# 2’s Complement: The Binary Representation of Signed Integers

For simplicity, consider a 4-bit binary odometer. This *nibble*-sized counter is capable of representing 16 different integers.

For the *unsigned* range of numbers, the binary representation of the decimal values from 0 to 15 are obvious.

For a *signed* representation, although the range may be less clear at first, it is surprisingly straightforward!

**After hearing my explanation, complete the table entries below for both unsigned and signed representations.**

|  |  |
| --- | --- |
| **Unsigned 4 bit Integer Representation** | |
| Decimal | Binary |
| 15 | 1111 |
| 14 |  |
| 13 |  |
| 12 |  |
| 11 |  |
| 10 |  |
| 9 |  |
| 8 |  |
| 7 |  |
| 6 |  |
| 5 |  |
| 4 | 0100 |
| 3 | 0011 |
| 2 | 0010 |
| 1 | 0001 |
| 0 | **0000** |
| -1 |  |
| -2 |  |
| -3 |  |
| -4 |  |
| -5 |  |
| -6 |  |
| -7 |  |
| -8 |  |
| -9 |  |
| -10 |  |
| -11 |  |
| -12 |  |
| -13 |  |
| -14 |  |
| -15 |  |
| **Signed 4 bit Integer Representation** | |
| Decimal | Binary |
| 15 |  |
| 14 |  |
| 13 |  |
| 12 |  |
| 11 |  |
| 10 |  |
| 9 |  |
| 8 |  |
| 7 | 0111 |
| 6 | 0110 |
| 5 | 0101 |
| 4 | 0100 |
| 3 | 0011 |
| 2 | 0010 |
| 1 | 0001 |
| 0 | **0000** |
| -1 | 1111 |
| -2 | 1110 |
| -3 | 1101 |
| -4 | 1100 |
| -5 | 1011 |
| -6 | 1010 |
| -7 | 1001 |
| -8 | 1000 |
| -9 |  |
| -10 |  |
| -11 |  |
| -12 |  |
| -13 |  |
| -14 |  |
| -15 |  |