DECIMAL NUMBERS

In our daily lives we count using the decimal number system. Decimal is also known as base-10. In base-10, ten digits (0,1,2,3,4,5,6,7,8,9) are used in each place to describe any numerical value.

The place values in the decimal numeral system is based on powers of 10. Each number position has 10 times the value of the number to the right.

Decimal Place Value (Base 10)

Place Value	Hundred Thousands Place	Ten Thousands Place	Thousands Place	Hundreds Place	Tens Place	Ones Place
Exponential Notation	10^5	10^4	10^3	10^2	10^1	10^0
Value	100,000	10,000	1000	100	10	1

BINARY NUMBERS

Binary refers to a numbering system that uses only two digits, 0 and 1. In the binary numbering system, each digit represents a power of two allowing for the representation of any number as a sequence of 0's and 1's.

When looking at binary numbers the smallest place value is to the right and each digit is two times the value of the one immediately to its right.

Binary Number (Base-2)

Place Value	Eights Place	Fours Place	Twos Place	Ones Place
Exponential Notation	2^3	2^2	2^1	2^0
Value	8	4	2	1

TURNING BINARY NUMBERS INTO DECIMAL NUMBERS

Let's convert the binary number 0101 into decimal number!

Binary Number (Base-2)

Place Value	Eights Place	Fours Place	Twos Place	Ones Place
Exponential Notation	2^3	2^2	2^1	2^0
Value	8	4	2	1
2 Digits (0,1) can be used in Base-2 Number System	0	1	0	1

Binary Number (Base-2)

Eights Fours Twos Ones

0101

Let's translate this binary number 0101 to decimal. Since we can use only two digits (0 and 1) every time we see a 1 we add its place value to the overall total and every time we see a 0 it means that no additional place value is added to the overall total.

This means 0 + 4 + 0 + 1 = 5 in decimal!

TRY THIS!

Let's convert the following binary numbers into decimal numbers! Show all your work!

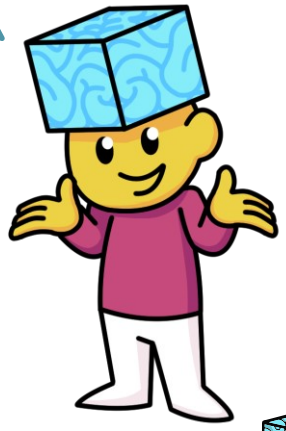
0001 =

1010 =

0111 =

1000 =

How many different numbers could you write in binary using only four digits (bits)?

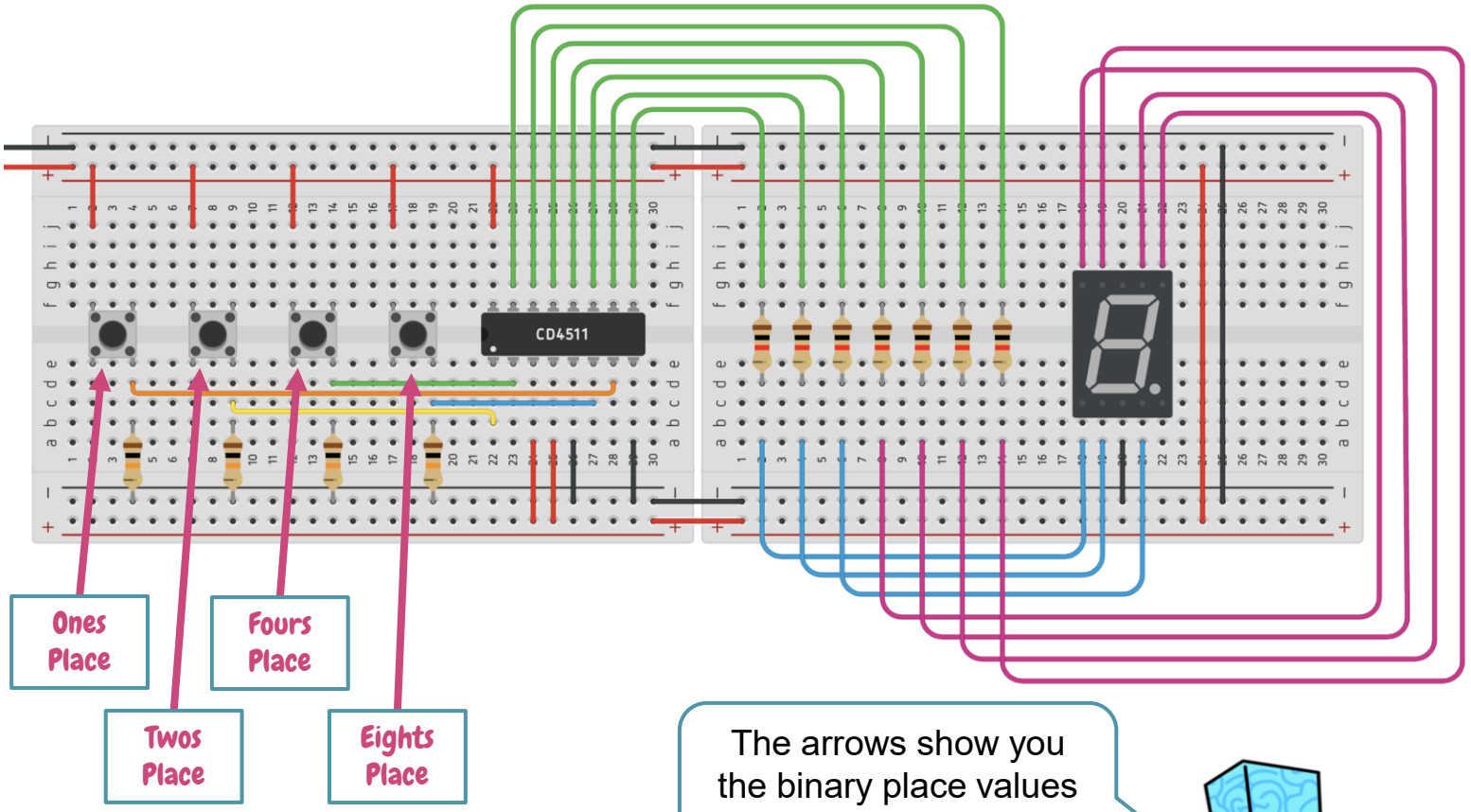


WHY DO WE USE BINARY?

We use binary numbers because computers work with electronic circuits that can be either on or off, represented by the values of 1(on) and 0 (off). By using binary numbers, we can easily represent any number, character, or other data in a series of 1's and 0's. This makes them ideal for representing and manipulating data in computer systems.

TRY THIS!

Let's build the circuit below and convert our binary input into decimal numbers on the display! ***Tip:*** when you activate any of the push button switches, it means 1 (on). When you don't activate a push button switch in means 0 (off).



Remember:
Pressing the button = 1 (on)
Not pressing the button = 0 (off)

The arrows show you the binary place values for each of the buttons!

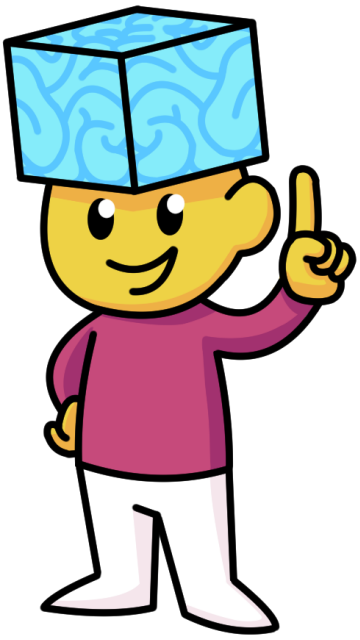
BITS, NIBBLES, AND BYTES

In a computer, when a switch is on, it represents the number 1, and when it's off, it represents the number 0. Each 1 or 0 in a binary number represents a *bit* (**B**inary dig**ITS**). A package of 4-bits is called a *nibble* and an 8-bit package (2 nibbles) represents a *byte*.

NAME	EXAMPLE
bit	1
nibble	1010
byte	11001011

TRY THIS!

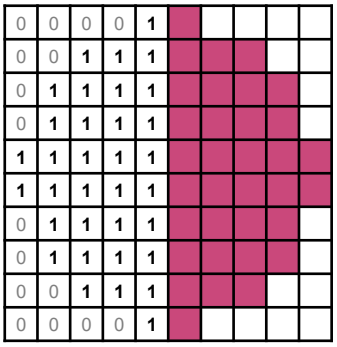
Look at the binary code below. Identify how many bits, nibbles and bytes it represents?

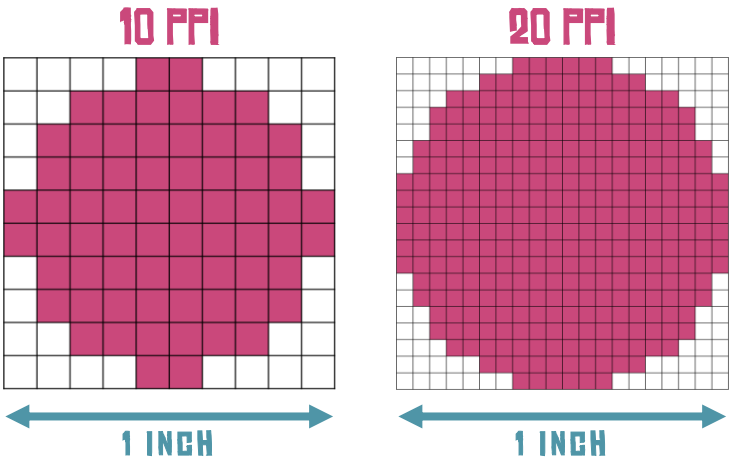


01100011 01101111 01101110 01100111
01110010 01100001 01110100 01110101
01101100 01100001 01110100 01101001
01101111 01101110 01110011 00100000
01101111 01101110 00100000 01100100
01100101 01100011 01101111 01100100
01101001 01101110 01100111 00100000
01110100 01101000 01101001 01110011
00100000 01101101 01100101 01110011
01110011 01100001 01100111 01100101
00100000 01111001 01101111 01110101
00100000 01100001 01110010 01100101
00100000 01100001 01110111 01100101
01110011 01101111 01101101 01100101

BITMAPS

A bitmap is a way to represent and store digital images in a computer. It is a type of format that uses a grid divided into tiny squares called pixels to describe an image. The pixels per inch (PPI) can be adjusted depending on the application.





The simplest digital images are monochrome (black and white) images that use one bit per pixel, “1” for black and “0” for white, or vice versa. The computer stores information about each pixel, such as its position and color, in a specific order.

TRY THIS!

Let’s convert the following bitmap image of the word HELLO into binary code. The first line of code is done for you as an example.