Name: ______________________________ USC ID: ________________________

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此后千秋第一歌

INF 551 – Fall 2016 (Morning)

Quiz 3: RAID + file systems (10 points)

10 minutes

1. [5 points] Consider the following RAID-4 setup, and a random workload comprising the writing of blocks #4 and #13. Suppose all five disks are identical with random bandwidth of **10MB/s**. Recall that the size of the block is 4KB. Assume the **subtractive** method is used to update the parity.

Disk 0	Disk 1	Disk 2	Disk 3	Parity
0	1	2	3	P0
4	5	6	7	P1
8	9	10	11	P2
12	13	14	15	P3

   a. [3 points] How much time (ignoring the latency) is needed to complete the workload?

$$T = \frac{4KB}{10MB/s}\times 2\times 2 = 1.6ms$$

   b. [2 points] What is the throughput of this RAID-4 for random write (please give specific value, not the generic value based on N and R)?

$$S = \frac{1}{2}\times R = \frac{10\text{MB/s}}{2} = 5MB/s$$

2. [5 points] Consider a file "file1" of the size 1KB. Suppose we execute the following two commands in sequence: "ln file1 file2", "ln -s file2 file3".

   a. [2 points] What will be the size of file2 and file3 as reported by the "stat" command?

file 2: 1KB

file 3: 5 bytes 好. 就是不用考虑终止符.

   b. [3 points] Which of the 3 files have the same inode number? Explain your answer.

File1 and file2 will have the same inode number. File2 is a hard link and it creates another name for the same file in the directory of the file the name is supposed to link to (file1).

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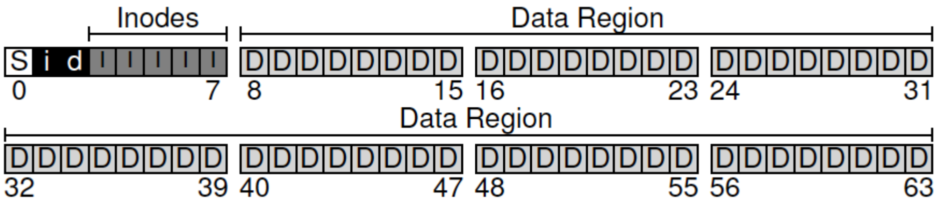
INF 551 – Spring 2016

Quiz 2: File systems (10 points)

10 minutes

Recall that we have seen a small file system stored in a disk of 64 blocks as shown below.



Now let us consider a new disk with **128** blocks, but the organization of file system on the disk remains the same. In other words, the new disk still has the first 8 blocks storing the superblock, two bitmaps (i-map and d-map) for tracking the free slots for inodes (i-map) and free data blocks (d-map). But the new disk now has additional 64 data blocks, numbered 64 to 127.

Suppose that the disk and file system have the following parameters.

Block size	4KB
Number of blocks on disk	128
Inode size	**512B**
Number of inode blocks	5 (blocks #3 to #7)

a. [2 points] How many files can the file system store on the disk?
Answer:
5 blocks store inodes: 4KB/block*5=20KB
Inode size=512B
File system can store: 20KB/512B=40 files

a. # inode per block
= 4KB / 512B = 8
total # inode = 8×5=40 ✓

b. [2 points] What is the maximum size of a file that can be stored in this file system?
Answer:
Data Region: 128-8=120
Maximum size: 120*4KB=480KB

b.
(128 − 8) × 4KB = 480kB ✓

c. [2 points] How many bits are there in the two bitmaps, i-map and b-map? 问的是实际用到的.
Answer:
i-map: 40 inodes * 1bit = 40 bits
b-map: 120 blocks * 1 bit = 120 bits

c. $4KB \times \frac{1024B}{1KB} \times \frac{8bit}{1B} = 32K$ ✗

d. [2 points] If the inumber of a file is 12, where is its corresponding inode located on the disk (i.e., offset)?
Answer:
Offset=inodeStartAddress+inumber*Inode size=12KB+12*512B=18KB

d. offset of 1st inode
+
# inode * inode size
= 3× 4KB + 512kB ×12
= 12KB + 6KB
= 18KB

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e. [2 points] Recall that some data block may be used to store pointers. Assume each pointer needs 2 bytes. How many pointers can a data block store?

Answer:

4KB/2Bytes=2048 pointers

e. block size = 4KB

total # printers = 4KB / 2B/pointer

= 2K poiters

= 2048 priters

* 非数据时要把 K、M、G 等简写

化成 2^n 计算后的格式；