Chapter 11

Multiple Choice Questions

1. A hard disk drive has 16 platters, 8192 cylinders, and 256 4KB sectors per track. The storage capacity of this disk drive is at most

A) 128 TB.
B) 32 TB.
C) 32 GB.
D) 128 GB.

Ans: D
Feedback: 11.1.1
Difficulty: Easy

2. What are the two components of positioning time?
A) seek time + rotational latency
B) transfer time + transfer rate
C) effective transfer rate - transfer rate
D) cylinder positioning time + disk arm positioning time

Ans: A
Feedback: 11.1.1
Difficulty: Easy

3. The surface of a magnetic disk platter is divided into ____.
A) sectors
B) arms
C) tracks
D) cylinders

Ans: C
Feedback: 11.1.1
Difficulty: Easy

4. Which of the following statements regarding solid state disks (SSDs) is false?
A) They generally consume more power than traditional hard disks.
B) They have the same characteristics as magnetic hard disks, but can be more reliable.
C) They are generally more expensive per megabyte than traditional hard disks.
D) They have no seek time or latency.

Ans: A
Feedback: 11.1.2
Difficulty: Medium

5. An advantage of SSDs over HDDs is

A) SSDs are cheaper per megabyte than HDDs.
B) SSDs are more reliable than HDDs.
C) SSDs are faster than HDDs.
D) B and C

Ans: D
Feedback: 11.1.2.1
Difficulty: Medium

6. A Flash Translation Layer

A) translates user data to a format that can be written on the NVM.
B) tracks which physical block contains the most number of consecutive invalid pages.
C) tracks which physical block contains only valid pages.
D) tracks which physical block contains only invalid pages.

Ans: D
Feedback: 11.1.2.2
Difficulty: Medium

7. DRAMs are now commonly used for mass data storage, because

A) programs can share data easily when using RAMs.
B) DRAMs are cheaper than SSDs.
C) programs may not need the data they store in future.
D) storage capacity of DRAMS is typically much larger than HDDs.

Ans: A
Feedback: 11.1.3
Difficulty: Medium

8. Compared to USB, NVMe provides

A) both higher throughput and lower latency.
B) higher throughput, but higher latency.
C) lower latency, but lower throughput.
D) neither higher throughput and lower latency.

Ans: A
Feedback: 11.1.4
Difficulty: Easy

9. Number of sectors per track increases as we move from inner zone to outer zone, because

A) the drive can increase its rotation speed as the head moves from the outer to the inner tracks.
B) the drive can decrease its rotation speed as the head moves from the outer to the inner tracks.
C) angular velocity of disk rotation can vary.
D) angular velocity of disk rotation can remain constant.

Ans: D
Feedback: 11.1.5
Difficulty: Easy

9. An I/O system call does not include

A) memory address.
B) storage device address.
C) CPU speed.
D) whether the operation is input or output.

Ans: C
Feedback: 11.2
Difficulty: Easy

10. Which of the following disk head scheduling algorithms does not take into account the current position of the disk head?
A) FCFS
B) C-SCAN
C) SCAN
D) All scheduling algorithms take into account the current position of the disk head

Ans: A
Feedback: 11.2
Difficulty: Easy

11. Disk scheduling algorithms in operating systems consider only seek distances, because

A) rotational latency is insignificant compared to the average seek time.
B) modern disks do not disclose the physical location of logical blocks.
C) the operating systems may have other constraints such as writes may be more urgent than reads.
D) it is difficult to optimize seek time in disk hardware.

Ans: B
Feedback: 11.2
Difficulty: Easy

12. The SCAN scheduling algorithm ____.
A) services the request with the minimum seek time
B) services the request next to the current head position in the direction of the head movement
C) chooses to service the request furthest from the current head position
D) services the request next to the current head position in the opposite direction of the head movement

Ans: B
Feedback: 11.2.2
Difficulty: Medium

13. Consider a disk queue holding requests to the following cylinders in the listed order: 116, 22, 3, 11, 75, 185, 100, 87. Using the SCAN scheduling algorithm, what is the order that the requests are serviced, assuming the disk head is at cylinder 88 and moving upward through the cylinders?
A) 116 - 22 - 3 - 11 - 75 - 185 - 100 - 87
B) 100 - 116 - 185 - 87 - 75 - 22 - 11 - 3
C) 87 - 75 - 100 - 116 - 185 - 22 - 11 - 3
D) 100 - 116 - 185 - 3 - 11 - 22 - 75 - 87

Ans: B
Feedback: 11.2.2
Difficulty: Medium

14. Consider a disk queue holding requests to the following cylinders in the listed order: 210, 67, 11, 99, 87, 90, 19, 150. Using the C-SCAN scheduling algorithm, what is the order that the requests are serviced, assuming the disk head is at cylinder 88 and moving upward through the cylinders?
A) 87 – 90 – 99 – 67 – 19 – 11 – 150 - 210
B) 210 – 67 – 11 – 99 – 87 – 90 – 19 - 150
C) 90 - 99 - 150 - 210 - 11 - 19 - 67 - 87
D) 90 - 99 - 150 - 210 – 87 – 67 – 19 - 11

Ans: C
Feedback: 11.2.3
Difficulty: Medium

15. To further optimize I/O performance, some SSD schedulers

A) merge adjacent read requests but not adjacent write requests.
B) merge adjacent write requests but not adjacent read requests.
C) merge all adjacent I/O requests.
D) do not merge requests at all.

Ans: B
Feedback: 11.3
Difficulty: Easy

16. Solid state disks (SSDs) commonly use the _____ disk scheduling policy.
A) C-SCAN
B) SCAN
C) FCFS
D) None of the above

Ans: C
Feedback: 11.3
Difficulty: Easy

17. If a few bits in an HDD sector or NVM page are corrupted, the controller can recover the correct values using ECC only if

A) the bit corruption is limited to the data portion of the sector/page.
B) the bit corruption hasn't occurred in the ECC of the sector/page.
C) the bit corruption hasn't occurred in the ECC or the header of the sector/page.
D) number of bits corrupted is low irrespective of where the corruption occurs in the sector/page.

Ans: D
Feedback: 11.4
Difficulty: Hard

18. Which of the following statement about device formatting is FALSE?

A) Device manufacturers store the initial file-system data structures in the device.
B) Operating system can create multiple partitions with in a single device.
C) Volume creation is implicit when a file system is placed directly within a partition.
D) Not every partition contains a copy of the operating systems.

Ans: D
Feedback: 11.5.1
Difficulty: Medium

19. A full bootstrap program

A) is stored in ROM to ensure to avoid any infection from viruses.
B) is part of an operating system
C) may be infected by viruses.
D) runs after the operating system has been loaded in memory.

Ans: C
Feedback: 11.5.2
Difficulty: Hard

20. Which of the following is TRUE about managing defective blocks?

A) Defective blocks can be handled by OS by ensuring that the file system doesn't allocate those blocks.
B) Low level formatting can set aside spare sectors not visible to the operating system.
C) Controllers can be instructed to replace a bad block by moving all sectors following the defective sector one sector forward until a spare sector is reached.
D) All of the above.

Ans: D
Feedback: 11.5.3
Difficulty: Easy

21. Difference between sector sparing and sector slipping is

A) sector sparing uses spare sectors while sector slipping does not.
B) sector sparing results in copying of a single sector while sector slipping may result in copying of multiple sectors.
C) sector sparing can help recover from hard errors while sector slipping cannot.
D) sector slipping can help recover from hard errors while sector sparing cannot.

Ans: B
Feedback: 11.5.3
Difficulty: Easy

22. Which of the following is FALSE about swap space use?

A) Swap space may be used to hold an entire process image.
B) Swap space may be used to store only pages that have been pushed out of main memory.
C) Swap space may be used to store the file system.
D) Swap space can be a dedicated swap partition, a swap file, or a combination of swap partitions and swap files.

Ans: C
Feedback: 11.6.1
Difficulty: Easy

23. In a swap map in Linux

A) counter value 0 indicates that the page slot is occupied by a swapped page.
B) counter value 5 indicates that the page slot is occupied and the page is shared by five processes.
C) counter value -1 indicates that the page slot is available.
D) counter value -5 indicates that the page slot was occupied by a page that was shared by five processes, and is now available.

Ans: B
Feedback: 11.6.3
Difficulty: Medium

24. Which of the following is TRUE about NAS and Cloud storage?

A) Cloud storage is accessed like a file system while NAS is API based.
B) In an event of temporary network disconnection, an application using NAS will typically hang while an application using cloud storage will typically pause.
C) Cloud storage is typically accessed over a LAN while NAS is accessed over a WAN.
D) All of the above.

Ans: B
Feedback: 11.7.2 & 11.7.3
Difficulty: Medium

25. Which of the following is FALSE about Storage Area Networks?

A) SANs make it possible for clusters of servers to share the same storage.
B) SANs use storage protocols rather than network protocols.
C) Allocation of storage to hosts is static.
D) Multiple hosts can attach to the same SAN.

Ans: C
Feedback: 11.7.4
Difficulty: Medium

26. RAID level ____ is the most common parity RAID system.
A) 0
B) 0+1
C) 4
D) 5

Ans: D
Feedback: 11.8.3 & 11.8.4
Difficulty: Medium

Essay Questions

1. What is constant angular velocity in relation to disk drives?

Ans: If the rotation speed of a disk is to remain constant, the density of the bits must be changed for different tracks to ensure the same rate of data moving under the head. This method keeps a constant angular velocity on the disk.
Feedback: 11.1.5
Difficulty: Medium

2. What are the factors influencing the selection of a disk-scheduling algorithm?

Ans: Performance of a scheduling algorithm depends heavily on the number and types of requests. Requests for disk service can be greatly influenced by the file-allocation method. The location of directories and index blocks is also important. Other considerations for scheduling may involve rotational latency (instead of simply seek distances) and operating system constraints, such as demand paging.
Feedback: 11.2
Difficulty: Medium

3. What is a disadvantage of the FCFS scheduling algorithm?

Ans: FCFS can cause the disk head to move wildly over large distance skipping some of the cylinders in between even there is a request waiting to service them. As a result, average performance is quite poor.
Feedback: 11.2.1
Difficulty: Medium

4. What is the advantage of C-SCAN over SCAN disk head scheduling?

Ans: The C-SCAN algorithm is a variant of SCAN algorithm. Like SCAN, C-SCAN moves the head from one end of the disk to the other, servicing requests along the way. When the head reaches the other end, however, it immediately returns to the beginning of the disk without servicing any requests on the return trip. This results in C-SCAN providing a more uniform wait time
Feedback: 11.2.3
Difficulty: Medium

5. Describe how Solaris ZFS file system uses checksums to maintain the integrity of data.

Ans: ZFS maintains checksums of all data and metadata blocks. When the file system detects a bad checksum for a block, it replaces the bad block with a mirrored block that has a valid checksum.
Feedback: 11.5.1
Difficulty: Medium

6. Describe an approach for managing bad blocks.

Ans: One approach to managing bad blocks is sector sparing. When the disk controller detects a bad sector, it reports it to the operating system. The operating system will then replace the bad sector with a spare sector. Whenever the bad sector is requested, the operating system will translate the request to the spare sector.
Feedback: 11.5.3
Difficulty: Medium

7. Describe why Solaris systems only allocate swap space when a page is forced out of main memory, rather than when the virtual memory page is first created.

Ans: Solaris systems only allocate swap space when a page is force out of main memory, because modern computers typically have much more physical memory than older systems and—as a result—page less frequently. A second reason is that Solaris only swaps anonymous pages of memory.
Feedback: 11.6.3
Difficulty: Medium

8. What is a storage-area network?

Ans: A storage-area network (SAN) is a private network (using storage protocols rather than networking protocols) connecting servers and storage units. The power of a SAN lies in its flexibility. Multiple hosts and multiple storage arrays can attach to the same SAN, and storage can be dynamically allocated to hosts.
Feedback: 11.7.4
Difficulty: Medium

9. Describe one technique that can enable multiple disks to be used to improve data transfer rate.

Ans: One technique is bit-level striping. Bit-level striping consists of splitting the bits of each byte across multiple disks so that the data can be accessed from multiple disks in parallel. Another method is block-level striping where blocks of a file are striped across multiple disks.
Feedback: 11.8.3
Difficulty: Difficult

True/False Questions

1. A track is the smallest unit of data transfer in a hard disk drive.

Ans: False
Feedback: 11.1.1
Difficulty: Easy

2. Disk controllers do not usually have a built-in cache.

Ans: False
Feedback: 11.1.4
Difficulty: Medium

3. SCAN disk head scheduling offers no practical benefit over FCFS disk head scheduling.

Ans: False
Feedback: 11.2
Difficulty: Easy

4. In general, SCAN disk head scheduling will involve less movement of the disk heads than C-SCAN disk head scheduling.

Ans: True
Feedback: 11.2
Difficulty: Medium

5. Solid state disks (SSDs) commonly use the FCFS disk scheduling algorithm.

Ans: True
Feedback: 11.3
Difficulty: Easy

6. Windows allows a hard disk to be divided into one or more partitions

Ans: True
Feedback: 11.5.1
Difficulty: Easy

7. In Solaris, swap space is only used as a backing store for pages of anonymous memory.

Ans: True
Feedback: 11.6.3
Difficulty: Medium

8. Data striping provides reliability for RAID systems.

Ans: False
Feedback: 11.8.2
Difficulty: Medium

9. In asynchronous replication, each block is written locally and remotely before the write is considered complete.

Ans: False
Feedback: 11.8.3
Difficulty: Medium

10. RAID level 0 provides no redundancy.

Ans: True
Feedback: 11.8.3
Difficulty: Easy