Project 3: FAT32 File System
Part 3

Function: read FILENAME OFFSET SIZE

- Read SIZE bytes of the FILENAME starting at OFFSET and print to stdout
- Throw error if
  - File doesn’t exist in current working directory
  - File is directory
  - File isn’t open for reading
  - Offset is larger than file size

Function: read FILENAME OFFSET SIZE

- Data is stored in a file as RAW bytes inside the FAT32 image file (no worrying about endianness)
- Don’t worry about the contents – use fwrite to write to stdout
- The example below shows a text file with the contents “Hi there!\n”

Function: read FILENAME OFFSET SIZE

- To read in the contents from FILENAME,
  - check that FILENAME is open with MODE r, rw, or wr
  - Find position in the image file to read
  - Use fread to read the image file
- You may need to iterate through multiple clusters to print the requested content

Function: read FILENAME OFFSET SIZE

- Note: OFFSET may not be perfectly divisible by sector_size (i.e. OFFSET may not be synchronized with the cluster.)
- The / and % operators are your friend:
  - OFFSET / bytes_per_sec = cluster offset
  - OFFSET % bytes_per_sec = byte offset within cluster

Function: read FILENAME OFFSET SIZE

At *each* cluster, need to calculate which bytes to read based on SIZE and OFFSET!

- Edge cases: OFFSET > sizeof(FILENAME)
  - Print error
- SIZE > sizeof(FILENAME),
  - Print entire file
- OFFSET + SIZE > sizeof(FILENAME)
  - Prints sizeof(FILENAME) **-** OFFSET bytes (from offset to end of file)

Function: read FILENAME OFFSET SIZE

```
vagrant@ubuntu-bionic:~/project3/src$ ./FAT32 fat32.img
Welcome to the ./FAT32 shell utility
Image, fat32.img, is ready to view
For a list of commands, type "help" or "h"
/] open hello r
/] size hello
10
/] read hello 0 10
Hi there!

/] read hello 2 5
 ther
/] read hello 5 12
ere!

/] exit
exiting fat32 utility
vagrant@ubuntu-bionic:~/project3/src$
```

Function: write FILENAME OFFSET SIZE STRING

- Write SIZE bytes in the form of STRING to FILENAME starting at OFFSET
- Throw error if
  - Filename doesn’t exist
  - Filename is a directory
  - File is not open for writing

Function: write FILENAME OFFSET SIZE STRING

- To write STRING to FILENAME,
  - Check MODE to ensure file was opened with w, wr, rw
  - Find position in image file
  - Write STRING to image file using fwrite
- Once again, the file might span multiple clusters
  - You may need to allocate new clusters

Function: write FILENAME OFFSET SIZE STRING

- Edge cases:
- OFFSET > sizeof(FILENAME)
  - Print error
- OFFSET < sizeof(FILENAME)
  - OFFSET + SIZE <= sizeof(FILENAME)
    - Overwrite the data there
  - OFFSET + SIZE > sizeof(FILENAME)
    - Overwrite data starting at OFFSET and expand the file to contain the rest of the buffer
    - This may require allocating a new cluster
- Make sure to update DIR_Size appropriately for all writes!

Function: write FILENAME OFFSET SIZE STRING

- What if the length of STRING is not equal to SIZE?
  - If sizeof(STRING) < SIZE, write STRING and pad the rest of the space with zeroes (‘\0’, null byte)
  - If sizeof(STRING) >= SIZE, just use the first SIZE bytes of STRING

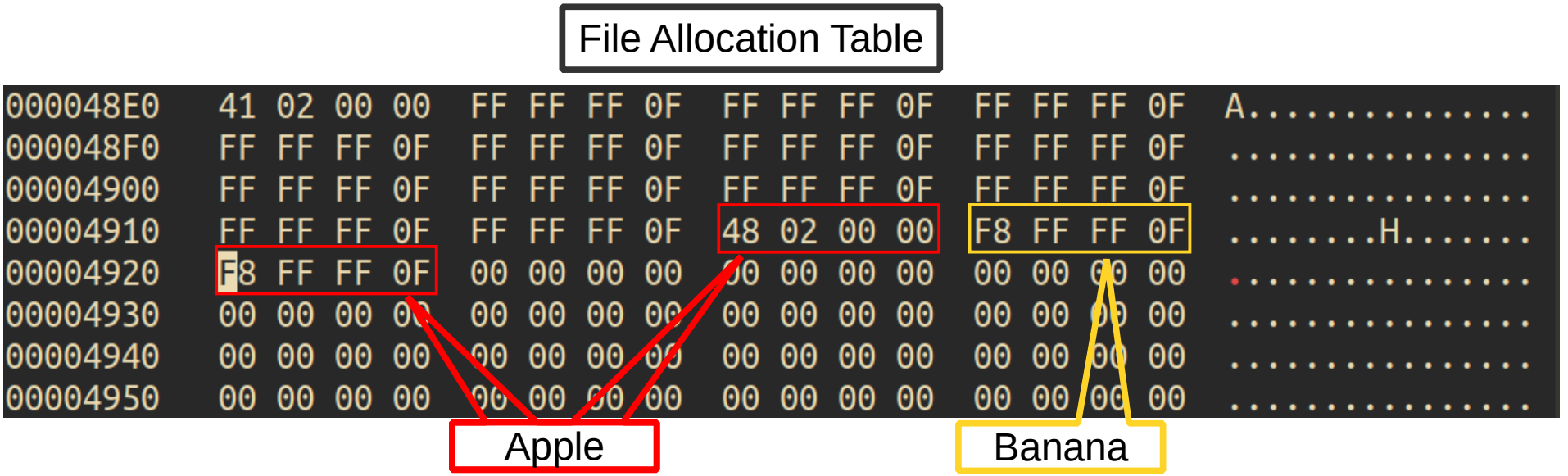
Expanding Files

- Find an empty cluster
- Have last cluster of file point to new cluster
- Have new cluster point to end of file

Function: write FILENAME OFFSET SIZE STRING

```
vagrant@ubuntu-bionic:~/project3/src$ ./FAT32 fat32.img
Welcome to the ./FAT32 shell utility
Image, fat32.img, is ready to view
For a list of commands, type "help" or "h"
/] creat apple
/] creat banana
/] size apple
0
/] open apple wr
/] write apple 500 16 "This is an apple"
/] read apple 500 16
This is an apple
/] size apple
516
/] exit
exiting fat32 utility
vagrant@ubuntu-bionic:~/project3/src$
```

Function: write FILENAME OFFSET SIZE STRING



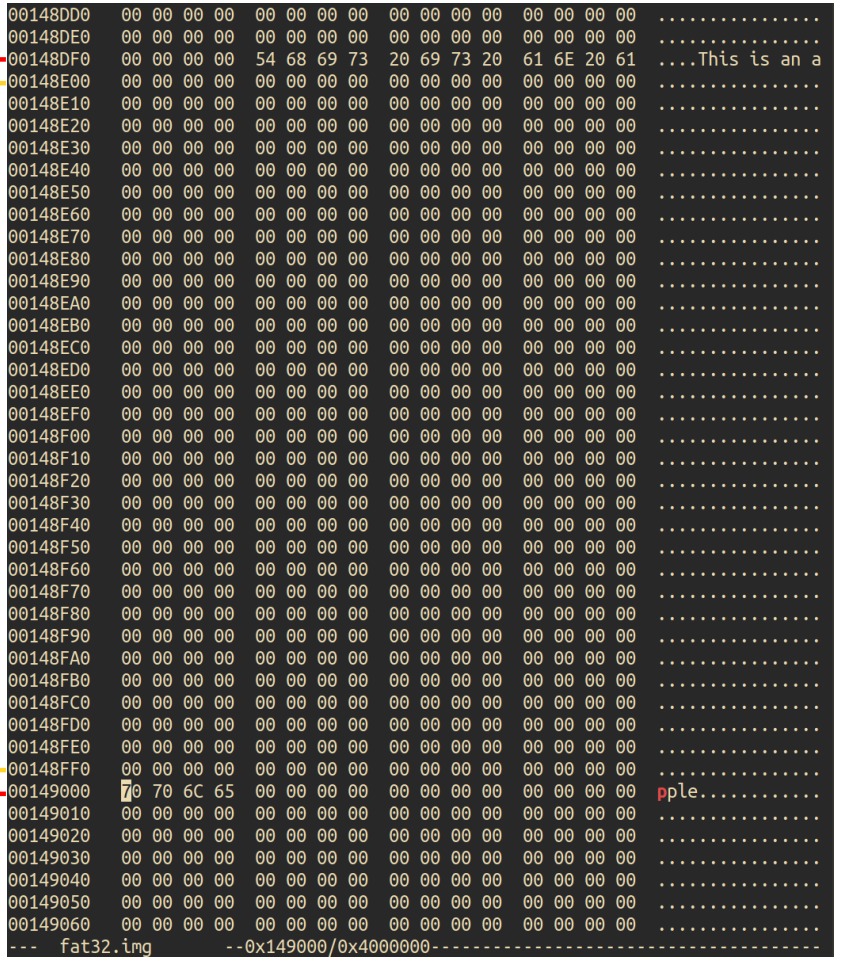
- Apple contains two clusters (0x0246 and 0x0248) – the first cluster points to the second cluster and the second cluster points to end of file (0x0FFFFFF8)
- The banana cluster sits in between the apple cluster and points to end of file

Function: write FILENAME OFFSET SIZE STRING

End of apple first cluster

Banana cluster

Start of apple second cluster



When in doubt, check the FATspec!