# Data Representation

Lesson 2 – Hexadecimal - Binary

# Learning Purpose

## Previous Learning

- Understanding the binary number system
- Converting between binary and denary

By the end of this lesson I will be able to:

- Understand the need for hexadecimal
- Convert between hexadecimal and binary

## Future Learning

Data Representation:

- Converting between denary and hexadecimal

Subject Specific Vocabulary: hexadecimal, nibble, byte, bit

# Preparation

- Go to Class Notebook
- Section: Data Representation
- Page: Binary

# Binary Number System in Computing

Refresher - binary number system

- The binary number system works on **base 2** number system, consisting of two values: **0 and 1**
- The binary number system is used in computer devices because it is **easier to represent ONLY two states (on and off) when using electronic circuits** (switches)

**Binary place values**

- In GCSE Computer Science, we usually use an 8 - bit number.
  **8 - bit numbers** are referred to as a **byte**.

# Hexadecimal

Page: Hexadecimal

- Because binary numbers are very long …
  - example, the denary number 150 is 10010110 in binary,
- … they are not ideal for use by humans – we could easily make a mistake when writing down long streams of 1s and 0s.
- Hexadecimal number system works on base 16 - that is, there are **16 different symbols** to represent each single value
- The hexadecimal system uses **numbers 0 to 9**, then uses **letters A to F** to represent the remaining values

# Hexadecimal

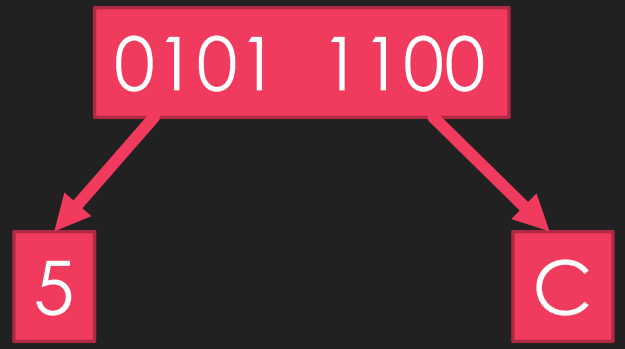
- This table shows the relationship between denary, binary and hexadecimal:

| Denary | Bin | Hex |
|---|---|---|
| 0 | 0000 | 0 |
| 1 | 0001 | 1 |
| 2 | 0010 | 2 |
| 3 | 0011 | 3 |
| 4 | 0100 | 4 |
| 5 | 0101 | 5 |
| 6 | 0110 | 6 |
| 7 | 0111 | 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 |

# Converting Binary to Hexadecimal

- To convert binary to hexadecimal, starting from the right, we group the binary numbers into groups of 4 (or nibbles)
- We then convert each nibble into a single hexadecimal value.

Example:




- Therefore **01011100** is equivalent to **5C**

| Denary | Bin | Hex |
|---|---|---|
| 0 | 0000 | 0 |
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| 8 | 1000 | 8 |
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| 12 | 1100 | C |
| 13 | 1101 | D |
| 14 | 1110 | E |
| 15 | 1111 | F |

# Exercises – Bin to Hex

Convert the following from binary into hexadecimal:

1. 00001000 **8**
2. 01000100 **44**
3. 11000011 **C3**
4. 11111111 **FF**
5. 10100100 **A4**

# Worksheet – Bin to Hex

# Worksheet Answers – Bin to Hex

- Answer 1 = 10
- Answer 2 = 29
- Answer 3 = 46
- Answer 4 = 54
- Answer 5 = 93
- Answer 6 = A8
- Answer 7 = EE
- Answer 8 = DE

# Converting Hexadecimal to Binary

- To convert hexadecimal into binary, we convert each single hexadecimal value into a four-digit binary number.

Example:

- **DA**

- The D is equivalent to 13 in denary or 1101 in binary
- The A is equivalent to 10 in denary or 1010 in binary
- Therefore **DA** is equivalent to **11011010** in binary

| Denary | Bin | Hex |
|---|---|---|
| 0 | 0000 | 0 |
| 1 | 0001 | 1 |
| 2 | 0010 | 2 |
| 3 | 0011 | 3 |
| 4 | 0100 | 4 |
| 5 | 0101 | 5 |
| 6 | 0110 | 6 |
| 7 | 0111 | 7 |
| 9 | 1001 | 9 |
| 10 | 1010 | A |
| 11 | 1011 | B |
| 12 | 1100 | C |
| 13 | 1101 | D |
| 14 | 1110 | E |
| 15 | 1111 | F |

# Exercises – Hex to Bin

Convert the following from Hexadecimal into binary (provide your answers as a byte)

1. 12 **0001 0010**
2. 7C **0111 1100**
3. 55 **0101 0101**
4. 6D **0110 1101**
5. FA **1111 1010**

# Worksheet – Hex to Bin

# Worksheet Answers – Hex to Bin

- Answer 1 = 00101111
- Answer 2 = 00110000
- Answer 3 = 01001101
- Answer 4 = 01100111
- Answer 5 = 10011101
- Answer 6 = 10101001
- Answer 7 = 11001011
- Answer 8 = 11101010

# Task – How to convert

- Add to your notes to explain:
  - How to convert from binary to hexadecimal
  - How to convert from hexadecimal to binary
- Use an example