

CISC2005 Principles of Operating Systems

Assignment 5

Release date: April 25, 2023

Every Student MUST include the following statement, together with his/her signature in the submitted homework.

I declare that the assignment submitted is original except for source material explicitly acknowledged, and that the same or related material has not been previously submitted for another course. I also acknowledge that I am aware of University policy and regulations on honesty in academic work, and of the disciplinary guidelines and procedures applicable to breaches of such policy and regulations.

Signed (Student _____)

Date _____

Name _____

SID _____

General homework policies:

A student may discuss the problems with others. However, the work a student turns in must be created COMPLETELY by oneself ALONE. A student may not share ANY written work or pictures, nor may one copy answers from any source other than one's own brain.

Each student **MUST LIST** on the homework paper the **name of every person he/she has discussed or worked with**. If the answer includes content from any other source, the student **MUST STATE THE SOURCE**. Failure to do so is cheating and will result in sanctions. Copying answers from someone else is cheating even if one lists their name(s) on the homework.

If there is information you need to solve a problem but the information is not stated in the problem, try to find the data somewhere. If you cannot find it, state what data you need, make a reasonable estimate of its value, and justify any assumptions you make. You will be graded not only on whether your answer is correct, but also on whether you have done an intelligent analysis.

Question 1: Unix File System

Consider the Unix File System as we discussed in the lecture. It uses i-nodes to index directories and files.

- (a) Assume only the address of the data block for root directory (not the i-node of root directory) is cached. All other contents stored in the File System are not cached. Assume the content of directories can be stored in only one data block. How many disk operations are needed to read the first byte of a file: /1/2/mydoc.txt? Explain your answer.
- (b) Assume within an i-node there are 12 direct pointers, a single-indirect pointer, and a double-indirect pointer. Assume a 4KB block size, and disk addresses that are 32 bits. What is the maximum file size (measured in number of blocks) on this Unix system?

In this question, we are going to unearth the data and metadata from a very simple file system. The disk has a fixed block size of 16 bytes (pretty small!!) and there are only 20 blocks overall. A picture of this disk and the contents of each block is shown below (each cell represents 4 bytes, and the ID of the block is at the bottom of each column):

The disk is formatted with a very simple file system. The first block (Blk. 0) is a superblock. It has just four integers in it: 0, 1, 2, and 3, in that order. *The root inode (i.e., inode for "/") of this file system is in Blk. 3 in the diagram.*

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type: 0 means regular file, 1 means directory
size: number of blocks in file (can be 0, 1, or 2)
direct pointer: the ID of the first block of file (if there is one)
direct pointer: the ID of the second block of file (if there is one)

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name of file
the block ID of the inode of the file
name of next file
the block ID of the inode of next file
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Finally, assume that in all cases, no blocks are cached in memory. Thus, you always have to read from this disk all the blocks you need to satisfy a particular request. Also assume you never have to read the super block (just to make your life easier).

Now you have to answer some questions:

- (a)** To read the contents of the root directory, which blocks do you need to read?

- (b)** Which files and directories are in the root directory? List the names of each file/directory as well as its type (e.g., file or directory).

- (c)** Starting at the root, what are names of all the reachable regular files in this file system?

- (d)** What are the names of all the reachable directories?

- (e)** What is the biggest file in the file system?

(f) What are the contents of the biggest file?

(g) What blocks are free in this file system? (that is, which blocks are not in use?)