Digital Media 2

In Year 9 we covered the Digital Media area of graphics - static and some animated images. We are now going to examine and learn about the other areas, including audio, video, text and hypertext, as well as putting these all together to create useful presentations.

Characteristics of Digital Media
- represented as 1’s and 0’s in binary (or digital) code - text, images sound and video can all be represented as a series of digits
- can be copied and reproduced perfectly - every time you paste text or a graphic it is exactly like the original, every DVD has exactly the quality of the original. Analog videotapes for example degrade or have reduced quality every time they are copied, because they are not digital.

Digital Camera
There are two basic types of digital cameras, though these overlap somewhat, with the better quality cameras -
1. still cameras (some can take limited video)
2. video cameras (some can take still photos)

The digital still camera is one of the most remarkable instances of this shift to digitising data, because it is so truly different from its predecessor. Conventional cameras depend entirely on chemical and mechanical processes - you don't even need electricity to operate them. On the other hand, all digital cameras have a built-in computer, and all of them record images electronically.

The Digital approach has been enormously successful. Since film still provides better picture quality, digital cameras have not completely replaced conventional cameras. But, as digital imaging technology has improved, digital cameras have rapidly become more popular.

You need to directly sample the original light that bounces off your subject, immediately breaking that light pattern down into a series of pixel values. At its most basic level, this is all there is to a digital camera.

Just like a conventional camera, it has a series of lenses that focus light to create an image of a scene. But instead of focusing this light onto a piece of film, it focuses it onto a semiconductor device that records light electronically. A computer then breaks this electronic information down into digital data. All the fun and interesting features of digital cameras come as a direct result of this process.

Cool Facts
- With a 3-megapixel camera, you can take a higher-resolution picture than most monitors can
display.
• You can use your Web browser to view digital pictures taken using the JPEG format.
• The first consumer-oriented digital cameras were sold by Kodak and Apple in 1994.
• In 1998, Sony inadvertently sold more than 700,000 camcorders with limited ability to see through clothes.

Instead of film, a digital camera has a sensor that converts light into electrical charges.

The image sensor employed by most digital cameras is a **charge coupled device** (CCD). Some cameras use **complementary metal oxide semiconductor** (CMOS) technology instead. Both CCD and CMOS image sensors convert light into electrons. A simplified way to think about these sensors is to think of a 2-D array of thousands or millions of tiny solar cells.

Once the sensor converts the light into electrons, it reads the value (accumulated charge) of each cell in the image.

The amount of detail that the camera can capture is called the **resolution**, and it is measured in pixels. The more pixels a camera has, the more detail it can capture and the larger pictures can be without becoming blurry or "grainy."

Some typical resolutions include:

- **256x256** - Found on very cheap cameras, this resolution is so low that the picture quality is almost always unacceptable. This is 65,000 total pixels.
- **640x480** - This is the low end on "real" cameras. This resolution is ideal for e-mailing pictures or posting pictures on a Web site.
- **1216x912** - This is a "megapixel" image size -1,109,000 total pixels -good for printing pictures.
- **1600x1200** - With almost 2 million total pixels, this is "high resolution."
- **2240x1680** - Found on 4 megapixel cameras - the current standard.
- **4064x2704** - A top-of-the-line digital camera with 11.1 megapixels takes pictures at this resolution.

The overall quality of the images taken is determined by both the resolution of the camera and the degree of compression used when storing the image. Compression uses an algorithm to reduce the size of the image - see details later in this topic.

**Exercise 1**

Read the passage above about the digital still camera (from Howstuffworks.com) and find the terms in the passage to match the descriptions in the table and write them in.
The Purpose of Digital Media

Digital media can of course be used in a variety of forms for a huge range of tasks, so we will be looking at its use under a few headings -

1. **E-music** is simply digitised music such as MP3 or that recorded onto CD’s. What makes e-music different is that it can be downloaded from the internet - thus threatening the sellers of music CD’s - for the very big market they previously had to themselves. Because the MP3 format is digital, the quality remains high no matter how many times it is copied and the compression of the files means that downloads are quite quick and many songs may easily be fitted onto a hard drive (or MP3 player).

A number of websites, like Napster used to provide free access to thousands of songs - until copyright infringement court battles stopped the free downloading of what was considered ‘pirated’ e-music. New sites like i-Tunes Music Store now provide users with the chance to download and pay for songs and albums legally, and this has led to price reductions in popular CD selling prices as a result.

**NOTE** -MP3 is from MPEG layer 3 - a standard of the Motion Pictures Expert Group, and is the usual format for downloaded music from the internet, since they are compressed and download quickly.

2. **Digital Newspaper**

Many Australian newspapers (as well as overseas ones) have digital versions of their paper online. Since journalists already type their stories in on computers, the text is all digital and pictures are either digital or can be scanned in, the effort to produce a digital newspaper is quite small - and stories can be updated regularly through the day if needed.

As well, animations, sounds and videos can be added to this digital version to add further detail to stories. Readers are also able to browse the news in ways that are different to flicking through conventional newspapers, and in fact, some allow the reader to ‘create your own newspaper’ - to include only the parts you would normally look at.
Thus the ability to see a summary of the major news items, the ability to refer back to previous stories (on the same or similar topic) and get sound and video at times are some of the main advantages of digital newspapers.

3. Interactive TV
This is television where the viewer gets to interact or communicate back through some type of interface to the program. On some pay TV sports shows, for example, the viewer can select the camera angle to view the game, or maybe to choose from a range of possible outcomes for some drama. Already doctors have assisted in operations taking place thousands of kilometres away, switching cameras and aiding inexperienced doctors with life saving surgery.

Digital TV may allow a wide range of future options including pressing buttons on your remote to actually take part a contestant in quiz shows - without having to travel to the TV studio. ‘Survivor’, ‘Mole’ and ‘Dancing with the ...’ type programs could have an immediate vote from the audience. Indeed ITV could allow voting to take place from home for elections of the future, viewers could also do things like choose options in movies or ‘soaps’ and have different outcomes.

4. Games
Since the computer game industry makes huge profits, many of the advances in digital media have their beginnings in games. Nintendo, Sony, Sega and Microsoft (Xbox) needed faster and smaller hardware and more involved software - some of which found its way into other digital devices or services.

In only 20 years, games have gone from arcades to personal computers and hand held game devices, with fast moving animations, sounds and music. Simulations for other purposes, e.g. military, have gained a great deal from interactive games technology.

Digital media is used in two basic ways for games -
• offline in say games machines not connected to any network e.g. Sony Playstation CD,DVD
• online in games where the internet allows players from a wide area to compete against each other in MUDs (multi-user domains).

5. E-commerce
This is basically digital business over the internet. This could range from -
• buying a book at Amazon.com, to
• booking a restaurant for dinner tonight,
• selecting and booking a holiday to Queensland,
• finding a house to buy or rent, or
• transferring money at your bank.
Exercise 2

Investigate each of the following sites and make brief notes on what you can do or find:

1. Amazon.com
2. Realestate.com.au
3. Apple.com/iTunes/Music
4. smh.com.au (Sydney Morning Herald site)

Questions

(i) Define the term ‘interactive’ as used with computer games, TV or newspapers.
(ii) Discuss reasons why digital newspapers have not replaced some or all of the printed versions of newspapers.
(iii) Why do most people download MP3 files rather than other music formats?
(iv) Have you used or seen interactive TV? If so for what purpose? If not, what would you like to be able to do with iTV?
(v) Games may be divided into a number of categories such as action, sports, arcade and multiplayer. Name TWO computer games you play and give their category and a description of what you have to do to play well.

To be completed by - ..........................................................

Types of Digital Media Products

Examples of digital media products are to be found all around us, including:
- stored on CDs, DVDs, hard disks, etc.
- transmitted over the internet
- add-ons or plug-ins such as Flash player

Some such products handle only one type of digital media - termed single task. Others handle more than one type of digital media - termed multiple task. Many of these have great influences on our lives, at school, at work and at home.

DESKTOP PUBLISHING

DTP is an often used application for the production of newspapers, magazines and all kinds of brochures. The software combines text, hypertext, graphics and other media in flexible forms to produce attractive documents. While they will generally all be printed, they may also be saved as screen displays for electronic use by web browsers.
As opposed to just word processed documents, DTP generally has features like typeface, body text, captions and column layouts worked out and master pages designed so that text and graphics may be imported and positioned with text wrap and other features built into the software.

Examples of DTP programs include - PageMaker, Publisher and QuarkXPress.

**Exercise 3**

1. Open the file **DTP** from the ForStudents file (in the StaffFolder)
2. Plan a single page 2 column document (in either AppleWorks WP or Word) which will contain all of the text and one appropriate graphic - filling the single page.
3. Include a footer with your name and the date in it, along with a caption on the chosen picture, a drop cap, and a selected font to match the content for a teenage audience.

Carefully check your document, then print it out. Due by ..........................................................

**GRAPHICAL DESIGN**

We covered Graphics back in Year 9 and we should all remember the power of images to communicate a great deal to the viewer - from charts and graphs which clearly display trends, to emotive pictures which can add humour, sadness, happiness, etc. to text at a single glance.

We should all remember the old saying - “A picture is worth a thousand words”.

Graphics are of 2 main types -
- **Paint** type - bitmapped graphics made up of pixels - for logos, coloured illustrations, etc. with sources from scanned photographs, digital pictures, clip art, etc. Artists use software such as Photoshop and Painter to produce or enhance or modify graphics.
- **Draw** type - vector graphics as objects and line drawings, used for diagrams, plans, etc. which are very accurate, may be resized with no loss of clarity and make only small files

**Exercise 4**

1. Select a team sport played at Westfields Sports from the list below - you will be completing a number of exercises based around your choice so choose wisely.

<table>
<thead>
<tr>
<th>List</th>
<th>baseball</th>
<th>basketball</th>
<th>cricket</th>
<th>golf</th>
<th>rowing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hockey</td>
<td>lawn bowls</td>
<td>netball</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>rugby league</td>
<td>rugby union</td>
<td>soccer</td>
<td>softball</td>
<td></td>
</tr>
<tr>
<td></td>
<td>swimming</td>
<td>tennis</td>
<td>volleyball</td>
<td>water polo</td>
<td></td>
</tr>
</tbody>
</table>

*Westfields Sports Information and Software Technology J. Smith 2006*
Complete the following table -

<table>
<thead>
<tr>
<th>Logo</th>
<th>Organisation Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

2. Plan and design a pencil drawing for a suitable Logo for that team (1 cm - 8 cm size)

*Put your finished product in a display folder to be handed in.*

3. Produce your logo on the computer (AppleWorks Draw and/or Paint) - this needs to work in the 1 cm up to 8 cm size range since you will be using the logo for a number of purposes. You will need to design both colour (on screen) and black and white (printed) versions. Colour versions to be marked on screen.

Print out a single page containing versions -
- 1 cm black and white
- 8 cm black and white

*Put your finished product in a display folder to be handed in.*

4. Plan the team letterhead (see examples) which will contain the logo (1 cm size).

Complete your letterhead in AppleWorks word processor, check it and print it out.

*Put your finished product in a display folder to be handed in.*

**Question** - what functions does a logo perform for an organisation?

Display folder to be handed in by - .........................................................
**AUDIO SEQUENCES**

Audio includes sounds from the spoken word (as in voice over) through to background music, sound effects and songs. Audio sequences are the handling of digital sounds as a continuous series of sounds or as a waveform.

Audio is a sometimes undervalued part of digital media, in that makers sometimes forget the powerful emotions that our sense of hearing can create. Enhancing a presentation with the right background music, building up to a critical part of a video or sound effects to highlight a special point, are all likely with correct planning and execution.

Since a lot of computer speakers are of lower quality (compared to stereo ones) sound engineers have to select music or alter music to not exceed the distortion limits of these speakers. Most audio is captured from analog data - such as a bird’s song, a person singing or a guitar playing. Sounds are actually vibrations (waves of varying pressure) in the air - with varying frequency and amplitude.

**Frequency** is also termed pitch -

- is the number of complete waves passing a fixed point per a second
- higher pitched sounds move faster than lower pitched ones and have a closer waveform
- is measured in hertz

**Amplitude** is -

- volume of sound, the taller the waveform, the louder the sound

Microphones, sound cards, mixers and amplifiers are often used to produce digital sound from the natural analog sound.

**MUSICAL COMPOSITIONS**

CDs were the first media to hold digital audio (from 1982), but musical compositions were and still are made in the MIDI format (musical instrument digital interface). This is good for music, with small file size and no recorded sounds, but cannot be used for speech. Instead, it uses codes based on certain instruments and can vary the pitch and duration of each note e.g. MIDI keyboards allow piano, organ and a range of other instruments to be played. The quality of MIDI sounds depends on the quality of samples stored on the sound card wave table and the quality of the speakers producing the sound.

Digital music compositions can be in waveform (WAV), audio interchange file format (AIFF), MP3, CD audio or MIDI formats.
**Exercise 5**

1. Open the program **GarageBand** (available in your dock)
2. Select Create New Song
3. Select New (File Menu)
4. Click on the Loop Browser (see diagram next page)

- click on Rock/Blues and Piano
- click and drag 70's Ballad Piano 05 to the Timeline and drag out to around 10 seconds
- click and drag 70's Ballad Piano 04 and place next to previous and drag out to 6 seconds
- click on Relaxed and add a series of Delicate piano parts (e.g. 3, 4 and 5) to end up with a good sounding background of 30 to 40 seconds
5. Click on Select New Track (Track menu) and add another instrument to your piano background e.g. Drums, Guitars, etc.

6. Your finishing point will depend on your musical skills

7. Open your song in iTunes

Animation has extended from the first cartoons, through many of the Disney movies, up to the present mixed real action and animation.

**2-D animations** are of two basic types, both based on frames -

1. **Cel animation** creates total frames with background and moving images (termed sprites), so that each frame has its background and sprite(s). This is illustrated below -
2. **Path-based animation** is created by setting a path for the sprite to follow from a starting point to a finishing point across the background (which is only changed when needed).

Using this method the animator or editor can make decisions on how to create or change an image based on the previous image in the sequence.

In traditional cartoon animation, the individual frames of a movie were initially drawn on paper over a light source. The animators (mostly inbetweeners) would put the previous and next drawings exactly beneath the working drawing, so that they could draw the 'inbetween' to give a smooth motion.

In computer software, this effect is achieved by making frames (semi) transparent and projecting them on top of each other.

The cel is an important innovation to traditional animation, as it allows some parts of each frame to be repeated from frame to frame, thus saving labour. A simple example would be a scene with two characters on screen, one of which is talking and the other standing silently. Since the latter character is not moving, it can be displayed in this scene using only one drawing, on one cel, while multiple drawings on multiple cels will be used to animate the speaking character.

3D animation, as used in movies such as Toy Story, creates the whole animation on a potenti
computer using specialised software to produce the full digitised animation.

**Exercise 6**

1. Open the program Flash (available on your dock)
2. Collect your computer numbers set of instructions for Using Flash - Flash MX For Beginners
3. There are 5 lessons to complete - you need to read carefully and follow these exactly.

To be completed for viewing by - .................................................................

**VIDEO PRODUCTION**

Video and animation have final products which look similar, but video is captured as a continuous flow of images rather than a set of still images run together. Digital video cameras are quite affordable these days and the software to edit them is generally straightforward, so many families have video histories of each member from birth throughout childhood and beyond. Dubbing, adding captions and adjusting colours, brightness, etc., are sometimes skills used to edit video.

At amateur level software like iMovie, and Studio, are easy to use, while professionals use Premiere, and Final Cut Pro require some time to master. The computing power needed to move the huge amounts of data around to edit video is much greater than almost all other applications - with megabytes having to be moved each second.

Since only the most powerful computers (and graphics cards) can manage this, other techniques have had to be used to cope, including:
- reducing the number of colours to be displayed (to thousands or even 256)
- reducing the size of the screen the video plays on (to half or quarter screen)
- slowing the rate at which the frames are displayed (from 25 to say 20 per second)
- compressing the data by averaging backgrounds, etc.

**Exercise 7 Making a Video Clip**

1. Choose a song (no longer than 3 minutes) you can bring to school on an original CD (not a copy)
2. Plan (using a storyboard) a video clip with a number of still pictures and up to 30 seconds of video for your song, plus titles, credits and references for all components
3. Download some suitable video - open this in the program iMovie (available on your dock) and edit it down to **30 seconds maximum**
4. You need to display text, audio, graphics and video in your clip
Data Storage

When we are creating a file, be it text, audio or video for example, the data is held in the computer memory (the RAM or primary memory) and if the power suddenly fails, all of the data will be lost unless it has been saved to a secondary storage device.

The computer is able to store the data (which exists as ON and OFF pulses of electricity within the computer chips and wires) in several different ways -

<table>
<thead>
<tr>
<th>COMPUTER</th>
<th>SECONDARY STORAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric pulses</td>
<td>Magnetic (hard and floppy disks)</td>
</tr>
<tr>
<td>(1’s and 0’s)</td>
<td>Optical (CD’s and DVD’s)</td>
</tr>
</tbody>
</table>

Secondary storage is divided into two basic types, determined by the access we have to the data -
1. Sequential access - the slower form, where all the data is searched through from the start of the file to locate the required data - as on a tape.

2. Direct access - the faster form, where the required data is located directly, without having to go through the whole file or series of files - as on a CD.

Data Types for Digital Media Products

When we use a digital recording device - such as a digital still camera, we are able to save and store the data in a range of formats. The choice of these will be determined by such things as - the type of display method to be used (on screen, published to the Web, printout, etc.), the type of computer being used (Mac, IBM, etc.) the software to edit it, and others.

Examples include -
• TEXT and NUMBERS - ASCII, which allows 128 symbols to be coded, including the alphabet.
• AUDIO - MIDI, which completely describes musical notes as a code.

**Note** - file sizes will vary between formats (sometimes greatly) as formats have been created for sometimes different purposes and some are much older or suited to a particular device type of even brand. 

**Exercise 8  File Formats**

[1] To do -
(i) open AppleWorks word processor page and turn the page side on (landscape view)
(ii) create a wide table on the page - with 5 columns and 7 rows
(iii) put the 5 headings (above) in the columns and bold them 
(iv) use the internet, books, etc. to work out which column to put the file format names into from the following list (alphabetically).

LIST -  
AIFF  ASCII  Animated GIF  AVI
BMP  DOC  EPS  Flash
GIF  HTML  JPEG  MIDI
MPEG  MP3  PDF  RTF  PICT  TIFF
Quicktime  Real audio  WAV  WMP

(v) your table needs to have all 22 terms and the letters also expanded to their full form 
e.g. GIF and graphic interchange format
(vi) add your name and the date as a footer on the page 

To be printed out and handed in by - .................................................................

[2] To do - as a group of 4 -6 students
1. choose a full page of just text from a book and scan it on the flatbed scanner 
2. save the page as - (i) TIFF 
   (ii) JPEG 
3. using the OCR program OmniPage scan the page and save the page as a word processing document (AppleWorks or Word) 
4. open the word processing document and do a Save As, saving it as a PDF file 

You now have 4 files containing exactly the same information but with different ways of representing the text. Make a table - headed - File Name, File Format, File Size and Comments so you can compare and comment on all differences.
Manipulation Techniques
When a range of data is in digital form, it is able to be manipulated using a range of techniques to give interesting and sometimes unexpected effects and results.

1. Text Manipulation - the usual cut, copy, paste, drag-and-drop as well as typeface (font type), text size, line spacing and spell check are all easily done with a word processor, and more specialised software can give more extensive manipulation features. Some programs allow speaking text for the disabled.

2. Graphical manipulation - draw and paint programs provide a huge range of tools and techniques to manipulate images. These include things like - cropping, distorting, rendering, morphing and tweening.

Exercise 9 Image Manipulation

[1] To do -
1. Make a table in AppleWorks - 3 columns and 10 rows - with column headings Term, Meaning and How to Do This.

2. Type the following into the Terms column - Crop, Distort, Lasso, Fill, Tween, Warp, Panorama. - then research and complete the other two columns.

[2] Using selected software, complete as many of the above techniques as possible. Show an original image (on the left side of the page and the manipulated one next to it (labelled to show the effect).

3. Audio manipulation - is incredibly varied and generally simple to do, depending on the software - from echoes, fade-ins and fade-outs to pitch and tempo changes. Hopefully you experienced a range of these in Exercise 4.

Varying the sampling rate (how many times per second the sound is checked on - up to 44100
times per second) or the **bit rate** (8, 16 or 24 commonly) will have a major effect on the quality of the sound.

**Exercise 10**

To do -
1. open the program Powerpoint from your dock
2. plan a presentation entitled Audio Manipulation - using a simple story board
3. produce your presentation remembering the various media available to you within this program.

To be completed for viewing by - .................................................................

**4. Video** manipulation - is made up of the amazing special effects - for the professional through to the home amateur. These include manipulations from transitions between clips, to all kinds of effects, adding sounds and titles.

**5. Animation** manipulation - since animation is an illusion caused by fooling the eye, the two types of animation can be manipulated to smooth out the motion and the rate of frame movement increased to get rid of some jerky parts. Addition of small things - like shadows and their direction, dust from moving feet, etc. can make cartoon or 3D animation more realistic. Morphing, warping and inbetweening are important aspects for the modern animator - hopefully you completed some of this in Exercise 5.

**Exercise 11**

To do -
1. View the 30 minute excerpt from the movie SIMONE.
2. Research and name 3 examples of movies and 3 of TV adds where special effects have been particularly effective in your opinion, and state why they are so effective.
3. Discuss the possibility of actors selling their image and/or voice in a one-time deal, and the movie-makers using these as they wish to produce future movies without live actors at all. What are the good points and the possible problems if this became the standard way of movie
making?

4. If only digital actors were needed to make adds and movies, what range of effects would this have on the entertainment industry (variety, costs, etc.)?

   To be completed by - ...........................................................

**Exercise 12**

To do -

1. Using the digital still camera, each class member will have their picture taken and the file placed into their folder.

2. Using the internet, research the following techniques - so that you have notes on -
   • where these are used
   • what they do, as well as
   • diagram(s) to explain each term (using your photo where appropriate)

   (i) Cropping
   (ii) Rendering
   (iii) Time coding
   (iv) Sampling
   (v) Morphing
   (vi) Tweening

   You are to choose the presentation technique, including - paper printout, Powerpoint, Flash animation, etc.

   To be completed by - ...........................................................

**The Digitising Process**

As previously stated, digitising is the process of changing analog data into a digital form. This is performed in a number of different ways, often depending on the nature of the media involved. We have already scanned some text and pictures and digitised your image, and now we will examine some other techniques -

1. **Frame Grabbing**
   This is literally the grabbing of frames from continuous analog data - such as some images from a video or some bars of music from a song.

   Video cameras use video-capture (frame grabber) cards to grab up to 30 frames per second (one frame at a time) and these are then displayed rapidly to give the illusion of smooth motion. The higher the number of frames grabbed - usually between 20 and 30 per second, the better the digitised output will be. The higher the frame rate though, the higher the storage space required.
Once stored in the computer, the frames can be manipulated, with the order or even the content of the frames being altered.

**Exercise 13**

To do - using the strobe light we will do the following -

[A] Alter the speed of the ceiling fans (without touching the controls)
1. What range of speeds do the fans appear to be operating at?
2. How is this effect actually working?

[B] Alter the motion of a class member walking
3. What effects does the lighting have on your view of the person?
4. Why did the really early movies look a bit like this?
5. What are the minimum and maximum frame rates for normal human movement?

[C] Place an object down on the desk (pen top, rubber, pen, etc.,) preferably in a definite colour and different to the desk colour. Stare down at the object for 20 seconds. Remove the object and stare at the spot where the object was.
6. What happens when you look at the vacant spot on the desk?
7. Explain why this happens and what this means for movie-makers.

To be completed by - ...........................................................

2. **Bitmapping**

Bitmaps are literally maps of the state of the pixels in the computer memory. Each pixel may be ON as indicated by a 1 or OFF as indicated by a 0, or it can be represented in varying shades of colour (up to over 16 million colours)

```
0 1 1 1 1 1 1 1 1 1 1 1 1 1 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
0 0 0 0 1 0 0 0 0
```

When the pixel is monochrome (black or white) only one bit is needed to store its state - that is it is either on or off. It is stored with a **bit depth of 2** - 2 to the power of 1 (two alternatives)

If there are 4 possible colours (say red, green, blue and yellow) then it is stored with a **bit depth**
of 4 - 2 to the power of 2 (four alternatives).

With 256 possible colours it would be stored with a **bit depth of 8** - 2 to the power of 8 (256 alternatives).

3. **Optical Character Recognition**
As we have seen in Ex 8, OCR software allows us to scan in text and use it in a word processor to manipulate it. That means that it translates optically scanned bitmaps of hand written or printed text into codes to stand for each character. It achieves this by comparing each individual character to the character images it has stored and tries to match them by pattern recognition e.g. The letters in -

\[
\text{Pattern} \quad \text{Pattern} \quad \text{Pattern}
\]

would all be compared to the images within the program to obtain the best match.

**Note** - hand written text is much harder to translate than typed text.

**Factors Affecting File Size**
Because most digital media products will require fast access storage of files (both primary and secondary storage), and fast processing of files which contain a range of high resolution media types, the files are often very large.

1. **Memory Size**
The storage of files is done on two levels -
- **RAM or Primary memory** - is the space to hold the data while the computer is manipulating the media files.
- **Secondary memory** - is the storage medium used to save the media files for future use, such as hard disks, CD’s and DVD’s.

Most multimedia computers would have a minimum of 1 gigabyte (1024 megabytes) of RAM, and hard drive space of at least 100 gigabytes.
Backup and archiving is done onto
- CD’s (smaller files up to 700 megabytes) and
- DVD’s (files up to 4.7 gigabytes)

2. **Processing Speed**
Not only do these large files need to be stored, they need to be processed quickly so that they can be displayed at the rate to give smooth video, but they need to be located on the secondary storage and accessed at a very fast rate - generally around one millisecond.

If the computer is not able to handle this huge amount of processing quickly then the multimedia being presented will simply not flow. One way of reducing the problem is to **compress** the files -
since a hard drive is able to read a compressed file faster than an uncompressed one. Compression is now a standard part of the operating system of the computer.

### File Size Reduction

Depending on the file type (graphic, video, etc.) there are a number of ways to reduce the size of a file - but many methods result in a loss of quality. Methods include:

- **Graphic**
  - lowering the resolution of the image - less dots per inch,
  - using less palette (e.g. millions to thousands) or limiting the

- **Video**
  - all of those above, and

- **Audio**
  - reducing the sampling rate (sound samples taken per second)
  - changing to mono instead of stereo
  - not recording all of the frequencies (see MP3 below)

### 3. Colour Palette

The colour palette is the number of colours the bit depth allows to be displayed. As more colours are used, so the size of the file increases, as shown by a simple graphic - where:

- a black and white image will use 1 bit
- a colour image will use from 3 bits to 8 bits (256 colour palette)
- up to 24 bit colour with over 16 million colours in the palette

Obviously reducing the colour palette will lower the file size.

### 4. Compression

This is the process of reducing the physical size of data in files, with decompression being the conversion process back to the original form for retrieval of the data. A number of standard file formats have compression inbuilt such as JPEG and MPEG.

Compression generally works by a codec or coder - decoder program (especially for audio and video). Different codes use different algorithms to carry out compression and decompression, with the better ones able to work with the computer hardware at decompression time to increase the speed.

Compression actually works due to the redundancy or repetition of a lot of the data - which can be eliminated. This redundant data can easily be seen if we look at a photograph, where the background is generally large areas of the same or similar colour and texture. Therefore all file types can be compressed to some extent - text, audio, images and video. An example would be a video file of 15 MB compressed to 150 KB.
There are two methods of compressing data - lossy and lossless.

<table>
<thead>
<tr>
<th>Lossy</th>
<th>Lossless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some data (tones in a picture) is discarded during compression and so is lost</td>
<td>Repeated codes are coded into a summary and uncodes as the original</td>
</tr>
<tr>
<td>Used for images, sound and video where lost data is not as noticeable</td>
<td>Used for text files where no data can be lost</td>
</tr>
<tr>
<td>File may be reduced to 5% of original</td>
<td>File may be reduced to 30% of original</td>
</tr>
</tbody>
</table>

**Lossy compression** is seen in -

- JPEG graphics, where different levels of compression are allowed. Here the similar pixel colours are combined and the user determines the level of similarity. No decompression is performed since the data removed is not saved in the compressed version, this being used mainly for photographs and medical imaging.

- MP3 sound files achieve compression by removing the frequencies that the human ear cannot detect (thus the lost data is not really noticeable).

- MPEG also uses a method where each new scene has a main frame stored complete, with only the image sections that change from frame to frame being stored. Thus only each scene change needs to be stored intact along with the often small changes in pixels for quite a number of frames - thus allowing up 200:1 reduction in file size and 95% less storage space being common. This method can also be used for sound compression, with only differences between successive sound samples being recorded.

**Note** - sometimes when a DVD movie plays up you see the decompression failing as the picture pixelates and becomes blocky on the screen.

**5. Audio Sampling Rates**

Like image and video files, audio files can become very large - e.g. a 4 minute song on a CD can be 40 megabytes in size. The rate at which the sound is sampled is one of the variables for the file size.

For audio there are 3 factors which determine the file size -

- the sampling rate - which are measured in kilohertz (kHz), with the common ones being 11, 22 and 44.1 kHz

- the bit rate - which is normally either 8, 16 or 24

- the number of channels used - one for Mono, 2 for Stereo 4 for Quad sound.
6. Frames per Second

Animation and video both use frame rates, measured in frames per second to deliver the motion to the screen. Hundreds or even thousands of frames are needed even for simple animations and these must be displayed at a rate to give the impression of natural motion. The larger the number of frames per second the better the quality of video display, but the file size grows enormously. For example, a single frame in 24 bit colour takes about 1 MB of storage, which means that the 30 frames per second equates to -

\[
30 \text{ MB} \times 60 \text{ for each minute} = 1800 \text{ frames}
\]

For 1 minute of video = 2.4 GB

Exercise 14

To do -

1. Produce TWO media presentations using exactly the same material and content, with text and numbers being least important compared to the other media forms.

2. For ONE of these use the best quality available (resolution, frame rate, sample rate, etc.)

3. For the OTHER use the lowest quality available (resolution, frame rate, sample rate, etc.)

Print out a comparison the two presentations, based on -

(i) quality of display
(ii) file size of each
(iii) which parts had the least difference
(iv) which parts had the most difference
(v) a conclusion as to the quality versus the file size for each of the displays of the same material

To be completed by - ...................................................................
Display and Distribution

Display refers to the presentation of digital media. Distribution is the sharing of digital media with others.

The method of display will vary depending on the form of the media itself and often on the audience and where they will be viewing the display. For example, a school class may best see a display via a media projector, whereas for a whole nation, distribution of a CD or using the internet may be more effective. Considerations like age, interests and technology experience will be critical to the effectiveness of a multimedia display.

- Hard copy - a printout on paper will be suitable for charts or graphs, photographs.
- Soft copy or electronically displayed - for animations, audio and videos.

As communication technologies progress it may be that everybody will soon be carrying a device which performs the functions of - phone, message centre, entertainment centre (TV, Music, etc.) computer, internet, etc. and multimedia will mostly go through this one device.

Media for Distribution

The media currently used to distribute multimedia includes -

- CD’s - hold around 700 MB and commonly used for audio
- DVD’s - hold around 4.7GB and commonly used for video
- Floppy disks - hold 1.4 MB and commonly used for text and small graphics
- Hard disks - hold 20 to 400 GB and used for most media types (limited video)
- Internet - unlimited capacity, global and cheap to distribute via downloads but copyright an issue

Exercise 15

To do -
The following terms are used with the distribution of media, define each one and briefly describe their use in the distribution of multimedia - as a multimedia display (with text, audio and animation - at least)
1. Streaming
2. Buffering
3. Webcasting
4. Caching

To be completed by - .................................................................

Factors Influencing Electronic Display and Distribution

- Resolution - high resolution displays give better quality by using a larger number of pixels or sounds. If the resolution is increased at display time, the result may be distortion of the media,
while lowering the resolution lowers the download time for the media, but also reduces its quality.

- **Bandwidth** - is the amount of data (in bps) that can be transmitted. Baseband is where only one signal transmits at a time. Broadband is where several channels can be transmitted at once.

- **Hardware** - the processors and amount of RAM are important to the user, so digital media products should have these clearly indicated.

- **Availability** - of programs or executable players are essential to users for using the media. For example, to display a Powerpoint presentation, Powerpoint player is needed.

**Exercise 16**

**Final Project -**
1. Select your favourite **sporting team** (e.g. Wests Tigers, Swans, Swifts, etc.) OR

your favourite **sporting event** (2006 Commonwealth Games, World Cup Soccer, etc.)

2. Draw up (in pencil on paper) a storyboard design for a multimedia presentation to display the highlights of the current season (and maybe some past glories) for the team or the event you have selected. Put this into a display folder for handing in.

3. Locate a range of resources and record them in your folder as a bibliography.

4. Produce a well designed multimedia presentation using Powerpoint (or other program if negotiated with your teacher) of at least 30 screens and including text, numbers, graphics, audio and video.

5. Make a list of the characteristics or good points of a really good presentation, print out and add to your folder - you will be using this to rate several other presentations.

   To be completed by - ...............................................................

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