

Unsigned binary numbers

- Each bit represents a power of 2
- For unsigned numbers in a fixed width field
 - » the minimum value is 0
 - » the maximum value is $2^n - 1$, where n is the number of bits in the field
- Fixed field widths determine many limits
 - » 5 bits = 32 possible values ($2^5 = 32$)
 - » 10 bits = 1024 possible values ($2^{10} = 1024$)

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Binary, Hex, and Decimal

| | $2^8 = 256_{10}$ | $2^7 = 128_{10}$ | $2^6 = 64_{10}$ | $2^5 = 32_{10}$ | $2^4 = 16_{10}$ | $2^3 = 8_{10}$ | $2^2 = 4_{10}$ | $2^1 = 2_{10}$ | $2^0 = 1_{10}$ | Hex ₁₆ | Decimal ₁₀ |
|--|------------------|------------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|-------------------|-----------------------|
| | | | | | | | | 1 | 1 | 0x3 | 3 |
| | | | | | | 1 | 0 | 0 | 1 | 0x9 | 9 |
| | | | | | | 1 | 0 | 1 | 0 | 0xA | 10 |
| | | | | | | 1 | 1 | 1 | 1 | 0xF | 15 |
| | | | | | 1 | 0 | 0 | 0 | 0 | 0x10 | 16 |
| | | | | | 1 | 1 | 1 | 1 | 1 | 0x1F | 31 |
| | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0x7F | 127 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0xFF | 255 |

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Binary, Hex, and Decimal

| Binary ₂ | $16^4 = 65536_{10}$ | $16^3 = 4096_{10}$ | $16^2 = 256_{10}$ | $16^1 = 16_{10}$ | $16^0 = 1_{10}$ | Decimal ₁₀ |
|---------------------|---------------------|--------------------|-------------------|------------------|-----------------|-----------------------|
| 11 | | | | | 3 | 3 |
| 1001 | | | | | 9 | 9 |
| 1010 | | | | | A | 10 |
| 1111 | | | | | F | 15 |
| 1 0000 | | | | 1 | 0 | 16 |
| 1 1111 | | | | 1 | F | 31 |
| 111 1111 | | | | 7 | F | 127 |
| 1111 1111 | | | | F | F | 255 |

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Binary, Hex, and Decimal

| Binary ₂ | Hex ₁₆ | $10^3 = 1000_{10}$ | $10^2 = 100_{10}$ | $10^1 = 10_{10}$ | $10^0 = 1_{10}$ | Decimal ₁₀ |
|---------------------|-------------------|--------------------|-------------------|------------------|-----------------|-----------------------|
| 11 | 0x3 | | | | | 3 |
| 1001 | 0x9 | | | | | 9 |
| 1010 | 0xA | | | | 1 | 0 |
| 1111 | 0xF | | | | 1 | 5 |
| 1 0000 | 0x10 | | | | 1 | 6 |
| 1 1111 | 0x1F | | | | 3 | 1 |
| 111 1111 | 0x7F | | | 1 | 2 | 7 |
| 1111 1111 | 0xFF | | | 2 | 5 | 5 |

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