address lines specify the address where the data is traveling to or from along the data lines. For example, each memory location in the computer has a different address. To store the data that is on the data lines to a specific memory location, the computer places that memory location's address on the address lines.

The control lines send signals from the microprocessor to the various devices. For example, when storing data to a location in memory, the computer places the data to be stored on the data lines and the address of the memory location on the address lines. But the data is stored in the chip only when the control lines activate the RAM chip's circuitry so the data will be stored.

PRIMARY AND SECONDARY STORAGE

RAM is sometimes referred to as ***primary storage.*** RAM is electronic, and requires a constant supply of electricity to store the data. Because data stored in RAM is lost if power is interrupted, RAM is called ***volatile*** storage.

So why use RAM if it loses data when the power goes off? The answer is speed. RAM offers a relatively fast way to store and retrieve data. RAM is usually installed near the microprocessor on the computer's main circuit board, called a ***motherboard.*** The microprocessor constantly stores data to RAM and retrieves data from RAM.

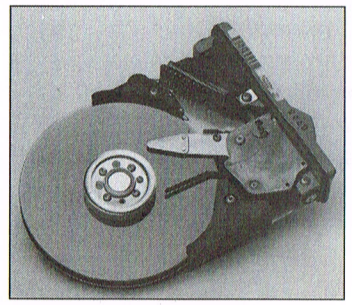

FIGURE 1-11
A hard disk drive is an example of secondary storage.

You will recall that earlier in this chapter we compared RAM to the top of your desk. Obviously, the space on the surface of a desk is limited. So is RAM.

Data which is waiting to be used needs to be stored in some type of "filing cabinet." In the computer, this more permanent "filing cabinet" storage is called ***secondary storage.*** Secondary storage usually comes in the form of disks. Programs and data stored on disks remain stored when power is turned off. The ***hard disk*** installed in your computer is an example of secondary storage. Figure 1-11 shows a hard disk drive with its top removed. A hard disk is sealed to prevent dust from affecting the sensitive disk.

A ***floppy disk*** is also an example of secondary storage. A floppy disk uses a thin flexible disk on which to store the data. Both hard disks and floppy disks store data by placing magnetic fields on the surface of the disk—the same principle used by audio and video tapes. The data stored on hard or floppy disks, by means of magnetic fields, remains when the power is turned off.

Extra for Experts

Comparing Primary and Secondary Storage

Programming computers requires that you understand trade-offs. A trade-off occurs when you must choose between two or more solutions, none of which are perfect solutions. Data storage in a computer involves a trade-off among speed, capacity, volatility, and cost.

The advantage of RAM is its speed. Its disadvantages are its volatility and its cost. Although the price of RAM has come down dramatically over the years, when compared to other types of storage, it is still relatively expensive. Therefore, the capacity of a computer's RAM is almost always less than the capacity of other forms of storage.

Disks offer large capacity and less volatility at low cost. The trade-off is that, in general, the less-expensive the storage, the slower the access speed. It takes longer to get data from a disk than from RAM.

NETWORKS

Individual computers, working alone, can accomplish very sophisticated tasks. However, when groups of computers work together, expanded opportunities present themselves. Connecting computers together is called networking. ***Networks*** are groups of computers that are connected by some communications link that allows them to share data or hardware resources. For example, two or more computers in an office or school can be networked so that hard drive space or printers can be shared. A network can also reach around the world. Every day, computers communicate with each other over phone lines (using modems), over special wires, or even using satellites.

Networks allow computer users to send electronic mail **(*e-mail*)** to other computer users in the same building or on the other side of the planet. Networks allow programs and data to be shared quickly and efficiently.

The Internet is a network of networks. Because the Internet is world-wide, it allows information, e-mail, messages, and files to be exchanged by anyone in the world whose computer has access to the Internet. Access to the Internet is available to practically anyone with a computer, a modem, and a phone line.

On the Net

More information about the history and development of the Internet is available at http://www.ProgramCPP.com. See topic 1.3.2.

SECTION 1.3 QUESTIONS

1. In a microprocessor, what coordinates the activity of the execution unit?
2. What part of the microprocessor takes the instructions from the instruction fetch unit and determines what must be done to get the instruction processed?
3. The speed of a microprocessor's clock is measured in what units?
4. CISC is an acronym for what phrase?
5. Define instruction set.
6. What is typically stored on ROM chips?
7. What are the four types of lines that make up the computer's bus?
8. What is typically used for a computer's primary storage?
9. What does it mean when we say RAM is volatile?
10. Why does a computer use RAM rather than just using disks for all of its storage?