

Intro to Binary Numbers - Why should you care?

Binary

adjective

1. relating to, composed of, or involving two things.
2. relating to, using, or expressed in a system of numerical notation that has 2 rather than 10 as a base.

noun

1. the binary system: binary notation.
2. something having two parts.

Binary is more than only counting with zeros and ones!

- A way to represent letters, characters, and symbols (English, Spanish, Chinese, etc..) to computers. To a computer, there's no such thing as the number 23 or the letter "A". Those are representations meaningful to people, but they are actually a binary number on a lookup table that points to a picture of the letter "A" or the number 23.
- In addition to letters and numbers, computer designers represented command characters like `Enter`, `Backspace`, `Shift`, or `Interrupt` as binary so they could exist on the lookup table and map to keyboard keys. Each key needs to point to a binary number on that lookup table.
- Bitwise operators = faster/cheaper than division and multiplication for low energy processors
- Binary logic AKA Boolean logic gives us boolean algebra. Boolean logic is a **BIG DEAL**
- Bitmasking, which is used in everything from `audio compression` to video game graphics

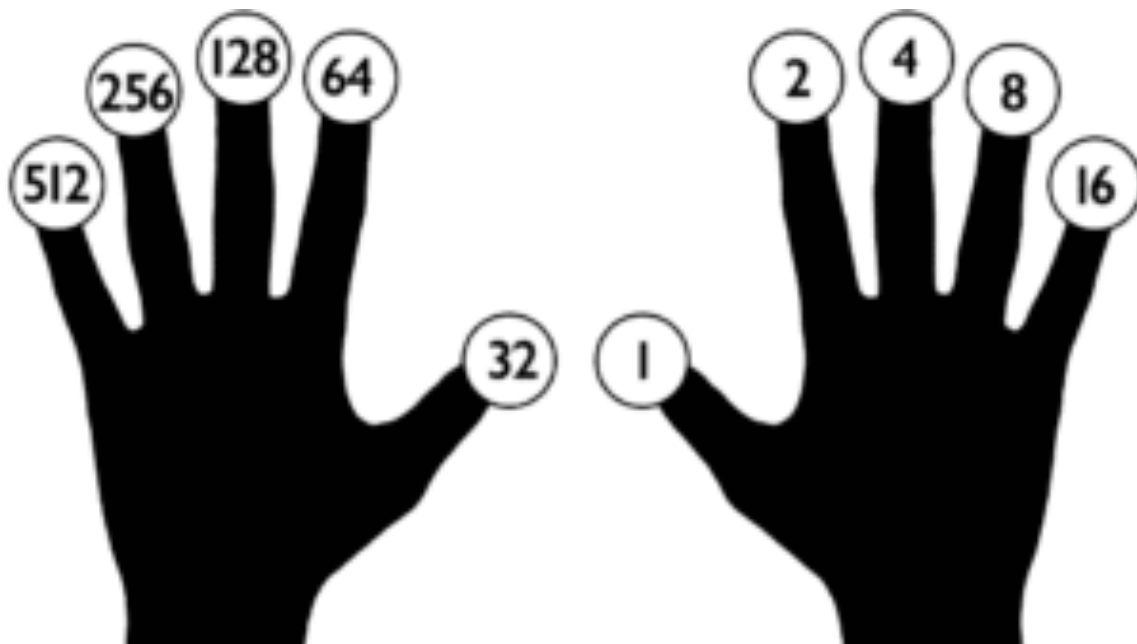
Why is binary a big deal for computers and software?

- In a way, software development is all about representing patterns in order to represent information.
- People have created all kinds of counting systems. Base 2, Base 10, Base 8, Base 16.
- Computers and Base 2 work because a 0 represents off and a 1 represents on, like a switch.
- Think of each binary exponent as a switch that can be turned on or off.
- The first computers were physical computation machines. A clock is a physical computer! The Ancient Greeks invented a machine called the `Antikytera` that computed months and seasons.

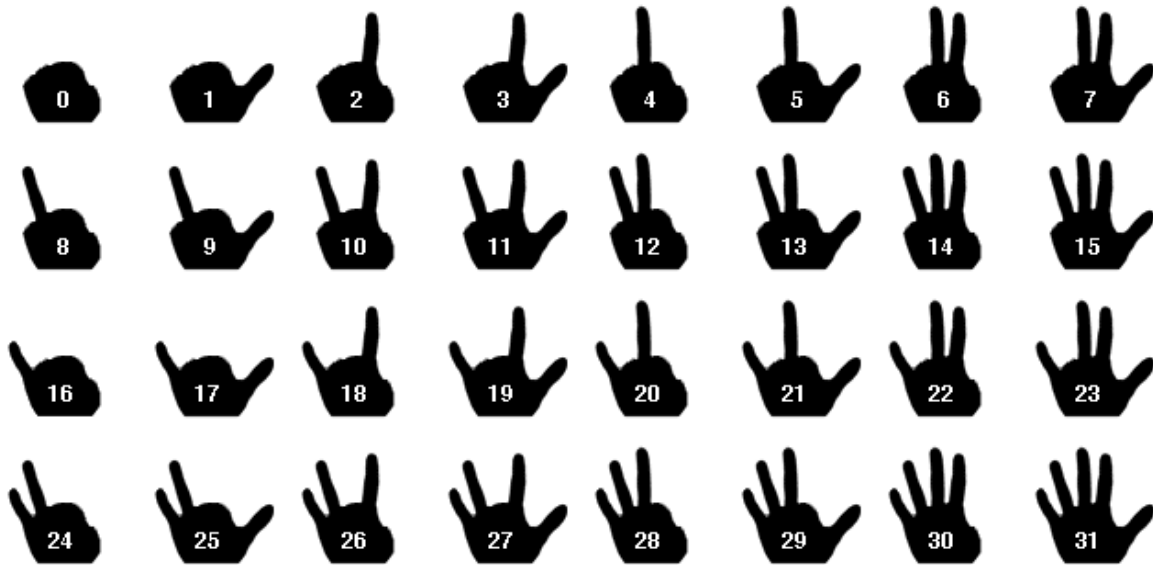


- The second wave of computers were electrically powered, but analog. What does that mean?
 - When you think `analog`, think record players. They're electrically powered but not digital.
 - This was when we used vacuum tubes and transistors. Computers were the size of entire rooms.
 - When the switch is `on`, there's current. When it's `off`, there's no current.
- Digital computers store the `on` or `off` of a switch as a `0` or a `1`. With digital representation of bits, we can store massive amounts of information on modern computers. A keyless remote for a vehicle these days has the same computing power and storage as the Apollo 11 Guidance Computer that got
- Allows the expression of as many letters, numbers, symbols, and command codes in a `byte` as possible. A `byte` is 8 bits. For example, the ASCII has 256 characters, numbers, symbols, and control codes.

You can count to 1,023 on your fingers!



Each finger represents an exponent of 2 from 0 to 9



| Expression | Exponent | Value in Base 10 |
|------------|----------|------------------|
| 2^0 | 0 | 1 |
| 2^1 | 1 | 2 |
| 2^2 | 2 | 4 |
| 2^3 | 3 | 8 |
| 2^4 | 4 | 16 |
| 2^5 | 5 | 32 |
| 2^6 | 6 | 64 |
| 2^7 | 7 | 128 |
| 2^8 | 8 | 256 |
| 2^9 | 9 | 512 |

More info

- ASCII lookup table <https://www.ascii-code.com/>
- Bitmasking and video game graphics
<https://gamedevelopment.tutsplus.com/tutorials/how-to-use-tile-bitmasking-to-auto-tile-your-level-layouts--cms-25673>
- "Why Use Binary" by Professor Brailsford <https://www.youtube.com/watch?v=thrx3SBEPt8>