Overview

Computers have become more and more a part of daily life. At the grocery store, computers read the price code, send the price to the cash register, print it out on the receipt, show the price on a visual display, and even say the price in a synthesized voice. In your car, computers monitor fuel consumption and warn of unbuckled seat belts. In your office, computers schedule appointments, keep track of voice mail messages, as well as check grammar and spelling. Computers in the form of automated teller machines allow you to make deposits to or withdrawals from your bank account at any one of hundreds of locations. Computers in the home help balance your checkbook, regulate the air-conditioning system, and control the microwave oven. New uses for computers are being developed daily.

Personal computers (PCs) increasingly are helping people gain direct access to services and information. By going online, you can send email, fax a document, do your banking, shop for gifts, or search for information without leaving your home. Most colleges recommend that students have their own computers. In
addition, the prices of computers continue to decrease as their powers increase. With all these advantages and trends, many users can't imagine life without PCs.

The goal of this course is to enable you to select a computer system that meets your needs. The course is divided into four lessons. Lesson 1 provides a brief history of computers. Then it describes the components of a typical PC system, including hardware and software. Lesson 2 explains some of the ways computers are used today. Lesson 3 describes the ways users who are visually impaired access the computer. Lesson 4 lists the steps for selecting a PC and appropriate access technology. It then outlines the alternatives for financing the purchase and getting user training. Included with your course materials is the Technology Resource List, which includes companies and organizations that provide computer equipment and services to those who are visually impaired.

Although much of this course is designed to help people who are visually impaired access a PC, you certainly don’t have to have a visual impairment to take this course. Anyone interested in helping a family member, client, or student gain more independence
with a PC would benefit from this course. Nor do you need previous experience with PCs. Even if you’ve never sat down at a computer in your life, you can benefit from the material in this introductory course.

You don’t need to access a PC or complete any prerequisite courses in order to take this course. To complete it, however, you’ll need the materials that The Hadley School for the Blind has provided, as well as writing materials in the medium of your choice. If you are taking the cassette version of this course, you also need your own tape recorder.

The section reviews that follow each section are for your personal development only. You can check your comprehension by comparing your responses to the ones provided. Do not mail your responses to your Hadley instructor. You can always contact your instructor, however, to clarify concepts or discuss your answers. To do so, refer to the contact information card that is included with your course materials.

To complete the course, you are required to submit four assignments, one at the end of each lesson. These assignments enable your instructor to measure your ability to apply the concepts presented in the lessons.
Submit each assignment when you complete each lesson, using the mailing labels provided. Begin studying the next lesson, but wait for your instructor’s reply before sending in the next assignment. In this way, you can apply any corrections to subsequent exercises and assignments.

Now, if you’re ready to become better informed about PCs, begin Lesson 1: What Is a PC?
Lesson 3: Access Technology for PCs

Now that you have some basic knowledge about PCs, you probably have questions about how a person who is visually impaired can use one. Lesson 1 briefly described the history of computers, listed the components of a PC system, and identified some operating systems. Lesson 2 described some of the ways computers are used today. This lesson describes the ways users who are visually impaired access the computer.

As you're no doubt aware, those who are blind and many of those who are visually impaired cannot use a monitor. The term *access technology* refers to alternatives that allow those with disabilities to use a computer. In this course, the term refers specifically to technologies that enable users who are visually impaired to gain access to information displayed on the monitor. Paper braille, electronic braille, synthetic speech, and large print are all alternative ways of accessing information. Most of these technologies do not interfere with the visual display, so usually sighted and visually impaired users can share the same information simultaneously. Because of varying needs
of users and the technology available today, you will find that some devices incorporate useful design and others have deficiencies. In addition, not all access technology works with all computer systems. Familiarizing yourself with the information in this lesson will enable you to assess which access technologies would work best for you.

**Objectives**

After completing this lesson, you'll be able to
a. describe how users who are visually impaired access information on a PC
b. determine which access technology is most compatible with your preferred medium

**Key Terms**

The following terms appear in this lesson. Familiarize yourself with their meanings so you can use them in your course work.

braille display: (also called a refreshable braille display) a device that displays 20 to 80 characters of braille at a time
braille embosser: a device used for printing paper braille
hard copy: printed material (as opposed to material displayed on a monitor)

OCR: optical character recognition software that translates the image of characters into text

screen reader: software that sends information from the monitor to a sound card or braille display

synthetic speech: audible words assembled from prerecorded or electronically generated sounds

**Accessing a PC**

Computer users with visual impairments have various ways to access the information on PCs. These include

- large print on paper
- paper braille
- on-screen large print, using screen magnification and other adjustments
- synthetic speech
- braille display
- scanner

No single access technology will do all things for all users. Many users find that they work best using two
technologies simultaneously. For example, some who use either large print or braille as their primary access technology find that synthetic speech is a necessary, secondary access technology because of eyestrain or reading rate. Others who use primarily speech access, use braille or large print when editing. Many users find that they need the features and quality of a higher-priced access system at work, although they can use a less sophisticated and expensive system at home. This section describes the features, advantages, and limitations of each of these technologies. Refer to the Resource List included with your course materials for additional sources of information about most of these technologies.

Large Print on Paper

One way to access information on a computer is to print it in a large-size font. A font is a set of characters in a particular style. Type size is measured in points. Fourteen-point type is the minimum size for large print. If you're taking the large print version of this course, this section is in 18-point type. Printed material is called *hard copy*. Many people prefer to read documents in hard copy rather than displayed on the
monitor. You can then take the printed copy and read it elsewhere, file it, or send it to others.

**Paper Braille**

If you read braille, one way to access information on your PC is to emboss it. An embosser is used like a printer. It creates a paper braille copy of text from a computer or another device, such as a notetaker (described in a later section of this lesson). A braille translation software program is required to translate the text from the computer into braille. A variety of embossers are available in a wide range of prices. New embossing devices exist that can even produce a combination of braille and print on the same page!

Most braille embossers use fanfold paper, which feeds continuously through the machine so you don’t have to feed individual pages. Using the standard 11-by-11.5-inch braille paper gives you 40 to 42 characters per line and 24 to 26 lines per page. You can control the number of lines and columns to accommodate different sizes of paper. Braille embossers can run at speeds ranging from 20 to 600 characters per second. Not surprisingly, as the speed increases, so does the price.
Sideways embossing (also called landscape) is possible on some embossers. Embossing the text sideways on the page enables you to print a multicolumn text on two pages. You would then cut and tape them together and read them as a single elongated page.

Some embossers can emboss tactile graphics, which are drawings composed of raised dots. It’s usually not easy to produce these, though some manufacturers claim that it is. The production of tactile graphics requires special programs and occasionally, special hardware add-ons. Though the user who is blind can run these programs and make minor changes, a sighted person or a scanner needs to input the original data. Fortunately, programs to help people who are blind create their own graphics are coming on the market. It is not too difficult to use braille characters to create simple graphics such as lines and boxes. One Web site makes chemical diagrams available to students who are blind. The student can get the data from the Web site and send it to a braille embosser, enabling him or her to study diagrams that would otherwise be inaccessible.

Perhaps the principal advantage of braille embossers is the access they provide to a whole page of material.
They allow braille readers to scan an entire page for specific information, compare one line of information to another, and read material displayed in columns. Braille embossers also provide an extremely portable record. Paper braille can be read anytime, anywhere, without relying on any other device. For braille readers, paper braille is often the preferred output when editing a document or searching for specific information in a large document.

The limitation of paper braille is its bulk. Braille paper is bigger, holds less information per page, and takes up more space than does regular printed paper. For example, the braille version of a small ink-print pocket dictionary is seven volumes.

Because braille paper costs more than regular paper, the expense of paper braille is another significant limitation. To lessen this problem, some embossers have a setting that permits brailling on varying weights of paper. Using paper that isn’t as heavy as regular braille paper is good for reading and then discarding. Some machines can emboss on both sides of the paper. Called interpoint embossing, this is another way to save paper bulk and cost.
Most braille embossers are transportable; though they’re heavy and bulky, they can be moved by one person. They may prove to be louder than some individuals can tolerate. An acoustic enclosure can be purchased to surround the embosser and absorb some of the noise. This enclosure adds to the bulkiness of the unit and to the purchase price.

**Large Print Using Screen Magnification**

Perhaps the simplest method of enhancing screen readability is to use a larger monitor. By using a monitor that measures 19 to 25 inches diagonally, many users can read the information that was illegible to them when they used the standard 15- to 17-inch screen. Most programs, including system software, enable users to magnify screen characters and images without investing in additional technology. Many people find that they can read the screen when they combine various low vision aids. For example, a person might use a magnifier, a large monitor size, and built-in screen magnification. Some find that changing the polarity of the display—reversing dark characters on a light background to light characters on a dark background—helps tremendously. The low vision user can also
choose from a number of colors for the background and foreground. Adjusting lighting and blocking out glare are important as well.

Many people who are visually impaired, however, need to use more sophisticated technology. Screen magnification programs enable the user to set the magnification level he or she requires. You open this program before opening the application programs. Screen magnification programs include options to change background and foreground colors. Because magnified images take up more room, these programs include various ways to scroll through or view all of the information that would normally appear on a screen. Most screen magnification programs can also read a document on your screen in synthesized speech. When evaluating such programs, the more control you have over the display, the better the program.

A benefit of large print access with screen magnification is that it enables many people who are visually impaired to read the computer screen without adapting to synthesized speech or learning braille. Perhaps the chief limitation of large-print screen magnification is that, depending on the user and the
degree of magnification chosen, reading magnified characters may be slow. Fatigue and eyestrain, as well as hand and wrist strain from using the mouse, can also result. These limitations can be overcome, however, by using the synthesized speech feature of screen magnification programs.

**Synthetic Speech**

Do you want a talking computer? A PC can voice what is being typed on the keyboard or displayed on the screen. It's a very popular way to access a PC for those who are visually impaired. To produce usable speech output, a computer needs two things: a sound card, which was mentioned in Lesson 1 in the section concerning hardware, and a screen reader, which is software.

The sound card converts digital information from the computer into audible sounds. Sound cards already come in virtually all new computers, and their quality is constantly improving. It was once the case that you needed to purchase a dedicated speech synthesizer, which is separate internal or external hardware specifically for speech output. With today's sound cards, however, that is no longer true. It is important to
make sure a computer's sound card is multichannel rather than single channel. Multichannel enables the sound card to produce other sounds, such as alert beeps or chimes, while it is talking.

To make use of the sound card for speech access, you need screen-reader software. The screen-reader program picks up all the information that is being sent to the monitor and sends it to the sound card so it can be voiced. Among the features you'd expect to have in a screen reader are the abilities to

- review or skip over lines, words, and sentences
- spell a particular word
- announce punctuation
- adjust the pitch and speed of the voice
- read formatting, such as color, highlighting, and columns

Experienced users listen at 150 to 300 words per minute. (The normal human speaking rate is 150 to 200 words per minute, and the average print reading rate is between 300 and 400 words per minute.) Some screen readers can speak at rates of up to 720 words per minute. At first, speech at the fastest speeds is impossible to understand, but people adapt with
practice. Some programs enable the user to choose from among a number of voices, male and female. In addition, speech is now available in a steadily growing number of languages, including Spanish, French, Italian, and even British English. As sound cards and screen-reader software continue to develop, the speech quality continues to become more and more humanlike.

The degree of control you have over the way the screen reader interprets the visual information is perhaps the most important consideration when purchasing a speech system. A good way to determine which speech synthesizer and screen reader will work for you is to try different ones out. Ask friends, visit dealers, and talk to experts and users at rehabilitation facilities. You can also get free demonstration packages from manufacturers.

One advantage of speech synthesizers is speed of reading. Many users find that they can read material faster using speech than with any other access technology. Another advantage of a speech synthesizer is its ease of use. Given up to 3 hours of practice, most people can understand almost any speech synthesizer with good pronunciation software. However, you
should still take time to choose a synthesizer that best fits your needs and preference.

Perhaps the greatest disadvantage of speech is that it’s transitory. That is, once a word is spoken, it’s gone. Of course, you can have it repeated, but it’s not the same as being able to see or touch it. With speech, it’s difficult to compare materials, because you must remember one line while reviewing another. Some details such as capitalization and punctuation are not as easily detected with speech as with other access technologies. You can’t hear some errors, such as extra spaces or words that sound alike but are spelled differently. Finally, there is no way to interpret graphics using speech synthesis. For these reasons, some people prefer to use speech in combination with either large print or braille.

**Braille Display**

Another way to access a computer is to use a braille display, also called a *refreshable braille display*. This is a device that displays 20 to 80 characters of braille at a time. It's called "refreshable" because as the reader finishes reading one display, he or she presses a key for the next display. The braille display sits close to the
regular keyboard. This setup makes it easy to switch between reading and typing.

Like synthesized speech, braille display consists of two parts: the braille display, which is hardware, and screen-reader software. Most screen-reader software today can send information to a speech synthesizer, a braille display, or both. The software usually includes a translation program that can display information in contracted braille. In addition, many braille translation programs interpret the formatting available in most word processors, such as tabs, boldface, and italics, alignment, and columns. These programs, however, do not yet interpret every available format. Furthermore, they still cannot translate material with a high degree of mathematical or scientific content. Programmers are constantly improving braille translation software to enable automatic translation of text files according to braille format rules. These programs are still far from perfect, however.

A braille display usually has two sets of controls. One set works like the cursor keys, which enable you to navigate around the screen, while the other set tracks what is being displayed.
One type of refreshable braille display is designed to be a stand-alone device. It has a regular keyboard attached, its own disk drive, as well as text editing and printing commands. The user can create, edit, and store documents with these devices alone. A printer or embosser can be connected to produce ink-print or paper-braille copies. It can be connected to a computer, in which case you can use either the keyboard or the braille device to input information. These refreshable braille devices can store information from the computer onto disks for future reference. Most of these devices can operate for a limited time on battery and are quite portable.

The advantages of refreshable braille displays are
- They give immediate braille access without having to wait for the material to be embossed.
- They are very quiet.
- The stand-alone devices or refreshable braille displays on a laptop computer give the user the ability to work away from the desktop computer.

The limitations of these devices are
- When this course was published, braille displays ranged in price from about $4,000 for a 20-cell
display, to $5,000 for a 40-cell display, and up to $15,000 for an 80-cell display.

- Only a very small area can be viewed at a time on the 20- to 40-cell displays. This makes it difficult to identify some formats or find and compare specific data.
- Reading braille displays for a long period of time is tiring.

**Notetakers**

One well-designed and useful piece of equipment available to those who are visually impaired is a notetaker. The purpose of this personal device is to input and output information in accessible formats, including refreshable braille and/or synthesized speech. It is about the size of a videocassette and weighs 1 to 3 pounds. You can easily carry a notetaker with you anywhere. These devices often have braillewriter keyboards, though they can have regular keyboards attached. The regular keyboard and speech output make it an attractive device to those who do not use braille. Devices with only speech output are less expensive than those that also have braille display.
Notetakers with braille keyboards have built-in translation programs. These enable you to input in contracted braille and automatically have the data translated for ink printing or spoken output. The quality of the speech isn't as good as with a PC's sound card, but it can be improved somewhat by connecting an external speaker through the earphone jack.

You can do much more than take notes on notetakers—they include built-in text editors, which are simplified word processors. They can also have an organizer, a date book, a phone book, and a file management program, to name a few. Typically, these programs are proprietary, meaning that the company that developed the notetaker created them and you cannot install programs created by another company. But the next generation of notetakers should remove this barrier.

Notetakers do have significant amounts of RAM, but they cannot compare to the amount of RAM a PC has. Some notetakers have ports for printers, disk drives, and communication with a computer. So you can use a notetaker as both a speech and braille access device by plugging it into your PC for a fraction of the cost of
devices described earlier. Some notetakers enable you to access the Internet to send email and read Web sites. Another new feature on the latest models includes the ability to use the global positioning system (GPS). This enables you to pinpoint your exact location to within 100 to 10 meters. Depending on your needs, you can use a notetaker instead of a PC. But its real power is best realized when it is used in conjunction with a home or office computer.

**Optical Scanner**

One of the most improved computer devices in recent years is the optical scanner. This device can read text or illustrations printed on paper and translate the information into a form the computer can use. A scanner is frequently recommended as a part of a computer system for someone who is blind because it can read fairly accurately a wide variety of documents.

Scanners capture images, so in order to be useful, you need optical character recognition (OCR) software. This software translates the image of characters into text. Most scanners sold today come with OCR software. Once the images are translated, you can read the scanned information using speech or braille.
Scanners do have some limitations. They may have difficulty reading poor-quality print, a document that has been photocopied more than twice, or text printed on both sides of thin paper (such as pages of phone books and newspapers). Scanners cannot decipher handwriting. Also keep in mind that although a scanner may read a document perfectly, you may not be interested in the whole document. An example of this can be invoices, in which you just need to see the line items and amount due. Therefore, before buying a scanner, determine the types and formats of the materials that you want scanned.

**Section Review**

Review the information in this section by responding to these items. A suggested response follows each item.

1. Describe what screen-reader software does.

   Screen readers capture information that the computer sends to the monitor and send it to a speech synthesizer and/or a braille display.

2. Which two items does a PC user need before the PC can voice the information displayed on the monitor?
A screen reader and a speech synthesizer are needed for the PC to voice information.

3. List five ways low vision users can make the computer screen more readable without expensive hardware.

Low vision users can
• use large monitors
• use magnifiers and special glasses
• magnify images and text through system and regular program software
• adjust lighting and glare
• vary the color and polarity of the display

4. Describe a braille embosser.

A braille embosser produces paper braille. A braille translation software program is required to first translate text into braille.

5. List some advantageous features of a notetaker.

• small size and light weight
• option of using a brailler or a regular keyboard
• speech output and/or refreshable braille
• built-in text editor (like a word processor)
- organizer, date book, phone book
- capability of connecting to a PC
- Internet connectivity
- GPS availability

**Ensuring Compatibility**

Your PC, the application software you use, and your access technology need to communicate successfully. This is referred to as compatibility. Unfortunately, you cannot assume that any product you purchase will communicate with any other product. Some access technologies are designed to work only with certain types of computers or operating systems. For example, screen magnification software must be compatible with the video card and the operating system. In addition, note that access technology is typically version specific. This means that a particular access technology such as a screen reader will function very well with the current version of a program—Microsoft Word, for example. But if Microsoft releases a new version of Word, the screen reader may not work as before. This is because the screen reader has been programmed to find items exactly where Microsoft's programmers placed them on the screen. In a new version of Word, programmers may
have moved items around and added new items. The screen reader has not been programmed to find new items or items in different places. The best thing to do is to keep your access technology as current as possible.

When PCs first became available for use in homes and businesses, people who were visually impaired used custom software. This software accommodated most existing hardware. Its commands and screen formats were easy to manipulate. With increased demand for accessible computers in the workplace, however, access to commercial software became more important than ease of use. Therefore, little custom software is available today.

Access systems that are specifically designed to work with commercial application software are said to be transparent, because the commercial application software isn’t affected by their presence. The transparent access system is particularly useful to the employee who must use the same commercial software that his or her sighted coworkers use. Even with the most modern access technology, however, commercial programs, designed as they are for visual use, can be
difficult for users who are visually impaired. Some of the difficulties arise from the graphics, lines of repeated characters (such as asterisks), and randomly located pop-up messages.

Section Review

Review the information in this section by responding to these items. A suggested response follows each item.

1. What does compatibility mean?

   Compatibility is the ability of various components to communicate successfully. For example, hardware, software, and the access technology need to be compatible.

2. What is meant by transparent access?

   Access systems that are specifically designed to work with commercial application software are said to be transparent, because the commercial application software isn’t affected by their presence.
Summary
This lesson described the ways users who are visually impaired access the computer. It also discussed compatibility issues for access technology.

Assignment 3
If you have received feedback on your previous submission, complete this assignment. Begin by giving your full name, address, and phone number. Also indicate the name of this course, Assignment 3, your instructor’s name, and the date. Then provide your responses. Be sure to indicate the item number along with your response. Instructions for mailing your assignment are included in the Overview.

Are the following statements true or false? If false, reword the statement to make it true.
1. Tactile graphics are easily produced with the braille embossers currently on the market.
2. Braille embossers can run at speeds ranging from 20 to 600 characters per second.
3. Images that appear on the screen can be enlarged for easier reading by using handheld low vision aids, using software that reprocesses the text before being displayed, and using a larger monitor.
4. A sound card is all that is needed to have a "talking computer."
5. Most people can read material faster using speech than with any other access technology.

Respond to the following items in two or three sentences. Base your answers on your own needs or those of your family member, client, or student.
6. List at least two factors that can make the purchase of a refreshable braille display undesirable.
7. List at least five appealing features in a notetaker.
8. Types of access technology include speech, refreshable braille display, and large print. Identify two of these that a person who is visually impaired can use in combination.
9. List at least five features of a speech access system that should be demonstrated before it is purchased.

Answer only one of the following essay questions. Base your answers on your own needs or those of your family member, client, or student. Limit your answer to 250 words (about one print page, three braille pages, or a 1-minute recording) or less.
10a. Which access technology would you choose for your primary access or that of your family member, client, or student? Which for the secondary? Why?

10b. What primary access technology is preferred, and what features should it contain?

Once you have completed this assignment, send it to your instructor according to the instructions in the Overview to this course. Then proceed to Lesson 4: Selecting a PC and Access Technology.