Converting to Decimal

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1 Introduction

1.1 Process

The process of converting from other bases to decimal follows a consistent pattern. You need to:

1. Write down the number in the given base.
2. Assign powers of the base to each digit from right to left.
3. Multiply each digit by its corresponding power of the base.
4. Sum all the results to get the decimal equivalent.
    - For bases greater than 10, you may need to use letters to represent values greater than 9.

1.2 Mathematical Representation

Where:
b = base of number to convert
i = index of the digit (from right to left) in the number to convert
l = number of digits in number to convert (length)
v = decimal value of the digit at index i

$$\sum_{i=0}^{l-1} v_i * b^i \tag{1}$$

2 Converting from Binary to Decimal

2.1 Process

Binary is the base-2 number system, consisting of only two digits: 0 and 1. To convert a binary number to decimal, follow these steps:

1. Write Down the Binary Number: Start by writing down the binary number you want to convert.
2. Assign Powers of 2: Starting from the rightmost digit (the least significant bit) and moving left, assign powers of 2 to each digit, starting with 2^0 for the rightmost digit, 2^1 for the next, 2^2 for the one after that, and so on.
3. Multiply and Sum: Multiply each binary digit by its corresponding power of 2 and sum all the results.
4. Calculate the Decimal Equivalent: The sum from step 3 is the decimal equivalent of the binary number.

2.2 Mathematical Representation

We can just replace b with 2 in the summation in section 1.2:

$$\sum_{i=0}^{l-1} v_i * 2^i \tag{2}$$

2.3 Binary to Decimal Example

Let's illustrate with an example. Convert the binary number 1101 to decimal:

Remember: we go from right to left to get the values from the binary number.

$$1 * 2^0 + 0 * 2^1 + 1 * 2^2 + 1 * 2^3 = 13 \tag{3}$$

3 Converting from Hexadecimal to Decimal

3.1 Process

Hexadecimal is the base-16 number system, consisting of sixteen digits: 0 - F. To convert a hexadecimal number to decimal, follow these steps:

1. Write Down the Hexadecimal Number: Start by writing down the hexadecimal number you want to convert.
2. Assign Powers of 16: Starting from the rightmost digit (the least significant bit) and moving left, assign powers of 16 to each digit, starting with 16^0 for the rightmost digit, 16^1 for the next, 16^2 for the one after that, and so on.
3. Multiply and Sum: Multiply each hexadecimal digit by its corresponding power of 16 and sum all the results.
4. Calculate the Decimal Equivalent: The sum from step 3 is the decimal equivalent of the hexadecimal number.

3.2 Mathematical Representation

We can just replace b with 16 in the summation in section 1.2:

$$\sum_{i=0}^{l-1} v_i * 16^i \tag{4}$$

3.3 Hexadecimal to Decimal Example

Let's illustrate with an example. Convert the binary number 1A3 to decimal:

Remember: we go from right to left to get the values from the binary number.

Remember: in hexadecimal, A=10, B=11, etc.

$$3 * 16^0 + 10 * 16^1 + 1 * 16^2 = 419 \tag{5}$$