

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?

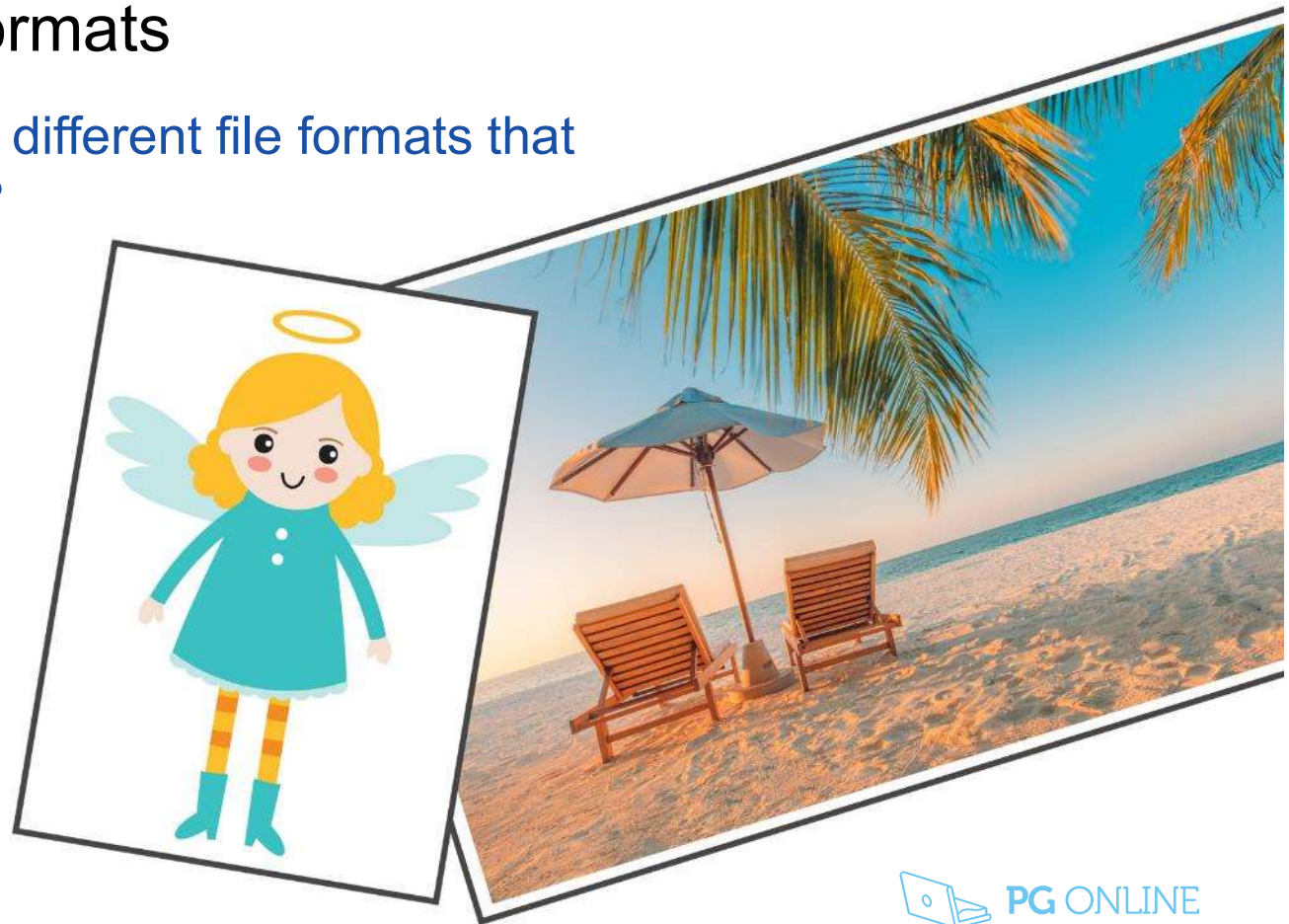


Image file types

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 **P**ICturer **E**Lement 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

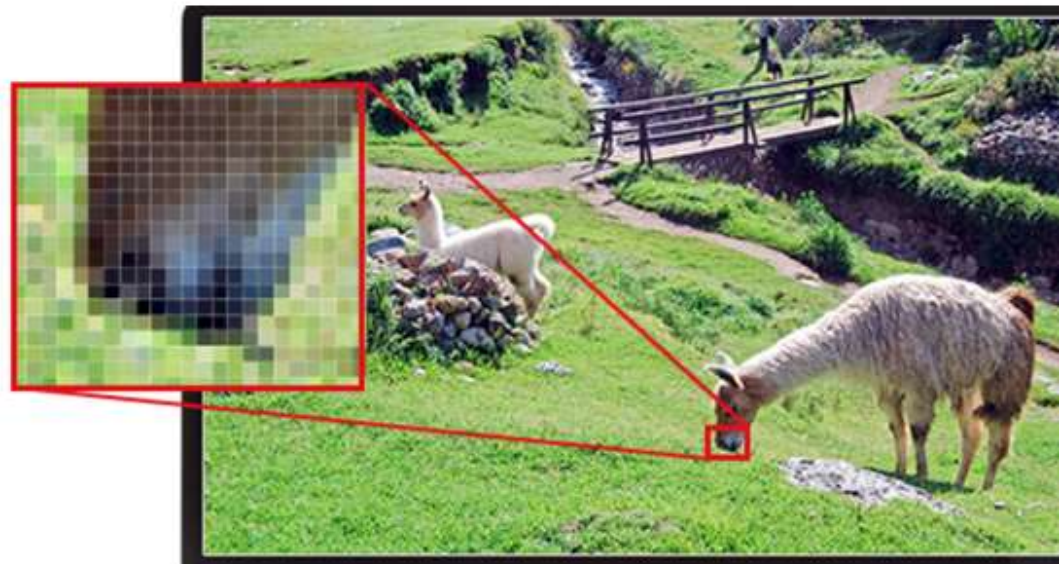


Image resolution

- 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?

				10	10				
			10	10	10	10			
		10	10						
	10	10	10	10					
11	01	11	11	01				01	
11	01	01	01	01	01				
11	01	01	01	01	01				
11	01			01	11				
11	01			01	11	11			
11	01			01	01	01	01	01	

01 =  10 = 
00 =  11 = 

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

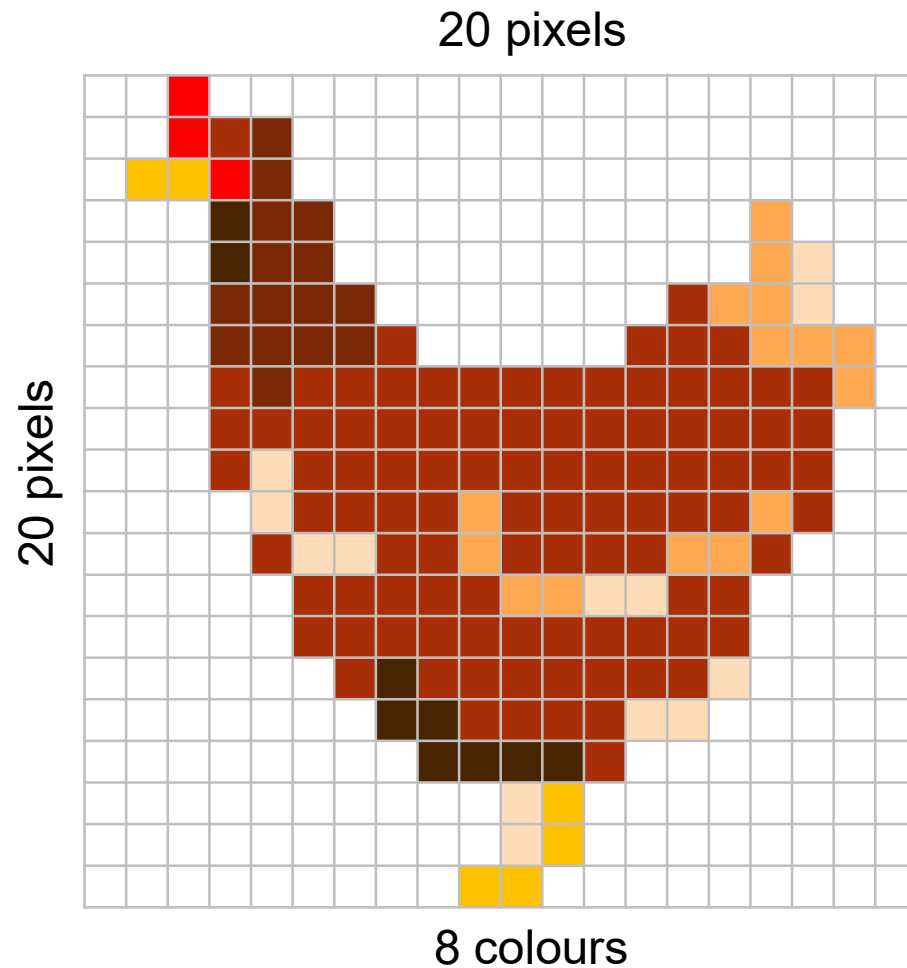
8 bits per pixel = $2^8 = 256$ colours

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:



Worksheet 4

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



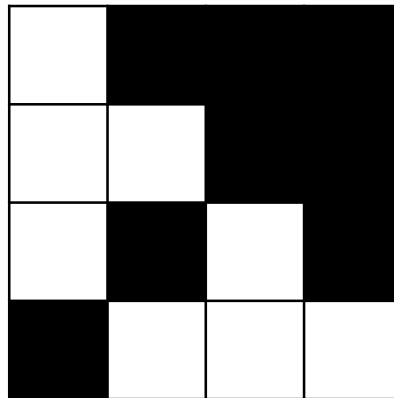
PBM monochrome images

- 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:

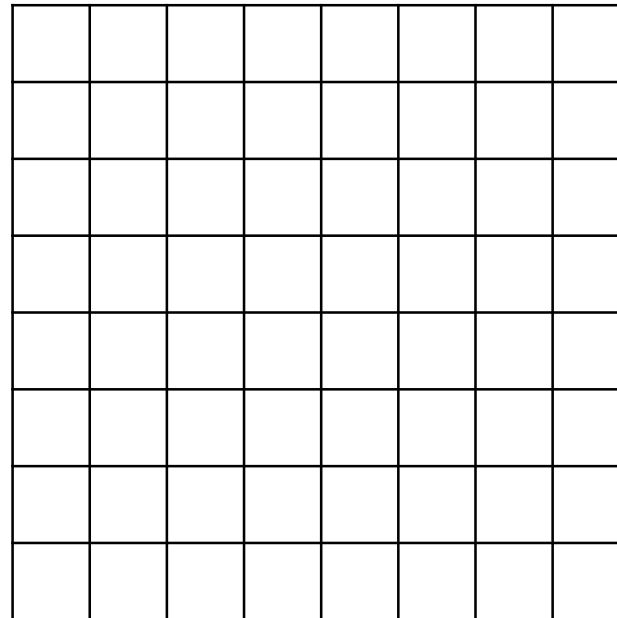


0111,
0011,
0101,
1000

Converting a bit pattern into a monochrome image

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

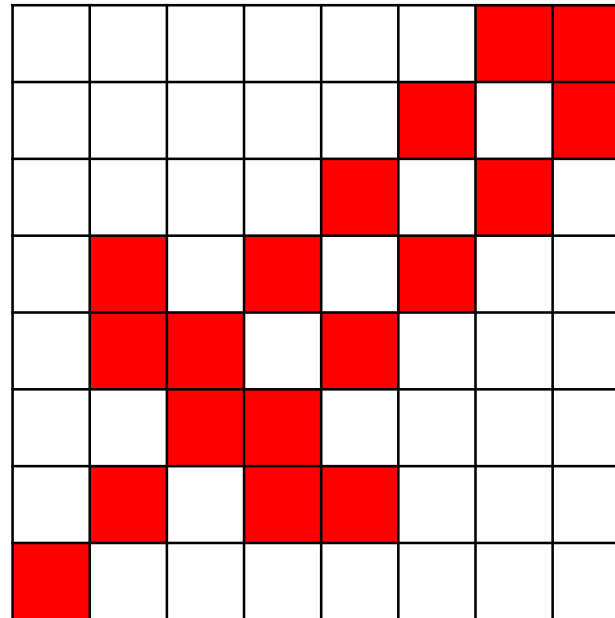
```
00000011  
00000101  
00001010  
01010100  
01101000  
00110000  
01011000  
10000000
```



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
```



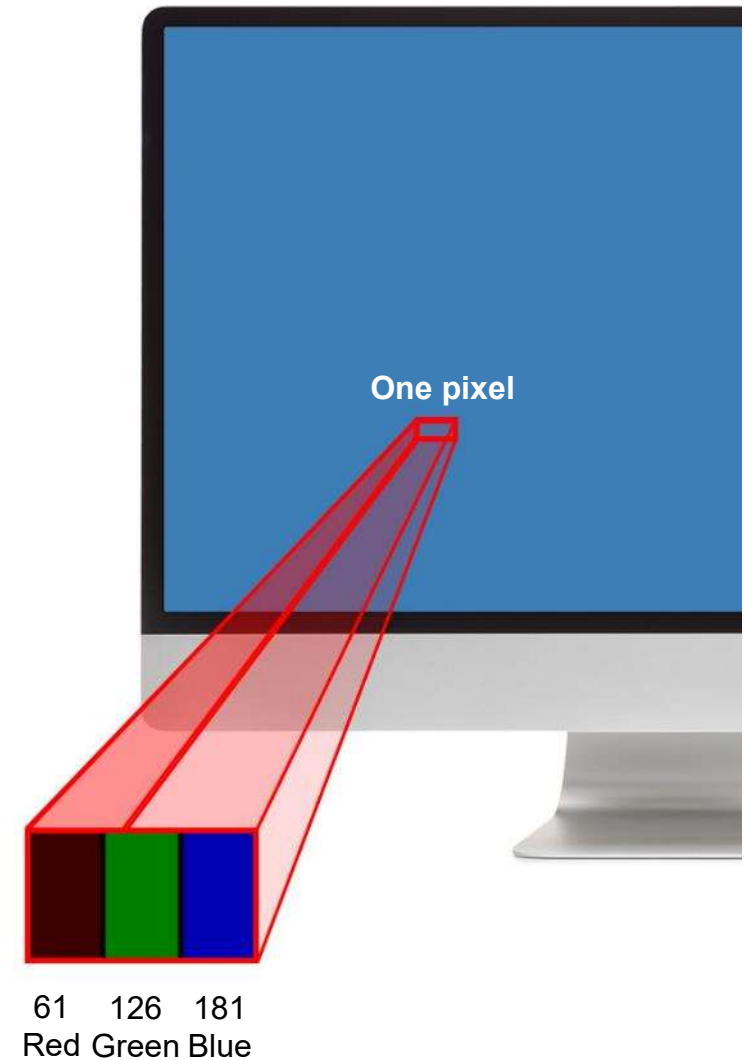
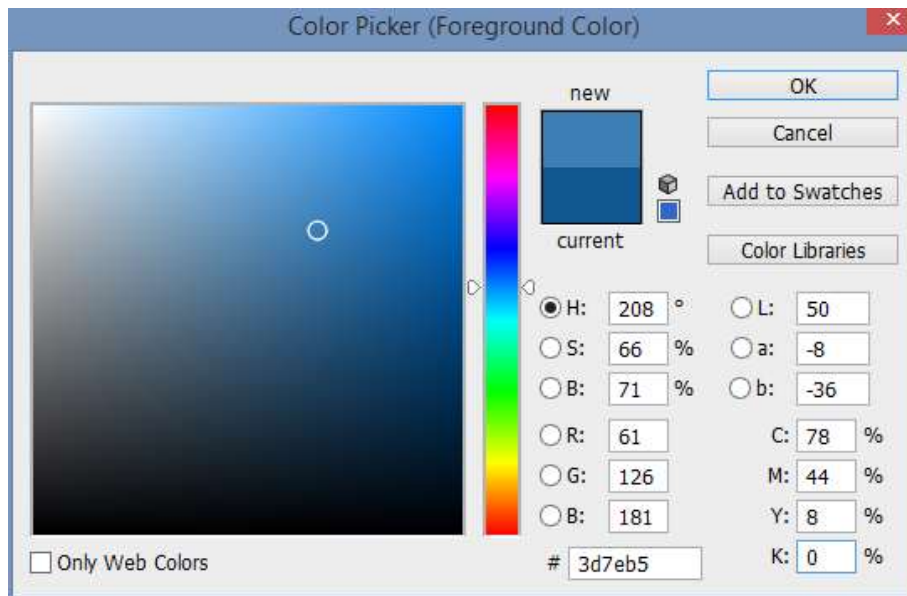
Worksheet 4

- 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



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 $3 \times 8 = 24$ 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?

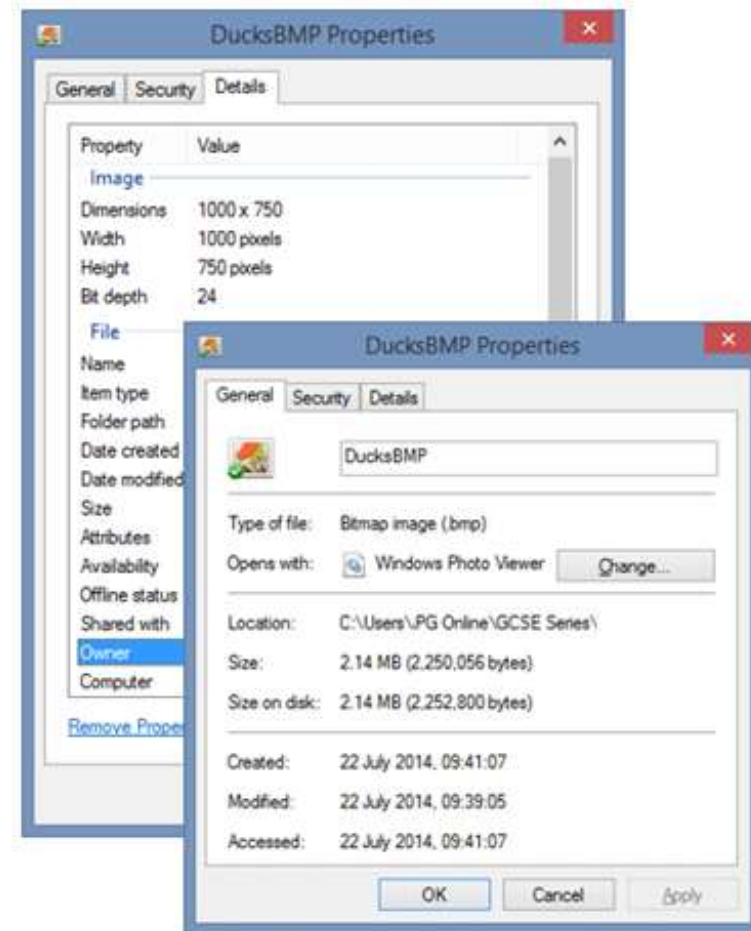


Image metadata

- 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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