Tiverton High School Year 11
J277 GCSE Computer Science
Knowledge Organiser / Recap
Part 3: Memory, Storage and Files

COMPUTING: IT >> DIGITAL-LITERACY >> COMPUTER SCIENCE

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Unit 1-2-1 Primary Storage (Main Memory)

Primary storage means **memory that is inside the main computer**. Primary storage usually includes some RAM and some ROM. Primary storage is used to store program instructions and data **for programs that are running**.

RAM means **Random Access Memory**. The contents of any memory location in RAM can be **examined** (read) and also **changed** (written). **RAM is volatile**. All data that was stored in RAM will be **lost** when the power is turned off to the computer. When you switch on the computer, RAM is totally empty.

ROM means **Read-Only Memory**. Instructions and data are **permanently** etched into the circuitry of a ROM chip. **ROM** is **non-volatile**. **The contents of ROM cannot be changed or erased**, they can only be examined. They are **read only**. Anything stored in ROM is **persistent**. The contents of ROM will be **kept**, even when the power is switched off.

RAM and ROM are both made up of **memory locations**. Each memory location can hold a certain number of binary digits. The **contents** of a memory location either hold a **data value** to be processed or a **program instruction** to be executed. Each memory location is given a unique **memory address** (a number) so that you don't confuse it with any other memory locations.

Before you can run a program, it must first be **loaded** into the computer's main memory (the RAM) from secondary storage (e.g. disk). The program instructions are usually copied from a file on a hard disk into a block of memory locations in RAM.

A computer has a limited amount of **physical RAM** to hold programs and data. A hard-disk drive has much more storage space than physical RAM. Data can be stored **temporarily** in a special file on a hard-disk drive to free up space as physical RAM becomes full. Temporarily using secondary storage space instead of physical RAM is called **virtual memory**.

Unit 1-2-2 Secondary Storage

Secondary storage devices are used for **long term storage** of data and instructions. We say that secondary storage is "**persistent**" or "**non-volatile**". Programs and data are stored in **files**. Files are stored **even when the computer is switched off**.

Magnetic Hard Disk Drive	A **high capacity** device that can often store as much as **8 TB** of data on one drive. Data is stored using tiny **magnetised** areas on a rapidly spinning metal disk. Magnetic hard-disks can be **damaged** accidentally by a **sudden impacts** or if it is dropped. Data can be **corrupted** or **erased** accidentally by **magnetic fields** from **speakers**, or **heat**.
Solid State Drive	An alternative to using a magnetic hard disk drive, but does not contain any moving parts. Data is stored using **tiny components** in **solid-state circuits** called **flash memory**. Solid-state drives are not affected by magnetic fields or extreme temperatures. They are very **lightweight** and **impact-proof**, making them ideal for use in laptops. They cannot hold quite as much data as magnetic disk drives and are **more expensive per GB**. Solid State Drives can sometimes start to **wear out** after data has been written to the same area a large number of times. Areas of the drive can then become **less reliable** for storing your data.
CD-ROM	A **removable optical disk** that stores data as tiny **pits**, burnt into the surface by a **laser beam**. A single CD-ROM usually stores up to **700 MB** of data. Highly **portable**, making it ideal for **backing up files** or **transferring data** to other computers. Very **cheap to manufacture**, making them ideal to **distribute software utilities** and **audio**. CDs are **not very durable**. One **scratch** can make individual files or the whole disk **unreadable**.
DVD-ROM	A **removable optical disk**, similar to a CD-ROM, but with a much larger storage capacity. A single DVD-ROM can store enough compressed data for a **whole feature-length movie**. It can usually store at least **4.7 GB** of data, although some types of DVD can store much more. Because a DVD can hold more data than a CD, they are used as **installation disks** for software.
Blu-ray	An **removable optical disk** that can store enough data for **several hours of HD video**.

Unit 1-2-3 Units of Data Storage

A **bit** is the **smallest** amount that a computer can store - one **binary digit**. **8-bit binary** means a **pattern** of exactly **8 binary-digits**. **8-bits** allow **256 possible combinations** between **00000000** and **11111111**. This is why 8 bits can represent between **0** and **255** in base ten.

1 byte	=	**8 bits** (an ASCII character takes 1 byte)
1 kilobyte	=	**1000 bytes**
1 megabyte	=	**1000 kilobytes** (or 1000 x 1000 bytes)
1 gigabyte	=	**1000 megabytes** (or 1000 x 1000 x 1000 bytes)
1 terabyte	=	**1000 gigabytes** (or 1000 x 1000 x 1000 x 1000 bytes)
1 petabyte	=	**1000 terabytes** (or 1000 x 1000 x 1000 x 1000 x 1000 bytes)

Unit 1-2-5 Data Storage: Compression and File Types

Music and video files can contain a lot of data. Large files and streams of data can take a long time to transfer over the Internet. If the file can be **compressed**, either by **reorganising** or **reducing the amount of data**, then it can be sent and received **faster**.

Compression re-organises data. Compressed files usually has a **smaller file size** than the original. It takes the computer **time** to compress the data – it's got to work out how to organise the data in a more **efficient** way. Before you can use the data again, the computer needs to **de-compress** the file, which also takes time. It must **re-organise the data** into a form that can be used easily.

Sometimes, parts of the original data are **removed** during compression. When the file is uncompressed again, some of the data will be **lost forever**. This is called **lossy compression**. The data that was removed can **never** be recovered again.

When compressing **executable programs** and **text documents** we need to use **loss-less compression**. Otherwise, if a program instruction was lost, **the program would not be the same**. The **meaning** of a text document could also be **changed**.

Text Documents

.txt	is an uncompressed **plain text document**. The text file contains only **unformatted text characters**.
.rtf	is an uncompressed **rich-text file**. The text file contains characters which can be **formatted** using **bold**, **italics**, **colour**, **font sizes** etc.
.pdf	is an Adobe **Portable Document Format** file. It can hold **rich-text**, **font definitions** and high-quality **vector diagrams**. Because the file contains the **font definitions** for each font face used it is **portable** - the document will look the same, regardless of the type of computer or phone being used. PDF files can also compress text and pictures to reduce the amount of data that they hold.

Images

.bmp	is an uncompressed **bitmap image** format used widely by Microsoft Windows programs.
.tif	is an uncompressed **high-quality bitmap image** that can contain **millions of colours**. TIFF file sizes can be very large as they often contain so much uncompressed data.
.jpg	is a bitmap image that uses **lossy compression**. JPEGs are used widely for **photographs** and can include **millions of colours**, making pictures very **realistic**.
.gif	is a compressed bitmap image that can only use up to **256 different colours**. This is only suitable for **simple graphics** and **animations**, or regions of **flat colour** that are all the same.
.png	is a **Portable Network Graphic**. This stores high-quality graphics using one or more separate layers.

Audio/Sound/Music

.wav	is an **uncompressed audio waveform**. These files are often very large, but result in high-quality audio.
.mp3	is an **audio file** that uses **lossy compression**. The MP3 file is usually approximately 10 times smaller than their original. The sound quality can be quite low.

Video/Movies

.avi	is an **uncompressed video file** used widely by Microsoft Windows programs.
.mp4	is a **compressed video file** that uses **lossy compression**.

Programs

.exe	is an uncompressed **executable program file**.