The processing of a single machine-level instruction is called a **machine cycle.** A machine cycle has two parts: the *instruction cycle* (the I-cycle) and the *execution cycle* (the E-cycle). The instruction cycle begins when the control unit in the CPU fetches and decodes an instruction from primary memory. The control unit then places the part of the instruction that tells the ALU what it is supposed to do in the instruction register and the part of the instruction indicating where the relevant data is located in the address register. Then the execution cycle begins. Data that is to be processed is moved from its location in primary memory into the storage register. The control unit then tells the ALU to perform the operation specified by the instruction in the instruction register. The results of the operation are sent to the accumulator, where they are stored temporarily until they are returned to primary memory. Figure 3.12 illustrates the machine cycle.

Add	Compare and Swap	Move
Subtract	Branch and Save	Move Character
Multiply	Branch on Condition	Reset
Divide	Load	Store
Compare	Load Register	Store Character

Figure 3.11
Some Basic Instructions That Can Be Represented By Circuits

All the amazing things that most computers do are based on this simple machine cycle. To execute even the most complicated programs, the computer merely repeats the machine cycle over and over and over again, perhaps millions of times per second, until the entire program has been processed. (We describe another form of processing, called parallel processing, that can execute instructions simultaneously instead of sequentially in Section 3.3.)

Of course, all this occurs at blindingly fast speeds. Speed in the computer world can be measured in a number of different ways. One way is the number of instructions per second that the CPU can process. Today's computers can process millions of instructions per second. This unit of measurement is called **MIPS** (millions of instructions per second). Figure 3.13 lists speeds in MIPS for microcomputers, workstations, minicomputers, and mainframes. Speed, particularly of supercomputers, is also

MIPS

Two parts

Machine cycle

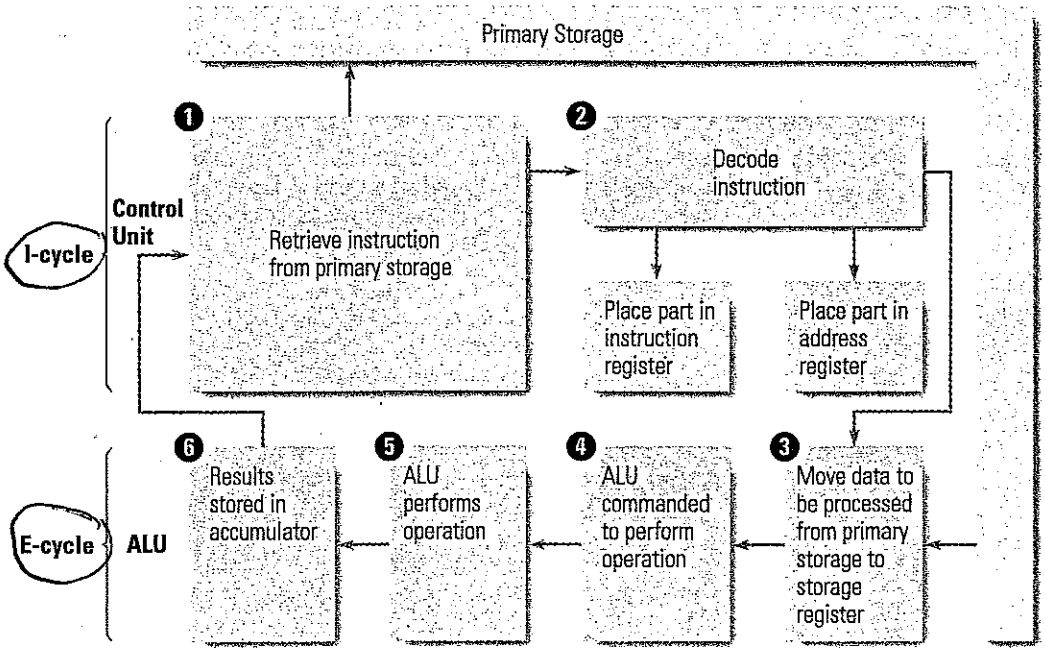
=

fetch/execute cycle

=

I cycle/E cycle

Figure 3.12
The Machine Cycle
Retrieving an instruction from primary storage, decoding it, executing it, and storing the results are the basic steps of a machine cycle. We call the first half of the machine cycle the I-cycle (instruction cycle) and the second half the E-cycle (execution cycle).



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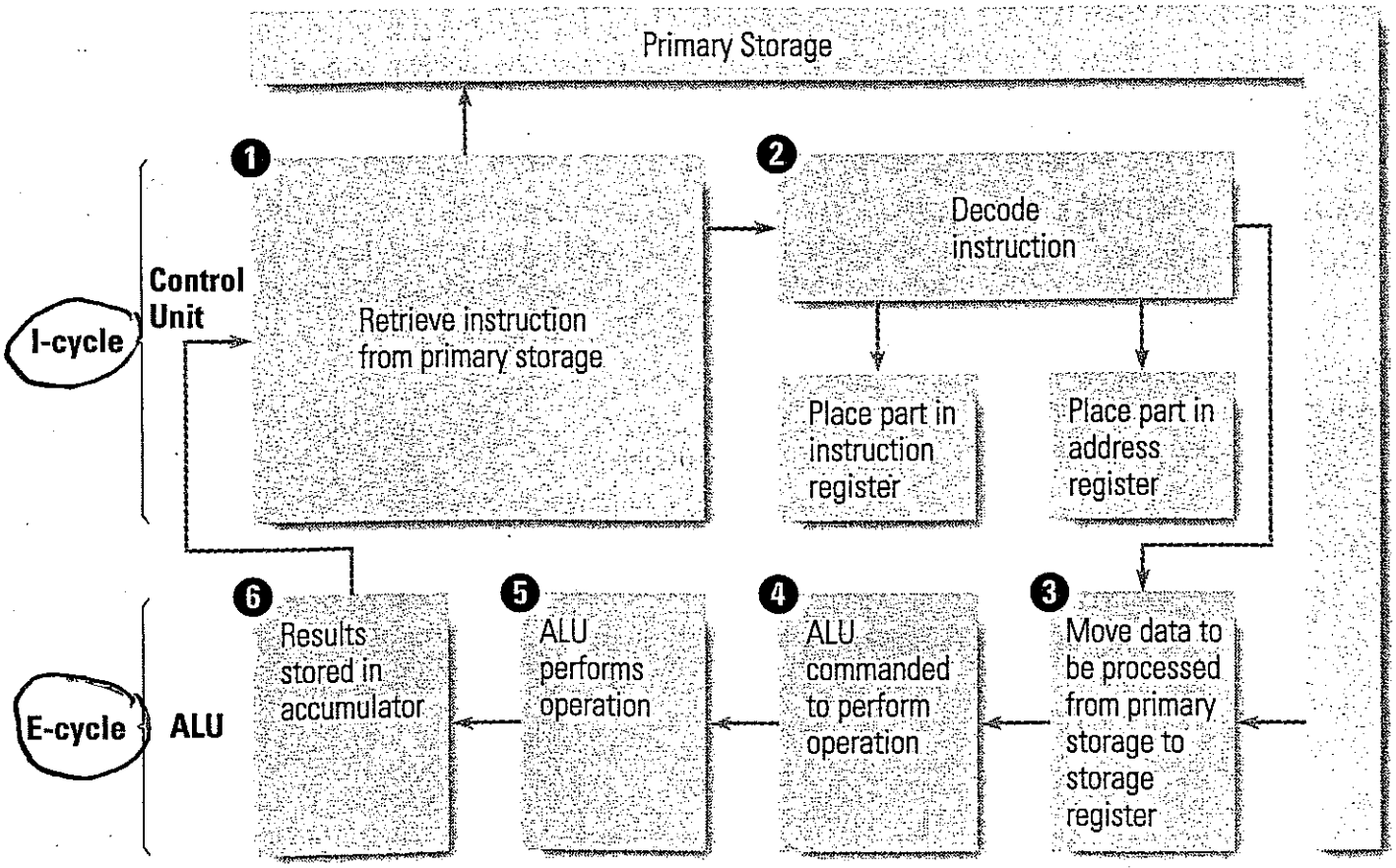

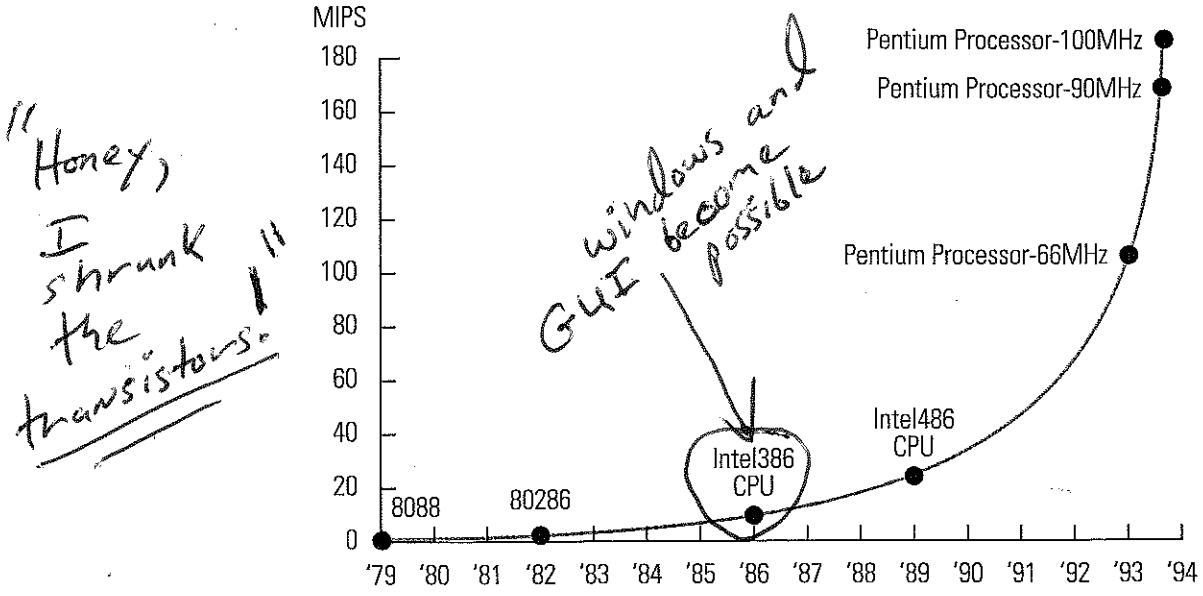

Figure 3.17
The Changing Power of Microprocessors
The power of Intel microprocessors has increased dramatically over the past 15 years. Motorola's 68000 family of microprocessors follows the same pattern.