CSCE 410/611 Operating Systems Spring 2023

Homework for Week 13

(Due Date: Check Canvas)

1. Consider a very simple file system for a tiny disk. Each sector on the disk holds 2 integers, and all data blocks, indirect blocks, and inodes are 1 disk sector in size (each contains 2 integers). All Files stored on disk are interpreted as directories by the file system (there are no “data files”). The file system defines the layout for the following data types on disk:

inode = 1 pointer to a data block + 1 pointer to indirect block

indirect block = 2 pointers to data blocks

directory = a regular file containing zero or more pairs of integers; the first integer of each pair is a file name and the second is the file’s inode number.

The value “99” signifies a null pointer when referring to a disk block address or directory name. An empty directory has one disk block with the contents “99 99”. The inode number for root directory “/” is 0.

The following data is stored on the disk:

inode array:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10  6 | 7  99 |  | 8  99 |  |  | 3  99 |  |  |  |  |  |  |  |  |  |

disk blocks:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 32  3 |  | 96  1 |  |  | 1  99 | 99  99 | 99  99 |  | 57  6 |  |  |  |  |  |

(a) How many entries can appear in a maximum-sized directory? (Each entry is a pair of integers)

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data block -> indirect data block -> 2 data blocks this is caused from inode-> data block -> inode -> data block -> inode -> data block which is 10 -> 3 and 1

(b) List all directories stored on this disk (full path names) along with the names of the files stored in each directory)

| Path name | inumber | inode | data | Content /subdirectories |
| --- | --- | --- | --- | --- |
| / | 0 | 6 | 10,1 | /32, /57, |
| /32 | 3 | n/a | 8 | n/a |
| /57 | 6 | n/a | 1 | /57 /96 |
| /96 | 1 | n/a | 7 | n/a |

(c) Modify the above data structures to add an empty directory called “87” tao directory “/”.

inode array:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10  6 | 7  99 |  | 8  99 |  |  | 3  99 |  |  |  |  | 12  14 |  |  |  |  |

disk blocks:

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 32  3 |  | 96  1 |  |  | 1  12 | 99  99 | 99  99 |  | 57  6 |  | 87  11 |  | 99  99 |  |

| Path name | inumber | inode | data | Content /subdirectories |
| --- | --- | --- | --- | --- |
| / | 0 | 6 | 10,1 | /32, /57 , /87 |
| /32 | 3 | n/a | 8 | n/a |
| /57 | 6 | n/a | 3 | /57 /96 |
| /96 | 1 | n/a | 7 | n/a |

2. [1] Describe the modifications to a FFS file system that would happen when a process requests the creation of a new file /tmp/foo and writes to that file sequentially until the file size reaches 20 KB. (This question is vague. Try the best you can.)

The inodes would rotate to hold a large file size, the data pointers would fill directly then to indirect updating the inodes on the way. The directory would need to be updated with /tmp and update the inodes as well to then show the pointers and shift them.

References

[1] A. Silberschatz, P. Galvin, and G. Gagne, *Applied Operating Systems Concepts*, John Wiley & Sons, Inc., New York, NY, 2000.

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[2] Deitel, Deitel, and Choffnes, *Operating Systems*, Pearson / Prentice Hall, 2004. [3] A. S. Tanenbaum, *Modern Operating Systems*, Pearson / Prentice Hall, 2008. [4] L. F. Bic, A. C. Shaw, *Operating Systems Principles*, Prentice Hall 2003. [5] C. Crowley, *Operating Systems, A Design-Oriented Approach*, Irwin 1997. [6] M. Herlihy, N. Shavit, *The Art of Multiprocessor Programming*, Elsevier, 2008

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