

Class: CSC-415-01 Spring 2020

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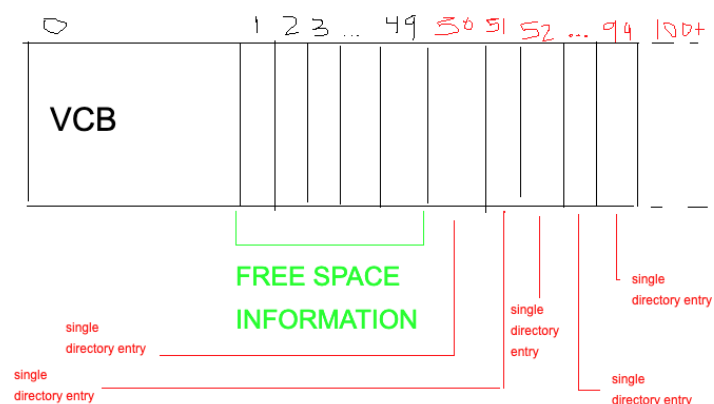
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Assignment 3 – File System – Team Last Minute

Description of the file system

Our file system uses the predefined LBA block logic provided by Professor Bierman. An LBA block is considered a 512 byte chunk of data that can be written to and read from. We utilize these functions to set up a system by which data can be stored in a hierarchical fashion, representing a tree. Each node of the tree is considered a 'directory', and each directory can either be a file **or** another directory. This creates an upside tree, where the top directory is called the 'Root' directory, and every directory thereafter is below the root. A directory may have any number of children, however a file cannot have any children. Thus, any file **must** be a leaf on the tree structure.

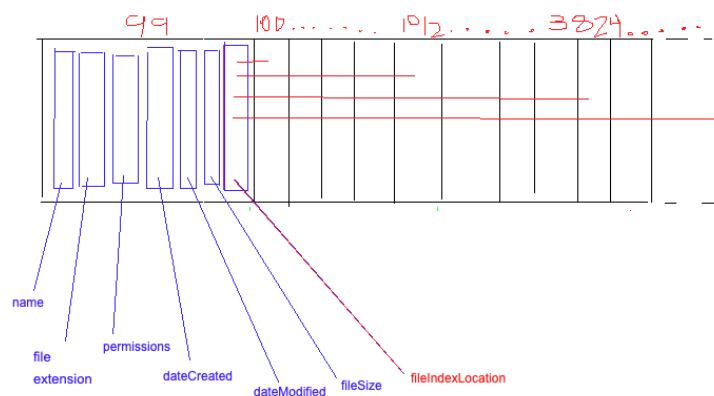
It is important to note that for the sake of this file system, the LBA blocks can be interacted with as if they were an array. By reserving certain LBA for specific functionalities, the file system can accurately keep track of data. Below is a visual explanation of how we utilize the LBA blocks.



It can be seen that the 0th block in the LBA is reserved for the Volume Control Block. This structure is responsible for keeping track of data that is relevant to the entire file system. This includes information such as volume size, volume name, total number of directories, total number of blocks, and the current active directory. Whenever any part of the file system needs any of this information, it has a fast and easy way to access it via the Volume Control Block.

Following the volume control block, LBA blocks 1-49 are reserved for the Free Space Information Blocks. This section of the LBA is there for one reason: to let the file system know which LBA blocks are used and which LBA blocks are free. Once again, whenever any part of the file system needs a free LBA block, it has a fast and easy way to find it via the Free Space Information blocks.

Finally, LBA blocks 50-99 are reserved for directory entries. As mentioned before, a directory is either a file or another directory. These LBA blocks store the information relevant to a directory. Below is a visual representation of what a single directory entry looks like. It has many fields which describe the directory such as name, file extension, permissions, date created, date modified, and file size. The final field (labeled as 'fileIndexLocation') is an array to other LBA blocks. For a directory, this array points to the location of its subdirectories. For files, this array points to the LBA blocks in which the data for the file is stored.



By combining all these features together, a host of functionalities can be created to interact with the file system. In the end, a drive can be created, which simply interacts with these functions to manipulate the file system in the way the user intends.

Issues faced

One issue we faced originally was keeping track of the current working directory. We noticed that we need to know the current working directory at **many** places within the program, and it became a hassle to pass this global variable around. After a while, we opted to simply save the current working directory inside the Volume Control Block. We then created a function which would access this variable. After implementing this change, we were able to get and set the current working directory, from **anywhere** inside the program. This change made it much easier to work with the file system.

Another issue we faced was knowing whether a directory was actually a directory or a file. In order to solve this, we used the 'file extension' field that a file normally uses. In other words, if the file extension was "DIRECTORY", then we knew that that directory entry was in fact a directory. If there was anything else, such as "pdf", "exe", "txt", ...etc, then we knew that directory entry was a file.

Detail of how driver program works

The driver program is fairly straightforward. It's only job is to implement the functions that the file system has. At run time, the first thing it does is check if a partition already exists in the file system. If a partition does not exist, the driver calls the initiation functions, which are responsible for creating the volume control block, the free space information, and the root directory. However, if a partition does exist, then the driver skips the aforementioned steps, and simply enters the main loop: user input. In this loop, the driver takes in user input, validates it, and executes that specific functionality. Once that functionality is done, the loop is repeated. The program ends when the user exits the file system via a command, at which point the partition is safely closed.

Screenshots showing each of the commands

List Directories

```
> ls
  o Movies
  o Music
  o Pictures
  o Documents
  o Downloads
```

```
> |
```

Create Directories

```
> ls
  o Movies
  o Music
  o Pictures
  o Documents
  o Downloads
```

```
> mkdir sampleDirectory
```

```
> ls
  o Movies
  o Music
  o Pictures
  o Documents
  o Downloads
  o sampleDirectory
```

```
> |
```

Add File

```
> ls
  ○ Movies
  ○ Music
  ○ Pictures
  ○ Documents
  ○ Downloads
  ○ sampleDirectory

> touch sampleFile

> ls
  ○ Movies
  ○ Music
  ○ Pictures
  ○ Documents
  ○ Downloads
  ○ sampleDirectory
  ● sampleFile.txt

>
```

Remove File

```
> ls
  ○ Movies
  ○ Music
  ○ Pictures
  ○ Documents
  ○ Downloads
  ○ sampleDirectory
  ● sampleFile.txt

> removefile sampleFile.txt

> ls
  ○ Movies
  ○ Music
  ○ Pictures
  ○ Documents
  ○ Downloads
  ○ sampleDirectory

>
```

Copy File

```
> tree
● ROOT
  ○ Movies
  ○ Music
  ○ Pictures
    ○ SamplePictures
      ● Farm.png
      ● Sunset.gif
      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads
    ○ sampleDirectory
    ● sampleFile.txt

> copyfile sampleFile.txt Movies

> tree
● ROOT
  ○ Movies
    ● sampleFile.txt
  ○ Music
  ○ Pictures
    ○ SamplePictures
      ● Farm.png
      ● Sunset.gif
      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads
    ○ sampleDirectory
    ● sampleFile.txt

> |
```

Move File

```
> tree
● ROOT
  ○ Movies
  ○ Music
  ○ Pictures
    ○ SamplePictures
      ● Farm.png
      ● Sunset.gif
      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads
    ● sampleFile.txt

> movefile sampleFile.txt Movies

> tree
● ROOT
  ○ Movies
    ● sampleFile.txt
  ○ Music
  ○ Pictures
    ○ SamplePictures
      ● Farm.png
      ● Sunset.gif
      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads

> |
```

Set Metadata

```
> info sampleFile.txt
File Name: sampleFile.txt
File Size: 0
File Permissions: 455
File Creation Date: 1589095849
File Modification Date: 1589095935

> chmod sampleFile.txt 667

> info sampleFile.txt
File Name: sampleFile.txt
File Size: 0
File Permissions: 667
File Creation Date: 1589095849
File Modification Date: 1589095999

>
```


Copy From Linux

```
sampleLinux.txt

SAMPLE HIGH-SCORING RESPONSE
In the fifteenth and sixteenth centuries, European nations began to claim different regions in the New World. Using new sea technologies such as the astrolabe and improved navigation techniques, Europeans sought new trade routes to the Indian Ocean and Asia. Sailing west and finding new continents instead, the Europeans soon realized the economic potential of the Americas. The Spanish, French, and British each took a unique approach to how they utilized the New World territories in which they settled, resulting in distinct and profound patterns of social development.

The Spanish had two major goals: to gain wealth and to spread Catholicism to the native populations. Realizing the potential to mine precious metals and profit from large-scale agriculture, the Spanish forced American Indians into labor, such as through the encomienda system. Violence and deception were often used to subdue the indigenous populations, aided by the technological superiority of European weapons and the spread of devastating diseases. Although some Spanish came as missionaries with the goal of converting American Indians to Christianity and often protested the abusive treatment of the American Indians, even missions sometimes essentially forced labor and coerced assimilation to Spanish culture. In the long term, a hierarchical social structure developed in the Spanish colonies in which the Spanish-born and their descendants (peninsulares and creoles) dominated those of mixed background (mestizos and mulattos) and especially those of pure African or American Indian heritage. Overall, millions perished between disease and mistreatment, devastatingly weakening traditional cultures but enriching the Spanish.

The French differed from the Spanish in their relationship with the indigenous populations. Using the St. Lawrence River for transportation and trade, the French profited from trading fur pelts, particularly beaver, with the American Indians, and then sending the pelts to Europe. These traders profited from the knowledge and goods of the American Indian populations who lived there, and certainly desired to develop mutually profitable relationships with them. Overall, this more cooperative relationship helped preserve American Indian cultures and led to alliances between the French and different American Indian nations. These alliances benefited the French in later wars with the British.

The British were more interested in establishing permanent communities in North America. Jamestown, Britain's first successful settlement, was economically based. The relationship with the American Indians turned hostile as the number of British settlers increased and they sought to occupy more land for tobacco production. In New England, many of the settlers were Pilgrims or Puritans seeking free expression of their religious beliefs. Here, the British also disrupted American Indian societies and established a relationship of hostility between the groups as the British not only encroached on the native people's land for farming but they also began to spread smallpox, killing a large percentage of the indigenous populations. Large-scale conflicts broke out; many British and American Indian villages were destroyed during Metacom's War, but it was the American Indian tribes who were largely displaced or eliminated. The British, like the Spanish, resorted to violence to secure their own economic ends and irrevocably disrupted American Indian societies as a result.

Overall, where Europeans sought permanent settlements or economic gain at the expense of the forced labor of others, American Indian societies experienced population decline, upheaval, and ultimately, threats to their traditional lands and traditions.
```

```
> tree
● ROOT
  ○ Movies
  ○ Music
  ○ Pictures
    ○ SamplePictures
      ● Farm.png
      ● Sunset.gif
      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads

> copyfromlinux sampleLinux.txt .

> tree
● ROOT
  ○ Movies
  ○ Music
  ○ Pictures
    ○ SamplePictures
      ● Farm.png
      ● Sunset.gif
      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads
    ● sampleLinux.txt

> |
```

```
filesystem — -zsh — 123x53
00D5C0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | .....
00D5D0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | .....
00D5E0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | .....
00D5F0: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 | .....

00D600: 53 41 4D 50 4C 45 20 48 49 47 48 2D 53 43 4F 52 | SAMPLE HIGH-SCOR
00D610: 49 4E 47 20 52 45 53 50 4F 4E 53 45 0A 49 6E 20 | ING RESPONSE.In
00D620: 74 68 65 20 66 69 66 74 65 65 6E 74 68 20 61 6E | the fifteenth an
00D630: 64 20 73 69 78 74 65 65 6E 74 68 20 63 65 6E 74 | d sixteenth cent
00D640: 75 72 69 65 73 2C 20 45 75 72 6F 70 65 61 6E 20 | uries, European
00D650: 6E 61 74 69 6F 6E 73 20 62 65 67 61 6E 20 74 6F | nations began to
00D660: 20 63 6C 61 69 6D 20 64 69 66 66 65 72 65 6E 74 | claim different
00D670: 20 72 65 67 69 6F 6E 73 20 69 6E 20 74 68 65 20 | regions in the
00D680: 4E 65 77 20 57 6F 72 6C 64 2E 20 55 73 69 6E 67 | New World. Using
00D690: 20 6E 65 77 20 73 65 61 20 74 65 63 68 6E 6F 6C | new sea technol
00D6A0: 6F 67 69 65 73 20 73 75 63 68 20 61 73 20 74 68 | ogies such as th
00D6B0: 65 20 61 73 74 72 6F 6C 61 62 65 20 61 6E 64 20 | e astrolabe and
00D6C0: 69 6D 70 72 6F 76 65 64 20 6E 61 76 69 67 61 74 | improved navigat
00D6D0: 69 6F 6E 20 74 65 63 68 6E 69 71 75 65 73 2C 20 | ion techniques,
00D6E0: 45 75 72 6F 70 65 61 6E 73 20 73 6F 75 67 68 74 | Europeans sought
00D6F0: 20 6E 65 77 20 74 72 61 64 65 20 72 6F 75 74 65 | new trade route

00D700: 73 20 74 6F 20 74 68 65 20 49 6E 64 69 61 6E 20 | s to the Indian
00D710: 4F 63 65 61 6E 20 61 6E 64 20 41 73 69 61 2E 20 | Ocean and Asia.
00D720: 53 61 69 6C 69 6E 67 20 77 65 73 74 20 61 6E 64 | Sailing west and
00D730: 20 66 69 6E 64 69 6E 67 20 6E 65 77 20 63 6F 6E | finding new con
00D740: 74 69 6E 65 6E 74 73 20 69 6E 73 74 65 61 64 2C | tinents instead,
00D750: 20 74 68 65 20 45 75 72 6F 70 65 61 6E 73 20 73 | the Europeans s
00D760: 6F 6F 6E 20 72 65 61 6C 69 7A 65 64 20 74 68 65 | oon realized the
00D770: 20 65 63 6F 6E 6F 6D 69 63 20 70 6F 74 65 6E 74 | economic potent
00D780: 69 61 6C 20 6F 66 20 74 68 65 20 41 6D 65 72 69 | ial of the Ameri
00D790: 63 61 73 2E 20 54 68 65 20 53 70 61 6E 69 73 68 | cas. The Spanish
00D7A0: 2C 20 46 72 65 6E 63 68 2C 20 61 6E 64 20 42 72 | , French, and Br
00D7B0: 69 74 69 73 68 20 65 61 63 68 20 74 6F 6F 6B 20 | itish each took
00D7C0: 61 20 75 6E 69 71 75 65 20 61 70 70 72 6F 61 63 | a unique approac
00D7D0: 68 20 74 6F 20 68 6F 77 20 74 68 65 79 20 75 74 | h to how they ut
00D7E0: 69 6C 69 74 65 64 20 74 68 65 20 4E 65 77 20 57 | ilized the New W
00D7F0: 6F 72 6C 64 20 74 65 72 72 69 74 6F 72 69 65 73 | orld territories

00D800: 20 69 6E 20 77 68 69 63 68 20 74 68 65 79 20 73 | in which they s
00D810: 65 74 74 6C 65 64 2C 20 72 65 73 75 6C 74 69 6E | ettled, resultin
00D820: 67 20 69 6E 20 64 69 73 74 69 6E 63 74 20 61 6E | g in distinct an
00D830: 64 20 70 72 6F 66 6F 75 6E 64 20 70 61 74 74 65 | d profound patte
00D840: 72 6E 73 20 6F 66 20 73 6F 63 69 61 6C 20 64 65 | rns of social de
00D850: 76 65 6C 6F 70 6D 65 6E 74 2E 0A 0A 54 68 65 20 | velopment...The
00D860: 53 70 61 6E 69 73 68 20 68 61 64 20 74 77 6F 20 | Spanish had two
00D870: 6D 61 6A 6F 72 20 67 6F 61 6C 73 3A 20 74 6F 20 | major goals: to
00D880: 67 61 69 6E 20 77 65 61 6C 74 68 20 61 6E 64 20 | gain wealth and
00D890: 74 6F 20 73 70 72 65 61 64 20 43 61 74 68 6F 6C | to spread Cathol
00D8A0: 69 63 69 73 6D 20 74 6F 20 74 68 65 20 6E 61 74 | icism to the nat
00D8B0: 69 76 65 20 70 6F 70 75 6C 61 74 69 6F 6E 73 2E | ive populations.
00D8C0: 20 52 65 61 6C 69 7A 69 6E 67 20 74 68 65 20 70 | Realizing the p
00D8D0: 6F 74 65 6E 74 69 61 6C 20 74 6F 20 6D 69 6E 65 | otential to mine
```

Copy To Linux

```
> tree
● ROOT
  ○ Movies
  ○ Music
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      ● Farm.png
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      ● Mountain.png
      ● Ocean.jpg
    ○ Documents
    ○ Downloads
    ● sampleLinux.txt

> copytolinux sampleLinux.txt copiedFile.txt

>
```

Proof of Copy Working

```
filesystem — -zsh — 89x24

Last login: Sun May 10 00:49:23 on ttys005
[(base) pedrosouto@Pedros-MBP filesystem % ls
copiedFile.txt          fsLow.h                inputParser.c
fileSystem.txt          fsStructures.h         inputParser.h
fsImplementation.c      fsdriver3.c            sampleLinux.txt
fsImplementation.h      hexdump
fsLow.c                 hexdump.c

[(base) pedrosouto@Pedros-MBP filesystem % diff copiedFile.txt sampleLinux.txt
(base) pedrosouto@Pedros-MBP filesystem %
```

sampleLinux.txt

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Overall, where Europeans sought permanent settlements or economic gain at the expense of the forced labor of others, American Indian societies experienced population decline, upheaval, and ultimately, threats to their traditional lands and traditions.

copiedFile.txt

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