**Tutorial 6: Device Management**

Q1. List and explain **TWO (2)** operations of a device manager.

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| **Operations of a device manager**   * + - Solve structured interaction between units, to know which components are busy and which are free     - Handle buffer records and queue request to accommodate request that come in during heavy I/O traffic and accommodate disparity of speeds between CPU and I/O devices |

Q2. Give **ONE (1)** example of sequential access media and **TWO (2)** categories of direct access media. For each of the media given, briefly describe their access operation.

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| * **Magnetic tape** * Data is recorded on 8 parallel tracks that run length of tape. * Ninth track holds parity bit used for routine error checking. * Number of characters that can be recorded per inch is determined by density of tape (e.g., 1600 or 6250 bpi).  |  |  | | --- | --- | | * **DASD with fixed read/write heads** | * **DASD with movable read/write heads** | | * Fixed-head disks -- each disk looks like a phonograph album. * Covered with magnetic film that has been formatted, usually on both sides, into concentric circles. * Each circle is a track. Data is recorded serially on each track by the fixed read/write head positioned over it. * One head for each track. | Movable-head drums have only a few read/write heads that move from track to track to cover entire surface of drum.   * Least expensive device has only 1 read/write head for entire drum * More conventional design has several read/write heads that move together. * One read/write head that floats over the surface of the disk. | |

Q3. Discuss all the factors that affect the access time of direct access storage devices that use moveable read/write heads.

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| Factors that affects the access time of DASD that use moveable read/write heads are:  **Search time (rotational delay)** - Time it takes to rotate DASD until requested record is under read/write head.  **Transfer time** (fastest of the three factors) - When data is transferred from secondary storage to main memory.  **Seek time** (slowest of the three factors) - Time required to position the read/write head on the proper track. |

Q4. Differentiate between the I/O channel and I/O control unit.

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| **I/O channel** | **I/O control Unit** |
| * It keeps up with I/O requests from CPU and pass them down the line to appropriate control unit | * It interprets signal sent by channel |

Q5. In a large direct sales company, analysis on sales transaction data stored in a database table is performed on weekly basis.

1. Polling and interrupt are the two commons I/O operation techniques to perform the test of the flag (the status of device). Briefly explain these **TWO (2)** I/O operations techniques.

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| 1. **Polling (Programmed I/O)** - Polling uses a special machine instruction to test flag.  * CPU periodically tests the channel status bit (in CSW). * If polling is done too seldom, channel could sit idle for long periods of time.   b)  **Interrupt** -Use of interrupts is a more efficient way to test flag.   * Hardware mechanism does test as part of every machine instruction executed by CPU. * If channel is busy flag is set so that execution of current sequence of instructions is automatically interrupted. * Control is transferred to interrupt handler, which resides in a predefined location in memory. |

1. Discuss TWO (2) drawbacks if interrupt-driven I/O technique is used in reading the sales transaction data.

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| The amount of sales data to be read from the database table will probably be very huge, giving rise to the drawback:   * Consumes a lot of processor time, because every word of data must pass through the processor. * One interrupt will be generated for every one word transferred ie: processor time is not spent constructively for executing processes. * Every single transfer of data bytes will interrupt the CPU for I/O events and this will not optimize the CPU usage for the events. |

1. Discuss clearly how Direct Memory Access (DMA) can be used to overcome each of the drawbacks in Q5 (ii). Support your answer by including the information that must be passed from the CPU to the DMA controller prior to the DMA transfer.

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| After the processor issues a command to the DMA module, passing to it the following information, the processor then continues with other work.   * The type of operation, in this case a read operation * The address of the I/O device involved * The starting location in memory to write * The bock size (number of words) to be written   The DMA module transfers the entire block of data, one word at a time, directly from the disk where the database table is stored to memory without going through the processor. |

Q6. Consider a multimedia system that contains both audio and video components. Would you use polled I/O, interrupt driven I/O or Direct Memory Access (DMA)? Give reasons for your choice.

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| **Use DMA – synchronizing Audio and Video Streams**  In a multimedia system, the streaming content consists of both audio and video component. Because of the data rates at which these streams run, DMA channels must be used to interface with the audio codec and the video encoder to ensure that the streams are synchronized to ensure quality. |

Q7. Suppose that a disk drive has 220 cylinders, numbered 0 to 219. The driver is currently serving a request at cylinder 65 and the head was previously serving a request at cylinder 70. The queue of pending requests is, in the order received as below:

58, 188, 69, 200, 30, 158, 48, 74, 105

Calculate the total head movements using the following seek strategies.

1. SSTF scheduling

***65 🡪 69 🡪 74 🡪 58 🡪 48 🡪 30 🡪 105 🡪 158 🡪 188 🡪 200***

***head movements = 223***

1. SCAN scheduling

***65 🡪 58 🡪 48 🡪 30 🡪 0 🡪 69 🡪 74 🡪 105 🡪 158 🡪 188 🡪 200***

***head movements = 265***

1. LOOK scheduling

***65 🡪 58 🡪 48 🡪 30 🡪 69 🡪 74 🡪 105 🡪 158 🡪 188 🡪 200***

***head movements = 205***

Q8. Suppose a disk has 200 cylinders, numbered from 0 to 199. The drive is currently serving an I/O request at cylinder 120 and the disk head was previously serving a request at cylinder 78, and there is a queue of disk access requests for cylinders as below:

**142, 134, 125, 62, 144, 46, 196, 188**

Starting from the current head position, illustrate the head movements using the following disk scheduling algorithms. Compute the total head movement based on your illustration.

(i) FCFS scheduling

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| |  | | --- | | FCFS  120->142->134->125->62->144->46->196->188  Total head movement: 22+8+9+63+82+98+150+8=440 | |

(ii) SSTF scheduling

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| SSTF  120 -> 125 -> 134 -> 142 -> 144 -> 188 -> 196 -> 62 -> 46  Total head movement: 5+9+8+2+44+8+134+16=226 |

(iii) SCAN scheduling

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| SCAN  120-> 125-> 134-> 142-> 144-> 188-> 196-> 199-> 62-> 46  Total head movement: 5+9+8+2+44+8+3+137+16=232 |

(iv) LOOK scheduling

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| LOOK  120-> 125-> 134-> 142-> 144-> 188-> 196-> 62-> 46  Total head movement: 5+9+8+2+44+8+134+16=226 |

Q9. Explain why Shortest-Seek-Time-First (SSTF) disk-scheduling algorithm tends to cause starvation problem. You may provide scenario to support your answer.

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| SSTF tends to favor middle cylinders over the innermost and outermost cylinders.  The center of the disk is the location having the smallest average distance to all other tracks. Thus, the disk head tends to move away from the edges of the disk. Here is another way to think of it. The current location of the head divides the cylinders into 2 groups. If the head is not in the center of the disk and a new request arrives, the new request is more likely to be the group that includes the center of the disk; thus, the head is more likely to move in that direction.  Suppose that we have two requests in the queue, for cylinder 14 and 186, and while the request from 14 is being served, a new request near 14 arrives. This new request will be serviced next, making the request at 186 wait. While this request is being serviced, another request close to 14 could arrive. In theory, a continual steam of requests near one another could cause the request for cylinder 186 to wait indefinitely. This scenario becomes increasing likely as the pending –request queue grows longer. |

**Self-Review**

Q1. A disk drive has 1000 cylinders, numbered 0-999. The driver is currently serving a request at cylinder **540** and the head previously serving a request at cylinder **610**. The queue of pending requests are shown in **Table 5** below:

**Table 5:** Queue of pending requests

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| Time (ms) | 13 | 20 | 32 | 40 | 44 | 52 | 60 |
| Cylinder | 600 | 350 | 320 | 800 | 830 | 770 | 630 |

By referring to **Table 5**, calculate the total head movements using the following disk seek strategies:

1. SCAN scheduling

**SCAN**

540 🡪 350 🡪 320 🡪 0 🡪 600 🡪 630 🡪 770 🡪 800 🡪 830

Total head movement = 190 + 30 + 320 + 600 + 30 + 140 + 30 + 30

= 1370

1. Shortest Seek Time First (SSTF) scheduling

540 🡪 600 🡪 630 🡪 770 🡪 800 🡪 830 🡪 350 🡪 320

Total head movement = 60 + 30 + 140 + 30 + 30 + 480 + 30 =800