DEPARTMENT OF Computer Science

# Unit 9.1 (CS) - Number Systems

Year 9 Computer Science
Knowledge Organiser

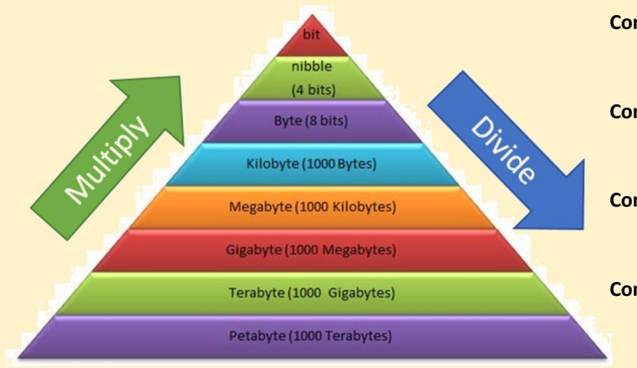
## Key Vocabulary

| | |
|---|---|
| **Units of Storage** | The names given to the measurement units for data. Bit, Nibble, Byte, Kilobyte, Megabyte, Gigabyte, Terabyte, Petabyte. |
| **Number System** | A set of rules for displaying numerical values. |
| **Base Number** | The value that a number system is built around. Controls the column headings and available digits to show a value. |
| **Binary** | Base-2. Column headings: 16, 4, 8 , 2, 1 etc. (2x bigger each time). Only uses digits 0 and 1. |
| **Denary** | Base-10. Column headings: 1000, 100, 10, 1 etc. (10x bigger every time) Uses digits 0-9. |
| **Hexadecimal (Hex)** | Base-16. Column headings: 256, 16, 1 etc. (16x bigger each time). Uses digits 0-9 and A-F. |
| **Use of Binary** | Matches the computers On/Off values used to store and send data. Allows us to program computers with machine code. |
| **Use of Denary** | Used by humans for maths. Also called the decimal system. |
| **Use of Hexadecimal** | Shorthand version of binary. Easier for humans to understand and faster to enter than binary. 4 binary digits converts into 1 hex digit. |
| **Binary Shift** | Moving the ones in a binary number to the left or right to multiply or divide it by 2 (one place), 4 (2 places), 8 (3 places) etc. |
| **Overflow Error** | Where there is not enough space in memory to store the whole result of a binary calculation, resulting in an incorrect answer. |

## Key Objectives

| | |
|---|---|
| I can convert data from one unit of storage to another. | |
| I can explain why binary, denary and hexadecimal are used. | |
| I can convert numbers between binary, denary and hex. | |
| I can perform a binary shift and explain what happened to the binary value | |

## UNITS OF STORAGE




**Convert 5 Megabytes to Kilobytes:**

5 x 1,000 = 5,000 KB

**Convert 2,000 Kilobytes to Megabytes:**

2,000 / 1,000 = 2 MB

**Convert 1 Gigabyte to Kilobytes:**

1 x 1,000 x 1,000 = 1,000,000 KB

**Convert 5,000 Megabytes to Terabytes:**

(5,000 / 1,000) / 1,000 = 0.005 TB

*8 /8 | *1000 /1000 | *1000 /1000 | *1000 /1000 | *1000 /1000 | *1000 /1000

| bit | Byte | KB | MB | GB | TB | PB |
|---|---|---|---|---|---|---|
| 8,000,000 | 1,000,000 | 1,000 | 1 | 0.001 | 0.000001 | 0.00000001 |

## DENARY AND HEXADECIMAL

Converting the **Hex** number **5C** into **Denary**:

| 16 | 1 | |
|---|---|---|
| 5 | C | **1.** Write Headings<br>**2.** Write hex underneath |

5x16 = 80 12x1 = 12 — **3.** Multiply each digit by its heading.

80 + 12 = 92 — **4.** Add results together

**Answer = 92**

Converting the **Denary** number **167** into **Hex**:

| 16 | 1 | |
|---|---|---|
| A | 7 | **1.** Write Headings |

**2.** How many whole 16's fit into 167?

**16 x 10 = 160**

**(we write A instead of 10)**

**3.** how many are left over?

**167 - 160 = 7**

## BINARY AND HEXADECIMAL

**Using the example 11000110:**

**1.** Convert each hex digit into a group of 4 binary digits.

**2.** Convert each group of 4 binary digits into 1 hex digit.

| 1100 | 0110 |
|---|---|
| B | 6 |

| 38 | 1101 | A7 |
|---|---|---|
| **Denary** | **Binary** | **Hexadecimal** |
| 0 | 0 | 0 |
| 1 | 1 | 1 |
| 2 | 10 | 2 |
| 3 | 11 | 3 |
| 4 | 100 | 4 |
| 5 | 101 | 5 |
| 6 | 110 | 6 |
| 7 | 111 | 7 |
| 8 | 1000 | 8 |
| 9 | 1001 | 9 |
| 10 | 1010 | A |
| 11 | 1011 | B |
| 12 | 1100 | C |
| 13 | 1101 | D |
| 14 | 1110 | E |
| 15 | 1111 | F |

### ADDING 2 BINARY NUMBERS TOGETHER

| Rules |
|---|
| 0 + 0 = 0 |
| 0 + 1 = 1 |
| 1 + 1 = 0 carry 1 |
| 1 + 1 + 1 = 1 carry 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| + | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| | | 1 | 1 | | | | | |

Start

## BINARY SHIFTS

| Start number (binary) | Start number (denary) | Shift to perform | Answer (binary) | Answer (denary) | Effect on the number? |
|---|---|---|---|---|---|
| 10100100 | 164 | -> 1 place | 01010010 | 82 | Divided by 2 |
| 01101010 | 106 | <- 1 place | 11010100 | 212 | Multiplied by 2 |
| 01010000 | 80 | -> 2 places | 00010100 | 20 | Divided by 4 |
| 00011100 | 28 | <- 2 places | 01110000 | 112 | Multiplied by 4 |

SCAN ME

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