2^x vs 10^y Ambiguity

2^x vs 10^y is a common area of confusion in computer science because of the different measuring systems that humans use compared to computers. As we use decimal-based measurements, it may seem difficult to adapt to the computer's binary computing systems.

Measurement Systems

- Binary systems such as RAM memory and memory capacity are **measured in binary values** while hardware such as hard disk storage or network bandwidth are **measured using decimal values**.
- Because of this, the binary measurement has its own set of prefixes that match our decimal measurement system.

Different Prefixes of Measurement Systems

Binary Measurement System	Bytes	Decimal Measurement System	Bytes
Kibibyte (KiB)	2^{10} = 1,024	**Kilobyte (KB)**	10^3 = 1000
Mebibyte (MiB)	2^{20} = 1,048,576	**Megabyte (MB)**	10^6 = 1,000,000
Gibibyte (GiB)	2^{30} = 1,073,741,824	**Gigabyte (GB)**	10^9 = 1,000,000,000
Tebibyte (TiB)	2^{40} = 1,099,511,627,776	**Terabyte (TB)**	10^{12} = 1,000,000,000,000

These prefixes can also be applied with other measurements! Resulting in units such as kibibits, gibibits, and their corresponding higher-order multiples.

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Example 1: If a PC build has 24GB of RAM, how many bytes of memory does it have?

24GB of RAM -> 24 * 2^30
            -> 25,769,803,776 bytes or around 25.77GB of memory!

(note that 2^30 is 1GiB or 1,073,741,824 bytes)
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Example 2: Your current WiFi speed has an upload speed of 20 Mbps, what would be
the speed in mebibytes?

20Mbps -> 20 * 10^6                    (Conversion of megabits to bits)
       -> 20,000,000 bits per second
       -> 20,000,000 / 8               (Conversion of bits to bytes)
       -> 2,500,000 bytes per second
       -> 2,500,000 / 2^20             (Conversion of bytes to mebibytes)
       -> 2.3841..
       -> 2.38 mebibytes per second    (Rounded up final answer)
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