CS105 – Computer Systems Spring 2023

Week 12: File IO

SOLUTION

April 17-19, 2023

1. Consider the following code:

```
int main(int argc, char* argv[]){
    char buf[3] = "ab";
    int r = open("file.txt", O_RDONLY);
    int r1 = dup(r); // equivalent to dup2(r, r1);

    read(r, buf, 1);

    int pid;
    if((pid=fork()) == 0) {
        r1 = open("file.txt", O_RDONLY);
    } else{
        waitpid(pid, NULL, 0);
    }

    read(r1, buf+1, 1);

    printf("%s", buf);

    return 0;
}
```

   Assume that the disk file `file.txt` contains the string of characters `CS105` . Also assume that all system calls succeed. What will be the output when this code is compiled and run?

   This code will print the string `CCCS`.

2. Consider a file systems that uses indexed allocation with the following parameters:

   - The disk is comprised of 2048 256-byte blocks.
   - Block numbers are 4-byte values.
   - Directory entries are 32 bytes.
   - Inodes contain 8 direct pointers, 1 indirect pointer, and 1 doubly-indirect pointer

   (a) What is the maximum size file that can be stored using only direct pointers?

   $$8 * 256 = 2048 \text{ bytes } = 2 \text{ KB}$$

   (b) What is the maximum size file that can be stored in this file system?

   $$8 * 256 + 64 * 256 + 64^2 * 256 = 1067008 \text{ bytes } \approx 1 \text{ MB}$$

   (c) What is the maximum number of files that can be stored in a single directory?

   $$33342 \texttt{ files}$$

   (d) What sequence of block accesses would have to occur to read (all of) a 21-byte file located in the root directory?

   (1) read inode 2 (root inode), (2) read data block for root directory, (3) read inode for file, (4) read data block for file.

   (e) What sequence of block accesses would have to occur to read (all of) a 1959-byte file located a subdirectory of the root directory?

   (1) read inode 2 (root inode), (2) read data block for root directory, (3) read inode for subdirectory, (4) read data block for subdirectory, (5) read inode for file, (6-13) read 8 data block of file.

   (f) What sequence of block accesses would have to occur to read (all of) a 18688-byte file located in the root directory?

   (1) read inode 2 (root inode), (2) read data block for root directory, (3) read inode for file, (4-11) read 8 direct data blocks for file, (12) read indirect block for file, (13-77) read 64 data block of file accessible through indirect node, (78) read doubly indirect block, (79) read indirect block accessed through doubly indirect block, (80) read final data block.