Chapter-4
I/O Management (2Q) (1N/1T)

Q) I/O operation

Ans: Computers communicate with the external world via input/output.

→ Inputs are the signals or data received by the system and outputs are the signals or data ~~received by it~~ ~~sent by it~~ sent from it.

→ Keyboard/mouse is a input device for a computer, while monitors and printers are output device.

1111 Q) What are the different I/O techniques? Describe each in brief

or

What are the three different ways to do I/O?

or

Principle of I/O

Ans: The ~~different~~ three different techniques for I/O operation are:-

i) Programmed I/O

ii) Interrupt driven I/O

iii) Direct memory Access

1) Programmed I/O

Ans. The programmed I/O technique is one of the most simple type of I/O technique for the exchange of data or any types of communication between the processor and the external devices.

→ It is the simplest form of I/O where CPU does all of the work.

→ When the processor issues a command to the I/O module, it must wait until the I/O operation is complete.

→ In this method, the CPU continuously polls the device to see if it ready to accept another data or request data. This behaviour is often called polling or busy waiting.

→ In this method, the processor executes a program that gives it direct control of the I/O operation, including sensing device status, sending a read or write command, and transferring the data.

P.T.O →

with diagram

11 ⇒ Interrupt Driven I/O. (Asked twice as separate qus)

Ans: This technique is used to overcome the limitation of programmed I/O.

→ The CPU hardware has a wire called the interrupt-request line that the CPU senses after executing every instruction.

→ In interrupt driven I/O, instead of making the processor to verify the status of I/O module. It is the responsibility of I/O module to intimate the processor by interrupt signal.

→ When the CPU detects an interrupt signal, the CPU saves a state and jumps to the Interrupt Service Routine (ISR).

→ The interrupt handler determines the cause of the interrupt, performs the necessary processing, and executes a return from interrupt instruction to return the CPU to the execution state prior to the interrupt.

→ i.e. after completion of executing interrupt routine CPU returns to previous program and continue what it was doing before.

→ An interrupt or exception causes CPU to transfer the control temporarily from its current program to another program i.e interrupt handler.

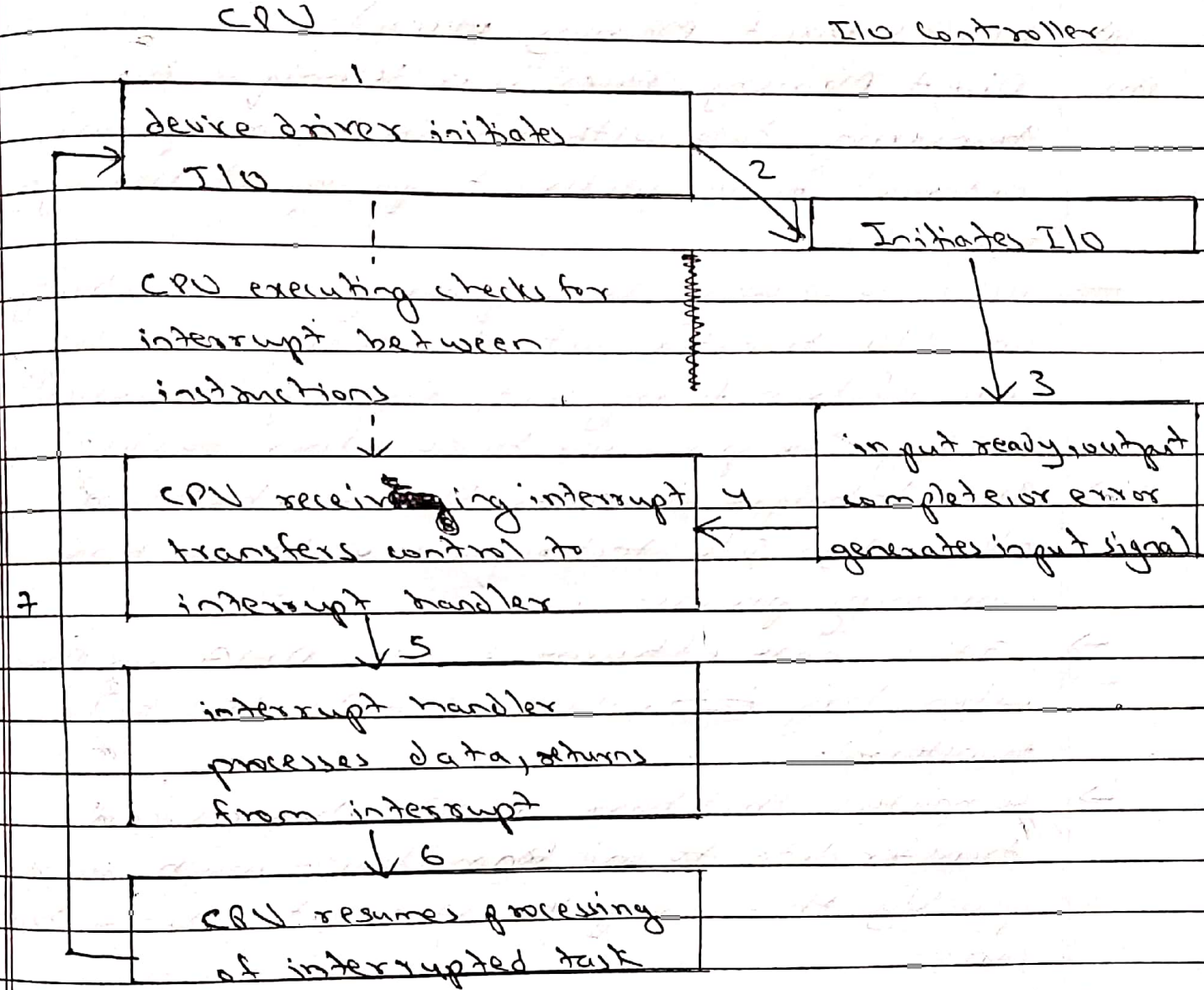

fig:- Interrupt driven I/O cycle

1111

Q) DMA (Direct Memory Access)

Ans: Direct Memory Access is a technique for transferring data within main memory and external device without passing it through the CPU.

→ DMA is a way to improve processor activity and I/O transfer rate by taking over the job of transferring data from processor, and letting the processor to do other tasks.

→ This technique overcomes the drawbacks of other two I/O techniques which are time consuming process.

→ It is more efficient to use DMA method when large ~~data~~ volume of data has to be transferred.

→ Computers that have DMA channels can transfer data to and from devices much more quickly than computers without a DMA channel can.

→ It is useful for making quick backups & for real time processing.

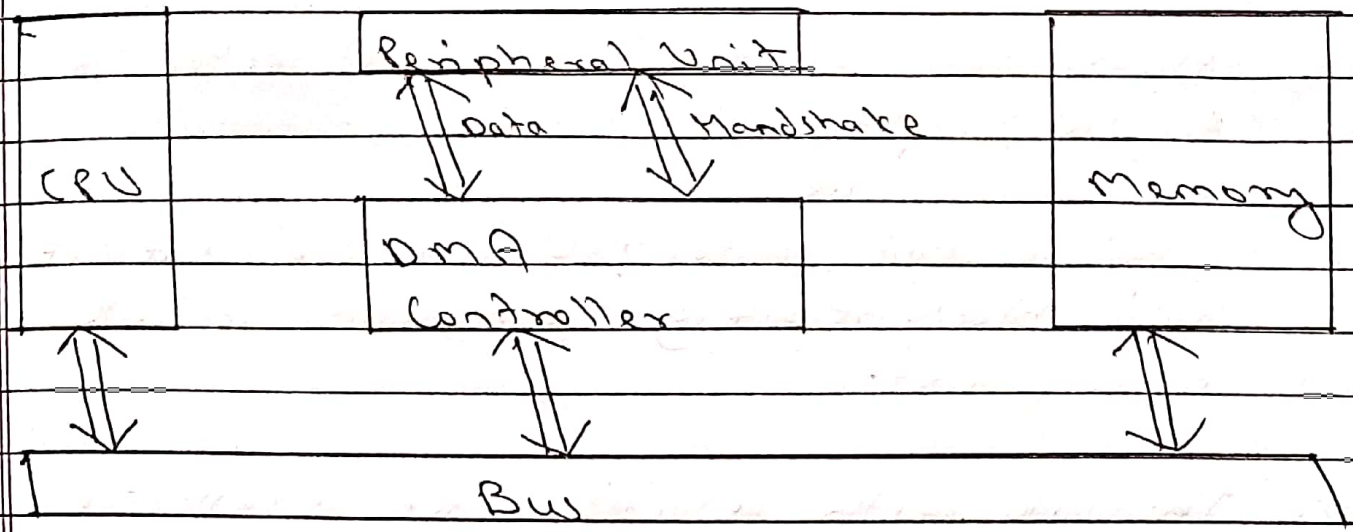

Fig: DMA Controller
Data Transfer

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Q.7) How does OS handle the bad sector in the disk? Explain.

or

What is bad sector? Describe the different bad block recovery mechanisms in disk management.

Ans. The disk with detected sector is called as bad block.

-> Depending on the disk and controller in use these blocks are handled in variety of ways.

- Method 1: "Handled Manually"
- Method 2: "sector sparing or forwarding"
- Method 3: "Sector slipping"

1) Method 1: "Handled Manually"

-> If block go bad during normal operation, a special program must be run manually to search the bad blocks and lock them away as before.

-> Data that resides on the bad blocks are usually lost.

1) Method 2: "Sector Sparing or forwarding"

-> The controller maintains a list of bad blocks on the disk.

-> Then the controller can be told to replace each

bad sector logically with one of the spare sectors.
→ This scheme is known as sector sparing or forwarding.

→ A typical bad-sector transaction might be as follows:-
⇒ The operating system tries to read logical block 7.
⇒ The controller calculates the ECC (Error correction code) and finds that the sector is bad.
⇒ It reports this finding to the operating system.
⇒ The next time that the system is rebooted, a special command is run to tell the controller to replace the bad sector with a spare.
⇒ After that, whenever a system requests logical block 7, the request is translated into the replacement sector's address by the controller.

(iii) Method 3: "sector slipping"
→ For an example, suppose that logical block 17 becomes defective, and the first available spare follows sector 202.
→ Then, sector slipping would remap all the sectors from 17 to 202, moving them all down one spot.
→ That is, sector 202 would be copied into the spare, then sector 201 into 202, and then 200 into 201, and so on, until sector 18 is copied into sector 19.
→ Slipping the sectors in this way frees up the space of sector 18, so sector 17 can be mapped to it.

solution for dynamic storage allocation

or

13) What are tertiary storage devices? Explain about any two such devices.

Ans: The main objective of the tertiary storage devices is to provide huge storage capacity at low cost.

→ Several types of tertiary storage devices are ~~floppy disks~~ magnetic disk, optical disk, optical tapes etc.

→ These storage devices are composed of fixed storage drives and removable media units.

→ They are also known as backup devices.

→ Some of the devices are explained below

i) Magnetic disk

→ A magnetic disk is a storage device that uses a magnetization process to read, write, rewrite and access data.

→ Hard disks, floppy disks, etc are common example of magnetic disk

→ The data in the magnetic disk is randomly accessed.

ii) Optical disk

→ An optical disk is any computer disk that uses optical storage techniques

→ It stores data digitally and uses laser beams to read and write data.

→ It uses the optical technology in which laser light is centered to the spinning tasks.

→ In the optical disk, the data is sequentially accessed.

→ The examples of optical disks are CDs, DVDs, etc.

iii) Optical tapes

→ Optical tape is a medium for optical storage generally consisting of a long and narrow strip of plastic on to which patterns can be written and from which the patterns can be read back.

→ Compared to disk, a tape is less expensive and holds more data.

→ In this random access is much slower.

→ Tape is an economical medium for purposes that do not require fast random access. e.g. backup copies of disk data, holding huge volumes of data.

1.a) Describe about stable storage implementation.

Ans: Information residing in stable storage is never lost.

-> To implement stable storage:-

i) We need to replicate the required information on multiple storage devices (usually disks) with independent failure modes.

ii) Update information in a controlled manner to ensure that we can recover the stable data after any failure during data transfer or recovery.

-> A disk write results in one of three outcomes

1) Successful completion -> the data were written correctly on disk

2) Partial failure -> a failure occurred in the midst of transfer, so only some of the sectors were written with the new data, and the sector being written during the failure may have been corrupted.

3) Total failure -> The failure occurred before the disk write started so the previous data values on the disk remain intact.

-> whenever a failure occurs during writing of a block, the system needs to detect it and invoke a recovery procedure to restore the block to a consistent state.

→ To do that, the system must maintain two physical blocks for each logical block.
→ An output operation is executed as follows:
i) Write the information onto the first physical block.
ii) When the first write completes successfully, write the same information onto the second physical block.
iii) Declare the operation complete only after the second write completes successfully.

→ During recovery from a failure each pair of physical blocks is examined.
→ If both are the same and no detectable error exists, then no further action is necessary.
→ If one block contains a detectable error then we replace its contents with the value of the other block.
→ If neither block contains a detectable error, but the blocks differ in content, then we replace the content of the first block with that of the second.
→ This recovery procedure ensures that a write to stable storage either succeeds completely or results in no change.

IIII 5) RAID

or

How data is maintained and managed using RAID technology? Is there any chance of losing data using it? Describe each of available model in details.

Ans: RAID stands for Redundant Array of Independent Disk.

→ Disk drivers have continued to get smaller and cheaper, so it is now economically feasible to attach a large number of disks to a computer system.

⇒ Having a large number of disks in a system presents opportunities for improving the rate at which data can be read or written, if the disks are operated in parallel.

→ Furthermore, this setup offers the potential for improving the reliability of data storage, because redundant information can be stored on multiple disks. Thus, failure of one disk doesn't lead to loss of data.

→ A variety of disk-organization techniques, collectively called redundant arrays of independent disks (RAID), are commonly used to address the performance and reliability issues.

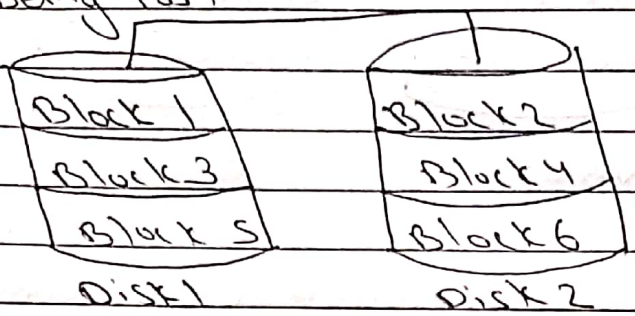
→ RAID levels are :-

1) RAID level 0

→ It splits data (file) into block of data.

→ It is easy to implement & offers great performance.

→ The failure of just one drive will result in all data in array being lost



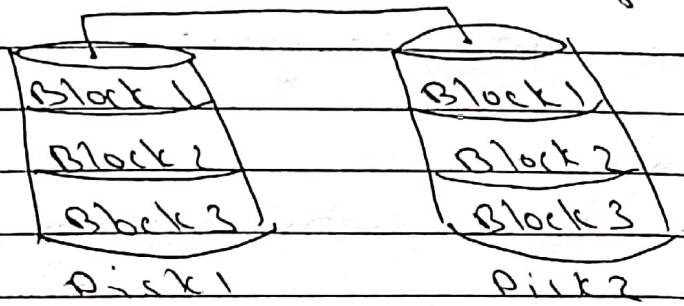
2) RAID level 1 - Mirroring

→ A complete file is stored in a single disk.

→ A second disk contains an exact copy of the file.

→ It is expensive

→ If one drive fails, data can be copied from replacement drive.



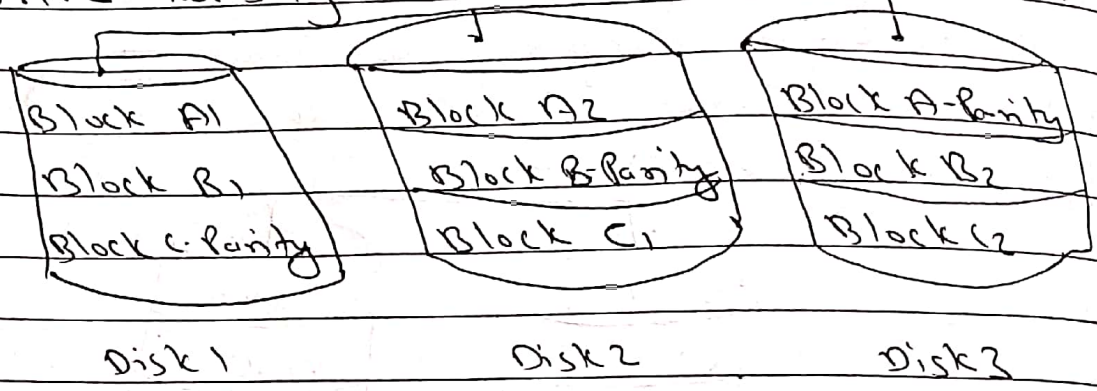
3) RAID level 5

→ This level is based on block-level stripping with parity.

→ The bottleneck can be eliminated in RAID level 5

→ Read data transactions are very fast while write data transactions are somewhat slower.

→ If a drive fails, you still have access to all data.



1 (c) Advantages & Disadvantages of Memory-Mapped I/O

Advantages

→ An I/O device driver can be written entirely in C

→ No special protection mechanism is needed to keep user process from performing I/O

→ Every instruction that can reference memory can also reference control register.

Disadvantages

→ Caching a device control register would be disastrous

→ All memory modules and all I/O devices must examine all memory references.