Lecture 1 - Number Systems

CONVERTING BINARY TO DECIMAL

Steps:

1. Get the last digit of the binary number, call this digit the **currentDigit**.
2. Make a variable, let's call it **power**. Set the value to 0.
3. Multiply the **current digit** with (2^**power**), store the result.
4. Increment **power** by 1.
5. Set the the **currentDigit** to the previous digit of the binary number**.**
6. Repeat step 3 until all digits have been multiplied.
7. Sum the result of step 3 to get the answer number.

Example

Convert BINARY **11101** to DECIMAL

NOTES	MULTIPLICATION	RESULT
Start from the last digit of our example number (1110**1**). Let's call this **currentDigit**. The value is 1. Multiply that digit with 2^0. Note that the power of 0 of any number is always 1. Note the **^** operator means **to the power of**. Ie: 2^0 is equivalent to 2^0 2^1 is equivalent to 2^1 2^2 is equivalent to 2^2 2^3 is equivalent to 2^3 2^4 is equivalent to 2^4 and so on.	1*(2^0)	1
Process the previous digit, which is 0, multiply that digit with the increasing power of 2	0*(2^1)	0

111**0**1 (current digit is in bold)		
Process the previous digit, which is 1, note that 2^2 means 2*2 11**1**01 (current digit is in bold)	1*(2^2)	4
Process the previous digit, which is 1, note that 2^3 means 2*2*2 1**1**101 (current digit is in bold)	1*(2^3)	8
Process the previous digit, which is 1, note that 2^4 means 2*2*2*2 **1**1101 (current digit is in bold)	1*(2^4)	16
Here we stop because there's no more digit to process		
This number comes from the **sum** of the RESULTS column	ANSWER	29

Basically, this is the same as saying:

1*(2^4) + 1*(2^3) + 1*(2^2) + 0*(2^1) + 1*(2^0)

or

1*(16) + 1*(8) + 1*(4) + 0*(2) + 1*(1)

The reason it's easier to start backward is because:

- Counting the number of digits takes extra time, and you might count wrongly.
- If you don't remember what a particular power-of-2 value, it's easy to calculate it from the previous value. For instance, if you don't remember what the value of 2*2*2 is, then just double the value of 2*2 (which you already have - if you had started backward).

Another Example

Convert BINARY **1010** to DECIMAL

MULTIPLICATION	**RESULT**
0*(2^0)	0
1*(2^1)	2
0*(2^2)	0
1*(2^3)	8

ANSWER	10

Is constructing a table like above required? No, it just depends on your preference. Some people are visual, and the table might help. Without a table, it's also easy. If you want to be a speed counter, just remember that the value of the multiplier is always the double of the previous one.

1, 2, 4, 8, 16, 32, 64, 128, 256, 512, ...

POWER OF 2s	**RESULT**
2^0	1
2^1 = 2	2
2^2 = 2*2	4
2^3 = 2*2*2	8
2^4 = 2*2*2*2	16

Example

Convert BINARY **1010001** to DECIMAL.

Again, I'm starting backward here:

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(1*1) + (0*2) + (0*4) + (0*8) + (1*16) + (0*32) + (1*64) =
  1   +   0   +   0   +   0   +   16   +   0    +   64   = 81
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