

# Template Week 1 – Bits & Bytes

Student number: 585303

## Assignment 1.1: Bits & Bytes intro

### What are Bits & Bytes?

A **bit** (binary digit) is the smallest unit of data in a computer, representing 0 or 1. It is the basic part of all computer data.

A **byte** is formed by 8 bits and represents one character that can be a letter or a symbol. It is mostly used to measure data and memory and can store 256 possible values (0-255). Bigger units include KB, MB, GB, and TB.

### What is a nibble?

4 bit (half of a byte)

### What relationship does a nibble have with a hexadecimal value?

Each nibble matches one hexadecimal digit, because 4 bits can represent 16 different values (0-F)

### Why is it wise to display binary data as hexadecimal values?

People are generally bad at reading long strings of 0s and 1s, so displaying binary data in hexadecimal makes it much easier for humans to read, write, and understand.

### What kind of relationship does a byte have with a hexadecimal value?

A byte is 8 bits, and each hexadecimal digit represents 4 bits. So one byte always becomes exactly two hexadecimal digits. This makes hexadecimal an easy and short way to show the value of a byte.

### An IPv4 subnet is 32-bit, show with a calculation why this is the case.

IPv4 is 32 bits because it uses four bytes, and each byte is 8 bits, so  $4 \times 8 = 32$  bits.

Example: An IPv4 address looks like this: 192.168.1.10

This address has 4 numbers, and each number fits into one 8-bit byte.

So the total size is: 4 bytes  $\times$  8 bits per byte = 32 bits

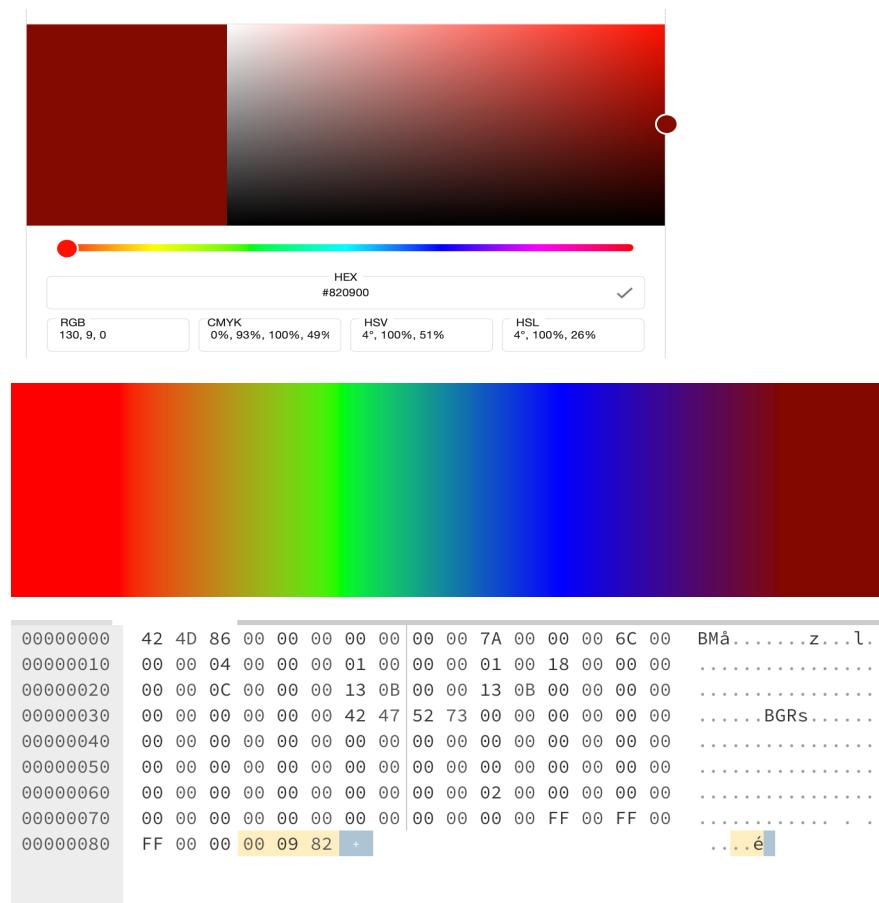
### Assignment 1.2: Your favourite color

Hexadecimal color code: 820900

### Assignment 1.3: Manipulating binary data

Color	Color code hexadecimal (RGB)	Big Endian	Little Endian
RED	FF0000	FF0000	0000FF
GREEN	00FF00	00FF00	00FF00
BLUE	0000FF	0000FF	FF0000
WHITE	FFFFFF	FFFFFF	FFFFFF
Favourite (previous assignment)	820900	820900	00 09 82

### Screenshot modified BMP file in hex editor:



#### Assignment 1.4: Student number to HEX and Binary

Convert your student number to a hexadecimal number and a binary number.

Explain in detail that the calculation is correct. Use the PowerPoint slides of week 1.

1) Convert 585303 (decimal)  $\rightarrow$  hexadecimal

$$\begin{aligned} 585303 \div 16 &= 36581 \text{ remainder } 7 \\ 36581 \div 16 &= 2286 \text{ remainder } 5 \\ 2286 \div 16 &= 142 \text{ remainder } 14 \rightarrow E \text{ (hexdigit)} \\ 142 \div 16 &= 8 \text{ remainder } 14 \rightarrow E \text{ (hexdigit)} \\ 8 \div 16 &= 0 \text{ remainder } 8 \end{aligned}$$

Hexadecimal result = 8EE57

2) Convert to binary

$$\begin{array}{ll} 8 \rightarrow 1000 & \\ E \rightarrow 1110 & \\ E \rightarrow 1110 & \text{Binary result:} \\ 5 \rightarrow 0101 & 10001110111001010111 \\ 7 \rightarrow 0111 & \end{array}$$

3) Verify that is correct

$$\begin{aligned} 8 \times 16^4 &= 524288 \\ E(14) \times 16^3 &= 57344 \\ E(14) \times 16^2 &= 3584 \\ 5 \times 16^1 &= 80 \\ 7 \times 16^0 &= 7 \quad + \\ & \hline & 585303 \end{aligned}$$

Explanation:

I divide my student number (decimal number) by 16 repeatedly to get the hex digits (remainders). That gives 8EE57. Each hex digit maps to 4 binary bits (nibbles), so 8EE57  $\rightarrow$  1000 1110 1110 0101 0111. Re-converting the hex digits using place values ( $8 \times 16^4 + 14 \times 16^3 + 14 \times 16^2 + 5 \times 16 + 7$ ) giving as a result 585303 and proving the conversion is correct.