

Compression



Papers Dock

COMPUTER SCIENCE 9618 PAPER I

Compression

“Reduction Of File Size”

Why do we need to compress a file ?

- The data files are very large
- It would take a long time to send the non compressed file
- compressed files will download faster
- A higher bandwidth would be needed to transmit the uncompressed file.

bandwidth = rate of data transfer

Types Of Compression

Lossless File Compression : In this technique the data is not lost, and the compressed file can be decompressed as the original

Lossy File Compression : In this technique the data is lost, and the decompressed file is not same as the original

Application Of Lossy And Lossless

Lossless File Compression : accuracy of the data is important

Lossy File Compression : accuracy of the data is not important and smaller file size needed as lossy reduces file size more than lossless

Scenario Based Question

Question : Abdullah wants to compress the source. Identify the most appropriate compression technique he could use.

- Lossless
- In this technique data is not lost
- Any lost data will mean that program will not work

Question : Photograph is to be emailed. Identify the most appropriate compression technique he could use.

- Lossy
- All the data is not required
- The number of colors can be reduced without the user noticing
- Email requires a significantly smaller file size
- Takes a shorter time to transmit

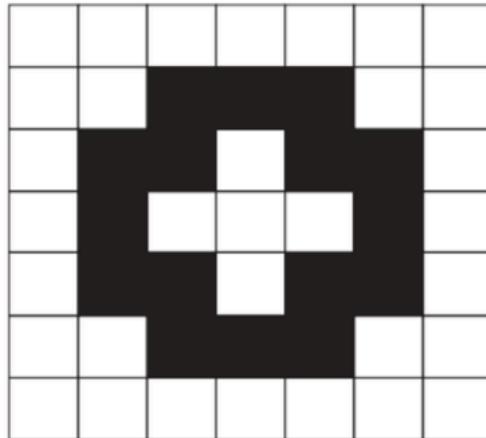
- Lossless
- A high quality image may be needed
- All of the data is needed and can not afford to lose any data

How a bitmap image can be compressed

RLE (Run length Encoding)

Lossless Compression

6) A black and white bitmap image is shown.



Colour	Code
Black	1A
White	3B

Papers Dock

Explanation

- Looks for runs of consecutive pixel of the same color
- Store the color value once and the number of times it occurs
- Lossless method of compression
- reference to the given image (depends on the question)

JPEG

Explanation

- Removes the parts of the image which are not noticeable to human eyes.

Crop : removes pixels (Lossy Compression)

RLE : Stores color code and count of repetition (Lossless)

JPEG : removes part of images which are ignored by human eye (Lossy)

Fewer Colors : use fewer bits per pixel (Lossy)

Question : Describe lossy methods that can be used to compress the image.

Reduces bit depth

reduces the number of bits per pixel which means each pixel has fewer bits

Reduces number of colors

fewer color means fewer bits needed to store each color

Reduce image resolution

fewer pixels per unit measurement means less binary to store

Question : Describe lossless compression methods that can be used to compress the image.

- **Run-length encoding**
- **Replace sequences of the same colour pixel with color code and number of identical pixels**

How a vector image can be compressed

Run-Length Encoding (RLE) compresses a text file by replacing consecutive repeated characters with a pair, the count of repetitions and the character itself. For example, "AAAABBCCDAA" becomes "4A3B2C1D2A." This method is effective when characters repeat consecutively.



How a sound can be compressed

**MP3 uses technology known as audio compression
Sound file can be compressed by using the perceptual
shaping algorithm**

**Perceptual Music Shaping Removes Certain Sounds
(Lossy Compression)**

**Frequencies that are outside the human hearing range
(20 Hz to 20000 Hz)**

**If two sounds are played at the same time, only the louder
can be heard by the ear so the softer sound is removed**

**Question : Describe lossy methods that can be used to
compress a sound.**

**Reduces Sampling Resolution
reduces the number of bits per sample which means each
sample has fewer bits**

**Reduces Sampling Rate
reduces the number of samples per second which means less
bits to store**

**Perceptual Music Shaping
removing part of sound which are not noticeable to human
ear**

Question : Explain the reason why Bobby compresses file ?

- Reduces the file size
- Faster to transmit/download
- Original file is too large for email storage/attachment

Question : Describe lossless methods that can be used to compress a sound.

**Reduce amplitude to only the range used
limited amplitudes mean fewer bits per sample**

Run-length encoding

Where consecutive sounds are the same record the binary value of the sound and number of times it repeats

Record the changes instead of the actual sounds

Example: Instead of recording the full amplitude of each sound sample (e.g., 100, 102, 101, 103), you only record the change from the previous value (e.g., 0, +2, -1, +2).

Question : Describe how lossless compression can be used to reduce the file size of a text file

- Can use run-length encoding
- Identifies groups of repeated characters
- replaces them with one copy of the character and the number of times it occurs

Question : Explain why lossy compression should not be used on a text file ?

- **None of the original data can be lost / deleted**
- **The (text) file would be corrupted or the (text) file cannot be opened**

Question : Explain the reason why compressing why compressing the photographs will benefit the customer ?

- **The customers will be able to download the photographs in less time**
- **and they will take less of the customer's bandwidth**
- **The photographs will take up less space on the customer's storage medium**
- **therefore the customers can store more images**
- **and will have more space for other files**

Question : The bitmap video is not compressed before transmission to the VR headset.

Give two reasons why the video does not need to be compressed.?

- **Dedicated connection to the headset // not sharing bandwidth**
- **Already fast connection that can transmit the data without slowing**
- **Video may already be a small file size and does not need further reduction**
- **Video is not saved so storage is not an issue in the headset**

Compression

Question 1

- (b) The image is compressed using lossless compression.

Identify **one** method of lossless compression that can be used to compress the image **and** describe how the method will reduce the file size.

Lossless compression method

Description

.....

.....

.....

[3]

Question 2

- (b) Bobby wants to email the sound file to his school email address. He compresses the file before sending the email.

- (i) Explain the reasons why Bobby compresses the sound file.

.....
.....
.....
.....

[2]

- (ii) Bobby uses lossless compression.

Describe how lossless compression can compress the sound file.

.....
.....
.....
.....

[2]

Question 3

- (ii) Riya needs to email the photograph. She compresses the photograph before sending it using an email.

Describe **two** lossy methods that Riya can use to compress the image.

Method 1

.....
.....
.....

Method 2

.....
.....
.....

[4]

Question 4

- (d) The first row of pixels in the image from **part (b)** is shown:

B	B	B	B	B	B	B	B	B	B
---	---	---	---	---	---	---	---	---	---

Explain how this row of pixels can be compressed using lossless compression.

.....
.....
.....
.....

[2]

Question 5

- (iii) Describe how lossless compression can be used to reduce the file size of a text file.

.....
.....
.....
.....
.....
..... [2]

- (iv) Explain why lossy compression should **not** be used on a text file.

.....
.....
.....
.....
.....
..... [2]

Question 6

- (c) An Operating System may include a utility program to compress text files.

Describe **one** appropriate method of compressing a text file.

.....
.....
.....
.....
.....
.....
..... [3]

Question 7

- (c) A second bitmap image is stored using a colour depth of 8 bits per pixel.

The file is compressed using run-length encoding (RLE).

- (i) The table shows the compressed and uncompressed values for parts of the image file.

Each colour of the pixel in the image is represented by a hexadecimal value.

Complete the table. The first row has been completed for you.

Uncompressed image	RLE compressed image
EA F1 F1 F2 F2 F2 EA	1EA 2F1 3F2 1EA
	2AB 2FF 11D 167
32 32 80 81 81	

[2]

- (ii) RLE is an example of lossless compression.

Explain why lossless compression is more appropriate than lossy compression for a text file.

.....
.....
.....
.....
..... [2]

Question 8

- (c) The photographs are compressed before they are uploaded to a web server. Customers download the photographs from this web server.

- (i) Explain the reasons why compressing the photographs will benefit the customers.

.....
.....
.....
.....
.....
..... [3]

- (ii) An image can be compressed using run-length encoding (RLE).

Explain the reasons why RLE may **not** reduce the file size of a bitmap image. Give **one** example in your answer.

.....
.....
.....
.....
.....
.....
..... [3]

Question 9

- (c) Explain why a bitmap image is often compressed before it is attached to an email.

.....
.....
.....
..... [2]

Question 10

- 6 (a) A real-time video of a music concert needs to be streamed to subscribers.

Tick () **one** box to identify the most appropriate type of compression **and** justify your answer.

Lossy	Lossless

Justification
.....
.....
.....
.....

[3]

Question 11

- (b) The program is distributed by downloading the source code and its library files from a web server.
(i) Explain the reasons for compressing the files.

.....
.....
.....
.....

[2]

Question 12

- (iii) The bitmap video is **not** compressed before transmission to the VR headset.

Give **two** reasons why the video does **not** need to be compressed.

1

.....
2

.....
..... [2]

Question 13

- (b) The photograph is compressed before being uploaded to a web server.

- (i) Give **three** benefits of this photograph being compressed using lossy compression instead of lossless compression.

1

.....
2

.....
3

.....
..... [3]

- (ii) Explain how run-length encoding (RLE) will compress the photograph.

.....
.....
.....
.....
..... [2]

(c) Identify **two** elements of a bitmap image that can be changed to reduce its file size.

1

.....
2

.....
[2]

9608 Topical Past Papers

Question 14

(b) The file is too large to be emailed and the file size needs to be reduced.

(i) Name one lossless compression technique that can be used to reduce the size of the sound file.

.....

.....

[1]

(ii) Describe **one** lossy compression technique that can be used to reduce the size of the sound file.

.....

.....

.....

.....

[2]

9608/12/M/J/20/2

Question 15

(5b) Wei wants to compress the source code to transport it to another computer.

Identify the most appropriate compression technique he should use.

Justify your choice.

Compression technique

Justification

.....
.....
.....
.....

[3]

9608/13/M/J/20/5b

Question 16

(1d) A recording of a concert is stored as a file. The file is compressed using lossy compression before it is streamed to users.

(i) State why this file needs to be compressed.

.....
.....

[1]

(ii) Define the term **lossy compression**.

.....
.....

[1]

(iii) The file could be compressed using lossless compression.

Explain why lossy compression is a more appropriate compression technique than lossless for this file.

.....
.....
.....
.....
.....

[3]

9608/11/M/J/19

Question 17

(e) Data can be compressed using either lossy or lossless compression.

Tick (\checkmark) one box in each scenario to identify whether lossy or lossless compression should be used. Justify your choice.

(i) A program written in a high-level language.

Lossy	Lossless

Justification

.....
.....
.....

[2]

Lossy	Lossless

(ii) A photograph that needs to be emailed to a friend.

Justification

.....
.....
.....

[2]

(iii) You need to upload a video that you have created to a website.

Lossy	Lossless

Justification

.....
.....

[2]

9608/11/O/N/19

Question 18

(b) A black and white bitmap image is shown.



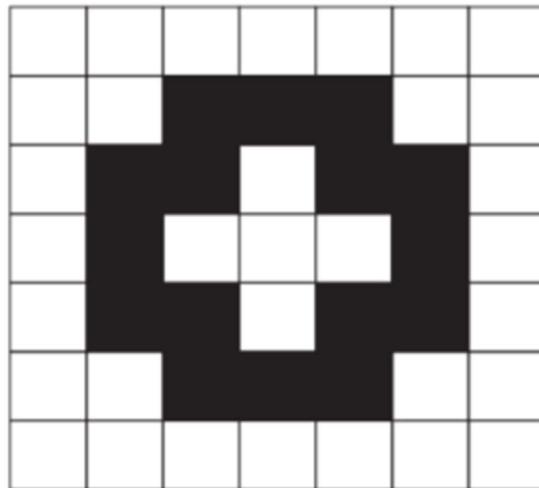
(ii) The image is compressed before it is attached to an email. Explain how run-length encoding (RLE) will compress the image.

.....
.....
.....
.....
.....

[2]

Question 19

- 6) A black and white bitmap image is shown.



- (b) Run-length encoding (RLE) is used to store the image with the following colour codes.

Colour	Code
Black	1A
White	3B

Show how run-length encoding is used to store the image.

.....

.....

.....

[3]

Question 20

(ii) The file size of the photograph needs to be reduced before it is placed on the website.

Draw lines to link each method of reducing the file size of the image to:

- Its description and
- Its compression type, where appropriate.

Description	Method	Compression type
Removes pixels	Crop the photograph	Lossy
Reduces number of pixels per inch	Use run-length encoding	
Uses fewer bits per pixel	Use fewer colours	Lossless
Stores colour code and count of repetitions		

[5]

Question 21

(ii) The photograph needs to be sent by email but the file size is too big. It needs to be compressed.

The table lists several methods of making an image file size smaller.

Tick (✓) one box on each row to indicate whether each method is lossy or lossless

Compression method	Lossy	Lossless
Cropping the image		
Reducing the resolution of the image		
Using run-length encoding (RLE)		
Reducing the colour depth of the image		

(c) Explain how run-length encoding would compress the image in **part (a)**.

.....

.....

.....

.....

.....

.....

[3]

Question 22

(b) The students use software to compress the sound clips before emailing them.

(i) Circle your chosen method of compression and justify your choice.

Lossy / Lossless

Justification:

.....

.....

..... [3]

Students also email images to the radio station for use on its website.

These are compressed before sending using run-length encoding (RLE).

(ii) Explain what is meant by run-length encoding.

.....

.....

.....

.....

.....

..... [3]

(iii) The following diagrams show:

- the denary colour code that represents each colour
- the first three rows of a bitmap image

Colour symbol	Colour code (denary)
B	153
W	255

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	B	B	B	B	B	B	B	B	B	W	W	W	B	B	B	
1	B	B	B	B	B	B	B	B	W	W	W	W	W	W	B	
2	B	B	B	B	B	B	B	W	W	W	W	W	W	W	W	
...																
95																

Show how RLE will compress the first three rows of this image.

Row 1:

Row 2:

Row 3: [2]

Question 23

- (c) Explain the difference between lossless and lossy data compression techniques.

.....
.....
.....
.....
.....
.....

[3]

Question 24

- (c) When storing music tracks in a computer, the MP3 format is often used. This reduces file size by about 90%.

Explain how the music quality is apparently retained.

.....
.....
.....
.....
.....
.....
.....

[3]

Answer

Answer 1

1(b)	1 mark for naming method, 1 mark per description to max 2 <ul style="list-style-type: none">• Run-length encoding• Replace sequences of the same colour pixel• ... with colour code and number of identical pixels	3
------	--	---

Answer 2

7(b)(i)	1 mark per bullet point <ul style="list-style-type: none">• Reduces the file size• Faster to transmit/download• Original file is too large for email storage/attachment	2
7(b)(ii)	1 mark per bullet point to max 2 e.g. <ul style="list-style-type: none">• Reduce amplitude to only the range used• ... limited amplitudes mean fewer bits per sample• Run-length-encoding• ... Where consecutive sounds are the same record the binary value of the sound and number of times it repeats• Record the changes instead of the actual sounds	2

Answer 3

5(b)(ii)	1 mark for each bullet point to max 2 for each method <ul style="list-style-type: none">• Reduce bit depth<ul style="list-style-type: none">• ... reduces the number of bits per colour / pixel which means each pixel has fewer bits• Reduce colour palette // reduce number of colours<ul style="list-style-type: none">• ... fewer colours mean fewer bits needed to store each colour• Reduce image resolution<ul style="list-style-type: none">• ... fewer pixels per unit measurement means less binary to store	4
----------	--	---

Answer 4

1(d)	<p>1 mark per point</p> <ul style="list-style-type: none"> • Use run-length encoding // RLE • Record the colour <u>Blue</u>, and the number of times it occurs <u>10</u> 	2
------	---	---

Answer 5

1(a)(iii)	<p>1 mark per point to max 2</p> <ul style="list-style-type: none"> • Can use run-length encoding • Identifies groups of repeated characters ... • ... replaces them with a one copy of the character and the number of times it occurs 	2
1(a)(iv)	<p>1 mark per point to max 2</p> <ul style="list-style-type: none"> • None of the original data can be lost / deleted • The (text) file would be corrupted // the (text) file cannot be opened 	2

Answer 6

7(c)	<p>1 mark for each bullet point (max 3):</p> <ul style="list-style-type: none"> • lossless compression • Run Length Encoding • repeated sequences of characters are replaced by <ul style="list-style-type: none"> • ... a single copy of the character • ... and a counter of the number of characters 	3
------	---	---

Answer 7

8(c)(i)	<p>1 mark for each correct underlined part:</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; padding-bottom: 5px;">Uncompressed sound</th><th style="text-align: center; padding-bottom: 5px;">RLE compressed sound</th></tr> </thead> <tbody> <tr> <td style="text-align: center; padding-top: 5px;">EA F1 F1 F2 F2 EA</td><td style="text-align: center; padding-top: 5px;">1EA 2F1 3F2 1EA</td></tr> <tr> <td style="text-align: center; padding-top: 5px;"><u>AB AB FF FF 1D 67</u></td><td style="text-align: center; padding-top: 5px;">2AB 2FF 11D 167</td></tr> <tr> <td style="text-align: center; padding-top: 5px;">32 32 80 81 81</td><td style="text-align: center; padding-top: 5px;"><u>232 180 281</u></td></tr> </tbody> </table>	Uncompressed sound	RLE compressed sound	EA F1 F1 F2 F2 EA	1EA 2F1 3F2 1EA	<u>AB AB FF FF 1D 67</u>	2AB 2FF 11D 167	32 32 80 81 81	<u>232 180 281</u>	2
Uncompressed sound	RLE compressed sound									
EA F1 F1 F2 F2 EA	1EA 2F1 3F2 1EA									
<u>AB AB FF FF 1D 67</u>	2AB 2FF 11D 167									
32 32 80 81 81	<u>232 180 281</u>									
8(c)(ii)	<p>1 mark for each bullet point:</p> <ul style="list-style-type: none"> • all the data is required // no data can be lost • ... otherwise text file will be corrupted / not make sense 	2								

Answer 8

1(c)(i)	1 mark each Examples: <ul style="list-style-type: none">• The customers will be able to download the photographs in less time• ...and they will take less of the customer's bandwidth• The photographs will take up less space on the customer's storage medium• ...therefore the customers can store more images• ...and will have more space for other files	3
1(c)(ii)	1 mark each to max 2 for explanation; 1 mark for an image related example <ul style="list-style-type: none">• RLE stores a colour and the number of times it occurs consecutively• An image may not have many sequences of the same colour• It would need to store each colour and then the count/number 1 which adds data Example: <ul style="list-style-type: none">• Red-Green-Blue would become Red 1 Green 1 Blue 1	3

Answer 9

1(c)	1 mark for each bullet point (max 2) <ul style="list-style-type: none">• Reduced bandwidth usage when transmitting the message• Reduced transmission time from email client to email server• Reduced storage space on the email• Email accounts often have a maximum size for an attachment	2
------	---	----------

Answer 10

6(a)	<p>1 mark for each bullet point (max 3)</p> <p>Lossy compression (ticked)</p> <ul style="list-style-type: none">• Loss of quality will not be noticed• Needs to be viewed in real time so less bandwidth needed if file size smaller• Smaller file sizes will reduce buffering so the video will play more smoothly• Viewers may watch on different devices, so may not need high quality resolution <p>Lossless compression (ticked)</p> <ul style="list-style-type: none">• Original recording may not have been made in high resolution• Could be streaming to high bandwidth devices• The reduction in the file size is sufficient for the receiving device• Viewers do not want any loss of quality	3
------	---	----------

Answer 11

5(b)(i)	<p>1 mark for each bullet point (max 2).</p> <ul style="list-style-type: none">• To reduce the time it takes to download the program files from the web server // to upload them to the server in the first place• To reduce the amount of storage space used on the web server // user's device	2
---------	--	----------

Answer 12

2(d)(iii)	<p>1 mark each to max 2:</p> <ul style="list-style-type: none">• Dedicated connection to the headset // not sharing bandwidth• Already fast connection that can transmit the data without slowing• Video may already be a small file size and does not need further reduction• Video is not saved so storage is not an issue in the headset	2
-----------	---	----------

Answer 13

2(b)(i)	1 mark each to max 3: <ul style="list-style-type: none">• The file takes less storage space on the web server than if lossless compression was used• The file is faster to upload/download to/from the server than if lossless compression was used• The file uses less bandwidth to transmit than if lossless compression was used• The file consumes less data allowance than if lossless compression was used	3
2(b)(ii)	1 mark each: <ul style="list-style-type: none">• Identifies consecutive repeating pixels of the same colour• Stores the colour /pattern and the number of times it repeats	2
2(c)	1 mark each to max 2: <ul style="list-style-type: none">• Colour/bit depth• Image resolution	2

Answer 14

2(b)(i)	1 mark only from: <ul style="list-style-type: none">• Run-length encoding• Huffman Coding• Any other valid encoding method	1
2(b)(ii)	1 mark per bullet point to max 2 <ul style="list-style-type: none">• Reduce sampling rate<ul style="list-style-type: none">• ... fewer samples taken per second means less data is being stored <p>Or</p> <ul style="list-style-type: none">• Reduce sample resolution<ul style="list-style-type: none">• ... fewer bits are used to represent each sample, so less data is stored	2

Answer 15

5(b)	<p>1 mark for a lossless technique 1 mark per bullet point for justification to max 2</p> <ul style="list-style-type: none">• Lossless does not lose any data• Any lost data will mean the program will not work	3
------	--	---

Answer 16

1(d)(i)	<p>1 mark per bullet point to max 1</p> <ul style="list-style-type: none">∞ The data files are very large∞ It would take a long time to send the uncompressed file // Compressed files will download faster∞ A higher bandwidth would be needed to transmit the uncompressed file	1
1(d)(ii)	<p>1 mark per bullet point to max 1</p> <ul style="list-style-type: none">∞ Data is lost∞ The decompressed file is not the same as the original	1
1(d)(iii)	<p>1 mark per bullet point to max 3</p> <ul style="list-style-type: none">∞ Lossy creates a smaller file than lossless // lossy compresses further than lossless∞ The recording of the concert is a large file size and needs <u>significant</u> reduction in size∞ Lossy removes detail which can be lost without people noticing∞ By example e.g. reduction in sound quality <u>will not be noticed</u>	3

Answer 17

5(e)(i)	<p>1 mark per bullet to max 2</p> <p>Lossless:</p> <ul style="list-style-type: none">• All the data is needed // the original file is fully restored• If any data is lost, the program will not run• Probably does not require significant reduction in file size // a program written in a high-level language is just text, so does not need much reduction in size	2
---------	---	---

5(e)(ii)	<p>1 mark per bullet to max 2</p> <p>Lossy:</p> <ul style="list-style-type: none"> • All the data is not required • The number of colours / resolution can be reduced without the user noticing • Email requires a significantly smaller file size // takes less time to transmit <p>Lossless:</p> <ul style="list-style-type: none"> • A high quality image may be needed • All of the data is needed // cannot afford to lose any data // the original file is fully restored 	2
5(e)(iii)	<p>1 mark per bullet to max 2</p> <p>Lossy:</p> <ul style="list-style-type: none"> • Some loss of quality will not be noticed // high quality video not needed on the website • A more significant reduction may be needed • Takes a shorter time to upload / download // requires less bandwidth <p>Lossless:</p> <ul style="list-style-type: none"> • A high quality video may be needed • Might only be a short video clip • All of the data is needed // cannot afford to lose any data // the original file is fully restored 	2

Answer 18

2(b)(ii)	<p>1 mark for the explanation</p> <ul style="list-style-type: none"> • Stores the colour and the number of times it occurs <p>1 mark for example from</p> <ul style="list-style-type: none"> • An example from the bitmap given e.g. B5, W1, B1 and so on 	2
----------	---	---

Answer 19

6(b)	<p>1 mark for correct method (colour code and number of pixels)</p> <p>1 mark for first 7 groups correct</p> <p>1 mark for remainder correct</p> <ul style="list-style-type: none"> • 3B9 1A3 3B3 1A2 3B1 1A2 3B2 • 1A1 3B3 1A1 3B2 1A2 3B1 1A2 3B3 1A3 3B9 	3
------	--	---

Answer 20

1(b)(ii)	<p>1 mark per method correctly linked to its description max 3 1 mark for each compression type correctly linked to its method(s). max 2</p> <table border="1"><thead><tr><th>Description</th><th>Method</th><th>Compression type</th></tr></thead><tbody><tr><td>Removes pixels</td><td>Crop the photograph</td><td>Lossy</td></tr><tr><td>Reduces number of pixels per inch</td><td>Use run-length encoding</td><td>Lossy</td></tr><tr><td>Uses fewer bits per pixel</td><td>Use fewer colours</td><td>Lossless</td></tr><tr><td>Stores colour code and count of repetitions</td><td></td><td></td></tr></tbody></table>	Description	Method	Compression type	Removes pixels	Crop the photograph	Lossy	Reduces number of pixels per inch	Use run-length encoding	Lossy	Uses fewer bits per pixel	Use fewer colours	Lossless	Stores colour code and count of repetitions			5
Description	Method	Compression type															
Removes pixels	Crop the photograph	Lossy															
Reduces number of pixels per inch	Use run-length encoding	Lossy															
Uses fewer bits per pixel	Use fewer colours	Lossless															
Stores colour code and count of repetitions																	

Answer 21

1(b)(ii)	<p>1 mark for correct tick in each row.</p> <table border="1"><thead><tr><th>Compression method</th><th>Lossy</th><th>Lossless</th></tr></thead><tbody><tr><td>Cropping the image</td><td>✓</td><td></td></tr><tr><td>Reducing the resolution of the image</td><td>✓</td><td></td></tr><tr><td>Using run-length encoding (RLE)</td><td></td><td>✓</td></tr><tr><td>Reducing the colour depth of the image</td><td>✓</td><td></td></tr></tbody></table>	Compression method	Lossy	Lossless	Cropping the image	✓		Reducing the resolution of the image	✓		Using run-length encoding (RLE)		✓	Reducing the colour depth of the image	✓		4
Compression method	Lossy	Lossless															
Cropping the image	✓																
Reducing the resolution of the image	✓																
Using run-length encoding (RLE)		✓															
Reducing the colour depth of the image	✓																
1(c)	<p>1 mark per bullet point to max 3</p> <ul style="list-style-type: none">• Looks for runs of consecutive pixels of the same colour• Stores the colour value once and the number of times it occurs• Lossless method of compression• Reference to the given image in context	3															

Answer 22

(b) (i) **No mark** awarded for identifying method. **Three marks** for justification. [3]

Lossy – Three points from:

- The human ear will not notice that the decompressed stream will not be identical to the original (file) / that parts of the original data have been discarded / removed / deleted.
- File size reduction is greater than using lossless.
- Email has limits on file sizes (on attachments) / a smaller file will take less time to transmit.
- The file may not need to be of high precision / accuracy.
- The producer has requested an mp3 file.

Lossless – Three points from:

- The file needs to be high precision / accuracy.
- None of the original data is lost / the decompressed file will be identical to the original.
- The producer has requested a flac file.

(ii) **Three** points from: [3]

- Lossless method of compression.
- Reduces (the physical size of) a string of adjacent, identical characters/pixels / bytes etc..
- The repeating string (a run) is encoded into two values.
- One value represents the number of (identical) characters in the run (the run count).
- The other value is the code of the character / colour code of pixel etc. in the run (the run value).
- The run value and run count combination may be preceded by a control character.
- Any valid example given.

(iii) **Two marks** for three correct rows, **one mark** for two correct rows. [2]

Row 1: 153 10 255 3 153 3

Row 2: 153 9 255 6 153 1

Row 3: 153 7 255 9

Alternative correct answer:

Row 1: 153 9 255 2 153 2

Row 2: 153 8 255 5 153 0

Row 3: 153 6 255 8

Answer 23

(c) Any **three** from:

For full marks both techniques must be mentioned.

- lossless designed to lose none of the original detail/lossless allows original file to be recreated exactly
- lossless technique based on some form of replacement
- mention of type of replacement, for example RLE, FLAC etc.
- by example: e.g. 000–1111–222222–333 = 3–0, 4–1, 6–2, 3–3 etc.
- maximum compression about 50%
- lossy may result in loss of detail compared to original file/lossy does not allow original file to be re-created exactly
- lossy techniques make decision about what parts of sound/sound file are important and discards other information
- only keeps sounds human ear can process/discards sounds most people cannot hear
- ... then applies lossless technique, for further reduction
- lossy compression can reduce to about 10%
- an example of jpeg, mp3 or other correct examples of compressed formats.

No double credit to opposite answers, e.g. lossless maintains detail, but lossy loses detail just one mark.

[3]

Answer 24

(c) any **three** from:

- mp3 is a **lossy** compressed format
- uses psycho-acoustic modelling
- and perceptual music/noise shaping
- certain parts of the music can be eliminated without significantly degrading the listener's experience
- removes sound that the human ear can't hear
- only keeps sounds human ear can hear better than others
- discards softer sound if two sounds played together

[3]