# CS50

Bits and Bytes

Overview

In order to store information and perform computations, computers use a unit of measure known as a **bit**. A bit, which is short for a "binary digit," is a unit of measure which has exactly two possible values: 0 and 1. By representing digital data as a long sequence of bits—each with a value of 0 or 1—computers can store large amounts of information using just two values. Computers are also capable of performing mathematical operations on bits, in order to modify the data that the computer has stored.

Key Terms

- bit
- byte
- kilobyte
- megabyte
- gigabyte
- terabyte

0 — Bit

1 — Bit

A bit can have one of just two values: 0 or 1

Byte

| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
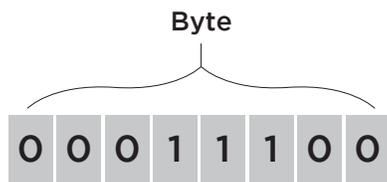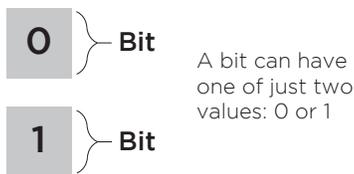
Together, a sequence of 8 bits is a byte. There are 2^8 possible ways to arrange 8 bits, so there are 2^8 (or 256) different values that a byte can have.

Sequences of Bits

One individual bit can only store two different values: 0 and 1. In terms of their physical representation inside of a computer, you can think of a bit as an electrical switch that can be switched on (represented by the value 1) or switched off (represented by the value 0).

However, one bit alone isn't very helpful for representing larger amounts of data. Therefore, sequences of bits are often used in order to allow computers to represent more combinations of numbers. **Bytes** are sequences of eight bits grouped together. Since there are 8 bits in a byte, and each bit can represent 0 or 1, there are 2^8 = 256 different possible bytes that can exist.

Bytes can also be grouped into larger units of data. A **kilobyte** is equal to 1,000 bytes. A **megabyte** is equal to 1,000 kilobytes (or 1 million bytes). A **gigabyte** is equal to 1,000 megabytes (or 1 billion bytes). And a **terabyte** is equal to to 1,000 gigabytes (or 1 trillion bytes). Even larger units exist (such as petabytes and exabytes) as well.

But even the largest units of data on a computer ultimately boil down to just sequences of 0s and 1s.

Representing Data

With a single bit, a computer can store information about whether a value is true or false, such as whether a laptop or phone is currently charging. With a byte (8 bits), there are enough possible combinations to represent characters. One byte can represent a single letter.

Larger data units can be used to store even more complex data types. The table at right demonstrates just a few such possibilities: a kilobyte is able to represent a few paragraphs of text, a megabyte is approximately equal to the size of a minute of music, and a gigabyte is equal to about half an hour of high definition movie.

Unit	Definition	Storage Space
Bit	0 or 1	yes or no
Byte	8 bits	a single letter
Kilobyte	1000 bytes	a few paragraphs
Megabyte	1000 kilobytes	one minute of MP3 music
Gigabyte	1000 megabytes	30 minutes of an HD movie
Terabyte	1000 gigabytes	16 seasons of The Simpsons