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COMMON ASSESSMENT TASK

Level 1 Digital Technologies 2021

91887 Demonstrate understanding of compression coding for a chosen media type

Credits: Three

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of compression coding for a chosen media type.	Demonstrate in-depth understanding of compression coding for a chosen media type.	Demonstrate comprehensive understanding of compression coding for a chosen media type.

Type your School Code and 9-digit National Student Number (NSN) into the space below. (If your NSN has 10 digits, omit the leading zero.) It should look like "123-123456789-91886".

Make sure that you have the scenario page.

Answer ALL parts of the assessment task in this document.

You should aim to write **800–1500 words** in total.

Your answers should be presented in 12pt Times New Roman font, within the expanding text boxes, and may include only information you produce during this assessment session. Internet access is not permitted.

Save your finished work as a PDF file as instructed by your teacher.

By saving your work at the end of the examination, you are declaring that this work is your own. NZQA may sample your work to ensure this is the case.

Excellence

TOTAL   **07**

ASSESSOR'S USE ONLY

Instructions

The task in this assessment requires you to discuss compression methods for one media type (image, video, or audio) with reference to the scenario provided.

Read the scenario and all parts of the task before you begin.

All your answers must be based on the same media type.

Scenario (specify "A" or "B"):

B

Chosen media type (specify "image", "video", or "audio"):

Image

Assessment Task

(a)   Explain the reasons why files of your chosen media type might be compressed.

Compressed images have many advantages. Common compressed images include png and jpg. File compression is used to reduce file size. As cameras take better quality photos, more data needs to be stored. Cameras commonly store files on SD cards. These SD cards have limited space and can fill up quickly preventing any new photos from being stored. One solution to this is to use file compression. This would allow more photos to be stored on the same SD card. JPG files can take up 5% of the room of the same photo in raw format. This means you could store 20x as many photos before needing to upload them to another device or delete them. The same logic applies to file space on servers. Servers only have so much storage, and depending on the configuration it can be costly to increase or upgrade the limit. Compressing archived files can ensure there is plenty of space on the server and save the school money.

Compressed images also load faster. As the file size of a compressed image is much, much smaller, the loading times for websites can be greatly decreased. Internet speed is measured in megabytes per second. If someone's internet has a 4 megabyte per second download speed, it would take them 10seconds to download a 40 megabyte uncompressed image. This time can be reduced to fractions of a second if the file size is reduced through compression. The problem can be particularly evident for image galleries(eg the schools facebook page). As there are so many images it could be impractical to wait minutes in this day and age for the file to load. Often internet usage is capped. By reducing the file size it allows the user to download more images without reaching their cap, allowing more people to view the photos :)

(b)   (i)   Explain how files of your chosen media type can be represented using bits in an **uncompressed** form.

Images can be expressed in uncompressed form using a bitmap(bmp). Images are broken up into pixels, the smallest amount of detail in an image. A bitmap is an array, where each cell corresponds to a pixel. In this way, 1 bit is used to store the value of 1 pixel. A bit is the smallest piece of data a computer can store. A bit is either 0 or 1(or low and high). For example the array below could correspond to the image below. Each 0 corresponds to a white square, each black corresponds to a 1. The number of rows and columns in the array can be scaled up or down as needed(e.g. to change the file size). This image size data is stored in the metadata of the image. If this format was used in real life, the integer 1000010100100101 would be used to represent the image below of a very pixelated minecraft sword:

Bitmap:

1	0	0	0
0	1	0	1
0	0	1	0
0	1	0	1

Image:
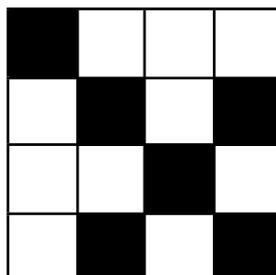
This method isn't particularly useful in real life, as most images contain colour(or at least varying levels of grey(grescale)). To fix this, rather than have 1 bit per pixel, we can use 3 bytes(1 byte per red, green and blue). 1 byte is 8 bits. If 0 is a bit, 01001111 is a byte. As a byte can be converted to its decimal equivalent, a bite can be used as a scale from 0 to 255 of how much a specific colour there is, 00000000(0) being none of that colour, and 11111111(255) being the max amount of that colour. Digital displays use the primary colours red green and blue to display colour. Varying the amount of each colour can be used to make other colours. If all bytes are 00000000, there is no colour in the image making black. If all bytes are 11111111, all colours are at their highest making white. The table below shows some common colours:

Red	11111111 00000000 00000000	Turquoise	00000000 11111111 11111111
Green	00000000 11111111 00000000	Purple	00001111 00000000 11111111
Blue	00000000 00000000 11111111	Magenta	11111111 00000000 11111111
Yellow	11111111 11111111 00000000	Orange	11111111 00001111 00000000

Using both the bitmap and 3 bytes per pixel, you can code for a 24 bit colour image. Where each cell in the array contains 3 bytes of colour data. For example here is a very simple pattern:

Array of pixels:

11111111 00000000 00000000	00001111 00000000 11111111	11111111 00000000 11111111
00001111 00000000 11111111	11111111 00000000 11111111	11111111 00000000 00000000
11111111 00000000 11111111	11111111 00000000 00000000	00001111 00000000 11111111

Image
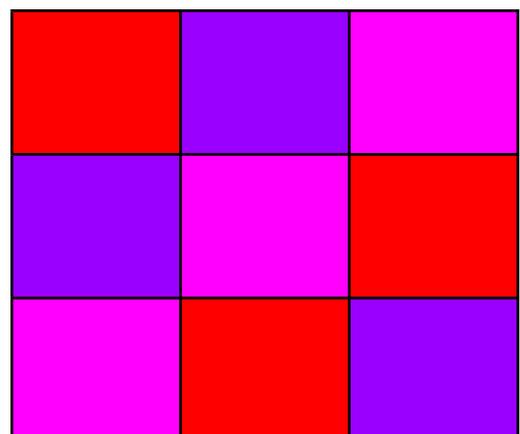
As the amount of data in an image increases, so does the file size. By looking at the difference between the black and white bitmap and the colour image it is clear that it is not always best to store images uncompressed, as the file size can get very large.

(ii)   Explain how a method of **lossless compression** works for files of your chosen media type.

A common form of lossless compression used is run length encoding. Run length encoding was commonly used for fax machines that sent black and white images. Run length encoding works by combining a 'run' of the same colour into a single integer saying how many of that pixel there is. What colour the pixel pixel is alternates between white and black however many times are needed to fill the row, starting with the number of white pixels. For example 3,2,4 would correspond to a row with 3 white pixels, then 2 black pixels and them 4 white pixels. So that image has a total of 9 pixels per row. The example below shows how the number 6 could be encoded using run length encoding.

The pixels tha make up 6:   Run Length encoding equivalent:

	1,3,1
	0,1,4
	0,1,4
	0,4,1
	0,1,3,1
	0,1,3,1
	1.3.1

The first row is 1, 3, 1, as there is 1 white pixel at the start of the row, then 3 black pixels, then 1 white pixel.

The original 6 could be recreated exactly how it is in the image. That is the benefit of lossless compression. It reduces file size while not sacrificing quality.

This method of lossless compression has fallen out of widespread use as run length encoding does not work as well as other lossless compression methods, especially when dealing with colour and images that contain a lot of detail or noise.

(c) (i) Referring to the scenario, select one of the required outputs for your chosen media type where a **lossy compression method** would be appropriate, and:

- explain why this method would be more suitable for the output than another compression method

- explain how this method would affect the output from the end user's perspective.

Lossy compression would be suited for images in the schools online newsletter, specifically jpegs. A jpeg image has many advantages over uncompressed images and lossless compressed images. Jpegs(or lossy compression in general) have the smallest file size when it comes to compression. As lossless compression needs to retain all detail, the file size is inevitably larger. Jpegs are able to remove data that might not have been noticed anyway and significantly reduce the file size. Any artifacts that are noticeable don't matter as it is a newsletter, a link to a full size losslessly compressed image could be provided under the image. As the file size is smaller, it would decrease the loading time for the school's newsletter. As the newsletter needs to be stored on the reader's device while they are reading it, the file size does matter as many people have a small amount of storage, especially on mobile phones.

A less superior method of displaying the image could be a png file. Png files are losslessly compressed. This reduces the file size compared to raw files, but is still significantly worse than jpegs. A png file would retain all detail in the image, but this is unnecessary as people aren't reading the newsletter for the photo quality. If they need a higher quality photo they could contact the head of the school's media team(me).

Jpegs are designed to significantly reduce file size(high compression ratio) while retaining an image that looks to the viewer the same as the original. But this isn't always the case. Jpeg works by grouping pixels together and either making them the same colour(if they are similar enough) or reducing the colour depth. This may make the image appear less colourful and possibly blurry. Jpeg artifacts can occur when the compression algorithm does a bad job at compressing the image. This can leave large splotches on the image, making it almost unrecognizable. If artifacts occur when producing the newsletter, the image can simply be recompressed using a larger compression ratio.

(ii) Referring to the scenario, select one of the required outputs for your chosen media type where a **lossless compression method** would be appropriate, and explain why it would be more suitable than another method.

Lossless compression would be best suited for the A3 prints of the images. As the image is being printed, file size is not an ongoing concern, the physical image does not take up anyspace. As the selection of images could easily fit on a thumb drive, images don't take up alot of space compared to other file types. As the media team head I would edit and only select the best images to go for printing to ensure there aren't too many images to fit on the drive. Lossless compression also retains all data. This is important when dealing with prints, especially when the image has been scaled up to A3.

Jpegs would be unsuitable for stirring files before printing. As file size is no concern, there is no benefit to a jpeg. When printed, jpeg artifacts become especially visible. People are able to look closer at the image than they normally could. The upscaling of the image would only increase the impact of the artifacts. As the prints will be on display, colour depth is important. As the colour depth is reduced with jpegs, they are again unsuitable.

(iii)   Referring to the scenario, select one of the required outputs for your chosen media type where an **uncompressed storage method** would be appropriate, and explain why it would be more suitable than another method.

Copies to be stored on the school network archive could be stored using a raw format. The school's network contains a large amount of available storage. This means the large file size of raw files is able to be stored. To save raw files, I must have shot in Raw. This provides many advantages as Raw files are less sensitive to errors in focus as other file types are. This means beginner photographers are able to worry less about the focus as it is more forgiving. Raw files are very versatile as they can be saved to any format. As they contain all detail captured by the camera sensor, any format needed can be created. If someone in the future wanted to use the photos for another purpose(e.g. an advertisement for the school), the image in the highest quality is available for them to work with. The images could also be edited to match the brightness and colour levels as other photos. Other formats do not allow this.

There would be marginal benefit to storing images on the school archive in a lossless compression format like png. The filesize of pngs are smaller, but as the school has many large drives on the server this isn't a huge problem at the moment. PNG files are more widely supported than Raw files, raw files require specialist software to view and edit. But as this is the archive, only people who know what they are doing will be there to use the photos, and they should have the software to edit the raw. PNG files could not be edited to match the colour of other pictures. This makes them less suitable for using for any other purpose other than keeping a record of the event.

Excellence Exemplar 2021

Subject	Level 1 Digital Technologies		Standard	91887	Total score	07
Q	**Grade score**	**Annotation**				
1	M7	The candidate has demonstrated a deep understanding of why compression is important in the real world, giving well-explained examples. Their in-depth explanation of how bits are used to represent images includes clear examples using both 1- and 24-bit depth colour. The explanation of a lossless compression method shows a good understanding of how Run Length Encoding works, although more could have been written about the limitations of this method. Appropriate outputs were selected for each compression type, and the candidate has justified their choices in a real-world context. They have contrasted the effectiveness of the compression method against other methods, and clearly explained the benefits or limitations of each. Some confusion about how JPEG works was evident, but this has not detracted from the overall demonstration of their understanding.				