

CSCI 3150 Introduction to Operating Systems

Assignment 2

Deadline: **23:59, October 26, 2025**

Total Marks: 100

October 8, 2025

Question 1

Suppose that there is a file with SFS and we have read the contents of its inode and related data blocks into the memory as shown in Figure 1.

| Contents of indirect data block(each cell is 4bytes long) | |
|---|-----|
| | |
| Data block 30 | |
| Cell 0 | 34 |
| Cell 1 | 36 |
| Cell 2 | 40 |
| Cell 3 | 45 |
| Cell 4 | 46 |
| Cell 5 | 49 |
| Cell 6 | 51 |
| Cell 7 | 52 |
| Cell 8 | 54 |
| Cell 9 | 60 |
| Cell 10 | 71 |
| Cell 11 | 90 |
| Cell 12 | 93 |
| | ... |
| | |
| inode of a file | |
| | ... |
| direct_blk[0] | 6 |
| direct_blk[1] | 11 |
| indirect_blk | 30 |
| | ... |

Figure 1: A file in SFS. The contents of inode and indirect block are shown.

Answer the following questions:

- (a) What is the maximum size of a single file in SFS (suppose each data block is **8KB**)? (10 marks)
- (b) Provide data block numbers in sequence that will be read from the disk (only data blocks that contain file data) when `read_t(inum, offset, buf, count)` is called in a user program, where `inum` is the corresponding inode number for the above inode, and `buf` is a pointer that points to a user-defined buffer. (40 marks)

| | read(inum, offset, buf, count) | The data block numbers in sequence that will be read from (only list the data blocks that contain file data) |
|-----------|--------------------------------|---|
| Example 1 | read(inum, 130, buf, 400); | 6 |
| Example 2 | read(inum, 130, buf, 9000); | 6,11 |
| (i) | read(inum, 130, buf, 19000); | |
| (ii) | read(inum, 8191, buf, 8193); | |
| (iii) | read(inum, 8192, buf, 24576); | |
| (iv) | read(inum, 16384, buf, 40960); | |

Question 2

There exists following directory hierarchy in SFS shown as Figure 2.

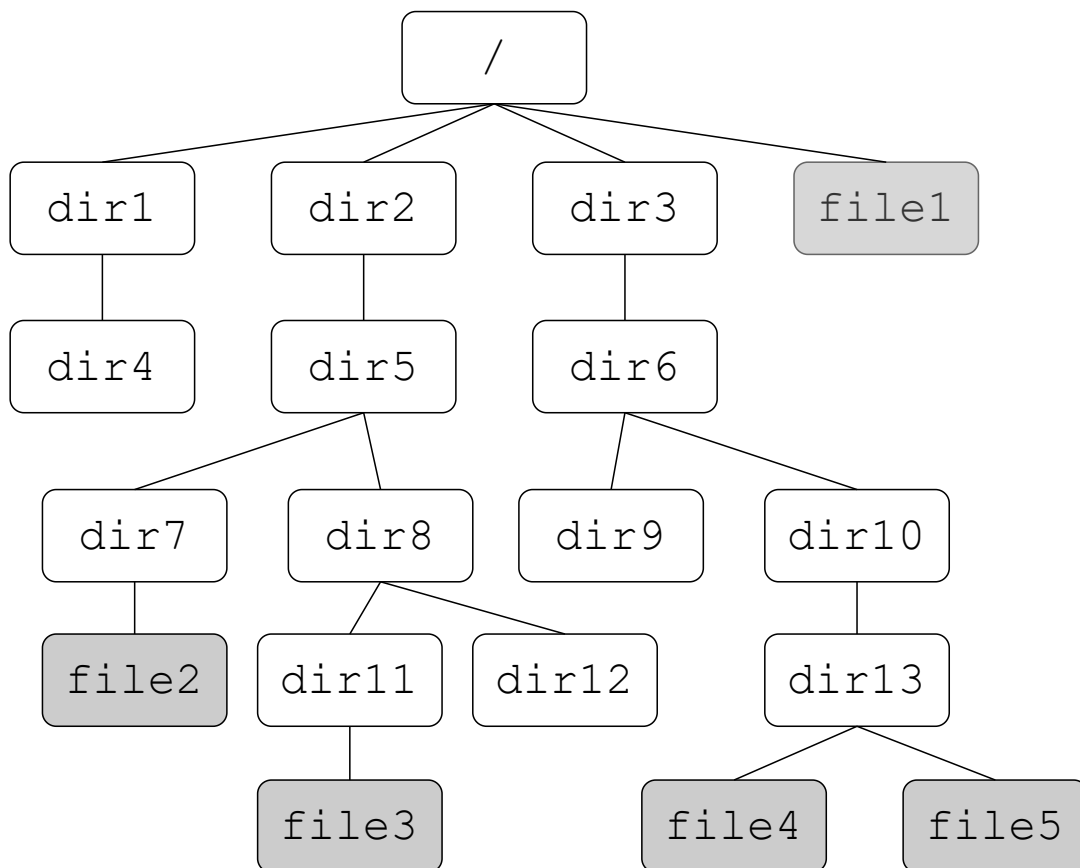


Figure 2: Directory hierarchy.

Here, “/” is the root directory; “dir1”, “dir2”, “dir3”, “dir4”, “dir5”, “dir6”, “dir7”, “dir8”, “dir9”, “dir10”, “dir11”, “dir12” and “dir13” are directories; “file1”, “file2”, “file3”, “file4”, “file5” are regular files.

Suppose we have known that the inode numbers of “/”, “dir1”, “dir2”, “dir3”, “dir4”, “dir5”, “dir6”, “dir7”, “dir8”, “dir9”, “dir10”, “dir11”, “dir12”, “dir13”, “file1”, “file2”, “file3”, “file4” and “file5” are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17 and 18 respectively.

Each directory occupies only one data block (each data block is 4KB), and the data block numbers allocated to “/”, “dir1”, “dir2”, “dir3”, “dir4”, “dir5”, “dir6”, “dir7”, “dir8”, “dir9”, “dir10”, “dir11”, “dir12” and “dir13” are 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 respectively.

Answer the following questions:

- (a) Suppose that each directory entry of a directory is defined by the following structure:

```

typedef struct dir_mapping
{
    char f_name[20]; /* The file name of the file */
    int i_number;    /* The inode number of the file */
} DIR_NODE;

```

And each directory should at least contain two mapping items, “.” and “..”, for the current directory and its parent directory respectively (note: the parent of the root directory is itself). For example, the content of data block 6 (which is the data block of “dir6”) is:

| f_name | i_number |
|--------|----------|
| . | 6 |
| .. | 3 |
| dir9 | 9 |
| dir10 | 10 |

Give the contents of data blocks 0, 1, 5, 8 and 11, respectively (you can omit the header “f_name” and “i_number”). (30 marks)

- (b) Suppose a user provides the following absolute path:

/dir3/dir6/dir10/dir13/file5

Show the sequence of the inode numbers and data block numbers we need to pass in order to obtain the inode number of file5 (starting from the root directory “/”). (20 marks)

For example, if a user wants to access file1, the sequence is: inode 0 → data block 0 → inode 14.

What to submit: a PDF containing you answers.