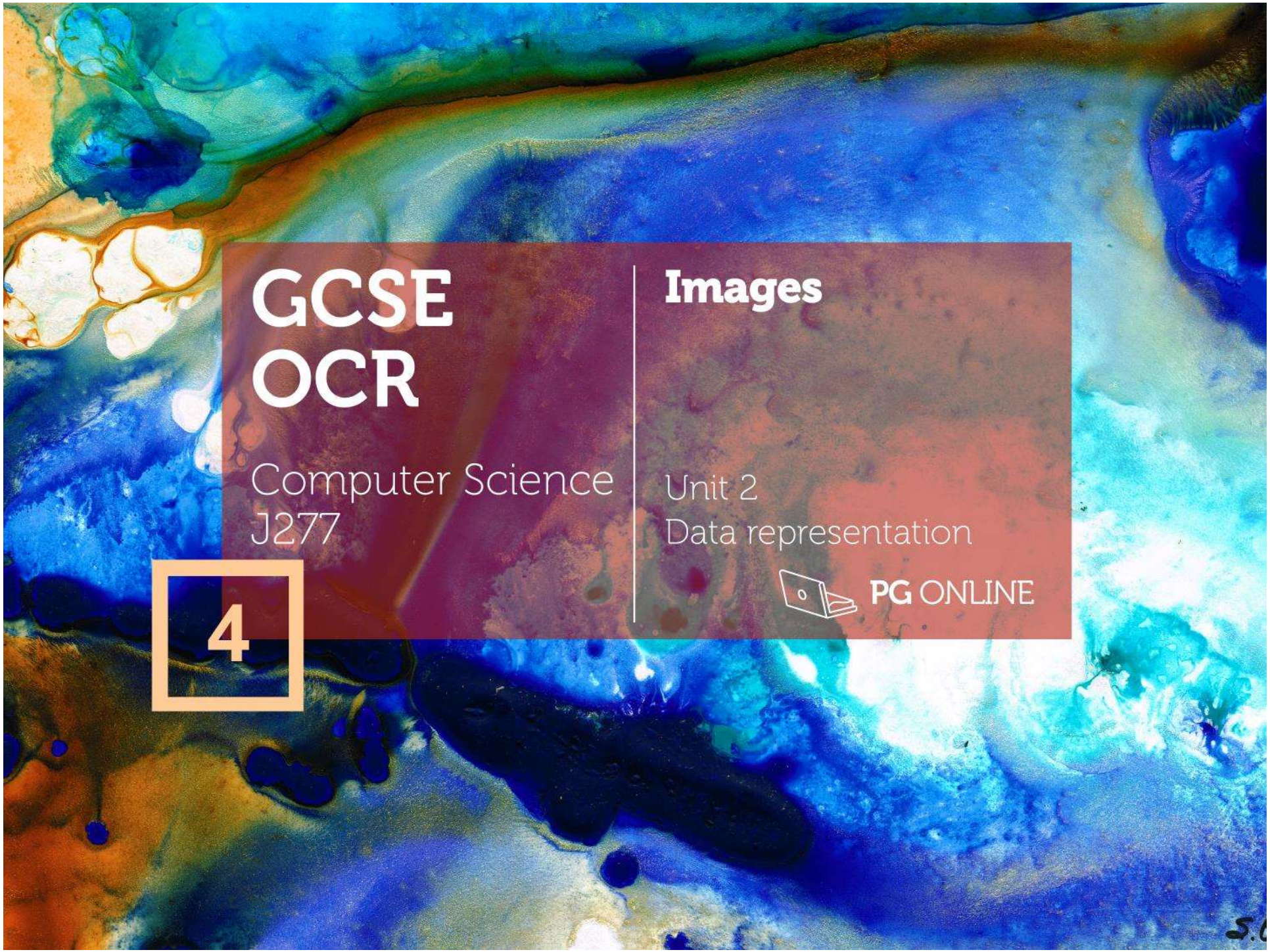

GCSE
OCR
Computer Science
J277
4
Images
Unit 2
Data representation
PG ONLINE

Objectives

- Understand how a bitmap graphic is made up of individual pixels
  - Explain how each pixel is represented in binary
  - Understand that the number of bits per pixel determines the number of available colours for an image
- Explain the need for image metadata
- Explain the relationship between file size and image resolution

Starter

- Digital images can be stored on a computer in many different file formats
  - What are five different file formats that can be used?

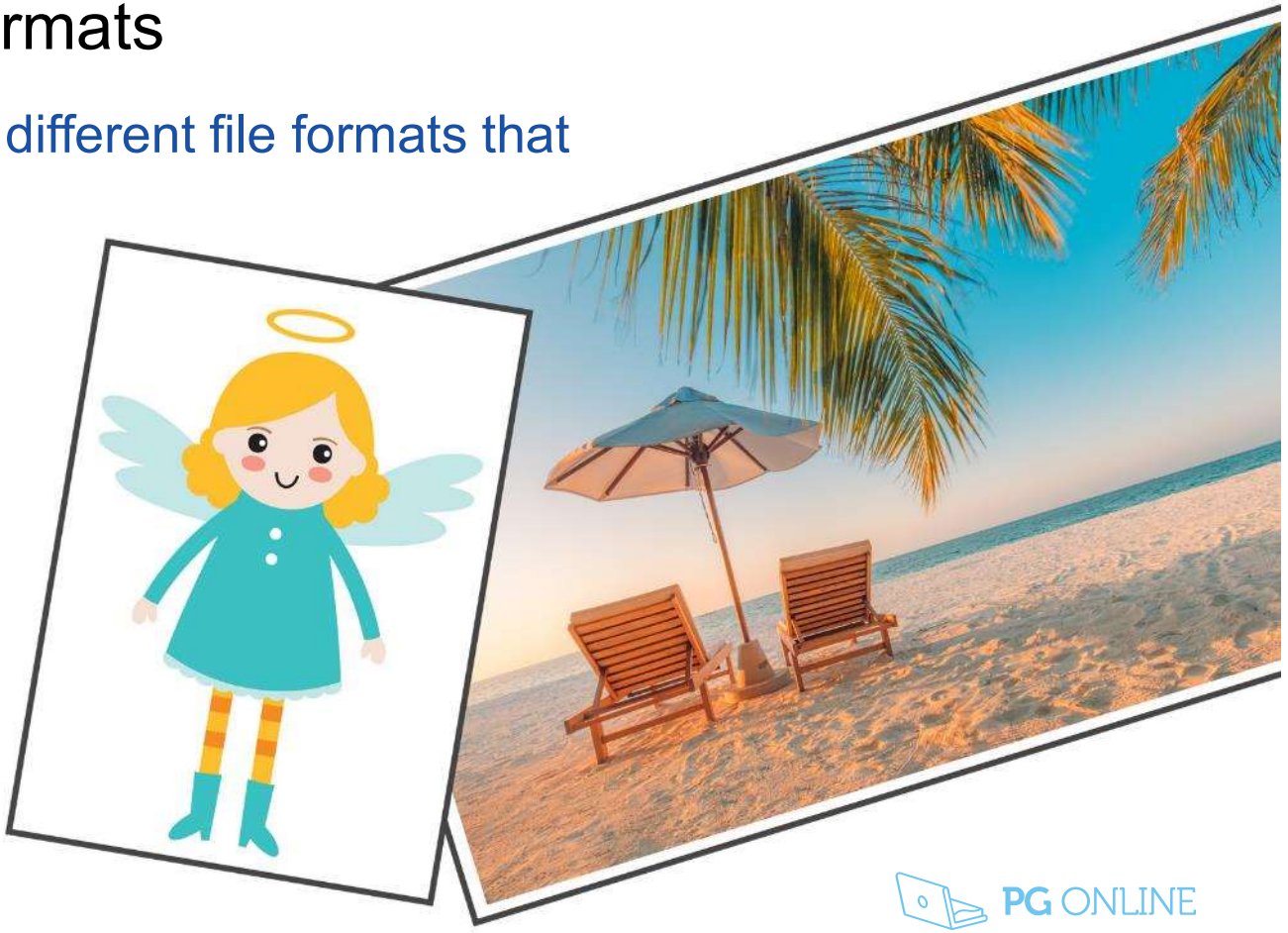


Image file types

Answers

- Bitmap image file formats:
  - BMP
  - JPG
  - GIF
  - PNG
  - TIFF
- Vector image file format:
  - SVG
- There are also editing formats such as Illustrator (AI) and Photoshop (PS)

Bitmap (or Raster) images

- Bitmap images are made up of **PIC**ture **EL**ement or **pixels**
  - A pixel is the smallest identifiable area of an image
  - Each pixel is a single colour and is given a binary value which represents that colour e.g. 111100000000 might equal red
  - A pixel's colour can be changed by changing this value

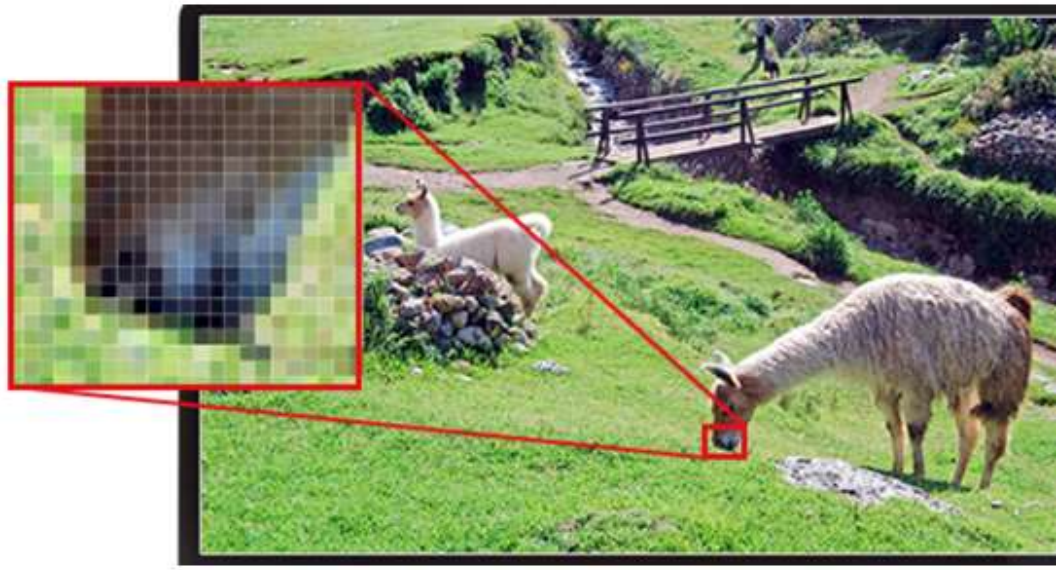


Image resolution

- Resolution is the concentration of pixels within a specific area
- The area is defined by the image width and height in pixels e.g. 1920x1080
  - 72 PPI (Pixels Per Inch) = typical screen resolution
  - 300 DPI (Dots Per Inch) = print quality resolution
  - Smartphones may have very high resolutions 300+ PPI

Creating an Image

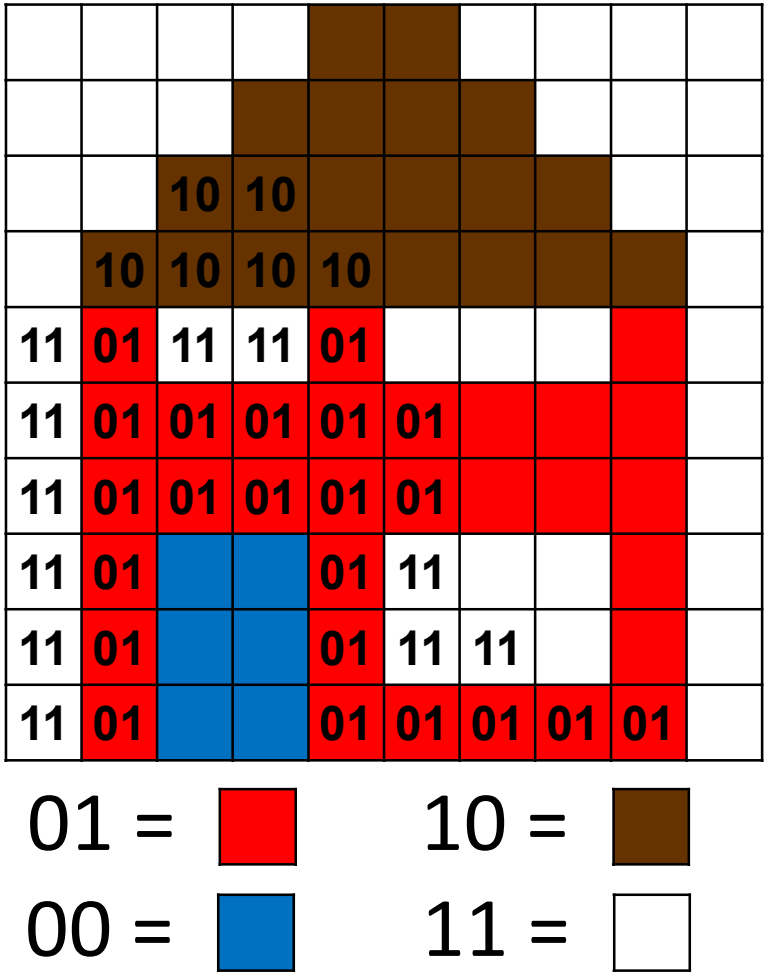
- Each pixel is given a binary value
- Each value represents a different colour
- Using one bit per pixel allows only 2 values, 0 and 1

  1 = Black, 0 = White

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

Increasing the number of colours

- More bits per pixel = more colour combinations
  - 1 bit = 2 Colours
  - **2 bits = 4 Colours**
  - 3 bits = 8 Colours
  - 4 bits = 16 Colours
- How many bits per pixel required for 256 colours?



Colour or bit depth

- Each pixel can represent a finite number of colours
  - A pixel is attributed a number of *n* bits
  - The number of combinations (2^n) dictates the bit depth and therefore the number of colours that can be represented
  - A higher bit depth gives a greater range of colour and a better quality of image

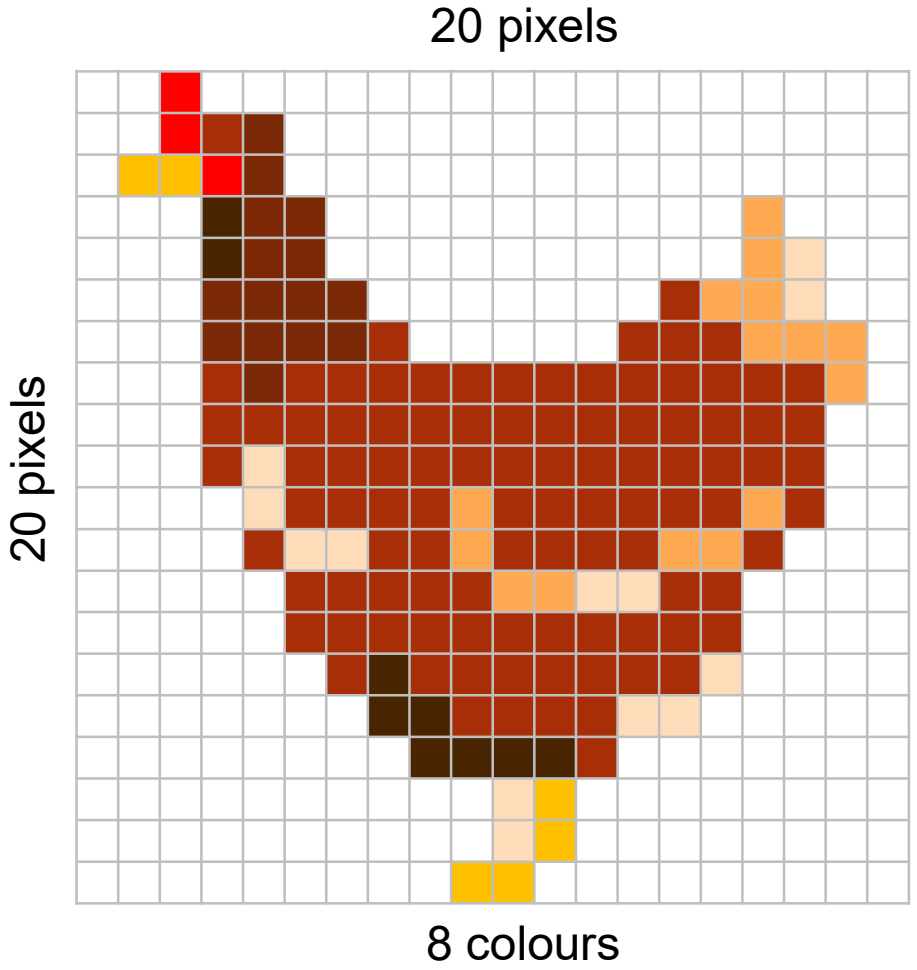
8 bits per pixel = 2^8 = 256 colours

16 bits per pixel = 2^{16} = 65,536 colours

24 bits per pixel = 2^{24} = 16,777,216 colours

Colours and resolution vs File Size

- How does the number of colours affect file size?
- How does the size of the image affect file size?



Effects of varying colour depth

- Changing the colour depth of an image will affect the number of colours it can display, as shown below:

2 Colours | 4 Colours | 8 Colours | 16 Colours | 256 Colours | 16.7m Colours

Worksheet 4

- Complete **Task 1** on **Worksheet 4**

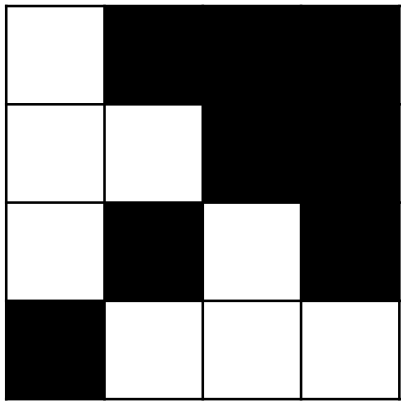
PBM monochrome images

- Store image dimensions
- Change ‘colours’ by changing binary values

```
10 10
0 0 0 0 1 0 0 0 0 0
0 0 0 1 1 0 0 0 0 0
0 0 1 1 1 0 1 0 0 0
0 1 1 1 1 0 1 1 0 0
1 1 1 1 1 0 1 1 1 0
0 0 0 0 1 0 1 0 0 0
1 1 1 1 1 1 1 1 1 1
0 1 1 1 1 1 1 1 1 0
0 0 1 1 1 1 1 1 1 0
0 0 0 0 0 0 0 0 0 0
```

Representing a monochrome image in binary

- A monochrome image can be represented in binary as a bit pattern
  - The following icon can be represented by the corresponding bit pattern:

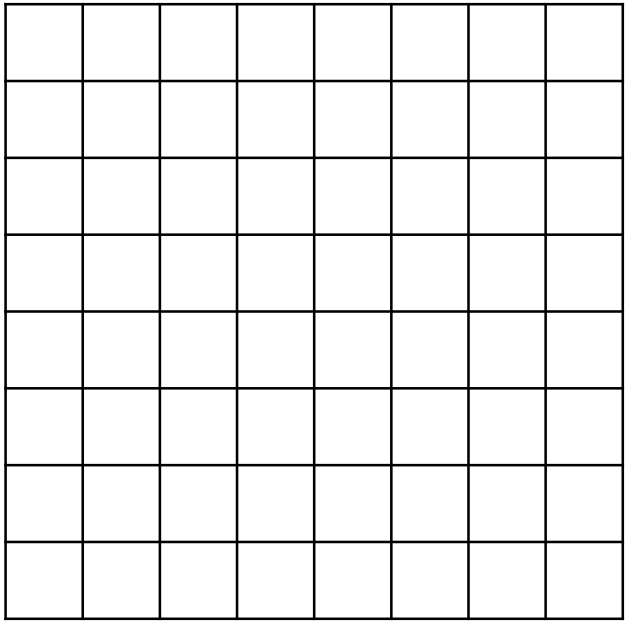


```
0111,
0011,
0101,
1000
```

Converting a bit pattern into a monochrome image

- Convert the following bit pattern into an 8x8 icon:

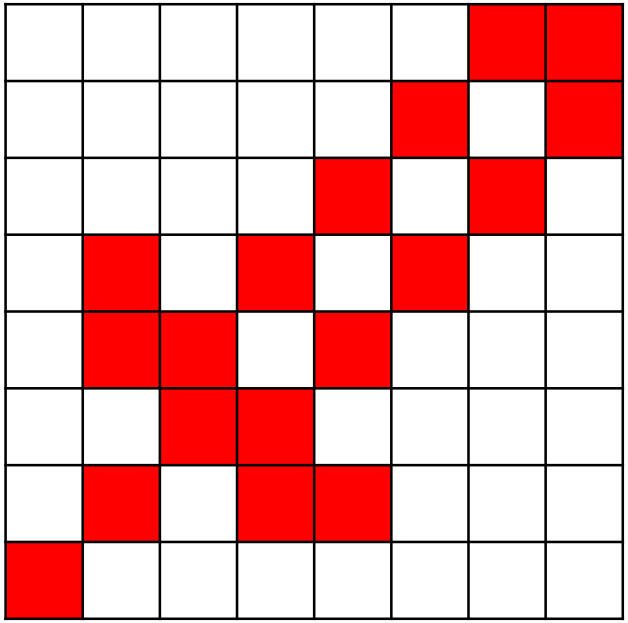
```
00000011
00000101
00001010
01010100
01101000
00110000
01011000
10000000
```



Converting a bit pattern into a monochrome image

- Convert the following bit pattern into an 8x8 icon:

```
00000011
00000101
00001010
01010100
01101000
00110000
01011000
10000000
```

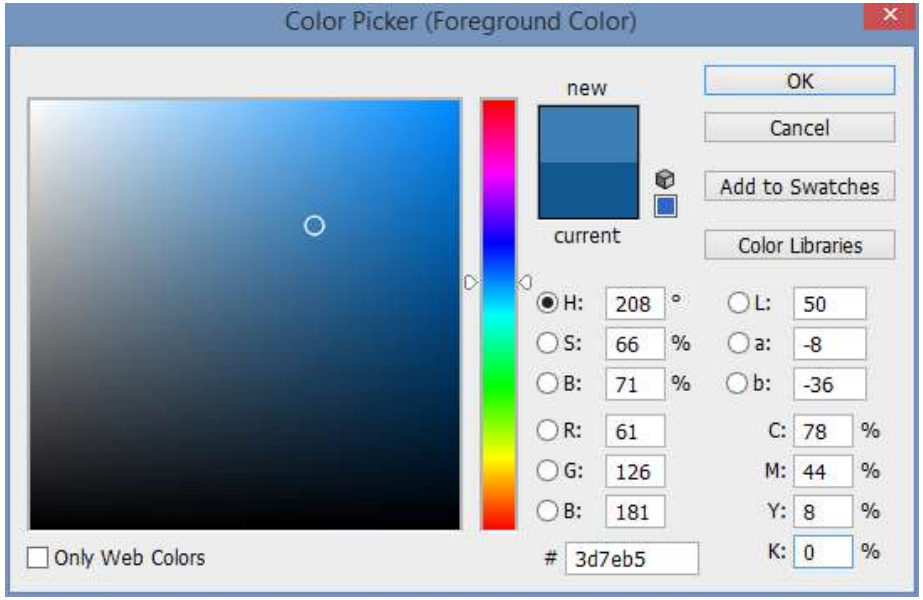


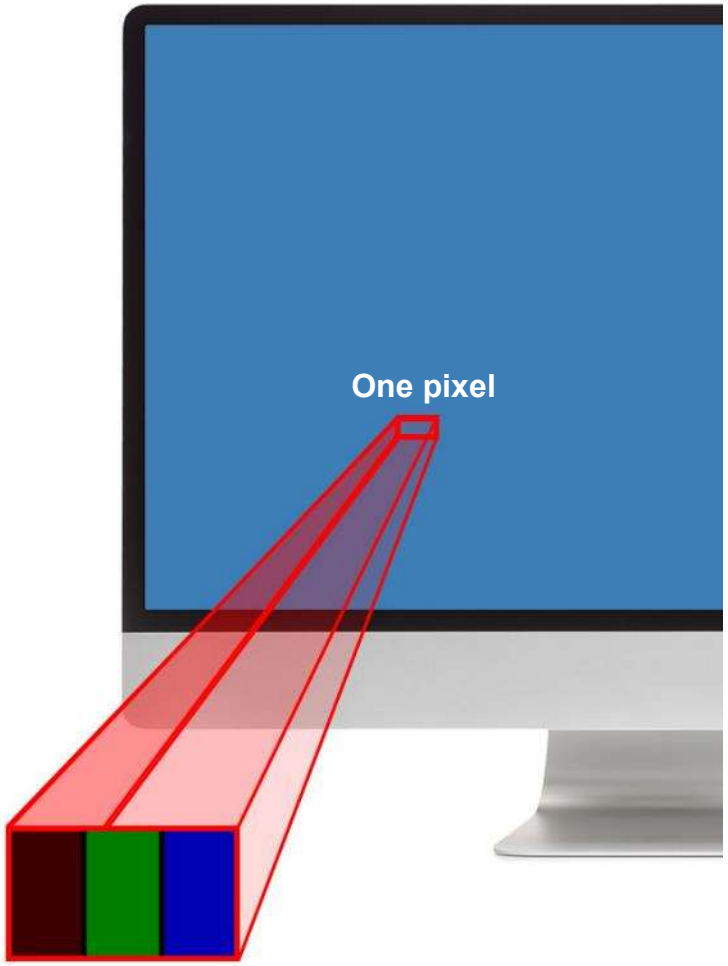
Worksheet 4

- Complete **Task 2** on **Worksheet 4**

Colours

- Each pixel has a proportion of red, green and blue
  - From a distance, it makes up one colour





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Looking at colour values

- Colour values of individual pixels are expressed in software as denary RGB values and in hexadecimal
  - Why isn't binary used in this instance?
- RGB (Red, Green and Blue) values range between 0-255
  - How many bits are required for each of the red, green and blue components of a pixel?
  - How many bits are required for the whole pixel?
  - In 32-bit colour what are the last 8 bits for?

Looking at colour values

Answers

- Software colour pickers are used by designers and developers
  - They use numerical values and hex as these are easier for people to read, write and remember and reduce errors if copied
- RGB values between 0-255
  - Each colour requires 8 bits to store the range 0-255
  - The whole pixel requires 3*8 = 24 bits (16.8 million colours)
  - In 32 bits per pixel 8 bits are given to a transparency channel (to allow a background to show through)

Why file sizes don't always add up

- DucksBMP has a resolution of 1000 x 750px
- The colour depth is 24 bit = 16 million colours
  - What is the file size in bytes and MB?
  - Why is there a difference in the actual file size of 56 bytes?

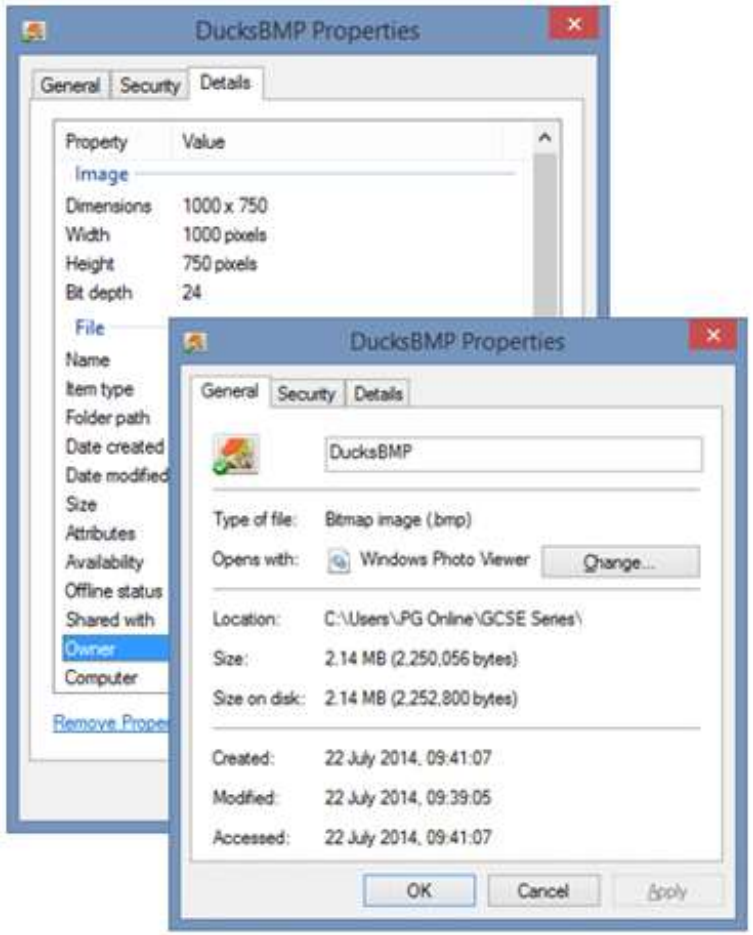

Image metadata

- Metadata is data about data
- It is information other than image data that is stored with a file
- This will include:
  - Colour depth in bits per pixel
  - Resolution (Height and width in pixels)
  - Date created
  - Author
- Why would the file DucksJPG be a different file size?

Plenary

- Fill in the gaps in each of the below sentences:
  - A bitmap graphic is made up of _____
  - Each _____ is represented in binary
  - The _____ determines the number of available colours for an image
  - Image _____ holds data about the image such as
  - _____
  - The greater the _____ of the image, the greater the file size

Plenary

Answers

- A bitmap graphic is made up of individual pixels
- Each pixel is represented in binary
- The number of bits per pixel determines the number of available colours for an image
- Image metadata holds data about the image, such as colour depth, resolution, date created, author
- The greater the resolution of the image, the greater the file size

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