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EXCELLENCE EXEMPLAR 2022

1



NEW ZEALAND QUALIFICATIONS AUTHORITY
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COMMON ASSESSMENT TASK

Level 1 Digital Technologies 2022

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 “123-123456789-91887”.

The task in this assessment is in **FOUR** parts.

Answer parts (a), (b), and (c), and then choose **ONE** of parts (d), (e), or (f).

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** 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 assessment, you are declaring that this work is your own. NZQA may sample your work to ensure this is the case.

Instructions

The assessment task requires you to discuss compression methods for one or more media types (image, video, or audio).

You must answer parts (a), (b), and (c).

Choose only ONE of parts (d), (e), or (f) on lossless compression:

- (d) Huffman coding
- (e) Run-length encoding
- (f) LZW.

You may copy and paste (snip and / or screengrab) relevant information from the following resources to support your answers.

Read all parts of the assessment task before you begin.

Resource A: Images



Fig. 1

Resource B: Audio



Fig. 2

Resource C: Video



Fig. 3

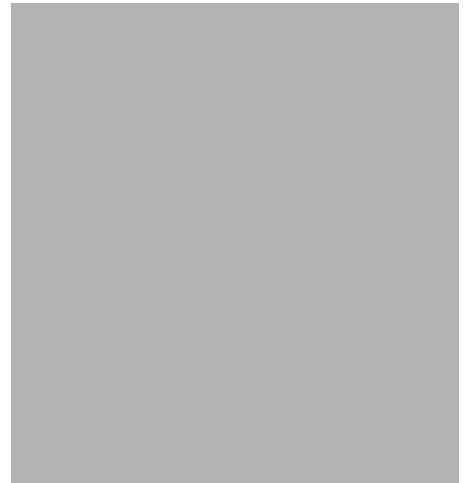


Fig. 4

Acknowledgements

Material from the following sources has been adapted for use in this assessment:

<https://helpx.adobe.com/photoshop/key-concepts/compression.html>

<https://boomspeaker.com/320kbps-vs-flac/>

<https://aws.amazon.com/blogs/media/part-1-back-to-basics-gops-explained/>

Assessment Task

- (a) Referring to ONE media type (image, video, or audio), explain the reasons why files of this media type might be compressed.

Media type: Image.

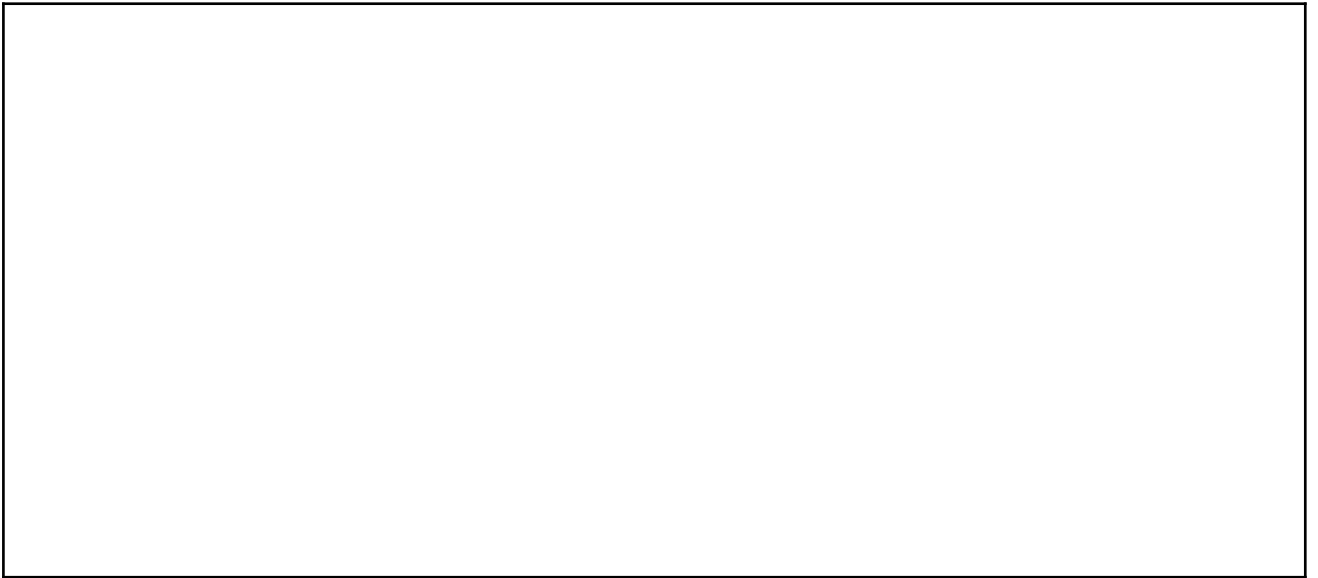
Images are compressed for a number of reasons. Raw images are the exact raw data captured from a camera and as such the image is close to exactly the same as you would see in real life. A raw image requires a lot of storage on a disk, or drive to be retained in a computer because the amount of data required to represent the worlds colours is quite heavy. We compress image files to save on storage. Compressing images can be done multiple ways and they allow us to vastly increase the number of images that can be stored on our devices. Another reason to compress an image is to save on the amount of time required for an image to load on a website. Large images that require a lot of storage have long download times, which can put a strain on a users internet connection and prevent an image from loading on a users screen when visiting a website. We compress the image such that internet connection is not strained by images loading, and so that they load quickly on to a user's screen. An example of why image compression is important is fax machines. Without the use of compression it is said that fax machines would take 7 times longer to copy, send, and print images, which need to be sent at higher speeds to optimise businesses.

- (b) Give examples of times when you have used either lossy or lossless compression. Why was it appropriate to use this compression method in these cases?

Most phones including my phones are set to take images and compress them into a lossy, JPG format. The reason this is done is to prevent high amounts of storage being taken up by images which would severely decrease the limit to how many images I can save to my phone. Although most phones have around 30 - 60gb of internal storage, my phone personally has over 1500 images saved to it, if they were not compressed I would not be able to save nearly as many images as I currently have.

Another example is when me and my friends send memes to each other, usually in the form of GIFs, which is a lossy compression image format used for small images where quality is certainly not the most important factor, and short animations. Memes are sent frequently these days, a huge form of pop culture and without the use of compression techniques, sending each other funny memes would not be worth it, as the upload speeds at which the memes are sent from one person to another would be so slow everyone would loose interest.

Sometimes for art, or business (class), or fundraising projects in school I am told to make an A3 poster to advertise products to sell, to make money. When choosing an image format to use to print on A3 I would immediately use a TIF file, which is a lossless form of image compression that is better used for professional printing. While I am not technically 'professional' the whole idea of the business course is to learn how to be 'professional' which would imply the use of professional techniques like printing in TIF. Printing in TIF allows us compress the image, saving on storage while not loosing any of the image data. If I were to use a lossy compression on an A3 sized paper I would worry that artifacts from the compression would be super visible, and detract from my product. I would not at all want people to be turned away from a delicious hot dog, brownie or muffin because the picture looks strange, like a deformed finger, or feces. The use of lossless compression ensures that my product looks like how it would in real life, attracting customers to my sales stand.



SCenARIO: Sharing school photos

You are the head of your school's digital media team and have taken photos, video, and audio of the kapa haka group's latest performance. Because your school is small and in a rural area, internet access can be patchy. The principal would like to share the recordings with whānau and the community.

There are two options available to the principal:

- Emailing the files as attachments and / or
- Storing them on the school's server and emailing a link to download them.

- (c) Consider the scenario above. You may also include snips from Resources A, B, and C on pages 2 and 3.

Select ONE of the media types (photos, video, or audio) and recommend an option to the principal. Refer to the scenario in your recommendation. You may select the same media type as you discussed in part (a).

Media type: Image

- (i) What would be the most appropriate compression method for the scenario?

Lossy compression - Jpeg

Also I would store them on the schools server, and email a link to download them.

- (ii) Explain why this method would be more suitable than another compression method. Justify your choice by comparing and contrasting it with another compression method.

Lossy compression in the form of JPEG would be far more suitable for a rural area with a weaker internet access. Since lossy techniques reduce file size far more than lossless compression, the time required to download images from the internet or an email will be reduced significantly. While lossless compression is a valid and very useful form of compression it simply does not do as much compression as lossy. These are not going to be professional grade images for the whole world to see, just a small amount of people in a distant rural area.

What needs to be considered is their physical situation: If the area is truly rural it would imply not a large majority of people would be there, families would not be so big and they would probably have cousins - aunties, grandparents, all living far away distances from the rural area, because again, not many people are living there. If the students want to send pictures off to their families in other parts of the country, it would be made far easier by having a small file size, allowing for quicker upload speeds, and far less strain on their already weak internet connection.

Since JPEG can have its ratio of compression to quality adjusted, I would suggest the school upload different versions of the compressed images, with options to download the highest quality images JPEG files (little to no actual compression), through a range of others which progressively lower in quality. This would allow the families to have full control over what their image quality is. And since there is practically unlimited storage on

a school server, the need to worry for storage requirements is not a problem.



- This is an example of the possible range of images a family could choose to download from the school server, with the one on the left having little compression - not too many artifacts, and large compression (artifacts are visible but not in full screen).


(iii) Explain how this method would affect the output from the end user's perspective.

Using this method will allow for the users to have a quick download speed - allowing them to see their child's images far quicker than having to download a raw image, or a lossless compressed image since the file size is much smaller. Lower quality iterations of the images may lead to the development and eventual recognition of artifacts, but at the right level of compression they will not be noticeable.



If we look at this image above, it is a good representation of what a highly compressed image vs a less compressed image may look like. Although when zooming up on the tiny little leaf on that plant's flower we may see artifacts, ignoring that section and focussing on the image as a whole we can see that the difference is seemingly not there, practically unnoticeable.

Jpeg compression works a lot better on images of real life, where colours transition seamlessly into each other, and there are so many colours present that colour transition, and contrast quality dips are practically unnoticeable. This is the opposite for artificial images like pictures of letters up against a white surface, where the blocky pixels are very noticeable. You will notice on the grass the images are completely indistinguishable. Lossless compression makes use of the fact that humans cannot perfectly perceive every thing, and every colour. So in a JPEG image some colours will be changed in order to save on space, but not at all changing the way a human perceives it. The grass is such a good example because it is all green - all the same colour and all mushed together. Slight colour imperfections will go unnoticed because 1. There's so much green the human eye simply could not notice, and 2. There would be colours present that are able to be removed because humans simply can't perceive them. If we think about this in the context of a school haka image we would know that much like the grass, there would be a lot of boys, very close to



each other, all wearing the same uniform and performing the same moves very close to each other, much like the grass - as such, removing certain colours and changing slight parts of the image would not affect the overall look of the image as a whole because all the colours look the same anyway. The family members viewing the images wouldn't really notice any image quality imperfections. Another reason JPEG is preferred is because the images are most likely going to be viewed from the computer screen, not printed out - this means that computer image loading times is important to consider, which is simply faster with a smaller image file. And since your average computer screen is nowhere near A3 sizes, artifacts will not be too visible.

Also - The reason I would send them a link to download the image files from the server themselves is so that image size isn't constricted to the file size maximum of the email system they are using. Emails usually have a set amount of data that can be sent through them, and exceeding that data limit projects an error image on your screen, not allowing you to even send the image! It just makes more sense for the principal to put them on the server, and allow the parents to download as many images as they want at a time, at any given file size. Also sending the image through an email puts strain on both the principal and families internet speeds, whereas just having them available for download on the server will only cause possible strain on the family downloading the images internet.

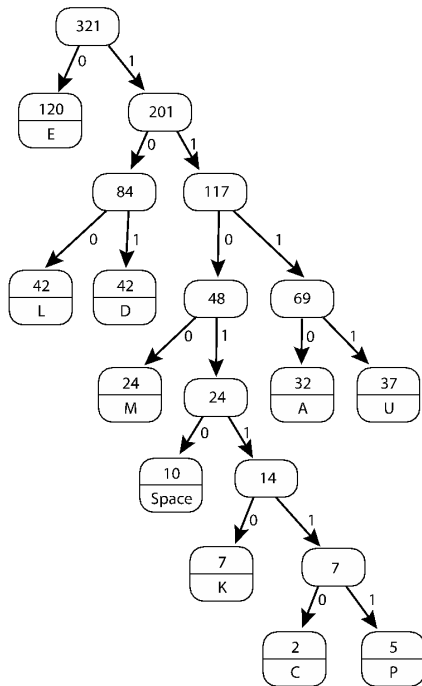
Overall using JPEG allows for more options for the families to download in terms of image quality compared to storage cost, it allows for faster download and upload speeds, and it does this all without any major effects on quality of image.

Lossless compression

Answer EITHER part (d) Huffman coding OR part (e) Run-length encoding OR part (f) LZW

(d) Huffman coding

Note: If you are answering this part, don't answer parts (e) or (f).



(i) Using the Huffman tree above, decode the code 1100 1111 1101110 110110

(ii) Using the Huffman tree above, encode the word DAME

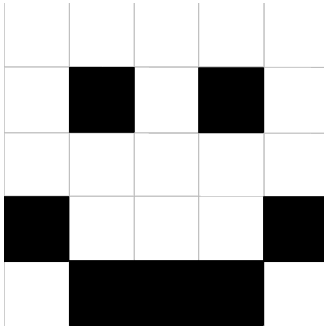
(iii) If the phrases A MUDDLED MEAL and PACK UP A CUP are encoded with the Huffman tree above, which phrase will be compressed by more? Justify your answer.



(e) **Run-length encoding**

Note: If you are answering this part, don't answer parts (d) or (f).

(i) Encode this image using run-length encoding.



5
1, 1, 1, 1, 1
5
0, 1, 3, 1
1, 3, 1

(ii) Decode the code below by filling in any 'black' boxes with a cross (X).

0, 5
1, 3, 1
2, 1, 2
2, 1, 2
5

X	X	X	X	X
	X	X	X	
		X		
		X		

(iii) Consider the two 13×13 images below. Which of these will result in a larger file size than the original when compressed using run-length encoding? Justify your answer.

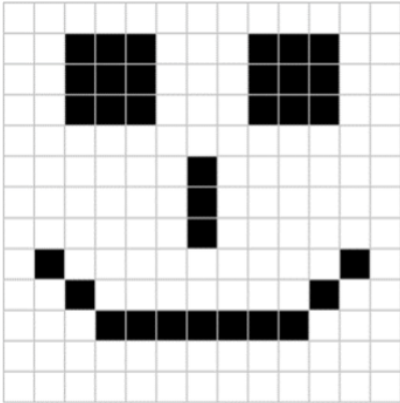


Image A

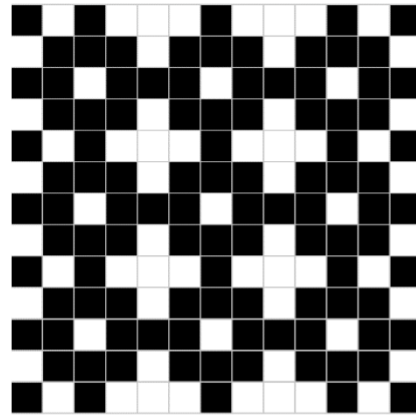


Image B

Image B will result in a larger file size. This is because B has erratic patterns of white and black squares. For run length encoding to be efficient, the actual 'runs' of pixels need to have long sections of the same value, meaning: it is most efficient when a 'run' of values is all white, because this can be represented by just one number. For image A, since the top line is all white the top line can be represented just by the number 13, whereas the top line of Image B has to be represented as 0, 1, 1, 1, 3, 1, 3, 1, 1, 1 - Which is 10 times larger than image A! Image A's top line is compressed to 1/13 or less than 8% of its original file size. Image B will have a larger file size when compressed using run length encoding because it is easier to store just the bit values for every pixel than try and store the values for every 'run' that occurs in that image.

(f) **LZW**

Note: If you are answering this part, don't answer parts (d) or (e).

Code	Character string	Code	Character string
0	Just drift away	5	day
1	,	6	Day
2	yeah	7	dreaming
3	(8	so sweet
4)	9	.

(i) Use the dictionary above to encode the following song lyrics.

Just drift away, yeah
Just drift away (day dreaming, so sweet, yeah)
Just drift away (day dreaming, so sweet, yeah)
Day dreaming, so sweet, yeah
Just drift away

(ii) Use the dictionary above to decode the following code.

0 9 6 7 1 8 1 2 9

(iii) How could the dictionary above be changed to improve the compression of the message in (i)? Justify your answer.



Excellence Exemplar 2022

Subject	Digital Technologies Level 1		Standard	91887	Total score	07
Q	Grade score	Annotation				
1	E7	<p>The candidate has identified multiple reasons why compression might be used and has explained the benefits of using compression in each case.</p> <p>The candidate has given examples of when they have used lossy and lossless compression, with clear explanations of why their choice was appropriate and better than the alternative.</p> <p>They have been able to apply their understanding to the scenario, selecting an appropriate compression method. Their selection is justified by explaining the benefits and contrasting these against other methods. They have a broad understanding of how JPG compression works and integrate this into their justification.</p> <p>They have shown a good understanding of how Run Length Encoding works, and have given a clear explanation of why image A will compress better than image B.</p>				