

Memory and data storage

Key definitions

Term	Definition
Musical instrument digital interface (MIDI)	This system is associated with the storage of music files. MIDI files consist of lists of commands which instruct a device how to produce a musical note/sound
MPEG-3 (MP3)	Uses audio compression to store music in an MP3 file format
MPEG-4 (MP4)	Can store multimedia rather than just music
Joint Photographic Experts Group (JPEG)	JPEG files use a LOSSY format file compression method. JPEG is used to store photographs as a reduced file size
Lossless	All the data from the original files are reconstructed when the file is again uncompressed
Lossy	Unnecessary data is eliminated forming a file that can't be reconstructed to get back to the original file
Primary memory	Includes RAM, DRAM, SRAM and ROM
Secondary storage	Includes hard disk drives, solid-state drives, and off-line storage (CDs, DVDs, DVD-RAM and blu-ray disks)

File formats

Musical instrument digital interface (MIDI)

This system is associated with the storage of music files. No sounds are stored (as in the case of MP3 and MP4); it is a form of communications protocol allowing musical instruments to interact. MIDI files consist of lists of commands which instruct a device how to produce a musical note/sound; for example: NOTE on/off or KEY PRESSURE, and so on. Also included would be a pitch byte and a velocity byte. The electronic instruments and computer both need MIDI interfaces to allow them to communicate.

Since MIDI files don't contain actual audio tracks, their size is relatively small. This makes them very suitable for storing sounds/music on devices with limited memory; for example, storing ring tones on a mobile phone.

MPEG-3 (MP3) and MPEG-4 (MP4) files

MP3 uses audio compression to store music in an MP3 file format. These can often be 90% smaller than comparable CD music files. They use a lossy format. The music quality is retained by using perceptual music shaping (i.e. removing sounds that the human ear can't clearly distinguish).

MP4 files are slightly different to MP3 files since they can store multimedia rather than just music (i.e. music, video, photos and animation).

Joint Photographic Experts Group (JPEG) files

JPEG files use a lossy format file compression method. JPEG is used to store photographs as a reduced file size. They rely on certain properties



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of the human eye (e.g. its inability to detect small brightness differences or colour hues).

Text and number file formats

Text is stored in ASCII format and text files are usually stored in a lossless format.

Numbers can be stored as real, integer, currency, and so on. Lossless format is used since accuracy of data is very important.

Lossless and lossy file formats

With lossless file compression, all the data from the original files is reconstructed when the file is again uncompressed.

With lossy file compression, unnecessary data is eliminated forming a file that can't be reconstructed to get back to the original file.



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Memory and storage

Primary memory

Primary memory refers to Random Access Memory (RAM) and Read Only Memory (ROM).

- RAM – this memory is volatile/temporary in nature.
It is used to store data, programs or parts of the operating system *currently* in use. The memory can be written to or read from.
RAM can be dynamic (DRAM) or static (SRAM). DRAM needs to be constantly refreshed to retain the data; it uses millions of transistors and capacitors. SRAM doesn't need to be constantly refreshed to retain its data; it uses flip flops.
- ROM – this memory is non-volatile/permanent in nature.
It is used to store the start-up procedures or BIOS (basic input/output system). The memory can only be read and not written to.

Hard disk drive (HDD)

Hard disk drives use circular platters coated in magnetic material. Several read–write heads are used so that all the surfaces can be accessed; data is stored in sectors and tracks in blocks.

Access to data is slower than with RAM. Many applications require the read–write heads to move in and out several times to seek the appropriate data blocks. This is referred to as latency – the time taken for a specific block of data on a track to rotate around to the read–write head.



Solid-state drives (SSD)

Solid-state drives have no moving parts; therefore all data is retrieved at the same rate and latency is not an issue. Most common types of SSD use NAND chips to control the movement of electrons (and therefore data). Some solid-state systems use EEPROMs (electronically erasable programmable read only memory) which utilise NOR chips.

There are a number of advantages in using SSDs when compared to HDDS:

- they are more reliable and robust (no moving parts)
- they are much lighter in weight and also much thinner
- they consume less power and also run much cooler
- no need to wait for SSD to ‘get up to speed’ and also have a faster data access rate.

Off-line storage

Off-line storage devices include: CD/DVD/ DVD-RAM (all optical), blu-ray disks (optical media), flash memory/memory stick/SD-XD cards (solid-state devices) and removable hard disk drives (magnetic media).

CD/DVD

CDs and DVDs use a red laser light to write and read the data. Each disk has a single spiral track that runs from the centre to the outer edge. They can be ‘-R’ (write once and can then only be read) or ‘- RW’ (can be written to and read from several times). DVDs can hold more data than CDs due to dual layering technology (i.e. the disks have two individual recording layers).

DVD-RAM



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This technology is nearly obsolescent. It uses a number of concentric tracks (unlike CDs and DVDs) enabling simultaneous read–write operations to take place. They have great longevity which makes them ideal for archiving of data.

Blu-ray disks

Blu-ray disks use blue laser light to read and write the data. Since the wavelength of blue light is 405 nm (compared to red light wavelength of 650 nm), they can store considerably more data. They use a single polycarbonate disk (unlike DVDs which use a sandwich of two polycarbonate disks); because of this, blu-ray disks don't suffer from birefringence (i.e. light refraction into two separate beams which can cause reading errors).

Flash memory/ memory sticks

These use solid-state technology and usually connect to the computer through the USB port. They are very small and lightweight which makes them ideal for transferring files and photos between different computers.

As with SSD, they use NAND chips and have no physical moving parts. They need to be read every now and then to retain their data integrity and it is important to follow the correct removal procedure to avoid corrupting the storage device.



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