Python
Binary & Bitwise Operators

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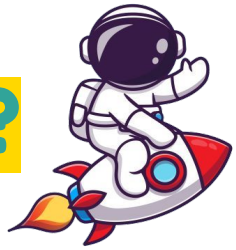
READY TO START?



السلام عليكم

Doa ilmu bermanfaat

رَبِّ زِدْنِي عِلْمًا وَارْزُقْنِيْ فَهْمًا وَاجْعَلْنِيْ مِنَ الصَّالِحِيْنَ

Robbi zidnii 'ilmaa warzuqnii fahmaa, waj'alnii minash-shoolihiin

"Ya Allah, tambahkanlah aku ilmu dan berikanlah aku rezeki akan kepahaman, dan jadikanlah aku termasuk golongan orang-orang yang saleh."

As Saffat ayat 6

إِنَّا زَيَّنَّا السَّمَاءَ الدُّنْيَا بِزِينَةٍ الْكَوَاكِبِ

Sesungguhnya Kami telah menghiasi langit dunia (yang terdekat) dengan hiasan (berupa) bintang-bintang.

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PAY ATTENTION!

RULES

for Teacher & Student

- Prepare Laptop / PC
- Focus & Listen carefully
- Open Cam and Mic
- Share screen project
- Good Communication
- Respect and kindness
- Do your best

In this lesson, you will learn about

1. Numeral System
2. Binary
3. Decimal
4. Bitwise

Introduction

A numeral system (or system of numeration) is a writing system for expressing numbers; that is, a mathematical notation for representing numbers of a given set, using digits or other symbols in a consistent manner.

source: https://en.wikipedia.org/wiki/Numeral_system

There are many symbols can represent numbers

Binary

A binary number is a number expressed in the base-2 numeral system or binary numeral system, a method of mathematical expression which uses only two symbols:

0 and 1

Computer, which is an electrical device, communicates bettween each other using electricity that converted int a binary code

electricity off = 0
electricity on = 1

Binary

It means that, computer only knows 0s and 1s as its language.

So, why computer can do so much things like processing numbers, texts, images, videos and many more?

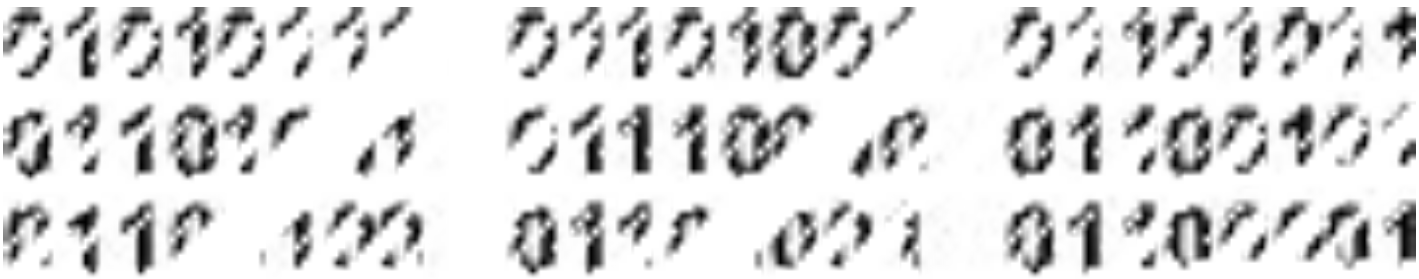
The answer is **conversion**.

With the help of Operating System and Software we are using, communication between human and computer is created.

This activity known as operating computer.

Binary

So, computer needs a conversion (from / to binary) to process all the things when it is operated



Example: The word 'Wikipedia' represented in ASCII binary code, made up of 9 bytes (72 bits).

Binary - Decimal

Decimal is a numeral system that we all familiar with. It starts from zero, ends at nine.

0 1 2 3 4 5 6 7 8 9

This is the numeral system we mostly use in our daily life.

Computer needs to process its binary code into or from decimal to understand each other (human - computer)

Decimal to Binary

Let's start with decimal and convert is to binary, we want to know, what computer will get, if we use decimal in it.

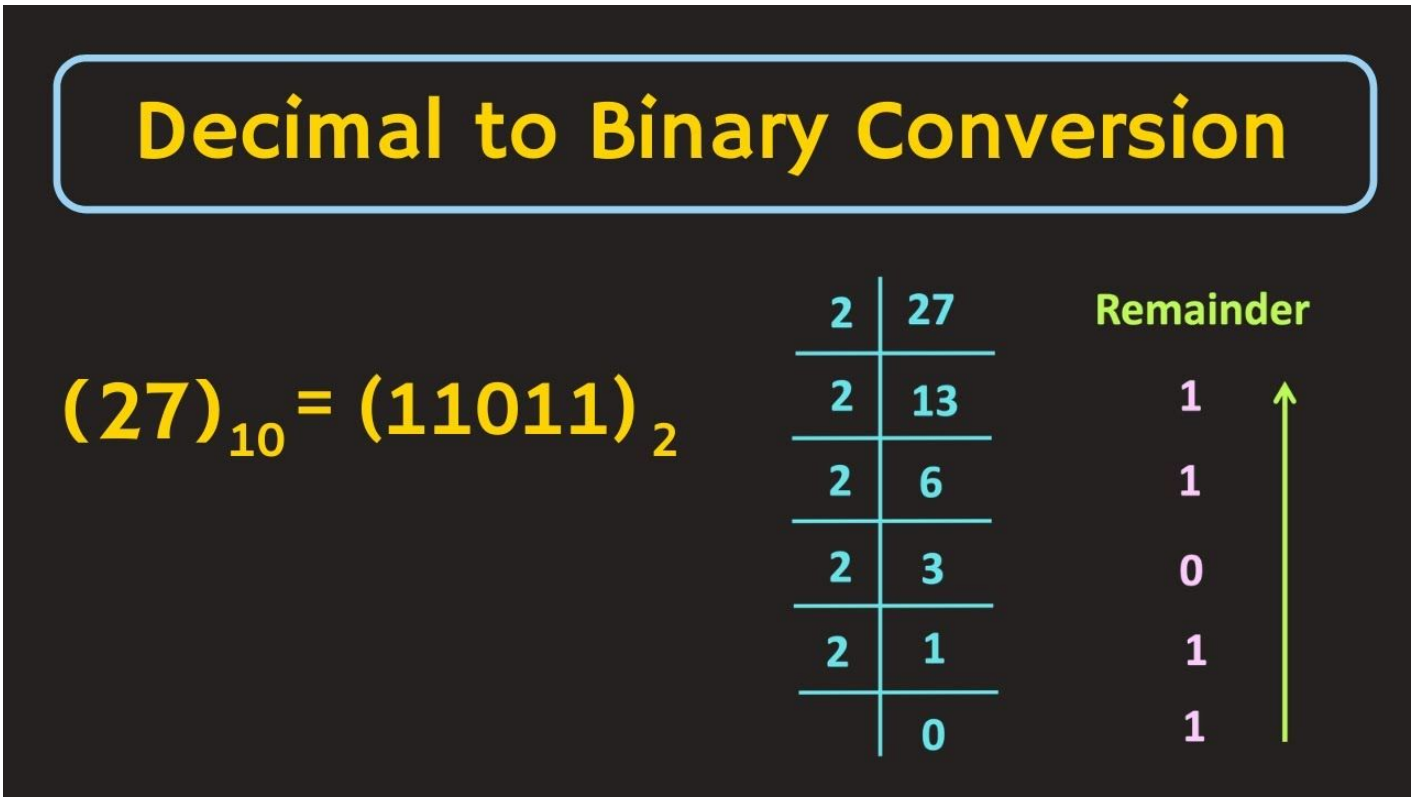
Equivalent Binary Number of Decimal Number System

Decimal Number	Binary equivalent	Decimal Number	Binary Equivalent
0	0000	8	1000
1	0001	9	1001
2	0010	10	1010
3	0011	11	1011
4	0100	12	1100
5	0101	13	1101
6	0110	14	1110
7	0111	15	1111

source:
https://electronicscoach.com/binary-number-system.html

Decimal to Binary

Here is the way to convert decimal into binary



source: ALL ABOUT ELECTRONICS

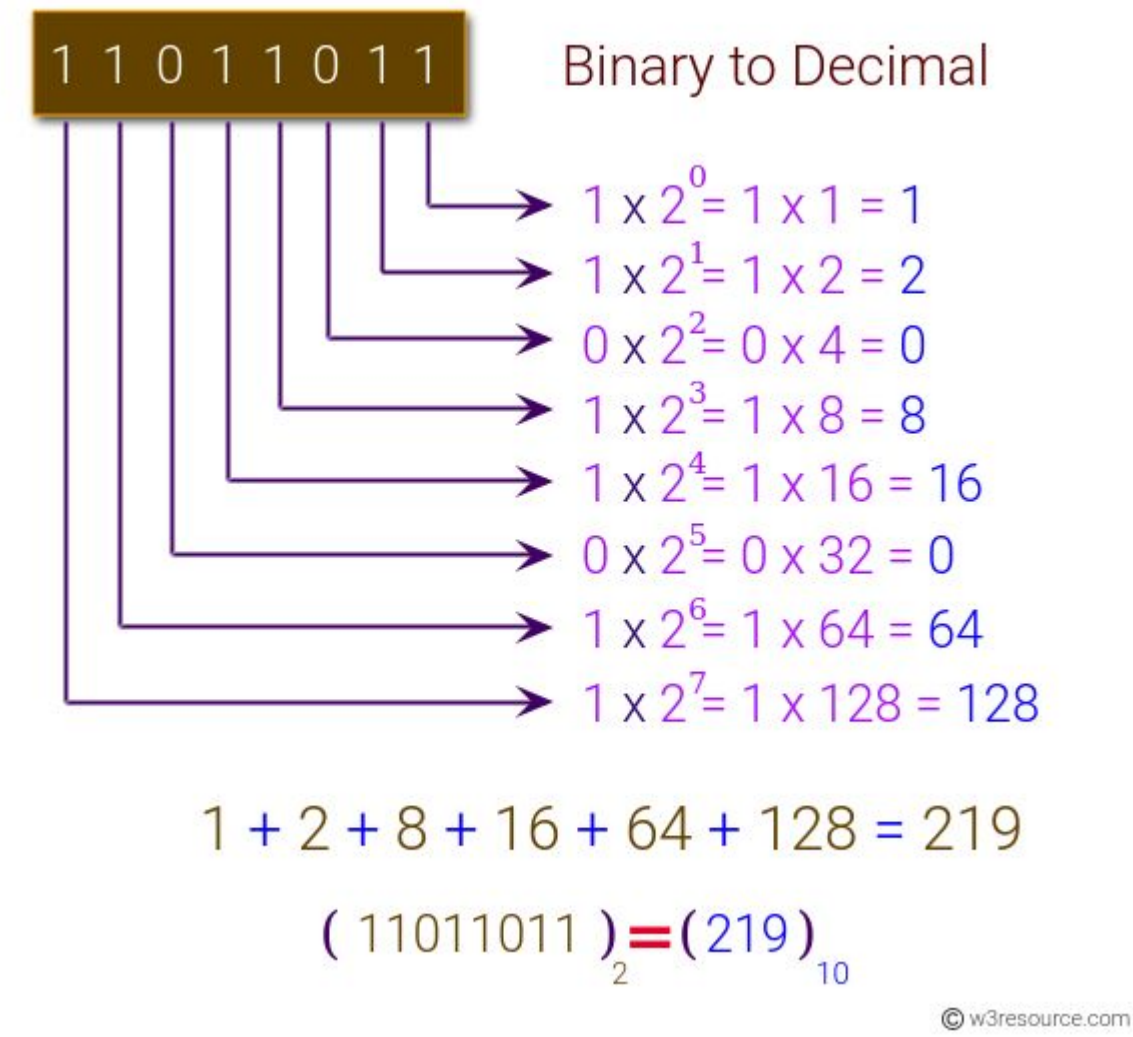
Decimal to Binary

We can convert decimal to binary using python script

```python
# decimal to binary conversion

# describe a decimal number
decimal_number = 12

# convert to binary
# using bin function
to_binary = bin(decimal_number)

print(to_binary)

# it will return string
# with 0b... format

#remove '0b' using .replace()
to_binary.replace("0b","")
print(to_binary)
```

Binary to Decimal

Here is the way to convert decimal into binary



source: w3resource.com

Binary to Decimal

We can convert binary to decimal using python script

```python
# binary to decimal conversion

# describe a binary number
# as a string
binary_number = "11011011"

# convert to decimal
# using int() function
to_decimal = int(binary_number, 2)

print(to_decimal)

# it will return integer
```

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Bitwise Operator

Bitwise operation operates binary numeral at the level of its individual bits.

Operator	Name
&	AND
|	OR
^	XOR
~	NOT
<<	Zero fill left shift
>>	Signed right shift

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Bitwise Operator

and - Sets each bit to 1 if both bits are 1

```python
# bitwise operator - and (&)

number1 = 15
number2 = 14

and_operator = number1 & number2
print(f"{number1} & {number2} = {and_operator}")

# output:
# 15 & 14 = 14
```

15	=	1	1	1	1		
14	=	1	1	1	0	&	(and)
		1	1	1	0	=	14

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Bitwise Operator

or - Sets each bit to 1 if one of two bits is 1

```python
# bitwise operator - or (|)

number1 = 15
number2 = 14

or_operator = number1 | number2
print(f"{number1} | {number2} = {or_operator}")

# output:
# 15 & 14 = 15
```

15	=	1	1	1	1		
14	=	1	1	1	0	|	(or)
		1	1	1	1	=	15

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Bitwise Operator

xor - Sets each bit to 1 if only one of two bits is 1

```python
# bitwise operator - xor (^)

number1 = 15
number2 = 14

xor_operator = number1 ^ number2
print(f"{number1} ^ {number2} = {xor_operator}")

# output:
# 15 ^ 14 = 1
```

15	=	1	1	1	1		
14	=	1	1	1	0	^	(xor)
		0	0	0	1	=	1

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Bitwise Operator

not - Inverts all the bits

```python
# bitwise operator - not (~)

number1 = 15

not_operator = ~number1
print(f"~{number1}= {xor_operator}")

# output:
# ~15 = -16
```

```
 15 = 0000000000001111
~15 = 1111111111110000 = -16
```

using Binary signed 2's complement

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Bitwise Operator

left shift - Shift left by pushing zeros in from the right and let the leftmost bits fall off

```python
# bitwise operator - left shift (<<)

number1 = 15

left_shift = number1 << 1
print(f"{number1} << 1 = {left_shift}")

# output:
# 15 << 1 = 30
```

```
    15 = 0 0 1 1 1 1
15 << 1 = 0 1 1 1 1 0 = 30
```

Bitwise Operator

right shift - Shift right by pushing copies of the leftmost bit in from the left, and let the rightmost bits fall off

```python
# bitwise operator - left shift (<<)

number1 = 15

right_shift = number1 >> 1
print(f"{number1} >> 1 = {right_shift}")

# output:
# 15 >> 1 = 7
```

```
    15 = 0 0 1 1 1 1
15 >> 1 = 0 0 0 1 1 1 = 7
```

Project

Let's create a project based on the case!

Case = Numeral System Converter

- Create a new file called numeral-system-converter.py
- Create an input for user to input binary or decimal number in it
- Convert the input into decimal or binary number
- Print the result

Conclusion

- Numeral System is a writing system or symbols express number
- Binary Number only contains 0 and 1, and is used by computer to communicate as a representation of electricity
- Decimal Numbers contains 0-9 numbers, also known as human-readable number
- Between human and computer, we communicate using OS or software that converts between decimal and binary, to make anything like number, text, audio, images, videos, etc