

Your Name: _____

1. **disk.** As shown this figure - generated by the simulator `disk.py`, the disk head's initial position is at sector 6. Compute the seek, rotation, and transfer times for the following request: sector 33. Assumptions: the disk platter rotates 1 degree per time unit, seeking from one track to the right next track takes 50 time units, transferring (i.e., reading from or writing to) a sector takes 30 time units. Transferring starts when the disk head is 15 degrees ahead of the target sector, ends when the disk head is 15 degrees after the target sector. Note that this disk spins **clockwise**. (15 points)



- Assume a block size of **2048 bytes** and the addresses (for pointers) are **32-bit**, answer the following questions for the ext2 file system. Please express your answers in appropriate units like KB, MB, GB, TB, PB etc.

- Answer: $2048 \times 12 = 24\text{KB}$

- Answer: $2048 \times 12 + (2048 / (32 / 8)) \times 2048 = 24K + 1M = 24K + 1024K = 1048KB$

3. Which operation has taken place in between states. A simulation trace is generated below using the tool vsfs.py.

(initial state) State 1:

```
inode bitmap  11110000
inodes        [d a:0 r:5] [d a:1 r:2] [f a:2 r:1] [d a:3 r:2]
               [] [] [] []
data bitmap   11110000
data          [(.,0) (.,0) (f,1) (s,2) (h,3)] [(.,1) (.,0)] [f] [(.,3) (.,0)]
               [] [] [] []
```

State 2:

```
inode bitmap  11111000
inodes        [d a:0 r:5] [d a:1 r:3] [f a:2 r:1] [d a:3 r:2]
               [f a:-1 r:1] [] [] []
data bitmap   11110000
data          [(.,0) (.,0) (f,1) (s,2) (h,3)] [(.,1) (.,0) (o,4)] [f] [(.,3) (.,0)]
               [] [] [] []
```

State 3:

```
inode bitmap  11111100
inodes        [d a:0 r:6] [d a:1 r:3] [f a:3 r:1] [d a:3 r:2]
               [f a:-1 r:1] [f a:-1 r:1] [] []
data bitmap   11110000
data          [(.,0) (.,0) (f,1) (s,2) (h,3) (c,5)] [(.,1) (.,0) (o,4)] [f] [(.,3) (.,0)]
               [] [] [] []
```

1. Please list all the directories/subdirectories/files at the initial state. (10 points)

For example:

Directories: '/', 'g', 'w'

Files: 't', 'm', 'w/p'

Answer:

directories: '/', 'f', 'h'

files: 's'

Note: The character "f" in the inodes row has a different meaning than the "f" in the data row. The former represents a file, the latter means the file or the directory is named "f".

2. Based on this trace, which operation has taken place in between state 1 and state 2? Hints: It is either a create or a mkdir operation, and create() is used to create an empty file, while mkdir() is used to create a directory. Choose one from these two options, and make sure you specify the parameter: the full path of the file or directory created. For example, if you believe a directory /a/b/c is just created, then say mkdir("/a/b/c"); and if you believe a file is /d/e is created, then say create("/d/e"). (10 points)

Answer: create("/f/o")

3. Based on this trace, which operation has taken place in between state 2 and state 3? Hints: again, it is either a create or a mkdir operation. Please specify the full path. (10 points)

Answer: `create("/c");`

4. Draw the file system state.

A simulation trace is generated below using the tool `vsfs.py`. Assumption: when a file or directory is created, if allocating an new inode is needed, the file system will always try to allocate first available inode; or if allocating a new data block is needed, the file system will always try to allocate the first available data block.

Initial state

```
inode bitmap  10000000
inodes        [d a:0 r:2] [] [] [] [] [] [] []
data bitmap   10000000
data          [(.,0) (.,0)] [] [] [] [] [] [] []
```

`mkdir("/x");`

State 1:

```
inode bitmap  11000000
inodes        [d a:0 r:3] [d a:1 r:2] [] [] [] [] [] []
data bitmap   11000000
data          [(.,0) (.,0) (x,1)] [(.,1) (.,0)] [] [] [] [] [] []
```

`create("/c");`

State 2:

?

`create("/x/y");`

State 3:

?

1. Please draw the file system state at state 2. (10 points)

Answer:

```
inode bitmap  11100000
inodes        [d a:0 r:4] [d a:1 r:2] [f a:-1 r:1] [] [] [] [] []
data bitmap   11000000
data          [(.,0) (.,0) (x,1) (c,2)] [(.,1) (.,0)] [] [] [] [] [] []
```

2. Please draw the file system state at state 3. (10 points)

Answer:

```
inode bitmap 11110000
inodes       [d a:0 r:4] [d a:1 r:3] [f a:-1 r:1] [f a:-1 r:1] [] [] [] []
data bitmap  11000000
data         [(.,0) (.,0) (x,1) (c,2)] [(.,1) (.,0) (y,3)] [] [] [] [] [] []
```

5. Analyzing the corruption states. (20 points)

Based on the following different corruption states, please detail what exact inconsistency do you see.

1.

```
inode bitmap 1100100010000110
inodes       [f a:0 r:6] [f a:-1 r:1] [] [] [d a:7 r:3] [] [] []
              [d a:8 r:2] [] [] [] [] [f a:15 r:1] [f a:12 r:1] []
data bitmap  1000001010001001
data         [(.,0) (.,0) (g,8) (t,14) (w,4) (m,13)] [] [] [] [] [] [] [(.,4) (.,0) (q,1)]
              [(.,8) (.,0)] [] [] [] [x] [] [] [y]
```

Answer: INODE 0 should be type d, rather than f.

2.

```
inode bitmap 1100100010000010
inodes       [d a:0 r:6] [f a:-1 r:1] [] [] [d a:7 r:3] [] [] []
              [d a:8 r:2] [] [] [] [] [f a:15 r:1] [f a:12 r:1] []
data bitmap  1000001010001001
data         [(.,0) (.,0) (g,8) (t,14) (w,4) (m,13)] [] [] [] [] [] [] [(.,4) (.,0) (q,1)]
              [(.,8) (.,0)] [] [] [] [x] [] [] [y]
```

Answer: INODE BITMAP corrupt bit 13: bitmap shows 0, but inodes say it is a file.