**How to count in Binary?**

**What is Binary?**

* **Binary** is how computers "think" and communicate. Instead of using 10 digits like humans (0–9), computers use just **two digits: 0 and 1**. This is called **Base-2**.
  + **Real-life example**: Imagine a light switch. It’s either ON (1) or OFF (0). Computers use these two states to represent everything they do.

**How Do Humans Count?**

* Humans use **Base-10 (Decimal)** because we have 10 fingers.
  + In the decimal system, we have digits 0 through 9.
  + Example: To write the number 253:
    - 2 represents **200** (2 × 100),
    - 5 represents **50** (5 × 10),
    - 3 represents **3** (3 × 1).
  + This is called **place value**.

**How Do Computers Count in Binary?**

* Computers use **Base-2** (binary). Each digit in binary is called a **bit** (short for "binary digit").
  + Example: The binary number **1010** is read as:
    - **1 × 8** + **0 × 4** + **1 × 2** + **0 × 1** = 10 in decimal.

**How Does Binary Work?**

1. **Powers of 2**:
   * Binary place values are based on powers of 2. Going from right to left, each place doubles:
     + 1, 2, 4, 8, 16, 32, 64, 128, etc.
2. **How to Convert Binary to Decimal**:
   * Write down the binary number.
   * Multiply each digit (0 or 1) by its place value.
   * Add the results.
   * **Example**: Convert **1010** to decimal:
     + Place values: 8, 4, 2, 1
     + Multiply: (1 × 8) + (0 × 4) + (1 × 2) + (0 × 1) = 10.
3. **How to Convert Decimal to Binary**:
   * Start with the decimal number.
   * Divide it by 2, writing down the remainder (0 or 1).
   * Repeat until you reach 0.
   * Write the remainders backward to get the binary number.
   * **Example**: Convert **10** to binary:
     + 10 ÷ 2 = 5 (remainder 0)
     + 5 ÷ 2 = 2 (remainder 1)
     + 2 ÷ 2 = 1 (remainder 0)
     + 1 ÷ 2 = 0 (remainder 1)
     + Binary: **1010**.

**Why Does Binary Matter?**

* **Bits and Bytes**:
  + 1 binary digit = **1 bit**.
  + 8 bits = **1 byte**.
  + A byte can represent 256 values (from 0 to 255, because 0 counts as a value).
* **Example**:
  + Binary **11111111** = Decimal **255**.
  + Binary **00000000** = Decimal **0**.

**ASCII and Binary**

* **ASCII** assigns binary values to characters so computers can represent text.
  + Example: The letter **h** is represented in binary as **01101000**.
    - Place values: 64 + 32 + 8 = **104** (the decimal value for "h").
  + Computers use binary to store and process text in a way we can read.

**Why Powers of 2 Are Cool**

* The pattern in binary numbers comes from doubling:
  + 1, 2, 4, 8, 16, 32, 64, 128…
  + If you add these numbers up, you get **255**, which is the highest value a single byte can represent (don’t forget, 0 is also a value!).

**How Does This Apply to Real Life?**

* **Networking**: Computers use binary for things like IP addresses and data transfer.
  + Example: An IP address like **192.168.1.1** is stored in binary under the hood.
* **Security**: Binary helps computers encode and decode secure data.

**Final Example**

* Let’s say your computer receives the binary number **01101000**. How does it understand it?
  + Using ASCII, it knows this binary number = Decimal **104**, which represents the letter **h**.

By learning binary, you understand the basic language of computers! It's like unlocking the secret code that powers everything from your keyboard to the internet. 🎉