Converting Binary Directly into Decimal

1. Create a table for exponents and their place values.

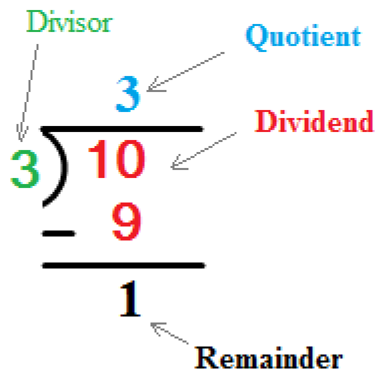
2. Write the binary number underneath each associated place value.

3. Add up the place values of each 1 digit in the binary number.

Exponents	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Place Values	256	128	64	32	16	8	4	2	1
Binary Number		1	0	1	1	0	1	0	1
		128 + 32 + 16 + 4 + 1 = 181							
Binary Number	1	1	1	0	0	1	1	1	0
		256 + 128 + 64 + 8 + 4 + 2 = 462							
Binary Number				1	0	1	1	0	1
		32+ 8 + 4 + 1 = 45							

Converting Decimal into Binary – Method 1

Reminder: There are four terms that describe the four numbers involved in division.



Dividend: the number being divided.

Divisor: the number which divides the dividend

Quotient: the number of times the divisor will go in the dividend. (the whole number obtained after division)

Remainder: The remaining amount left over which is less than the divisor or too small to be divided by the divisor to get a whole number. Sometimes after division an amount is left over, it is called as remainder.

In this method, the you want to convert is the Dividend, your Divisor is always 2, and your Remainder is always 0 or 1.

1. Begin with the original number, find the Quotient and Remainder

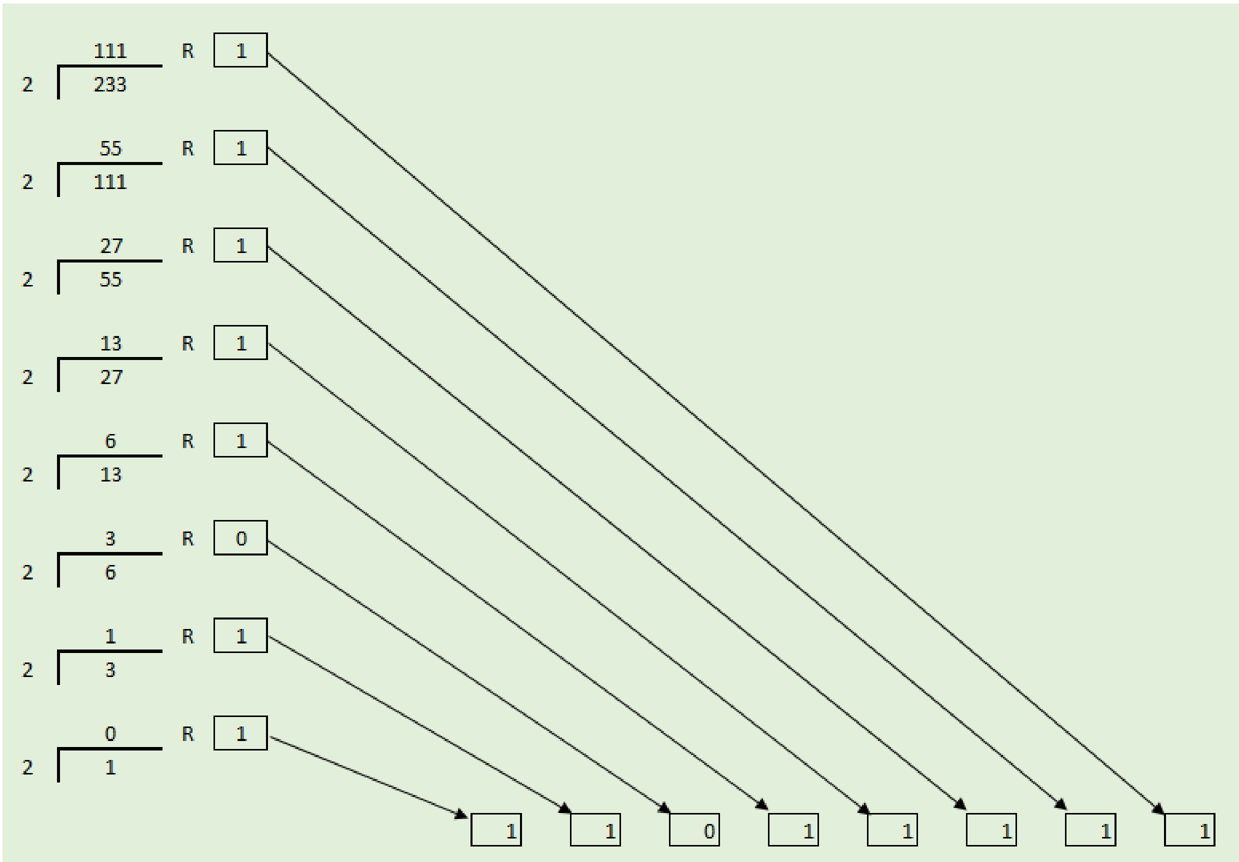
2. Use the Quotient as new Dividend and repeat the division.

3. Continue until the Quotient becomes 0.

4. The series of the Remainders form the binary numbers

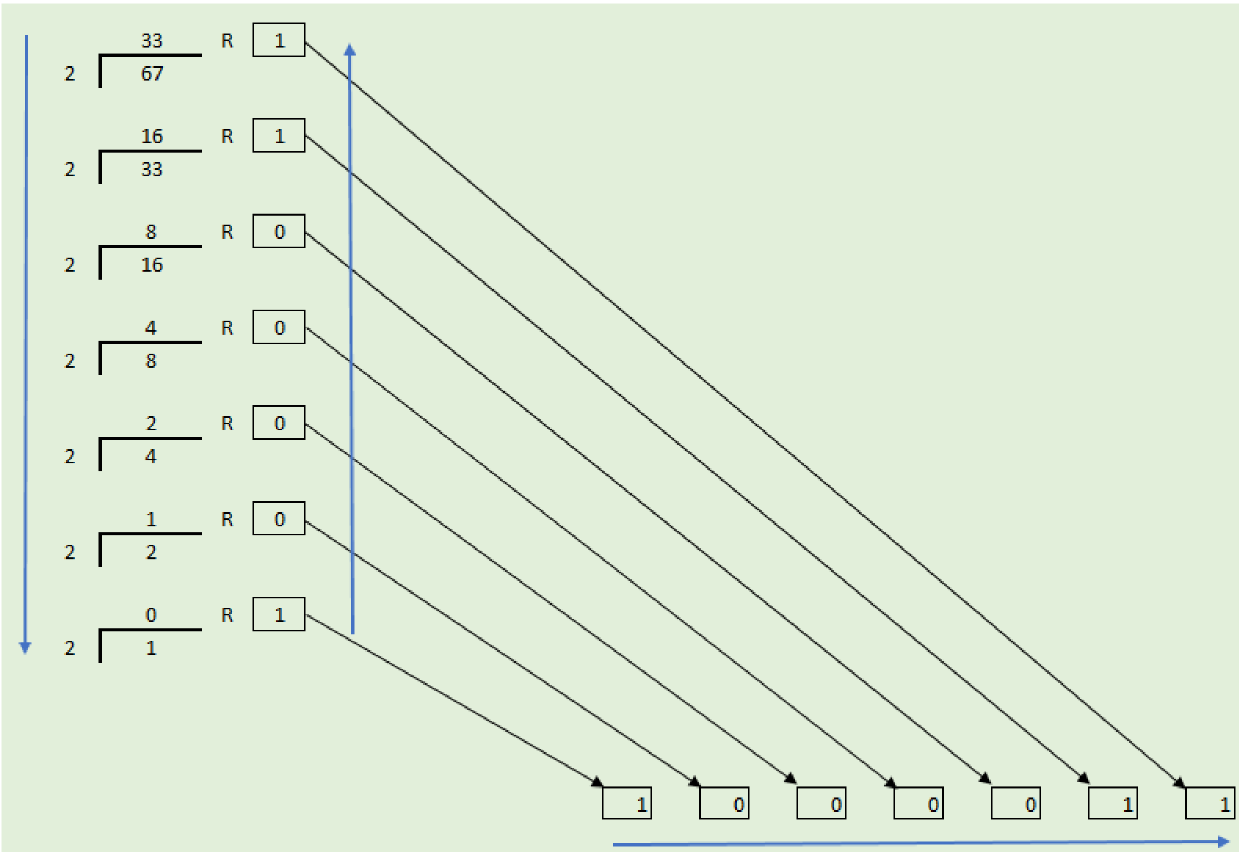
Note: The number is written from right to left beginning from the last Remainder to the first one. (Method 1 is also called Right-Left Decimal to Binary method.)

Example 1: Find the equivalent binary of 223



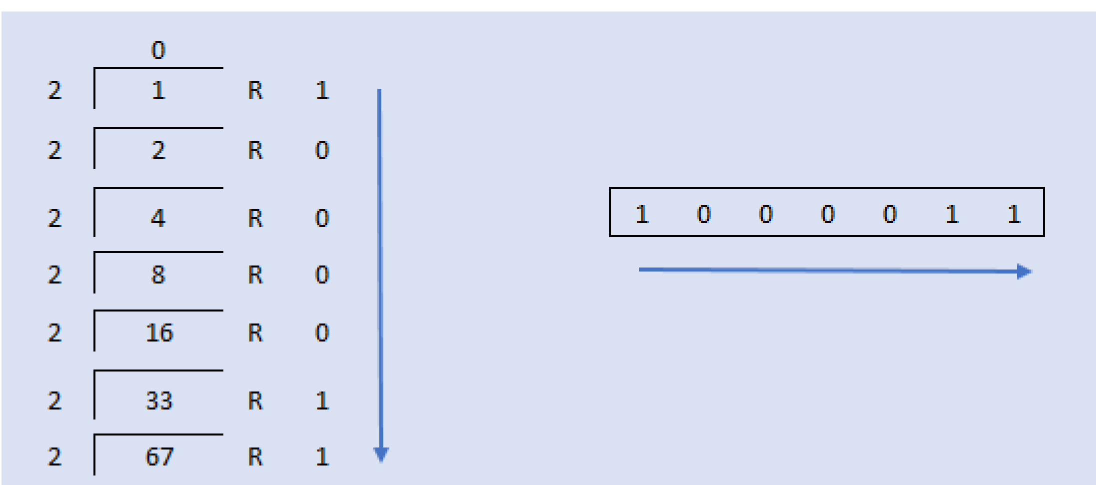
Therefore, $233_{10} = 11011111_2$

Example 2: Find the equivalent binary value for 67



Therefore, $67_{10} = 1000011_2$

Here is an alternative way of doing the above steps, which is easier doing by hand.



Converting Decimal into Binary – Method 2

Look at Example 2 done in previous page. Number 67 in decimal base is equivalent to 1000011 in binary base. The binary digits came from the remainder values of successive divisions. Let's make the following two observations:

1. Every time the value of the quotient was odd, the remainder was 1 (see, 67, 33, and 1) and every time the value of the quotient was even, the remainder was 0 (see, 16, 8, 4, and 2).

2. If we subtract the remainder from the value and then divide it by 2 we get the new quotient. For example, (67-1)/2 = 33, (33-1)/2 = 16, (16-0)/2 = 8, etc.)

We can use those observations to form the solution. Note that although subtraction of 1 is necessary when the number is odd, subtraction of 0 is not necessary when the number is even.

Example 1: Find the equivalent binary value for 85

The number 85 is odd. Hence, the last digit is 1. Subtract 1, we get 84. Then dividing 84 by 2 we get 42.

___ ___ ___ ___ ___ ___ ___ ___ ___ 1

The number 42 is even, hence its last binary digit is 0. Dividing 42 by 2 we get 21.

___ ___ ___ ___ ___ ___ ___ ___ 0 1

21's last binary digit is 1 (as it is odd). Subtract 1 and divide by two again: we get 10.

___ ___ ___ ___ ___ ___ ___ 1 0 1

10's last binary digit is 0. 10/2 = 5.

___ ___ ___ ___ ___ ___ 0 1 0 1

5's last binary digit is 1. Then 4/2 = 2.

___ ___ ___ ___ ___ 1 0 1 0 1

2's last binary digit is 0. Dividing 2 by 2, we get 1.

___ ___ ___ ___ 0 1 0 1 0 1

Now the binary digit 1 represents the number 1.

___ ___ ___ 1 0 1 0 1 0 1

Therefore, $85_{10} = 1010101_2$

Binary Addition

Binary addition is similar to decimal addition. However, in binary addition it carries on a value of 2 instead of a value of 10. For example, consider the decimal addition of 29+36 resulting in 65. When you perform the operation you add 6+9 which result in 15. In the result you write the digit 5 and carry over 1. This 1 will then be added to the digits of 2 and 3.

Similarly, in binary addition when you add 1 and 1, the result is 2, but since 2 is written as 10 in binary, we write a digit 0 and a carry of 1. Therefore, in binary addition, 0 + 0 = 0, 0 + 1 = 1, 1 + 0 = 1, and 1 + 1 = 10 (which is 0 carry over 1)

Example 1											
Base 2 Place	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		
Carryover											
				1	0	1	1	0	1		45
			+		1	0	0	1	0	+	18
				1	1	1	1	1	1		63

Example 2											
Base 2 Place	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		
Carryover			1	1	1	1					
				1	0	1	1	0	1		45
		+			1	1	1	1	0	+	30
			1	0	0	1	0	1	1		75

Example 3											
Base 2 Place	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0		
			1	1	1						
Carryover		1	1	1	1	1	1	1			
				1	0	1	1	0	1		45
				1	1	1	0	1	1		59
	+				1	1	1	1	0	+	30
		1	0	0	0	0	1	1	0		134