**Operating Systems**

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Operating Systems Environments & Administration

1. Answer the following questions about hard drives:
   1. Explain each of the following hard drive components:
      1. Platter

Answer: A metallic plate that is used to store data in a hard drive.

* + 1. Cylinder

Answer: A type of virtual construct that is created when read/write heads are on the same track but on different platters.

* + 1. Track

Answer: A platter is broken down into thousands of concentric circles known as tracks. Theses tracks are where data is stored in a hard drive. The outermost track is Track 0 and the innermost track is the highest numbered track.

* + 1. Sector

Answer: A track is broken up into even smaller sections known as sectors. A sector is the most basic unit of data storage on a hard drive.

* + 1. Block

Answer: A block is group of sectors that an operating system can point to. A block can contain one or more sectors.

* + 1. Read/Write Head

Answer: Read/write heads float over the platter of the hard drive and are responsible for reading and writing data.

* + 1. Arm

Answer: The arm is responsible for moving the read/write heads over the platter in unison.

* + 1. Spindle

Answer: The spindle is responsible for holding platters of a hard drive in place. They are held in such a way there is enough space for the read/write heads to access the data on the platters.

* 1. Where on a platter is **Track 0** located?

Answer: The outermost circle.

* 1. How many read/write heads exist in a hard drive containing four (4) platters?

Answer: 2 (heads) \* 4 (platters) = 8

* 1. Explain each of the three (3) factors of **Access Time**:
     1. Seek Time

Answer: The time required to position the read/write head on the proper track. The slowest of the three factors.

* + 1. Search Time (rotational delay)

Answer: The time it takes to rotate the disk until the requested record is moved under the read/write head.

* + 1. Transfer Time

Answer: The time taken to transfer data from secondary storage to main memory. The fastest of the three factors.

* 1. Given the following hard drive characteristics, calculate **Total Access Time**:
     1. Track order to access data: 10, 5 and 15 (assume read/write head is located at **Track 0**)
     2. Average Seek Time: 0.75 ms per track
     3. Average Search Time (rotational delay): 8.4 ms
     4. Average Transfer Time (100 bytes): 0.1 ms
     5. Sizes of Data: 5 - 300 bytes, 10 - 150 bytes, 15 - 500 bytes

Answer:

Access Time = Seek Time + Search Time + Transfer Time

For 10th track:

Seek time = (Average Seek Time \* No. of Tracks) = 0.75 \* 10 (10 tracks from Track 0 to Track 10) = 7.5 ms

Search Time = 8.4 ms

Transfer Time = Average Transfer Time \* (Size of Data / Given Transfer Byte Size) = 0.1 \* (150 / 100) = 0.15 ms

Access Time = 07.5 + 8.4 + 0.15 = 16.05 ms

For 5th track:

Seek time = (Average Seek Time \* No. of Tracks) = 0.75 \* 5 (5 tracks from Track 10 to Track 5) = 3.75 ms

Search Time = 8.4 ms

Transfer Time = Average Transfer Time \* (Size of Data / Given Transfer Byte Size) = 0.1 \* (300 / 100) = 0.3 ms

Access Time = 3.75 + 8.4 + 0.3 = 12.45 ms

For 15th track:

Seek time = (Average Seek Time \* No. of Tracks) = 0.75 \* 10 (10 tracks from Track 5 to Track 15) = 7.5 ms

Search Time = 8.4 ms

Transfer Time = Average Transfer Time \* (Size of Data / Given Transfer Byte Size) = 0.1 \* (500 / 100) = 0.5 ms

Access Time = 7.5 + 8.4 + 0.5 = 16.4 ms

Total Access Time = The Three Access Times Combined = 16.05 + 12.45 + 16.4 = 44.9 ms

1. List and explain the three (3) primary differences between a hard drive and an optical disc.

Answer: Magnetic disks have many circular tracks, the size of their sectors varies, their spinning speed is constant (CAV), and their surface layer consists of a magnetic media. In contrast, optical discs have one spiral track, the size of their sectors are identical, their spinning speed is variable (CLV), and their surface layer consists of a polycarbonate plastic.

1. Answer the following questions about **RAID**:
   1. What does the acronym RAID stand for?

Answer: Redundant Array of Inexpensive Disks

* 1. Which RAID Level is **not** considered a true form of RAID?

Answer: RAID Level 0

* 1. Which RAID Level does **not** provide data redundancy or error correction?

Answer: RAID Level 0

* 1. Given two (2) **500 GB** hard drives configured as **RAID Level 0**, how much usable drive space exists?

Answer: 2 x 500 GB = 1000 GB = 1TB

* 1. Given two (2) **500 GB** hard drives configured as **RAID Level 1**, how much usable drive space exists?

Answer: All data you store on one hard drive is mirrored in the other hard drive. Therefore, only one of the two hard drives are usable. Hence, only 500 GB of usable drive space exists.

* 1. Given three (3) **500 GB** hard drives configured as **RAID Level 5**, how much usable drive space exists?

Answer: At least 3 hard drives are needed for RAID Level 5. An amount equivalent to one of the hard drives is used for recovery data and cannot be used by the user. Therefore, 500 GB of data is not available to the user leaving 1000 GB or 1 TB of usable drive space.

* 1. Which **RAID Level** (0, 1 or 5) would create the **maximum** amount of usable drive space and provide **data redundancy** and **fault tolerance**?

Answer: RAID Level 5

1. Explain the following file elements:
   1. Field

Answer: A group of related bytes that can be identified by the user with a name, type, or size.

* 1. Record

Answer: A record is made up of a group of related fields.

* 1. File

Answer: A group of related records that contains information that an application uses to generate reports.

* 1. Database

Answer: A group of interconnected files that allow users to easily access the stored data.

* 1. Program File

Answer: Files that contain instructions.

* 1. Data File

Answer: Files that contain data.

* 1. Directory

Answer: A special file that contains listings of filenames and their attributes.

* 1. Subdirectory

Answer: A directory within an existing directory.

1. List and explain the eight (8) types of information typically stored in a file descriptor.

Answer:

* Filename—Filenames must be unique within the same directory. In some operating systems, the filenames are case sensitive
* File type—Characteristics of the file that are dependent on the system (for example, files and directories)
* File size—Size of the file
* File location—The first physical block (or all blocks) in which the file is stored
* Date and time of creation of the file
* Owner of the file
* Protection information—The level and type of access that users have to the file
* Max record size—The fixed or maximum size of the record

1. Explain the primary differences between an **absolute** filename and a **relative** filename.

Answer: Absolute filename includes all path information. It is a combination of the relative name and the extension. Relative filename is the name of the file without the path information that appears in directory listings and folders. This is used to differentiate the file from files in the same directory.

1. Answer the following questions about **fixed-length** and **variable-length** records:
   1. What is the primary difference between fixed- and variable-length records?

Answer: Fixed-length records have a fixed size which may lead to data truncation/corruption or wasted space. However, they are easy to access directly. Variable-length records are of variable size and hence do not have the same disadvantages of fixed-length records. However, they are not easy to access directly as it is not easy to calculate exactly where each record is located.

* 1. What happens if a data element is smaller than the fixed-length of the respective field?

Answer: The leftover data is truncated leading to data corruption.

* 1. What happens if a data element is larger than the fixed-length of the respective field?

Answer: Storage space is wasted.