

Week 1 – Bits & Bytes

Student number: 578438

Assignment 1.1: Bits & Bytes intro

What are Bits & Bytes?

Bit is the smallest unit of the data in a computer which represents value of 0 or 1.

Bytes is the standard unit used to represent a character of data. 1 Byte consists of 8 bits.

What is a nibble?

A nibble consists of 4 bits.

What relationship does a nibble have with a hexadecimal value?

1 nibble is equivalent to 1 hexadecimal value.

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

Because it is easier and simpler to write and read compared to binary data.

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

2 hexadecimal digit is equivalent to 1 byte.

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

An IPv4 is split in 4 spaces, with 8 bits in each space, if we multiply the 4 spaces by the 8 bits that are in each space, we get the result $4 * 8 = 32$.

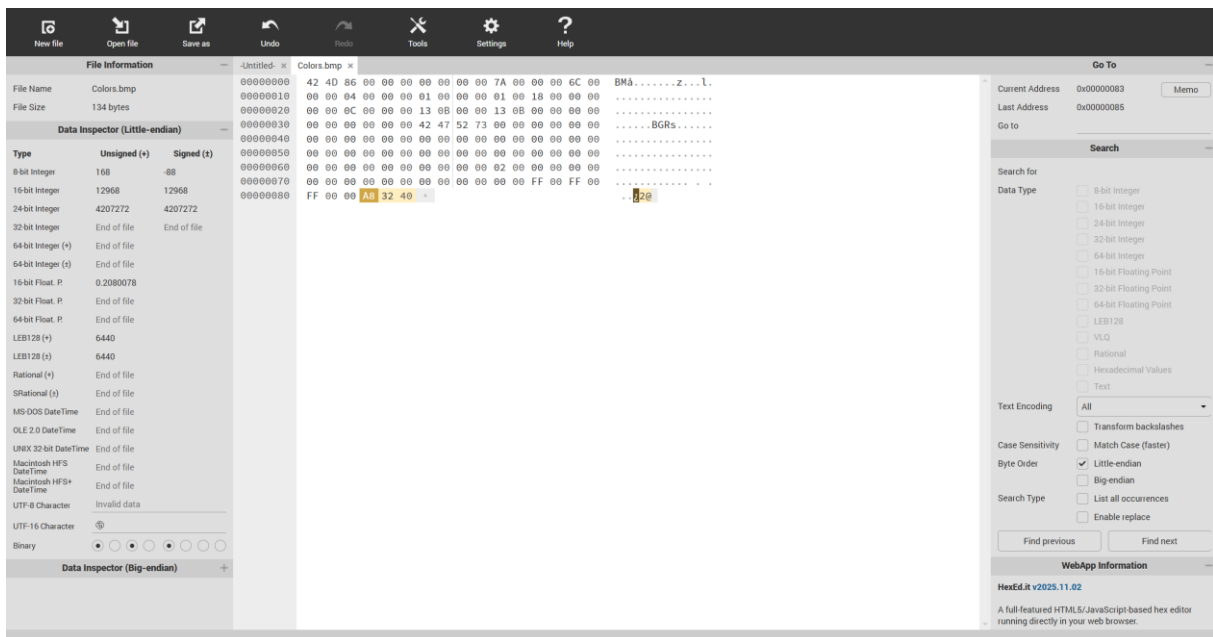
Assignment 1.2: Your favourite color

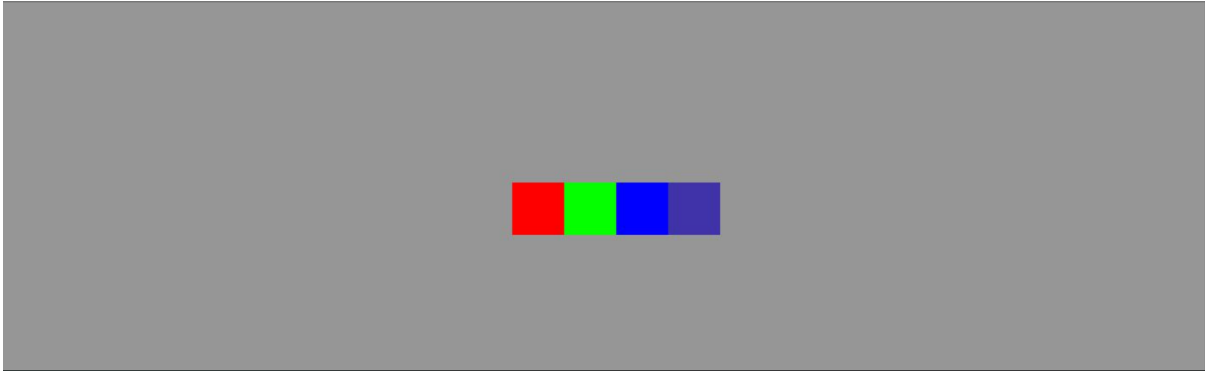
Hexadecimal color code: 4032A8

Assignment 1.3: Manipulating binary data

| Color | Color code hexadecimaal (RGB) | Big Endian | Little Endian |
|------------------------------------|----------------------------------|------------|---------------|
| RED | FF0000 | FF 00 00 | 00 00 FF |
| GREEN | 00FF00 | 00 FF 00 | 00FF00 |
| BLUE | 0000FF | 00 00 FF | FF 00 00 |
| WHITE | FFFFFF | FF FF FF | FF FF FF |
| Favourite (previous assignment) | 4032A8 | 40 32 A8 | A8 32 40 |

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.

Student number: 578438

Student number in Binary: 10001101001110000110

$$578438/2 = 289219 \quad 0$$

$$289219/2 = 144609 \quad 1$$

$$144609/2 = 72304 \quad 1$$

$$72304/2 = 36152 \quad 0$$

$$36152/2 = 18076 \quad 0$$

$$18076/2 = 9038 \quad 0$$

$$9038/2 = 4519 \quad 0$$

$$4519/2 = 2259 \quad 1$$

$$2259/2 = 1129 \quad 1$$

$$1129/2 = 564 \quad 1$$

$$564/2 = 282 \quad 0$$

$$282/2 = 141 \quad 0$$

$$141/2 = 70 \quad 1$$

$$70/2 = 35 \quad 0$$

$$35/2 = 17 \quad 1$$

$$17/2 = 8 \quad 1$$

$$8/2 = 4 \quad 0$$

$$4/2 = 2 \quad 0$$

$$2/2 = 1 \quad 0$$

$$1/2 = 0 \quad 1$$

To convert a decimal number to binary, we divide the decimal number by 2, and keep track of the remainders, after that, we read the remainders from last to first, and that is the binary representation of the decimal number.

Decimal to binary

Example: Convert Decimal 19 to Binary

1. $19 \div 2 = 9$, remainder 1
2. $9 \div 2 = 4$, remainder 1
3. $4 \div 2 = 2$, remainder 0
4. $2 \div 2 = 1$, remainder 0
5. $1 \div 2 = 0$, remainder 1

Now, reading the remainders from bottom to top, the binary representation of **19** is **10011**.

Divide by 2:

Converting a **decimal number** to **binary** involves dividing the decimal number by 2 and recording the remainders.

Steps to Convert Decimal to Binary:

1. Divide the decimal number by 2.
2. Record the remainder (it will be either 0 or 1).
3. Divide the quotient (the result of the division) by 2 again.
4. Repeat the process until the quotient becomes 0.
5. Read the remainders from bottom to top to get the binary equivalent.

Fig: From Slide 30

Student number in Hexadecimal: 8D386

$$578438 / 16 = 36152 \mid 6$$

$$36152/16 = 2259 \quad \mid 8$$

$$2259/16 = 141 \quad \mid 3$$

$$141/16 = 8 \quad \mid 13$$

$$8/16 = 0 \quad \mid 8$$

The conversion of decimal to hexadecimal applies the same logic as the decimal to binary conversation, but instead of dividing by 2, we divide the decimal value by 16. If we wanted to convert from hexadecimal directly to Binary, we would have to convert each hexadecimal digit to binary (Using the same logic of decimal to Binary, since the digits carry the same value) taking into consideration that each digit corresponds to 4 binary digits, and then combine the binary groups

Decimal to hexadecimal

Example: Convert Decimal 945 to Hexadecimal

1. $945 \div 16 = 59$, remainder **1**
2. $59 \div 16 = 3$, remainder **11**(B in hex)
3. $3 \div 16 = 0$, remainder **3**

Reading the remainders from bottom to top, the hexadecimal representation of **945** is **3B1**.

Divide by 16:

To convert a **decimal number** to **hexadecimal** (base-16), you divide the number by **16** and use the remainders to form the hexadecimal equivalent.

1. Divide the decimal number by 16.
2. Record the remainder, which will be a value from 0 to 15.
3. Divide the quotient by 16.
4. Repeat until the quotient becomes 0.
5. Read the remainders from bottom to top to get the hexadecimal value.

MY Student number in hexadecimal to binary: 8D383 = 10001011001110000110

8D383

$$8 / 2 = 4 \mid 0$$

$$4 / 2 = 2 \mid 0$$

$$2 / 2 = 1 \mid 0$$

$$1 / 2 = 0 \mid 1$$

$$8 = 1000$$

$$D = 13 / 2 = 6 \mid 1$$

$$6 / 2 = 3 \mid 0$$

$$3 / 2 = 1 \mid 1$$

$$1 / 2 = 0 \mid 1$$

$$D = 1101$$

$$3 / 2 = 1 \mid 1$$

$$1 / 2 = 0 \mid 1$$

$$3 = 0011$$

$$8 / 2 = 4 \mid 0$$

$$4 / 2 = 2 \mid 0$$

$$2 / 2 = 1 \mid 0$$

$$1 / 2 = 0 \mid 1$$

$$8 = 1000$$

$$6 / 2 = 3 \mid 0$$

$$3 / 2 = 1 \mid 1$$

$$1 / 2 = 1 \mid 1$$

$$6 = 0110$$

Hexadecimal to binary

Example: Convert Hexadecimal 1A3 to Binary

- ✓ Convert each hexadecimal digit to binary:
 - 1 in hexadecimal = **0001** in binary.
 - A in hexadecimal = **1010** in binary.
 - 3 in hexadecimal = **0011** in binary.
- ✓ Combine the binary groups:
 - **0001 1010 0011**

So, the hexadecimal number **1A3** is **000110100011** in binary.

Hexadecimal:

To convert a **hexadecimal number** (base-16) to **binary** (base-2), follow a simple process because each hexadecimal digit corresponds to exactly **4 binary digits** (since $2^4 = 16$).

Steps to Convert Hexadecimal to Binary:

1. **Write down the hexadecimal number.**
2. **Convert each hexadecimal digit** to its 4-bit binary equivalent.
3. **Combine all the binary groups** to get the final binary number.

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