Two's Complement

Two's complement is a [mathematical operation](http://en.wikipedia.org/wiki/Mathematical_operation) on [binary numbers](http://en.wikipedia.org/wiki/Binary_number), as well as a binary[signed number representation](http://en.wikipedia.org/wiki/Signed_number_representation) based on this operation. Its wide use in computing makes it the most important example of a [radix complement](http://en.wikipedia.org/wiki/Method_of_complements).

In two's-complement representation, positive numbers are simply represented as themselves, and negative numbers are represented by the two's complement of their absolute value.  In general, negation (reversing the sign) is performed by taking the two's complement. The two's-complement system has the advantage that the fundamental arithmetic operations of [addition](http://en.wikipedia.org/wiki/Addition" \o "Addition),[subtraction](http://en.wikipedia.org/wiki/Subtraction" \o "Subtraction), and [multiplication](http://en.wikipedia.org/wiki/Multiplication" \o "Multiplication)are identical to those for unsigned binary numbers. This property makes the system both simpler to implement and capable of easily handling higher precision arithmetic. Also, [zero](http://en.wikipedia.org/wiki/Zero) has only a single representation, obviating the subtleties associated with [negative zero](http://en.wikipedia.org/wiki/Negative_zero), which exists in [ones'-complement systems](http://en.wikipedia.org/wiki/Ones%27_complement).

To get the two's complement of a binary number, the [bits](http://en.wikipedia.org/wiki/Bit) are inverted, or "flipped", by using the [bitwise NOT](http://en.wikipedia.org/wiki/Bitwise_NOT) operation; the value of 1 is then added to the resulting value, ignoring the overflow which occurs when taking the two's complement of 0.

For example, using 1 byte (= 2 [nibbles](http://en.wikipedia.org/wiki/Nibble) = 8 bits), the decimal number 5 is represented by

0000 01012

The most significant bit is 0, so the pattern represents a non-negative value. To convert to −5 in two's-complement notation, the bits are inverted; 0 becomes 1, and 1 becomes 0:

1111 1010

At this point, the numeral is the [ones' complement](http://en.wikipedia.org/wiki/Ones%27_complement) of the decimal value −5. To obtain the two's complement, 1 is added to the result, giving:

1111 1011

The result is a signed binary number representing the decimal value −5 in two's-complement form. The most significant bit is 1, so the value represented is negative.

The two's complement of a negative number is the corresponding positive value. For example, inverting the bits of −5 (above) gives:

0000 0100

And adding one gives the final value:

0000 0101

The two's complement of zero is zero: inverting gives all ones, and adding one changes the ones back to zeros (since the overflow is ignored). Furthermore, the two's complement of the most negative number representable (e.g. a one as the most-significant bit and all other bits zero) is itself. Hence, there appears to be an 'extra' negative number.

Work Citied

"Two's Complement." *Wikipedia*. Wikimedia Foundation, 28 Sept. 2014. Web. 30 Sept. 2014.