Base Two Number System

The base two number system is called the binary system.

The only digits in this system are zero and one (two digits, the largest is one less than the base.) In computer language, every decision is made electronically, with each switch having only two options – on or off.

In base ten (Decimal System) we can count up to ten and then our hands are full, so we have to use a marker and start over. If horses were the dominant intelligent life on this planet, they would use the Binary System (That's ooone, twooo… Wilburrr!)

In base ten, the numbers to the left of the decimal point represent, in order, ones (10^0), tens (10^1), hundreds (10^2), thousands (10^3), ten-thousands (10^4), and so on.

In base two, the numbers to the left of the "binary" point represent, in order, ones (2^0), twos (2^1), fours (2^2), eights (2^3), sixteens (2^4), thirty-twos (2^5), sixty-fours (2^6), etc.

Counting in base two would look like this:

1, 10, 11, 100, 101, 110, 111, 1000, 1001, 1010, 1011, 1100, 1101, 1110…
One, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, thirteen, fourteen…

So what would fifteen be? The largest power of two that will go into 15 is 8, going one time with 7 remainder. The next smaller power of two is 4, going into 7 one time with 3 remainder. Then we divide the 3 by 2, getting one with one remainder, which we then divide by one, evenly. So fifteen is 1111 in base two. Reading from left to right, we have one 8, one 4, one 2 and one 1. So sixteen will be 10000 (this is read "one, zero, zero, zero, zero, base two.")

Going the other direction (which we seldom do in non-decimal bases), the place values in base ten are tenths, hundredths, thousandths, and so on. In other words, each place value to the right of the decimal point is one over some power of ten.

In base two, the place values to the right of the binary point are halves, fourths, eighths, sixteenths, thirty-seconds, sixty-fourths, and so on, with the denominator increasing by a power of two each time.

In base ten, 0.01011 would be "one thousand eleven hundred thousandths." In base two, the same symbol would be "eleven thirty-seconds." You have no halves, one fourth, no eighths, one sixteenth, and one thirty-second. Now add $\frac{1}{4} + \frac{1}{16} + \frac{1}{32}$. That's $\frac{8}{32} + \frac{2}{32} + \frac{1}{32}$, or $\frac{11}{32}$.