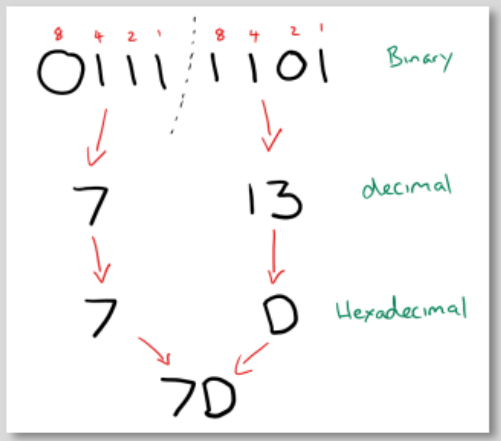## ▶ Binary to Decimal

1. Write the base 2 number system above the value.
2. Add up any number with a 1 below it.

$$128 \quad 64 \quad 32 \quad 16 \quad 8 \quad 4 \quad 2 \quad 1$$
$$01101110 \rightarrow 0110 1110$$
$$64 + 32 + 8 + 4 + 2 = 110$$

▶ Binary to Hexadecimal

1. Split the binary number into 2 nibbles.
2. Convert each nibble to decimal and the hexadecimal.

$$8 \quad 4 \quad 2 \quad 1 \quad 8 \quad 4 \quad 2 \quad 1$$
$$0111 / 1101 \quad \text{Binary}$$
$$7 \qquad 13 \quad \text{decimal}$$
$$7 \qquad D \quad \text{Hexadecimal}$$
$$7D$$

▶ Decimal to Binary

1. Start from the left and check if 128 will fit into your number, if it does, write a 1 under it and take 128 from the total. Keep going along the binary values.

▶ Decimal to Hexadecimal

1. Find how many 16s fit into your decimal number. Write this down as you first value.
2. Write the remainder as the second number (in hexadecimal).

$$166 = 10 \times 16's \text{ and } 6 \times 1's$$
$$A6$$

▶ Hexadecimal to Binary

1. Follow the Binary to Hexadecimal instructions in reverse.

▶ Hexadecimal to Decimal

1. Multiply the first value by 16 and the second by 1. Add them all together.

$$B4$$
$$11 \times 16 = 176 \qquad 4 \times 1 = 4$$
$$176 + 4 = 180$$

Dec to Hex Table

1 = 1
2 = 2
3 = 3
4 = 4
5 = 5
6 = 6
7 = 7
8 = 8
9 = 9
10 = A
11 = B
12 = C
13 = D
14 = E
15 = F

Overflow

When a carry occurs on the most significant bit.
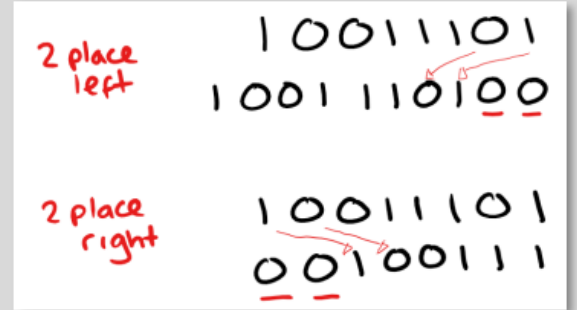
```
        11000101
        10110011
Answer  01111000
Carry   100001110
```

- Identifying that a carry on the MSB has occurred
- CPU detects that a carry has occurred and sets the overflow flag to true.

▶ Binary Shift

Left = Multiply, Right = Divide
1 place.....X or ÷ by 2
2 places.....X or ÷ by 4
3 places.....X or ÷ by 8

2 place left
$$10011101$$
$$1001110100$$

2 place right
$$10011101$$
$$00100111$$

REMEMBER - Hexadecimal is just shorthand for binary. It takes up no less space.