

1.(12%) Please explain the features (including advantages and disadvantages) of the following directories as details as possible. Use a diagram example for each to show the directory structure:

- (a) Tree-Structure Directories
- (b) Acyclic-Graph Directories
- (c) General Graph Directories

2.(8%) What are *share lock* and *exclusive lock* ? What are *mandatory* and *advisory* file-locking mechanisms ?

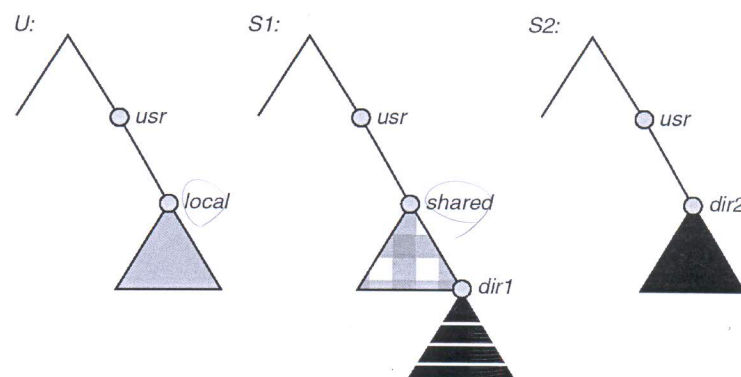
3.(12%) Explain how the following allocation strategies work for file system. What are their advantages and disadvantages ?

- (a) Contiguous allocation
- (b) Linked allocation
- (c) Indexed allocation.
- (d) File allocation table (FAT)

4.(10%) In the Network File System (NFS), there are major protocols: *mount protocol* and *NFS protocol*. Explain how these protocols work as details as possible. Also show the schematic view of the NFS architecture.

5.(8%) For the following three independent file systems, please draw the final file system of U looks like after the following two mountings:

- (1) mounting S1:/user/shared over U:/user/local
- (2) mounting S2:/user/dir2 over U:/user/local/dir1



6. (10%) Consider a file currently on a disk that has both logical and physical block sizes of 512 bytes. Assume that the information about each file is already in memory. For each of the three allocation strategies (contiguous, linked, and indexed), answer the following questions:

- (a) How is the logical-to-physical address mapping accomplished in this system ? (For the indexed allocation, assume that a file is always less than 512 blocks long)
- (b) If we are currently at logical block 12 (the last block accessed was block 12) and we want to access logical block 5, how many physical blocks must be read from the disk ?

7.(8%) None of the disk-scheduling disciplines, except FCFS, are truly fair (starvation may occur).

- (a) Explain why this assertion is true.
- (b) Describe a way to modify algorithms such as SCAN to ensure fairness.
- (c) Explain why fairness is an important goal in a time-sharing system.
- (d) Give three or more examples of circumstances in which it is important that the operating system be *unfair* in serving I/O requests.

8.(12%) Suppose that a disk drive has 2,000 cylinders, numbered 0 to 1999. The drive is currently serving a request at cylinder 150, and the previous request was at cylinder 130. The queue of pending requests, in FIFO order is:

100, 1500, 900, 1750, 950, 1600, 1000, 1800, 540

Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms ?

- (a) FCFS
- (b) SSTF
- (c) SCAN
- (d) LOOK
- (e) C-SCAN
- (f) C-LOOK

9.(10%) There are six RAID levels in the RAID structure as shown follows. Please explain the major features of each RAID level.



(a) RAID 0: non-redundant striping.



(b) RAID 1: mirrored disks.



(c) RAID 2: memory-style error-correcting codes.



(d) RAID 3: bit-interleaved parity.



(e) RAID 4: block-interleaved parity.



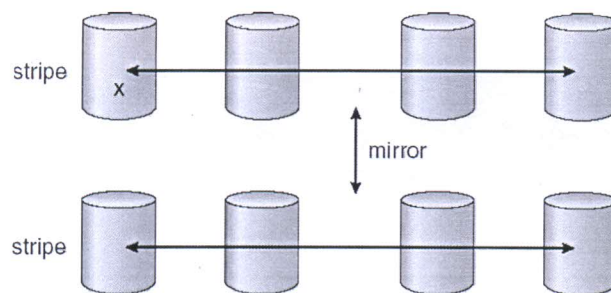
(f) RAID 5: block-interleaved distributed parity.



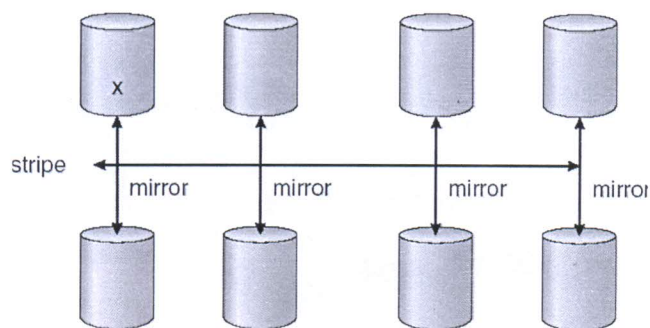
(g) RAID 6: P + Q redundancy.

10.(10%) Please explain and compare the features of RAID levels 0+1 and 1+0.

For the following figure, explain what happens when RAID 0+1 with a single disk failure and RAID 1+0 with a single disk failure.



a) RAID 0 + 1 with a single disk failure.



b) RAID 1 + 0 with a single disk failure.