Leaving Cert Computer Science Grinds - Week 6

Topic: Computer Data

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Education is the key to success

Leaving Cert Computer Science Grinds

Week 6: Computer Data

Sound & Visual Check

“I am now talking….”

“If you **cannot** hear me or see my screen please say “Cannot hear/see you” on the chat.

“If some of you can’t hear me, please restart your computer and join the class again.”

Leaving Cert Computer Science Grinds

Week 6: Computer Data

Lesson Overview:

By the end of this lesson you should:

- **Understand** the different data file sizes.
- **Understand** different data types.
- **Understand** how data is used for image, sound & video.
- **Know** what is meant by ASCII & Unicode.
- **Know** the difference between lossy & lossless compression.

1 bit	Bit	=	0 veya 1
1 byte	Byte	=	8 bit
1 Kilobyte	KB	=	1024 bytes
1 Megabyte	MB	=	1024 KB
1 Gigabyte	GB	=	1024 MB
1 Terabyte	TB	=	1024 GB
1 Petabyte	PB	=	1.024 TB

Primitive data types

- A primitive data type is one which is provided by a programming language
- They include:
  - integer a whole number such as 34, 0, -1, 567432
  - real/float a number with a fractional part such as 3.142, -67.5
  - Boolean can only take the value True or False
  - character a letter, number or special symbol such as “a”, “A”, “6”, “&”, %”
  - string anything enclosed in quote marks, for example “Jason”, “01798 158794”, “This is a string”

How are different data types held?

- All data types are held in binary
- Without knowing what the data type is, it is not possible to say what a particular bit pattern represents

```
00101000 111110001 01010111 00100100
```

- This could be one integer, 4 integers, a real number, a string, 4 characters,…
- or even a sound, a pixel or a tiny piece of a graphic

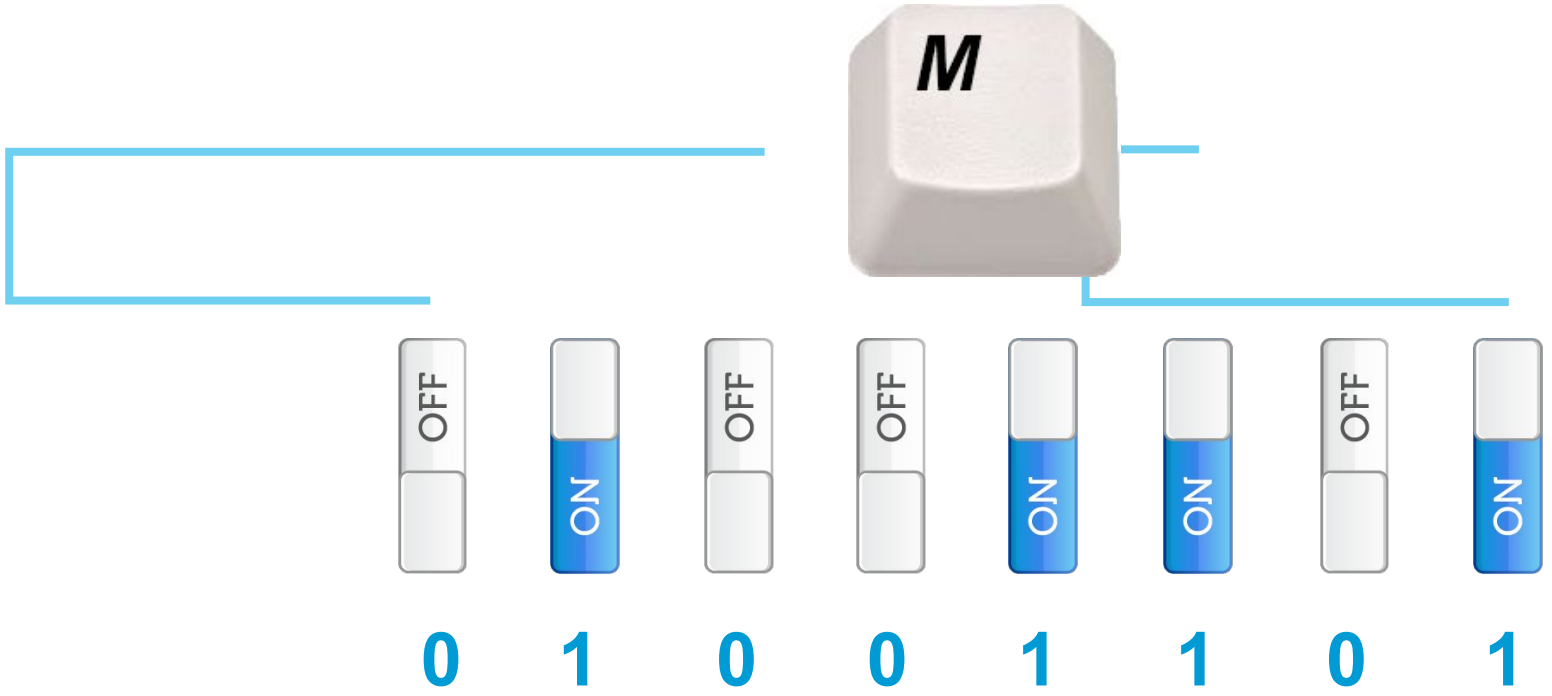
Base 2

- Numbers which use **base 2** are commonly referred to as **binary** numbers
- Can you see a pattern in the binary values?

Denary	Binary
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011

Representing text characters

- If a computer understands only 1s and 0s, what happens when the ‘M’ key is pressed on the keyboard?



Representing characters in binary

- Every character on the keyboard is represented by a binary value
- Uppercase letters (capitals) have different values from lowercase characters
- Punctuation symbols have their own characters
- How many characters are there on a standard keyboard? How many bits would be required to represent this many combinations?

The ASCII code

- **ASCII** (American Standard Code for Information Interchange) has become the standard code, used worldwide
- It was originally developed in the 1960s for representing the English alphabet
- It encodes 128 characters into 7-bit binary codes
- Characters include numbers 0 to 9, uppercase and lowercase letters A-Z, a-z, punctuation symbols and a space character

The ASCII character set

- What happens if you press ***ALT+65*** on a keyboard?
- What character is represented by 0100000 (32)?
- What is the ASCII character for the number 7? Is this the same as the binary value for 7?
  - Why not? What is happening? What does this mean?

Decimal	Binary	Character	Decimal	Binary	Character	Decimal	Binary	Character
32	00100000	space	64	01000000	@	96	01100000	'
33	00100001	!	65	01000001	A	97	01100001	a
34	00100010	"	66	01000010	B	98	01100010	b
35	00100011	£	67	01000011	C	99	01100011	c
36	00100100	$	68	01000100	D	100	01100100	d
37	00100101	%	69	01000101	E	101	01100101	e
38	00100110	&	70	01000110	F	102	01100110	f

Programming with text and numbers

- The ASCII code for ‘7’ is 011 0111
- The binary code for the digit 7 is 0000 0111
- When you write a program in Python, for example, you have to specify whether a variable is text or integer
  - You cannot do arithmetic with numbers which are represented in ASCII

7- and 8-bit ASCII

- Numerous different codes for representing characters have been invented, but ASCII is commonly used nowadays on PCs
- Originally only 7 bits were used but now the eighth bit is used to give extra characters such as ©, ® etc
  - How many different characters can be encoded using seven bits? Eight bits? 16 bits?

Working with string input

- In Python, two strings can be concatenated, or joined together, using the + symbol

```
firstname = input("Please input your first name: ")
secondname = input("Please input your second name: ")
fullname = firstname + " " + secondname
print ("Your full name is ",fullname)
```

- If you enter **Mike** for a first name and **Bell** for a second name, the computer will display

```
Your full name is Mike Bell
```

ASCII representation of numbers

- Try typing ***ALT + 55***
- What is the binary representation of the ASCII character 7? Is this the same as the binary value for 7?
  - Why not? What does this mean?

Decimal	Binary	Character	Decimal	Binary	Character	Decimal	Binary	Character
48	00110000	0	53	00110101	5	58	00111010	:
49	00110001	1	54	00110110	6	59	00111011	;
50	00110010	2	55	00110111	7	60	00111100	<
51	00110011	3	56	00111000	8	61	00111101	=
52	00110100	4	57	00111001	9	62	00111110	>

Converting ASCII to pure binary

- Clearly, we cannot do arithmetic with ASCII characters
- Programming languages deal with the input of numbers in different ways
- In some languages, variables have to be declared as type char, string, integer, real etc. at the beginning of the program
  - In other languages such as Python, all data is input as string, and if it is to be regarded as an integer, it has to be converted using an inbuilt function

e.g.

```
xString □USERINPUT
x = INT(xString)
```

Using different alphabets

- To represent other alphabets for different languages, a new code allowing for many more characters is needed
- **Unicode** was developed to use 16 bits, giving 65,536 possible combinations – enough to represent every character in every language

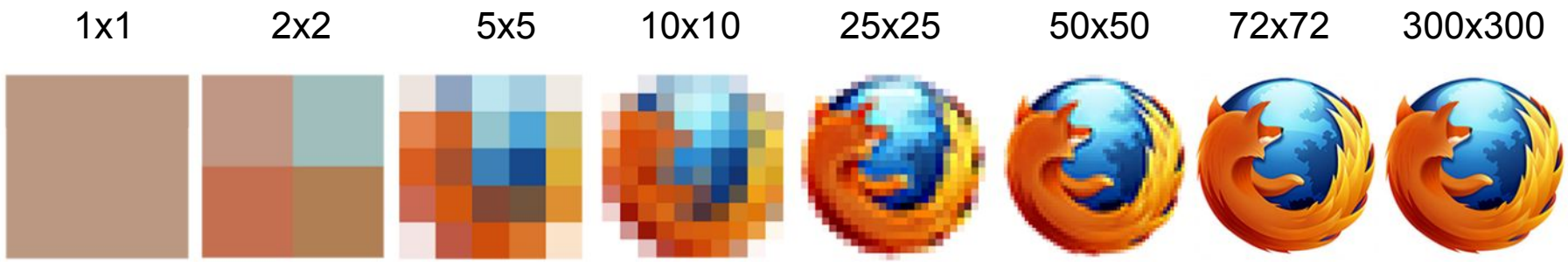
Unicode

- To display the word **Olympian** in the Greek alphabet, for example, you could use the Control Panel in Windows to install a Greek keyboard
- Then, of course, you need to buy a new keyboard so you know where the letters are!

ολύμπιος

Image resolution

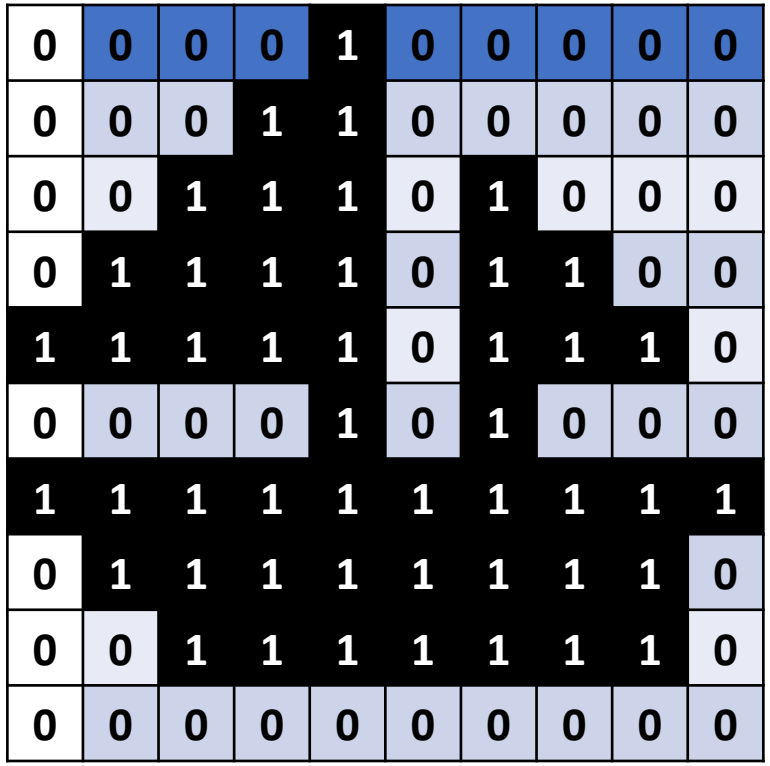
- Resolution is the concentration of pixels within a specific area
- The area is defined by the image width and height in pixels e.g. 3264x2448
- 72dpi = screen resolution
- 300 dpi = print quality resolution



Creating an Image

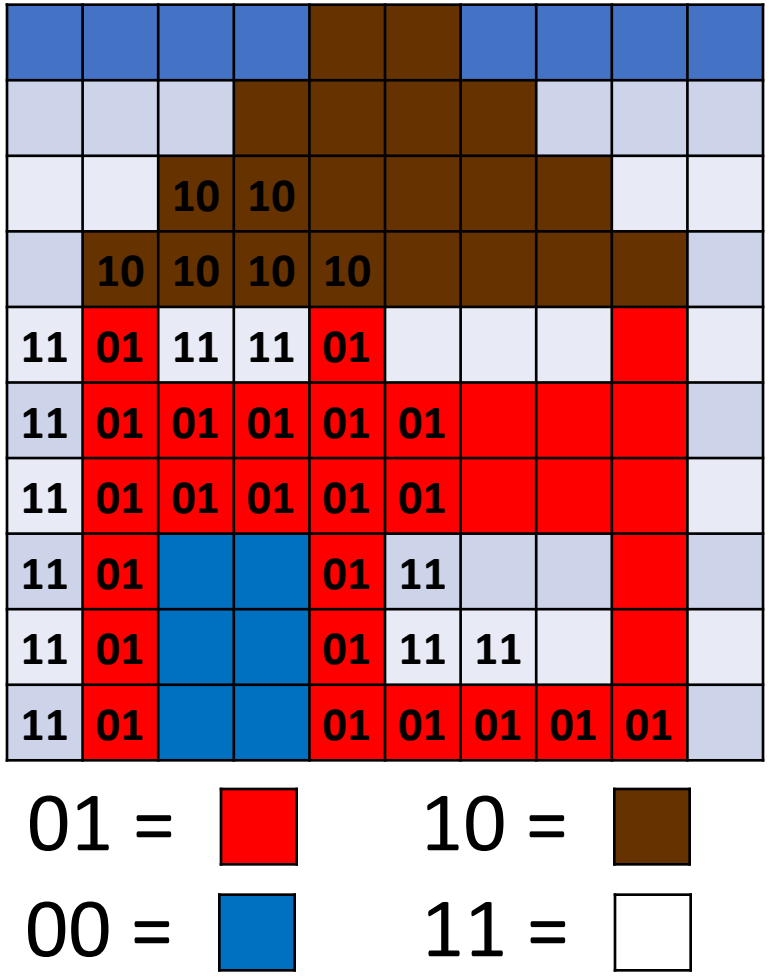
- Each pixel is given a binary value
- Each value represents a different colour
- Using one bit per pixel allows only 2 values, 0 and 1

  1 = Black, 0 = White



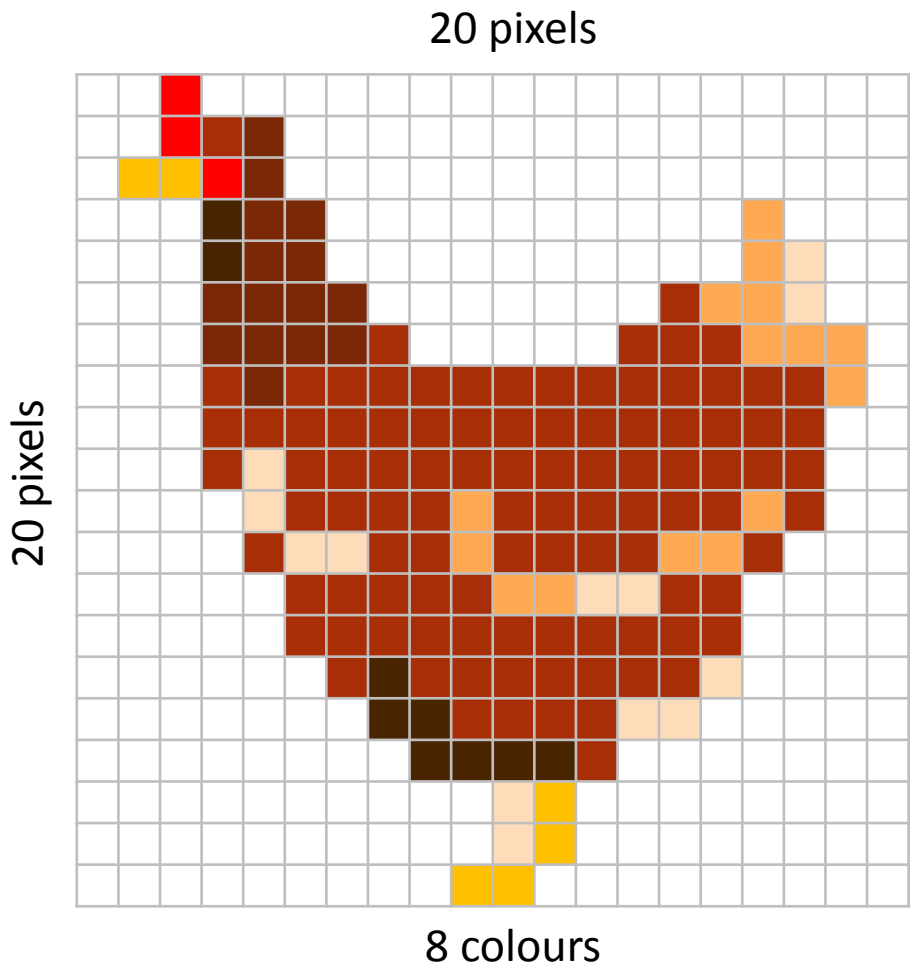
Increasing the number of colours

- 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?



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?



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

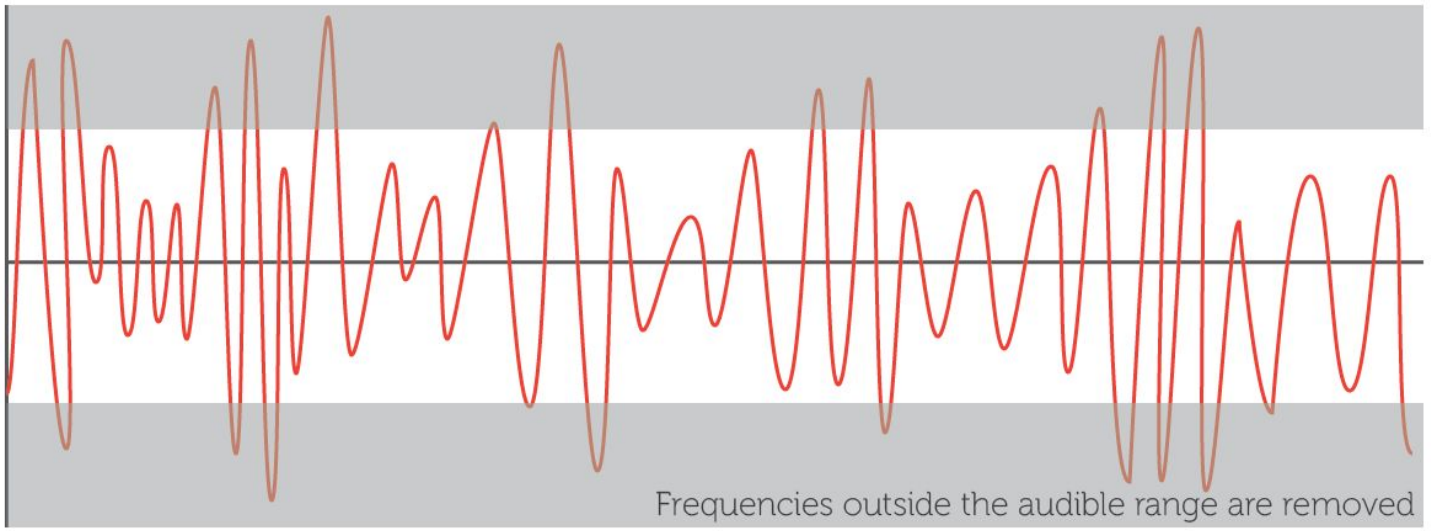
Variation in quality

- 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

Lossy compression – MP3

- Lossy compression removes the sounds in the frequency ranges that we can’t so easily hear or that least affect the perceived playback quality
- Lossy compression leaves out some data – this can affect the sound quality



Lossless compression

- Lossless compression leaves ou repeated data and instead make a note of how many times it is repeated
- *E.g. 10 x 5 takes less space to store than*

  5+5+5+5+5+5+5+5+5+5

Revision Questions (Ordinary Level)

- How many bytes are in 2 kilobytes? (2 marks)
- What is meant by the term Unicode? (3 marks)
- How many different numbers can 8 bit binary represent? (2 marks)

Revision Questions (Higher Level)

- What is the difference between lossy & lossless compression? (4 marks)

- What data type should be given to each value below. (5 marks)
  “Sean” 202 -12.3 TRUE B

- Explain how image file size can impact the quality of an image. (6 marks)

Next Weeks Lesson:
Leaving Cert Computer Science Grinds - Week 7

Topic: Networks

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