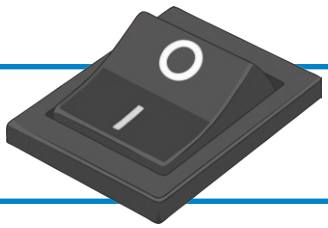
Fun with Binary Codes

The binary number system (referred to as **base 2**) has only two **bits** instead of the usual 10 in the decimal number system (also referred to as **base 10**). It relies on powers of 2 and numbers are represented by series of 0s and 1s.

Think of a light switch that is either off (0) or on (1). It is the same for transistors: they are either not conducting (0) or conducting (1).



Once you have got to grips with how it works, you could have fun writing coded messages to friends.

A **bit** (binary digit) is the smallest unit of data in a computer.

How does it work?

Power of 2	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	32	16	8	4	2	1

Example:

If you want to represent the number 32 in binary, you simply 'switch on' the 2^5 box and place zeros in the other boxes:

Power of 2	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	32	16	8	4	2	1
Binary	1	0	0	0	0	0

If you want to represent 12 in binary, switch on the 2^2 and 2^3 boxes and switch off the others:

Power of 2	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	32	16	8	4	2	1
Binary	0	0	1	1	0	0

We do this because $2^3 + 2^2$, or 8 + 4, gives us 12.

Complete the table below to represent the numbers 1 to 10 in binary. The number 5 has been completed for you.

Decimal number	Calculation	Binary number
1		
2		
3		
4		
5	$2^2 + 2^0$	101
6		
7		
8		
9		
10		

Working Backwards: Binary to Decimal

If you have a binary number, you can convert it to a decimal by placing the ones and zeros in their correct place values in the power of 2 boxes. Start at the 2^0 box and work backwards to the left. For example, 1110001 is shown in the boxes below.

Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	64	32	16	8	4	2	1
Binary Number	1	1	1	0	0	0	1

Now just add the 'lights on' – or the 1s.

64 + 32 + 16 + 1 = 113 in base 10 or as a decimal number.

Now try these examples:

a. 0101011

Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	64	32	16	8	4	2	1
Binary Number	0	1	0	1	0	1	1

0101011 in base 10 = _____

b. 0100111

Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	64	32	16	8	4	2	1
Binary Number							

0100111 in base 10 = _____

Extension

a. Investigate the history of the binary system and binary coding. Write a short report on what you find out.

b. Teach a friend how to use binary and practise sending codes to each other.

c. There are more complicated 'bases' and some which even incorporate letters as well as numbers. Find out what you can about these and see if you can convert between them. An interesting one to start you off is called hexadecimal.

Fun with Binary Codes Answers

Complete the table below to represent the numbers 1 to 10 in binary. The number 5 has been completed for you.

Decimal number	Calculation	Binary number
1	2^0	**1**
2	2^1	**10**
3	$2^1 + 2^0$	**11**
4	2^2	**100**
5	$2^2 + 2^0$	101
6	$2^2 + 2^1$	**110**
7	$2^2 + 2^1 + 2^0$	**111**
8	2^3	**1000**
9	$2^3 + 2^0$	**1001**
10	$2^3 + 2^1$	**1010**

Now try these examples:

a. 0101011

Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	64	32	16	8	4	2	1
Binary Number	0	1	0	1	0	1	1

0101011 in base 10 = **32 + 8 + 2 + 1 = 43**

b. 0100111

Power of 2	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Decimal	64	32	16	8	4	2	1
Binary Number	**0**	**1**	**0**	**0**	**1**	**1**	**1**

0100111 in base 10 = **32 + 4 + 2 + 1 = 39**