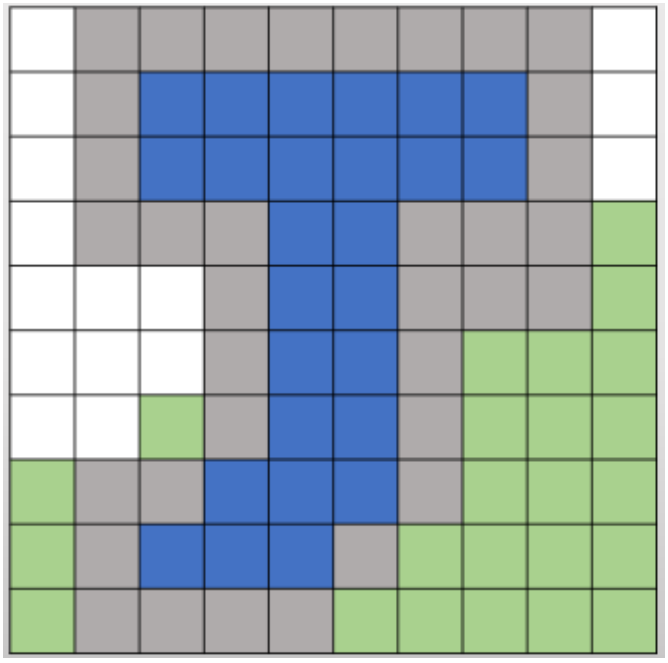
1.3.1 Compression

1. **Figure 1** shows a bitmap graphic has an image size of 10 x 10 pixels.

Each image uses four colours: white, grey, blue and green.

Figure 1



a) Describe how a row of pixels, such as the first row in **Figure 1**, could be represented in compressed form by using run length encoding.

[2 marks]

- **A run is a sequence/series of pixels of the same colour // the number of consecutive pixels of the same colour are counted**
- **The run length and the colour of the pixels in the run is stored**
- **E.g. 1W8G1W**

Figure 2 shows an image of a woodland scene.

Figure 2

b) The image in **Figure 1** is compressed using run length encoding. The compressed fill is 80% smaller than the original file.

The image in **Figure 2** is compressed using the same technique and the compressed file is approximately the same size as the original file.

Explain why the run length encoding method was not able to compress the image in **Figure 2** as much as it could compress the image in **Figure 1**.

[2 marks]

- **There are fewer repeating colours so runs would be shorter // the image has many more different colours**
- **For shorter runs the additional run length data may cancel out or outweigh reduction in storage of pixel colour data**

2. The paragraph of text in **Figure 3** is to be compressed using a dictionary-based compression method.

Figure 3

> Unfortunately time after time it is the case that programmers fail to put enough effort into commenting their code. Effort put into commenting could make the code easier to maintain when the time comes to do this.

a) Dictionary-based compression is an example of a lossless compression method.

Explain the key difference between lossless and lossy compression methods.

[1 mark]

- **The original data can be fully recovered if lossless compression is used**
- **The original data cannot be fully recovered if lossy compression is used**

b) Explain how the paragraph of text in Figure 1 could be compressed using a dictionary-based method.

[2 marks]

- **A dictionary is built that maps sequences of words/strings in the text onto tokens/numbers**
- **The words/strings in the text are then replaced by the corresponding tokens/numbers from the dictionary**

c) After the text in **Figure 3** has been compressed it is to be transmitted across a computer network.

Explain why dictionary-based compression is not very effective for compressing small amounts of text for transmission.

[1 mark]

- **For small pieces of text there is little repetition**

3. An image is 20 pixels wide by 30 pixels tall. The colour of each pixel is represented using one byte.

Here is a row of data from the original image. The colour of each of the 20 pixels is shown as a decimal value, with commas used to separate the data for the different pixels:

80, 82, 0, 0, 9, 223, 223, 224, 220, 76, 76, 24, 24, 24, 253, 254, 255, 76, 76, 76

The image is to be compressed using Run Length Encoding (RLE). The RLE method used will:

- Represent the length of a run using one byte
- Represent a colour using one byte.

In decimal, the RLE for the colour of the first four pixels would be:

1, 80, 1, 82, 2, 0

a) Calculate how much memory the row of pixels will take up before **and** after it has been encoded using RLE.

[1 mark]

- **Memory before RLE: 20 Memory after RLE: 26**

b) Comment on the effectiveness of the use of RLE to encode this row of pixels **and** explain why this is the case.

[1 mark]

- **This compression was not effective because the amount of memory used has increased // because there were very few runs**