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COMMON ASSESSMENT TASK

Level 1 Digital Technologies, 2019

91887 Demonstrate understanding of compression coding for a chosen media type

Credits: Three

Achievement Criteria		
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 header at the top of this page. (If your NSN has 10 digits, omit the leading zero.)

Make sure that you have the scenario page.

Answer all parts of the assessment task in this document.

Your answer should be presented in 12pt Arial font, within the expanding text boxes, and may only include information you produce during this examination session.

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

Save your finished work as a PDF file with the file name used in the header at the top of this page ("SchoolCode-YourNSN-91887.pdf").

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 that this is the case.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

**Excellence
08**

INSTRUCTIONS

The assessment task in this document relates to compression methods for ONE media type (audio, image or video).

The separate scenario page includes two options for you to choose from.

Read the scenario page and the assessment task before you begin. **All your answers must be based on the same media type** from your chosen option.

Type the scenario (A, B or C) in the space below:

C

Type your chosen option from the scenario (audio compression, image compression or video compression) in the space below:

Image
Compression

Begin your answers on page 3.

ASSESSMENT TASK

(a)   Explain in detail and justify the format(s) you use for your chosen scenario. Common recording formats include:

        for audio: WAV, MP3, AIFF, WMA

        for image: RAW and JPEG

        for video: 1080p, MP4, AVI, WMV.

For the chosen scenario of being the head student of the school's media team, I will be setting the team of student's cameras on RAW. This is because RAW is the pure image of the moment shot, presented exactly as how the camera sees the scenario. As we are not reporters who'd try avoid manipulation of their photography, the photography having such potential in editing allows us more freedom to suit the various outputs required.

Since I'm the head of the school student-media team, I have had some decent experience in editing and will likely produce a significantly more visually appealing photograph than the pre-set algorithms on the DSLRs (Digital Single Lens Reflex). It allows me to avoid inconsistencies as the algorithm may be different on every camera depending on the model and brand. With the JPG shooting with 2 colour filters to detect the exact light intensity of photons when shutter is pressed (0-255) and guessing the intensity of the other 2 colours (RGB), RAW will produce a more accurate representation of this event.

Having the DSLR set in RAW will also shoot in HDR. The RAW photograph can be later edited into a JPEG, therefore I would prefer working with something which has a little more versatility than only taking the photograph. So that I can edit the photos with a bit of personality integrated in it. I can then make every image look appealing to the audience on the magazine, newsletter, Website/Facebook and A3 posters with careful editing. Also, shooting in RAW is more forgiving for minor focusing issues as not all the students will have very good photography skills since some photographers may be just starting out in this field.

RAW does take more storage than JPG and means that each student photographer is able to take relatively less photographs compared to if they take them in JPEG. However, as storage is now cheaper with 128GB being $125 (when photography first began, it costed the same price without adjustment for inflation), it is less of an issue nowadays. If in the odd case that the camera SD card does risk of filling up, it teaches the student photographers to be more thoughtful of when they take a picture. Ensuring higher quality in every photograph instead of simply taking a picture of everything they see around them. This therefore produces an overall higher quality in the images and attracts relatively more audience for taking the image in RAW.

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

In uncompressed form, the images can be represented in pixels. Each pixel has 3 bytes, each dedicating to a colour, red/green/blue, of the sRGB (Standard Red Green Blue) spectrum. Every colour has 256 different levels of brightness (0-255). 1 bit has 2 combinations, 2 bits has 4 combinations, 4 bits have 16 combinations, therefore 8 bits has 256 combinations (16^2). With the 3 levels of brightness mixed, there is now a total combination of 256^3=16,777,216 different colours for every pixel. Roughly equal to 16.7 million. The colours: red, green, and blue are mixed to form all the different colours on the spectrum.

Red + Green + Blue	Black
Red + Green	Yellow
Green + Blue	Purple
None	White

Each byte contains 2 nibbles, each consisting of 4 bits. This means that for every pixel, there are 4*2*3=24 bits (6 nibbles) which combine to form the 16.7 million different colours on the sRGB spectrum. 16.7 million is not the total number of colours, however if we go past that into something such as the Adobe RGB, those colours outside sRGB cannot be displayed on a normal monitor which most of us have.

For example, if a certain photograph shot at the school's Wearable Arts evening by one of the students with a DSLR and completely fills up a typical 1920 by 1080 display without enlargement or artefacts, there are a total of 2,073,600 pixels in the photograph. From now knowing that each pixel consists of 24 bits, the calculation can be made that there are a total of 24*2,073,600=49,766,400 bits in that particular photograph. Reaching a total combination of colours of $16,777,216^{2,073,600}$ possible combinations of colours, this number is pretty much infinite.

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

The image files might be compressed because space is a scarce resource, meaning it is not unlimited. Storage costs money, so we generally aim to reduce the storage size required as much as possible without losing the quality of the original image through compression. Although this is less of a problem nowadays with 128GB costing the same amount as 128MB from when photography was first popular ($125), it saves everyone a bit of money. Eventually leading to a big saving on money spent on storage through Earth's population. If the compression method is compressing to 50% of original size, this is equal to giving consumers 50% off storage space.

On top of this, compressing a file also significantly increases the transmission speed for downloading and uploading images. It would be very frustrating for me as the head of school student media team if it takes ages to simply download a photograph from the student photographers to my desktop from the shared drive on school's network (where student photographers have uploaded to from the DSLRs). It would also be stressful for the student photographers waiting to go home because the photographs they took are taking a very long time to upload to the school shared drive. Even company stocks will fall from the reduction of users if compression began to fade away. This is as no one would want to wait 5 minutes for an E-mail attachment to finally open or to load a website. The general public will begin finding other alternatives for these and business will fall.

Lossless is the compression method where the original image quality is not lost at all. Through the process of compression, the image will have no difference on the end-user's perspective after decompression (it is identical to the original). This is usually the type of compression used for high quality photographs and is stored in a format such as PNG.

Lossy compression generally compresses to a smaller file which can be transmitted (downloaded/uploaded) at a faster speed. Some of the information, however, will be forever lost during this process when an original copy is not kept. It reduces the brightness of the photograph or even colours which the human eye cannot perceive. Therefore, if the image uses a well-built lossy compressed method such as JPEG, the user will not be able to detect much if any difference in the quality of the image, while also transmitting at a faster rate/taking up less storage. JPEG generally can fit twice the number of PNG files in the same amount of storage, transmitting twice as fast, and 5 times when comparing to BMP (Bitmap).

(d)   Explain how lossy file compression can affect media quality from an end-user's perspective.

From the end-user's perspective, lossy file compression can sometimes cause decrease in quality from the original photograph. Although lossy compression attempts to reduce storage taken/faster transmission speed by taking away components which the human eye cannot perceive, it may cause a difference in quality and artefacts to appear.

However, it should not have much of a difference on the end-user's perspective if the lossy compression method is well developed (JPEG). JPEG is the most commonly used lossy compression method nowadays. High JPEP usually leads to no difference in the end-user's perspective and at most a little. End-users will be likely to see a difference in low JPEG as the file is significantly compressed. They will still be able to clearly understand the photograph, it is the experience that is affected.

Human eyes perceive what we expect to see. When a JPEG file is split into 8*8 squares, we don't observe the photograph as being split up as we do not expect it to be split (only if under high enough resolution, and it does not have to be very high). JPEG cannot be enlarged even on high JPEG and it will be very noticeable to the human eye with artefacts after enlargement.

We don't perceive brightness very well, so a reasonable decrease in the brightness of an image will not be noticeable as it is out of the brightness range we can detect (most lossy part of JPEG compression). We can roughly perceive 1 million shades of colour with our human eye. Any colours outside that range can be reduced for compression without us noticing any difference (especially colours outside the sRGB spectrum).

(e)   Referring to your chosen option for the scenario, select ONE of the required outputs and type it in the space below:

> Photographs for the school's website and Facebook page, including a gallery page with thumbnail links to full-size images

For this output, identify an appropriate type of compression method (either lossy or lossless), and then:

  explain why you would use lossless or lossy compression, outlining the advantages and disadvantages of compression for the output using this method

  justify your decision, explaining why your chosen compression method would be the most appropriate

  give examples of appropriate file types for the compression method.

> This output requires both thumbnails and full-sized images (the school's website is counted as full sized images). For the thumbnail, I would choose lossy compression as the appropriate method of compression, saving it as JPEG. Since the thumbnail is small, human eyes cannot perceive very well the lost parts of images during compression. This means that there will be no difference for the end-users to be looking at a regular full sized PNG photograph or a much more compressed JPEG version of it. Using lossy compression in this scenario is especially useful in this scenario as it reduces the amount of space taken significantly on the gallery page, and most importantly increases the load speed of the gallery webpage. Assuming there are a lot of images in the gallery page, all the increased speed by having every photograph thumbnail in JPEG rather than PNG will be game changing.
>
> JPEG works by first converting RGB to YC_bC_r (Brightness, Colour blue, Colour red). The brightness of the image is first toned down. DCT then takes place right before quantization, which reduces unnecessary brightness the human eye cannot perceive. Quantization is also the most lossy part in the entire process. Depending on the amount of compression, there can be a lot or relatively not as much space saved in this step (differentiating between high JPEG and low JPEG). Then, entropy coding occurs with RLE (Run Length Encoding and Huffman coding working in zig zag format. RLE works by counting the repeated pixels and expressing them as a frequency value. Instead of red, red, red, green, green, Blue it will be expressed as 3 red, 2 green, 1 blue. This can sometimes cause the file to become bigger, but is unlikely, especially with Huffman coding being used after it to fully compress the file into JPEG.
>
> For the full-sized images on the school's website, Facebook page, and thumbnail linking to it in the gallery page, I would instead choose lossless compression as my suitable compression method. This is because lossy compressed images can easily have visible lowered quality of the photograph and lead to artefacts. This will likely bring a bad impression onto the school and especially this event (Wearable Arts evening) to the end-users. Complaints will be filed to me and also bringing a bad reputation to me as I am the head of school student-media team, being in charge of the overall photography of this school event. Therefore, I will use lossless compression and save it as PNG files for the high quality, full-sized images. It will likely attract more end-users to the site and bring an overall much more enjoyable experience for them.
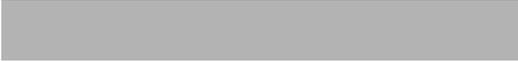
PNG is compressed with the use of DEFLATE. This works first by using LZ77 and then Huffman coding to complete this lossless compression. A colour dictionary to store the meaning and image compressed into a string of code during LZ77. Huffman coding then combines the 2 combinations with the lowest frequency, repeats, then forms a tree diagram. This method stops being efficient after 24 branches, but it is extremely unlikely to reach that amount if not impossible. With 2 compression methods being combined to form a PNG file, it is still going to be significantly reduced in size / very much faster transmission when comparing to the original file (although not as reduced in size as JPEG is) while not losing any resolution or quality.

If the images are needed to be printed by end-users, it can easily be temporarily turned into TIFF format to be printed in CYMK (Cyan Yellow Magenta Black). The TIFF file can be deleted right after.

Excellence Exemplar 2019

Subject	Digital Technologies		Standard	91887	Overall grade	08
Q	**Grade**		**Annotation**			
		The candidate chosen an appropriate compression format for their selected scenario. They justified their decisions and supported these by including comparisons to other file types. They showed understanding of how uncompressed data could be represented using bits, using detailed examples. Their explanation of why files captured in their chosen media type might be compressed showed a clear understanding of the technical aspects of compression. They included reference to file types, file size, end users and technical considerations. The candidate's explanation of lossy compression was detailed, showing a good understanding of the technical process involved and how this affected end-user perceptions. The candidate chose appropriate file type(s) for their selected output scenario and justified their decisions. They explained the advantages and disadvantages of potential file types that could be used, taking into account end-user requirements and technical limitations.				