# Numeral Systems, Metric Prefix and Logarithm

## Numeral Systems

**Binary (base 2):** represented by strings of [0, 1]
e.g. "$0110111_2$"

**Decimal (base 10):** represented by strings of [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
e.g. "$9836_{10}$"

**Hexadecimal (base 16):** represented by strings of [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F]
e.g. "$A38F29_{16}$" or "$BEEF_{16}$" or "$CAFE_{16}$"

## Metric Prefix

Note: $2^{10} = 1024 \approx 10^3$

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|---|---|---|---|---|---|---|---|---|
| **pico** | (p) | $10^{-12}$ | | | | **tera** | (T) | $10^{12}$ |
| **nano** | (n) | $10^{-9}$ | ← | $10^0 = 1$ | → | **giga** | (G) | $10^9$ |
| **micro** | (μ) | $10^{-6}$ | | | | **mega** | (M) | $10^6$ |
| **milli** | (m) | $10^{-3}$ | | | | **kilo** | (k) | $10^3$ |

## Logarithm

Logarithm reverses the operation of exponentials. In general, $b^y = x$ and $y = log_b x$.
e.g., $2^5 = 32 \; and \; log_2 32 = 5$

### Logarithmic Identities:

**Product:** $\boldsymbol{log_b xy = log_b x + log_b y}$

e.g. $log_{10} 100 = log_{10} 10 + log_{10} 10 = 1 + 1 = 2$

**Quotient:** $\boldsymbol{log_b \frac{x}{y} = log_b x - log_b y}$

e.g. $log_{10} 1000 = log_{10} 10000 - log_{10} 10 = 4 - 1 = 3$

**Power:** $\boldsymbol{log_b (x^y) = y \, log_b x}$

e.g. $log_{10} (100^2) = 2 \, log_{10} 100 = 2 \cdot 2 = 4$

**Change of base:** $\boldsymbol{log_b a = \frac{log_{10} a}{log_{10} b}}$ (May use any base, base 10 is arbitrarily chosen here)

e.g. $log_2 8 = \frac{log_{10} 8}{log_{10} 2} = \frac{0.903}{0.301} = 3$