Why can't I save when I see the message: DISK WRITE PROTECTED?
The program needs to write something on a disk, but it can't because you've covered the write-enable notch with a write-protect tab on a 5.25-inch disk, or the disk was write protected by the manufacturer to keep you from altering it. On a 3.5-inch disk, you have moved the write-protect tab to uncover the rectangular hole in the upper-right corner of the disk.

If the disk is write protected, try to remember why you (or the manufacturer) chose to protect this information. To be on the safe side, you might remove the write-protected disk and insert another formatted disk for saving your data.

Why do I see garbage (lots of funny letters and symbols) on the screen?
If you see garbage on the screen, the first program wasn't entirely erased from memory when you turned the system off. Wait a full minute before turning on your computer. Better yet, switch from one program to another by pressing ⌘-Control-Reset. Be sure to release Reset before you release the other two keys.

How can I quit from my program?
Most programs give you an easy way out. If your program doesn't have a Quit option on the menu, try these escape methods until you find one that works. Press Q for quit. Press Esc for escape. Press Control-C. Press Control-C, then press Return. Press Control-Reset. Press ⌘-Control-Reset. Or turn off the power.
Why does my Apple IIc Plus go so fast?
If you have trouble with the timing of an application — if messages appear and disappear before you have time to read them — this may be caused by the special accelerator in the Apple IIc Plus. Try restarting by holding down the Esc key and pressing Command-Control-Reset. Release the Reset key, and when you see the word Normal on the screen release the Esc key; then release the other keys. If you don’t see the word Normal, try again. If the application works correctly, you’ve found the problem. To turn the accelerator back on for other applications, just restart the computer without pressing the Esc key.

What should I do when I see the message “Unable to Load ProDOS?”
The system files on the startup disk may be missing or incomplete. Try a different startup disk. (If you are using a hard disk as a startup disk, you need to install the latest System File update on the hard disk.)

If the System Speed option in the Control panel of the Apple IIgs computer is set to Fast, it may be interfering with the application. Some older Apple IIe software applications must run in the Normal mode on the Apple IIgs computer. Use the Text Control Panel to change the System Speed setting to Normal.

What do I need to know to format, partition, and use my hard-disk drive effectively?
Hard-disk drives offer a great combination of power and convenience. You can store your favorite applications (word processors, database managers, spreadsheet programs, and so on) as well as your data. However, there are some basics you need to understand to use your hard drive effectively.
ProDOS (the operating system that most IIe and IIc owners use) and GS/OS (the Apple IIgs operating system when using ProDOS disks), function under a size limitation. Today, the largest volume that ProDOS 8 can access is 32 MB. How can you use an 80 MB drive with an Apple II? The answer is partitioning, or dividing your hard drive into two or more volumes of manageable size that your Apple will read as separate drives in the slot to which your hard drive is attached.

If your drive uses an Apple standard SCSI (small-computer system interface) card, the Apple IIgs computer includes a utility (Adv.Disk.Util) that can create as many as seven partitions. ProDOS normally recognizes only two, while GS/OS will see up to 32 partitions.

If you’re going to be using mostly ProDOS applications, make sure you keep all the data for those programs in the first two partitions of your hard drive. Otherwise, you will not be able to access the data from inside your ProDOS 8 program.

Installing GS/OS on your hard drive is simple. Set up your hard drive according to the manufacturer’s instructions, then use the Advanced Disk Utility on the System Tools disk to format your drive under GS/OS. At this point, you must decide on the number and size of your partitions. After partitioning your hard drive, use the Installer to install the system software onto the first partition of your hard drive. Finally, check your slot assignments in the Control Panel. If your hard-drive controller card is in slot 7, the Startup Slot can either be “7” or “Scan.” If your SCSI card is in another slot, change the Control Panel accordingly.

The key to happy hard drive ownership is organization. Before you open the box of your new multimegabyte hard-disk drive, sit down and think carefully about how you use your Apple. What applications do you use? Do you have lots of small data files or a few large ones? The answers to these questions will tell you a lot about how you want to format and partition your hard drive.
How do the slots work on the Apple IIgs Control Panel?

Each slot on the Control Panel has two or three options. One of these options is “Your Card,” because you can always stick a card in one of the Apple IIgs’ seven slots. When you’re not busy using one of the slots, the Apple has specific things in mind for them. For example:

Slot 1: Printer. On the IIgs, a printer plugged into the external jack takes up this slot (Appletalk in ROM 03 only)

Slot 2: Modem. On the IIgs, a modem plugged into the external jack takes up this slot

Slot 3: Text display

Slot 4: Mouse port

Slot 5: Smart port (e.g., your Apple 3.5-inch disk drive)

Slot 6: Disk port (your 5.25-inch disk drive)

Slot 7: AppleTalk. If you have a hard drive, it usually goes here, unless you also want to be connected to an AppleTalk network (ROM 01 only)

Startup slot: If you assign a startup slot, the Apple will look there first. If you select “Scan,” it will start looking in slot 7 and count down until it finds a valid startup device (or gives you an error message).

What’s the deal with “daisy chaining” disk drives?

Don’t let the flowery language confuse you. What “daisy chaining” amounts to is connecting several drives in a series, “head to tail.” This feature eliminates the need for a card, like the old Disk II controller — with as many plugs as you have drives. Be sure you connect your Apple 3.5 Drive, then the UniDisk (Apple II 3.5 drive), then the Apple 5.25 Drive, in that order. If you have more than one of any of these units, keep them together. The maximum for daisy-chained devices is four.
An Apple II Success Story

Computers used to make this entrepreneur 'nauseous,' now they run his business

California entrepreneur James Plotkin, who owns the Pasadena Vacuum and Sewing Center (two locations) and rental properties in Pasadena, bought his first Apple IIgs three years ago for his children. "You couldn't make me touch a computer then," he says. "The thought of using one made me nauseous. However, I saw how much the kids liked the machine, so I decided to give it a try to solve some of my business problems."

James wanted a way to better control his retail business' sales and inventory records and produce useful reports. He was having no luck searching through a maze of database applications, including those made for MS-DOS machines, when he spotted an ad in InCider/A+ magazine for DB Master Professional. He purchased the program, and is now able to design databases specifically tailored to meet his business' needs. "For instance, I can do accounts receivable with aging and get detailed reports instantly," he says.
Keeping track of inventory and re-ordering merchandise is also much easier to do with the Apple II and DB Master Professional. The software allows James to quickly determine the exact number of a particular brand of vacuum cleaner or sewing machine he has sold during the past year. “If a factory salesman is in my office asking me to order 1,200 of a particular model for next year, I can call up a report of my sales figures from a database with just a few keystrokes,” he says. “If I discover that I only sold 12 of those models last year, I certainly don’t want to re-order a 10-year supply!” James also uses DB Master Professional for invoicing, preparing mailings to customers, and to record and track information regarding his rental holdings and 30 tenants.

For a guy who once disliked computers, James now owns two Apple IIgs systems — one at home and one at work. The IIgs at work is equipped with an Apple 40 MB hard drive, two Apple 3.5-inch drives, and two Apple 5.25-inch drives. The home system has an 80 MB hard drive made by CMS Enhancements, Inc., and an Apple 20 MB hard drive. In addition to DB Master Professional, James also uses WordPerfect for the IIgs for word processing and AppleWorks GS for preparing newsletters for his customers and the Pasadena business and retail associations of which he is a member.

“I love my Apple II computers. They’ve made me more efficient,” he says. “I wouldn’t give them up.”

Please see the “Third-Party Products” listing in the Information Resources section for more information about third-party products mentioned in this Apple II success story.
Apple supports you by supporting the people who sell and service Apple II products, as well as those who develop software and peripheral devices for Apple II computers. All these people are partners in Apple’s effort to help you do more with your Apple II — inspire learning, boost creativity, and help you work more efficiently.

When you buy an Apple II computer — or a printer, disk drive, or expansion card — a variety of warranty, service, and upgrade programs are available. This section helps you learn how to tap these resources through authorized Apple dealers. You will also learn how you can join a local user group to share up-to-date information about Apple II computers, related products, and a host of other services. And if you’re curious about how Apple helps third-party developers bring you great products for your Apple II, take a look at the article about “Apple Developers.”
Dealers

How Apple makes Apple II computers available to buyers

When you are ready to buy an Apple II, you also want a reliable resource for additional Apple II products and support, including training, software, and other third-party products, as well as service.

There are more than 1,200 authorized Apple dealers who sell Apple II computers in the United States. Authorized dealers assure that you get the best possible help when you buy an Apple II product or when you need service. Authorized dealers receive special training and up-to-date product information from Apple — and that knowledge gets passed on to you in the form of better answers to your questions and better service for your Apple II.

You may enjoy dropping by and browsing around your local dealership. Or you may prefer to call a dealership ahead of time to be sure they carry and support Apple II products. (Authorized Apple dealers choose specialization areas such as business, networking and communication, desktop publishing, education, and other fields. Not all Apple dealers carry the Apple II product line.) You will probably want more from your dealership after your initial computer purchase, so be sure to ask questions about service policies and timelines, third-party software and hardware availability, Apple II training, and other computer-related issues to assist you in your purchase decision and dealer selection.

If you are interested in locating the authorized Apple dealer nearest you, please refer to the “Dealer Listings” article in the Information Resources section. You may also call (800) 538-9696 for the name and phone number of an authorized Apple dealer who carries the Apple II computers. This 800 number operates 24 hours a day, seven days a week.
Customer Service and Support

Apple makes it easy to maintain your Apple II computer.

When you count on your computer — whether it's to write a report on time or pay bills on time — you want assurances. You want to know what to do if something goes wrong. You want to know how to avoid unexpected repair bills. You want to know that someone is there to help in an emergency. Apple's customer service and support provides these assurances.

Apple Computer offers service, support, and training through a wide range of support organizations. These providers include authorized Apple resellers (dealers), authorized Service Providers, authorized Training Providers, as well as other members of the Apple community. Apple is committed to offering these providers products, programs, and tools to ensure a high level of customer satisfaction.

Apple is working to ensure the availability of service options that are tailored to meet the unique needs of every possible customer. As part of Apple's commitment to quality service, Apple offers hardware troubleshooting and system software training, superior diagnostic tools, and documentation, technical support, and upgrades to its service providers. Apple is committed to high-quality service parts and the timely delivery of new and replacement parts.

Support Products for All Apple Customers

Customer Assistance Center 800 Number Starting October 29, 1990, the Assistance Center will provide customers with a toll-free number, (800) 776-2333, to call when their support provider hasn't been able to resolve their problems or questions. Customers will be able talk with trained staff members. The Assistance Center is not a technical support line, but is a way for customers to resolve issues about Apple policies, programs, and products.
Warranty  Every Apple hardware product purchased after January 1, 1990 carries a one-year limited warranty against defects in workmanship.

Apple Care  Apple Care is an extended maintenance agreement that covers Apple products once the warranty has expired. Customers can purchase Apple Care coverage at any time while they own the product. Any out-of-warranty equipment must be inspected by an authorized Apple reseller before the Apple Care service agreement begins.

Software Update Program  The Software Update Program provides subscribers with all updates and documentation released during the subscription period for various Apple system, networking, and communications software. Subscriptions include right-to-copy licenses.


Technical Information Source  The Technical Information Source is a CD-ROM-based technical support product that provides diagnostics, system utilities, a system software archive, a technical support database, technical reference stacks, and training stacks. A Macintosh HyperCard front end, search and feedback capabilities, and on-line documentation provide information quickly and easily.

Apple II Upgrade Programs  Apple II Upgrade Programs provide a solution to intermittent problems that were identified after the initial product shipped. These upgrade programs are usually provided at no cost to the customer. Contact the service department of your authorized Apple dealer.
All of the following programs are currently in effect. However, they are subject to change at any time. If you think that you are experiencing a problem that might be covered by the programs listed below, contact your dealer and ask about the following upgrade programs.

**Video Graphics Controller and IIgs ROM Upgrade** A new Video Graphics Controller (VGC) chip and a new ROM are available to upgrade Apple IIgs systems produced through mid-January 1987. The new Video Graphics Controller corrects video display problems that may occur in double high-resolution and standard text modes. The new ROM corrects minor bugs and provides enhancements for future software releases. It is required for system software 4.0 or later.

**Apple IIc ROM Revision** Some communication software applications on older models of the the Apple IIc may not operate properly. The most common occurrence will be garbage on the screen or no action when using the Terminal Mode if a modem is connected to the serial port. A ROM exchange may be needed.

**Apple IIe Revision A to Revision B Logic Board Upgrade** Purchasers of early, unenhanced Apple IIe system may have a revision A logic board. You may want to upgrade to an unenhanced revision B logic board if you want to:

- take advantage of the system's double high-resolution feature
- use a card designed for slot 7 that does not work in your revision A board because of the absence of the “ColorRef” and “SYNC” signals
- enhance your system by purchasing the Apple IIe ROM Enhancement Kit, as the enhancement ROMs are incompatible with the unenhanced revision A logic board
Apple 3.5 Drive Daisy Chain Problem  In certain configurations, a spinning problem may occur when Apple 3.5 Drives and UniDisk 5.25 Drives are daisy-chained. This causes no permanent damage to any part of the drive or the media; however, the data in RAM is lost because of the power down.

The spinning problem is intermittent and only occurs on Apple 3.5 Drives with revision A Daisy Chain interface Boards and the following configurations:

☐ An Apple IIgs with one or more Apple 3.5 Drives attached and one or more UniDisk 5.25 Drives daisy-chained to one of the Apple 3.5 drives

☐ An Apple IIgs with one or more Apple 3.5 Drives attached and a DuoDisk daisy-chained to one of the 3.5-inch drives

ROM Upgrade for UniDisk 3.5  A new ROM may be required to use a UniDisk 3.5 with older models of the Apple IIc.

Apple II SCSI Card and Profile Interface Card ROM Upgrade  Apple IIgs users who upgrade to Apple IIgs system software Version 4.0 or greater must use the latest revisions of both the Apple II SCSI Interface Card and the ProFile Interface Card. Apple revised the ROM on the Apple II SCSI card to make it compatible with the Apple CD SC and Apple IIgs system software.

Apple IIgs Memory Expansion Card Exchange  Some Apple IIgs Memory Expansion Cards were built with RAM chips with the wrong refresh cycle. A symptom of the wrong refresh cycle is that memory intensive applications such as AppleWorks crash, and causes the system to display an error code. If you have this symptom, please contact your Apple dealer.

Apple II 256K Memory Expansion Kit Exchange  Some of the Apple II 256K Memory Expansion Kits used with the Apple IIgs Memory Expansion Cards have the wrong refresh cycle. If you have the symptoms described for the Apple IIgs Memory Expansion Card above, please contact your Apple dealer for a free exchange.
User Groups

If you want to find out how to get peak performance from your Apple II, get together with the people who have the answers — Apple user groups. Here's the information you need to make this important connection.

User groups are organizations of people who want to make the most of their Apple II computers — and have fun in the process. User groups provide an opportunity to share information, get support, and gain insights. Wherever you are and whatever your interests, there's probably an Apple user group nearby.

Knowledge — User groups provide a forum for sharing facts, ideas, experience

Apple user groups provide an open forum for questions, answers, and ideas. Most groups publish newsletters, hold regular meetings, and provide speakers and opportunities for discussions. At these meetings, you can get help with specific problems. You can learn how to use your Apple II computer to its fullest. You'll also enjoy user group meetings for the sheer enthusiasm and mental stimulation their members offer.

User groups typically support special-interest groups, conduct seminars, provide public-domain software libraries, and maintain on-line bulletin board systems to answer your questions and keep you apprised of the latest Apple-oriented news.

Many user groups have formed within corporations, government agencies, and universities. These groups usually cater to the specific work-related needs and interests of their members.

User groups have a long-standing and well-deserved reputation as friendly havens for computer users of all skill levels. If you are a novice and have questions about your new Apple II system, you can be sure that someone else has had the same questions — and probably has the answers you need.
Software — User groups have advice, demos, and public-domain software
User groups are an excellent source of information about software. Publishers often demonstrate new products at user group meetings. More experienced users can give you advice about the best packages for your specific needs.

Most user groups also maintain collections of demonstration software and public-domain software. These range from simple utilities and games to well-developed applications for business and education.

Support — The Apple User Group Connection provides user group support
Apple supports user groups with an organization called the Apple User Group Connection. This organization is dedicated exclusively to the Apple user group community and offers several services:

AppleLink   Registered user groups have their own bulletin board on AppleLink, Apple's electronic mail and information system. AppleLink has special folders where you can discuss questions about hardware, software, and peripherals with Apple, with developers, and with other user groups. Also, information about new Apple and third-party products is routinely reported on AppleLink. In addition, you'll find conference announcements, classified ads, and much more.

Regular communications   User groups registered with the Apple User Group Connection receive regular mailings from Apple, including data sheets for new products, technical notes, and development hints. The bimonthly Quick Connect newsletter and a quarterly videotape keep user groups in touch with news from one another and from Apple.

System software updates   User groups can become licensed distribution agents for Apple system software. This service makes it even easier for you to get the latest Apple IIgs system software.
Special purchase programs  Registered user groups are eligible for discounts on select Apple products that can enhance the groups' services — products that help with producing a newsletter, for example, or maintaining an electronic bulletin board system.

Forums  Apple sponsors events that bring together user group leaders and members to discuss issues of importance to the user group community.

Speaker assistance  Registered Apple user groups receive notices about Apple and third-party representatives who are available to speak about new products or other issues. You can also post requests for speakers on AppleLink.

Startup — Making a user group happen
If you live in an area without an Apple II user group or if you want to meet with people who have a particular interest in the Apple II, you can start a new user group. But don't take the job lightly.

Launching and running a user group requires a lot of time and effort. Before getting started, make sure that you're really positioned for success. Get some help. You may want to start by calling the nearest computer resellers — an authorized Apple dealer, campus bookstore, or other sales contact. See how these people respond to the idea of a local user group. What do they think the interest will be? What would they like the group to offer? How would they get involved? And so on. Maybe they would like to participate in founding the group or becoming part of the staff — in helping the group take any of the first steps toward getting started.

You can also find help by advertising in a local computer publication or community newsletter, contacting a local community college's computer science department, getting air time (sometimes available at no charge for community-service messages) on a local radio station or community talk show, or placing a notice on company or community bulletin boards. Chances are, there's someone out there who is thinking along the same lines as you. Maybe they, too, are looking for some help.
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The Phone Number — (800) 538-9696, extension 500

Apple will help you find the user group nearest you. It will also help you find groups that specialize in subjects that interest you or even tell you how to start your own user group. For information, call the toll-free number for the Apple User Group Connection. Or write to:

The Apple User Group Connection
Apple Computer, Inc.
20525 Mariani Ave., M/S 36AA
Cupertino, CA 95014

Craig Elliott manages the User Group Connection. He has worked with user groups across the country, developed programs for dealers, and worked with marketing teams on networking and communications.
How Apple works with developers

by Elizabeth Lynch

If you own an Apple II, you’re almost certainly using software developed by an independent developer. You might be interested to know how Apple works with these independent developers to bring you lots of great software.

Apple’s commitment to its products extends beyond selling personal computers. Apple measures its success by your ability to use your Apple II productively and creatively, whether you’re working on something as specialized as video or performing basic word processing functions.

To make sure your personal computer helps you do all the things you want to do, Apple works with independent software and hardware developers. The goal is to ensure that you have a broad range of innovative software applications and peripheral products from which to choose. The larger your choice of products, the more power you have to make your Apple II work for you.

Apple Developer Group

Apple’s approach to working with third-party software and hardware developers is a global one. Corporate headquarters in Cupertino and Apple subsidiaries throughout the world have dedicated groups committed to working with developers in several ways.

Apple representatives may work one-on-one with selected developers to provide technical and marketing advice specific to their product. In working closely with this limited number of developers, Apple can help guide these developers into the most innovative development directions.
Support programs and services meet the needs of the larger developer base. Although programs differ from country to country, a common feature among most developers programs is the regular flow of information from Apple to developers. Such information might include samples of programming code or information about the marketing directions Apple is anticipating. This flow of information keeps developers in step with Apple’s technical and marketing directions and, ultimately, means great products for you.

**Apple’s Developer Support Programs**

Apple’s developer landscape is diverse. Our developers range from the largest in the industry to enthusiasts interested in programming for personal satisfaction. Apple operates three programs in the U.S., which meet the varying needs of these developers. The most experienced, established, and skilled developers use the Partners and Associates Programs, which provide services such as technical support via electronic mail (Partners Only), a developers hotline, a developers monthly mailing, and AppleLink Electronic Communications.

The Apple Programmers and Developers Association — APDA™ — is a mail order distribution service available to any serious Apple user or developer who is writing programs or doing development work. It’s Apple’s entry-level source of development tools and documentation for development customers worldwide.

Apple developer programs are administered by the Developer Programs group and can be contacted by writing:

Apple Computer, Inc.
Attn: Developer Programs
20525 Mariani Ave., M/S 75-2C
Cupertino, CA 95014
(408) 974-4897

Elizabeth Lynott has worked in Developer Programs at Apple for nearly two years. She manages Apple’s communication with developers, including the publication of The Developer Handbook.
Any organization that has been around for 13 years and attracts 28,000 members in a metropolitan area must be doing something right. And when the organization's focus is computers, it's even more impressive. That's the story of the Boston Computer Society (BCS).

An organization like BCS is commonly referred to as a user's group, a moniker that really does not adequately describe its true scope and impact. Take one microcosm of the BCS — Apple/Boston — for example. If your children are learning to use a computer in a Boston area school, their teachers probably learned how to use the same computer system at a Apple/Boston monthly meeting or weekend seminar. "Half of the members who regularly attend our monthly meetings are educators. So we decided to start a special interest group for educators within Apple/Boston," says Al Willis, co-director of Apple/Boston. "Teachers pick up a lot of useful information during the educators session and bring it back into the schools."
Al probably knows the value of computers in education better than anyone. In fact, his success with computers in school is quite likely responsible for his success today as a computer consultant. Al started using an Apple II in high school in 1979, while working on a science fair project about DNA. He decided to write an educational, teaching program about DNA on the school’s sole Apple II. He entered his project in the Boston Science Fair in 1980 and won first prize. Al’s latest project is desktop publishing. Using his home computer system — an Apple IIgs with 1.75 MB memory, an Apple Color Monitor, Apple 5.25-inch and 3.5-inch drives, a CMS 40MB hard drive, and AppleWorks GS software — he’s doing the layout for a book titled “The African Meeting House,” which will be published by the Museum of Afro-American History in Boston.

Apple/Boston has about 2,000 members and meets in the Beaver Country Day School in Chestnut Hill, Mass. The monthly meetings feature speakers from the computer industry, who demonstrate new products or discuss technological trends. Before each meeting a special session is called for beginners only, which allows Apple novices to ask basic questions without the fear of embarrassment. The meetings are simulcast on America Online, an on-line service for Apple II and Macintosh users nationwide. “We usually have 15 to 20 people join us interactively on-line,” says Al. “The simulcast is an integral part of Apple/Boston. In fact, one of our members, Tim Barwick, who is now a forum producer for America Online, got his start in the group. Apple/Boston was even selected to beta test the service.”

Apple/Boston also offers members a library of public domain software as well as the latest Apple System Software, and runs a computer bulletin board service (BBS) called the Apple/Boston Connection.

All in all, Apple/Boston seems more like a horde of job skills training and professional development, than simply a user’s group.

Please see the “Third-Party Products” listing in the Information Resources section for more information about third-party products mentioned in this Apple II success story.
Understanding Technical Information

Personal computing with the Apple II minimizes your need for an in-depth understanding of technical concepts. Still, a vast amount of technical expertise — which interests many hackers and non-hackers alike — has gone into making the Apple II easy to use.

This section covers the more technical aspects of the Apple II, including the history of the Apple II hardware and its operating system. You'll also find practical and not-too-technical information in an overview of the features of the new Apple II GS system software, Version 5.0.
Have you ever wondered what DRAM is? Or what’s double about Double Hi-Res? Or why your Apple II uses a 6502-type microprocessor instead of an 8080-type processor — and what difference it makes? If you have ever asked questions like these, read on. (If you’re new to computing, start by reading “The Fundamentals” article in the Understanding the Basics section.)

Today's computer is, in essence, a microprocessor, some memory chips, an input device, and a video display. This simple listing of components, however, belies the myriad of decisions that went into the design of the Apple II. Which microprocessor do you use and how do you evaluate its performance against others? What kind of memory chip do you use, and how do you best take advantage of its benefits? How do you add new features to new models and still keep all the old features?

Every feature of the Apple II grew out of such questions and their answers.

The Microprocessor — Why it’s a 6502, not an 8080

In 1975, Steve Wozniak was thinking about building his own microcomputer. He decided to use a 6800 microprocessor instead of the then fashionable 8080 used in most microcomputers. But there was one problem: money. The going price for a single 6800 or 8080 was about $275, which, in those days, was more than he wanted to pay for a microprocessor.

Then Wescon, the annual electronics trade show, came to San Francisco. One of the companies at the show was MOS Technology, a small IC manufacturer that had just introduced the 6502 microprocessor, which was similar to the 6800. The MOS Technology representative at the show was selling 6502s for $30 each. By the time Wozniak left the show, he had bought one.
Since then, all Apple II computers have used the 6502 or one of its two descendants, the 65C02 and the 65C816. The 6502 and 65C02 are 8-bit microprocessors. The 65C816 is a 16-bit microprocessor. The bit numbers refer to the largest increment of data the microprocessors can handle in a single instruction. The size of a microprocessor determines its cost and processing speed, not its functionality. Even the smallest microprocessor can compute large numbers, handle large databases, or manipulate large documents — it just takes a little longer.

Performance is also related to clock speed. All microprocessors have a clock, but this clock doesn't tell time. Rather, it controls the execution of instructions and synchronizes the microprocessor to the rest of the hardware. The relationship between clock speed and performance has been a source of confusion in comparisons between 6502-type processors and 8080-type processors — the 8080, 8088, and 8086.

For computers of comparable cost, the clock speed of a 6502 is generally slower than that of an 8080. But the 6502 does more work during each clock cycle. The effective performance of a 6502-based computer is the same as that of an 8080-based computer whose clock speed is about 2.5 times as fast. In other words, a 6502 computer running at 1 megahertz (MHz) is about as powerful as an 8080 computer running at 2.5 MHz. The Apple IIc Plus, with its 4 MHz clock, can be compared to an 8080-based machine with a clock speed of 10 MHz.

**Memory — That’s D-RAM, and the D makes all the difference**

The memory chips used in the Apple II are DRAM chips. (The acronym is not a unit of liquid measure — it's pronounced *dee*-ram, short for Dynamic Random Access Memory.) Nowadays almost all microcomputers use DRAM, but at the time Wozniak designed the first Apple computer, microcomputers all used static RAM (SRAM, pronounced *ess*-ram).
I/O Input and Output  Input is information transferred to a computer from an external source, such as a keyboard, mouse, disk drive, or modem. Output is information transferred from the computer to an external destination, such as a video display, printer, or modem.

Yes, Virginia, there was an Apple I

You may have wondered whether or not there was an Apple I. Actually, there was, although it was called the Apple computer. The machine that inspired the myth was built in a garage and funded by selling a programmable calculator and a VW van to get money to buy parts.

In 1975, when Wozniak was designing that first Apple computer, computer hobbyists were building small computers from kits. Those kit computers resembled the minicomputers of the time. Their only built-in input/output (I/O) consisted of binary lights and switches on the front panel. A technician or programmer could use the lights and switches for stepping through a program or repairing the computer. For a user running an application, however, the computer was connected to an external terminal, typically a Teletype.

Memory on those kit computers came in increments of 1 kilobyte — that’s one thousandth of a megabyte — and most of those computers had less than 8 kilobytes of RAM. For program and data storage, small computers used either audio cassettes, which were frustratingly slow, or the then standard 8-inch floppy disks, which were expensive.

The first Apple computer was an assembled and tested circuit board. It was not a kit, but some assembly was required. To make a complete system, the purchaser added a power transformer, a keyboard, a video monitor, and an appropriate case or box.

Two important innovations set the first Apple computer apart from the other small computers of its time:

1. It contained built-in circuits for a video terminal. The user needed only a keyboard and TV monitor, while other small computers required an external terminal.

2. It provided 8 kilobytes of built-in RAM, using DRAM. Other small computers required plug-in boards with 1 kilobyte or 4 kilobytes of SRAM.

By building all the electronics onto a single board and using advanced technology, Wozniak had produced a computer for hobbyists for about $1,000 — a price much lower than that of competing machines.
In a RAM chip, each bit is stored as an electrical charge in a small capacitor. Because the storage device for each bit is smaller than the equivalent static RAM device, DRAM technology can pack more bits into each chip, and the price per bit is lower. What's more, its capacitors do not dissipate power, so DRAM uses less power than SRAM, and the computer's power supply can be smaller and cheaper.

Wozniak's decision to use the 4-kilobit DRAM chips when he designed the first Apple computer was well informed. He knew that the 4-kilobit chips would soon be followed by 16-kilobit chips that used the same size package, the same pin arrangement, and the same kind of memory refresh. By the time the Apple II was introduced, the 16-kilobit chips had become available, and Wozniak could offer a computer with four times as much memory as his first machine.

The original Apple II had three rows of RAM chips, eight in each row. Each chip had one output pin, so it took eight chips in parallel to store data by the byte. With 4-kilobit chips, each row could store 4 kilobytes, and the maximum memory size was 12 kilobytes. With the 16-kilobit chips, the maximum memory size was 48 kilobytes. At the time Wozniak designed the Apple II, 48 kilobytes was an enormous amount of RAM for a microcomputer. More recent Apple II models use larger RAM chips. In some models, each RAM chip has more output pins — usually four or eight — so it no longer takes eight chips to make a bank of RAM.

DRAM presented one problem to Wozniak — impermanence. DRAM is called dynamic because the charges in the capacitors aren't permanent. Over time, the charges leak away, so they must be renewed periodically by a process known as memory refresh. Refreshing memory requires additional circuitry that makes the computer more complicated. When Wozniak was designing the first Apple computer, he realized that the advantages of low power and low cost more than made up for the additional complexity required for memory refresh. Besides, he had devised a method to perform the memory refresh almost for free, by combining it with the video display.
The Video Display — The circuitry solves two problems at once

The image on a video display is redrawn 60 times every second. A computer generating a video display has to keep sending data to the display even when the data isn't changing, continually refreshing the image on the screen.

In the Apple II, specific areas of RAM called the display pages are connected to special-purpose hardware that generates the signals that drive the video monitor. There are four display pages in all Apple II computers: two for text and Lo-Res graphics and two for Hi-Res graphics. The Apple II GS has a Super Hi-Res display page. The display hardware generates addresses that cycle through the selected display page over and over again. The display hardware reads the data at those addresses and converts it into the video signals that produce patterns of dots on the display screen.

By an interesting coincidence, the process of refreshing the video display is similar to the one used to refresh the memory in DRAM chips. To perform memory refresh, the computer must send a sequence of addresses to each chip. Wozniak took advantage of this similarity and designed the display hardware in the Apple II to refresh the memory in the DRAM chips at the same time that it refreshes the display. That way, the Apple II gets the benefits of dynamic RAM without needing additional circuitry to refresh it.

The Text Display — How it was doubled

The original Apple II and the Apple II Plus had a 40-column text display made up of 24 rows with 40 characters in each row — all in uppercase. At first, this limited display was acceptable, but as more people used Apple II computers for more purposes, the 40-column display began to seem too limited. Third-party developers produced expansion cards that provided 80 columns, with lowercase, but the cards were expensive and not well integrated with all applications. By the time Apple started to design the Apple IIe computer, it was obvious that the 80-column display should be built in.
Why there was no source listing for Integer BASIC

The original Apple II came with the Integer BASIC interpreter as a permanent feature of the system ROM. As people began to develop applications, they started asking for the source listing for BASIC so they could get information about the inner workings of the interpreter. They hoped to be able to use some of its routines as subroutines in their applications, thus making the applications smaller. (Remember that RAM was expensive and cassette I/O was slow, putting a premium on compact programs.)

Whenever a developer asked for the source listing for Integer BASIC, Apple always refused. You'll see why when you learn how Integer BASIC came to be written.

The year was 1975. The event — a meeting of the Homebrew Computer Club held at Stanford University. The speaker was Steve Wozniak, who was demonstrating a single-board computer he had designed for himself — the machine that became the Apple I.

So how did Wozniak demonstrate his new machine? He ran small programs using his homebrew BASIC interpreter. And how did he load the interpreter? He typed it in, in hexadecimal machine language, from the keyboard. He had to type it, because he didn't have tape or disk storage yet. He had to type it in hexadecimal because there was no assembler or interpreter built into that first computer. Woz had written his BASIC interpreter in machine language on a bare piece of hardware!

The designer of the 80-column display on the Apple IIe had three goals:

- minimize the added cost
- keep the existing graphics displays
- keep the 40-column text display for the sake of compatibility
To see how the designer accomplished these goals, you have to see how the 40-column display works.

A video display is made up of dots — or *pixels* — arranged in horizontal lines that are drawn one after another, very rapidly. For the display used in the Apple II, it takes 40 microseconds for the video display to sweep across each horizontal line on the screen. The hardware for the 40-column display reads data from the computer's text display at the rate of one byte per microsecond. Each byte contains one character, so 40 microseconds is just time enough to generate 40 characters:

\[
40 \text{ microseconds} \times 1 \text{ character per microsecond} = 40 \text{ characters}
\]

Each row of characters is eight video lines high, so the hardware scans the text data for each row eight times and generates eight horizontal lines before going on to the next row of text.

To double the number of columns in the text display without changing the existing displays, the designer decided to double the existing text page by using two banks of RAM with the same addresses and reading from both banks at the same time. The hardware in the Apple IIe thus generates addresses in the display page at the same rate as before, but now it reads two bytes of display data — one from each bank — during each microsecond:

\[
40 \text{ microseconds} \times 2 \text{ characters per microsecond} = 80 \text{ characters}
\]

One advantage of this approach is low incremental cost: The display hardware requires only slight changes from the original 40-column design. The main changes were the addition of memory to double the column width of the text page and a character generator that had to run twice as fast. (The character generator is the hardware that converts bytes of data into dots on the screen.) The other display hardware could remain much the same as before.

Another advantage of this approach is its compatibility with applications written for the 40-column display. The hardware for the 40-column display is still there in the newer models, so older applications need not be changed to run on newer machines.
One of the problems with doubling the column width of the text page was how to store different display data in the two banks. Software can't store display data in the auxiliary text page in the normal way — just using different addresses — because the addresses are the same in both banks. To handle this problem, the designer added a bank-select switch that can be changed by the software. Once this software switch was available, it became possible for the Apple IIe to use parallel banks of RAM not only for the display page but for the entire 64-kilobyte address space, thereby doubling the amount of RAM in the system.

The original 80-column Text Card for the Apple IIe was a low-cost option containing only enough auxiliary RAM to double the text page — 1 kilobyte. It was soon followed by the Extended 80-column Text Card with 64 kilobytes of auxiliary RAM, giving the Apple IIe a total of 128 kilobytes of RAM.

**Graphics — Doubled text leads to Double Hi-Res**

Once the designer of the Apple IIe had made the changes necessary to double the column width of the text display, it took only minor changes to double the Hi-Res graphics display as well. The result was Double Hi-Res. That display not only has double the number of dots for graphics, it can also generate more colors. The old Hi-Res graphics displayed six colors. Double Hi-Res has 16, the same 16 colors formerly available only in Lo-Res graphics.

At first, no one seemed to want Double Hi-Res. The marketing people had recognized the need for doubling the text display, but they didn't see any need for another graphics mode. The developers didn't see a market for Double Hi-Res because the extended 80-column card was optional and applications couldn't depend on having it. An added disincentive for developers was Apple's failure to promote Double Hi-Res or to provide graphics subroutines for it.

The breakthrough came with the introduction of the Apple IIc, which has the second 64 kilobytes of RAM built in. (A similar version of the Apple IIe came later and is often referred to as the enhanced Apple IIe.) With Double Hi-Res no longer optional, developers began to write applications for it, even though they still had to write their own graphics subroutines.
Good Ideas — They keep coming

Good ideas didn’t stop with the older Apple II models. The newest Apple II models have their share of interesting features. To name just two:

- A high-speed cache on the Apple IIc Plus provides improved performance without compromising the operation of older programs.
- Memory shadowing on the Apple IIGs is an efficient way to use its larger memory while still allowing older programs to use memory for input/output (I/O).

If you have found these explanations interesting, you might enjoy browsing through Apple’s *Technical Introduction to the Apple IIgs*, available from Addison-Wesley Publishing Company. (This book is listed in the “Articles, Books, and Publications” article in the Information Resources section.)

Allen Watson, who has a degree in mathematics, bought an Apple II with 8K of RAM in December 1977 and has been writing about the Apple II ever since. His work has appeared in Apple technical manuals for Apple IIe, Apple IIc, and Apple IIgs, as well as for Macintosh computers.
The Operating System

Apple II users have seen lots of operating systems over the years — DOS 3.1, ProDOS, ProDOS 8, ProDOS 16, GS/OS, and most recently the Apple IIgs system software, version 5.0. If the alphabet soup of system names leaves you hungry for more meaningful communication, this history of the Apple II operating systems should satisfy your appetite.

Nearly everyone has heard the adage that “hardware is nothing without software,” which is true. Without software, your Apple II computer might as well be turned off. Its microprocessor doesn’t do anything of its own accord. It simply executes instructions, one after another, until someone disconnects the power. It’s always running a program, even if the program is just looking to see if you’ve pressed a key yet.

If you’re like most people, you’re probably interested primarily in application programs, such as word processors and database managers. While different application programs generally perform different tasks, there are certain tasks that every application has to handle. For example, all applications have to communicate with you. Most use the keyboard and the computer screen for this purpose.

Because you like to keep information where you can get to it easily, most applications also need to talk to storage devices. The most popular storage device is the disk drive. However, a disk drive is pretty difficult to communicate with. It responds to basic commands such as “look here,” “read some information,” and “write some information.” Application programs like to issue commands, however, such as “read a file” and “write a file.” To assure that disk drives follow these commands, a program has to group raw bits of information into bytes, group bytes into larger chunks for easier management, and then group all of that information into files. Such a program is called a disk operating system, or DOS for short.
A DOS is a specialized control program known more generically as an operating system, or OS. An operating system is usually working in your computer’s memory at the same time as an application, so the application can ask it to perform tasks such as reading and writing files or communicating with you via the keyboard and screen.

When you switch your computer on, the ROM looks for a miniature program that’s stored on an interface card attached to a storage device and uses it to load another program from disk. This second program then uses the miniature programs on the interface card (known as firmware because they run on a hardware card) to load the rest of the operating system. It’s kind of like bringing yourself up by your bootstraps, which is why it’s called booting the system. And the process still works the same way today as it did in 1978, when Steve Wozniak invented the Disk II, the first floppy disk drive for the Apple II. (Apple IIc and IIgs computers have built-in ports where you can plug in disk drives without using interface cards. The computer pretends there’s an interface card there anyway, so the operating system knows how to boot itself.)

**DOS 3.1 — Designed to work with the Disk II disk drive**

While Wozniak was working on the Disk II disk drive, he and other Apple engineers were also busy at work on an operating system to go with it. They released their first effort, DOS 3.1, in the summer of 1978. (Versions earlier than 3.1 were never released to the public because they didn’t work well enough.)

The firmware on the Disk II interface card expected every disk to be a 5.25-inch disk, divided into 35 parts, called tracks. Each track was further divided into 13 sectors, each with 256 bytes of data. If a disk wasn’t organized this way, it couldn’t be booted. DOS 3.1 worked with this disk organization.

Apple engineers made several changes to the operating system in the months after its initial release. In mid-1979, DOS 3.2.1 was released as the most stable version.
DOS 3.3 — An upgrade to accommodate Pascal, higher storage

At the same time, another group of Apple engineers was working on an implementation of the Pascal programming language to complement the BASIC language built into the Apple II. When it was released in 1979, UCSD Pascal for the Apple II — or Apple II Pascal — came with its own disk operating system. This system didn't organize disks the same way as DOS 3.2.1 and its predecessors. Instead of 13 sectors, it divided the disk's 35 tracks into 16 sectors, each with 256 bytes, boosting the total storage per disk from 113K under DOS 3.2.1 to 140K.

Because the disk organization had changed, Apple had to upgrade the Disk II controller card to boot the new Pascal disks. It also modified the disk operating system to use the new 16-sector-per-track storage capability, calling the new version DOS 3.3.

Upgrading to the new system was not without drawbacks:

- DOS 3.3 could not directly read disks formatted by DOS 3.2.1 or earlier versions. To remedy this problem, Apple included a utility called MUFFIN, which read files from the older disks.
- The new hardware wouldn't boot the older disks. Again, Apple supplied a utility called BOOT13 to boot 13-sector-per-track disks.
- DOS 3.3 functioned best if 32K or more was present, even though it only occupied about 10K itself.

DOS 3.3 wasn't easy for applications to use, either. The interface between DOS 3.3 and the application program was not well defined. Programmers had to work around DOS to perform some necessary tasks, or sometimes they had to call routines inside DOS to do things that DOS itself would not do. As a result, enhancing and fixing bugs in DOS 3.3 became troublesome — any minor change could easily move routines that applications depended on.
**patch**  An alteration to a program that patches right over existing program instructions just as a clothing patch is sewn over torn fabric.

**Apple III**  The Apple III was a business computer that Apple sold from 1980-1984. It is best remembered today as the machine for which early versions of ProDOS and AppleWorks were written.

The main drawback of DOS 3.3, however, was that it was designed to support the Disk II disk drive. As time went on, other storage devices became accessible to microcomputers — devices such as hard disks and 3.5-inch disk drives. DOS 3.3 could not talk to these devices without patches.

**ProDOS — Power, sophistication à la SOS**

Apple wanted to bring a more powerful operating system to the Apple II — one similar to the operating system used on the more expensive Apple III. This system was called SOS — Sara's Operating System, named after engineer Dick Huston's daughter. (It was also called the Sophisticated Operating System.)

SOS featured device drivers — small programs used to communicate with storage devices. Device drivers could tell SOS how to access any given storage device; the system didn't have to have that knowledge built in as DOS 3.3 did. SOS also provided communication with nonstorage devices such as printers.

SOS also featured a hierarchical directory structure so you could create special kinds of files called *subdirectories* that contained other files. For example, you could create a subdirectory named "Taxes" and keep all your tax-related files in that subdirectory for easy access. Subdirectories could be nested as deep as you wanted, the only constraint being disk space. DOS 3.3, by contrast, had only one level of file organization.

Not all of the power of SOS could be harnessed for the Apple II because the Apple II had a maximum of 64K of RAM at that time. SOS required 256K. However, engineer Dick Huston did bring the hierarchical file system and advanced programming interface of SOS to the Apple II and called it *ProDOS* — for Professional Disk Operating System. While DOS 3.3 expected all programs to work with files the way BASIC did, ProDOS gave programmers the flexibility to work with files in new, more powerful ways.
Apple's ProDOS-compatible devices

The following Apple devices have firmware interfaces to ProDOS:

- **UniDisk™ 3.5**: Apple's first 3.5-inch disk drive for the Apple II
- **Apple II Memory Expansion Card**: Works as a RAM disk for the Apple II under ProDOS
- **Apple IIc Memory Expansion Card**: Works as a RAM disk for the Apple IIc under ProDOS
- **Apple II SCSI Card**: Connects Small Computer System Interface (SCSI) hard drives to the Apple II. Revision C of the original card added CD-ROM support
- **Apple II High Speed SCSI Card**: Connects any SCSI device to the enhanced Apple IIc and the Apple IIgs
- **Apple II ProFile Interface**: Allows ProDOS to work with 5 MB or 10 MB ProFile hard disks

ProDOS did not have the ability to handle any storage device through a driver as SOS did, but it could access any storage device whose firmware followed guidelines published by Apple. By designing an interface card to be ProDOS compatible, third-party developers could create storage devices that were compatible with ProDOS from the moment they were plugged in. Apple also released several ProDOS-compatible devices and interfaces of its own.
ProDOS was released in January 1984. At the same time, Apple announced that all future development would be in ProDOS and that DOS 3.3 would never be changed again — that is, there would be no enhancements and no bug fixes. Apple encouraged third-party developers to move to ProDOS as well, and many did. However, running a BASIC program under ProDOS required about 16K more memory than running under DOS 3.3. Also ProDOS was a more complicated programming environment than DOS 3.3, and users who were unfamiliar with subdirectories found it more complicated. So some people chose to stay with DOS 3.3. Even today, people still use educational software that runs under DOS 3.3. Although no hardware change was required for ProDOS, it couldn’t read DOS 3.3 disks directly. Apple supplied a program called CONVERT to do the task and later built the capability into the Apple II system utilities, which shipped with every Apple IIc and Apple II disk controller card from 1985 through the present.

**ProDOS 16 — A new system for the 16-bit Apple IIgs**

The advent of the Apple IIgs in September 1986 made some extraordinary demands on the operating system. The Apple IIgs had a 16-bit microprocessor, while older Apple IIs had 8-bit microprocessors. The new microprocessor made it possible to create faster and more powerful software, and the operating system had to meet the challenge. But ProDOS could not be modified to do so and remain compatible with older Apple II computers. So a new operating system was born — ProDOS 16.

The original ProDOS became ProDOS 8 and was available for 8-bit computers (including the Apple IIgs, in 8-bit mode). The new ProDOS 16 made it possible for Apple IIgs applications to communicate with storage devices without entering 8-bit mode. In effect, ProDOS 16 was simply an easier way for applications to use ProDOS 8 — most ProDOS 16 calls were translated into ProDOS 8 calls made by ProDOS 16.
When will ProDOS 8 use bigger volumes?

Many people have asked Apple when ProDOS 8 will be modified to recognize more than two drives per slot. Or when it will support more than 32 MB per volume. Or when some other ProDOS restriction will be lifted. The answer is: These restrictions won't be lifted. Here's why.

Application programs get ProDOS 8 to do work for them by making calls to ProDOS 8's machine-language interface, or MLI. When a program calls the MLI, it passes along a command and some memory to be used for the results. For example, if a program wants to read 50 bytes of data from a file, it tells the MLI what file to read and where to put the information in memory.

The size of these data structures is limited. If you want to know the size of a file in ProDOS 8, you give ProDOS 8 three bytes in which to return the file's size. The largest value that can be returned in three bytes is a value of 16 megabytes, which is ProDOS's maximum file size. The ProDOS file system, which dictates how files are stored on disk, only keeps three bytes for this value, so it can't be any bigger. Similarly, the number of drives in a given slot is stored as a 1-bit value, where a 0 means one drive and a 1 means two drives. The bit is either 0 or 1; it can't be anything else. ProDOS also stores a volume's size in a 2-byte field that represents how many 512-byte blocks are on the disk. The maximum value is 65,536 blocks of 512 bytes each, or 32 megabytes.

All of these fields are an integral part of how ProDOS works. To change them now would introduce incompatibilities with nearly every ProDOS application ever written. A change would also create a new disk storage format that the current ProDOS implementation (either ProDOS 8 or GS/OS's ProDOS FST) could not read. Apple feels that no one really wants a new operating system that doesn't work very well with any existing applications. So, no changes.
device driver  A program that handles the transfer of data to and from a peripheral device, such as a printer or disk drive.

The engineers for the Apple IIgs had a bolder move in mind, however. The successes of SOS, of ProDOS, and of the Macintosh Operating System had already shown them the power of including some kind of device driver — either as a short program or included with the hardware — in the operating system. Device drivers meant that the operating system didn’t have to have built-in knowledge of every kind of storage device. However, the operating system still had to have built-in knowledge of the disk storage format. ProDOS knew only how to work with ProDOS disks (and SOS disks, since the formats were the same). It couldn’t work directly with DOS 3.3 disks, for example.

Nevertheless, the experience with device drivers led to a new question. Why not create a kind of driver that knows how the disk format works? Then, when the operating system asked this special “translator” for a file on disk, the translator would figure out how the file was stored on the disk and ask device drivers to read the appropriate bytes from the disk. With such a system, people could use ProDOS disks or DOS 3.3 disks or any kind of disk for which a translator existed.

GS/OS — File system translators (FSTs) for different disk formats

The idea worked well. The engineers built a new native operating system for the Apple IIgs, known as GS/OS. It included as integral components a set of translators for disk formats known as file system translators — or FSTs.

GS/OS was released in September 1988 and originally shipped with three FSTs — one for ProDOS disks, one for character devices, and one for the CD-ROM international standard (ISO 9660 and its predecessor, High Sierra).

GS/OS also allowed device drivers to be loaded from disk at boot time instead of residing on the device hardware. A driver that is stored in memory and written specifically for the Apple IIgs can be more efficient than a driver that is attached to hardware and has to run on all Apple II computers. For example, Apple’s driver for revision C of the Apple II SCSI Card was five times faster than the driver on the card.
GS/OS also eliminated restrictions in the design of ProDOS 8. ProDOS 8 could support only two storage devices in any slot. GS/OS has no such limit. ProDOS 8 was limited to 16 MB per file and 32 MB per volume. The comparable limits for GS/OS are 256 times bigger per file and at least 128 times bigger per volume. (However, to be compatible, the ProDOS file system translator has to stay within the limits of ProDOS.)

**Apple IIgs System Software, Version 5.0 — A look at the future**

ProDOS 8 is now a mature system. It probably won't change much in the future. But GS/OS has already been expanded with the release of Apple IIgs system software, version 5.0. Among its new features is an AppleShare FST that allows the operating system to use AppleShare file servers as disks. See “The Apple IIgs System Software, Version 5.0” in this section for more details.

You can expect more of this kind of expansion for GS/OS in the future. Early versions of device drivers for the Apple Scanner and Apple Tape Backup unit are already available to developers. You can expect to see additional FSTs for GS/OS as well, giving your existing software the capability to read disks it currently can't understand. And, of course, Apple intends to deliver performance enhancements wherever possible so that equipment you already own works better for you. The power of Apple II operating systems has grown over the years, and more power is yet to come.

Matt Detheridge works in Apple's Developer Technical Support group, where he was the technical lead for Apple IIgs System Software 4.0 through 5.0. He has written dozens of technical notes as well as articles for APDalog and Call-A.P.P.L.E. magazines. He hopes his friend Michael Opitz will read this book and fall into uncontrollable laughter at the sight of the word “dododdododdodudy,” for some cosmically unexplained reason.
The Apple IIgs System Software, Version 5.0

The latest version of the Apple IIgs system software is version 5.0. It's a major step forward for the Apple IIgs, with improvements in performance, graphics, and file operations. The new version supports hard disks with a capacity of 32 MB or more and introduces file system translators to maintain compatibility with other systems. Whether you're a user who wants to get the maximum power from the operating system or someone who just wants to take advantage of performance benefits, spend a few minutes reading this overview and take a look at the suggestions for using some of the features of version 5.0.

In May 1989, Apple introduced the Apple IIgs system software, version 5.0 — a significant upgrade of the system software. The upgrade package includes two disks and a 216-page manual. An October 1989 update, version 5.0.2, fixes some initial bugs. (Plans for version 5.0.3 are underway for release in late 1990.

To use the system software version 5.0.2, you need to make sure you have ROM 01 or ROM 03 installed in your Apple IIgs. You need a minimum of 512K of memory to run the system software. For best performance, it's strongly recommended that you have at least 768K. If you plan to use AppleShare or SCSI devices, you need 768K of memory (Version 5.0.3 will require 1 MB of memory).

If you are using the original Apple II SCSI Card, you must have an updated ROM (version C) installed on the card so that the system software can recognize it. For details about this Apple II upgrade please see the “Customer Service and Support” article in the Apple Sales, Service, and Support section.

SCSI: An acronym for Small Computer System Interface, pronounced “SKUH-zee.” SCSI devices include hard disks and other devices that require high-speed communication with your computer.
Performance — The new system software is faster, easier

Apple IIgs system software, version 5.0, improves your computer's performance by 5 to 8 times — on the average — over version 4.0.

The graphics routines have been optimized, so the time required to write to the screen is reduced by half. Disk access and file operations are faster, too. And new printer drivers reduce printing time by a factor of four in version 5.0.3.

An Installer program simplifies installation. This program comes on the Apple IIgs System Tools disk. With it, you can add or remove capabilities from your startup disks.

FSTs — A way to translate data from one computer world to another

The new system software includes file system translators — FSTs — that let you use the new operating system with other file systems or file servers. For example, if you've created a file under ProDOS, a file system translator can automatically determine how the file was saved on your disk and then open it correctly. Version 5.0 includes four such FSTs:

- Char.FST manages writing to the screen and reading from the keyboard
- Pro.FST manages reading from and writing to ProDOS
- HS.FST manages reading from High Sierra and ISO 9660 CD-ROMs
- AppleShare.FST manages reading from and writing to AppleShare file servers

Apple plans to make additional FSTs available in the future. See "The Operating System" in this section for more details.
SCSI system cable  SCSI devices like the AppleCD SC are connected to your computer via a SCSI cable. You connect the first device to the computer with a SCSI system cable. Additional devices can be connected with SCSI peripheral interface cables.

CD-ROM — Volumes of information and music, too
You can use the AppleCD SC — an optical compact disc reader — with your Apple IIgs. You simply install a SCSI card in one of the expansion slots and run a SCSI system cable from the slot to the AppleCD SC. Then all you need to do is turn on the AppleCD SC, turn on your computer, and insert the CD-ROM disc in the AppleCD SC.

A CD-ROM disc called CD-ROM Explorer comes with the AppleCD SC. The disc is organized in three partitions, one each for Apple IIgs, Apple II, and Macintosh. These partitions are designed to take advantage of the particular capabilities of each of these computers.

A disc that contains the CD Remote desk accessory also comes with the AppleCD SC drive and the Apple II High Speed SCSI Card. You can use this desk accessory to play music from a digital audio disc in your AppleCD SC drive. When you use the Apple IIgs Installer to install CD-ROM software, the CD Remote desk accessory is automatically installed.

The CD Remote desk accessory reads digital audio discs,

so you can play music from the desktop of your Apple IIgs.
About version numbers

Version numbers for system software can be confusing because system software actually includes numerous files, each of which has its own version number. Here are the version numbers for some of the major files in the Apple IIgs system software, version 5.0.2:

- GS/OS 3.1p
- BASIC.System 1.4
- ProDOS 8 version 1.8
- Finder 1.3

The Cache — Faster file operations

GS/OS uses a RAM cache and the Cache Manager manages it. The Cache Manager temporarily stores copies of frequently used information in the cache. The operating system can then get the information from memory rather than accessing the disk each time it needs the information. Because it’s faster to get information from memory than from disk, GS/OS can perform such operations as copying and moving files faster than previous versions. The time saved is particularly significant if you store files in nested folders.

You can change the size of the RAM cache with the RAM Cache option in the graphic Control Panel. (You can also use this option to change the memory allocation for a RAM disk.)
**Finder**  The program that helps you to manage the way information is stored on disks and lets you move quickly from one application to another. The Finder is the part of the Apple IIgs operating system, GS/OS, that you see.

**dialog box**  A box that the Apple IIgs displays to request information or ask you to confirm an action. In many cases, dialog boxes contain warnings and are accompanied by a beep.

**new desk accessory (NDA)**  A mini-application that you can use without leaving your main application. New desk accessories are available from the Apple menu whenever you're using the Finder or any graphics-based application that supports the Apple menu.

**classic desk accessory (CDA)**  A mini-application that is available from the Desk Accessories menu, which you can reach by pressing Command-Control-Esc.

---

**The Menus — They look a little different**

The new Finder™ version in Apple IIgs system software, version 5.0, is Finder 1.3. The menus in this new version have been changed a bit for consistency among Apple computers. Some commands have keyboard shortcuts — a combination of the command key and a character. These shortcuts appear in the menu beside the command name.

Some commands have been moved or changed. The following is a summary of these changes.

**The Apple menu**  This menu lists the new desk accessories (NDAs) installed on your Apple IIgs. These include the graphic Control Panel and the CD Remote desk accessory, if you've installed it. In the new version, the RAM Cache command no longer appears in the Apple menu. You set the size of the RAM cache in the graphic Control Panel.

---

Finder 1.2

```
About the Finder...
Help...
```

Finder 1.3

```
About the Finder™...
Help...
Control Panel
```
The File menu  The Icon Info command, which used to appear in the File menu, now appears in the Special menu. The Rename command has been removed, but you can use the Duplicate command to create a file copy with a new name.

Finder 1.2

Finder 1.3

The Edit menu  The Select All command has been moved from the Special menu to the Edit menu.

Finder 1.2

Finder 1.3
The View menu  This menu is the same in both versions of the Finder.

Finder 1.2

Finder 1.3

The Disk menu  This menu did not exist in the previous version of the Finder, but its commands should all be familiar — they used to be in the Special menu. (The Initialize Volume command is now the Initialize command.)

The Special menu  As already noted, the Select All command has been moved to the Edit menu. The Remove command has been removed! Eject, Erase, Initialize Volume, and Verify are now in the Disk menu. Icon Info, which used to be in the File menu, now appears here.

Finder 1.2

Finder 1.3
In addition to these menu changes, a number of new features, commands, and options have been added to version 5.0. The rest of this article summarizes some of these features and how you use them.

ExpressLoad — How to be sure it’s loaded
ExpressLoad is designed to improve the performance of the loading process with Apple IIgs system software.

- To determine whether ExpressLoad is loaded, hold down the Option and Command keys for several seconds as you start your computer.
  The “Welcome” window appears as usual. The message “ExpressLoad” appears on the screen below the thermometer if you had enough memory to load ExpressLoad. ExpressLoad loads on all systems with more than 512K of memory.

BASIC.System — A new monitor command
With the new version of BASIC.System in version 5.0 of the system software, a new monitor command has been added — MTR. You can now use this command instead of the notorious CALL-151.

The syntax for the MTR command is

```
1 MTR
```
or
```
10 PRINT CHR$(4);"MTR"
```

System Files — You can deactivate them selectively
You can now prevent some system files from being loaded when you start your system. The type of files that can be deactivated are shown in the following table.
File | Folder | Type
--- | --- | ---
New desk accessory | :System:Desk.Accs: | $B8
Classic desk accessory | :System:Desk.Accs: | $B9
Device driver | :System:Drivers: | $BB
GS/OS file | :System:FSTs: | $BD
Control Panel document | :System:CDEV: | $C7

Here's how to deactivate one of these files.

- Select the system file you want to deactivate.
- Choose Icon Info from the Special menu. Or hold down the Command key and press I.

The Inactive option appears on the General card in the information window for the file.

The file is deactivated when the Inactive option is checked.
If the file is already deactivated, clicking the Inactive option reactivates it.

- Restart your system.
  Files are not deactivated or reactivated until you restart your system.

**Disk Space — How to gain a little more**
If you are working without a hard drive, you may be feeling cramped for disk space, particularly when you want to use an extra font or desk accessory. Although Apple recommends a hard disk as the best way to get the space you need, you can remove some system files to gain a little extra space. These are the files you can remove:

**In the System:Drivers: folder**
- AppleDisk 5.25  Removes the 5.25-inch disk driver
- Modem  Allows printing through the modem port

**In the System:System.Setup: folder**  If you have ROM version 01, you can remove TS3. If you have ROM version 03, you can remove TS2.

**In the System:CDEVs: folder**  You can remove all the files in the CDEVs folder except Alphabet, DirectConnect, RAM, and Printer. However, it’s best to keep all the CDEVs.

**Other files**  The files P8, BASIC.Launcher, and BASIC.System are only required if you are running applications under ProDOS 8 or using AppleSoft BASIC. As with the CDEV files, it’s best to keep these files on your system disk. However, if you never use any ProDOS 8 application, you can get rid of them to gain some space for installing fonts and desk accessories.
Another way to gain some disk space is to use a shareware NDA called Font-DA Installer. (You can get this file from CompuServe or some bulletin board systems [BBSs], but be sure to pay the shareware fee if you use it.) You copy the Font-DA Installer in the :System:Desk.Accs: folder and restart your computer. Next, you delete all the files in the :System:Fonts: folder except FastFont and Shaston 16. Then, when you need a font, you load it from another disk using the Font-DA Installer.

Print Quality — Use double-size fonts for higher quality

When you're using an ImageWriter II printer with the Apple IIGS, you can improve your print quality by installing double-size fonts in the font file. That is, if you are printing in 12-point Geneva, install 24-point Geneva, too.

On the Apple IIGS screen, as in ImageWriter output, images are formed from a group of small dots. The more closely these dots are grouped, the greater the resolution — the crispness — of the image. Resolution is usually expressed in dots per inch (dpi). The greater the dpi, the better the resolution.

The resolution of ImageWriter output is 144 dpi, which is twice that of an image displayed on the screen. When you're printing a text document in Best quality, the Apple IIGS looks first for the font that is twice the size of the one displayed on the screen. This font contains twice as much information about the shape of the characters as the font displayed on the screen. The Apple IIGS can use this additional information to produce a smaller image with twice the resolution. Of course, you can print your text even if you don't have the double-size font. But the image won't be as sharp.

Startup — How to do it faster

The way you use your system software files and folders can slow you down or save you time when you switch on your Apple IIGS. Here are some time-saving guidelines:
Avoid frequent changes to the Fonts folder.
Each time you start the font manager, it reads the files in the Fonts folder and saves the description of the fonts in the Font.Lists file if the folder's contents have changed since the last startup.

Avoid frequent changes to the CDEV folder.
When you boot your system, the graphic control panel reads the contents of the CDEV folder and saves some parameters in the CDEV.DAT file if the folder has been changed since the last startup or even the last time you opened the graphic Control Panel.

Remove the drivers you don't use from the Drivers folder.

Remove the desk accessories you don't use from the Desk.Accs folder.

For More Information
If you want more information about using the new system software on your Apple IIgs, take a look at these resources:

Apple IIgs Owners Guide

Emile Schwarz works in the Product Marketing Group in Apple Computer France, writes for two Apple II magazines, and has written one Apple II book, with a second book currently under way.
An Apple II Success Story

Tyler Weisman may not be the ultimate Apple II 'power user,' but he's close.

With the possible exception of Apple II inventor Steve Wozniak, perhaps no one in America gets more personal enjoyment and satisfaction from the Apple II computer than Tyler Weisman of Gainesville, Florida. Tyler, who is halfway through the master's program in health occupation at the University of Florida, was once a licensed paramedic. His ultimate career goal is to one day work as a county director of emergency or health services in Florida or serve in the same capacity with the state government. "I don't know if I have the political savvy for such a position yet," he admits, "but I'm working on it." While that assessment may or may not be true, there's no denying that Tyler Weisman has about as much computer savvy and experience as a layperson can get.

He got into personal computing as a hobby eight years ago when he purchased an Apple II Plus — at the urging of a close friend who is a computer dealer. "I was hooked on the Apple II right away," he says.
"I couldn't get enough of it." Tyler's passion for the computer grew throughout the 1980s, and he updated in sequence to an Apple IIc, Apple IIe, Apple IIgs (ROM version 1), and Apple IIgs (ROM version 3), which he currently uses. "In addition to the computers, I have also used about every Apple II peripheral Apple Computer ever made, with the exception of a laser printer," he says. "And it's not that I don't want a laser printer, it's that I can't justify the cost at the moment."

Tyler's current collection of Apple II hardware and software is most impressive, resembling a small computer store. His hardware ranges from the Apple Video Overlay Card to the Apple MIDI Interface to assorted joysticks and game paddles. Tyler's most-often-used software includes Point-to-Point, for telecommunications; AppleWorks GS, for word processing, and spreadsheet and database functions; Music Studio, "for fun"; HyperStudio; Paintworks Gold; and Publish-It!

Tyler does a lot more than college assignments and play games and music on his Apple II. He and his wife, Leah, a special educator at the Lake City, Florida, Middle School, have started a business in Gainesville. P&L Industries offers accounting, database management, data processing, desktop publishing, word processing, and audio and video taping services to departments and colleges at the University of Florida, and to other clients. Tyler is also a freelance writer for Apple II national newsletters and magazines, and a library SYSPS (system operator) for the GEnie national on-line electronic information service, which is owned by General Electric Information Services Co. "I keep pretty busy," he says, "but, whatever I do, I'll always have an Apple II with me."

People who know Tyler know he isn't kidding.

Please see the "Third-Party Products" listing in the Information Resources section for more information about third-party products mentioned in this Apple II success story.
Information Resources

A guide such as this can only begin to provide the kind of information you need to use your Apple II computer to its fullest extent. It's fortunate that other resources abound.

In addition to computers listed in the Understanding the Basics section, the resources introduced in the Apple Sales, Service, and Support section, and third-party products referred to in our Apple II success stories, there are many other products and resources to help you use your Apple II more effectively.

This section includes a wealth of information about Apple II products, user groups, dealers, resource centers for people with disabilities, as well as lists of third-party products, articles, books, publications, and on-line services.

We hope this section helps you find the resources you need so you can do more with your personal productivity partner, the Apple II.
Apple Product Information

Dozens of products to expand and enhance your Apple II

In addition to the computers, Apple produces a wide assortment of hardware for the Apple II, including monitors; storage devices; expansion cards; printers; and modems, cables, and connectors.

Monitors

**Apple Monochrome Monitor IIe**
This is a 12-inch monochrome monitor for the Apple IIe. It displays 80-column text and high-resolution graphics.

**AppleColor Composite Monitor IIe**
This is a 14-inch color monitor for the Apple IIe. It displays 80-column black and white text and high-resolution color graphics.

**Apple II GS RGB Color Monitor**
This is the recommended color monitor for the Apple II GS personal computer because it takes full advantage of the computer's advanced graphics capabilities. It displays graphics in up to 256 colors at a time from a palette of 4,096 colors. For text-intensive applications, it can also display crisp, clear 80-column text.

**Apple Monochrome Monitor IIc/II GS**
This is a lower cost 12-inch monochrome monitor for the Apple IIc which also works well with the Apple II GS. It displays 80-column text and high-resolution graphics.
Storage Devices

Apple Hard Disk 20, 40, 80, 120, 160SC
The SC Hard Disk is available in 20, 40, 80, 120, and 160 MB sizes and can be used with the Apple IIc and Apple IIgs. ProDOS and AppleSoft BASIC can only address up to 32 MB. However, larger disks can be divided into partitions of 32 MB or smaller. The SC Hard Disk requires a SCSI card.

Apple 5.25 Drive
This disk drive works with all Apple II personal computers. It uses standard 5.25-inch disks and provides 140K storage capacity on each disk.

Apple 3.5 Drive
This drive for the Apple IIgs, Apple IIc Plus, and all Macintosh computers reads 3.5-inch 800K disks. This drive is indispensable if you are using GS/OS.

UniDisk 3.5 Drive
This disk drive works with all Apple II personal computers. It uses standard 3.25-inch disks and provides 800K storage capacity on each disk.

UniDisk 3.5 Accessory Kit (Apple II+ or Apple IIe)
This is a controller card for the UniDisk 3.5. You need the card for the first UniDisk drive you connect to an Apple IIe or Apple II Plus.

AppleCD SC
This peripheral device reads CD-ROMs. You can use it with an Apple IIe or Apple IIgs. It comes with headphone and audio outputs, as well as a CD-ROM disk with sets of applications for the Apple IIe and Apple IIgs. The disks also contain software for playing audio compact discs — CD Remote for the Apple IIgs and CDREMOTE.OBJ for the Apple IIe. The AppleCD SC requires a SCSI card for use with the Apple II.
Expansion Cards  

64K Extended 80-Column Card
This memory expansion card for the Apple IIe or Apple II Plus increases the total memory to 128K and supports the 80-column display.

Apple IIgs Memory Expansion Card
This memory expansion card for the Apple IIgs adds 256K of memory. Using 256K kits, you can expand the memory on this card to 512K or 1,024K. (You cannot use the card with 786K.)

Apple II Memory Expansion Card
This memory expansion card for the Apple IIe adds 256K of memory. Using 256K kits, you can expand the memory on this card to 512K or 1,024K. (You cannot use the card with 786K.)

Apple II 256K Memory Expansion Kit
This kit contains eight 32K RAM chips for installation on the Apple IIgs or Apple IIe Memory Expansion Card. You can install one or three kits for a total of 512K or 1,024K. The components in this kit are 100 percent compatible with the Apple IIgs, which may not be true of non-Apple kits.

Super Serial Card
This card provides a serial (RS-232) port for the Apple II, Apple II Plus, and Apple IIe personal computers. A serial port is necessary for using serial devices such as the Apple Data Modem 2400 and the ImageWriter II printer. The card comes with an installation manual and a tool for attaching the RS-232 connector.

Apple II High-Speed SCSI Card
With this card, you can connect your Apple IIe or Apple IIgs to any device that uses the Small Computer System Interface (SCSI), such as hard disk drives and CD-ROM drives. It requires an Apple IIgs with a minimum of 768K of RAM or an enhanced Apple IIe.
Apple IIe Workstation Card
This card expands the capabilities of the Apple IIe to reach devices connected through AppleTalk networks. With the Workstation card, Apple IIe users can share printers and documents with other Apple IIe, Apple IIgs and Macintosh users across LocalTalk networks. Workstation software is included.

Apple II Video Overlay Card
This card offers owners of Apple IIe and Apple IIgs computers the ability to merge two powerful channels of communication — video and computing. With it, you can superimpose Apple II screen images on video from a variety of sources, including VCR, videodisc, video camera, or television. You can display the combined images on an RGB or composite monitor and record them on videotape using a VCR. The VideoMix software, which you use to control the merging of graphics and video images, comes with the card.

Printers  ImageWriter II
This impact dot-matrix printer prints in color or black and white. Its features include:

Printing modes
- Draft: 240 characters per second at 10 characters per inch (2-1/2 pages per minute)
- Standard: 180 characters per second (2 pages per minute)
- Near-letter-quality: 45 characters per second (1/2 page per minute)

Paper feed
- Single sheets or continuous form
- Multiple carbon copies — original plus three copies
- Optional sheet feeder for automatically feeding up to 100 cut sheets
Character sets

- 96 ASCII characters
- 32 MouseText characters
- 28 international characters
- Two banks of personalizable characters so you can define your own character set and download it to the printer

You can add an optional LocalTalk card to allow access by multiple users for cost-effective printing.

**ImageWriter II Cut Sheet Feeder**
A sheet feeder for automatically feeding up to 100 single sheets. Note that the sheet feeder and forms tractor cannot be mounted on the ImageWriter II at the same time. You must remove one to install the other.

**ImageWriter II 32K Memory Option**
This card increases the plug-in memory for the ImageWriter.

**Personal LaserWriter NT with Toner Cartridge and Letter Cassette**
This PostScript laser printer works with the Apple IIe and Apple IIgs, using a LocalTalk connection. The Apple IIgs uses a LocalTalk cable connected to the modem port. On the Apple IIe, the LocalTalk cable connects to the Apple IIe Workstation Card.

**LaserWriter IIINT with Toner Cartridge and Letter Cassette**
This PostScript laser printer, with a 68000 CPU, works with the Apple IIe and Apple IIgs, using a LocalTalk connection. The Apple IIgs uses a LocalTalk cable connected to the modem port. On the Apple IIe, the LocalTalk cable connects to the Apple IIe Workstation Card.
**LaserWriter II+TX with Toner Cartridge and Letter Cassette**
This PostScript laser printer, with a 68020 CPU, works with the Apple IIe and Apple IIgs, using a LocalTalk connection. The Apple IIgs uses a LocalTalk cable connected to the modem port. On the Apple IIe, the LocalTalk cable connects to the Apple IIe Workstation Card.

**LaserWriter II+TX Upgrade Kit**
This kit upgrades the LaserWriter II+NT to a LaserWriter II+TX by replacing the electronics.

**LaserWriter II Envelope Cassette**
You can add this bin to the LaserWriter II+NT or LaserWriter II+TX to feed envelopes automatically.

**Modems, Cables, and Connectors**

**Apple Personal Modem**
This is a compact 1200/300-baud modem that provides a cost-effective data communications solution for any Apple personal computer system. It is compatible with both tone and pulse phone systems. To use it, you need the following cables:

- **Computer**
- **Accessory**
- **Apple IIgs and Apple IIe Plus**
- **Apple IIe System Peripheral-8 Cable**
- **Apple IIe, Apple II and, Apple II Plus**
- **Apple IIe Modem-8 Cable and**
- **Apple Super Serial Card**
- **Apple IIc**
- **Apple IIc Peripheral Cable**

**Apple Data Modem 2400**
This is a 2400-bps high performance modem that enables users to exchange information with other standard data modems. This modem uses the same cables as the Apple Personal Modem.
Apple SCSI Cable System
This cable connects any SCSI peripheral device to the SCSI card of an Apple IIe or Apple IIgs.

Apple SCSI Peripheral Cable
This cable connects one SCSI peripheral device to another.

Apple SCSI Cable Extension.
This cable is an extension for the SCSI peripheral cable.

Apple SCSI Cable Terminator
This is an impedance adaptor for SCSI peripheral devices such as Apple hard disks and the AppleCD SC.

Apple System Peripheral – 8 Cable
This cable connects an Apple IIgs or Apple IIc Plus to serial port peripheral devices such as modems and printers.

Apple II Modem – 8 Cable
This cable connects an Apple IIgs, Apple II Plus, or Apple IIe to a modem via a connection to the Apple Super Serial Card.

Apple IIc Peripheral Cable
This cable connects an Apple IIc to serial port peripheral devices such as modems and printers.
Apple MIDI Interface
With this interface device, you can connect instruments that use the MIDI standard to an Apple IIgs and then use MIDI software to manage these instruments. The MIDI IN and MIDI OUT connectors are standard 5-pin DIN connectors. The connection is made via an 8-pin DIN miniconnector. The MIDI interface comes with two MIDI connecting cables, one serial connecting cable, and the user's manual.

LocalTalk Locking Connector Kit – DB9
This kit provides a connector box that connects to an AppleTalk network, a LaserWriter, LaserWriter Plus, LaserWriter IIINT, LaserWriter IIINTX, or an ImageWriter equipped with the LocalTalk Option. It includes the connection box and a 2-meter cable with a connector.

LocalTalk Locking Connector Kit – din8
With this cable you can connect any of the following to an AppleTalk network:
- Apple IIgs CPU
- ImageWriter II printer
- LaserWriter IIINT printer
- LaserWriter IIINTX printer

It includes a 2-meter (6½ foot) cable with connector and a connection box.

LocalTalk Locking Cable Kit – 10-Meter
This cable connects to LocalTalk connector boxes up to 10 meters (about 33 feet) apart. The cable comes with a connector.
LocalTalk Locking Cable Kit – 25-Meter
This cable connects two LocalTalk connector boxes up to 25 meters (about 83 feet) apart. The cable comes with a connector.

LocalTalk Locking Cable Kit – 100-Meter
With this kit, you can make up to 10 LocalTalk cables of custom lengths. The kit includes:
- 100-meter roll of LocalTalk cable
- Four connector boxes
- 20 LocalTalk sockets, each with a few centimeters of cable
- 20 assembly boxes

In addition to the contents of this kit, you need a LocalTalk DB9 Kit or a LocalTalk DIN 8 Kit for each device you want to connect.
Apple II opportunities are waiting for you at a local user group.

There are more than 1,000 user groups that have formed within communities, schools, corporations, government agencies, and universities throughout the country.

The Apple User Group Connection supports user groups in many ways, from regular communications to special purchase programs and forums — including helping you locate a user group that is in your local area or a user group that specializes in subjects of interest to you. Apple also provides information to help you start your own user group!

For more information about user groups — what they are, and what they can do for you — please see the “User Groups” article in the Apple Sales, Service, and Support section.

For more information, please call the Apple User Group Connection toll-free number, (800) 538-9696, extension 500. Or write to:

The Apple User Group Connection
Apple Computer, Inc.
20525 Mariani Avenue, M/S 36AA
Cupertino, CA 95014
Where to buy Apple II products and where to get them serviced

The following authorized Apple dealers specifically requested to be included in The Apple II Guide. We feel these dealers will be your most knowledgeable resource for answering questions of any kind about your Apple II.

In order to locate the dealer nearest you, please check the dealer listings that follow. This list is alphabetical by state, alphabetical by city within each state, and alphabetical by dealer name within each city.

Please note that the end of each dealer listing details additional support services if available, including repair/service (R), software (S), training (T), and third-party products (3). Please refer to the key at the bottom of every other page.

If you don’t find a dealer in your area listed here, please call (800) 538-9696 for the name and phone number of the nearest authorized Apple dealer who carries the Apple II.

Authorized dealers assure that you get the best possible help when you buy an Apple II product or when you need service. Authorized dealers get special training and up-to-date product information from Apple — and that knowledge gets passed on to you in the form of better answers to your questions, better service for your Apple II.

### Alabama

Kemp's Office Center/Connecting Point
1201 Noble St.
Anniston, AL 36201
(205) 236-6396
Fred Kemp

AC3
105 Vulcan Rd.
Birmingham, AL 35902
(205) 879-7015

R S T 3
Alaska
ComputerLand
4240 Old Seward Hwy.
Anchorage, AK 99503
(907) 561-5191 or (800) 478-5191

The Computer Store-Anchorage
811 W. 8th
Anchorage, AK 99501
(907) 279-1515

ComputerLand
3403 Airport Way
Fairbanks, AK 99709
(907) 479-6502 or (800) 478-6580

Arizona
Mesa Computer Mart, Inc./
Connecting Point
1153 E. Main St.
Mesa, AZ 85203
(602) 833-1155
James L. Tanner

ComputerLand of Arizona (Phoenix)
15002 N. 25th Dr.
Phoenix, AZ 85023
(602) 351-2700
Stacy Kolczak/Roxanne Tohr

ComputerCraft - Tempe
1734 E. Southern Dr., #1
Tempe, AZ 85282
(602) 820-5590
David Lowe/Lee Balderex

Arkansas
MegaByte/Connecting Point
1061 Joyce St.
Fayetteville, AR 72703
(501) 443-0007
John Burnness

Micro Computer Center
3712 S. University
Little Rock, AR 72204
(501) 565-3481
Mary Carle

Juneau Electronics
8111 Glacier Hwy.
Juneau, AK 99801
(907) 789-1400
Dave Belzak

ComputerLand of Arizona (Tucson)
6153 E. Broadway
Tucson, AZ 85711
(602) 790-8505
Kevin Treanor

MicroAge Computer Center
362 W. 32nd St.
Yuma, AZ 85364
(602) 344-4440
Bob Cassidy
California

Sun Computers
2400 S. Wible Rd., #14
Bakersfield, CA 93304
(805) 837-2400
Mike Passaglia

Sun Computers
20925 S. Bonita St.
Carson, CA 90746
(213) 329-8373
Paul Paz

MicroAge Computermart
315 S. Diamond Bar Blvd., Ste. C&D
Diamond Bar, CA 91765
(714) 861-7505
Robert Mondier

Sun Computers
23701 El Toro Rd.
El Toro, CA 92630
(714) 859-1818
Mike Hamilton

Online Connecting Point - Fresno
6789 N. Blackstone
Fresno, CA 93701
(209) 432-4324
Gary Murphy/Doug Gaither

Computer Center of Hayward, Inc.
23951 Mission Blvd.
Hayward, CA 94544
(415) 538-7308
any salesperson

Sun Computers
16775 Beach Blvd.
Huntington Beach, CA 92647
(714) 848-5574
Craig Deutsch

Sun Computers
5200 Jackson Dr.
La Mesa, CA 92041
(619) 462-8882
Norm Wain

Software Service and Computers
23062 Lake Forest Dr., Ste. D-1
Laguna Hills, CA 92653
(714) 583-1000

A. V. Computer Center
44519 N. 10th St. W.
Lancaster, CA 93534
(805) 945-0747 FAX (805) 949-7670
Grant Michael

Computer Plus
4500 El Camino Real
Los Altos, CA 94022
(415) 948-4500
Cherie Hackworth

Wolf Computer
105 N. Santa Cruz Ave.
Los Gatos, CA 95030
(408) 354-1210
Jeff Cable

ComputerCraft - California/Monterey
411 Pacific St., #100
Monterey, CA 93940
(408) 373-2772
John Jones/Key Reger

Sun Computers
428 South Atlantic Blvd., #102
Monterey Park, CA 91754
(818) 570-0901
John Liu

R  Repair/Service
S  Software
T  Training
3  Third-Party Hardware

354  THE APPLE II GUIDE
Napa Computer Center
721 Lincoln Ave.
Napa, CA 94558
(707) 257-7790
Aaron Smith
R S T 3

ComputerCraft - California/Palo Alto
2675 El Camino Real
Palo Alto, CA 94306
(415) 326-9999
Bob Selin/Margaret Waddle
R S T 3

A.V.C. Computers, A MicroAge Affiliate
2821 Zinfandel Dr.
Rancho Cordova, CA 95670
(916) 638-2242
Mike Ostrow
R S T 3

Software Service and Computers
6667 Indiana Ave.
Riverside, CA 2506
(714) 787-4833
R S T 3

Peninsula Office Equipment
231 Main St.
Salinas, CA 93901
(408) 424-2525
Greg Mainis/Jan Nator/Carolyn Keeler/Randy Scherer
R S T 3

ComputerLand of San Diego
4237 Convoy St.
San Diego, CA 92111
(619) 560-9912
R S T 3

ComputerLand of San Diego
5710 Ruffin Rd.
San Diego, CA 92123
(619) 560-9910
R S T 3

Incomp Computer Centers, Inc.
6256 Greenwich Dr., Ste. 100
San Diego, CA 92122
(619) 452-0600
FAX: (619) 452-3674
R S T 3

Sun Computers
9005 Complex Dr.
San Diego, CA 92123
(619) 565-1881
Dan Devries
R S T 3

Sun Computers
5810 Mitamar Rd.
San Diego CA, 92123
(619) 535-9888
Moses Rangel
R S T 3

Computer Plus
25 First St.
San Francisco, CA 94105
(415) 546-5646
William Taylor
R S T 3

ComputerCraft - San Francisco
465 California St., Ste. 100
San Francisco, CA 94104
(415) 989-3741
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3610 Stevens Creek Blvd.
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(408) 244-8100
Kathie McLaughlin/Jennifer DeToy
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1422 Monterey St.
San Luis Obispo, CA 93401
(805) 541-4884
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ComputerCraft - California/San Rafael
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San Rafael, CA 94901
(415) 454-3600
Tim Meadows/Dave Voorhees

ComputerLand of Santa Barbara
3931 State St.
Santa Barbara, CA 93105
(805) 967-0413
Harry Houpis

ComputerLand
1775 S. Broadway
Santa Maria, CA 93454
(805) 928-2239
Kevin DeKorte

ComputerLand of Santa Maria
1775 S. Broadway
Santa Maria, CA 93454
(805) 928-1919
Debra Ervin

MicroAge Santa Monica
2020 Santa Monica Blvd., Ste. 100
Santa Monica, CA 90404
(213) 828-4911

ExecUtron Computers
2735 Santa Rosa Ave.
Santa Rosa, CA 95407
(707) 528-8881

Santa Rosa Computer Center, Inc.
353 College Ave.
Santa Rosa, CA 95401
(707) 528-6480
Bill Parkhurst/Steve Wilder

Candid Computers
4390 Cochran St.
Simi Valley, CA 93065
(805) 522-3823
Fax: (805) 522-4678
Jeff Billau/Greg Sadowski

Computer Base
1950 Lake Tahoe Blvd.
South Lake Tahoe, CA 95731
(916) 544-6502

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(209) 473-1241
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(408) 735-1199
Cathy Barradas

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(818) 708-9988
Nick Deascentis

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(213) 325-6200
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13828 Redhill Ave.
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(714) 544-0299

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Ukiah, CA 95482  
(707) 463-2556  
Randy Hust  

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ComputerLand of San Buenaventura  
1839 Knoll Dr.  
Ventura, CA 93003  
(805) 650-8808  
Aaron Baker  

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Victorville, CA 92345  
(619) 241-7108  

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(303) 693-8400  

DMA Connecting Point  
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Colorado Springs, CO 80903  
(719) 475-2488  

DMA Connecting Point  
1806 Dominion Way  
Colorado Springs, CO 80918  
(719) 540-8656  

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Yucca Valley, CA 92284  
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Gloria Stricklin  

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Denver, CO 80220  
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Fort Collins, CO 80526  
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644 Main St.
Grand Junction, CO 81501
(303) 245-2373
Stephen Hillman/Diana Beltz

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Greeley, CO 80631
(303) 356-7224
Rick Berry

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Lakewood, CO 80228
(303) 988-9140
Andy Gold

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Littleton, CO 80123
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(203) 748-2300
Jon Orkin

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207 Pitkin St.
East Hartford, CT 06108
(203) 528-2114

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Donna Vaccaro

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145 Cherry St.
New Canaan, CT 06401
(203) 966-7200
Brian Shahan/Erik Apotheker/
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50 Washington St.
Norwalk, CT 06854
(203) 838-3617 or
(800) 999-8978
Jean Muccini

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590 Boston Post Rd.
Old Saybrook, CT 06475
(203) 388-9999 or
(800) 648-3282 (in Connecticut)
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941 Queen St.
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(203) 621-8945
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2145 S. DuPont Hwy.
Dover, DE 19901
(302) 697-0333
Jim Payne

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208 Astro S/C
Newark, DE 19711
(302) 738-9656

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210 S. Kings Ave.
Brandon, FL 33511
(813) 689-0840

ComputerLand of Clearwater
30331 U.S. Hwy. 19 N.
Clearwater, FL 34621
(813) 785-5579

Ray's Computer Center
18350 U.S. 19 N.
Clearwater, FL 34624
(813) 535-1414 FAX: (813) 535-7500

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(407) 637-6018

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FAX: (305) 446-1545
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Wethersfield, CT 06109
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Wilmington, DE 19808
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Ft. Wayne, IN 46825
(219) 483-8107
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2945 Jewett St.
Highland, IN 46322
(219) 972-1393
Vincent Vrtony
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Mishawaka, IN 46545
(219) 256-5688
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6331 S.R. 23
South Bend, IN 46635
(219) 277-4972
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West Lafayette, IN 47906
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The Computer Tree
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Creston, IA 50801
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(712) 883-2248
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Mason City, IA 50401  
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124 W. State St.  
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2909 Richmond Rd.
Lexington, KY 40509
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Lori Sosh

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Bluechip Computer Center
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Alexandria, LA 71301
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Rockville, MD 20852
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R S

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(313) 996-1616
R S T 3

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AC3 Computer Center
413 E. Huron
Ann Arbor, MI 48104
(313) 994-6344
R S T 3
<table>
<thead>
<tr>
<th><strong>R</strong></th>
<th><strong>S</strong></th>
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<tbody>
<tr>
<td>Computers Plus</td>
<td>Advanced Management Systems</td>
<td>710 N. Washington Ave.</td>
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<td>710 N. Washington Ave.</td>
<td>Holland, MI 49423</td>
<td>Barb Story</td>
<td>(616) 396-6821</td>
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<tr>
<td>Bay City, MI 48708</td>
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<td>Olson Anderson Co.</td>
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<tr>
<td>(517) 894-2776</td>
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<td>106 S. McLellan St.</td>
<td>Advanced Business Equipment, Inc.</td>
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<td>Bay City, MI 48708</td>
<td>127 S. Stephenson Ave.</td>
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<td>(517) 893-9568</td>
<td>Iron Mountain, MI 49801</td>
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<td>John Jill/John Harris/Jan Knop</td>
<td>(906) 774-6096</td>
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<td>R S T 3</td>
<td>Gene Jandrey</td>
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<td>Connecting Point Computer Center</td>
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<td></td>
<td>29316 Orchard Lake Rd.</td>
<td>Computer City</td>
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<td>Farmington Hills, MI 48018</td>
<td>110 W. 12 Mile Rd.</td>
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<td>Madison Heights, MI 48071</td>
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<td>(313) 544-1216</td>
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<td>29433 Orchard Lake Rd.</td>
<td>Advanced Management Systems</td>
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<td>Farmington Hills, MI 48108</td>
<td>2838 Henry St.</td>
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<td>(313) 553-4171</td>
<td>Muskegon, MI 49441</td>
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<td>R S 3</td>
<td>(616) 739-3395</td>
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<td>Connecting Point Computer Center</td>
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<td>28251 Ford Rd.</td>
<td>MicroAge Computer Center</td>
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<td>Garden City, MI 48135</td>
<td>39831 Grand River</td>
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<td>(313) 422-2570</td>
<td>Novi, MI 48375</td>
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<td>R S 3</td>
<td>(313) 473-0530</td>
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<td>Alternate Computer Supply</td>
<td>Olson Anderson's Computers Plus</td>
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<td>17256 Robbins Rd.</td>
<td>42150 Grand River</td>
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<td>Grand Haven, MI 49417</td>
<td>Novi, MI 48375</td>
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<td>(616) 842-1891</td>
<td>(313) 349-7666</td>
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<td>R S T 3</td>
<td>Gerald Perrett/Elanna Broder/</td>
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<td>Advanced Management Systems</td>
<td>Ian Brown</td>
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<td>3083 28th St.</td>
<td>Advanced Management Systems, Inc.</td>
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<td>Grand Rapids, MI 49508</td>
<td>2160 W. Grand River, Ste. 1</td>
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<td></td>
<td>(616) 956-6686</td>
<td>Okemos, MI 48864</td>
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<td>R S T 3</td>
<td>(517) 349-9540</td>
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<td>ComputerLand</td>
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<td>3109 Broadmoor, S.E.</td>
<td>Connecting Point Computer Center</td>
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<td>Grand Rapids, MI 49512</td>
<td>29934 Southfield Rd.</td>
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<td>(616) 942-2931</td>
<td>Southfield, MI 48076</td>
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<td>R S 3</td>
<td>(313) 443-0350</td>
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</table>
The Computer Haus/
Connecting Point
1045 S. Airport Rd. W.
Traverse City, MI 49684
(616) 946-1045
Tim Watson
\textbf{R S T J}

MicroAge Computers - Troy
797 E. Big Beaver Rd.
Troy, MI 48083
(313) 528-3535
\textbf{R S J}

\textbf{Minnesota}

Computer 1
307 N.W. 8th St.
Brainerd, MN 56401
(218) 828-4650
\textbf{R S J}

HCI Connecting Point
14017 Grand Ave. S.
Burnsville, MN 55337
(612) 892-6611
\textbf{R S T J}

TEAM Connecting Point
Computer Center
Village Mall,
2220 Mountain Shadow Dr.
Duluth, MN 55811
(218) 722-2409
\textbf{R S T J}

HCI Connecting Point
8017 Glen Ln.
Eden Prairie, MN 55344
(612) 944-1356
\textbf{R S T J}

Incomp Computer Centers
10371 W. 70th St.
Eden Prairie, MN 55344
(612) 828-9550
\textbf{R S T J}

ComputerLand - Edina
7025 France Ave. S.
Edina, MN 55435
(312) 920-6100
\textbf{R S T J}

Oricon Electronics
11240 E. Nine Mile Rd.
Warren, MI 48089
(313) 757-8192
Mike Tartan
\textbf{R S T J}

UMI Computers
1200 Lyndale Ave. N.
Faribault, MN 55021
(507) 332-2241
Scott Lang
\textbf{R S T J}

Rolandson Computer Center
201 W. Lincoln Ave.
Fergus Falls, MN 56537
(218) 736-6548
Dale Wick
\textbf{R S T J}

TEAM Connecting Point
Computer Center
Central Square Mall
Grand Rapids, MN 55744
(218) 326-6683
\textbf{R S T J}

Heath/Zenith Computers
101 Shady Oak Rd.
Hoplis, MN 55343
(312) 938-6371
\textbf{R S T J}

HCI Connecting Point
555 Third Avenue N.W.
Hutchinson, MN 55350
(612) 587-2940
\textbf{R S T J}

ComputerLand - Minneapolis
109 S. 7th St., Roanoke Bldg., Ste. 222
Minneapolis, MN 55402
(312) 333-3151
\textbf{R S T J}
Mississippi

BESCO
1213 Hwy 45 N.
Columbus, MS 39701
Jamie Lancaster

Missouri

ComputerLand
2121 William St.
Cape Girardeau, MO 63701
(314) 335-4171

Connecting Point
609 Locust
Chillicothe, MO 64601
(816) 646-0090

Mid-Missouri Computer Services, Inc.
301 Stadium Blvd., Biscayne Mall
Columbia, MO 65203
(314) 445-4496

Connect Land - Rochester
1201 S. Broadway, Crossroads Ctr.
Rochester, MN 55904
(507) 281-0968

ComputerLand - Roseville
2471 N. Fairview Ave.
Roseville, MN 55113
(612) 636-2366

Team Electronics
7166 10th St. N.
St. Paul, MN 55128
(612) 738-1243

Dave Schroeder

ComputerLand - St. Cloud
240 2nd Ave. S.
Waite Park, MN 56387
(612) 259-0590

Repair/Service
Software
Training
Third-Party Hardware
The Bottom Line - Computers, Inc.
14260 Manchester Rd.
Manchester, MO 63011
(314) 391-0301

DataPro Computer Systems/Connecting Point
1024 Highway 63 S.
Rolla, MO 65401
(314) 364-0035

Database Systems of Springfield, Inc.
1550 E. Battlefield Rd., Ste. C.
Springfield, MO 65804
(417) 883-5665

Connecting Point
510 N. Belt
St. Joseph, MO 64506
(816) 233-6822

Montana

Computech
1301 11th Ave. S.
Great Falls, MT 59405
(406) 761-8954
Mary Nicholson

ValCom Computer Center
1112 Helena Ave.
Helena, MT 59601
(406) 449-7816
Michael M. Marlow

Nebraska

The Computer Works
1706 Galvin Rd.
Bellevue, NE 68005
(402) 291-7809

Fremont Office Equipment
2313 13th St.
Columbus, NE 68601
(800) 223-0393
Brenda Licari

Advent Computers
1130 S. Brentwood Blvd.
St. Louis, MO 63117
(314) 863-8181

The Bottom Line - Computers, Inc.
790 N. Hwy. 67
St. Louis, MO 63031
(314) 837-1200

Computer Junction/Connecting Point
214 Elm St.
Washington, MO 63090
(314) 239-7544

Vester, Inc./ComputerLand of Helena
25 S. Last Chance Gulch
Helena, MT 59601
(406) 443-3200
Tom Bohn

Fremont Office Equipment
648 N. Broad St.
Fremont, NE 68025
(800) 333-6586
Dick Klebe

Computer Hardware, Inc.
325 N. St. Joseph
Hastings, NE 68901
(402) 463-3456
Computer Hardware, Inc.
2315 2nd Ave.
Kearney, NE 68847
(308) 234-9335
R S T 3

Computer Systems
400 N. 48th St.
Lincoln, NE 68504
(402) 467-5571
R S T 3

OFFICE CONNECTION
1909 Vicki Ln.
Norfolk, NE 68701
(402) 379-2692
Dallas Goeller
R S T 3

Team Electronics
801 S. Dewey
North Platte, NE 69101
(308) 534-4645
R S T 3

Database Systems
2819 S. 125th Ave., Ste. 276
Omaha, NE 68144
(402) 330-3600
R S T 3

Connecting Point
1912 Broadway
Scottsbluff, NE 69361
(308) 632-5514
R S T 3

Nevada

Computer Base
1213 S. Carson St.
Carson City, NV 89701
(702) 885-9000
R S T 3

Computerite
1601 E. Sahara Ave.
Las Vegas, NV 89104
(702) 369-0322
Audrey Jordan
R S T 3

ComputerLand of Las Vegas
1370 Flamingo, Ste. K
Las Vegas, NV 89119
(602) 351-2700
Lisa Lisciarelli
R S T 3

ComputerBase
1290 E. Plumb Ln.
Reno, NV 89502
(702) 827-9200
R S T 3

ComputerCraft - Nevada/Reno
4084 S. Kietke Ln.
Reno, NV 89502
(702) 826-8080
Diane Kennedy/John Coddington

New Hampshire

Diversified Computers, Inc.
141 Winchester St.
Keene, NH 03431
(603) 357-4360
Diane/Prancie/Floyd/Heather/
Gene/Bonnie
R S T 3

Computer Mart of N.H.
669 E. Industrial Park Dr.
Manchester, NH 03103
(603) 625-1474
R S T 3
Electronic Education Center
669 E. Industrial Dr.
Manchester, NH 03103
(603) 625-1474 or (800) 344-3102
Diane Houle

Computer Mart of N.H.
139 Daniel Webster Hwy.
Nashua, NH 03060
(603) 888-1190

New Jersey
World of Computers, A Connecting Point Store
520 Main St.
Boonton, NJ 07005
(201) 335-1470
Mike Migliaccio/John Melchior

Computer Workshop
900 Haddonfield Rd.
Cherry Hill, NJ 08002
(609) 665-4404

The MDI Computer Store, A MicroAge Affiliate
Rt. 130 & Princeton Rd.
East Windsor, NJ 08520
(609) 443-0900

Computerware Inc./CPA
1723 Rt. 27-Tops Shopping Plaza
Edison, NJ 08818
(201) 248-9100
FAX: (201) 248-9361

American Business Products
155 N. Dean St.
Englewood, NJ 07631
(201) 569-0853

Computer Mart of N.H.
2800 Lafayette Rd.
Portsmouth, NH 03801
(603) 433-8876

Computer Town, Inc.
304 S. Broadway
Salem, NH 03079
(603) 893-8812
Thomas Jacobs

Computer Madness, Inc./CMI Systems
270 Rt. 9N
Englishtown, NJ 07726
(908) 462-9696
John Nelson/Zvi Biener/Joyce Nussbaum/Dorothy Jablonka

Computerware Inc./CPA
2940 Brunswick Pk.
Lawrenceville, NJ 08648
(609) 883-6660
FAX: (609) 883-6708

Jonathan's Computer Centers
444 W. Rt. 70
Marlton, NJ 08053
(609) 983-0668

Essex Computers/Connecting Point
One Gateway Ctr.
Newark, NJ 07102
(201) 622-3020
Oscar West-Crews

Boise Office Equipment
136 Somerset St.
North Plainfield, NJ 07060
(201) 755-5544