Knowledge Of Personal Computing Online • 1996-98

Q: What exactly is computer memory? Is it the disk? Is it RAM or ROM? Can you please explain?"

A: Yes, I can. First of all, sometimes the term "memory" is used in conjunction with the storage of data magnetically on hard or floppy disks. **This is incorrect. Magnetic data storage on disks is not memory.** Computer memory consists of electronic chips installed in sockets on the main circuit board that's inside your computer's case. Two kinds of memory are used in personal computers—ROM and RAM.

ROM stands for "**R**ead **O**nly **M**emory." Data is permanently stored in a ROM chip. It can only be read, or "played back," and no new data can be written, or "recorded." This is analogous to an audio CD, which can play back but can't record music. ROM is used to store setup and initialization data which the computer needs to properly start up, or "boot."

The second kind of PC memory is RAM, which stands for "**R**andom **A**ccess **M**emory." These types of chips are like a cassette deck, in that data can be temporarily recorded, played back, and erased during your computing session. When you run a program, the computer instructions that make up the program are copied to the RAM chips. Data that you generate as you use the program is also temporarily kept in RAM. When you save your data and exit the program, the data is copied from the RAM chips to a disk (either hard or floppy, depending on your personal routine) and the program instructions are erased. RAM is also called "volatile" memory, because it only holds data as long as it is energized by electricity. This means you can kiss your data good-bye if the document you're writing or the spreadsheet you're working on hasn't yet been saved to disk, and a power failure occurs; or you make a mysterious move that locks up the keyboard, and you're forced to restart the computer. Sound like a reason to save data frequently? I don't think I need to draw you a diag**RAM** to illustrate the **RAM**ifications of not p**ROM**ptly saving data when it changes significantly f**ROM** time to time.

Q: When I see ads for computers, I see "MB" all the time. Sometimes it's only 8MB and other times it's something like 340MB. What is it?

A: "MB" stands for "megabyte," a measure of digital information. Sometimes you might also see "KB" or just "K," which stands for "kilobyte." The amount of data a computer's components can hold is measured in thousands or millions of units called bytes. Some of these components are the hard drive inside the case, the floppy diskettes you insert in the slots on the front, the RAM memory chips on the main circuit board, and the storage chips on the video circuit board.

So what is a byte? All computer information is in the form of eight digits. Each digit can be either zero or one--for example, 10011001. These patterns of eight zeros and ones form a code which translates into the letters of the alphabet, numerals, punctuation marks, etc. Each individual "0" or "1" is called a bit. Each group of eight bits is called a byte. So each byte can be thought of as one character, like any letter or number. Now, what about the "K" and "MB"? The "K" stands for "kilo-", the prefix for "thousand." The "M" stands for "mega-", the prefix for "million." Put it all together and you get one kilobyte equals about a thousand bytes (actually 1024) and one megabyte equals about a million bytes.

But how much is that in understandable terms? Well, it's estimated that a double-spaced typewritten page contains about 2,000 individual characters (bytes), or 2K. That means a high density floppy disk with a capacity of 1.44MB (remember, that's 1.44 megabytes or 1,440,000 bytes) can hold the equivalent of approximately 720 double-spaced typewritten pages (1,440,000 divided by 2,000).

So what does that mean to you? Well, the larger the hard drive in your computer, or the more megabytes of capacity it has, the more programs and data it can hold. Sizes today range from about 340MB to as much as 1,000MB or more, which is known as a gigabyte.

With regard to RAM capacity, the more megabytes of chip memory your computer has, the faster it can run your programs and the more programs it can run at the same time to improve productivity. The minimum amount of RAM your computer should have these days is 8MB.

Finally, the video circuit board that runs your monitor determines how clear your screen is and how many colors it can produce. More chip storage capacity means higher resolution, a clearer picture, and more colors--thus, a 2MB video card is superior to a 1MB video card.

Q: What's the difference between a hard disk and a hard drive?

A: There is no difference—both terms refer to the same device inside your computer's case.

When it comes to understanding computer disks, the easiest analogy to use is a plain old audio cassette. Computer disks are coated with the same magnetic stuff as the tape in a cassette, except on both sides, and magnetic patterns are recorded in order to be played back. The idea of how they operate is the same, but the terms used are different. When we talk about cassette tapes, we use the terms "record" and "playback," but when we talk about computer disks we use the terms "write" and "read."

A floppy disk is so called because the coated disk inside the plastic case is flexible. With floppy disks, the read/write heads of the disk drive actually touch the spinning disk, just like the heads in an audio cassette recorder. For this reason, floppy drive heads need to be cleaned periodically, just like cassette heads. You can't just use Q-tips and alcohol on the heads, however, because you can't reach them. A special cleaning device looks like an ordinary floppy disk but contains a disk-shaped pad inside the plastic case, onto which you put a few drops of cleaning fluid. You should clean the heads on your floppy drive about every six months, or data loss can develop.

But what about a hard disk? Well, remember the old record-stacking turntables? Just imagine a turntable that not only would let you stack a number of records, but also had two tonearms for each record, one for each side. Then you could instantly play any song on any side of any record. Now if you substitute floppy disks for the records and read/write heads for the tonearms in our imaginary device, you have the basic idea behind the hard disk. Yes, that's right—the hard disk in your computer is like a jukebox for floppy disks, except that the actual platters in a hard disk are rigid, not flexible. The read/write heads actually look like miniature tonearms, but they do not physically touch the disks—they just come very close.

One last comment: the computer industry has decided to spell the magnetic variety "disk," with a K, while optical or CD-ROM media is referred to as a "disc," with a C.

Q: What exactly is DOS? Is it the same as MS-DOS?

A: DOS (pronounced "dahss") stands for Disk Operating System. In simple terms, DOS is a program that lays down the basic rules all other programs must follow. These rules determine how the keyboard, disk drives, and monitor all communicate with each other and with the electronic chip memory inside the computer.

The operating system for IBM-compatible computers was first called MS-DOS. Although at times you may think that the "MS" stands for "malicious system," it really stands for Microsoft, the company that wrote the program.

Computers whose disk drives, memory, etc. have different operating characteristics from IBM-compatible PCs, such as the Apple Macintosh, use different disk operating systems. Although all computers, even room-sized mainframes, must use a disk operating system, the term "DOS" has come to be associated with IBM-compatibles. The more generic term is now simply "OS" (pronounced as separate letters) for operating system, dropping out the word "disk." Any operating system must be copied or "loaded" into a computer's memory from a disk, either internal or external, before the computer can be used. This is called "booting" the computer.

Once the computer is initialized by loading the basic instructions supplied by the OS, it is ready to run your application software, such a word processing or personal finance program, or a game for you or your kids.

The current combination of DOS and Windows, which is the core operating system and an environment making it easier to use, is in the process of being replaced by an all-in-one operating system and friendly user environment called Windows 95.

The Apple Macintosh operating system, currently called System 7.5, has recently received a new name—Mac OS. The reason is that Apple has finally authorized other companies to make clones of the Mac in order to broaden the base of installed machines, thereby increasing market share for their system and allowing more software to be sold by Apple and others.

Apple's marketing people feel the operating system needs an official name, one the clone makers can use in their advertising to show that any software written for the genuine Apple Macintosh will also work on their machines.

Other popular operating systems for use on personal computers and workstations, which are like PCs on steroids (more powerful processors, tons of chip memory, huge hard disks) are OS/2, Windows NT, UNIX, Solaris, NeXTStep, Linux, and many others.

All require different amounts of hardware horsepower, work with different microprocessors, have varying amounts of commercial software available for them, and are used for specialized applications such as engineering, scientific, graphics and publishing, financial, and manufacturing.

Minicomputers and mainframes use dozens of operating systems, some dating back decades.

Most of the more esoteric and powerful operating systems require custom-written software, which large corporations are more likely to use.

Q: I'm seeing a lot about Windows 95 lately. Should I buy it? What's so great about it?

A: Much has been written about Windows 95 in the last few months. Although I can't begin to summarize everything there is to know about it here, I can give you a brief run-down on some pros and cons, and some issues to consider.

On the plus side, the user interface (the on-screen controls presented by the system to operate your computer and its programs) is more intuitive and easier to use. In fact, it's more like the Macintosh interface in a number of ways, which has always been considered more user-friendly. Current Windows 3.1 users might need a bit of time and training to get used to some of the new concepts, but once they do, computer operations should make more sense and take less time than before.

Another welcome change, and another feature that Mac users take for granted, is the ability to use long, descriptive file names instead of the current DOS formula of an eight-character file name, a period, and a three-character extension. With Windows 95 you can use up to 250 characters to give each file a name that not only makes sense now, but will make sense weeks from now when it's creation is but a dim memory.

Windows 95 has what's called a 32-bit architecture, which allows your computer to do many tasks at once. With the current version of Windows, multiple programs can be running, but only the one in the foreground is actually active, while the ones in the background are suspended. Windows 95's "multitasking," as it's called, will allow you to copy important files to a floppy disk for safekeeping, while at the same time download files via modem from the Internet, while at the same time print a document, while at the same time sort your mailing list, while at the same time play your favorite game (assuming your computer has enough RAM chip memory to load that many programs in the first place.)

Speaking of RAM, now we get to one of the downsides of Windows 95 -- higher horsepower requirements. Although Microsoft's official minimum requirements for running Windows 95 are a 386DX processor and 4MB of RAM, they recommend at least a 486 with 8MB of RAM. And for industrial-strength use, most computer publications are calling for a Pentium-class computer with at least 16MB of RAM or more.

Realistically, I wouldn't even think about installing Windows 95 on anything less than a 486 with 8MB of RAM. So this means if your computer is less powerful than that, buying Windows 95 is just the tip of the iceberg -- you're also looking at a processor upgrade, a memory upgrade, or perhaps a whole new computer. And to a large company with hundreds of computers, these upgrade costs can be considerable.

Another aspect of upgrading to Windows 95 is the fact that today's Windows software won't be able to take advantage of many of the new features, like long filenames. To fully take advantage of all the benefits of Windows 95, you'll have to upgrade all your programs to the Windows 95 versions which support all the fancy new features. So it's important to realize there can be hidden costs beyond just the purchase price of Windows 95 (which is around $90 through mail-order), and to decide whether these costs justify the value to you of the new features and capabilities you will gain by upgrading to Windows 95.

There's a lot more to know about Windows 95, and any current computer magazine can fill you in. But should you buy it? Well, IF you're not a large company and IF your computer has enough muscle and even IF you can't afford to upgrade all your current software, I say go for it. To a home or small business user, the are enough advantages even without Windows 95-specific program upgrades. And since all new computers will soon come with

Windows 95 pre-installed, today's computer users will encounter it sooner or later whether they want to or not.

Q: I was reading an ad for a computer system, and the specifications for the monitor said ".39 dot pitch, interlaced, 8-bit color." What does all that mean?

A: The image you see on a monitor is made up of tiny dots of light called "pixels," short for "picture elements." The distance between these pixels is called the dot pitch. The closer together the pixels are, the clearer the picture on the monitor, just as dots in a magazine picture being smaller and closer together result in a clearer image than the pictures formed by the larger and more spread-out dots in the Sunday comic pages. As a result, the lower the number given in the specifications of a monitor for dot pitch, the clearer the picture it can produce. For example, a monitor with .28 dot pitch, which is measured in millimeters, will produce a higher quality image than a monitor with a .39 dot pitch, since the dots are closer together.

Other terms encountered when evaluating monitor quality are "interlaced" and "non-interlaced." Today's monitors, just like TVs, produce a picture by sweeping an electron beam across the inside of a picture tube coated with a material that glows when energized by the electrons hitting it. To form a rock-steady picture, the electron "gun" shoots the energizing beam in one direction, say left to right, then turns off on the return trip from right to left, only to turn on again on the next left-to-right sweep to form the next line of the image. However, in order to produce more lines with which to form an image, some monitors cheat and leave the electron gun on all the time, on both the left-to-right and right-to-left sweeps. This results in a slight flickering of the image, which doesn't bother some people but drives other people crazy. This is called "interlacing" the image. It's a cost-cutting way to produce a higher-resolution image, albeit with the side effect of a slightly flickering picture. A higher-quality monitor will produce more lines of resolution, but scan them from left-to-right only, resulting in a steadier picture. This is called a "non-interlaced" image. Thus, when it comes to evaluating monitor quality, a "non-interlaced" monitor is better than an "interlaced" one.

Another term I just used is "resolution." This is the actual number of dots forming the monitor's image. Obviously, the more dots, the clearer the image. In days gone by, various computer video technologies produced images made up of 720 dots across by 350 dots down (720 x 350 pixel resolution), but in one color only (Monochrome Display Adapter, or MDA). Then came monitors with 4 colors, but with only 640 x 200 resolution (Color Graphics Adapter, or CGA), followed by 16 colors with 640 x 350 resolution (Enhanced Graphics Adapter, or EGA).

But enough of this history lesson. Modern monitors and video circuit boards incorporate the VGA, or Video Graphics Array, standard established by IBM when they released their PS/2 line of personal computers in the late 1980s. When first introduced, VGA produced a minimum of 16 colors at a resolution of 640 x 480. Almost immediately, IBM's competitors developed a so-called "Super VGA" standard of 256 colors at up to 800 x 600 resolution. Today, the VGA standard is sometimes a combination of the two. The most common configuration is 256 colors at 640 x 480 resolution. This number of colors is sometimes called "8-bit," referring to the fact that 2 to the 8th power, or 2 times itself 8 times, equals 256. The next step is 16-bit color, which equals 65,536 colors.

The ultimate configuration today, sometimes referred to as "photo-realistic," is 24-bit color, which equals about 16.8 million colors! Keep in mind that this kind of performance is not only a function of the monitor, but also the video circuit board, or video card, inside your computer's case producing the image signal. With regard to maximum resolution, it is not uncommon for today's video card/monitor combinations to be capable of 1024 x 768 resolution or more, resulting in a very clear picture, but with elements such as Windows icons and software pushbuttons being very small.

Needless to say, this type of high-end video capability can be expensive, and probably is only justified if you are a graphics professional dealing with photographic manipulation such as retouching, color correcting, or digital imaging.

What will the future hold with regard to resolution and number of colors? Your guess is as good as mine. I suppose we'll just have to monitor the situation very closely.

Q: I want to try creating some artwork on my computer, but when I went to buy an art program, the clerk asked my if I wanted a "paint" program or a "draw" program. What's the difference?

A: There are two methods used by computers to create and store artwork, and they reflect the file formats used by paint and draw programs. Which type of program is right for you depends on the type of artwork you intend to create.

If painting is more natural to you, or if you have a hand or flatbed scanner or send your film out to be processed and scanned onto Photo CDs, then you need a paint program to create, manipulate or edit your images. The Paintbrush program that comes with Microsoft Windows is a paint program. Some other paint programs are Adobe Photoshop, Corel Photo-Paint, and PhotoStyler, and there are many more.

The file format used by paint programs is called a "bitmap." A bitmap image is made up of dots, just like in the newspaper comic pages or the images on your computer monitor, except that they're square rather than round. Bitmap images are also called "raster" images. You can think of a bitmap image as having been created on a piece of graph paper with many tiny squares. Each square contains a bit of the image.

If the image is only black and white, each tiny square is either black or white. If the image is a scanned-in grayscale photograph, each tiny square is one of 256 different shades of gray. And if the image is either a scanned-in color photograph or a picture you have created in a color paint program, each tiny square contains a color. How many colors each square is capable of depends on your video hardware and the capabilities of your paint software.

The term "paint" program fits well because the pictures you create become part of the imaginary "canvas" of your computer, just like creating with real paint. To make changes or edit a bitmap image, each individual square or "pixel" (short for "picture element) must be altered, either individually or in groups. If you draw a red square and partially cover it with a blue circle, the two objects simply become an image made up of tiny red and blue pixels "painted" onto a white canvas.

Bitmaps look fine at the size they were originally created or scanned, but to enlarge them, the computer must actually add pixels to the ones already there, and must do its best to guess where they should go. On diagonal lines, which are actually made up of tiny squares, the guessing game is not very accurate, and the result is the "stairstep" jaggies that make it obvious an image is computer-generated. If you make a bitmap smaller, the computer tosses out some of the squares, and again must guess which ones to eliminate. The result is not nearly as bad as enlarging an image--in fact, sometimes the image looks better. But the best bet is to create or scan a bitmap image at the size you intend to eventually print it out.

If your images need to be more precise, like engineering or technical drawings, or need to be edited after having been created, then a draw program would be more suited to your needs. Examples of draw programs are CorelDRAW!, Adobe Illustrator, and Aldus Freehand, among many others.

The images resulting from a draw program are called "object" or "vector" images. They are stored by the computer as mathematical formulas, not as dots, and as a result they are always crystal clear no how much you shrink or enlarge them--no jaggies. In addition, draw files can easily be edited long after they were originally created, as the objects making up the image always stay distinct and separate from one another. It's something like taking pieces of string and forming them into the components of your image, and then stacking them on each other in layers to form the end product. However, unlike real "string-drawn" objects, computer-drawn objects can be filled in with colors, blends of colors, or patterns, and the "strings" forming their outlines can be varying colors, thicknesses, and patterns. If you draw a red square and partially cover it with a blue circle, the two objects stay distinct from each other, as though they had been cut from paper and laid one on top of the other. You can change colors, make each one larger or smaller, or change their order--that is, bring the square in front of the circle--at any time.

Q: What is MIDI? I know it has to do with computers and music, but I'm not exactly sure what it is.

A: MIDI stand for Musical Instrument Digital Interface. It's a communications standard agreed upon by musical instrument manufacturers in

1982 to allow different brands of electronic instruments such as keyboards to interconnect with each other. This connection capability also includes personal computers.

The most exciting aspect of connecting a MIDI keyboard to a computer is the capability of recording and editing music played on the keyboard with computer software. The music can then be played back from the computer's speakers or played remotely through the keyboard. Many of today's keyboard-based artists, such as Yanni, produce their albums this way, and in fact many of the live performances you hear in concerts are reinforced with MIDI-produced music. There are even MIDI devices to control concert lights and to adjust sound levels.

MIDI can be thought of as being similar to the old piano rolls--rolls of paper with holes in them that could mechanically trigger the keys in specially-made pianos, "player pianos," to play by themselves. Instead of holes in rolls of paper, MIDI-compatible instruments respond to electronic signals sent by another instrument or by a computer. These signals consist of commands and codes which tell the instrument what note to play and for how long, as well as how loud to play and sometimes what special effects to use. Keyboards are not the only kinds of MIDI instruments, however. There are MIDI adapters for guitars and various drum and percussion devices, as well as "wind controllers" for such instruments as saxophones and clarinets.

In order to connect a keyboard to your computer, the keyboard must have the proper sockets on the back, and the computer must have the proper connector, called a "MIDI interface." The popularity of computer sound cards has increased the interest in MIDI, since most sound cards have built-in MIDI capabilities. A computer equipped with a MIDI-capable sound card thus becomes somewhat like a computer-controllable synthesizer, but in order to create musical notes you must either place them on the screen with a mouse or generate them from your computer keyboard, both of which are not nearly as convenient as using a real musical keyboard.

A computer sound card generates the sounds of many standard instruments as well as some electronic sounds. You can play a musical part on a keyboard--say, a flute melody--which then appears on your monitor either as standard music notes or as colored bars. You can then edit any mistakes or duplicate repetitive parts. Then you can play another part--say, a drum beat--while hearing the music you already recorded. Layer by layer you can add each part until you have what sounds like a full band! But instead of actually recording the sound, only the musical commands needed to trigger the notes are being recorded, just like punching the holes in a piano roll. I used these MIDI techniques to create my recently released music album, "Black Hills Gold."

Q: The computers where I work were recently upgraded to Windows, but I have trouble using a mouse. Is there anything else I can use to move the cursor on the screen?

A: The mouse was once considered an optional input device, but with the tremendous popularity of the Microsoft Windows operating environment, which virtually requires a mouse, it has become a necessity. Or I should say, the ability to move an arrow-shaped cursor on the screen has become a necessity. And a mouse has always been necessary to operate an Apple Macintosh computer. But in both cases, a mouse is only one way to move an on-screen cursor.

There are many alternatives to the long-tailed plastic rodent that lives next door to millions of keyboards across the land, but first let me describe how a mouse works. A mouse translates hand motion into cursor motion. Most mice use a rolling ball to turn two rollers—one for horizontal and one for vertical motion—which then drive encoders that send signals to the PC. A mechanical mouse uses mechanical encoders. In an optomechanical mouse—the most common type—optical encoders use light instead of mechanical contacts to send signals to the PC. Buttons on the mouse are pressed to select on-screen commands or options, or held down while the mouse is moved to move objects around on the screen.

The most popular alternative to the mouse, the trackball, looks like an upside-down mouse with an enlarged ball. Instead of moving the whole device around on your desk to make the ball roll, the housing stays stationary while you simply move the ball with your fingers or the palm of your hand, depending on the trackball's design. This is very convenient when there is not a lot of desk space to be had, such

as when a laptop computer is being used on an airplane. I used a trackball for a number of years and much preferred it to a mouse, both for convenience and for the precision with which I could maneuver the cursor on the screen.

When my track ball died not long ago, however, I decided to try a new gizmo on the market called a GlidePoint. It consists of a small plastic pad about two inches across by about one and a half inches high, on which you simply slide your index finger. This type of input device made its debut on the Apple Macintosh Powerbook line of laptop computers. There is nothing rolling to collect dirt or dust, and no moving parts to wear out. Best of all, it costs less than a number of conventional mice and trackballs on the market. Well, I just love it. Not only do I find it more intuitive to just point and slide my finger to move the on-screen cursor, but instead of having to click a button to execute commands like you do with a mouse or trackball (which you can also do on the GlidePoint, if you prefer--it has three buttons around the pad), you can just tap your finger lightly on the pad either once or twice, depending on whether you're selecting or moving something on the screen, and the cursor acts as if you had pressed a button.

Anther fairly common input device is a digitizing tablet, having a rectangular surface with sensors embedded in it upon which a wired or wireless electronic pen is moved, thereby moving the cursor on the screen or causing lines to be drawn. Digitizing tablets are used most by those doing computer-aided design (or CAD), or graphic artists who prefer drawing with an electronic pen instead of trying to draw with a mouse. But for ordinary cursor movement, a trackball or GlidePoint is probably your best alternative to a mouse.

Q: What does ASCII mean?
A: ASCII, pronounced "as-key," is an acronym that stands for American Standard Code for Information Interchange. It refers to a text format that can be understood on virtually any computer platform, from IBM-compatible or Apple Macintosh PCs to room-sized mainframe computers. In simple terms, it is the most basic set of text characters, representing the alphabet (a b c), numbers (1 2 3), and punctuation marks (. , ; : ?). It does not support any type of text embellishment or formatting such as bold, italic, centering, underlining, larger sizes, etc., since these are handled in different ways by different programs and on different platforms. Thus, when you convert a word processing document to ASCII for the purposes of transferring it to another program or type of computer, all such "fanciness" will be lost, and only the basic text itself will remain. Certain DOS and Windows start-up files must be in ASCII format to be understood by your computer. The "Edit" program in DOS and the "Notepad" program in Windows create only ASCII text, which is why they have no provisions for such features as bold, italic, centering, etc.

Q: What does IDE mean?
A: IDE stands for Integrated Drive Electronics. This refers to a type of hard disk drive. In the past, the electronic circuits necessary to control a hard drive were located on a circuit board attached to the computer's main board, or mother board, while the drive itself contained mostly mechanical parts. In modern hard drives, however, both the mechanical and electronic components are integrated into the drive itself, and the controller board is merely a connection between the main board and the drive. This type of hard drive is called an IDE drive, and is the most common type currently available.

Q: What does RGB mean?
A: RGB stands for Red, Green, Blue, which are the colors of light that a monitor combines to form all the other visible colors. Another term for "color monitor" is "RGB monitor."

Q: What does WYSIWYG mean?
A: WYSIWYG, pronounced "wizzy-wig," stands for What You See Is What You Get. It refers to the capability of modern computers, monitors, and software programs to display text the way it will ultimately look when you print it out, thus allowing you to format your documents on-screen with the expectation they will print that way.

Q: What does CPU mean?
A: CPU stands for Central Processing Unit. Also known as a "microprocessor," the CPU is the "brain" of the computer, controlling all the other parts. The CPU fetches instructions from memory and processes them. This may cause it to transfer data to or from memory or to activate peripherals such as the keyboard, monitor, disk

drives or printer to perform input or output.

Q: I want to connect my computer to the "information superhighway," but I'm confused by all the alternatives. What's the best way to go about it?

A: Entire books are written nowadays on this subject, but I'll try to get you started.

To get your computer online, you must first have a modem. It's a device that connects your computer to the phone line. It can be housed in your computer's case (internal), or sit in its own little box (external). Modems, like computers, operate at various speeds, and of course, the faster the better. Modem speed is measured in bits per second, or bps. The fastest modems currently available operate at 28,800 bps (28.8 K) and start at about $150 mailorder. The most common modems operate at half that rate, or 14,400 bps (14.4 K), and can cost as little as $50 mailorder. Most computers that come with a modem already installed internally have 14.4 modems. This is the minimum speed required for adequate access to online services. In addition to sending and receiving computer data, virtually all of today's modems have fax capabilities as well.

As to the type of connection, there are currently two alternatives. One is to subscribe to a commercial online service, the one-stop information shops along the infohighway. The most popular are America Online, Prodigy, CompuServe, Delphi, GEnie, and the newcomer Microsoft Network (MSN). The charges for these services are similar to cable TV charges: a monthly fee for basic service and additional fees for "premium" services. Commercial online services' offerings typically include electronic mail (email), user forums or discussion groups on a wide variety of topics, software libraries containing programs that can be copied (downloaded) to your computer over the phone line, news and publications, business and financial information, hardware and software support and information, special interest resources, and Internet access. The services differ in such areas as ease of use, costs, and target audience. For example, America Online tends to be most popular with home users, whereas CompuServe caters to the business user, and Prodigy is a hit with kids. Since the access software for MSN is included in Windows 95, this up-and-coming service is expected to give the more established services some stiff competition, as evidenced by the hundreds of content providers signing up with Microsoft to offer their wares.

Most of these commercial online services offer free trial start-up periods with free access software and online time. The best way to find out which, if any, commercial service is right for you is to take advantage of these offers and try them out. The main drawback for us in the Northern Hills is the fact that the closest local access telephone numbers to these services are in Rapid City, and making a long distance call on top of the normal fees is pretty expensive. Of course, if the Extended Area Service proposal is approved by the Public Utilities Commission allowing toll-free calling to Rapid City, trying the commercial online services will be practical. Any computer magazine will contain ads telling you how to take advantage of these free offers.

The second alternative to going online is a direct connection to the Internet.

The Internet began in the late 1960s. Computer scientists were asked by the Pentagon to determine the best way for an unlimited number of computers to communicate without relying on any single computer for central control. They figured such a decentralized setup would better be able to survive a nuclear attack. Thus what was called the Arpanet was launched, initially linking just four research labs to let scientists and engineers test networking technology. As the Arpanet quickly expanded to include dozens of universities and corporations, programs were developed to help people exchange electronic mail (e-mail), as well as tap into remote databases, run computers from a distance, and exchange ideas via electronic bulletin boards. By the late 1980s there were millions of computers and thousands of networks using the Internet protocol, or digital communications scheme, and it's from their interconnections that the modern Internet has emerged. Today the Internet comprises 48,000 different networks around the world, all acting as one global virtual computer.

To tap into this global computer, just as with commercial online services, you need a connection via modem through a service provider coupled with the proper software for your type of computer. Access charge plans vary from unlimited monthly access for a flat fee, to hourly

charges, to some combination of the two. Dozens of programs are available to enable PCs or Macs to navigate the information superhighway, or "i-way" as it's now being called, and they can be found in any computer store or mailorder catalog. The proper programs can also be supplied by an Internet service provider such as Spearfish Computing Center, whose main computer is physically wired to the Internet, allowing you to connect to it by calling a local phone number. This is how I transmit my columns to the Pioneer every week via e-mail.

There are a number of functions available on the Internet besides e-mail, such as the ability to acquire programs (ftp, or file transfer protocol), participate in newsgroups and discussion forums, and operate remote computers from your own, such as researching by tapping into the computer of a distant university's library. But by far the most popular aspect of the Internet is the World Wide Web, which allows you to navigate colorful and graphically-oriented screens of information with the click of a mouse. Among many other things, the World Wide Web allows you to instantaneously access news, weather, and sports; shop electronically in virtual malls; search for information on almost any subject imaginable; and obtain product information from thousands of companies.

So whether you choose to subscribe to a commercial online service, most of which provide some kind of Internet access, or you decide to establish a direct Internet connection through an Internet service provider, there is an almost unlimited world of information waiting to be explored with your computer.

Q: In computer ads I see 486SX, 486DX, and 486DX/2 with numbers after them. What does that mean?

A: These are various types of microprocessor chips, also known as CPUs. The CPU, or Central Processing Unit, is the brain of your computer and determines its power, speed, and capabilities. The numbers that follow such designations, such as 486SX/25, 486DX/33, or 486DX2/66, represent the chips' speed in MHz, or megahertz, which is millions of cycles per second. As with most speed measurements, the faster the better. The letters SX, DX, and DX/2 are indicators of the capabilities of each chip.

The original IBM PC used a microprocessor made by Intel known as the 8088. A few years later, this chip was upgraded to one called the 80286, or 286 for short, in the IBM AT computer. These chips perform arithmetic using whole numbers, or integers. For scientific or engineering applications which require more precise computational power, auxiliary chips called math coprocessors were developed to work in conjunction with these main processors--the 8087 worked with the 8088, and the 80287 worked with the 80286. Having the proper coprocessor chip meant your computer could do things and run programs beyond what the average off-the-shelf unit could handle.

Then came the 80386, or 386 for short, which again represented an increase in computing power, but which also had a self-contained math coprocessor. However, this chip cost so much more than its predecessors that Intel eventually decided to do something to fill the price gap. That something was to introduce a 386 chip without the internal math coprocessor to keep the cost down, and it was called the 386SX. So seeing the letters SX after a chip's model number basically indicates that it's a stipped-down version of its more powerful sibling. The full-blown model with the internal coprocessor came to be known as the 386DX. So seeing DX indicates the top-of-the-line with regard to math performance. These letter designations have been carried over to the still-more-powerful 486 line of processor chips.

The next development in CPU technology by Intel is called the Overdrive chip, which doubles the speed of a slower chip and adds a math coprocessor. If you add an Overdrive chip to a computer already containing a 486SX/25, the end result is the equivalent of a 486DX processor running at 50MHz, or double the original speed; similarly, a 486SX/33 would be boosted to a 486DX/66. To the average user, the faster speed is of greater significance than the addition of the coprocessor; however, some spreadsheet and graphics programs can take advantage of a math coprocessor when it is detected, and allow more advanced features or better performance. When this speed-doubling technology is built into a computer to begin with, and not merely added as an upgrade, the letters DX2 are added before the resultant final speed--so, a 486DX2/66 is just a built-in version of a 486SX/33 enhanced by an Overdrive chip. Also available is a DX4 chip, curiously named because it

triples, not quadruples, a slower chip. Thus a 486SX/33 with a DX4 chip runs at approximately 100MHz.

Of course, with the release of the Pentium processor by Intel last year and its continued drop in pricing, any version of a 486-class chip will soon be virtually obsolete, let alone a 386 or 286. This drop in pricing is a result of--you guessed it--yet another advance in microprocessor technology currently code-named the P6 processor. This week I'll talk about the next step in processor technology--well, actually, the next few steps--in describing the Pentium family. But first, an explanation of the name Pentium. I mean, we had the 286, then the 386, and then the 486, so why not the 586? Well, the Pentium IS the 586, but Intel chose a name that could be trademarked rather than call it three numbers, which can't be trademarked. Intel knows this because it tried to trademark the 486 chip's designation when other companies reverse-engineered it and came out with work-alike clones. But the court ruled that Intel couldn't trademark the numbers 486, allowing rival chips called 486s to enter the market, so this time they invented a catchy name alluding to the 5 in 586--Pentium. But those other companies have now reverse-engineered the Pentium and are releasing chips actually called 586s, so basically these chips and the Pentium are equivalent. But when that happens, just like with the 486, Intel drops the price drastically in an effort to run the competitors out of the market. So these circumstances, coupled with the recent release of the equivalent of a "686," which Intel had code-named the P6 but is now calling Pentium Pro, are the reason for the drop in Pentium prices, thus demoting the 486 family to "has-been" status.

The Pentium first arrived with a speed of 60MHz, but that speed quickly accelerated to 75MHz, then 90MHz, then 120MHz, and is now up to 133MHz. But that's just the beginning of the MHz speed contest, with the new Pentium Pro zooming far ahead. The first Pentium Pro out of the blocks runs at 150 MHz, with siblings right behind at 166, 180, and 200MHz! And to confuse matters worse, Intel has also released Pentium Overdrive chips. So now, instead of upgrading your slow-poke 486SX25 or 33 to just a faster 486DX, don't stop there--go all the way to a 63MHz or 83MHz Pentium instead. By the way, due to its superior design and muscle, a slower Pentium will outperform a faster 486--for example, a 75MHz Pentium can do things a 486DX4/100 can't.

Do you really need this much power? That depends, as always, on what you use your computer for. If you're the average home user, a fast 486 is probably adequate, and since they cost the same as slow 486s did only a few months ago, they are your most cost-effective bet for entry-level applications. If you are a business or advanced home user, the Pentium is definitely the way to go, especially since they, too, are at bargain prices.

What about the Pentium Pro? Is it overkill? Well, to quote a source in PC Week, "I view the P6 [Pentium Pro] as an incremental upgrade [to Pentium.] The P7 is getting into mainframe class, and that will be significant." The P7, you ask incredulously? Yet another more powerful chip? Yes, it's right around the corner. And that means the confusion about CPUs isn't about to clear up--or slow down--any time soon.

Q: What does "cache" mean?
A: Cache (pronounced "cash") is a small fast area of chip memory holding recently-accessed data, designed to speed up subsequent access to the same or nearby data. It is based on the fact that retrieving data from virtually instantaneous electronic memory chips is must faster than retrieving data from a magnetic storage medium such as a disk. When data is read from your hard drive to main memory (RAM) a copy is also saved in the cache, along with some additional nearby data. The cache monitors subsequent requests for data to see if the required data is already in the cache. If it is (a "cache hit") then it's returned immediately and the slower hard drive read isn't needed. If the data is not cached (a "cache miss") then it is fetched from the disk but also saved in the cache in case it's needed again.

Q: What does "OCR" mean?
A: OCR stands for Optical Character Recognition. It's the method used to convert what is really a picture of text, such as a fax received by your fax modem or a scanned-in page of text, into "live" text that behaves as though it had been typed in, and can be edited, spell checked, copied into other documents, etc. This can either be done by a separate OCR program, or can be a built-in feature of the program that controls your fax modem or scanner.

Q: What does "PCI" mean?

A: PCI stands for Peripheral Component Interconnect. It is a recently-developed method of transferring data within your computer. Integrated into the main circuit board of your computer is a data highway, or "bus," which interconnects all the various components--the processor, the memory chips, the hard drive, the video circuit card, etc. The oldest bus design, which is still used in slower computers, dates back to the days of the original IBM PC--when the speed of its processor was only 4.77MHz, as opposed to the recently-released Pentium Pro processor which runs at up to 200MHz. So a much faster data highway method was needed to keep up with the speed increases in all computer components. The original design, called ISA for Industry Standard Architecture, has undergone various incremental upgrades, but the new PCI design, developed by Intel, is considered the modern standard.

Q: What kind of computer is a PowerPC? Is it like an IBM PC?

A: Actually, PowerPC refers to a type of microprocessor chip, not an entire computer. It is the result of an alliance between Apple, IBM, and Motorola. Processor chips for Apple Macintosh computers have been made by Motorola, and have had a different numbering scheme from the Intel-made chips in IBM-compatibles. Remember, IBM PCs started out with the 8088 and progressed to the 80286, 80386, 80486, and Pentium (commonly referred to as the 80x86 line). The Apple Macintosh, or Mac, started out with the 68000 and progressed to the 68020, 68030, and 68040 chips (commonly referred to as the 680x0 line).

All these chips have been based on a common operational scheme, or architecture, called Complex Instruction Set Computing, or CISC. These chips contain a wide variety of instructions that enable the computer to carry out its functions. However, Apple, IBM, and Motorola felt that CISC technology has almost reached it performance peak. They decided to jump off the CISC bandwagon and tap the power of an alternative chip architecture known as Reduced Instruction Set Computing, or RISC.

The main difference between CISC and RISC is that instead of the wide variety of instructions contained in a CISC chip, a RISC chip only contains the instructions used most often. However, it can execute these basic instructions very quickly. When complex instructions are required, the RISC chip builds them by combining sets of basic instructions. This means that most operations are handled far more rapidly by RISC than by CISC.

RISC chips of various types have been around a long time, powering various systems such as engineering workstations and high-end graphics machines. However, until the development of the PowerPC chip, nobody marketed an affordable RISC chip that could run familiar operating systems such as DOS, Windows, and the Mac OS. Apple's line of PowerPC computers, called PowerMacs, are the first systems to reach the consumer market. IBM plans to release a line of personal computers powered by the PowerPC chip very soon. And just like the various degrees of speed and power of the Pentium and Pentium Pro, PowerPC chips come in various models ranging from entry-level to state-of-the-art.

Will RISC-based PowerPC chips eventually replace the CISC-based chips manufactured by Intel and others? No one knows for sure. Only time will tell. But for those wanting the fastest personal computers currently available, the PowerPC is the power plant of choice.

Q: My kids want to upgrade our computer for multimedia. What exactly is multimedia, and what do I need to upgrade my computer?

A: Multimedia is a combination of text, still pictures (graphics), sound, animation, and video. It is not only beneficial for games and other entertainment software, but makes educational, reference, and business programs more effective and enjoyable as well.

Your computer can already display the visual components, but in order for your computer to deliver realistic sound, which is way beyond the capability of the tiny built-in speaker and simple circuitry, you need to install an internal circuit board containing much more sophisticated sound circuitry, commonly called a sound card. And to reproduce this improved sound you need a set of speakers, with their magnets specially shielded to prevent interference with the magnetic field of your monitor.

Multimedia data is very complex and takes up huge amounts of disk space. The best way to deliver such large amounts of data is with CD-ROM technology because if its

spacious capacity: up to 680 megabytes, or the equivalent of 472 high-density floppy disks. CD-ROM stands for Compact Disc-Read Only Memory, which indicates that the technology--to begin with, at least--involved playback (read) only, and not recording, or writing. Recordable CDs have been developed recently, but this process is still relatively expensive and out of the average consumer's reach. (By the way, as I mentioned in a past column, the computer industry has agreed to spell the magnetic variety of "disk" with a K, and the optical variety, like CD-ROM, "disc" with a C.)

The first CD-ROM drives were essentially industrial-strength audio CD players with the digital-to-analog (the signal your stereo can understand) converter removed, since computer data is all digital. But the speed of audio CD players, although fine for music, is much too slow in comparison to other types of computer drives. So, soon CD-ROM drives capable of spinning at twice the speed of audio CD players emerged, thus improving the speed of data access. Close on the heels of these double-speed, or 2X, CD-ROM drives, came triple- and quadruple-speed drives. It is now to the point where prices for quadruple-speed, or 4X, drives have dropped enough to make these speedsters the minimum you should consider as part of your multimedia upgrade. Six- and even eight-speed CD-ROM drives are just now making their way to market, but a 4X CD-ROM drive should be useful for a few years yet.

Finally, to quote Windows Magazine, "According to the guidelines established by the Multimedia Marketing Council, here's what you need in order to have a true multimedia PC: at least a 486SX/25 system with 4MB of RAM, a sound card capable of playing 16-bit, 8-note synthesized sound and MIDI, 16-bit color video, and a CD-ROM drive capable of sustaining a transfer rate of 300K per second (double-speed). We suggest, however, that you take that a bit further, and plan on the following enhancements of the MMC's recommendations: 8MB of RAM, a 16-bit stereo sound card with wave-table synthesis (containing actual musical instrument recordings), a hot 16-bit color video accelerator card, and the fastest CD-ROM drive you can afford."

Q: I want to learn more about my computer, and I read in a computer magazine that user groups are a good source of information. What exactly is a user group?

A: A user group, as the name implies, is a group of computer users with a common interest. There are PC user groups, Macintosh user groups, and even user groups for specific software programs and computer brands.

Many useful activities can take place within the framework of the user group. Discussions about the group's main subject are a primary feature, during which group members can share discoveries and solutions to their own everyday computer questions with each other, thereby saving each other valuable time and effort and minimizing having to troubleshoot problems through trial and error. Learning from each others' experiences is one of the quickest and most effective ways to become a "power user." Tips and shortcuts can also be traded, thus making everyone more productive and efficient. Local computer-oriented businesses can provide speakers from time to time to address members or give presentations.

Other topics of discussion can range from current computer news stories to more specific interests within the group. For example, special interest groups, or SIGs, are focus groups internal to the main user group. Their subject of interest can be a particular program, such as Photoshop, or an entire software category, such as graphics, spreadsheets, or word processing. These SIGs are basically mini-user groups that can meet either as part of the main user group or separately in a member's home. They can present reports at the main user group meeting or simply exist informally and apart from the main group.

Many user groups manage a shareware library for access by members. Shareware is software that's distributed on a "try before you buy" basis. User groups can also be affiliated with certain manufacturers and organizations. For example, some Macintosh user groups are officially recognized by Apple and are allowed to legally copy and distribute certain system software upgrades.

Q: In your last column you mentioned a kind of software that you could "try before you buy." Is it any good, and if so, where can I get it?

A: Shareware is a marketing approach for software written by talented authors and programmers who do not have the resources to promote their

products with full-page ads in leading computer magazines or on TV. Instead, they distribute their programs for free through online services or the Internet, on a "try before you buy" basis.

This allows users to evaluate the program for their needs as thoroughly as they wish. Then, if they intend to keep using it, they are on their honor to send the author a "registration fee," or, in essence, to buy it. Paying the registration fee can then entitle you to such niceties as a professionally printed user manual, instead of your having to print out your own from a text file included with the program; or it could entitle you to the next major upgrade or overhaul of the program for free. But the main thing it should do is to ease your conscience by doing the right thing and supporting the efforts of the authors who have risked allowing you to try their products for free.

There are many worthwhile shareware programs, as expertly written as any commercially-available programs, and covering just about any category or niche you can name. I use quite a few myself that I would be lost without, from little clocks that provide alarms and reminders in the title bar of my Windows programs, to compression and decompression utilities, to calendar creation and time management programs, to imaginative games and puzzles, to additional typefaces to dress up my documents, and on and on.

Due probably to low percentages of people actually sending in the requested registration fees, some shareware authors are refraining from distributing full versions of their programs as they did in the past, and are choosing instead to distribute scaled-down "demonstration" versions. Sometimes these demo versions include only some of the features of the full versions; or they may do everything the full versions do except allow you to save or print your work. So technically demo versions of shareware still fulfill their authors' aim of letting you evaluate the program for your needs before you decide to buy it or not.

The most common source of shareware is online, either through commercial services like America Online or CompuServe, or directly from the Internet, which has a number of shareware libraries and collections. In both cases, the programs are categorized in many ways for easier access, both by computer platform (Windows, DOS, or Mac) and by type (business, games, graphics, communications, utilities, etc.) Some of the Internet sites feature searching capabilities that let you enter key words to identify the kind of program you're looking for.

Sometimes a member of a user group will collect shareware programs from various sources, copy it to disks, and make it available at meetings for members without access to online services to test drive. There are also commercial services who do the same thing and charge a nominal fee for shareware programs on disks. You can find ads from these companies in the back pages of most computer magazines.

Regardless of how you get it, I recommend checking out shareware. You can find some wonderful and unusual programs at real bargains.

Q: What is a LAN?
A: LAN stands for Local Area Network. This is a system of personal computers that are linked together by wires so that they can share both information and resources such as printers and modems. The most common use of a LAN is to allow multiple users to access a common storehouse of data, such as customer transactions, product information, or sales figures. LANs allow workgroups to collaborate on projects by passing documents back and forth. Some network software even allows multiple users to work on different portions of the same document at the same time. Users on a network can communicate with each other by exchanging messages, called electronic mail or e-mail. Meetings can be set up automatically using scheduling software which consults each attendee's personal calendar and finds a date and time when everyone is free. Another upcoming use for networks is videoconferencing, where video cameras allow the faces of meeting members to appear in a window on the computer screen. As the name suggests, a Local Area Network is confined to a local area, such as a department or branch office. When distant LANs are hooked together, they form a WAN, or Wide Area Network. Online services and the Internet are other examples of large networks.

Q. What is a font? Is it the same as a typeface?
A. A typeface is a family of letters all of the same design. This family consists of a basic upright or normal style plus different variations such as a

slanted, or italic, style. These individual variations are called fonts. A typeface family can include as many as a dozen or more fonts; the most common family unit contains four fonts—upright (called roman), italic, bold, and bold italic. You can always tell what a font is because that's what your printer considers an individual component. For example, Times Bold Italic is an individual font in the typeface family called Times.

Typefaces are generally divided into two fundamental categories—serif and sans serif. A serif is a little embellishment or curlicue which appears at the ends of certain letters. Most newsprint uses a serif typeface—notice the little flag at the top of the letter "l" or "d," or the little ball at the end of the curve in the letter "f" or at the end of the tail of a "y." These are all serifs. An example of a serif typeface is Times, which was originally designed to be the body text typeface for the Times of London newspaper. Since the word "sans" means "without," sans serif typefaces are made up of letters without serifs. The letters are made up of just straight lines. Arial and Helvetica are examples of sans serif typefaces.

In desktop publishing circles, the general rule of thumb is to use a serif typeface for the main text, or body text, of a document, since the serifs are said to guide the eye and make reading easier. Headlines and other attention-getting but short passages are the best places to use a sans serif typeface, since the contrast with the serif body text makes the letters stand out.

To dress up a document in Windows or on the Mac, you can not only choose a particular typeface or variation, but also change the size of your text as a special effect. The text size is measured in "points." There are 72 points to an inch, so each point is one-seventy-second of an inch. But the easiest way to think about it is that normal typewriter-sized text is about 11 or 12 points, and a one-inch-high letter for a poster or sign is 72 points. Just experiment with the sizes in between and soon you'll be familiar with their relative degrees of emphasis.

Q: What is a UPS?
A: Aside from the popular delivery company, UPS stands for Uninterruptible Power Supply. It's a rechargeable battery in a case that sits between your computer and the wall outlet. You plug your computer into the UPS, and you plug the UPS into the wall. The battery provides a clean, steady supply of electricity to your computer, guarding against voltage fluctuations, dips, surges, or spikes. All of these can cause your computer to "hiccup" and damage or lose data. If severe enough, the computer itself could be damaged. In the event of a power failure, a UPS provides enough electricity to keep your computer running long enough to save your data to disk and exit your program in an orderly fashion, preventing a possible catastrophic data loss. The more important your data (or the more unreliable your electric supply), the more you need a UPS for your computer. Prices start at about $100 for a single-computer model.

Q. What is a SIMM?
A. SIMM stands for Single Inline Memory Module. It's a small circuit board onto which is attached a number of RAM (Random Access Memory) chips. Instead of having to install small individual chips in your computer, a SIMM makes this task much more convenient. The bottom of the SIMM fits into a slot on the main circuit board of your computer. SIMMs vary in capacity with the number and type of individual memory chips they hold. In addition, older SIMMs have 30 connecting pins on the bottom, while more modern SIMMs have 72 pins. If you plan to increase the amount of RAM in your computer to enable it to run more efficiently and handle more-sophisticated programs, you must know what kind of SIMMs—30-pin or 72-pin—your computer needs, as well as figure out what capacity and configuration it can accommodate. Some computers require adding SIMMs two at a time, while others can handle one at a time. The owner's manual for your computer has this information, or you can simply carry your computer into your neighborhood computer store and let them figure it out for you.

Q. What does GB mean?
A. GB stands for gigabyte. As you may remember, a byte can be thought of as a single letter of the alphabet, number, or punctuation mark. Multiply this by a thousand (actually, 1024), and you get a kilobyte, or KB. Multiply that by a thousand and you get approximately a million bytes, or a megabyte (MB). And multiplying by a thousand again results in a billion bytes (1000 megabytes). This is known as a gigabyte, or GB. This was once thought of as an astronomical amount of storage capacity, but

with the rapidly decreasing prices of hard drives, the term "gigabyte" is becoming more and more common. Does it go higher, you may ask? It sure does—a thousand gigabytes is known as a terabyte. It may take awhile for that huge amount to become commonplace, but at the rate things are going in the computer industry, I'm willing to bet it's sooner than we think.

Q: What does SCSI mean?
A: SCSI (pronounced "scuzzy") stands for Small Computer Systems Interface. It's a type of connection from a computer to a piece of accessory equipment, or peripheral, such as a scanner, disk drive, or tape drive.

IBM-compatible computers (PCs) come with two types of connection sockets, or ports, called serial and parallel, to connect external peripherals. In a serial connection data travels in a single-file stream, one bit at a time, while a parallel connection allows data to travel in a wider path 8 bits at a time, and is therefore faster. An external modem typically connects via a serial port, since it handles data in a sequential stream. Most printers connect to the parallel port, allowing a relatively fast transfer of data to be printed.

However, most PCs do not come with a built-in SCSI port, which transfers data much faster than either a serial or parallel connection. It's the Apple Macintosh that has popularized the SCSI interface, and because of its superior transfer characteristics and flexibility, SCSI is finally arriving on the PC scene. An add-in adapter circuit board, or SCSI card, is necessary to allow your computer to connect to SCSI-based peripherals, which can be internal, like a disk drive, or external, like a scanner. Most internal hard drives are available in IDE or faster SCSI versions. And most flat-bed scanners use a SCSI connection and come with the necessary interface card for PC models.

External CD-ROM drives, which are popular for laptop and notebook computers, and removable cartridge drives, which use media with high capacities like hard drives but which can be removed and interchanged like floppy disks, often have SCSI connectors, and thus can be used with either Macs or properly-equipped PCs. Alternatively, if convenience is more important to you than maximum performance, some of these drives are available with parallel connectors for PCs without SCSI ports, saving you from the expense and hassle of buying and installing a SCSI card. You unplug your printer from the parallel port, plug in the drive, and replug the printer in an additional socket supplied by the peripheral or its connecting cable. Usually only one parallel-based peripheral can be added in this way.

Another advantage afforded by SCSI is the fact that up to seven SCSI peripherals can be daisy-chained together and hooked to the same SCSI port on a computer. In fact, in one of the places I worked my Mac was connected to an internal hard drive, an external hard drive, a scanner, two removable cartridge drives, and a tape backup drive—all through one SCSI port! In my present PC, my sound card has a built-in SCSI connector, to which I have an external CD-ROM drive connected, and plan to also connect a removable cartridge drive and a scanner some day.

I'm starting to see ads for PCs with SCSI capabilities built-in from the factory, which means that we will also be seeing more SCSI-based peripherals in the future. If you're looking for a way to upgrade your computer that will add flexibility and increase performance, perhaps a SCSI card is in your future.

Q: I've seen the word RAID used in conjunction with hard drives. What does it mean?
A: Although you might think it's what to use to eliminate the bugs in poorly written software, it stands for Redundant Array of Inexpensive (or Independent) Disks (or Drives). RAID technology includes several methods of ganging together two or more off-the-shelf hard drives to create bigger, faster, and safer storage subsystems that you can use just like the single drives you're used to. Six types of RAID have been defined named Level 0 to Level 5, all involving different data storage schemes.

RAID storage divides data across two or more drives for faster read and write times. It uses a speed-enhancing technique known as "striping" to break up data onto different drives. Most of the time it involves the additional techniques of "mirroring" and "parity" to provide backup data in case of a drive failure.

Mirroring protects data by storing at least one extra copy of the data on a separate disk in the array, writing all data at least twice. This method is safe, but not as fast as the other methods. Parity can be thought of like this: it's as if the process creates a multi-part equation from your

data and stores one part of the equation on each data drive and the solution on a parity drive. If a data drive fails, the system can recalculate the equation to reveal the missing bits. But if two drives fail, not enough information remains for the parity scheme to recover your data. Replacing a drive in case of failure is called swapping.

The simplest, most popular, and least expensive RAID implementation is Level 0, which involves striping only, providing maximum speed and performance, but, contrary to its name, providing no redundancy, since no mirroring or parity is used. According to vendors and industry analysts, about 80 percent of RAID arrays sold are configured for Level 0.

How the data in a RAID array is broken up is controlled by RAID software or by a hardware controller built into a circuit board in the RAID enclosure or on an adapter board you install in your computer. A lower-end array of 4 to 10GB using a software-based RAID controller can cost between $1,500 and $15,000. Top-end RAID arrays have high-speed hardware controllers and maximum capacities in the hundreds of gigabytes, with costs running in the $100,000 to $200,000 range. At these prices, even low-end RAID technology is out of the reach of the average home or business computer user, but I would bet that eventually some form of RAID will be affordable to the masses, just like all the other wonders the computer industry manages to dream up.

Q: I just bought a computer system, but the number of computer accessories in the store was overwhelming. Which ones should I get?

A: There are a number of useful accessories you should add to your computer system.

The first is a surge protector. It is essential to offer some protection to your hardware, software and data from blackouts, brownouts, surges and spikes. The reason I say "some protection" is that there are some catastrophes that a surge protector won't survive, such as a very close lightning hit (so ALWAYS unplug your computer system, including peripherals, during an electrical storm). But for helping to tame an unreliable electrical supply, a surge protector is a must. Of course, a more costly but much more effective safeguard against electrical calamities is a UPS, or uninterruptible power supply, which I discussed a few columns back. But if you don't have $100 or so to dish out right now, then a surge protector for a fraction of that amount is a necessity. And if you have a modem, buy a surge protector model that also protects your modem from electrical spikes along the telephone lines.

While we're talking about electricity, be aware that static electricity like the spark you see and feel when you touch a door knob in the wintertime can be absolutely devastating to computer equipment. Before you touch your keyboard or mouse, it's a good idea to touch something grounded to dissipate that static charge. Grounding pads are sold that have a long wire attached to them which you fasten to the screw that holds your electrical outlet's plastic faceplate in place. By touching such a pad, a potentially dangerous charge is harmlessly eliminated. If you don't have something convenient and safe to touch near your computer before you use it, you might consider picking up one of these grounding pads.

Another item I wouldn't be without is a monitor-mounted document holder. The original such device was called a Curtis Clip, but there are many imitators on the market now. It's a swinging plastic arm with a clip that attaches to the upper corner of your monitor with velcro. Two velcro strips are supplied, one for each corner, so you can switch the position of the holder from one side of your monitor to the other when needed. But the best bet is to just buy two and have one on each corner permanently, like I have. No desk space is wasted and your documents are always close by and at eye level for handy reference. I'd be lost without them.

There are many other accessories available, such as mouse pads, monitor arms (booms to mount your monitor on, allowing you to keep it off of your desk and to swing it out of the way when you don't need it), underdesk keyboard drawers with mouse pad extensions, and foot rests. There are monitor screens that improve visibility and ease eyestrain by reducing glare from poorly-placed light sources, and that also filter radiation or provide privacy. There are wrist rests for keyboards and mice to alleviate or prevent some repetitive motion disorders such as carpal tunnel syndrome. Alternative input devices such as trackballs or glidepoint touch pads are also considered accessories, as are digitizing tablets, which I'll talk more about in another column. I'm sure there are many more I've missed, but which your

friendly computer store salesman will be more than happy to show you.

Suffice it to say that there are enough accessories out there to cost you a fairly high percentage of the price you paid for your system. The ones I've mentioned as the most useful are the ones I would recommend first. The rest are subject to your desires and your budget.

Q: I have a 486SX 33MHz with 4MB of RAM. How can I update this machine to increase its Internet performance? Should I get more RAM or an overdrive processor?

A: According to Family PC Magazine, which is a Ziff-Davis company (publisher of almost all the major computer magazines), the most cost-effective upgrade you can perform on a Windows system is to go from 4MB to 8MB of memory. Their testing labs determined that memory turns out to be the critical bottleneck in a Windows system. Upgrading to 8MB of RAM nearly doubles your system's performance. What does it cost? In a mail-order catalog I received today, a 4MB SIMM (single inline memory module) costs about $150 for either 30-pin or 72-pin types. Your computer's owner's manual will tell you which kind you need.

On the other hand, performance scores for CPU upgrades were the most surprising – and disappointing – results discovered in their testing. They determined that unless you have at least 8MB of RAM, the CPU upgrade doesn't do you a lot of good. With only 4MB of RAM, doubling the processor speed with a DX2 resulted in barely a 10% increase in performance, and tripling the processor speed with a DX4 yielded only a 20% increase – not the 100% or 200% increases you'd expect. Even more surprising, a Pentium OverDrive did no better than the DX4.

However, when the system has 8MB of RAM, the results of upgrading the CPU are what you'd expect from doubling the speed of your processor – in fact, the speed of their test system jumped to nearly 2.3 times that of the base system with both an increase to 8MB and a DX2 CPU upgrade. However, the DX4 still didn't triple the system speed, and the Pentium did little better than the DX4. Still, you'll probably want to upgrade both parts of your system at some point. But the RAM upgrade should definitely be first.

Other system enhancements tested by Family PC were cache upgrades (high-speed memory that sits between your CPU and RAM), hard drive and CD-ROM drive upgrades, and video adapter upgrades. As with other CPU upgrades, they were disappointed with the cache upgrade. And, though they don't strictly qualify as performance upgrades, adding new expansion devices such as a faster hard drive or CD-ROM drive can enhance overall system performance. A new video adapter won't speed up your system, but it will allow you to see more colors with higher resolution. In the final analysis, however, the overwhelming winner in the bang-for-the-buck category was still a RAM upgrade.

I also have a 33 MHz 486SX, but I already have 8MB of RAM. Last week I ordered a DX4 clock-tripler that will take my system to 100 MHz and add a math coprocessor for $140 from an Internet-based discounter.

A math coprocessor is an auxiliary chip developed to work in conjunction with the main processor providing more precise computational power. Although traditionally only engineering and scientific applications have benefited from having a math coprocessor, today's high-end graphics programs are making use of math coprocessors to allow elaborate special visual effects. Since I regularly use these programs, having a coprocessor chip is perhaps more important to me than to the average user. But this upgrade chip seemed to offer a lot of improvement for a reasonable amount of money.

To install the DX4, I opened up my computer by removing the case. I located the rather large, square 486SX chip on the main circuit board, or motherboard, of my computer and very carefully removed it with a tool supplied with the upgrade chip. Then I simply inserted the new chip and firmly pressed it down into the empty socket. One corner of the original 486 chip has the point flattened, indicating the location of connecting pin #1. Care must be taken to insert the new chip with its pin #1 in the same position, or damage could result to the new processor or to the motherboard. I also had to inform my motherboard of the presence of the higher-powered processor by reconfiguring some small jumper wires over small pins according to a diagram in the user's manual that came with my motherboard. Once this was done, I replaced

the case and turned on my computer.

The messages that flash on the screen when a computer first starts up, or boots, now reflected the fact that a math coprocessor was present. When Windows 95 finally appeared, I was hoping its formerly sluggish performance would be significantly faster. Well, it's faster, but not by as much as I had hoped. In fact, from running a performance measurement, or benchmark, program supplied with the processor upgrade before and after its installation, the indications are that the performance increase is only about 16%, which is in line with Family PC's findings of about a 20% performance increase from a clock-tripler upgrade while keeping the amount of memory the same. The good news, however, is that all the features of my graphics programs that require a math coprocessor to work now perform like a charm. In addition to graphics programs, some add-in programs that allow you to hear sounds or view 3D pictures over the Internet require a certain degree of processor horsepower that my old 486SX couldn't provide. All the ones I've tried so far finally work like they're supposed to with the new 100MHz processor.

The bottom line is: since I use programs that make use of a math coprocessor, this upgrade, although not as fast as I had hoped, does result in some speed increase and allows me to take full advantage of my graphics programs, so I'd have to say it's worth it to me. And, when I ultimately upgrade my memory to 16MB, I'll have the drastic performance boost I'm looking for.

But is a 16% performance increase worth $140 or more to the average non-graphics user? I guess you'll have to answer that one for yourselves.

Q: I have used Windows and Windows for Workgroups. Now I have Windows 95, but in software ads I also see the term "Windows NT." Is that the same as Windows 95?

A: No. Actually, Windows NT came between Windows for Workgroups (WFW—an upgrade to Windows 3.1) and Windows 95. Whereas Windows 3.1 and WFW are 16-bit operating systems, Windows NT ("New Technology") was the first 32-bit graphical operating system from Microsoft. Since Windows 95 is also 32-bit, software that can make the most of Windows 95 will also run optimally on Windows NT.

Released in September of 1993, Windows NT is essentially an industrial-strength version of the Microsoft Windows system most of us have used. It is an offshoot of OS/2 3.0, an earlier operating system jointly developed by Microsoft and IBM. Windows NT was developed from scratch as a multi-user networking system for heavy-duty corporate use, and as such requires much more in the way of hardware horsepower than the single-user Windows 3.1.

Windows NT's original advantages over ordinary Windows are many. It provides preemptive multitasking, which allows many programs to run at the same time (now offered by Windows 95 as well). It offers advanced file system support, and offered long filenames long before Windows 95, as well as better performance than the older DOS file system. Windows NT offers extremely large storage-device capacity and high reliability, which is important in mission-critical applications. It's also portable, which means it can run on different processor chips from different companies other than Intel, such as super-high performance RISC chips from Alpha and Digital.

At the time Windows NT was released, computers with 4MB of RAM were just beginning to become commonplace. This was enough to run Windows 3.0 and 3.1 comfortably. But Windows NT has always required a minimum of 16MB of RAM to even get off the ground, and the most powerful processors available. This was far beyond most ordinary single-user desktop configurations, but reasonable for department-level network servers in large corporations.

But that was then and this is now. And now, most computers come with 8MB of RAM, with 16MB being recommended for a speedy implementation of Windows 95. In fact, Windows 95 is ahead of Windows NT in some respects and behind in others. It features the new user interface everyone's been talking about, which supposedly makes an Intel-based computer look and act more like a Macintosh, long known for its user-friendliness. The current version of Windows NT, version 3.51, still has the older Windows 3.1 interface, but not for long. Windows NT 4.0, to be released in the third quarter of this year, will have the same look as Windows 95, and have a faster, more advanced file system. However, it will drop support for such "ancient" computer technologies as the

386 and 5.25-inch disk drives. Windows 95 is also ahead of Windows NT in its Plug and Play implementation, in which it can automatically recognize peripherals such as sound cards, CD-ROM drives, and modems, and properly configure the system to work optimally with them. For critical situations where reliabilty and security are of utmost importance, however, Windows NT is still the champ.

The resources required to run Windows NT now seem more attainable, although they are still somewhat advanced. To run NT at a good clip, you need at least a 486 with 24MB of RAM or a 90MHz Pentium with 16MB of RAM—still not your typical single-user desktop machine. Windows NT is popular with high-end graphics and engineering users because it's scalable, meaning it can adjust itself to take advantage of multiple processors. So, installed on a powerful multi-processor workstation-class computer, it can do complex graphics and computation-intensive number crunching with blinding speed.

The bottom line, and Microsoft's current position, is that Windows 95 is for single-user desktop configurations, and Windows NT is for industrial-strength corporate network server environments. However, the computer industry is speculating that eventually the two operating systems will merge into one all-purpose, all-powerful version of Windows that will require the computers of the future to make the most of their magic.

Q: How do I get photographs into my computer to send over the Internet?

A: There are three ways to convert photographs into a computer-readable format: 1) Scan them in with a scanner; 2) Have someone else scan them in for you and give them to you on a disk; and 3) Directly input pictures in digital format, bypassing conventional photography altogether.

The first two choices both involve using a scanner. A scanner passes tiny light-sensitive elements over the image to be digitized. A white light also passes over the image, and the elements detect the relative levels of reflected light and convert them into digital data. Most home and business scanners can recognize 8 bits of data per pixel, or picture element – the computer equivalent to the dots you see when you look closeup at a picture in the newspaper. For a black and white image, that translates to 256 distinct shades of gray. In the case of a color photograph, the scanner shines its light through three filters: red, green, and blue (RGB) on successive passes. This captures all the color information it needs to reproduce the photograph as it originally appears. Some scanners can capture all this information in only one pass, thus speeding up the color scanning process. These color scanners are referred to as 24-bit scanners, since they record 8 bits of data for each of 3 colors. This results in 16.8 million colors! However, the 7^{th} and 8^{th} bits of data are usually relatively inaccurate in comparison to the first 6 or 7, so the latest scanners on the market are capable of 30 bits of information, or 10 for each color. Then the 1 or 2 least accurate bits are discarded, leaving at least 8 bits of more precise information. This results in increased detail in shadow and highlight areas, providing a much more accurate rendition of the original photograph. Even for non-color images, 30-bit scanners are superior, as they provide 1024 levels of gray at 10 bits per pixel (bpp). This results in vastly increased detail in shadow and highlight areas that will show up even at relative low output resolutions.

Until recently scanners capable of 24-bit color cost about $1000 and up, with grayscale-only scanners coming in at around $500. But now that price point is occupied by the new 30-bit scanners, pushing the price for 24-bit flat bed scanners (as opposed to hand-held scanners) below former grayscale prices – in some cases, under $400. This makes image acquisition for newsletters, home-made greeting cards, and distribution over the Internet more affordable than ever. Hand-held scanners, which require you to drag them over the image, and which mostly are limited to a scanning width of 4 inches or less, can be had for $250 or less. One model, called EasyPhoto, sits on a motorized tray and lets you feed photographs into it. It comes with software that can both enhance and catalog your images. And, it can be lifted from its tray and manually dragged so you can scan an image out of a book. It seems to me like the highest-quality, lowest-cost all-around solution for converting existing photographs into digital form. However, for people on a strict budget, I've seen 24-bit, drag-only hand-held models for under $120.

Most of the scanners in the class we're investigating hook

up to your computer via a SCSI interface, which most Intel-based PCs don't come with, but which most scanners include in the package. Some scanners, including most hand-helds, simply plug into your parallel port, temporarily unseating your printer until you plug its cable into the scanner's included adapter. All scanners come with some kind of controlling software, and most include some kind of manipulation software, allowing you to at least crop, resize, rotate, and make some degree of color adjustments to your images.

If even the least-expensive scanners are still beneath your means, or if you just don't want to be bothered, solution number two is to simply have someone else scan your photos for you and give them to you on a disk. This could involve taking your existing photo prints to a local photography or print shop and paying a scanning fee. Another method becoming increasingly popular is to send your undeveloped film to a processing company that will both print and scan your photos. One such company is Seattle FilmWorks, which includes in the deal a free program called PhotoWorks which allows you to view, store, organize, print, and export your digitized photos. If you want to find out more, their number is 800-FILMWORK. Another alternative is to take your undeveloped rolls of film to Wal-Mart to have them developed and scanned onto a Photo CD. You can also take existing color negatives to have them transferred to Photo CD. For anyone unfamiliar with this format, Photo CD is a Kodak product that can be read by most CD-ROM drives or by special players that hook to your TV set. Photo CDs never really caught on in the consumer market, but they're very popular in graphic arts and desktop publishing circles as a means of storing and using high-resolution photographs for all types of publications. And that is the advantage of Photo CDs over floppy disk-based solutions like Seattle FilmWorks: on a Photo CD your pictures are stored in four degrees of clarity, or resolution – from low resolution, adequate for viewing on a computer screen or sending over the Internet; to two medium resolutions, for use in greeting cards or newsletters; to extra-high resolution, for critical publications like magazines, or for making duplicate prints. Another advantage is that the photos themselves can be used directly from the Photo CD, thus saving space on your computer's hard drive (the high-resolution photos can be as big as 20 megabytes each!) And the price for this quality and convenience? If you hand in a roll of undeveloped color film to be both processed and transferred to Photo CD, the cost for a minimum of 12 photos is 66 cents each plus the cost of the photo processing. If you hand in already-processed color negatives, the cost for a minimum of 12 transfers to Photo CD is 88 cents apiece. Once you start a Photo CD of your photos, you can keep adding more to the same CD in successive sessions until it's full.

Now for solution number three: bypassing conventional photography altogether and capturing images directly from your camcorder or from a totally digital camera. The first alternative involves either a video capture board which installs into your computer's case, or an external gizmo called a Snappy, which plugs into your computer's parallel (printer) port and into which you plug your camcorder, TV, laser disc player, or similar source of TV signals. These capture devices convert the video signal they receive into a picture that looks like it was scanned in with a conventional scanner. The pictures from these capture devices, however, run the gamut from barely usable to exceptional. In particular, the Snappy, which sells for about $200 and was originally developed by a supplier to the Hollywood special effects experts, can take a relatively rough video picture and somehow intelligently add extra pixels to increase the resolution to extremely high levels, resulting in a picture as good as or better than that possible with conventional flat-bed scanners costing over $1000! If you already have a camcorder, this seems to me to be the best overall solution for digitizing pictures for computer use, whether sending over the Internet or using in publications. All mailorder computer catalogs carry the Snappy. I want one myself!

The highest-quality but most expensive solution to getting pictures directly into your computer while bypassing conventional film photography is using a digital camera. These range in price from about $500 all the way up to $50,000 or more for professional models. The highest-quality cameras consist of what amounts to a tiny scanner in back, with conventional SLR film camera lenses and shutters in front. Who can afford a camera like

that? Well, the many newspaper and catalog photographers that use them say they pay for themselves in time and cost savings – cost not only of film, but also of high-end scanning and color separations for printing. One catalog photographer for a 99-store chain of home center stores in 12 western states was quoted in Publish Magazine as saying, "The initial cost of our camera was $40,000. Within the first year it saved us over $300,000."

For the average consumer, however, the less-expensive digital cameras are analogous to the less-expensive 35mm film cameras: one-piece, fixed focus units with built-in flashes. The most popular of these are the Casio QV-10A for about $500, the Epson PhotoPC for about $550, the Apple Quicktake 150 for about $600, and the Kodak DC series digital cameras ranging from about $330 to about $1000. All these prices are taken from various mailorder catalogs. You transfer the pictures from these cameras to your computer's hard disk via an included cable and software.

Well, so much for getting the pictures into your computer. How do you actually transfer them over the Internet?

The easiest way to transfer a file over the Internet is to attach it to an email message. Every time you send an email message, you have the option to include what's known as an attachment. It can be any type of file, not just a photo or graphics file.

A digitized photograph is a data file. It's not a runnable program. It has been created as output from a scanning or photo manipulation program. In order to view it, your recipient must have a program that can recognize the photo and load it as data. If there were one universal data format for photo-type graphics, transferring such files would be foolproof. But unfortunately, as I have discussed in past columns, there are a bewildering number of graphics formats for both photo-type scanned graphics (bitmaps) and illustration-type (vector) graphics. These formats are identified by their filename extensions; that is, the three-letter tags that come after the period. The most common bitmap graphic formats, and thus the ones your photos will most likely embody, are .TIF, .BMP, .GIF, and .JPG. The latter two are the standards for World Wide Web graphics, but it is not necessary for photos transferred as attachments to be in these formats. Other formats that might come into play are .PCD for Photo CD and .PCX, an older format that is still sometimes seen. The Paintbrush and Paint programs that come with Windows 3 and Windows 95 can recognize the .BMP format, so if you have a choice, it's probably your best bet if your recipient is running some form of Windows.

Q: I recently got onto the Internet through a local service provider, and they installed the World Wide Web browsing software on my computer. But sometimes when I'm online and it says to click and hear a sound, I get a message saying I need a plug-in. What does that mean? Can't the software they gave me play Internet sounds?

A: As you can read in almost any paper any day, the Internet is evolving very rapidly – so rapidly, in fact, that it's hard for browser software manufacturers to keep up with all the latest innovations, especially in the area of multimedia elements such as sound, video, animation, and 3D. By the time they build into their browsers the ability to decode or play back certain multimedia formats, the format developers come up with either a major upgrade or improvement, or an entirely different delivery scheme altogether. The only way to stay current with the fast pace of Web-based content is to enlist the aid of modular playback software that is automatically started by your browser when it senses a corresponding type of data coming over the line. This is the idea behind plug-ins.

Plug-ins are usually provided by the same company that makes the multimedia element you're trying to see or hear. They can be downloaded, or copied directly to your computer over the Internet, from the company's web site, usually for free. It used to be somewhat of a hassle to get these plug-ins and your browser, the most common of which are Netscape Navigator and Microsoft Internet Explorer, to hook up together. But the task has been simplified a great deal so that now it's almost a no-brainer. In fact, in the case of Netscape Navigator 3.0, if you try to access some multimedia content that Navigator can't handle by itself, you are automatically brought to a screen with a link that you click on to download the needed plug-in. Because each piece of multimedia content transmits unique coded information about its data type, browsers can reference an internal database in which all current plug-ins and their data codes are registered to tell if the necessary plug-in is installed in

your system. If it isn't found, the information is used to automatically bring you to the plug-in download page.

You click on the proper download link and the plug-in, which has been compressed to save space and transfer time, is copied over the phone line to the hard drive in your computer. You then find the new file in the Windows Explorer or File Manager, depending on which version of Windows you're running (or in the Finder if you're using a Macintosh) and double-click on it. The file decompresses itself, and depending on the installation program, either asks you where your browser is or finds it itself. In either case, your browser's internal database is automatically updated to include the new plug-in and its associated data code. From then on, any time you encounter that type of multimedia content on the Web, you can click on it and experience it without any further complaints from your browser.

Since I last checked there are 108 plug-ins currently available for Netscape Navigator in the areas of 3D and Animation, Business and Utilities, Image Viewers, and Presentations at http://home.netscape.com/comprod/mirror/navcomponents_download.html. In addition to these categories, plug-ins can be further classified by whether they use streaming technology or not. Since multimedia files are frequently quite large, they usually must first be transferred to your hard drive before they can start playing, resulting in delays that can sometimes be very long -- as long as 35 or 40 minutes or longer in the case of a three-minute high-quality stereo music file, depending on the speed of your modem. Streaming technology allows your plug-in to begin playing the multimedia content immediately and continuously as it "streams" from the Internet to your computer. The quality of streaming multimedia is generally not quite as good as files that are played directly from your hard drive, but the time savings is usually worth it, and the quality is improving rapidly.

There are three plug-ins any serious web surfer must have. The first is RealAudio 3.0 from Progressive Networks. This is a streaming sound player that has recently been upgraded, resulting in sound almost as good as the download-first kind. Many leading record labels now provide RealAudio music samples of their artists, and numerous radio stations, Internet broadcasters, and networks such as ABC and NPR provide news and information in RealAudio format. Live music "webcasts" of concerts are also becoming popular. The RealAudio 3.0 plug-in can be found at http://www.realaudio.com.

The second must-have plug-in is Shockwave from Macromedia, which not only plays music but also interactive animation. In fact, this technology has become so popular that it will be built into the next version of Netscape Navigator, so that a separate plug-in will no longer be required. The list of "shocked" websites reads like a Who's Who of major corporations desiring a cutting-edge multimedia web presence. Shockwave content must be played from your hard drive, however, so to minimize transfer time there is a practical limit to the size of the multimedia files. Look for Shockwave at http://www.macromedia.com.

The third plug-in is not for multimedia content, but for document presentation and navigation. Adobe Acrobat allows you to view documents just as they would look in print, complete with graphics, fancy typefaces, and creative layouts that ordinary web pages don't permit. You can find Acrobat at http://www.adobe.com.

Some other popular plug-ins include VDOLive for video, QuickTime VR for virtual reality, and Live3D (which comes with Netscape Navigator 3.0) for 3D. Once you have some experience with plug-ins and the media types they provide, you'll probably wind up with a dozen or more to enhance your web surfing with rapidly-evolving multimedia entertainment.

Q: I've recently seen ads for PC banking. Have you tried it? Is it worth getting?

A: PC banking has been available for some time through large national banks like Chase Manhattan or Wells Fargo. Various editions of Quicken, Managing Your Money, and other personal finance programs have been able to link up your computer with these banks via modem to permit you to monitor your account, make transfers between accounts, and pay bills. Only recently, however, has local PC banking been available in South Dakota.

I also saw the ads for PC banking through Norwest, and since that's my bank, I decided to give it a try. In fact, there's nothing to lose, because you get a thirty-day free trial to see if

you like it or not. You can get PC banking for your personal accounts or for business accounts. Either way, Norwest's on-line banking service provides 24-hour on-line access to your account information. Using your modem, you can dial in and download data from up to 50 Norwest checking, savings, credit card, line of credit and independent line of credit accounts directly into your money management software, allowing you to instantly see your recent account activity and monitor your account balances. At the present time you must be using one of the following financial software packages: Microsoft Money 3.0, Money for Windows 95 4.0, Money 97 5.0, Quickbooks 5.0, Quicken 5 for Windows, Quicken 6 for Windows, Quicken 5 for Macintosh, or Quicken 6 for Macintosh.

Three different plans are available through Norwest. First and most basic, Bank On-Line allows you to access balance and transaction information for your accounts, make transfers between accounts, and communicate with Norwest via email. The cost is $4.95 per month, which includes 8 on-line sessions per calendar month, plus 25 cents each additional on-line session. The second plan is called Pay On-Line, which combines on-line banking with electronic bill payment, including automatic payment of recurring and future bills from designated accounts. For $9.95 per month you get 8 on-line sessions and 20 bill payments per calendar month, plus 25 cents each additional on-line session and 41 cents each additional bill payment. The third plan is Quotes On-Line, combining the first two plans with an on-line quote function for stocks and mutual funds. This plan goes for $14.95 per month, and gives you 14 on-line sessions and the rest the same as Pay On-line. All these fees are preceded by 30 days free. By the way, an on-line session with Microsoft Money is defined as a connection to the service via a modem connection, or with Quicken as any number of connections made within one hour.

In case you might be worried about transmitting your financial information over public phone lines, Norwest's system incorporates built-in security to keep your financial data confidential. Before you can access your account information on-line or pay bills electronically, you have to register with Norwest and receive a Personal Identification Number (PIN) that authorizes access to your account data. In addition, your financial data is scrambled to protect it as it moves to and from your PC.

Well, as I said, since there's nothing to lose I decided to try it. I went to a local Norwest branch office and obtained a PC banking application. I filled in my personal information, the numbers of the accounts I wanted access to, the plan I was interested in, my modem speed, and the version of the software I was using. At the time I signed up, I was using Quicken 5 for Windows, so that's what I indicated. You also have to indicate which account you want to be billed monthly for the service.

I opted for the basic plan. A day or two after I signed up, I decided to upgrade to Quicken 6 for Windows, the most recent version. I called the bank and was told that the PC banking package for Quicken 5 was already on its way to me, but that it would also work with Quicken 6. For security purposes, you first get a separate letter with your PIN number (which is initially generated by Norwest but which you must change to something else during your first on-line session). A few days later, the main package arrived containing the information I had to enter for each of my accounts, and instructions on how to initialize and operate on-line banking in Quicken. The instructions in the book were, of course, for Quicken 5, but I was able to figure out how things worked in Quicken 6, and in no time I was making my first call. (Don't worry – it's a toll-free number.)

After hearing the familiar screeeeeee of my modem, a little picture on the screen showed two wires making a connection and little dots of data running back and forth. After about 30 seconds the modem disconnected, and my checking transactions appeared in a separate window, along with an error message telling me that the information for my savings account couldn't be transmitted correctly. Before calling the toll-free customer support number for assistance, I double-checked the setup windows for my accounts, and sure enough, my savings account had the right numbers but a box saying "checking account" was accidentally still activated. After changing it to "savings account," everything works perfectly.

When you click on one of the downloaded transactions in the separate window, Quicken attempts to match it to the corresponding transaction in the main register window by the

check number and the amount. If it finds a match, you click on "accept" and Quicken puts a little "c" in the Reconcile column to indicate that this check has cleared. The "c" will be replaced by an "R" when you formally reconcile your account, saving you from having to do it manually. And, when I am occasionally distracted and forget to record a check in my checkbook, the downloaded transaction labeled "new" alerts me long before I get my monthly statement in the mail, thus saving me from the possibility of accidentally overdrawing my account.

To me, all this convenience and time savings is worth $4.95 a month. I plan to stick with the service after my 30 free days are up. I would definitely recommend this service to anyone with a PC or Mac, a modem, and one of the required software packages. If you don't already use a financial management program, you might want to get used to its basic features for awhile before learning how to use it for on-line banking so things are not too confusing at first. But eventually I'm sure you too will wonder how you got along before without it.

Q: What exactly is Java? I know it has something to do with the Internet, but I don't quite understand what it is.
A: Before I explain what Java is, it would be helpful to give you some preliminary background information.

The reason people buy computers is to run programs. A computer program is nothing more than a set of instructions that gets the computer to do what you want it to do, whether it's to write and print a letter, balance your checkbook, or blast an alien in your favorite game. The most basic form of instruction your computer's brain can understand is called machine code, or native code. Each different computer platform—for example, Windows-based, Apple Macintosh, or Unix-based—requires a different type of machine code, since each has a different type of main brain chip (486, Pentium, PowerPC, etc.)

Computer programs can either be written directly in this low-level machine code, which is very tedious, or in high-level languages which are more like human English than primitive computerese, and which in turn generate the machine code. One line of a high-level programming language such as C++, Basic, or Pascal can generate many lines of machine code, making the task of programming much faster and easier.

There are two basic categories of programming languages: compiled and interpreted. With languages like C++ the source code generated by the language is compiled into machine code that can be directly executed by your computer, usually saved as a program file to be run later. With an interpreted language like Basic, the source code generated by the programming language is interpreted and executed by the computer right on the spot, line by line. This makes a program running under an interpreter generally slower than a compiled program.

Now, to answer the question at hand. Java is a programming language originally developed by Sun Microsystems in 1991 as a language for embedded applications such as those used in TV set-top boxes, hand-held devices, and other consumer-oriented electronics. Sun converted it to the Internet's World Wide Web in 1994, and it has started a revolution. The reason? Well, there are several reasons.

First off, although it is considered an interpreted language, Java has characteristics of both compiled and interpreted languages. Java source code is first compiled into an intermediate form called "byte code," which cannot run by itself, and is not optimized for any specific platform. It is a highly compressed representation of the source code, but it is not machine code, and therefore not tied to any particular hardware. This byte code is converted into machine code at the time you run the program by a platform-specific interpreter, called a Java Virtual Machine, or JVM.

Normally, programs written for one platform—Windows, for example—must be re-written, or ported, to run on another platform such as the Macintosh. But any platform for which a Java Virtual Machine exists can run programs written in Java. Since the Internet is populated with computers of many types, programs written in Java can be distributed over the Internet and run by these varied computers via their JVMs.

This "write once, run anywhere" capability of Java is especially attractive to application developers, and extremely useful for Internet users. Sun's own Web browser, HotJava, was the first to incorporate a built-in Virtual Machine capable of running Java programs, which usually take the form of a little application, or "applet."

Netscape Navigator was the next browser to feature Java support, and finally Microsoft joined the club with its Internet Explorer browser. Version 3 or higher of each browser is recommended. On the Web, Java is activated by a special HTML tag on a web page.

We'll talk more about Java's uses and future, along with another Web-based language called JavaScript, next time.

Q: What exactly is Java? I know it has something to do with the Internet, but I don't quite understand what it is.
A: Last time we talked about what Java is. This time we'll talk about its uses present and future, as well as another Web-related language with a similar name, JavaScript.

As mentioned last time, Java is a programming language. Although the most popular use of Java these days is to create simple applets such as scrolling banners and animation on Web pages, it can also be used for building full-blown applications. In fact, Corel Office for Java is the first suite of office productivity applications written entirely in Java and supported by Netscape Navigator 3.01 and higher. It consists of a word processor, spreadsheet, charting program, presentation application, and information manager. The prerelease, or beta, version, which must run within a Java-enabled browser, can be downloaded for free at http://officeforjava.corel.com/.

Given the runaway popularity of Java, a Java Virtual Machine (JVM) will eventually be built into all mainstream desktop operating systems, allowing Java programs and applets to run outside of a Web browser environment. In fact, the upcoming new version of the Macintosh operating system, Mac OS 8, scheduled to be released sometime this summer, will be the first desktop operating system with built-in Java support. This will allow Java applications to run just as though they were any other desktop applications, including the Corel software suite.

With regard to performance, the fact that Java programs are interpreted at runtime means they aren't exactly speed demons, but some Java VMs include what's called just-in-time compilers (JITs), which significantly increase performance. And, as illustrated by the Corel program suite, Java applications can also be compiled into machine language for fastest performance, but they lose their hardware independence as a result.

Java is an inherently secure language. It was designed so that applets cannot alter files on a computer's hard drive unless the client, or user, gives permission. Hackers will find it difficult to use Java applets to spread viruses or cause other damage due to the structure of the Java programming language.

Although all this sounds like fun, Java is a difficult programming language, similar to C++, and is not intended for the casual programmer and certainly not the end user. However, there's another popular language being used to spruce up web pages, called JavaScript, that is somewhat easier to use but not nearly as powerful.

Whereas Java is a product of Sun Microsystems, JavaScript was developed by Netscape, producer of the Navigator Web browser. It evolved from an earlier Netscape language called LiveScript and was renamed when it was made more compatible with Java. This compatibility allows the two languages to be used in conjunction with each other, exchanging messages and data. An example of this would be a JavaScript applet being used to display a data entry form and validating the input, with a more powerful Java program processing the information.

Unlike Java, JavaScript is pretty much a Web-only tool. Current uses include enhanced forms, simple Web database user interfaces, and navigation enhancements. Thus, whereas Java can generate a completely custom interface, JavaScript uses the HTML Web page as its user interface.

As a Netscape product, JavaScript initially was only supported by Navigator. Microsoft now supports it as well, but as a sort of clone known in its Internet Explorer browser as JScript. Since they are not 100% identical, it can be tough to write a JavaScript applet that behaves exactly the same in both browsers.

This inconsistency may soon be over, however, as JavaScript was recently accepted as a standard by the ECMA, a European association for standardizing information and communications systems. This standardization may move Microsoft to officially accept JavaScript and end the war for domination in this arena, since the final standard was worked on by Netscape, Sun, Microsoft, and IBM.

Q: My computer has a CD-ROM drive, but now I see many different types of drives advertised that start with CD or end with ROM – CD-R, CD-RW, DVD-ROM. Does that mean that my CD-ROM drive is obsolete? If so, which new type should I choose?
A: CD-ROM has been the primary delivery system for such high-volume content as databases and multimedia by virtue of its 680MB capacity. Not only has CD-ROM evolved into many related formats, but a totally new format, DVD, is on the horizon. Is the CD-ROM obsolete? I'll take a few columns to investigate the CD-ROM's past, present and future to answer this question and many more.

As I explained in the previous column on this subject, various CD standards have been published in the form of "color" books. Last time we talked about Red Book CD-ROMs – the original music CD format. This time we'll talk about Yellow Book CD-ROMs, which include the vast majority of CD-ROMs produced today.

The Yellow Book CD-ROM specification, announced by Philips and Sony in 1983, includes two data structures: Mode 1 and Mode 2.

Mode 1 defines CD-ROM data with ECC (Error Correction Code) and is used when data integrity and safety are of the utmost importance, like databases or programs. Mode 2 has no ECC, providing a bit more room for data. It is normally used in situations where data error is less critical, like video, audio, or graphic images.
The vast majority of CD-ROMs produced are Yellow Book, Mode 1 for Windows or DOS. These discs can be accessed by Macintosh or UNIX-based computers, but they don't behave like "native" Apple or UNIX discs. Even so, the plain vanilla CD-ROM is the single most standardized medium for data storage ever produced Multimedia-type CD-ROM offerings are the most common Mode 2 creations. Some of these are CD-ROM/XA; so-called bridge discs such as Photo CD, Karaoke CD, and Video CD; and CD-i, or Green Book. Besides Mode 2, all these formats have something else in common: they are all intended to play on specialized consumer electronics playback devices. Some, like Video CD and Photo CD, will also play on a computer.

Another specification defining a CD-ROM standard is known as ISO 9660, which was developed by an ad hoc committee called the High Sierra Group. This group came together to eliminate the early practice of each CD-ROM publisher using a different, incompatible CD-ROM file format. Extensions to this standard were developed to allow CD-ROM applications to operate on multiple platforms while retaining their "native" operability on their own platforms.

Another cross-platform CD-ROM alternative is a hybrid disc, which contains multiple partitions formatted for different operating systems, and that are only detected by the proper platform.

Next time we'll examine Green Book CD-ROMs, or CD-i, and White Book Video CDs. After that will be the Orange Book formats: CD-R, or CD Recordable, and CD-RW, or CD Rewritable. Finally, we'll investigate DVD, which originally stood for Digital Video Disc, and some of its offshoots, DVD-R, and DVD-RAM. So the DISCovery continues!

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I mentioned last time that CD rewritable, or CD-R, discs can be used with existing CD-ROM drives, but CD-RW, or CD rewritable, cannot. CD-RW discs use a different reflectivity value from CD-ROM or CD-R discs, so the lasers used in normal CD-ROM drives can't detect CD-RW discs. Well, there's good news. The Optical Storage Technology Association (OSTA) has convinced about 80 percent of all optical-storage suppliers to support its MultiRead specification. Finalized this past summer, MultiRead was carefully negotiated by OSTA, a consortium of 65 drive manufacturers. Some of its members include Hewlett-Packard, Kodak, Philips, Ricoh, and Sony. Essentially, participating manufacturers agree to produce optical devices capable of reading all four primary CD formats: audio CD, read-only CD-ROM, recordable CD-R, and rewritable CD-RW. OSTA expects future read-only DVD-ROM and recordable DVD devices to also comply. The first MultiRead-compliant drives went on the market this fall.

Speaking of DVD, what exactly is it? It is the blending of two initially competitive technologies. The first originated in January, 1993 when Nimbus Technology and Engineering of Gwent, Wales demonstrated a double-density Red Book CD-Audio disc containing two hours of MPEG 1 video at a trade show. The Red Book standard was chosen because at the time there was no other choice – Video CD had not yet been introduced and conventional CD-ROM specifications, because of the high overhead inherent in error correction, severely restricted the playback speed and capacity of the video data.

The second competitive technology to spawn DVD was a demonstration of Optical Disc Corporation's double-density White Book-format Video CD in October, 1993, again at a trade show. These innovations proved to be a source of embarrassment for Philips and Sony, who were the former innovators but who now had been beaten to the punch regarding the introduction of a CD able to contain and play back two hours of video on existing platforms.

By December of 1994 Philips and Sony unveiled their proposed high-density format, which they called MMCD. The following month an alliance of companies initiated by Toshiba and Time Warner announced support for a competing format called SD, for Super Density disc. Each competing side in this war tried to enlist various companies to side with them. Eventually, however, they agreed to combine the best features of each format to create a solution acceptable to both the computer and entertainment industries. The result was DVD, which originally stood for Digital Video Disc, then Digital Versatile Disc, and now just DVD. It was thought that this was finally the universal medium that would forever eliminate the incompatibilities and cross-platform problems that plagued the CD format before it. The expectation was that a single DVD disc could be played in a music player, a video player, a computer, or a game device, which would unite the computer market with the consumer electronics market.

This optimistic view took into account the data itself, but not the ways humans control and use it. The result is that there are now three read-only DVD formats in the works: one for video, one for audio, and one for computer data.

Q: When I read ads for computers, I keep seeing the term "MMX," as in "Pentium II with MMX technology." What is MMX?

A: "MMX" originally stood for "MultiMedia eXtensions," but now Intel, the developer of MMX, claims it doesn't stand for anything – it's just a brand name for an extension to the Intel Pentium chip architecture. MMX is found in enhanced Pentium and Pentium II chips, but not ordiniary Pentium or Pentium Pros. I'll try to eliminate the confusion about multiple Pentiums (Pentia?) in a future column.
MMX is actually a set of 57 additional instructions built into Intel microprocessor chips. This allows faster audio, video, graphics, and modem operations, but only from software written specifically to take advantage of MMX technology. To get somewhat technical, MMX instructions allow operations to be performed simultaneously on more than one set of data at a time. These capabilities work on integer data only – that is, data that doesn't contain any decimals or fractions.

Q: When I read ads for computers, I keep seeing the term "MMX," as in "Pentium II with MMX technology." What is MMX? Do I need it, and will my computer be obsolete if I don't get it?

A: "MMX" originally stood for "MultiMedia eXtensions," but now Intel, the developer of MMX, claims it doesn't stand for anything – it's just a brand name for an extension to the Intel Pentium chip architecture. First announced by Intel in March of 1996, the first generation of MMX-enhanced computers entered the market in January of 1997. MMX is found in enhanced Pentium and Pentium II chips, but not ordinary Pentium or Pentium Pros. I'll try to eliminate the confusion about multiple Pentiums (Pentia?) in a future column.

MMX is actually a set of 57 additional instructions built into Intel microprocessor chips. This allows faster audio, video, graphics, and modem operations, but only from software written specifically to take advantage of MMX technology. Types of software that benefit from MMX technology are 2D/3D graphics, audio, speech recognition, video compressor/decompressors (codecs), and data compression. To get somewhat technical, MMX instructions allow operations to be performed simultaneously on more than one set of data at a time. These capabilities work on integer data only – that is, data that doesn't contain any decimals or fractions.

In the past, additional chips have sometimes been added to a computer in a video or sound card to handle multimedia tasks without overloading the main processor. Called Digital Signal Processors, or DSPs, these coprocessors are now being replaced with MMX, which includes a "multiply-add" instruction that allows most of the capabilities of a DSP chip to be provided by the Pentium processor at very high speed.

Another feature of MMX is called SIMD: Single Instruction, Multiple Data. This means that a single instruction operates on multiple pieces of data in parallel. It allows the chip to reduce multiple compute-intensive loops common with video, audio, graphics, animation, and communications. According to Intel, "It's like a drill sergeant telling an entire platoon, 'About face,' rather than commanding each individual soldier one at a time."

A third improvement of MMX-powered Pentiums over their predecessors is more cache. On-chip cache size has been doubled to 32K, reducing the number of times the processor has to access slower, off-chip memory areas for information.

Do you need MMX? The most common employment of video, audio, graphics, and animation is in games; thus, people who play high-end games are the ones who will want MMX right now. Of course, Windows-based video editors, digital sound technicians, and computer animators consider it a must-have. Also, as multimedia becomes more prevalent on the Internet, MMX could become desirable in the short term for ardent web surfers. However, since mainstream productivity software like word processors, spreadsheets, databases, and checkbook or financial applications do not rely heavily on these multimedia components in their normal operation, MMX is not a requirement for ordinary business users at this time. However, Bill Gates and other industry leaders are predicting that some day we will not be controlling computers with keyboards or mice, but with our voices. Speech recognition could very easily be incorporated into everyday productivity applications – imagine dictating a letter to your word processor, or calling out numbers to your spreadsheet – so when that day comes, MMX could become a requirement.

Competitors of Intel such as AMD and Cyrix have managed to produce MMX-compliant chips, so an ad for a computer with MMX technology doesn't guarantee genuine "Intel inside." Not that that's a bad thing, since some of these chips have out-paced Pentiums in head-to-head competition, and they generally cost much less, making the computers that contain them more affordable. In order to stay ahead in the chip wars, Intel's next generation of chips, expected in early 1999 and code named Katmai, will have 70 more MMX instructions, called Katmai New Instructions, which will provide floating point, or non-integer, operations on parallel sets of data. So soon ordinary MMX itself will be obsolete, as more powerful chips continue to elevate our computing experience to new heights.