frac{2}{16} = \frac{1}{8}$
d - $\frac{2}{16} = \frac{1}{8}$
e - $\frac{4}{16} = \frac{1}{4}$
i - $\frac{4}{16} = \frac{1}{4}$
o - $\frac{4}{16} = \frac{1}{4}$

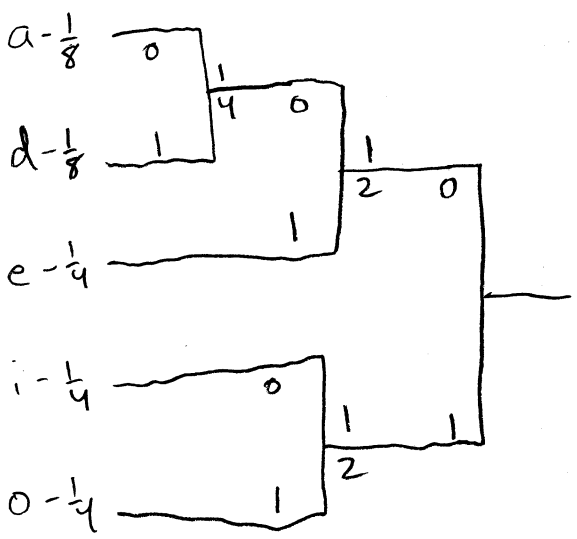
$H = 2\left(\frac{1}{8}\log_2 8\right) + 3\left(\frac{1}{4}\log_2 4\right)$

$H = \frac{3}{4} + \frac{3}{2}$

$H = \frac{9}{4}$ $H = 2.25$ answer question

20

(B)




a = 000
d = 001
e = 01
i = 10
o = 11

(C) 2.25 x 16 bits = 36 bits for compression

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cse 350
mid term

① A: 16, 15, 14, 13

B: F1: 8, 9, 11, 12
F2: 6
F3: 7, 3, 4, 5

C: 10

② on page 1 of mid term

③

```
int delete (fileSys & filesystem, string file) {

    int block = filesystem.getfirstblock(file);

    vector<int> blocks;

    if ( block != -1) {
        while ( block != 0 && block != -1) {
            blocks.push_back(block);
            block = filesystem.nextblock(file, block);
        }

        while ( blocks.size() > 0 {
            filesystem.delblock(file, blocks[blocks.size()-1]);
            blocks.pop_back();
        }

        filesystem.rmfile(file);
        return 1; // means all is good
    }
    return -1; // file didnt exist
}
```

④ A: $1,073,741,824 \times \frac{32}{8} = 4,294,967,296$

$\frac{4,294,967,296}{65,536} = 65,536$ blocks need of size 65,536 bytes

B: $10 + 1024 \times \frac{32}{8} + \left(1024 \times \frac{32}{8}\right)^2 + \left(1024 \times \frac{32}{8}\right)^3$

$= 10 + 4096 + 4096^2 + 4096^3$

$= 4106 + 4096^2 + 4096^3$

$\approx 6.8736 \times 10^{10} \simeq$ 68 Billion Block

Answer

$10 + 256 \times 256^2 + 256^3$

$1024/4 = 256$

⑤ A: $4096 \times 12 = 49,152$ Storage blocks

B: $4096 \times 512 \times 12 \times 65,536 \approx 1.65 \times 10^{12} \approx 1.6$ terabytes

C: $4096 \times 512 \times \frac{10,000}{60} = 349,525,333.3$ per second

$349 mb/s$

D: $\frac{60}{10,000} = .006$

⑥ on last page of midterm