CS 537: Intro to Operating Systems (Fall 2017)

Worksheet 12 - Crash Consistency and Journaling

Due: Dec 6th 2017 (Wed) email Simmi before 11:59 pm

Choose the best answer from the five choices for each question.
Imagine you have an VSFS-like file system that is creating a new empty file in an existing directory and must update 6 blocks: the **directory inode**, **two directory data blocks**, the **file inode**, the **inode bitmap**, and the **data bitmap**. Assume the directory inode and the file inode are in **different** on-disk blocks.

1. What is a scenario for which these 6 disk blocks would need to be written?
   (a) The new file is a hard link to an existing file
   (b) The size of the directory has grown to require another data block to hold the directory entries
   (c) No free data blocks were found
   (d) No free inodes were found
   (e) None of the above

Assume this filesystem does not perform any journaling and FSCK is not run. What happens if a crash occurs after only updating the following block(s)?

2. Inode Bitmap
   (a) No inconsistency (it simply appears that the operation was not performed)
   (b) Data/inode leak
   (c) Multiple file paths may point to same inode
   (d) Point to garbage
   (e) Multiple problems listed above

3. File inode
   (a) No inconsistency (it simply appears that the operation was not performed)
   (b) Data/inode leak
   (c) Multiple file paths may point to same inode
   (d) Point to garbage
   (e) Multiple problems listed above

4. All bitmaps, directory inode, and all directory data
   (a) No inconsistency (it simply appears that the operation was not performed)
   (b) Data/inode leak

(c) Multiple file paths may point to same inode

(d) Point to garbage

(e) Multiple problems listed above

5. File inode, data bitmap, directory inode, and all directory data

   (a) No inconsistency (it simply appears that the operation was not performed)

   (b) Data/inode leak

   (c) Multiple file paths may point to same inode

   (d) Point to garbage

   (e) Multiple problems listed above

Assume we've added a basic implementation of full-data journaling to our VSFS-like file system and perform the same **file create** operation as above that updates 6 blocks. Assume a **transaction header** block and a **transaction commit** block. Assume each block is written synchronously (i.e., a barrier is performed after every write and blocks are pushed out of the disk cache). If the system crashes after the following number of blocks have been synchronously written to disk, what will happen after the system reboots? (If the number of disk writes exceeds those needed, assume they are unrelated.)

6. 1 disk write (hint: just the transaction header block is written to disk)

   (a) No transactions replayed during recovery; file system in old state

   (b) No transactions replayed during recovery; file system in new state

   (c) Transaction replayed during recovery; file system in old state

   (d) Transaction replayed during recovery; file system in new state

   (e) Transaction replayed during recovery; file system in unknown state

7. 4 disk writes (hint: transaction header, plus 3 blocks to journal)

   (a) No transactions replayed during recovery; file system in old state

   (b) No transactions replayed during recovery; file system in new state

   (c) Transaction replayed during recovery; file system in old state

   (d) Transaction replayed during recovery; file system in new state

   (e) Transaction replayed during recovery; file system in unknown state

8. 7 disk writes

   (a) No transactions replayed during recovery; file system in old state

   (b) No transactions replayed during recovery; file system in new state

   (c) Transaction replayed during recovery; file system in old state

   (d) Transaction replayed during recovery; file system in new state

   (e) Transaction replayed during recovery; file system in unknown state

9. 8 disk writes

   (a) No transactions replayed during recovery; file system in old state
   (b) No transactions replayed during recovery; file system in new state
   (c) Transaction replayed during recovery; file system in old state
   (d) Transaction replayed during recovery; file system in new state
   (e) Transaction replayed during recovery; file system in unknown state

10. 9 disk writes

   (a) No transactions replayed during recovery; file system in old state
   (b) No transactions replayed during recovery; file system in new state
   (c) Transaction replayed during recovery; file system in old state
   (d) Transaction replayed during recovery; file system in new state
   (e) Transaction replayed during recovery; file system in unknown state

11. 10 disk writes

   (a) No transactions replayed during recovery; file system in old state
   (b) No transactions replayed during recovery; file system in new state
   (c) Transaction replayed during recovery; file system in old state
   (d) Transaction replayed during recovery; file system in new state
   (e) Transaction replayed during recovery; file system in unknown state

12. 14 disk writes

   (a) No transactions replayed during recovery; file system in old state
   (b) No transactions replayed during recovery; file system in new state
   (c) Transaction replayed during recovery; file system in old state
   (d) Transaction replayed during recovery; file system in new state
   (e) Transaction replayed during recovery; file system in unknown state

13. 15 disk writes

   (a) No transactions replayed during recovery; file system in old state
   (b) No transactions replayed during recovery; file system in new state
   (c) Transaction replayed during recovery; file system in old state
   (d) Transaction replayed during recovery; file system in new state
   (e) Transaction replayed during recovery; file system in unknown state