CSCI 4320 (Principles of Operating Systems), Fall 2005

Homework 6

Assigned: December 2, 2005.

Due: December 9, 2005, at 5pm. *Not accepted late.*

Credit: 20 points.

1 Reading

Be sure you have read Chapter 6.

2 Problems

Answer the following questions. You may write out your answers by hand or using a word processor or other program, but please submit hard copy, either in class or in my mailbox in the department office.

1. (5 points) Consider a simple operating system that provides only a single-level directory, but allows the directory to contain as many files as desired, with file names as long as desired. Would it be possible to use this system to simulate something resembling a hierarchical file system? How?

2. (5 points) Consider a digital camera that records photographs in some non-volatile storage medium (e.g., flash memory). Photographs are recorded in sequence until the medium is full; at that point, the photographs are transferred to a hard disk and the camera's storage is cleared. If you were implementing a file system for the camera's storage, what strategy would you use for file allocation (contiguous, linked-list, etc.) and why? Notice that this camera does not have the ability to delete photographs from its storage one at a time, so your file system does not need to support that.

3. (5 points) The textbook describes two strategies for keeping track of free blocks in a file system, one using a list of free blocks and one using a bitmap. What would happen if this free list or bitmap was completely lost because of a system crash — is there a way to recover/rebuild the list or bitmap, or do you have to just reformat the disk and hope you backed up any really important files? Answer separately for UNIX V7 and MS-DOS FAT-16 filesystems. (*Hint:* Read the last paragraph of section 6.4.3 carefully.)

4. (5 points) Consider a UNIX filesystem (as described in section 6.4.5) in which each i-node contains 10 direct entries, one single-direct entry, one double-indirect entry, and one triple-indirect entry. If a block is 1KB (1024 bytes) and a disk addresses is 4 bytes, what is the maximum file size, in KB? (*Hint:* Use the blocksize and size of disk addresses to determine how many entries each indirect block contain.)

3 Programming Problems

(Optional) Do the following programming problems. You will end up with at least one code file per problem. Submit your program source (and any other needed files) by sending mail to `bmassing@cs.trinity.edu`, with each file as an attachment. Please use a subject line that mentions the course number and the assignment (e.g., "csci 4320 homework 6"). You can develop your programs on any system that provides the needed functionality, but I will test them on one of the department's Fedora Core 4 Linux machines, so you should probably make sure they work in that environment before turning them in.

1. (Up to 5 extra-credit points) Write a program that given a directory D, blocksize B, and maximum number of blocks M as command-line arguments prints out how many files in D and its subdirectories are of size B or less, how many are of size between B and $2B$, etc., up to size MB. Include directories and symbolic links (but count the size of the link and not the file/directory it links to). Here is a sample execution.

```
[bmassing@Xena02]$ ./filesizes /var/www 512 20
Unable to open /var/www/HTML-Documents/howland-cousins/config:  Permission denied
Unable to open /var/www/HTML-Documents/About/The_Courses/cs3394.hci/dcernose/javapres/turnin/COM:  Permission denied
Unable to open /var/www/HTML-Documents/About/The_Courses/cs3291.java/dcernose/javapres/turnin/COM:  Permission denied
Unable to open /var/www/HTML-Documents/cs1300/config:  Permission denied
Unable to open /var/www/HTML-Documents/apache-documentation/manual/search:  Permission denied
Unable to open /var/www/HTML-Documents/TUSSW/config:  Permission denied
Unable to open /var/www/HTML-Documents/TUSSW/magpierss-0.61:  Permission denied
Results for directory /var/www:
               2870 files of size         1 blocks
                833 files of size         2 blocks
               1231 files of size         3 blocks
               1310 files of size         4 blocks
               7300 files of size         5 blocks
               9882 files of size         6 blocks
               5870 files of size         7 blocks
               3888 files of size         8 blocks
               1847 files of size         9 blocks
               1049 files of size        10 blocks
               1663 files of size        11 blocks
                745 files of size        12 blocks
                469 files of size        13 blocks
                697 files of size        14 blocks
                554 files of size        15 blocks
                545 files of size        16 blocks
                469 files of size        17 blocks
                322 files of size        18 blocks
                345 files of size        19 blocks
                291 files of size        20 blocks
               6917 files of size        21 blocks or more
```

   (Of course, you won't be able to examine files in directories you don't have access to. That's okay; just print error messages as above.)

   Hints: Read the man pages for `opendir`, `readdir`, and `lstat`. You might also be interested in the man pages for `chdir` and `strerror`.