IDs: 920484081, 921661426,921960921 921822951,

Github Link: https://github.com/CSC415-2022-Fall/csc415-filesystem-boberts

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Final Project - File System

Description:

Our Filesystem: BabyBobert

Team Boberts has taken on the task of creating a filesystem for a disk drive with a contiguous array of 512 byte chunks. The freespace within our filesystem is managed through a FAT memory allocation, each block of the FAT table corresponds to a block of memory, the busy attribute defines whether the block is allocated or not, the next attribute is the next attribute which defines the next block in the cluster. The FAT system allows us to easily link our blocks together. Then we reference the directoryEntry table where we can find the name and location of the first block. We were tasked to write the code to initialize and implement our filesystem. This included performing volume checks, initializing our volume, initializing our bit vector for space management, and initializing our directory system with the root directories. Within this timeframe many issues arose, as such, we have documented them-however with the complement of hours of brainstorming and an agile state of mind, we were able to mitigate most of our issues.

Approach:

After several milestones and plenty of thrown away idea, the Boberts decided on their plan on how to implement our filesystem. The first step is installation. This file system was created through the VirtualBox in our VirtualMachine provided by the professor named Operating Systems. Once we ran the machine and got it configured to our hearts desire, we cloned the repository. We changed the working directory to **csc415-filesystem-boberts/src** and ran the command "make run" to initiate the filesystem and display the "Prompt >" line for the user. From here, the user will input any command within our filesystem's range, which can be accessed through the "help" command, and expect the appropriate output. Though it may sound simple, the following pages will describe each excruciating step we took to initialize and implement each function required to make the filesystem work.

Initializing File System:

We started our file system by initializing the root directory and our free space management in the fsInit.c file. To initialize the root directory we allocated a dirEntry and set the filename to '/', indicating it's the root. We also set its attribute to 4, indicating that this path is a directory. Finally, we initialized its start and ending cluster index.

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The Initialization of the VCB is reliant on two separate functions, their roles are to create and verify the creation of the VCB respectively. VCBinit1 populates a new VCB object and places it into our filesystem and VCBinit2 verifies that it exists and that the signatures of the VCB match. If signatures do not match or the file system is not present then we call VCBinit1 and recreate the VCB.

The VCBinit2 function is then called, which allocates a VCB struct and LBAread 1 block into the VCB. From there, the function will check both authorization signatures for security purposes. If one signature fails, the function calls VCBinit1 again to reload the volume control block. We have also created a number of helper files in order to verify that the root directory is created and the FAT table has been allocated. They are called isThereRoot and isThereFAT. The fsinit.c creates the files if they do not exist and verifies that the VCB, Root directory, and the FAT are ready in the system volume.

FreeSpace Management:

The File Allocation Table was initialized in the fsInit.c file as well. To do this, we created an array of FileEntry structs with size of the number of clusters. The first element, element 0, is the volume control block. The second element, element 1, is the file allocation table. Finally, the third element, element 2, is the root directory entry.

Our group decided to use the File Allocation Table (FAT) for free space management. To implement the FAT we used an array of FileEntry structs which fills up from left to right. Each FileEntry struct contains a busy and next variable. The busy variable is to tell whether or not this FileEntry is being used. The next variable contains the index of the next block in the table.

In order to initialize our FAT table, we created several helper functions that would assist us in understanding and organizing our data.

First, we check if our FAT exists by calling: isFatThere(VolumeControlBlock *VCB){}. This function checks whether FAT exists or not and at which cluster it is retained in. If FAT has no previous existence, we can call initFAT(VolumeControlBlock *VCB) to initialize our table. Our initFAT function begins the initialization process by allocating a new FAT pointer and allocating the various attributes of the FAT system. We look into the VCB and get the start of the FAT block, then we write the FAT into our system volume. Then we check to see if our root directory is initialized within the FAT init inorder to verify that we have our root directory. After the allocation of the FAT table our file system is ready.

getFAT, writeFAT, getFirstFreeEntry

Our group decided to write additional helper functions for our file system. The first function implemented was **getFAT** which retrieves an array of FileEntry objects. The size of the array

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retrieved is the number of clusters in our volume control block. The second function coded is **writeFAT** which will write to the FileEntry. These two functions are used to read and write files.

//b.io functions

- b_open(char * filename, int flags)

The b_open function is used to open a buffered file. The function will first call the getFCB function to get our own file descriptor. This file descriptor is an index in the file control block array, fcbArray. Once we get our file descriptor, we will initialize file control block with the following attributes: offset, bytesRead, buff.

- b write(b io fd fd, char * buffer, int count)

The b_write function takes 3 parameters similar to its Linux counterpart, b_write can write up to count bytes from the buffer starting at buf to the file referred to by the file descriptor fd. In this function, count refers to the amount of bytes desired to be written into out buffer. In this case, we check if the count is larger than the buffer size and if so, we return as many bytes as possible without exceeding the buffer.

- b seek(b io fd fd, off t offset, int whence)

b_seek is also another function that has a Linux equivalent and takes 3 parameters, off_t offset, int whence and int fd. offset is the point of which we want to reposition the offset counter associated with the file descriptor(int fd). The variable whence provides us with the directive desired as we seek through the file. To do this, we check where the current offset is located as well as the file size, using the file descriptor. We then check whether the offset desired is within the means of the filesize, without going beyond the end of file.

- b_read(b_io_fd fd, char * buffer, int count)

The b_read function is used to read a buffer. The function will fill the current buffer with the number of bytes requested if there is enough room in the buffer. If there is not enough room in the buffer, then we will fill the buffer with the number of bytes available. If there are bytes leftover, then the function fills the buffer with those leftover bytes.

- b_close(b_io_fd fd)

The b_close function is used to free any allocated memory that was used. In this function we are freeing the file control block array, fcbArray.

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Helper Functions:

getFAT, writeFAT, getFirstFreeEntry

Our group decided to write additional helper functions for our file system. The first function implemented was **getFAT** which retrieves an array of FileEntry objects. The size of the array retrieved is the number of clusters in our volume control block. The second function coded is **writeFAT** which will write to the FileEntry. These two functions are used to read and write files.

Another helper function we implemented was the **firstFreeEntry function**, which returns the index of the first free cluster found. This function uses LBAread into a dirEntry and then for loops until an empty cluster is found.

Additionally, we implemented **parsePath** to return a pointer to another structure we created called ppReturn, under our directoryEntry header to allow for usage across the system. The function parsePath takes a given path as a parameter and checks whether or not the path exists in our filesystem. Then we parse the string using "/" as a delimiter to ensure that each part of the path is accounted for. We create several variables including currentlyParsing, current_wd (working directory) and isThere to access different parts of our file system and pass data to each part accordingly. We also check for relative and absolute paths as well as where the endOfFile is. We also use parsePath to input several data points into the corresponding directory entry, using the variables outputPath and out. Once our path is parsed, we return a pointer to the structure for the main function to use.

```
struct {
    dirEntry * directoryEntry;
    int index;
}typedef ppReturn;
```

Core structures:

- dirEntry struct

The dirEntry header file contains the dirEntry struct. This structure contains the important information needed for the directories. It contains the file name, file size, attribute, reserved, and starting cluster. The attribute variable is used to indicate if the given pathname is a directory or not. The attribute variable will be set to 4 if that is the case.

```
struct {
    char filename[11]; //first char will mark allocation
status(0x00:FREE,0xe5:DELETED)
    unsigned int attribute: 3;
    unsigned int reserved: 3;
    unsigned int starting_cluster: 8;
    struct timespec file_modification_date;
    uint64_t filesize; // 0:DIR
}typedef directory;
```

- VolumeControlBlock struct

The VolumeControlBlock struct holds vital information on the volume control block and can be found in the VCB.h file. The signatureP1 & signatureP2 are attributes for security purposes. The struct also contains variables to hold the number of sectors and clusters we will have in our File Allocation Table. Other important variables in this struct include the first_free, which holds the index of the first free cluster, and the data_start, which holds the block number of the root directory. The VCB struct also holds the starting cluster of the first directory.

```
struct {
    //'security'
    unsigned long signatureP1;
    unsigned long signatureP2;
    unsigned int volume_id;

    //Raw Volume Information
    uint64_t block_size;
    uint64_t number_of_blocks;

    /*sectors_per_cluster dictates what kind of FAT we will have(FAT16,FAT32, etc),

    unsigned int sectors_per_cluster;
    unsigned int number_of_sectors;
    unsigned int number_of_clusters;

    unsigned int dirent_start;
    unsigned int dirent_start;
    unsigned int dirent_size;
```

```
unsigned int first_free; // first free cluster
unsigned int working_directory; //starting cluster of first dir

unsigned int data_start; //block number of the root directory AKA the
data region
   unsigned int data_size;
   unsigned int file_count;

struct timespec file_access_date;
   struct timespec file_modification_date;
   struct timespec file_creation_date;
}typedef VolumeControlBlock;
```

Issues and Resolutions:

Our first issue that arose was around the way our filesystem was defined. Our filesystem went through many iterations where the structure changed drastically, due to alternate issues we faced. We solved that issue by fully committing to a FAT filesystem from a Bit map array. Specifically, we encountered many issues involving the allocation of our filesystem and the way our files were saved in the volume. parsePath was a particularly difficult function to create. Many of the issues that stemmed from parsePath were further exacerbated by the other files usage. When creating it was often difficult to figure out where the errors were in the file system, both due to the amount of code that was written and the ambiguity of the file system volume. The issues with parse path were solved by reading the code and many hours of debugging, changes and more debugging. We had issues linking files in the make file. This was solved by doing online research and understanding the make files.

Another key issue that was ubiquitous to our project were the conflicting methods of software methodology. While we had outlined clear goals for our project in our SCRUM meetings, in actual implementation we used conflicting methods from a waterfall method to rapid-iterative prototyping. Because of this, while we had the same goals, our methodology was different for each member. This proved to become a costly setback that we should have mitigated in the beginning stages of our project.

Issues in organization and design were a consistent problem the team faced as each push and pull from git would require hours of redesign to get a functioning code. In order to resolve this issue, we decided to make use of the CLion IDE's Code With Me to organize live group coding sessions. We would each work separately then have corresponding meeting times to have a shared screen that we could all update in real time. Then, one person would push it to github and the rest of the team members would pull and continue the cycle.

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Driver Program:

The main driver program for the file system is the fsshell.c program. This program handles the way that our filesystem is interacted with. The fsshell program calls all of the different file system operations. It handles the basic sanitizing of user input as well. Many of the functions were already implemented and it was up to us to complete the remaining functions that drove the fsshell programs.

//fsshell.c functions

fs_getcwd(char *buf, size_t size)

The get current working directory function, fs_getcwd, returns the full pathname of the current directory. To get the pathname, the function will first get the starting cluster from the volume control block. It will then read through all DirEntrys until it hits the root directory and append a '/' to the full name into a buffer. From there, it will return the buffer containing the full path name.

- fs_setcwd(char * buf)

The set current working directory function, fs_setcwd, takes in a pathname argument and then will use the parsepath function to find that directory. If the directory is found, the function will set the working directory to the starting cluster that is returned by parsepath. If the directory is not found, the function will return false to confirm the directory does not exist.

- fs mkdir(const char *pathname, mode t mode)

The make directory function, fs_mkdir, will create a directory by starting at the root. It will read the volume control block to find the first free cluster and get the current working directory. Then it will read the root directory to find the first free entry. It will set that first free entry to the dirEntry and set the cluster number to the first free cluster found previously. Since the first free cluster is now being used, we will increment the first free cluster in the volume control block. Finally, we will set the FAT entry to the starting cluster.

- fs isDir(char * path)

The is directory function, fs_isDir, checks if the current pathname is a directory. The function returns 1 if it is a directory, and 0 otherwise. The function starts by calling the parsepath function which will return the index of which block we are in. Then we will use LBAread to read that index into an allocated dirEntry. If the dirEntry attribute equals 4 then the pathname is a directory. If the dirEntry attribute is not equal to 4, the function will return false indicating the pathname is not a directory. The function will free the volume control block before ending.

- fs isFile(char * path)

The is file function, fs_isFile, checks if the current pathname is a file. The function returns 1 if it is a file, and 0 otherwise. The function starts by calling the parsepath function which will return

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the index of which block we are in. Then we will use LBAread to read that index into an allocated dirEntry. If the dirEntry attribute does not equal 4, then it is a file and the function will return true. If the dirEntry attribute does equal 4, the function will return false. The function will free the volume control block before ending.

- fs rmdir(const char *pathname)

The remove directory, fs_rmdir, is used to remove a directory taking in the given path as a parameter. This function will retrieve the index of the current block we are in by calling parsepath. If the index equals -1 then the does not exist and the function returns -1. If parsePath returns a pointer to the structure, and we confirm the path exists, we then check if the directory is empty. If the directory is not empty, then it is disqualified from being able to be removed and we display an error message along with returning -1. If the directory is empty, we get a directory entry, find the location using our pointer from parsePath. Then we, free location in free space, by setting the first char of the filename in our FAT Table to NULL. After this, we check if the files span over multiple clusters and the clusters associated with this directory are also flagged as deleted. Once the chain is removed we write directory back out to disk for the change

- fs_delete(const char *pathname)

The function, fs_delete, is used to remove a file from our filesystem. In a similar fashion to fs_rmdir, we first check if the path exists, if yes, we continue on our journey to remove the file associated with the given pathname, as one of our parameters, from the FAT table. We first call parsePath to find the location of this mystery file and where the starting cluster is. If the filesize extends past the size of one cluster block, we look for the following clusters in that cluster chain. For each cluster in the chain, if there is any, we set the busy flag to 0 to signify that this cluster is no longer in use. We also mark off the first char in the filename of the FAT table to show that this entry has been deleted. After removing the cluster and inserting the symbol for deletion, we write the blocks back out to memory for further use.

- fs stat(const char *path, struct fs stat *buf)

fs_stat is used to give the user the statistics of our filesystem. Our function takes a path and our fs_stat structure to assign the appropriate values to each variable. We implement this function in mfs.c as a way to return a pointer to the structure that will allow for the user to have access to the statistics of our filesystem.

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```
time_t st_modtime; /* time of last modification */
time_t st_createtime;
/* add additional attributes here for your file system */
};
```

fs_opendir(const char *name)

fs_opendir allocates a volume control block and retrieves the index of the current block it's in. If the index does not equal to -1, then the block is taken. Since the block is free to use, the function will open a new directory in it. The function will return the file directory in this case. If the index return equals to -1 then the function will return NULL.

struct fs_diriteminfo *fs_readdir(fdDir *dirp);

this function takes a pointer as a parameter and returns on to the fs_diriteminfo struct, readDir overwrites this structure, keep pointer in fdDir or intestate it in fdDir so we can give it to the user each time, pointer points to the structure where the filename is . , second ...,

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Screenshots of commands:

ls Lists the file in a directory

```
Prompt > ls

ls
asdf
fdsa
qwer
zxcv
```

cd Changes directory

```
"Prompt > cd asdf

48

asdf
```

md Make a new directory

```
iy��4∞Prompt > md fdsa
test:1 firstfree: 0
test:1 wd: 1
firstFree entry in dir: 3
next:0 output 0
Prompt > md test
test:1 firstfree: 0
test:1 wd: 1
firstFree entry in dir: 4
next:0 output 0
Prompt > md test2
test:1 firstfree: 0
test:1 wd: 1
firstFree entry in dir: 5
next:0 output 0
Prompt > md test3
test:1 firstfree: 0
test:1 wd: 1
firstFree entry in dir: 6
next:256 output 0
```

pwd Prints the working directory

```
♦♦Prompt > pwd

/asdf
Prompt > |
```

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Problem Area...

rm Removes a file or directory

This command also gave us several issues that resulted in the inability to properly perform this command and implement the function.

```
student@student-VirtualBox: ~/[
File Edit View Search Terminal Help
Fat has been initialized
Volume has been initialized...
Prompt > md k
sizeof FE:4
sizeof FE:4
relative
First Free Cluster Index:1
k reading blocks from 154
pp:comparing k, k
kreturning 154
PATH NUMBER: 154
testing k output 154
Prompt > touch k.txt
Prompt > rm k
sizeof FE:4
relative
First Free Cluster Index:1
k reading blocks from 154
pp:comparing k, k
kreturning 154
sizeof FE:4
relative
First Free Cluster Index:1
k reading blocks from 154
pp:comparing k, k
kreturning 154
index! 154
sizeof FE:4
filename index 0: 112
Prompt >
```

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touch Touches/Creates a file (also included above)

cat Limited version of cat that displace the file to the console

We were unable to implement a couple of commands to their fullest potential due to segmentation faults that resulted from the implementation of the b_io.c functions; due to this persistent error, several other commands did not result in the way we intended them to. However, we were pretty close to finding the best way to implement the b_io.c functions and provided our thinking process thus far.

- cp2l Copies a file from the test file system to the linux file system
- cp2fs Copies a file from the Linux file system to the test file system
- cp Copies a file source [dest]
- mv Moves a file source dest

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Hex Dump: full file at https://boberts.surge.sh/hexdump link

Dumping file ../src/SampleVolume, starting at block 0 for 19532 blocks:

000000: 43 53 43 2D 34 31 35 20 2D 20 4F 70 65 72 61 74 CSC-415 - Operat
000010: 69 6E 67 20 53 79 73 74 65 6D 73 20 46 69 6C 65 ing Systems File
000020: 20 53 79 73 74 65 6D 20 50 61 72 74 69 74 69 6F System Partitio
000030: 6E 20 48 65 61 64 65 72 0A 0A 00 00 00 00 00 0 n Header
000040: 42 20 74 72 65 62 6F 52 00 96 98 00 00 00 00 00 B treboR~
000050: 00 02 00 00 00 00 00 4B 4C 00 00 00 00 00 KL
000060: 00 00 00 00 00 00 00 00 00 00 00 00 0
000070: 52 6F 62 65 72 74 20 42 55 6E 74 69 74 6C 65 64 Robert BUntitled
000080: 0A 0A 00 00 00 00 00 00 00 00 00 00 00
000090: 00 00 00 00 00 00 00 00 00 00 00 00 0
0000A0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0000B0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0000C0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0000D0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0000E0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0000F0: 00 00 00 00 00 00 00 00 00 00 00 00 0
·
000100: 00 00 00 00 00 00 00 00 00 00 00 00
000110: 00 00 00 00 00 00 00 00 00 00 00 00 0
000120: 00 00 00 00 00 00 00 00 00 00 00 00 0
000130: 00 00 00 00 00 00 00 00 00 00 00 00 0
000140: 00 00 00 00 00 00 00 00 00 00 00 00 0
000150: 00 00 00 00 00 00 00 00 00 00 00 00 0
000160: 00 00 00 00 00 00 00 00 00 00 00 00 0
000170: 00 00 00 00 00 00 00 00 00 00 00 00 0
000180: 00 00 00 00 00 00 00 00 00 00 00 00 0
000190: 00 00 00 00 00 00 00 00 00 00 00 00 0
0001A0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0001B0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0001C0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0001D0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0001E0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0001F0: 00 00 00 00 00 00 00 00 00 00 00 00 0
000200: 68 65 6C 6C 6F 00 00 00 00 00 1C 00 00 00 00 hello
000210: 00 00 00 00 00 00 00 00 00 00 00 00 0
000220: 00 00 00 00 00 00 00 00 00 00 00 00 0
000230: 2E 00 00 00 00 00 00 00 00 00 04 00 00 00
000240: 01 00 00 00 00 00 00 00 00 00 00 00 00

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000250: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000260: 2E 2E 00 00 00 00 00 00 00 00 04 01 00 00 00	
000270: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000280: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000290: 71 77 65 72 00 00 00 00 00 00 04 00 00 00 00 qwer	
0002A0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0002B0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0002C0: 7A 78 63 76 00 00 00 00 00 00 04 00 00 00 00 zxcv	
0002D0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0002E0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0002F0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000300: 00 00 00 00 00 00 00 00 00 00 00 00	
000310: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000320: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000330: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000340: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000350: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000360: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000370: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000380: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000390: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0003A0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0003B0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0003C0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0003D0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0003E0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0003F0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000400: 64 61 72 6B 6E 65 73 73 00 00 00 34 01 00 00 00 darkness4	•
000410: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000420: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000430: 2E 00 00 00 00 00 00 00 00 00 04 01 00 00 00	
000440: 01 00 00 00 00 00 00 00 00 00 00 00 00	
000450: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000460: 2E 2E 00 00 00 00 00 00 00 00 04 01 00 00 00	
000470: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000480: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000490: 6D 79 00 72 00 00 00 00 00 00 04 00 00 00 00 my.r 0004A0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0004A0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0004C0: 6F 6C 64 00 00 00 00 00 00 00 00 00 00 00 00 00	
0004D0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
0004E0: 00 00 00 00 00 00 00 00 00 00 00 00 0	
000 1 E0. 00 00 00 00 00 00 00 00 00 00 00 00 0	

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0004F0: 66 72 69 65 6E 64 00 00 00 00 04 00 00 00 00 | friend.......

000500: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000510: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000520: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000530: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000540: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000550: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000560: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000570: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000580: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000590: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0005A0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0005B0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0005C0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0005D0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0005E0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0005F0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000600: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000610: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000620: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000630: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000640: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000650: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000660: 00 00 00 00 00 00 00 00	00 00 00 00 38 01 00 00 8
000670: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000680: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000690: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
0006A0: 00 00 00 00 00 00 00 00	<u>.</u>
0006B0: 00 00 00 00 00 00 00 00	· · · · · · · · · · · · · · · · · · ·
0006C0: 00 00 00 00 00 00 00 00	I I
0006D0: 00 00 00 00 00 00 00 00	I I
	00 00 00 00 00 00 00 00
0006F0: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
	00 00 00 00 00 00 00 00
000710: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000720: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000730: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000740: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000750: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000760: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00
000770: 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00

000780: 00 00 00 00 00 00 00 00 00 00 00 00 0
000790: 00 00 00 00 00 00 00 00 00 00 00 00 0
0007A0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0007B0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0007C0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0007D0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0007E0: 00 00 00 00 00 00 00 00 00 00 00 00 0
0007F0: 00 00 00 00 00 00 00 00 00 00 00 00 0
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000880: 00 00 00 00 00 00 00 00 00 00 00 00 0
000890: 71 77 65 72 00 00 00 00 00 00 04 00 00 00 00 qwer
0008A0: 00 00 00 00 00 00 00 00 00 00 00 00 0
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0008C0: 7A 78 63 76 00 00 00 00 00 00 04 00 00 00 00 zxcv
0008D0: 00 00 00 00 00 00 00 00 00 00 00 00 0
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000A10: 00 00 00 00 00 00 00 00 00 00 00 00 0
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000CA0: 00 00 00 00 00 00 00 00 00 00 00 00 0

IDs: 920484081, 921661426,921960921 921822951, Github Link: https://github.com/CSC415-2022-Fall/csc415-filesystem-boberts

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Github Link: https://github.com/CSC415-2022-Fall/csc415-filesystem-boberts

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Github Link: https://github.com/CSC415-2022-Fall/csc415-filesystem-boberts

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