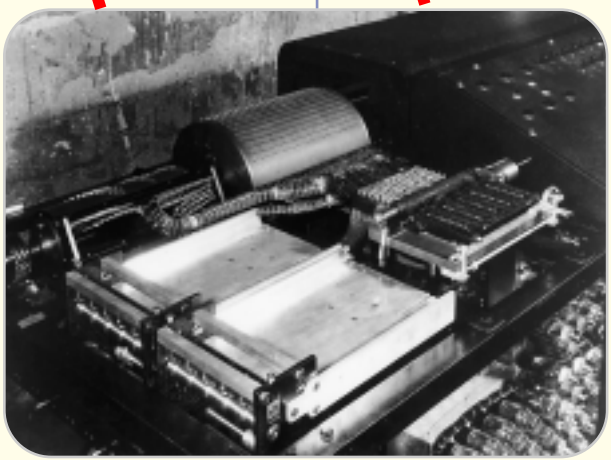
Mark I (1943) In a partnership with Harvard University, IBM creates a huge, programmable electronic calculator that used electromechanical relays as switching devices.

Zuse's Z1 (1938) German inventor Konrad Zuse creates a programmable electronic calculator. An improved version, the Z3 of 1941, was the world's first calculator capable of automatic operation.



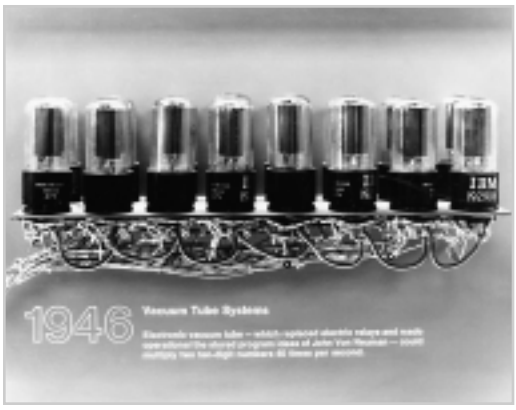


Figure 1B.4

The first generation of computers used vacuum tubes. Vacuum tubes failed frequently, so first-generation computers did not work most of the time.

UNIVAC gained fame when it correctly predicted the winner of the 1952 U.S. presidential election, Dwight Eisenhower. Since then, computers have been used to predict the winners in every presidential election.

From today's perspective, first-generation computers are almost laughably primitive. For input, punched cards were used, although UNIVAC could also accept input on magnetic tape. Power-hungry vacuum tubes provided the memory (see Figure 1B.4). The problem with vacuum tubes was that they failed frequently, so first-generation computers were down (not working) much of the time.

For all the limitations of first-generation technology, UNIVAC was a much more modern machine than ENIAC. Because it used fewer vacuum tubes than ENIAC, it was far more reliable. It employed the stored-program concept, provided a supervisory typewriter for controlling the computer, and used magnetic tapes for unlimited storage. Because the stored-program feature enabled users to run different programs, UNIVAC is considered to be the first successful **general-purpose computer.** A general-purpose computer can be used for scientific or business purposes, depending on how it is programmed.

Figure 1B.5

IBM's first commercial computer, the 701, wasn't popular because it didn't work with IBM's own punched-card equipment.

Although the stored-program concept made first-generation computers easier to use, they had to be programmed in **machine language,** which is composed of the numbers 0 and 1 because electronic computers use the binary numbering system, which contains only 0 and 1. People often find binary numbers difficult to read. Moreover, each type of computer has a unique machine language, which is designed to communicate directly with the processor's **instruction set,** the list of operations it is designed to carry out. Because machine language was difficult to work with, only a few specialists understood how to program these early computers.

Realizing that Rand's new computers posed a threat to its core business, IBM reacted quickly. In 1953, the company announced its first commercial computer, the IBM 701, but it wasn't popular because it didn't work with IBM's own punched-card equipment (see Figure 1B.5). The 701 was quickly followed by the highly-successful (and more user-friendly) IBM 650, which interfaced with the most widely-used punched-card technology in the world. Thanks to IBM's aggressive sales staff, IBM sold over a thousand 650s in the first year of the computer's availability.

Destinations

Explore the history of computing visually at The History of Computing, an outstanding Web presentation created by the Institute of Electrical and Electronic Engineers (IEEE).

The Second Generation (Early 1960s)

First-generation computers were notoriously unreliable, largely because the vacuum tubes kept burning out. To keep the ENIAC running, for example, students with grocery carts full of tubes were on hand to change the dozens that would fail during an average session. But a 1947 Bell Laboratories invention, the **transistor,** changed the way computers were built, leading to the second generation of computer technology. A transistor is a small electronic device that, like vacuum tubes, can be used to control the flow of electricity in an electronic circuit, but at a tiny fraction of the weight, power consumption, and heat output of vacuum tubes. Because second-generation computers were created with transistors instead of vacuum tubes, these computers were faster, smaller, and more reliable than first-generation computers (see Figure 1B.6).

had to be programmed in machine language, which is composed of the numbers 0 and 1.

5. Power-hungry transistors provided the memory for first-generation computers.
6. A high-level programming language enables programmers to write program instructions using Arabic-sounding commands and Roman numerals.
7. The key event in the third generation was the development of computers based on integrated circuits.
8. The first graphical user interface was developed at Apple Computer.
9. A third-generation innovation was the development of standards for computer networking.
10. The Advanced Research Projects Agency (ARPA), established by the U.S. Congress during the Cold War, played a key role in the Internet's development.

MATCHING

Match each key term from the left column to the most accurate definition in the right column.

_____ 1. calculator
_____ 2. vacuum tube
_____ 3. transistor
_____ 4. stored-program concept
_____ 5. instruction set
_____ 6. timesharing
_____ 7. integrated circuit
_____ 8. microprocessor
_____ 9. Internet protocols
_____ 10. backbone

a. the list of operations a processor is designed to carry out
b. a small, second-generation electronic device that can control the flow of electricity in an electronic circuit
c. a device that contains the entire control unit and arithmetic logic unit of a computer
d. a machine that can perform arithmetic functions
e. the standards that enable the Internet to work
f. a device that incorporates many transistors and electronic circuits on a single chip of silicon
g. the earliest electronic device that powered all electronic devices until the advent of solid-state devices
h. long-distance transmission lines that transfer data over interstate and continental distances
i. enables many people to use a computer simultaneously
j. the idea that the program and data should be stored in memory

MULTIPLE CHOICE

Circle the letter of the correct choice for each of the following.

1. Which of the following was considered the first true programmable digital computer?
   a. UNIVAC
   b. ERMA
   c. ENIAC
   d. Apple II
2. All computers that have been sold commercially have used which of the following?
   a. terminals
   b. transistors
   c. the stored-program concept
   d. vacuum tubes
3. What characterizes first-generation computers?
   a. vacuum tubes and punched cards
   b. magnetic tape and transistors
   c. minicomputers
   d. high-level programming languages
4. What kind of computer can be used for scientific or business purposes?
   a. timesharing computer
   b. general-purpose computer
   c. ENIAC
   d. abacus

PFSweb, Inc.

Have you ever purchased music, books, or clothes over the Web? Congratulations! You've participated in e-commerce! "E" what?? E-commerce. The "e" stands for electronic, and "commerce" means business. Doing business online, rather than in a "bricks-and-mortar" store, is what e-commerce is all about. It's taking the traditional buyer-seller relationship and moving it into cyberspace.

Lots of companies are getting into the dance, with hopes that their online stores will generate profits. It's easy for a company to put up a pretty marketing Web site in cyberspace to build their brands and promote their products. But moving it to the next level where customers can actually make purchases is a much trickier dance step. Behind the scenes, the site needs a way to process customer payments, check for fraudulent credit card usage, and get the merchandise shipped from the warehouse without missing a beat. It also needs a way for customers to ask questions—where's the order, how do I return something, and so on.

There's a company you've probably never heard of in Plano, Texas that helps e-commerce companies keep in step with the online buying and selling marketplace. It's called PFSWeb, Inc. The company's job is to orchestrate all the pieces that comprise an e-commerce site so that buying or selling is simple and seamless. Mark Layton, president of the company, has helped hundreds of growing e-commerce companies with their online stores by running all the "behind the scenes" tasks. The company can design Web sites, prepare online catalogs, process payments, check for fraud, calculate taxes, ship merchandise, and more for any size e-commerce site. Pretty much the same activities any physical business must manage if it's going to make money. The only difference is that online, all steps in buying are automated. The people at PFSweb have done their job if the buyer can't tell where the marketing Web site ends and the business transaction side begins. In fact, Mark's company has a saying that pretty much says it all: "From the Click of the Mouse, to the Knock at the House." They'll deliver. Now there's a reason to dance!

What do you think? Describe a recent online purchase you've made. Why did you buy online? Were the buying instructions clear? How did you pay for your purchase? Did the actual merchandise meet your expectations? Why? If you had problems or needed to make a return, how easy was it to take care of it?

WebLink Go to **www.prenhall.com/pfaffenberger** to see the video of Mark Layton and explore the Web.