1.3 Moore's Law

Predicting the Future

A recent newspaper headline reads as follows: "Engineers predict that in 10 years computers will be able to talk to us." How do they know this? What is the basis for their predictions?

Well, we are fortunate that history has shown that technological evolution often follows a fairly predictable path. Engineers routinely take advantage of this condition when determining if and when to design and build some new piece of fantastic technology.

Moore's Law and the Future Growth of Technology

Is there a systematic way to predict the future growth of technology? Well, in 1965, Gordon Moore, co-founder of Fairchild and the Intel Corporation, made a startling observation. Moore looked back in time and noticed that every two years, the number of transistors on his company's integrated circuits had doubled. This meant that his company's ICs were roughly twice as powerful or twice as fast as they had been two years earlier. And, as it turned out, this remarkable observation was true for nearly every computer chip manufacturer's products, irrespective of whether, the IC was a microprocessor or digital signal processor (DSP). This insightful observation has since been known as **Moore's law** and is used as one of the strongest principles for predicting the future of technology.

Moore's Law: *The number of transistors on an IC will double every two years. Equivalently stated, the computing power of ICs doubles every two years.*

What was particularly bold about this prediction was that Moore said that the doubling of speed, computing power, or number of transistors on digital ICs would continue indefinitely and, as such, computers would continue to get faster and faster. To fully understand the remarkable implication of Moore's law, we need first to understand the power of doubling, which is at the heart of his observation.

The Power of Doubling

Have you ever heard someone say "double or nothing" when gambling? If you have watched someone bet like this, then you no doubt noticed that the gambler either wins or loses a lot of money very fast. Doubling gets you to large numbers quite quickly. This observation can be quantified by developing some simple mathematical relationships that describe the power of doubling.

Assume that you begin with $\$X$, where X is any number you choose. If you double it, you will have $\$2X$. If you double it again, you will have $\$(2 \times 2)X$, or $\$2^2X$. Doubling once more gives you $\$(2 \times 2 \times 2)X$, or $\$2^3X$. From this set of results, it follows that if you double $\$X$, exactly N times, you will have $\$2^NX$.

To make this example more concrete, let's assume that we start with \$1, or $X = \$1$. If N were 5, that is, we double \$1 five times, we would have $\$2^5 = \$32$. If N were 10, that is, we double \$1 ten times, we would have $\$2^{10} = \$1024$. If N were 50, we would have $\$2^{50} = \$1.125 \times 10^{15}$. That is more than \$1 quadrillion. Wow!

INTERESTING FACT:

Gordon Moore stated Moore's law when there were fewer than 100 transistors on an integrated circuit. Today, there are many millions of transistors on an integrated computer chip!