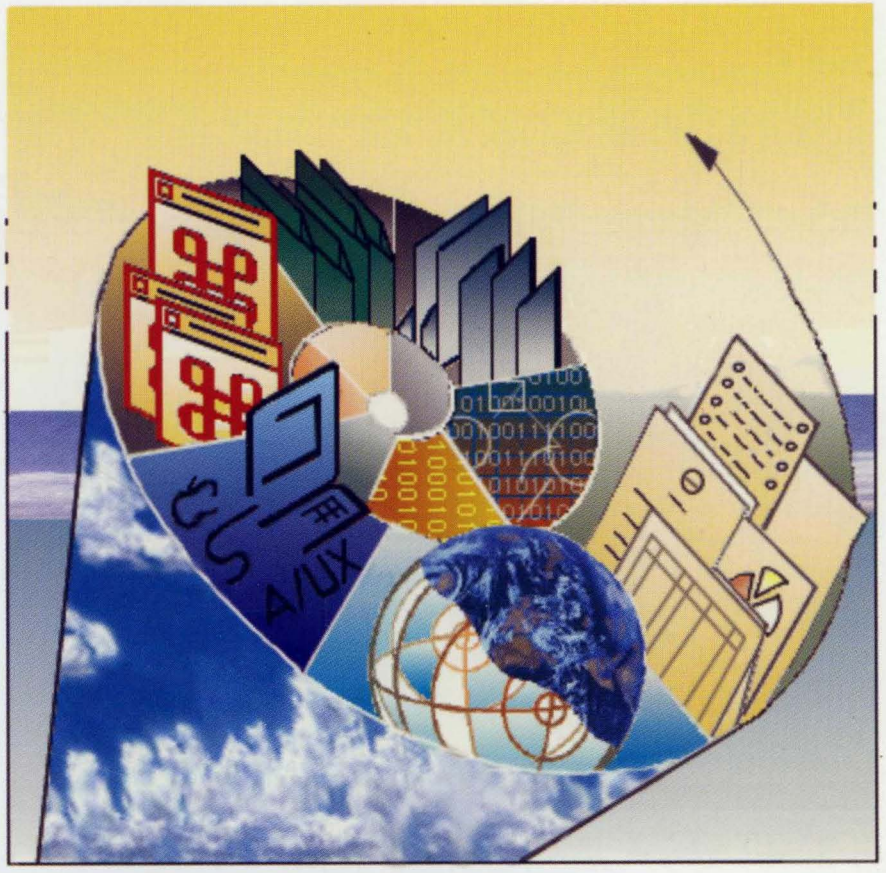
Road Map to A/UX®



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Road Map to A/UX®

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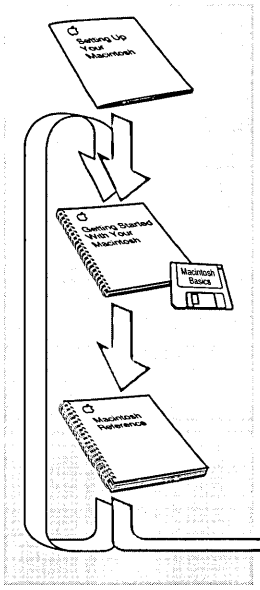
"Extension of the Macintosh to UNIX®"

The learning path through A/UX documentation



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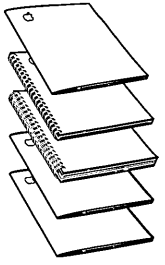
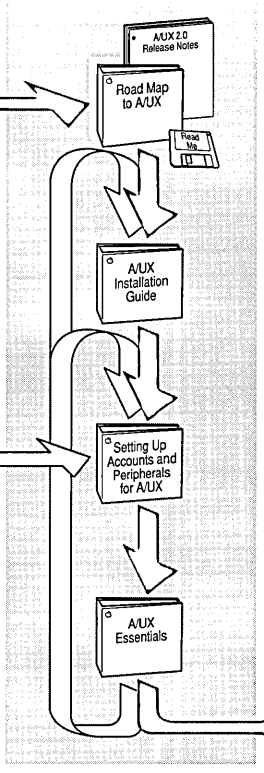
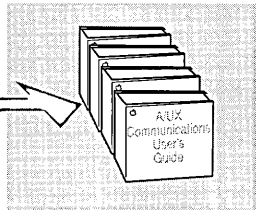


Apple guides for various peripheral devices



In the Accessory Kit with A/UX



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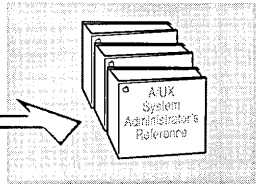

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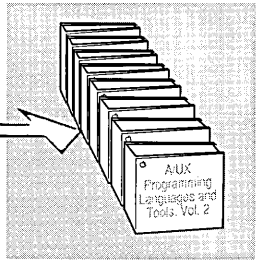


In the Programmer Kit for A/UX

Contents

Figures and tables

Preface

The A/UX operating system is Apple® Computer's version of the industry-standard AT&T UNIX® operating system. Like the original UNIX, A/UX is a complex structure of files, utilities, and applications. This book is called a road map because it is designed to help you navigate the highways and pathways of A/UX.

- Chapter 1, "The World of A/UX," gives you a bird's-eye view of A/UX Release 2.0 and explains how it relates to older versions of UNIX.
- Chapter 2, "A/UX Documentation," presents a compact survey of the A/UX publications. Although the Macintosh® interface to A/UX simplifies its operation for novices, the system also offers many features for advanced users. To fill the needs of the entire range of users, Apple provides a library of more than 6000 pages describing A/UX and explaining how to use it. Chapter 2 helps you understand where information is located in the guides and references of the A/UX library. This chapter was published with earlier releases of A/UX as *Road Map to A/UX Documentation*.
- Chapter 3, "A Closer Look at A/UX Release 2.0," goes more deeply into the "nuts and bolts" of A/UX. Written for the more technically sophisticated reader, it summarizes how the principal software units work together. It also lists some of the built-in facilities available for text handling, software development, and communications.

This book is intended for everyone who has an interest in A/UX. It can help you achieve a general understanding of the system and point you to sources of further information. It constitutes an overall guide to the powerful and exciting world of A/UX.

Chapter 1 **The World of A/UX**

A/UX Release 2.0 is based on the UNIX System V Release 2 Version 2 operating system with additional features from the Berkeley Software Distribution (BSD), versions 4.2 and 4.3. To this fully featured version of UNIX, Apple Computer has added a number of unique extensions based on the Macintosh Operating System (OS). The result is a system that both satisfies the standard specifications for UNIX capabilities and offers many advanced features not found anywhere else.

A/UX Software Release 2.0 and its related utilities constitute a powerful computing environment for a variety of users at different levels of experience. The system can be used by first-time users and people who have worked with UNIX or the Macintosh OS for years, by single users and users on networks, and by Macintosh programmers as well as UNIX programmers. Because it lets you access UNIX power through the Macintosh User Interface, A/UX provides one of the most versatile computing environments available for any computer.

A/UX includes hundreds of the standard utilities normally found on UNIX systems, along with comprehensive documentation describing how to use them. It lets you run off-the-shelf Macintosh applications in the Macintosh desktop environment as well as commercially available UNIX programs. It includes compilers, subroutine libraries, programming tools, and detailed documentation for developing your own software. Finally, it supports system extensions such as MacX™, the Macintosh X Window System server.

This chapter lists some of the main features of UNIX and describes the enhancements that distinguish A/UX Release 2.0 from other UNIX systems.

What is UNIX?

Originally developed by AT&T Bell Laboratories in the 1970s, **UNIX** is a general-purpose computer operating system and related set of utilities. It has become standard in university computing environments, on high-end engineering workstations, and in government computer installations. A growing number of businesses apply the capabilities of UNIX to a variety of tasks, particularly in the fields of software development, word processing, desktop publishing, database management, and computer-aided engineering, design, and manufacturing.

The following features are the main reasons that UNIX has become so popular:

- multitasking capability

  On UNIX systems, you can run several jobs simultaneously.

- multi-user capability

  Using a UNIX system, you can easily share files and tools with other users without sacrificing security or reliability.

- hardware-independent environment

  UNIX and its derivatives run on many different computers, so you can easily transport software developed under a UNIX system running on one type of hardware to UNIX systems running on other types of hardware.

- flexible command interpreters

  You can tailor the UNIX command interface to suit your needs.

- useful applications

  UNIX systems include hundreds of powerful utilities for such tasks as software development and maintenance, document preparation, and communication between users. These applications can be easily moved from one UNIX system to another.

- hierarchical file systems

  UNIX file systems permit flexible organization and private file-sharing for group projects.

- networking capabilities

  Through serial lines, modems, and network connections, UNIX makes it easy for you to share files, tools, and hardware resources with users of other computers.

- batch processing support

  You can set up a wide variety of noninteractive data processing tasks to run automatically on UNIX systems.

- system extensions

  You can enhance the power of UNIX by adding commercially available extensions, such as the X Window System.

A/UX—more than just UNIX

A/UX Release 2.0 starts with a fully featured, standard version of UNIX—one that meets or exceeds current industry and government standards, including those of AT&T, POSIX, FIPS, and ISO. But it goes further; it adds many features unavailable elsewhere. The A/UX enhancements include:

- the Macintosh desktop

  You can choose to interact with your computer graphically, by pulling down menus and working with icons on a desktop instead of being forced to remember written commands.

- Macintosh applications

  Hundreds of standard Macintosh applications, available from computer stores, run under A/UX without modification. You can use your favorite Macintosh word processor, desktop publishing software, spreadsheet, drawing program, or database manager within A/UX instead of having to acquire expensive and hard-to-learn UNIX software for these tasks. You can also work with several different Macintosh applications at the same time.

- Macintosh/UNIX integration

  A/UX Release 2.0 combines the Macintosh and UNIX worlds into a seamless computing environment, with shared files. You can mix-and-choose Macintosh, UNIX, and X Window System capabilities to suit each specific task.

- multiple shell windows

  You can use the A/UX CommandShell utility to open multiple shell windows. Each window can then run a different set of UNIX tasks as if it were a separate terminal.

- automated startup and shutdown

  You can easily set up your A/UX system to handle its startup process automatically every time you turn on your computer. Shutting down is also automatic: you just choose a menu item and A/UX does the rest.

- simplified system administration

  When needed, an automatic routine rescues your A/UX installation from system crashes. Other utilities help you perform routine administrative tasks such as adding new users. Thus A/UX makes it easier for you to maintain your system without constant help from an experienced UNIX administrator.

- extended file-sharing capabilities

  For standard UNIX networking, A/UX supports both AppleTalk® and TCP/IP protocols. In addition, A/UX Release 2.0 adds AppleShare® to the UNIX file-sharing capabilities. AppleShare lets you create simple but flexible local-area data networks using low-end Macintosh computers as servers.

- easier command generation

  A/UX Release 2.0 saves you from having to memorize complicated command formulas. You can issue a command just by clicking buttons in a dialog box that is tailored for each A/UX utility.

- Macintosh-style text editing

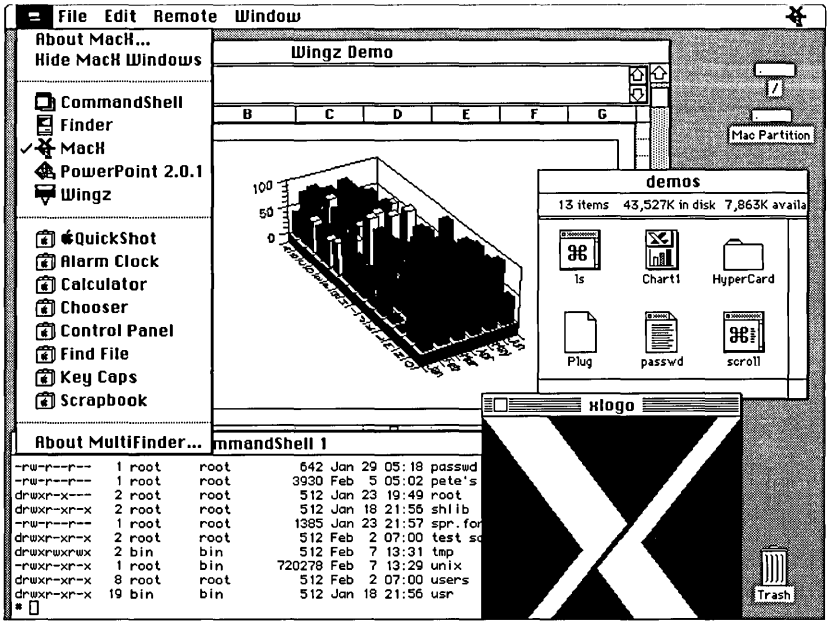
  You can do modern word processing with the Macintosh mouse and pull-down menus by using the A/UX TextEditor utility or a variety of off-the-shelf Macintosh applications. If you prefer, you can still use any of the traditional UNIX editors based on cursor keys and command formulas.

These added features, which make A/UX easier to use and administer than any other version of UNIX, are described more fully below.

The Macintosh desktop

A/UX creates the image of a **desktop,** a two-dimensional working environment represented on the terminal screen. The desktop environment is the core of the Macintosh User Interface. A typical desktop display is shown in Figure 1-1.

■ **Figure 1-1** A typical desktop display



In the desktop display, **icons** (small pictures) represent files. For example, a document file looks like a page with writing on it. A **directory**—a file that lists the names and locations of other files—looks like a file folder. Typical document and directory icons are shown in Figure 1-2.

■ **Figure 1-2** Typical icons

You can use the Macintosh mouse to open, move, and copy files by manipulating their icons. You can open applications by double-clicking on their icons. You don't need to remember cryptic command names for these operations.

Windows are your working areas on the desktop. When you enter text from the keyboard, or create a drawing with the mouse, or receive mail, the results appear in a window. You can keep several windows open at once and you can move or resize each one independently. Multiple windows on your desktop give you simultaneous access to Macintosh applications, UNIX shells, and X Window System applications.

The Macintosh desktop display is supported by a toolbox of graphics routines accessible to all software in the system. Programmers can use this toolbox to incorporate the Macintosh User Interface in new programs and tools designed to run under A/UX.

Macintosh applications

For many users, a significant factor when purchasing a UNIX system is the cost of application software. With A/UX this factor is minimized because many standard Macintosh programs run under A/UX. As a result, A/UX supports a large and inexpensive library of application software. The Macintosh applications that are available range from simple word processors and spreadsheets to sophisticated CAD/CAM systems and complete development environments. They all feature the meaningful graphics and consistent methods that make Macintosh software exceptionally easy to learn.

Macintosh applications run under A/UX just as they come from your dealer, without modification. If you already have a Macintosh computer, you probably own several applications that you can install in your A/UX system and use right away. Files created by a Macintosh computer without A/UX can be transported into A/UX, using floppy disks. Files modified by a Macintosh application running under A/UX can similarly be copied onto disks that a Macintosh computer without A/UX can read.

Thus you can install most of your favorite Macintosh software in your A/UX system and use it as you normally would, saving your work to A/UX files. With the capabilities that Macintosh applications provide, you probably won't need to purchase separate UNIX software and learn how to use it. However, when the job you need to do is not covered by a Macintosh application, you still have access to the full range of UNIX applications for installation in your A/UX system.

Macintosh/UNIX integration

A/UX Release 2.0 constitutes a unified, seamless computing environment in which both Macintosh and UNIX capabilities are always available. You can pick from either world the tools best suited to your immediate task. With the addition of X Window System for A/UX (a separate Apple product), you can also pick among X applications. Thus Macintosh and UNIX technology work together in A/UX, without artificial barriers, to give you the combined computing power of both.

Files created by Macintosh or X Window System applications are immediately accessible to UNIX utilities without conversion or translation. Files created by UNIX utilities can similarly be read by Macintosh and X applications. This means you can construct processing paths across

these worlds. For example, you can create files of text and graphics by using powerful Macintosh software, store them in a UNIX version control system with full security features, and then retrieve their current versions for integration and printing through a Macintosh desktop-publishing system.

At the programming level, A/UX makes the Macintosh Toolbox fully accessible to UNIX software. An increasing number of UNIX application developers are taking advantage of this feature by adopting the easy-to-learn Macintosh User Interface in their A/UX products.

Multiple shell windows

Besides using the Macintosh graphical user interface, you can type traditional UNIX commands directly into a CommandShell window, equivalent to what is called a console terminal in other UNIX systems. You can open several of these windows at one time, each independently sizable and moveable, and you can let tasks run in different windows while you are working interactively in one. This gives you the effect of multiple terminals, each with full pre-emptive multitasking, within a single computer. Multiple CommandShell windows can also share your desktop display with multiple Macintosh and X Window System applications.

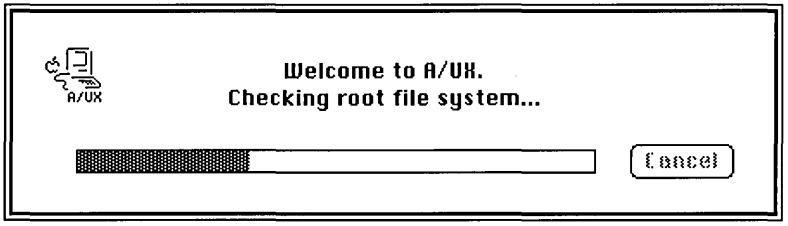
Each CommandShell window has its own shell and environment. For example, you can set a different current directory for each window so that you can work simultaneously in different file areas. The utilities and capabilities of the A/UX operating system are independently available to you in each CommandShell window.

Automated startup and shutdown

It is easy to set your A/UX system to start up automatically every time you turn on your computer. After you see the familiar "happy Macintosh" icon indicating that the hardware is working properly, the A/UX startup program takes over and performs the work of initializing the A/UX operating system.

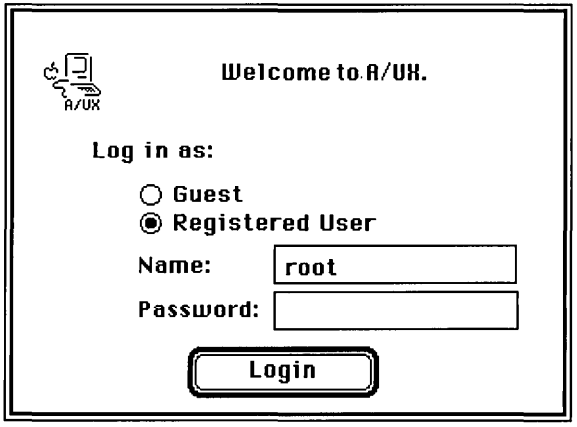
A series of informational screens, like the one shown in Figure 1-3, keeps you posted on the progress of the startup operation. You need intervene only in the unlikely event of a major system failure that the automatic startup program cannot repair.

■ **Figure 1-3** The startup screen



When the A/UX login dialog box appears, as shown in Figure 1-4, you can enter your user name and password and begin working. Since A/UX is a multi-user system, each registered user has a separate user account, password, and home directory. Even when you are working with Macintosh software, A/UX supports all the privacy and security features of a standard UNIX system.

■ **Figure 1-4** The login screen



Shutting down A/UX Release 2.0 is even easier than starting it up: you just choose a menu item and let the system do the rest.

Simplified system administration

In the past, the complexities of dealing with UNIX systems have required highly trained personnel to act as system administrators. These people are often referred to as "gurus" in deference to the esoteric knowledge they need to keep UNIX systems operating. By automating some of the usual UNIX administration tasks and by providing documentation aimed at novice users, A/UX Release 2.0 simplifies many system-administration tasks, reducing the need for gurus to maintain your system.

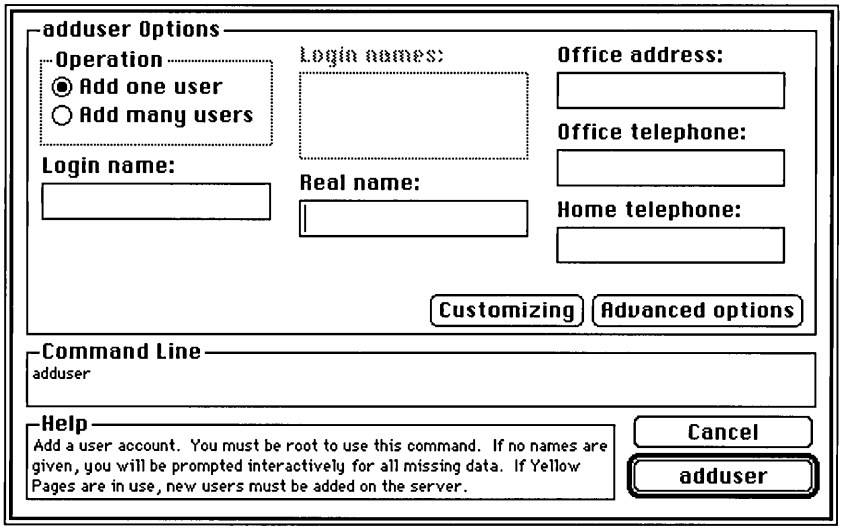
A/UX simplifies the process of adding peripheral devices by automatically integrating them into your system at startup time through a process called **autoconfiguration.** The autoconfiguration utility detects the presence of plug-in cards in your Macintosh computer and rebuilds the UNIX kernel to include their driver software. When you remove a card, it determines that the device is no longer available and reconfigures the system accordingly. For network-based devices that don't have plug-in cards (such as printers and file servers), A/UX provides the **Chooser**, a Macintosh utility that lets you select the devices you want to use from lists of the network connections and devices available to your system.

A/UX also contains a facility called **autorecovery** that can automatically repair damaged file systems and rebuild them from redundant copies if at all possible. This repair process ensures reliable A/UX operation and helps support the automated startup process described earlier.

In UNIX environments, it is often advantageous to divide disk storage space into partitions of different sizes. Apple HD SC Setup, a utility provided with every Macintosh computer, lets you partition hard disks for any mixture of Macintosh and A/UX partitioning schemes, including specialized schemes of your own design.

Finally, A/UX Release 2.0 includes a number of new utilities that help you perform routine system-administration tasks—such as adding new users to the system, managing user groups, and configuring serial ports. For example, to add a new user to your system you just click on the `adduser` icon and then fill out the dialog box shown in Figure 1-5.

■ **Figure 1-5** The `adduser` dialog box



Extended file-sharing capabilities

A/UX Release 2.0 supports both TCP/IP and AppleTalk network protocols. TCP/IP gives A/UX access to the Internet, the standard highway of communication among UNIX systems worldwide. AppleTalk makes it easy for you to set up local UNIX networks among Macintosh computers by using simple off-the-shelf connectors and cabling.

In addition, A/UX can act as a client system for AppleShare, the Macintosh file server software. AppleShare offers most of the same features as the Network File System (NFS) while adding two advantages of its own:

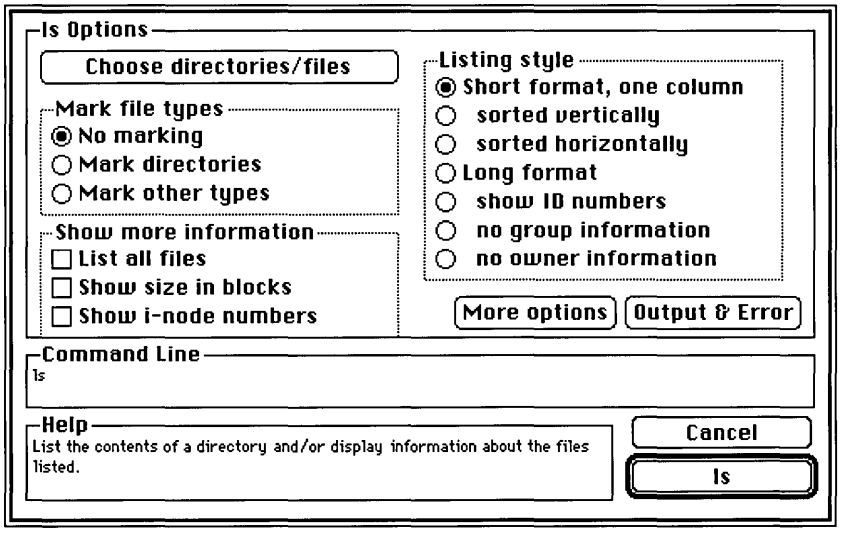
- You can construct a local AppleShare system very easily by installing low-end Macintosh computers (running Macintosh OS) as servers on your AppleTalk network.
- Files on an AppleShare server can be accessed both by A/UX systems and by Macintosh computers running only the Macintosh OS. Hence AppleShare acts as a bridge between A/UX and the standard Macintosh computing world.

AppleShare files are protected by normal security features, including password protection, user and group access privileges, and read-write controls.

Easier command generation

A/UX Release 2.0 includes a utility called Commando that builds UNIX command lines for you. When you use Commando to construct a given command (for example, the file-listing command `ls`), it presents a dialog box like the one shown in Figure 1-6.

■ **Figure 1-6** The Commando dialog box for the `ls` command



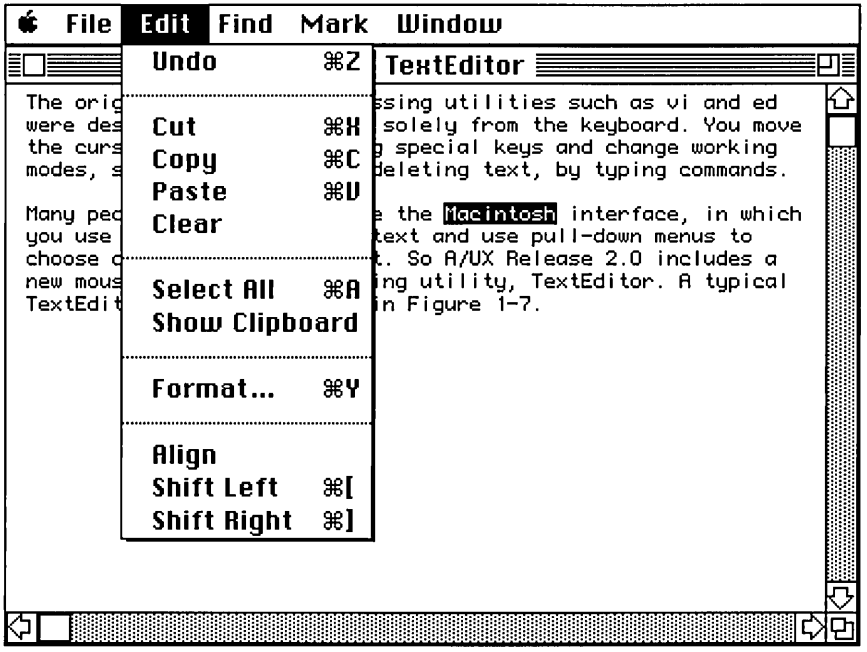
As you select the options you want by clicking the appropriate check boxes or buttons, Commando generates the command line. To execute the completed line, you click the outlined button that contains the command name. It is no longer necessary to type the command or memorize flag options; you can build even complex command strings by pointing and clicking. A/UX Release 2.0 includes Commando dialog boxes for more than 500 UNIX utilities.

Macintosh-style text editing

The original UNIX word-processing utilities such as `vi` and `ed` were designed to be operated solely from the keyboard. You move the cursor around by pressing special keys and change working modes, such as entering and deleting text, by typing commands.

Many people now prefer to use the Macintosh interface, in which you use the mouse to select text and use pull-down menus to choose operations on the text. So A/UX Release 2.0 includes a new mouse-based editing utility, TextEditor. A typical TextEditor display is shown in Figure 1-7.

■ **Figure 1-7** A typical TextEditor display



The Macintosh world

A/UX Release 2.0 brings the versatility and ease of use of the Macintosh computing world to the UNIX operating system. As you work with Macintosh applications, you discover whole new ways to use your computer. The Macintosh graphical user interface was described earlier. Other important features of the Macintosh world include:

- the Finder™

  The A/UX software Finder is a Macintosh application that runs perpetually under A/UX. It manages your desktop—the display of icons on your terminal screen—and depicts your files graphically so you can easily manipulate them.

- resources

  Macintosh applications store most of their user interface details in separate memory sections that can be edited without disturbing the program code. This makes it easy to change an application's language, icons, and other presentation elements.

- document data types

  Besides the usual date-time stamps, files created by Macintosh applications carry information about the type of data they contain and the kind of software that can work on them.

- fonts and desk accessories

  Certain public resources are stored in the Macintosh System Folder, where they are accessible at all times. Fonts contain typographic information for all applications that manipulate text; desk accessories are general utilities, such as the Calculator and the Alarm Clock, that you can use without quitting other work.

- the Chooser and the Control Panel

  The Chooser and Control Panel are Macintosh desk accessories included with A/UX. The Chooser helps you find and enable peripheral devices, such as printers and servers. The Control Panel lets you set certain general characteristics of your terminal, such as color capabilities, sound level, and keyboard configuration.

These features are described in more detail below.

The Finder

You could think of the A/UX **Finder** as a graphical shell that interprets physical actions instead of written commands. It creates a desktop display in which your files, directories, and applications appear as icons. The icons resemble real-world objects; directories appear as file folders, for example. Using the mouse, you can move the arrow cursor onto one of these objects and then do something with it. By double-clicking the mouse button, you can "open" the object: examine its contents if it's a directory, or start it up if it's an application. By dragging the object to the Trash icon you can delete it. By clicking on the object and then choosing the Get Info menu item, you can view information about it. In these ways you can tell A/UX what you want to do without having to remember UNIX command lines.

The A/UX Finder lets you open and run several Macintosh applications concurrently in multiple windows. Although you communicate with only one application at a time (via the keyboard and mouse), the others continue to operate in the background. You can copy and paste material between different files being controlled by the same or different applications without having to quit applications or save files. Multiple Macintosh applications can also share your desktop with multiple CommandShell windows and X Window System applications.

You can access the A/UX Finder at any time without disturbing other work. For example, you can stop what you're doing, use the A/UX Finder to rename or delete files you aren't working on, and then return immediately to your original task.

Resources

Every Macintosh application file contains several sections, called **resources,** that define its appearance and behavior. One resource section contains the application's executable code; others contain descriptions of its windows and menus, the text it displays in user messages, its icons, and similar details of its user interface.

With the A/UX resource editors, `rez` and `derez`, you can open and edit any application's resources. For example, you can translate into another language the user messages the application displays or you can redraw its icons. Hence you can customize Macintosh applications to meet special needs.

Document data types

In the Macintosh world, files created by applications are called **documents.** Documents may contain text, pictures, databases, spreadsheets, stacks, sounds, video, or other forms of information. At the time of its creation, every document is labeled with two four-character codes that define its type and its creator. The type code indicates how the binary pattern in the document file must be interpreted to make the file meaningful. For example, documents of type 'snd ' contain sound information that can be interpreted by the Macintosh Sound Manager. The creator code indicates what general class or make of software is needed to handle the file's content, such as a specific sound-synthesizing program.

You can open a document file just by double-clicking its icon, as displayed by the A/UX Finder. When you do so, the A/UX Finder reads the document's type and creator codes and searches the system for an application that can interpret the file. It starts the application running and uses it to open the document.

Thus you can open different documents in various media without needing to find their applications—in fact, without knowing what applications they require. The A/UX Finder does this work for you.

Fonts and desk accessories

The Macintosh System Folder contains resources that are public—that is, accessible to every Macintosh application. Among these resources are fonts and desk accessories.

Fonts are resources that contain pattern information for all the letters and symbols that A/UX can display or print. Besides the standard fonts that come with A/UX—Times®, Helvetica®, Courier, Symbol, and so on—there are hundreds of others you can buy and install. They cover many languages and all varieties of typography, including boldface, italic, and special display faces. When you add new fonts to the system, you automatically extend the capabilities of all its word-processing, drawing, and desktop-publishing software.

Desk accessories are mini-applications that you might want to use at any time. They are listed in the Apple menu that every application displays. You bring them onto the desktop as you need them and put them back when you're finished. Standard desk accessories include the Calculator (which looks like a pocket calculator), the Alarm Clock, the Scrapbook for storing parts of documents, and so on. A variety of other desk accessories are available from third-party vendors.

The Chooser and the Control Panel

The Chooser is a standard desk accessory that helps you enable and disable peripheral devices on your A/UX system. It displays lists of network nodes available to your computer, with the names of the printers and servers connected to each one. To enable a printer or server, you just select it by name. In some cases you may also need to log in with a password.

The **Control Panel** is a standard desk accessory that lets you set many general operating characteristics of your computer. You can adjust such factors as the amplitude of mouse movement, the blink rate of blinking cursors, and the level of sound output. With the Control Panel you can view certain network settings. You can conform your system to a special keyboard. If you have a color monitor, you can choose standard colors for parts of your desktop display. These capabilities help you customize the Macintosh User Interface to the exact form you find most comfortable and productive.

Licensing

As a licensee of AT&T's technology, Apple distributes a single-CPU, 16-user binary license with every A/UX operating system. This means that your Macintosh computer running A/UX Release 2.0 may have up to 16 remote or local users logged on at any given time.

To support larger A/UX networks, Apple offers a Right To Copy license that lets you expand the number of your CPUs and users as needed. With X Window System for A/UX, Apple offers both Right To Copy and site licenses. For further information about these and other licensing options, contact your authorized A/UX dealer.

Chapter 2 **A/UX Documentation**

Your guide to the world of A/UX is the library of A/UX documentation, currently numbering some two dozen different publications. This chapter of your road map can help you find your way among them.

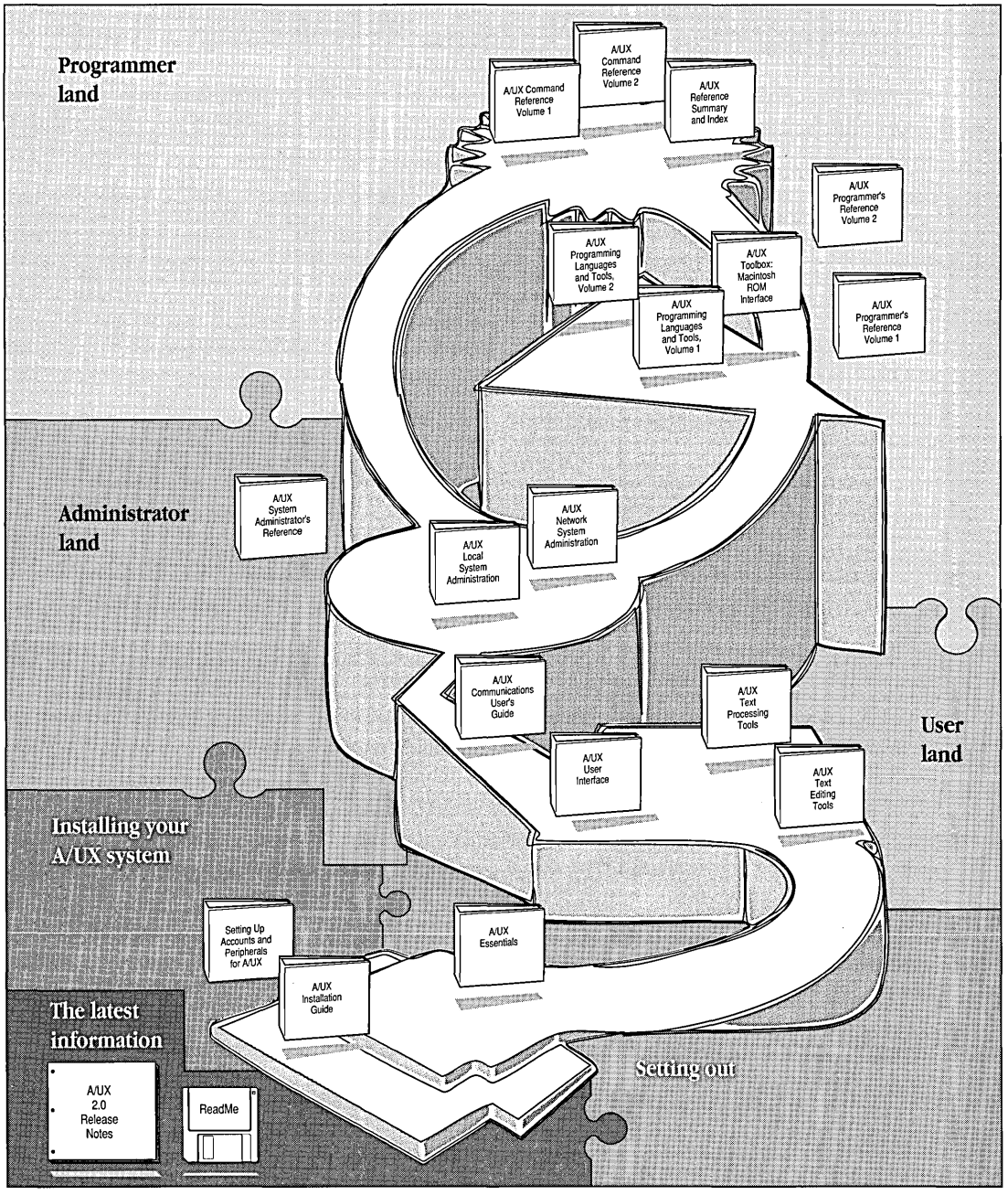
Think of the A/UX documentation as consisting of two main categories: guides and references. A/UX guides and references are organized by topic and sold in documentation kits. Table 2-1 gives you a complete list of the A/UX Release 2.0 publications and the kits in which they are sold. The documentation for a related product, X Window System for A/UX, is described later in this chapter.

The Accessory Kit included with the A/UX software contains guides that help you install and start up your A/UX system. Other guides in the User Kit, Administrator Kit, and Programmer Kit help you explore specific areas of A/UX and explain basic UNIX practice. The guides also list the resources available in A/UX and their benefits to you. They use examples, sample sessions, and explicit instructions to explain the operation of A/UX. Even if you are an experienced UNIX user, you should skim the guides for information specific to A/UX Release 2.0.

After reading the guides, you will want to keep the reference manuals handy. They list and explain in a concise, encyclopedic manner the A/UX commands, system calls, libraries, and file formats. You can view the contents of the reference manuals on your monitor screen as well as read them in paper format.

Used properly, the guides, reference manuals, and online reference facilities can lead you to a thorough understanding of A/UX. The map in Figure 2-1 shows the territories you traverse on your journey to A/UX expertise. Subsequent pages in this chapter describe the guides and reference manuals that appear on this map.

■ **Figure 2-1** The A/UX documentation road map



■ **Table 2-1** The documentation for A/UX Release 2.0

Documentation	Type	Number
Accessory Kit (included with the software)	Kit	M0427LL/A
Road Map to A/UX	Guide	
A/UX 2.0 Release Notes	Guide	
Read Me file	Guide	
A/UX Installation Guide	Guide	
Setting Up Accounts and Peripherals for A/UX	Guide	
A/UX Essentials	Guide	
User Kit	Kit	M0429LL/A
A/UX Text Editing Tools	Guide	
A/UX Text Processing Tools	Guide	
A/UX User Interface	Guide	
A/UX Communications User's Guide	Guide	
Administrator Kit	Kit	M0431LL/A
A/UX Local System Administration	Guide	
A/UX Network System Administration	Guide	
A/UX System Administrator's Reference, Sections 1M, 7, and 8	Reference	
Programmer Kit	Kit	M0430LL/A
A/UX Programming Languages and Tools, Volume 1	Guide	
A/UX Programming Languages and Tools, Volume 2	Guide	
A/UX Toolbox: Macintosh ROM Interface	Guide	
A/UX Programmer's Reference, Sections 2 and 3(A-L)	Reference	
A/UX Programmer's Reference, Sections 3(M-Z), 4, and 5	Reference	
A/UX Command Reference, Section 1(A-L)	Reference	
A/UX Command Reference, Sections 1(M-Z) and 6	Reference	
A/UX Reference Summary and Index	Reference	
Other programming books		
A/UX Network Applications Programming	Guide	APDA*
Building A/UX Device Drivers	Guide	APDA*

* Available only through the Apple Programmers and Developers Association (APDA™); see the end of this chapter for ordering information.

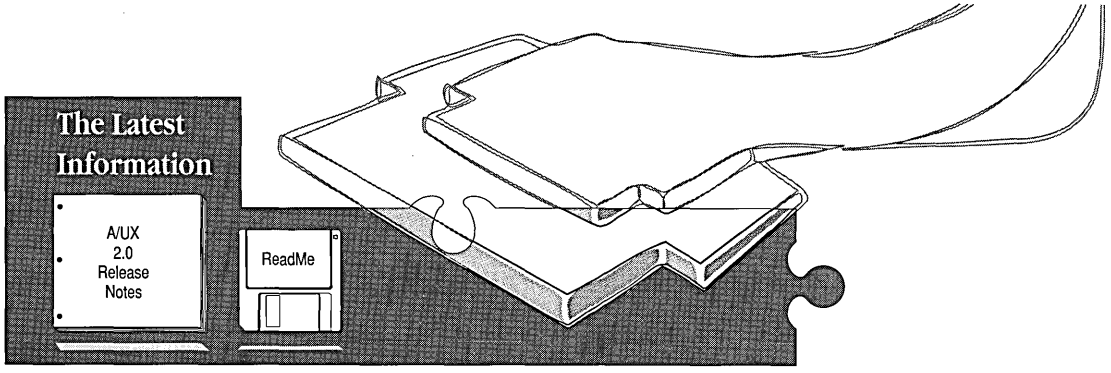
Getting the latest information

Before you start any journey, it is a good idea to check on the latest goings-on in the places where you intend to travel. In the A/UX world, new developments occur almost daily. Some of these developments occur after press time and cannot be documented in the usual fashion, so they are presented separately in a different format.

You get the latest A/UX news from two sources (shown in Figure 2-2), both of which are found in the A/UX Accessory Kit:

- *A/UX 2.0 Release Notes*
- the Read Me file

■ **Figure 2-2** Getting the latest information



A/UX 2.0 Release Notes

A/UX 2.0 Release Notes bring you late-breaking news about the current release of A/UX. You should skim through this document before installing or using your A/UX system.

A/UX 2.0 Release Notes are not bound. They are loose pages designed to replace other pages in specific books or to fit into a section of *A/UX Installation Guide* called "Release Notes."

What's in it

A/UX 2.0 Release Notes cover

- recent additions and changes to the system
- tips for using the system effectively
- new documentation pages to replace those changed after original publication

Where to find it

A/UX 2.0 Release Notes are packed in the A/UX Accessory Kit that accompanies every A/UX system.

Where to go next

You should read the Read Me file next.

The Read Me file

Once you have read *A/UX 2.0 Release Notes,* you should read the information in the Read Me file. It provides you with the latest possible information about your system.

What's in it

The Read Me file covers

- the latest changes to the system (later than *A/UX 2.0 Release Notes*)
- tips for using the system effectively
- warnings and workarounds for potential software problems

Where to find it

You can find the Read Me file on the *A/UX Read Me* disk in your A/UX Accessory Kit. This disk is meant to be used with the Macintosh OS, so you can read the file before you start up A/UX. Or you can read it in A/UX Release 2.0 if you have that system already installed.

You don't need a word processor to read the Read Me file. Simply find its icon and double-click on it. If you are not sure how to do this, read the user's guide that came with your Macintosh computer.

Where to go next

If your system has not been installed or if you have received an update for an older version of A/UX, read *A/UX Installation Guide* so that you can proceed with the installation or update.

If your system is already running and you want to add new peripherals at this point, you should read *Setting Up Accounts and Peripherals for A/UX.*

Otherwise, you should read *A/UX Essentials* next.

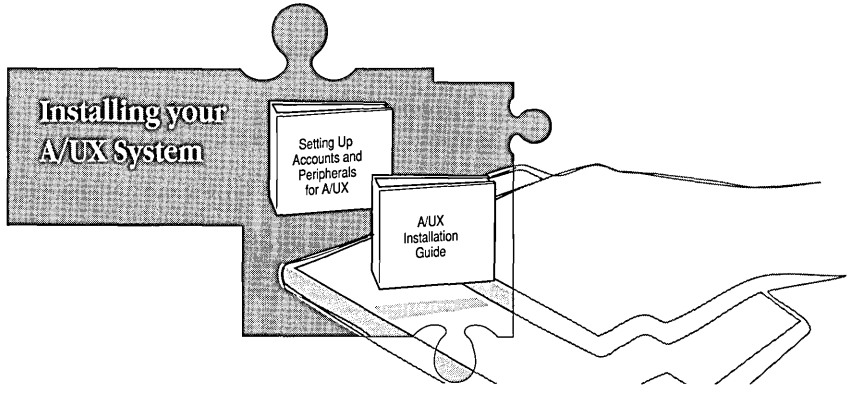
Installing your A/UX system

Before you can set out into the world of A/UX, the A/UX operating system must be installed on your Macintosh computer. The documentation that will help you is shown in Figure 2-3. In the past, each UNIX site normally required the services of an expert administrator to set up the UNIX software and keep it running. As part of bringing the power of UNIX to the desktops of individual users, Apple Computer has greatly simplified the process of installing and maintaining A/UX.

If you are the sole user of your system, you may need to install the A/UX operating system or the latest A/UX update yourself. You need *A/UX Installation Guide* to complete the installation properly. Installing A/UX or an A/UX update is usually very simple. If you don't have special requirements, you can finish the installation procedure in less than two hours. As part of your first installation (or at future times), you will probably want to add peripheral devices or new user accounts. *Setting Up Accounts and Peripherals for A/UX* tells you how.

If this is your first experience with Macintosh computers, you should start by reading the Macintosh operating guides. They tell you how to set up your equipment and put it into operation. Then you can run the guided tour disk (called *Macintosh Basics*) that is shipped with the computer. The tour disk helps you learn and practice basic Macintosh skills, such as using the mouse and pull-down menus. At the same time you will become familiar with the Macintosh desktop and its icons.

■ **Figure 2-3** Installing your A/UX system



A/UX Installation Guide

A/UX Installation Guide explains in step-by-step detail how to install A/UX and run it for the first time, how to install a new release to update your A/UX system, and how to perform some basic administration duties for getting started quickly.

Before performing the procedures in *A/UX Installation Guide,* you must set up your Macintosh computer by following the instructions in the guides that came with it. You must also know the basic Macintosh skills that are taught in the same guides and are demonstrated interactively by the training disk that comes with your Macintosh.

You should read *A/UX 2.0 Release Notes* and the Read Me file before installing or using A/UX Release 2.0.

What's in it

This guide covers

- software installation
- software configuration
- optional configurations
- software updating

Where to find it

A/UX Installation Guide is packed in the A/UX Accessory Kit that accompanies every A/UX system.

Where to go next

If you want to add one or more peripheral devices (such as a printer or hard disk), add additional user accounts, or connect your computer to a network, you should next read *Setting Up Accounts and Peripherals for A/UX.* Otherwise, go directly to *A/UX Essentials* to learn about using A/UX.

Setting Up Accounts and Peripherals for A/UX

Setting Up Accounts and Peripherals for A/UX explains in simple language how to expand your A/UX system by adding printers, hard disks, CD-ROM drives, tape backup drives, modems, terminals, and network connections. It also tells you how to add new users to your system without adding hardware.

You should read *A/UX Installation Guide* and get your A/UX system running before adding peripheral equipment or new user accounts.

What's in it

This guide covers the principles of system configuration and then tells you how to add and manage

- user accounts
- ImageWriter®and LaserWriter® printers (except the LaserWriter SC)
- Apple Hard Disk SC
- AppleCD SC® drive
- Apple Tape Backup 40SC drive
- Apple Personal Modem or a Hayes system-compatible modem
- Macintosh Plus and Macintosh SE/30 terminals
- connections to existing AppleTalk and TCP/IP network systems

Where to find it

Setting Up Accounts and Peripherals for A/UX is packed in the A/UX Accessory Kit that accompanies every A/UX system.

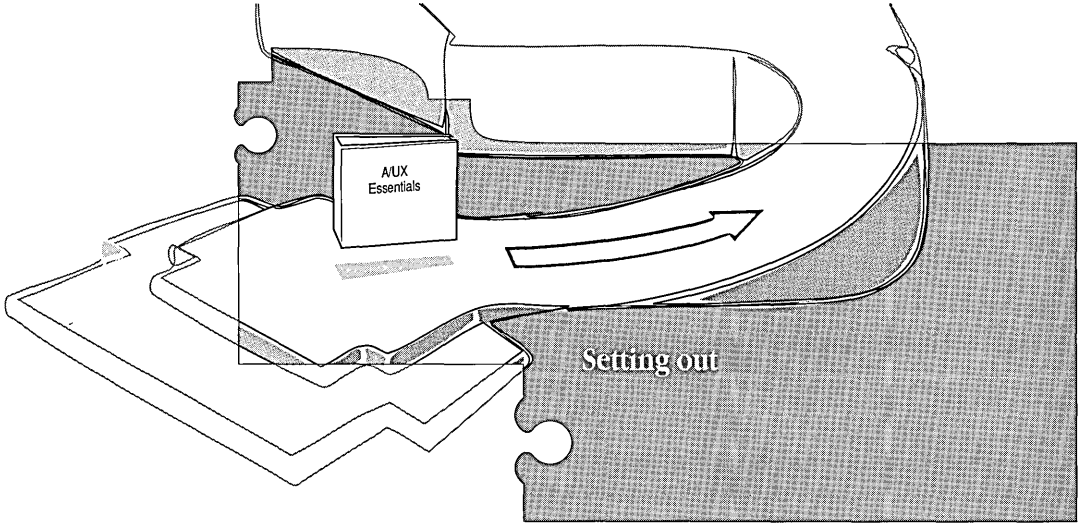
Where to go next

If you haven't yet read *A/UX Essentials,* you should do that next.

Setting out

After your Macintosh and its peripherals are set up and you have read the late-breaking A/UX information, the preparations are finished. You are ready to start your journey. Whether or not you are an experienced UNIX user, your starting point for A/UX is *A/UX Essentials,* as shown in Figure 2-4.

■ **Figure 2-4** Setting out on the road to A/UX



A/UX Essentials

All users should start their exploration of the A/UX world by reading *A/UX Essentials*. If you are completely unfamiliar with either the Macintosh or UNIX operating systems, this guide can be a great help in quickly learning how they are combined in A/UX Release 2.0.

Even if you are an experienced UNIX user, you still need to read this book to learn about the unique features of A/UX that are based on the Macintosh computer.

In previous releases of A/UX, this guide was named *Getting Started with A/UX*.

What's in it

This guide presents

- a hands-on tutorial for starting up and shutting down A/UX
- a summary of basic user actions, using both typed commands and the Macintosh graphical interface
- instructions for customizing the Macintosh environment
- hands-on directions for using the Commando command generator
- a tutorial for opening and using console windows
- instructions for using TextEditor, the new mouse-based editor
- a discussion of printing facilities
- tutorials for sending and receiving mail
- a reference for the desktop and its menus
- a troubleshooting section
- a glossary of terms used in the A/UX documentation

Where to find it

A/UX Essentials is packed in the A/UX Accessory Kit that accompanies every A/UX system.

Where to go next

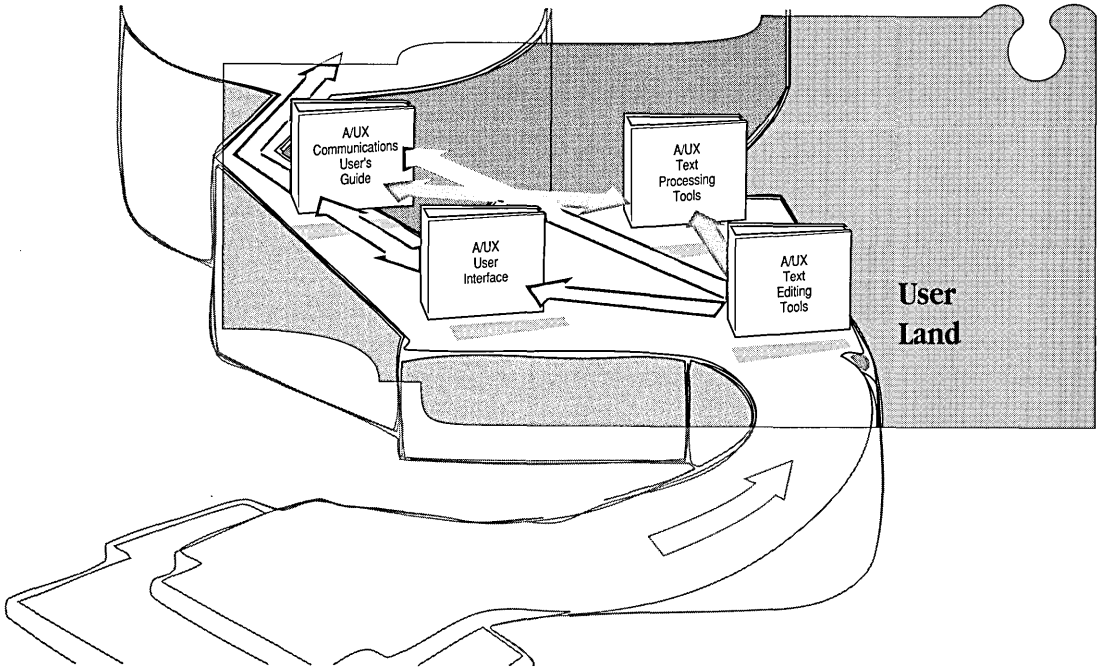
If you are new to A/UX and you want to explore its standard UNIX capabilities as a user, you should move on into the user land documentation shown in Figure 2-5.

If you are new to A/UX and want to use it to run an off-the-shelf Macintosh application, you should read that application's documentation.

If you are new to A/UX and you are the system administrator, you should skim through *A/UX Local System Administration* and *A/UX Network System Administration* and then spend some time exploring user land.

If you are an experienced UNIX user, you should first look at *A/UX Local System Administration* for information specific to A/UX and then go on to your area of interest.

■ **Figure 2-5** A/UX user land



Exploring user land

After installing A/UX and reading *A/UX Essentials,* you are ready to make use of the traditional UNIX utilities and application programs contained in A/UX. Figure 2-5 shows the four guides that are available to assist you:

- *A/UX Text Editing Tools*
- *A/UX Text Processing Tools*
- *A/UX User Interface*
- *A/UX Communications User's Guide*

If you are an experienced UNIX user, you may not need to read any of the guides, at least at the beginning. Otherwise, you can follow the suggestions below.

If you want to use a traditional UNIX text editor, such as `vi`, instead of TextEditor or a Macintosh word processor, you should read *A/UX Text Editing Tools.*

If you are planning to do traditional UNIX text formatting, you should read *A/UX Text Processing Tools* to learn how to prepare files that use `troff` macros.

You should read *A/UX User Interface* to learn to use at least one shell command interpreter.

If you are going to send or receive electronic mail, you should read *A/UX Communications User's Guide* to learn about the networking capabilities of A/UX Release 2.0.

A/UX Text Editing Tools

In addition to the new mouse-based editor, TextEditor (described in *A/UX Essentials*), A/UX Release 2.0 includes the traditional UNIX keyboard-driven editors: `vi`, `ex`, and `ed`. With these utilities you can enter, edit, and manipulate text. You can also create text files that can become executable programs or that can be formatted and printed with all the polish of a formal publication. To assist new users, *A/UX Text Editing Tools* offers detailed instructions and sample sessions for using the traditional UNIX keyboard editors.

You need to know at least one text editor to use A/UX effectively. You'll probably find that TextEditor is the fastest to learn and easiest to use, particularly if you have previous experience using Macintosh word processors. If you still prefer a keyboard-driven editor, you can learn `vi`, described in this guide.

What's in it

This guide covers

- differences between the keyboard-based text editors
- `ed`, an interactive line editor
- `ex`, an interactive line editor that is the basis of `vi`
- `vi`, an interactive full-screen editor
- `sed`, a batch stream editor

Where to find it

A/UX Text Editing Tools is packed with other A/UX user guides as part of the A/UX User Kit (order number M0429LL/A), available from your authorized A/UX dealer.

Where to go next

After you are familiar with one of the interactive editors (TextEditor or `vi`), you may wish to read *A/UX User Interface* next to get started with shell scripting, a high-level form of programming. This is an important gateway to the data-processing capabilities of A/UX.

If your primary use for A/UX is to produce high-quality printed documents, you should read either *A/UX Text Processing Tools* or the user's guide to your favorite Macintosh desktop-publishing program.

If you are already familiar with one of the A/UX shells and want to learn about electronic mail, you should read the parts of *A/UX Essentials* and *A/UX Communications User's Guide* that apply to the electronic mail capabilities of your installation. If you have a network administrator, that person can guide you to the right sections.

A/UX Text Processing Tools

A/UX provides the text-formatting utilities that make up AT&T's Documentor's Workbench (DWB), version 2.0. A/UX also includes other text-processing tools such as various macros for formatting documents. *A/UX Text Processing Tools* describes these facilities and tells you how to use them.

The text-processing tools enable you to add typesetter formatting codes to documents that you produce with A/UX. For example, you can specify fonts, character sizes, and character styles for your printed documents, as well as incorporate graphics.

You should read this guide if you are already familiar with one of the A/UX text editors (described in *A/UX Text Editing Tools*) and if you want to produce printed documents from text files by adding the formatting enhancements just described.

What's in it

This guide covers

- `nroff` and `troff`, text-formatting utilities
- `tbl`, the table-formatting program
- `eqn`, the mathematics typesetting program
- `pic`, the line-drawing program
- `grap`, the graph-drawing program
- the `ms`, `me`, and `mm` macro packages
- other related tools and commands

Where to find it

A/UX Text Processing Tools is packed with other A/UX user guides as part of the A/UX User Kit (order number M0429LL/A), available from your authorized A/UX dealer.

Where to go next

If you are not familiar with at least one of the traditional UNIX command-interpretation shells, you should read *A/UX User Interface* to gain a fundamental understanding of A/UX as an operating system. You can then progress to *A/UX Local System Administration.*

A/UX User Interface

A program known as a **shell** provides interactive access to the capabilities of A/UX through a command-line interface. The shell can also execute high-level programs, called **shell scripts.** Three shells are provided with A/UX, all accessible through CommandShell windows: the Bourne shell, the C shell, and the Korn shell. Each shell provides slightly different features and has its advocates among UNIX users.

A guide to conventional UNIX-style command interpreters, *A/UX User Interface* serves as an excellent introduction to the shells. It is also useful when you want to refresh your memory about shell features or you need to perform some particular scripting task.

If you have completed the A/UX tutorial in *A/UX Essentials,* you should read the introduction to *A/UX User Interface* to learn more about shells.

If you want to write your own software tools but you are not familiar with shell scripts, you should read about one of the shells. If you have a system administrator, that person can probably suggest which shell would be best for your needs.

If you want to become familiar with a new shell, you should read about the differences between the shells and then read the section pertaining to the one you want to learn.

What's in it

This guide covers

- differences between the shells
- the Bourne shell
- the Korn shell
- the C shell
- `shl`, a program for shell layering

Where to find it

A/UX User Interface is packed with other A/UX user guides as part of the A/UX User Kit (order number M0429LL/A), available from your authorized A/UX dealer.

Where to go next

If your system is not connected to a network, you may want to read the in-depth discussion of the `mail` utility in *A/UX Communications User's Guide* before going on to *A/UX Local System Administration*.

If your system is connected to a network, you should read the parts of *A/UX Communications User's Guide* and *Setting Up Accounts and Peripherals for A/UX* that apply to your installation. Your network administrator should be able to guide you to the right sections.

A/UX Communications User's Guide

A/UX offers a variety of communications and networking features, both for users who share a single computer and for users whose computers or terminals are connected together over a network. *A/UX Communications User's Guide* describes these features.

A/UX Communications User's Guide has chapters about communications between users on the local A/UX system, serial communications between several machines, and TCP/IP network communications between machines on local-area and wide-area networks.

Some or all of the networking topics may not apply to your site. Your system or network administrator can tell you which ones are applicable.

What's in it

This guide covers

- `mail`, a message-delivery program
- B-NET, Apple's version of the TCP/IP protocol suite, with related utilities for remote login, file transfer, and process execution at remote locations
- `uucp`, a utility for transferring files between UNIX systems
- `cu`, a utility for performing remote logins to UNIX hosts
- `slip`, a program for serial line access to a network

Where to find it

A/UX Communications User's Guide is packed with other A/UX user guides as part of the A/UX User Kit (order number M0429LL/A), available from your authorized A/UX dealer.

Where to go next

If you are interested in setting up or using an AppleShare file server, read the appropriate parts of *A/UX Essentials* and the Macintosh AppleShare documentation.

If you want to learn about traditional UNIX file sharing by means of the Network File System (with your computer as either a client or a server), read the appropriate parts of *A/UX Network System Administration.*

If you want to connect to an existing network, read *Setting Up Accounts and Peripherals for A/UX.*

Exploring administrator land

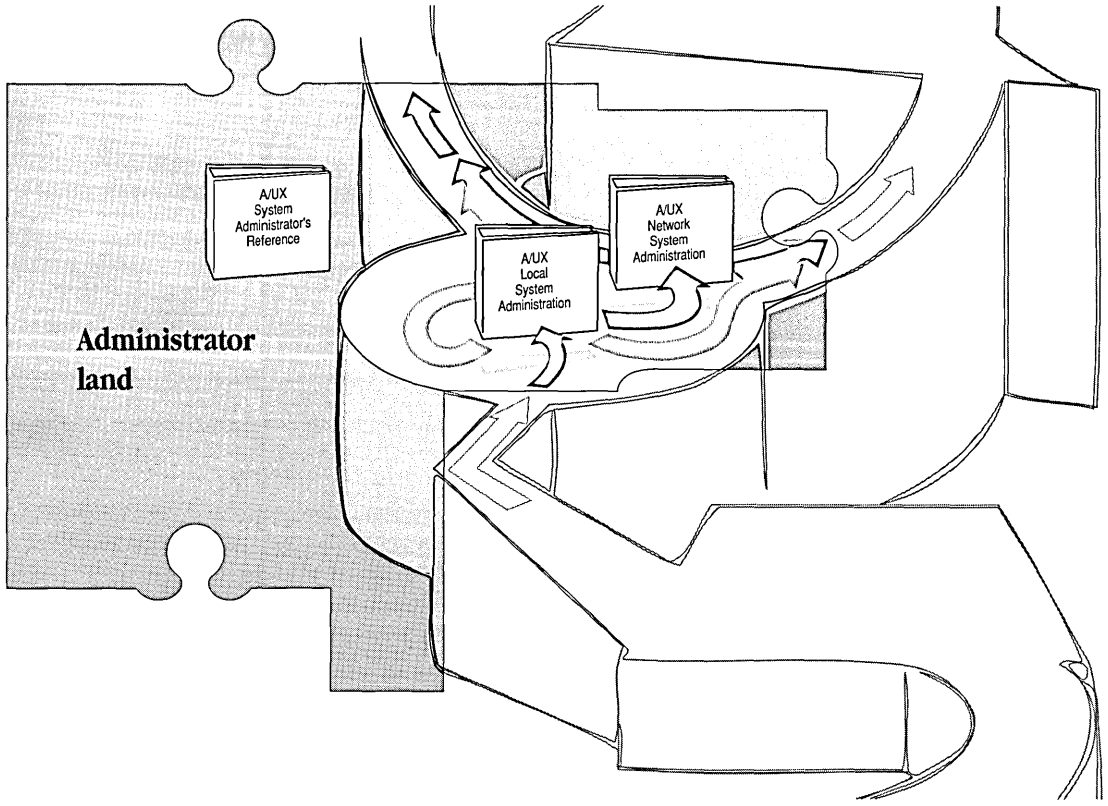
An administrator must perform certain tasks to keep any UNIX system functioning smoothly. The A/UX system administration tasks include setting up a system, adding and removing users, adding and removing peripheral devices, and making and mounting file systems. The A/UX network administration tasks include setting up, maintaining, and troubleshooting networks. Two guides and a reference are available to assist the A/UX administrator, as shown in Figure 2-6:

- *A/UX Local System Administration*
- *A/UX Network System Administration*
- *A/UX System Administrator's Reference*

If you are a sole A/UX user on one computer, you must administer the system yourself. If there are several users on your system, an administrator must be designated for your system. Whoever serves as system administrator needs to be familiar with *A/UX Local System Administration* and *A/UX System Administrator's Reference.*

If your A/UX system is part of a network, a network administrator must be designated. That person should be familiar with *A/UX Network System Administration* as well as with *A/UX Local System Administration* and *A/UX System Administrator's Reference.*

■ **Figure 2-6** A/UX administrator land



A/UX Local System Administration

A/UX Local System Administration explains the basic duties of the system administrator and describes the A/UX facilities available to monitor and maintain a single system. A companion guide, *A/UX Network System Administration,* covers network-related topics.

This guide is written for users who are charged with administering A/UX. Although features such as autoconfiguration and autorecovery have greatly simplified system administration on A/UX, the administrator's job is not always easy or routine.

If you are the only user on your system, you are probably your own system administrator. If you are not a seasoned A/UX user, refer to this guide to keep your A/UX system running smoothly.

If you have already administered a UNIX system, this guide can help you to understand the aspects of administration unique to A/UX and to fine-tune your A/UX system.

While performing system administration tasks, you should keep *A/UX System Administrator's Reference* at hand. You may also need to refer to the file format information in Section 4 of *A/UX Programmer's Reference.*

What's in it

This guide covers

- startup and shutdown
- user and group administration
- backups
- peripheral-device management
- file system checking
- system accounting
- the system activity package

Where to find it

A/UX Local System Administration is packed with the other A/UX guide and reference as part of the A/UX Administrator Kit (order number M0431LL/A), available from your authorized A/UX dealer.

Where to go next

After reading *A/UX Local System Administration,* you should know all you need to know to maintain your A/UX system with confidence.

If you want to learn about network administration, you should read *A/UX Network System Administration.*

If you want to learn the more advanced features of the A/UX system, you can explore programmer land. For an introduction to the A/UX programming environment, you should start with *A/UX Programming Languages and Tools, Volume 1.*

If you need a reminder about adding peripheral devices or new user accounts to your system, consult *Setting Up Accounts and Peripherals for A/UX.*

A/UX Network System Administration

A/UX Network System Administration describes the procedures and commands necessary to keep networking software running smoothly under A/UX. The guide does *not* describe how to maintain network hardware.

You should read this guide if you are charged with administering a computer network that includes A/UX systems.

What's in it

This guide covers

- setting up and using an AppleTalk network
- setting up and using a B-NET (TCP/IP) network
- setting up and maintaining the Network File System (NFS), including Yellow Pages (YP) service
- resolving network design issues
- setting up and maintaining subnets
- configuring a `sendmail` facility
- managing `uucp`

Where to find it

A/UX Network System Administration is packed with the other A/UX guide and reference as part of the A/UX Administrator Kit (order number M0431LL/A), available from your authorized A/UX dealer.

Where to go next

If you want more information about network theory or administering network software, you should see the documents listed in the appendix "Additional Reading" in *A/UX Network System Administration.*

If you are interested in developing network application software, you should read *A/UX Network Applications Programming.*

If you need a reminder about adding peripheral devices to your system, consult *Setting Up Accounts and Peripherals for A/UX.*

A/UX System Administrator's Reference

A/UX System Administrator's Reference presents the privileged commands and utility programs available to the system administrator and the network administrator. It corresponds to Sections 1M, 7, and 8 of the documentation traditionally distributed with UNIX systems. You should keep this reference at hand (or be prepared to view its contents on line) if you are the system administrator or network administrator at your site.

As the system administrator, you may also need to refer to the file format information contained in Section 4 of *A/UX Programmer's Reference.*

What's in it

This reference contains

- descriptions of privileged commands (Section 1M)
- descriptions of device files (Section 7)
- descriptions of stand-alone system startup and maintenance programs (Section 8)

Where to find it

A/UX System Administrator's Reference is packed with the A/UX guides that are part of the A/UX Administrator Kit (order number M0431LL/A), available from your authorized A/UX dealer.

How to view it on line

A/UX includes the contents of *A/UX System Administrator's Reference* in the standard UNIX man page format. This feature is like an online pocket guide; you can use it at any time on your journey through the world of A/UX. You simply enter `man` with the name of any A/UX system administration command, device file, or stand-alone program to display the appropriate man page on your screen. A related command, `apropos`, helps you locate man pages by subject.

Exploring programmer land

If you do shell scripting, you have already started on the road to becoming a UNIX programmer. But you can go much further: UNIX includes a complete environment for programming in C, Fortran, and other languages. Many users consider this kind of programming a forbidding task. If you are one of these users or if you plan only to run utilities and applications rather than develop them, you may not want to venture into programmer land.

However, the A/UX operating system offers tremendous resources to the serious programmer. The A/UX documentation for these resources is more detailed than (and organized differently from) other types of UNIX reference sets. Five guides and three references are available to assist the A/UX programmer, as shown in Figure 2-7:

- *A/UX Programming Languages and Tools, Volume 1*
- *A/UX Programming Languages and Tools, Volume 2*
- *A/UX Toolbox: Macintosh ROM Interface*
- *A/UX Programmer's Reference* (two volumes)
- *A/UX Command Reference* (two volumes)
- *A/UX Reference Summary and Index*
- *A/UX Network Applications Programming*
- *Building A/UX Device Drivers*

If you are not a UNIX programmer but aspire to be, you should first become familiar with *A/UX User Interface.* Then read *A/UX Programming Languages and Tools, Volume 1,* and *A/UX Programming Languages and Tools, Volume 2.* These books tell you how to use the A/UX programming tools with C, Fortran, and other languages.

Seasoned UNIX programmers who want to add elements of the Macintosh User Interface to their programs should read *A/UX Toolbox: Macintosh ROM Interface.*

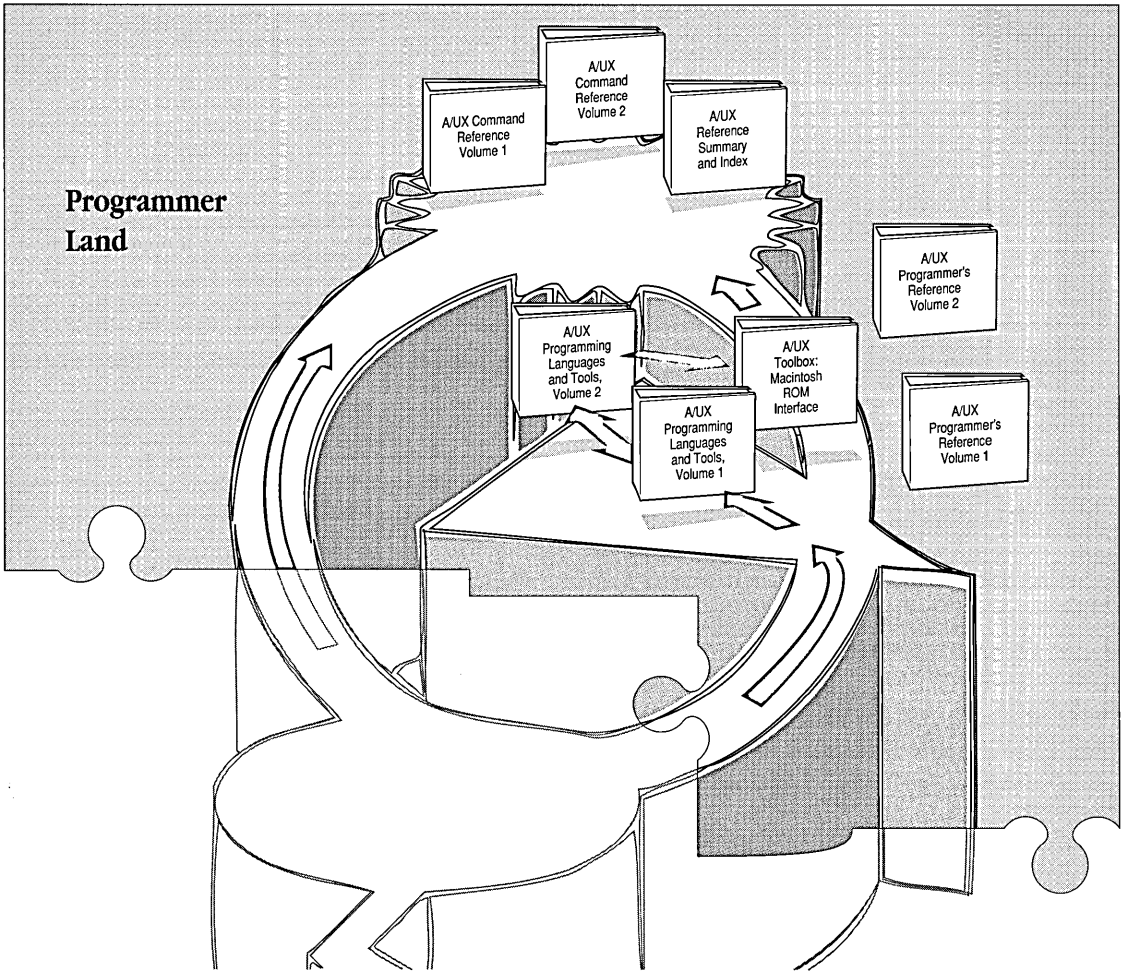
Macintosh programmers who want to write new applications to run under A/UX should read *A/UX Toolbox: Macintosh ROM Interface.*

If you want to learn more about applications programming for a network environment, you should read *A/UX Network Applications Programming.*

To learn more about peripheral devices and how they interact with A/UX, read *Building A/UX Device Drivers.*

If you are a seasoned UNIX programmer and you want your code to work in a POSIX environment, you should see the appropriate parts of *A/UX Programming Languages and Tools, Volume 1.*

■ **Figure 2-7** A/UX programmer land



A/UX Programming Languages and Tools, Volume 1

A/UX Programming Languages and Tools, Volume 1 is intended for the UNIX programmer. It describes the C and Fortran-77 programming languages, their accompanying function libraries and archives (including shared libraries), and the utility programs related to C and Fortran program development.

The bulk of programming for UNIX systems is done in the C language. Indeed, most of the A/UX operating system is written in the C language. C offers the ease of use of a high-level programming language with the great degree of control found in a low-level language.

Fortran (whose name is derived from *formula translation*) is a language popular with programmers writing scientific and mathematical applications. A/UX includes the `f77` compiler for compiling programs written in the Fortran-77 language. It also includes the `efl` processor for translating Extended Fortran source code into Fortran-77 source code.

If you are not yet an experienced UNIX programmer but want to be, you should read this guide.

If you are an experienced UNIX programmer and want your code to comply with POSIX standardization, you should see the appropriate parts of this guide.

If you want to learn about the utility programs, libraries, and related tools that complement the A/UX compilers, you should read *A/UX Programming Languages and Tools, Volume 2.*

Programmers should keep this guide at hand for quick access to programming information in general.

What's in it

This guide covers

- the A/UX programming environment
- the command syntax for the C compiler (`cc`)
- the C programming language, with implementation notes for Macintosh hardware
- the standard C, math, and object libraries
- shared libraries
- the command syntax for the Fortran compiler (`f77`)

- the Fortran programming language
- `efl`, an extended Fortran language
- other programming-language utilities, such as `lint`, the C program checker; `sdb`, the symbolic debugger; `as`, the assembler; `ld`, the link editor; and the Common Object File Format (COFF)
- POSIX and the A/UX POSIX programming environment, for programming in conformance with the IEEE POSIX standard

Where to find it

A/UX Programming Languages and Tools, Volume 1 is packed with other A/UX guides and references as part of the A/UX Programmer Kit (order number M0430LL/A), available from your authorized A/UX dealer.

Where to go next

To learn how to add elements of the Macintosh User Interface to your programs, you should read *A/UX Toolbox: Macintosh ROM Interface.*

To learn about other A/UX programming tools, you should read *A/UX Programming Languages and Tools, Volume 2.*

A/UX Programming Languages and Tools, Volume 2

In addition to the compilers and their associated program-generating tools, A/UX offers utilities that perform such tasks as version control, automatic program regeneration, and language preprocessing. *A/UX Programming Languages and Tools, Volume 2* describes those A/UX utility programs that are not related to specific programming languages.

You should read this guide if you want to expand your A/UX programming skills or if you want to learn about the wide variety of programming utilities included in A/UX. Parts of this guide are useful even if you only write shell scripts.

What's in it

This guide covers

- `make`, a program regeneration tool
- SCCS, the Source Code Control System for version control
- `awk`, a language for writing source text processors
- `lex`, a lexical analyzer, and `yacc`, a compiler-writing system
- `curses`, a terminal-independent screen I/O library
- `bc` and `dc`, languages for performing arithmetic calculations
- `m4`, a language for creating source text preprocessors
- other programming tools and facilities, such as `ar`, `cflow`, `nm`, `od`, `prof`, and `ctags`

Where to find it

A/UX Programming Languages and Tools, Volume 2 is packed with other A/UX guides and references as part of the A/UX Programmer Kit (order number M0430LL/A), available from your authorized A/UX dealer.

Where to go next

If you want to learn how to add elements of the Macintosh User Interface to your programs, you should read *A/UX Toolbox: Macintosh ROM Interface.*

A/UX Toolbox: Macintosh ROM Interface

A unique feature of A/UX is that it supports Macintosh application programs running under the A/UX system. To achieve this, applications call routines in the A/UX Toolbox. *A/UX Toolbox: Macintosh ROM Interface* describes what the A/UX Toolbox is and how to use it.

If you have programmed with the Macintosh User Interface and either want to write an application to run under A/UX or want to use elements of the Macintosh User Interface in your A/UX programs, you should read *A/UX Toolbox: Macintosh ROM Interface.*

If you want to use elements of the Macintosh User Interface in your A/UX programs but have not programmed with the Macintosh User Interface, you should read *Programmer's Introduction to the Macintosh Family* and *Technical Introduction to the Macintosh Family* before reading *A/UX Toolbox: Macintosh ROM Interface.* You should also have a copy of *Inside Macintosh* available for reference. These Macintosh books are published by Addison-Wesley and are available from APDA and retail bookstores.

What's in it

This guide covers

- the A/UX Toolbox—what it is and how to use it
- A/UX Toolbox utilities and extensions
- a compatibility checklist of differences between the A/UX Toolbox and Macintosh OS environments
- "Inside A/UX Macintosh," a detailed reference to the support for Macintosh capabilities in A/UX that is keyed to the book *Inside Macintosh*
- a description of how files are handled in the two environments and how they are automatically transformed when moved between environments
- resource file manipulation using the `rez` and `derez` utilities
- information about C header files available to the programmer

Where to find it

A/UX Toolbox: Macintosh ROM Interface is packed with other A/UX guides and references as part of the A/UX Programmer Kit (order number M0430LL/A), available from your authorized A/UX dealer.

Where to go next

A/UX Toolbox: Macintosh ROM Interface includes a comprehensive list of additional reading about program development in both Macintosh and A/UX environments.

A/UX Programmer's Reference

A/UX Programmer's Reference is an encyclopedic two-volume reference to all library routines and related information required by programmers. It corresponds to Sections 2 through 5 of the documentation traditionally distributed with UNIX systems.

You should keep this reference at hand (or be prepared to view its contents on line) if you do any programming in A/UX.

What's in it

This reference contains

- descriptions of system calls (Section 2)
- descriptions of subroutines (Section 3)
- descriptions of file formats (Section 4)
- descriptions of miscellaneous facilities (Section 5)

Where to find it

A/UX Programmer's Reference is packed with other A/UX guides and references as part of the A/UX Programmer Kit (order number M0430LL/A), available from your authorized A/UX dealer. It is furnished in two volumes. Volume 1 contains Section 2 and entries A through L of Section 3. Volume 2 contains entries M through Z of Section 3 and all of Sections 4 and 5.

How to view it on line

A/UX includes the contents of *A/UX Programmer's Reference* in the standard UNIX man page format. This feature is like an online pocket guide; you can use it at any time on your journey through the world of A/UX. You simply enter `man` with the name of any A/UX system call, subroutine, file format, or other programming facility to display the appropriate man page on your screen. A related command, `apropos`, helps you locate man pages by subject.

A/UX Command Reference

A/UX Command Reference is an encyclopedic two-volume reference to all of the system's user utilities. The format of this reference encourages quick access to information but the content does not lend itself to casual reading.

This reference covers user-level network commands and the available games, but not privileged system-administration commands, which are covered in *A/UX System Administrator's Reference.*

What's in it

A/UX Command Reference corresponds to Sections 1 and 6 of the user manual traditionally distributed with UNIX systems.

This reference contains

- descriptions of all A/UX commands that you can execute without special privileges (Section 1)
- descriptions of the games distributed with A/UX (Section 6)

Where to find it

A/UX Command Reference is packed with other A/UX guides and references as part of the A/UX Programmer Kit (order number M0430LL/A), available from your authorized A/UX dealer. It is furnished in two volumes. Volume 1 contains entries A through L of Section 1. Volume 2 contains entries M through Z of Section 1 and all of Section 6.

How to view it on line

A/UX includes the contents of *A/UX Command Reference* in the standard UNIX man page format. This feature is like an online pocket guide; you can use it at any time on your journey through the world of A/UX. You simply enter `man` with the name of any A/UX user command or game to display the appropriate man page on your screen. A related command, `apropos`, helps you locate man pages by subject.

A/UX Reference Summary and Index

A/UX Reference Summary and Index is an index to all the A/UX reference books. It is designed to point you quickly toward the source of any information you may need about A/UX.

What's in it

This reference contains

- a list of all A/UX commands, organized by function
- synopses of all A/UX commands, organized alphabetically, giving the syntax of each command
- an index to commands

Where to find it

A/UX Reference Summary and Index is packed with other A/UX guides and references as part of the A/UX Programmer Kit (order number M0430LL/A), available from your authorized A/UX dealer.

A/UX Network Applications Programming

A/UX Network Applications Programming describes the A/UX programming interfaces for the programmer who wishes to write network applications that work with AppleTalk, the Network File System (NFS), Yellow Pages (YP), and B-NET (TCP/IP) software.

If you want to learn more about applications programming for an AppleTalk network environment, you should first read *Inside AppleTalk,* the definitive AppleTalk document, available from APDA.

What's in it

This guide contains

- a programmer's introduction to AppleTalk
- a programmer's introduction to B-NET (TCP/IP)
- a programmer's introduction to the Remote Procedure Call (RPC) interface
- specifications for various protocols, including RPC, NFS, and Yellow Pages
- a specification for the External Data Representation (XDR) protocol for data portability

Where to find it

A/UX Network Applications Programming is available from APDA. You can find information about APDA at the end of this chapter.

Building A/UX Device Drivers

Building A/UX Device Drivers describes how to design and develop A/UX device drivers and how to configure them into the A/UX kernel. If you want to learn more about peripheral devices and how they interact with A/UX, you should read this guide.

What's in it

This guide contains

- an overview of device drivers and the A/UX kernel programming environment
- descriptions of block device drivers and character device drivers
- descriptions of specific types of drivers, including terminal, network, slot, SCSI, and Apple Desktop Bus™ drivers
- an explanation of the use of the A/UX autoconfiguration feature
- several sample source code listings
- information about kernel routines that drivers call

Where to find it

Building A/UX Device Drivers is packaged with disks containing source code to all the A/UX device drivers supplied by Apple in A/UX Release 2.0. This product, called the A/UX Device Drivers Kit, is available from APDA (order number M8037/B). You can find information about APDA at the end of this chapter.

X Window System documentation

The X Window System (also called "X") is a network-based windowing environment that was created at the Massachusetts Institute of Technology (MIT). At the time of its introduction it became a popular way to help developers give UNIX programs (called client applications) and UNIX systems a graphical user interface.

Apple offers X Window System for A/UX as a separate product, sold through retail outlets and through APDA. (You can find information about APDA at the end of this chapter.) X Window System for A/UX consists of two different components: MacX, a display server that presents the Macintosh User Interface, and X11, a traditional X user and developer environment. With either or both of them you can easily create a personalized X environment on your Macintosh computer. They are both based on Version 11 of MIT's X Window System.

The documentation for X Window System for A/UX starts with a set of release notes and a Read Me file, just as A/UX does. It continues with three other guides and a reference, as shown in Table 2-2.

■ **Table 2-2** The documentation for X Window System for A/UX

Documentation	Type	Number
X Window System for A/UX	Product	M0227LL/A
Read Me file	Guide	
X Window System for A/UX Release Notes	Guide	
Getting Started with X Window System for A/UX	Guide	
MacX User's Guide with *MacX for A/UX Supplement*	Guide	
X11 User's Guide for A/UX	Guide	
X11 Reference for A/UX	Reference	

Getting Started with X Window System for A/UX

Getting Started with X Window System for A/UX is an introduction to Apple's two X Window System products—MacX and X11. It explains what the products are and how to install them in A/UX Release 2.0.

What's in it

This guide covers

- how X Window System for A/UX works
- the differences between MacX and X11
- ways to set up and use MacX and X11
- factors to consider in choosing an X environment in which to work
- how to install MacX
- how to install X11

Where to find it

Getting Started with X Window System for A/UX is part of Apple's X Window System for A/UX product (order number M0227LL/A), sold separately from A/UX. This product includes the X Window System for A/UX software.

Where to go next

If you have installed MacX, read *MacX User's Guide* with *MacX for A/UX Supplement.* If you have installed X11, read *X11 User's Guide for A/UX.*

MacX User's Guide with *MacX for A/UX Supplement*

MacX is a display server that runs under both the Macintosh OS and A/UX. It lets Macintosh computers with either of these operating systems gain access to A/UX and other UNIX networks through the X interface. MacX provides the same windowing capabilities as the X Window System but uses the Macintosh Toolbox to provide a superior user interface. *MacX for A/UX Supplement* tells you how to use MacX under A/UX; *MacX User's Guide* tells you how to use MacX under Macintosh OS.

You should read *Getting Started with X Window System for A/UX* for information about MacX and installation instructions before reading this guide.

What's in it

This guide gives an overview of MacX and its features and covers

- starting and ending a MacX session in A/UX
- opening and disconnecting a client application in A/UX
- creating, editing, and executing remote commands
- moving, resizing, and iconifying windows
- adding and removing fonts and colors

Where to find it

MacX User's Guide with *MacX for A/UX Supplement* is part of Apple's X Window System for A/UX product (order number M0227LL/A), sold separately from A/UX. This product includes the X Window System for A/UX software.

X11 User's Guide for A/UX

X11 is a windowing environment that provides the standard X interface for A/UX. *X11 User's Guide for A/UX* describes X11 and tells you how to use it. X11 creates windows in which you can display concurrent UNIX and X applications. These windows can be moved, resized, overlapped, or completely hidden as desired. The X11 product includes the windowing environment, a complete development environment, and a full set of applications, including

- window managers
- terminal emulators
- text-management and image-management tools
- programming utilities for creating new X applications
- system-administration utilities

You should read *Getting Started with X Window System for A/UX* for general information about X11 and installation instructions before reading this guide.

What's in it

This guide covers

- basic X11 concepts and operations
- the use of X11 on a network
- X11 software architecture
- the use and customization of X11 client applications

Where to find it

X11 User's Guide for A/UX is part of Apple's X Window System for A/UX product (order number M0227LL/A), sold separately from A/UX. This product includes the X Window System for A/UX software.

X11 Reference for A/UX

X11 Reference for A/UX contains the manual pages for the X Window System for A/UX.

What's in it

This reference covers

- reference pages for user commands
- reference pages for programmer subroutines
- a summary of X commands
- synopses of X commands
- an index to X commands

Where to find it

X Window Reference for A/UX is part of Apple's X Window System for A/UX product (order number M0227LL/A), sold separately from A/UX. This product includes the X Window System for A/UX software.

How to view it on line

X Window System for A/UX includes the reference pages of *X Window Reference for A/UX* in the standard UNIX man page format. This feature is like an online pocket guide; you can use it at any time on your journey through the world of A/UX. You simply enter `man` with the name of any X Window System command or subroutine to display the appropriate man page on your screen. A related command, `apropos`, helps you locate man pages by subject.

Documentation sources

You can get your Apple A/UX publications from two sources: authorized A/UX dealers and the Apple Programmers and Developers Association (APDA). Each of these sources serves a specific audience.

Authorized A/UX dealers

Many Apple dealers have taken specialized training to become authorized to sell and support A/UX. Your authorized A/UX dealer carries all the publications necessary for most sites. To find the A/UX dealer nearest to you, call 1-800-538-9696.

APDA

The Apple Programmers and Developers Association is Apple's worldwide direct distribution channel for more than 350 Apple and third-party development tools and documentation products. Membership is open to anyone interested in developing Apple-compatible software or hardware products.

Some A/UX publications target an audience with technical needs outside the scope of most A/UX sites. Manuals dealing with such specialized subjects are sold separately by APDA. For example, APDA carries *A/UX Guide to POSIX*, a technical summary of the implementation details by which A/UX conforms to the POSIX specification.

For programmers and developers who work on Apple equipment, APDA provides a wide range of technical products and documentation from Apple and other suppliers. You can write to APDA at

APDA
Apple Computer, Inc.
20525 Mariani Avenue, Mailstop 33-G
Cupertino, CA 95014-6299

You can contact APDA by telephone or electronic mail at

1-800-282-APDA, or 1-800-282-2732 (USA only)
1-800-637-0029 (Canada)
408-562-3910 (from other countries)

Fax: 408-562-3971
Telex: 171-576
AppleLink: APDA

Apple Developer Programs

If you plan to develop hardware or software products for sale through retail channels, you can get valuable support from Apple Developer Programs. Write to

Apple Developer Programs
Apple Computer, Inc.
20525 Mariani Avenue, Mailstop 51-W
Cupertino, CA 95014-6299

Sources for non-A/UX documents

Documents related to A/UX but not part of the A/UX documentation are available from other sources. For example, *Inside Macintosh* is available in retail bookstores that carry technical books, and the POSIX specification, *Portable Operating System Interface for Computer Environments,* is available from the IEEE. APDA (described above) also carries a complete library of documentation of interest to Macintosh and A/UX users and programmers. Contact the APDA office for a catalog.

Chapter 3 **A Closer Look at A/UX Release 2.0**

This chapter describes A/UX Release 2.0 in greater technical detail and briefly tells you about its kernel, shells, file systems, utilities, and Macintosh interface.

This chapter assumes that you are already familiar with UNIX in some form. It tries to answer some of the questions that a UNIX or Macintosh user may have about the specific structure and capabilities of A/UX. If you are new to UNIX, it is recommended that you read the book *A/UX Essentials* before reading this chapter.

A/UX Release 2.0 contains all the capabilities of a fully featured UNIX system. For example, it complies with the following specifications:

- IEEE specification POSIX 1003.1-1988 FUS
- ISO standard 9945-1
- FIPS standard 151-1

A/UX Release 2.0 also supports standard network protocols, such as TCP/IP, and accepts standard system extensions, such as X windowing software.

But A/UX Release 2.0 is more than just a fully featured UNIX operating system; it is a system with a Macintosh User Interface and other important Macintosh capabilities. An essential function of this chapter is to point out those features that are unique to Apple's implementation of UNIX technology.

The structure of A/UX

As soon as you turn on your Macintosh computer, the Macintosh Operating System (OS) performs certain hardware checks and toolbox initializations. If A/UX is designated as the working operating system (the startup application), the Macintosh software then surrenders control to A/UX. The "happy Macintosh" symbol is replaced by the A/UX startup screen, and A/UX processes take over.

As shown at the bottom of Figure 3-1, the Macintosh hardware and the A/UX Toolbox cooperate to provide the physical equipment on which A/UX acts. The hardware includes the main logic board, the monitor and its video display card, the keyboard, the mouse, auxiliary cards, the disk drives, any attached terminals or printers, and all other peripheral devices.

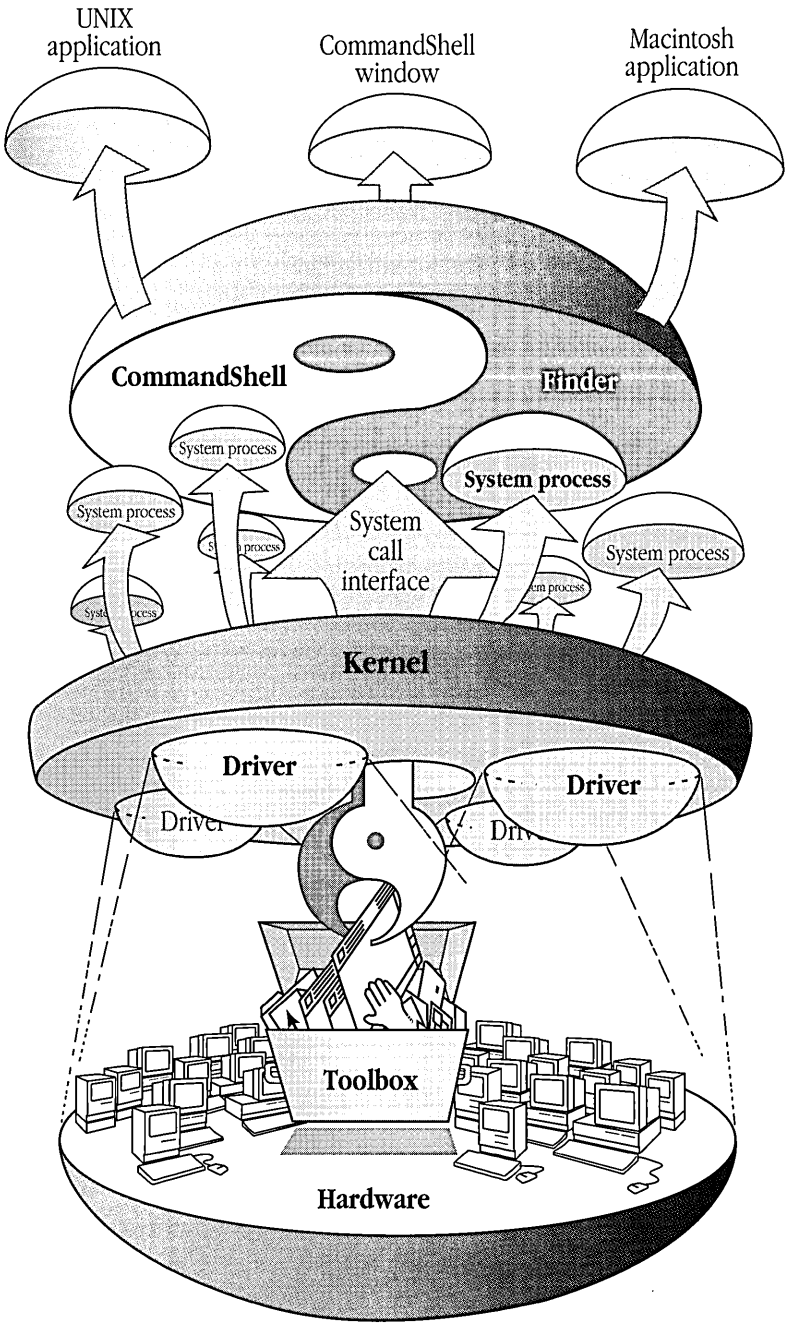
The **A/UX Toolbox** is a library that lets programs running under A/UX call many of the routines in the Macintosh read-only memory (ROM). The ROM routines are matched to the Macintosh hardware. They implement the graphical desktop display and the characteristic operating-system actions that give Macintosh computers their unique user interface. For example, the Macintosh Toolbox contains a set of routines (called QuickDraw™) that generate the icons, windows, and other graphical objects that appear in the Macintosh display.

The **kernel** lies at the center of A/UX; it is normally maintained as the file `/unix`. The kernel performs functions such as managing files, communicating with peripheral devices, and handling miscellaneous resource management tasks. It also provides a management layer, the system-call interface, between the hardware and user-level programs.

The A/UX kernel manages multiple processes running simultaneously on a single microprocessor by scheduling each one's access to processor time. It automatically starts the `init` process, which starts a number of system processes that always run in the background. These processes help with printing, communications, the login procedure, and other generalized system tasks.

A new kernel is generated each time a change occurs in hardware configuration. The new kernel incorporates into its code the drivers necessary to communicate with the equipment in your system and also generates the links it needs to the A/UX Toolbox. Thus the A/UX kernel controls the hardware by processing Toolbox calls and making calls to its own internal drivers. When an application needs to use a routine in the Macintosh Toolbox or gain access to a peripheral device, the kernel routes the necessary instructions.

■ **Figure 3-1** The structure of A/UX



When you start up a Macintosh application in A/UX, the kernel starts the A/UX Finder as a process and runs the application under it. The Finder lets multiple Macintosh applications run simultaneously and gives them shared access to such resources as the Clipboard, a scratch file with which you copy and paste data from one application to another.

When you start up a UNIX application or open a window to enter UNIX command lines, the kernel starts the CommandShell process. CommandShell then starts a shell process whose job it is to interpret user commands. You can open several overlapping or side-by-side CommandShell windows, each of which acts like a separate terminal would in a traditional UNIX system. The same or different shells can run simultaneously in multiple CommandShell windows, each interpreting commands for different tasks. While you work in one window, a job that you previously entered in another window can be completing itself automatically.

A/UX is unique in its ability to run both Macintosh and UNIX applications from its combined Finder-CommandShell environment. The Macintosh side includes hundreds of powerful programs, available inexpensively from Macintosh software dealers, that were developed to run on Macintosh computers without any UNIX system in mind. They include "what you see is what you get" desktop-publishing systems, computer-aided design and engineering programs (CAD/CAM), hypertext and hypermedia engines, spreadsheets, and sophisticated database managers. The UNIX side includes the many utilities that are part of A/UX as well as higher-level applications that you can buy from UNIX software vendors and install on your system.

UNIX applications running under A/UX can make Macintosh Toolbox calls. Hence they can include all the elements of the Macintosh desktop—windows, menus, and icons, as well as access to such resources as fonts and desk accessories. An increasing number of UNIX application developers are offering the Macintosh User Interface. Of course, you can do the same when you use the A/UX programming facilities to design and build your own software to run under A/UX.

Thus A/UX delivers the best of two worlds. It combines the ease of use of the Macintosh interface and the wealth of software already available for Macintosh computers with the traditional power of UNIX.

The rest of this chapter examines the A/UX hardware, kernel, system-call interface, Finder, shells, file system, and UNIX utilities in greater technical detail.

The hardware

Two important features of the UNIX operating system are its portability and its standardization. It is portable because you can adapt it to run on many types of hardware. Indeed, most computers of desktop size or larger are able to run some variant of UNIX. It is standardized because it is designed to work the same way regardless of the hardware on which it is running. UNIX technology achieves these features because almost all of the operating system is written in the high-level C programming language. Only small portions of the UNIX operating system are written in machine-specific assembly language.

As a fully featured UNIX system, A/UX Release 2.0 enjoys all the benefits of UNIX portability and standardization. A Macintosh running A/UX can communicate freely with non-Apple computers running other versions of the UNIX operating system, including most minicomputers and mainframes. Macintosh computers can run software developed for other UNIX environments, and software developed on a Macintosh running A/UX can be ported to other UNIX systems running on other computers. But besides its UNIX features, A/UX Release 2.0 gives you a gateway to the Macintosh world of hardware and system connectivity. The hardware possibilities available with A/UX Release 2.0 include:

- using Macintosh computers as terminals, workstations, and servers in a complete UNIX network
- choosing a variety of large or small display screens, both black-and-white and color
- using the Macintosh Extended Keyboard, with function keys and a separate numeric keypad
- connecting the Apple Hard Disk SC, AppleCD SC, and Apple Tape Backup 40SC
- using Apple LaserWriter and ImageWriter printers
- connecting a wide range of other peripherals, including CD-ROM drives, plotters, non-Apple printers, and non-Apple hard disk drives
- communicating with local and distant networks by convenient LocalTalk® and EtherTalk® hardware

A/UX runs on the Macintosh SE/30 and on computers in the Macintosh II family, including the Macintosh IIci, Macintosh IIcx, and Macintosh IIfx. The recommended minimum configuration for each computer in an A/UX Release 2.0 installation is 4 megabytes (MB) of random-access memory (RAM) and 80 MB of hard disk storage.

The A/UX kernel

The primary job of the A/UX kernel is to allocate hardware resources and to schedule tasks. As with other UNIX kernels, its most important operations include

- multitasking—scheduling process execution in a way that allows multiple jobs to share the microprocessor efficiently
- achieving virtual memory by paging—swapping segments between disk storage and RAM as needed
- managing device input and output by means of device drivers
- handling interprocess communication

A/UX Release 2.0 supports all the UNIX System V Release 2 Version 2 interprocess communication mechanisms, which include the following:

- semaphores—system calls that allow processes to synchronize execution (Semaphores usually mediate access to a resource among cooperating processes.)
- messages—system calls that allow processes to send formatted data streams to other processes
- signals—software interrupts that inform processes of the occurrence of asynchronous events (A/UX Release 2.0 supports both System V and BSD signals.)
- Streams—a collection of software tools for modularizing data transfer between device drivers and processes (For example, a Streams device driver controls the Apple Desktop Bus, which services the Macintosh keyboard and console. Streams support is very useful in the development of drivers for terminal or network devices.)

The system-call interface

When you run a program under A/UX, the program uses system calls to pass instructions to the kernel. This system-call interface operates in accordance with the UNIX System V Interface Definition (SVID) and also meets the IEEE specification POSIX 1003.1-1988 Full Use Standard

and the FIPS standard 151-1. The kernel, in turn, executes system calls by passing instructions to the hardware, as diagrammed in Figure 3-1. This means that you don't have to be concerned about low-level, machine-dependent details when running A/UX or developing software for it.

Libraries, particularly the C library `libc.a`, are an important part of the system-call interface to the kernel. They contain interfaces for all the system calls and subroutines and can be used by multiple programs.

Besides the standard UNIX libraries, A/UX supports the A/UX Toolbox. A/UX uses this library to route instructions to the Macintosh User Interface routines stored in ROM so that A/UX programs can include Macintosh windows, menus, and dialog boxes. As a result, cleanly written Macintosh programs can normally run under either the Macintosh OS or A/UX.

The system calls and libraries supported by the A/UX Toolbox are described in *A/UX Toolbox: Macintosh ROM Interface.* All other system calls and libraries, including the standard UNIX ones, are covered in *A/UX Programming Languages and Tools, Volume 1* and in *A/UX Programmer's Reference.*

The A/UX Finder

The A/UX Finder is the gateway through which off-the-shelf Macintosh applications communicate with A/UX. The Finder lets several applications run at the same time, each of which creates different windows that you can resize and move around on your desktop display. Clicking on any window makes it "active"—the one that accepts input from your mouse and keyboard. Nevertheless, applications in other windows continue to run. For example, a word-processing program can be printing a document in an inactive window while you work with a spreadsheet program in the active window. Windows created by Macintosh applications can also share the desktop display with CommandShell windows and windows created by X Window System applications.

The Finder helps you manipulate A/UX files graphically. In this role it lets you open, move, rename, and copy files without having to remember UNIX commands. For example, you can use the mouse to move a file between two UNIX directories by dragging its icon from a directory window to a folder icon that repesents another directory.

The A/UX Finder associates data files with their applications. If you double-click on a document created by a particular application (say, a word processing program), the A/UX Finder locates that application within your A/UX files and starts it running. At the same time the Finder tells the program to open the document. You see the document appear in its appropriate software environment without your having to find its application.

The A/UX Finder is based on the Macintosh MultiFinder®. You can find more technical information about MultiFinder in *Inside Macintosh*.

CommandShell

CommandShell is an A/UX utility that lets you open multiple windows on the screen, each of which acts like a separate terminal for UNIX line commands. When you enter a command in a CommandShell window, CommandShell sends it to one of the standard UNIX shells provided by A/UX: the Bourne shell, the C shell, or the Korn shell. Different windows may use the same or different shells.

The three A/UX shells have unique characteristics that make them useful for different sets of tasks:

- The **Bourne shell** (known in A/UX by the name `sh`) is the standard UNIX System V command interpreter. Newer Bourne shell capabilities supported by A/UX include user-definable shell functions, an option to collect accounting information about shell use, and support for multiple mail files.
- The **C shell** (`csh`) is a command interpreter that originated at the University of California at Berkeley. The C shell features a command language similar to the C programming language, a command history mechanism that enables you to repeat and edit previous commands, and the capability to give commands alternative names, or **aliases.** It also contains built-in job control functions that let you manipulate the number of processes running concurrently by moving processes into the background or foreground and by making them pause and resume.
- The **Korn shell** (`ksh`) combines many of the best features of the Bourne and C shells into a single package.

The restricted shell, `rsh`, is a related program that confines a user to a subset of the A/UX system commands. A system administrator may use this program to construct different levels of restriction. See *A/UX Local System Administration* for more information on `rsh`.

The A/UX shells let you submit one or more processes for sequential or simultaneous execution; these processes can start more shells and run additional processes. You can compose compound commands, and you can compose single commands that operate on multiple files. With its own internal command language, each shell also acts like a high-level interpreter; it handles variables, case statements, subroutines, and parameter passing. You can use this capability to compose and run your own shell scripts. Shells also let you redirect the input and output of each command they interpret, so you can pipe the output of one command to the input of another without needing to set up files for intermediate data.

For more detailed information about shell capabilities and shell commands, see *A/UX User Interface.*

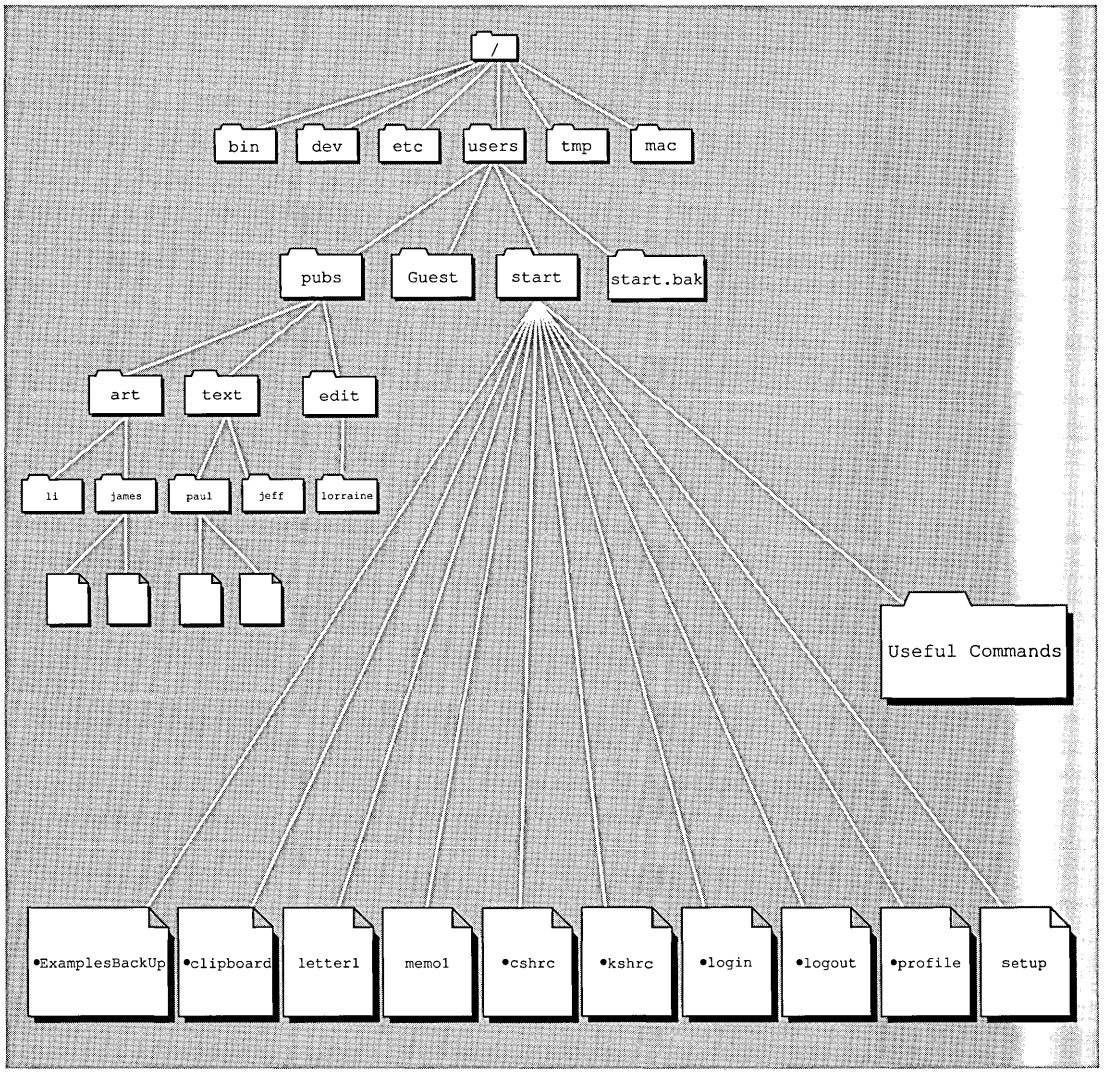
CommandShell is the gateway by which traditional UNIX programs run under A/UX. The rest of this chapter contains a summary of the various UNIX utilities and applications that are supplied with A/UX. When added to the hundreds of Macintosh applications that run under the A/UX Finder, they constitute a comprehensive selection of software for A/UX.

A/UX file systems

Macintosh computers running A/UX Release 2.0 maintain several file structures: AT&T UNIX file systems, BSD UNIX file systems, and Macintosh file systems. Files are easily transferred between the different systems. All A/UX file systems are hierarchical, with tree-like branchings as shown in Figure 3-2.

Each UNIX file system resides on a logical device, such as a disk or a disk partition, that contains files. The collection of all UNIX file systems mounted at a given time forms a **directory hierarchy.** At the top of every directory hierarchy is the **root** node, whose name is a slash (/). Branching from the root are **directories** (shown in Figure 3-2 as folders), which are files that contain lists of other files.

■ **Figure 3-2** A typical A/UX file structure



In the A/UX implementation of UNIX, the top directories beneath the root directory include `bin`, which contains many of the A/UX utility programs; `dev`, which contains A/UX device files; `etc`, which contains system administration programs and data files; `users`, which contains the home directories of A/UX users; `usr`, which contains programs that users commonly need; and `tmp`, a storage area for temporary files. A **home directory** is the directory that normally contains the files associated with a user account.

For each UNIX file or directory, permission to read, write, or execute can be assigned on an individual, group, or system-wide basis. This ability provides security against intruders while maintaining a flexible environment for sharing files among colleagues working on group projects.

The Macintosh file system is similarly structured. Macintosh files may be transferred to and from other Macintosh computers that don't have A/UX. For many tasks, this gives the user a choice of working inside or outside A/UX. For example, you can move work done on a Macintosh Portable computer into a UNIX environment simply by copying the work to a floppy disk and inserting the disk into a Macintosh computer running A/UX.

Document development utilities

Virtually all UNIX users have traditionally employed text-editing and text-processing applications to prepare letters, memos, source code, books, and manuals. UNIX text editors are useful to write plain text files; UNIX text processors can then format these files in a number of ways for printing on a variety of printers and typesetting machines.

Besides using the traditional UNIX facilities, described below, you can run commercially available Macintosh word processors and desktop-publishing applications under A/UX Release 2.0. Applications such as MacWrite® and Microsoft Word let you write, edit, format, and print documentation to virtually any level of professional quality without leaving A/UX. This book, for example, was written and formatted with Microsoft Word 4.0. You can obtain more information about these applications from any Macintosh software dealer.

UNIX text editors

A/UX Release 2.0 supplies several tools for creating and modifying text files.

- TextEditor is a new mouse-based editor that employs the Macintosh User Interface. Many people find TextEditor easier to learn and more efficient to use than the traditional UNIX editors described below.
- `ex` and `vi` form a text-editing family composed of a line editor (`ex`) and a full-screen editor (`vi`). These two programs were developed in BSD environments and have been the most commonly used UNIX editors in the past.
- `ed` is a simple, line-oriented interactive editor.
- `sed` is a batch stream editor that transforms text according to instructions supplied on the command line or stored in a command file. `sed` is used for both document preparation and programming.

A/UX also includes a number of filters that allow batch editing operations to be performed on text files. For example, the `tr` utility performs character translations, and `sort` can alphabetize lines in a file.

UNIX text processors

A/UX Release 2.0 offers version 2.0 of the **Documentor's Workbench (DWB),** a set of utility programs that help you format text files for output to a variety of devices. (Version 2.0 of DWB is not standard on AT&T's UNIX System V Release 2. Apple Computer provides DWB 2.0 by a special licensing arrangement with AT&T.) With these utilities, you can format text to include boldface and underlined characters, footnotes, headings, automatically numbered lists, tables of contents, justified paragraphs, line drawings, complex tables, graphs, and other features.

The main DWB 2.0 formatting utilities offered by A/UX are as follows:

- `nroff`, a program that formats text for output to terminals and line printers
- `troff`, a program that formats text for laser printers and phototypesetters
- `otroff`, the original `troff` program for C/A/T typesetters that provides compatibility with the `troff` program on earlier versions of DWB

- `grap`, a preprocessor that formats graphs and charts (a new feature of DWB 2.0)
- `tbl`, a preprocessor that formats tables from text
- `pic`, a utility that formats simple line drawings
- `eqn`, `neqn`, and `checkqn`—utilities for formatting and checking the command syntax of mathematical equations
- `mm`, a set of macro definitions for formatting general text
- `checknr`, a syntax checker for `nroff` and `troff` source files
- `checkmm`, a syntax checker for documents formatted with `mm` macros
- `man`, a set of macro definitions that formats text into manual pages like those in *A/UX Command Reference* and the online documentation

A/UX also provides TranScript, a suite of programs licensed from Adobe Systems. TranScript utilities translate the output from text and graphics formatters—such as `troff` and `plot`—into PostScript files for printing on Apple LaserWriter printers and other printers that support the PostScript page-description language. The printer and typesetter support in A/UX also includes postprocessor filters for the APS-5 phototypesetter, the Xerox 9700 printer, ImageWriter printers, and many others.

Other UNIX text-processing tools

A/UX provides several other UNIX text-processing utilities, including

- `spell`, a spelling checker
- `grep`, a program that searches for strings or regular expressions within files
- `diff`, a program that reports differences between two text files
- `diction`, a program that checks word use and, in conjunction with `explain`, recommends possible improvements
- `style`, a utility that analyzes sentence structure
- `me`, a set of macro definitions for formatting scholarly papers
- `ms`, another widely used set of macro definitions similar to `mm`

The software development environment

The UNIX operating system offers a rich software development environment. A/UX supports several programming languages with subroutine libraries and many sophisticated tools for writing, compiling, and debugging programs.

The AT&T System V Interface Definition (SVID) specifies how any system must perform to be considered compatible with System V. A/UX Release 2.0 adheres strictly to the SVID, which means that application source files written under the A/UX Release 2.0 software development environment usually require only recompilation to run on other UNIX systems that adhere to the SVID.

The A/UX development environment also offers features beyond the standard System V tools. A/UX includes selected 4.3 BSD system calls and utilities to make your work compatible with applications developed under BSD environments, as well as with POSIX and FIPS specifications.

Besides the software development facilities that come with A/UX Release 2.0, you can run many other commercially available development tools. They range from Ada and LISP utilities to object-oriented programming environments and expert system shells. Among them are several excellent environments for developing software for the Macintosh and other personal computers, including MS-DOS and OS/2 machines. Your favorite Macintosh, MS-DOS, or OS/2 development environment may already be ported to A/UX. Ask your authorized A/UX dealer for details.

UNIX programming languages

The A/UX programming environment offers several language compilers, including

- `cc`, a C compiler
- `f77`, a Fortran compiler
- `efl`, an extended Fortran compiler

C is the main UNIX programming language. **C** is a portable, high-level language that also offers very low-level operations, making it flexible and efficient for both application and system programming. In fact, like other UNIX operating systems, almost all of A/UX—including the C compiler itself—is written in C.

A/UX supports the Fortran programming language through its `f77` and `efl` compilers. **Fortran-77** is a high-level language, compiled by `f77`, that is especially useful for scientific and mathematical applications. The `efl` compiler translates source code written in Extended Fortran (a variant of Fortran) to Fortran-77 source code.

Assembly language programming is supported by `as`, the assembler utility.

A/UX offers several program debugging tools. The `lint` program, for example, helps you detect bugs, obscurities, inconsistencies, and portability problems in C source files. The `ctrace` utility is used for tracing C programs during execution. The `sdb` (symbolic debugger) program is useful for troubleshooting both C and Fortran-77 programs.

The following are the main libraries included in the A/UX programming environment:

- the standard C library, made up of functions and declarations used for file access, string testing and manipulation, character testing and manipulation, memory allocation, and other functions
- the Fortran intrinsic function library, consisting of the standard Fortran functions
- the math library, providing exponential, Bessel, logarithmic, hyperbolic, and trigonometric functions
- the object library, with functions for the access and manipulation of object files
- the A/UX Toolbox, containing routines that perform the Macintosh User Interface Toolbox and Macintosh OS functions

As with other implementations of System V, files compiled on A/UX follow the Common Object File Format (COFF), which makes them easier to move to other processors and operating systems.

A/UX also offers other UNIX programming utilities, such as `awk`, `bc`, and `yacc`. These utilities are described in the next section, "UNIX Programming Tools."

UNIX programming tools

A/UX Release 2.0 offers many useful utilities and libraries that simplify creating and maintaining programs. Listed here are a few of the programming tools available:

- Source Code Control System (SCCS)

  SCCS is a collection of commands used to control changes to source code and other text files (such as documentation). SCCS protects files by controlling access and update privileges and by preventing more than one user at a time from updating a file. SCCS also maintains an audit trail of revisions by identifying each revision of a file according to a version number, by recording who made each revision, by noting the date, and by including a comment indicating the reason for making the revision.

- `make`, a file regeneration utility

  The `make` program assists you in maintaining groups of interdependent files. This program relies on a description file in which you define file dependencies. After you change any part of one file, you can run `make` to regenerate all related files automatically.

- `curses`, a terminal-independent input and output utility

  The `curses` library is a collection of subroutines that manage video display terminals. The UNIX System V database `terminfo` contains a description of control sequences for hundreds of the most popular terminals, and you can add descriptions of others. Using the data in `terminfo`, `curses` executes programs that read from and write to terminals without concern for their specific type or brand. In addition to `terminfo`, A/UX also supports the older `termcap` database to preserve compatibility with software migrating from older systems.

- `awk`, a pattern-matching language

  The `awk` programming language is useful for pattern matching, data manipulation, information retrieval, and report generation. This tool is especially helpful when you must deal with information from record-oriented databases.

- `bc`, an arbitrary-precision arithmetic language

  The `bc` language is especially useful for computing accurately to many decimal places and for converting numbers from one base to another. The `bc` language features a complete control structure and an immediate-mode operation. The output of the `bc` compiler is interpreted and executed by a collection of routines that can perform arithmetic on indefinitely large integers and on scaled fixed-point numbers.

- `adb`, a general-purpose debugger
- `yacc`, a system for writing compilers
- `lex`, a program that generates a lexical analyzer for compilers and other language processors
- `cb`, a C program formatter
- `mkshlib`, a command that builds shared libraries
- `cpp`, a macro preprocessor for C
- `m4`, a macro preprocessor for C and Fortran
- RCS, a revision control system similar to SCCS

Communication utilities

A/UX Release 2.0 supports AppleTalk, a simple and popular networking system for users of personal computers and workstations. It also supports the traditional UNIX networking facilities. They are very powerful, although not as easy as AppleTalk to set up and maintain. The A/UX communications facilities let you and other users share computers, terminals, files, printers, modems, software, electronic mail, and other resources.

This section describes some of the AppleTalk, System V, BSD, and NFS networking features that are part of A/UX Release 2.0.

AppleTalk

AppleTalk, the easy-to-use network software from Apple Computer, is based on the Open System Interconnection (OSI) model specified by the International Standards Organization. A/UX supports printing and AppleShare client services on AppleTalk networks so your computer running A/UX can share these resources with other types of computers that support AppleTalk.

TCP/IP

A/UX includes B-NET, Apple's version of the widely used BSD 4.3 networking utility package. **B-NET** implements the standard UNIX Transmission Control Protocol/Internet Protocol (TCP/IP).

Widely adopted as a networking standard, TCP/IP has found its way from the ARPANET network of university and research facilities across the Defense Data Network of the U.S. Department of Defense and into commercial applications, office automation, and personal computer networks. The A/UX implementation of TCP/IP also supports subnetworks for more efficient message routing and Internet name domains for simplified host name administration.

The following B-NET applications allow you to communicate with other TCP/IP-supported computers on your network, regardless of their operating systems:

- `telnet`, a virtual terminal program, allows you to log in on and use remote computers as if your terminal were directly connected to those computers.
- `ftp`, a file-transfer facility, allows you to transfer ASCII and binary files to and from computers on your network. You do not need to know about the operating systems of the remote computers to transfer files between them and your computer.

B-NET also offers the following network commands. These commands are in many ways more convenient than `telnet` and `ftp`, but they can only be used between computers running operating systems (like A/UX) that support a derivative of the 4.3 BSD networking package.

- `rlogin` lets you log in to remote computers.
- `remsh` allows you to execute UNIX commands on remote computers. The `remsh` program is the same as the standard 4.3 BSD `rsh` utility, but it has been renamed to avoid conflict with the System V restricted shell program, `rsh`.
- `rcp` copies files between any two computers on the network.
- `ruptime` reports on the status of each computer on the local network.
- `rwho` reports the login names of all users currently logged in on all the computers in the local network.
- `talk` transmits messages between your terminal and that of another user. This utility is similar to the UNIX `write` program, which is used for communicating with users on the local computer, except that `talk` can also work across the network and uses a split screen to display both sides of the communication.

A/UX currently supports two methods of connecting to a TCP/IP network. One method requires an Ethernet card (such as the EtherTalk card available at your authorized Apple dealer) connected with coaxial cable to the network. The other method uses the Serial Line Interface Protocol SL/IP (part of the standard A/UX distribution) and a serial line connected to your computer.

A/UX provides the tools for you to develop your own custom B-NET network applications. The BSD `sockets` mechanism provides communication endpoints for network transmissions. The Transmission Control Protocol (TCP) uses a special technique to transmit sequenced packets of data. The User Datagram Protocol (UDP) uses a different technique that is faster but less reliable. A/UX's programming tools allow you to build new network applications with either protocol.

Serial communications

By connecting a serial line or modem from a Macintosh serial port to another computer running a standard version of the UNIX operating system, you can use the following A/UX communications utilities:

- `cu`, a System V program that helps you to log in to a remote UNIX system
- `tip`, a program that connects you to a remote UNIX system (a BSD program similar to `cu`)
- `uucp`, a program that permits you to send files from one UNIX system to another on a store-and-forward basis
- `uux`, a program that permits you to enter commands for execution on a remote UNIX system
- `slip`, a program that allows you to access a TCP/IP network over a serial line
- `mail` and `mailx`, System V and BSD mail facilities that offer electronic mail service to users across the network

A/UX also includes `Kermit`, a popular public-domain remote terminal and file-transfer program used for connecting microcomputers, minicomputers, and mainframe computers across modems and serial lines.

Network File System (NFS)

With an Apple Ethernet card or a SL/IP connection, A/UX fully supports the Network File System (NFS) protocols, providing NFS server, client, and Yellow Pages facilities.

Developed and licensed by Sun Microsystems, NFS lets users store and use files on different brands of computers running different operating systems. This capability makes A/UX particularly useful in a mixed-workstation network. NFS gives you transparent access to file systems located on other machines, and you can permit users at other computers to have access to A/UX files stored on your computer.

Transparent access to file systems means that users don't have to remember the physical devices or computers on which their files are located. Users do not have to know the operating systems of the remote computers. In a transparent access mode, system administrators for NFS servers choose which file systems to export for network access. Authorized users then mount these remote file systems onto their local file systems. Thereafter, workstation users manipulate the remote files with the commands and utilities they are familiar with on their local computers.

For example, A/UX commands from your computer can create, edit, and compile files located on a VAX™ computer running NFS. Likewise, users at IBM PC-compatible computers running NFS can use MS-DOS commands to get access to A/UX files on your system. This capability prevents your site from becoming tied to any particular workstation family by providing simplified access to the files of other types of computers.

Another advantage of NFS is that it eliminates the problems of storing multiple copies of files across the network. This advantage can result in substantial savings of storage space. For example, ten A/UX workstations on a network can save over 200 MB of disk storage by sharing common system files, such as the online manuals, the standard utility programs, the spelling dictionary, and so on.

The Yellow Pages (YP) facility provides a distributed network database service. A YP master server maintains a global copy of files important to the YP domain it serves. In this manner, network information can be maintained in one location. The master server routinely updates this information on one or more slave servers, to enable uninterrupted service in the event that a master server becomes unavailable to the network.

Other utilities

A/UX offers more than 500 UNIX utilities that perform thousands of functions. This section gives you only partial list. For complete details, consult *A/UX Reference Summary and Index.*

Many utilities manipulate files. They include

- `cat`, which creates, displays, or adds to the contents of a file
- `cp`, which copies a file
- `more` and `pg`, which display file contents one screenful at a time
- `mv`, which moves files
- `rm`, which removes files
- `ls`, which lists the files in a directory
- `lp`, which spools files to a disk for printing

Many utilities manipulate processes. Some of these are

- `ps`, for displaying information about active processes
- `nice`, for setting the priority of processes
- `at`, for scheduling processes to be executed at specific times
- `crontab`, for executing processes at specific intervals
- `kill`, for sending signals to processes

Commands for managing shells include

- `set` and `setenv`, built-in shell commands for customizing the C shell
- `cd`, a command that is built into each shell for changing the current directory
- `stty`, a utility for setting terminal characteristics
- `echo`, a utility for printing the expanded argument list of a command
- `shl`, a utility for managing shell layers

A/UX Release 2.0 contains hundreds of additional utilities, including many for system administration, user communication, and recreation (games abound on UNIX systems). The wealth of built-in tools and utilities, added to the hundreds of available Macintosh and UNIX applications, gives A/UX Release 2.0 the richest access to software of any version of UNIX available today.

Glossary

active window: The frontmost or top window on the desktop; the workspace in which the mouse and the keyboard are currently effective.

administrator: See **system administrator.**

alias: An alternate name used to invoke or identify a command, a network host, a list of users, or some other named entity.

APDA: See **Apple Programmers and Developers Association.**

Apple Desktop Bus (ADB): A low-speed, input-only serial bus that connects the keyboard, mouse, and optional input devices to the system bus.

Apple Programmers and Developers Association (APDA): Apple's worldwide direct distribution channel for more than 350 Apple and third-party development tools and documentation products. Membership is open to anyone interested in developing Apple-compatible software or hardware products.

AppleShare: Apple Computer's file server system using AppleTalk networks.

AppleTalk: Apple Computer's network software based on the **Open System Interconnection** model specified by the **International Standards Organization.**

application: A program used to perform a particular task, such as computer-aided drawing, document preparation, accounting, or payroll management.

argument list: All of the arguments passed to a program.

argument: A piece of information included on the command line in addition to the command; the shell passes this information to the command, which then modifies its execution in some particular way. Filenames, for example, are often supplied as arguments to commands, so that a command will operate on the named file.

ARPANET: A wide area network that links government, academic, and industrial installations around the world. Primarily connecting research sites, the ARPANET was developed in the 1960s by the Advanced Research Projects Agency of the U.S. Department of Defense. See also **Defense Data Network.**

assembler: A program development tool that converts assembly-language instructions into machine language.

assembly language: a low-level programming language that corresponds to a specific computer's binary machine language.

autoconfiguration: An A/UX facility that automatically configures device drivers into the kernel upon system startup.

autorecovery: An A/UX facility that automatically repairs damaged file systems and rebuilds a good system if possible.

A/UX: Apple Computer's version of the UNIX operating system. A/UX Release 2.0 is enhanced with many Macintosh features.

A/UX command: The name of an executable file distributed with the A/UX operating system. For example, `ls` is a binary executable distributed in the `/bin` directory that prints directory information to the terminal; typing `/bin/ls` as a command causes the file to execute. See also **shell program, built-in shell command.**

A/UX Toolbox: Libraries, subroutines, and utilities that provide access from A/UX to the Macintosh Operating System and to the Macintosh User Interface Toolbox in the Macintosh ROM.

B-NET: The A/UX implementation of the **Internet** protocols and utilities.

Berkeley Software Distribution (BSD): A version of the UNIX operating system developed at the University of California at Berkeley. The A/UX operating system incorporates many of the features of BSD versions 4.2 and 4.3.

Bourne shell: The standard UNIX System V command interpreter. See also **shell.**

BSD: See **Berkeley Software Distribution.**

built-in shell command: A command written into the shell itself rather than in a separate executable file.

button: A pushbutton-like image in dialog boxes where you click to designate, confirm, or cancel an action.

C shell: The standard BSD command interpreter. See also **shell.**

C: A portable programming language that offers both high-level and low-level features, making it flexible and efficient for developing application and system software. A/UX itself is written almost entirely in C.

CD-ROM: A method of storing mass data on optically-encoded disks. A typical CD-ROM disk can hold 600 MB of data.

central processing unit (CPU): The "brain" of the computer; the microprocessor that performs the actual computations in machine language.

check box: A square button that displays an "X" when you click it.

choose: To pick a command by dragging through a menu. You often choose a command after you've selected something for the program to act on. For example, you may select a disk and then choose the **Open** command from the File menu.

Chooser: A standard Macintosh desk accessory that helps you enable and disable peripheral devices on your system.

click: (v.) To position the pointer on something, and then press and quickly release the mouse button. (n.) The act of clicking.

client: (1) A computer that has access to services on a network. The computers that provide services are called **servers.** A user at a client may request file access, remote login, file transfer, printing, or other available services from servers. (2) A computer that can access the **X Window System for A/UX.**

Clipboard: A standard Macintosh file that holds material cut or copied from a document. The contents of the Clipboard are often immediately pasted into the same or another document.

command interface: The way in which a user communicates with the computer. A/UX Release 2.0 has two command interfaces: the traditional UNIX **command line** interface, and the Macintosh **graphical user interface.**

command line: The entire input string that you enter in response to the shell prompt to issue a command or to start a program. The command line includes the command itself and any **arguments** and **flag options.**

command syntax: The rules for forming command lines that A/UX will accept. Each command has its own specific syntax.

Commando: An A/UX utility that lets the user compose **command lines** by working in a **dialog box.**

CommandShell: An A/UX utility that creates multiple windows, each of which contains a **command interface** to one of the A/UX **shells.**

Common Object File Format (COFF): The output file produced on A/UX systems by the **assembler** (`as`) and the **link editor** (`ld`). The term "common" refers to how this format is used on a number of processors and operating systems, including A/UX.

compiler: A program development tool that converts instructions written in a higher-level language such as C or Fortran into assembly language.

console: The main terminal (that is, keyboard and screen) of your system. The console must be connected to your system. The console receives log and error messages from the operating system that are not sent to any other terminal.

Control Panel: A standard Macintosh desk accessory that lets you set characteristics of your console such as sound level and screen colors.

copy: To make an exact duplicate of a file or part of a file. When a named entity is copied, the copy must be given a different name.

CPU: See **central processing unit.**

crash: The condition in which a system becomes temporarily inoperable due to internal error or a mistake in operation or administration.

current directory: The last directory into which you moved with the `cd` command; this directory is the starting reference point for all relative pathnames you enter. Also called the *working directory.*

cursor: A symbol on the screen that indicates your position on the command line or inside a file. The cursor is usually a small box or an underscore, and it usually blinks.

database manager: An application that helps the user create, manipulate, and search structured files containing various kinds of data.

date/time stamp: Information in a file's header that tells when the file was created or last changed.

debugger: A program development tool that helps the programmer analyze the operation of a program.

Defense Data Network: A single, wide area, packet-switching network that integrates the **ARPANET** research network and the MILNET defense network.

desk accessory: A Macintosh utility program that can be invoked while an application is running. Desk accessories are accessed through the Apple menu displayed by every Macintosh application.

desktop publishing: An area of application software for producing printed documents with full typography, layout, and graphics.

desktop: The Macintosh **graphical user interface.** The viewing screen represents a surface on which objects appear as **icons** and workspaces are represented by **windows.**

development environment: An integrated collection of **program development** tools that support the whole process of writing and debugging programs in a given language.

device driver: Kernel-level software that controls the exchange of information between a process and a device.

device: See **peripheral device.**

dialog box: (1) A box that contains a message requesting more information from you. Sometimes the message warns you that you're asking your computer to do something it can't do or that you're about to destroy some of your information. In these cases, the message is often accompanied by a beep. (2) A box that an application displays to request information or to report that it is waiting for a process to complete.

directory hierarchy: The collection of all files on the currently mounted file systems.

directory: A file that contains a list of other files.

document: A file created by an application, usually containing information entered by the user.

Documentor's Workbench (DWB): A group of utilities used for formatting files. Files formatted by DWB utilities can be printed on a wide variety of output devices.

double click: (n.) Two clicks in quick succession, interpreted as a single command. The action of a double click is different from that of a single click: for example, clicking an icon selects the icon; double-clicking an icon opens it. (v.) To position the pointer where you want an action to take place, and then press and release the mouse button twice in quick succession without moving the mouse.

drag: To position the pointer on something, press and hold the mouse button, move the mouse, and release the mouse button. When you release the mouse button, you either confirm a selection or move an object to a new location.

DWB: See **Documentor's Workbench.**

editor: An application that lets you write and manipulate files of text.

environment: A list of characteristics that identifies you to the system and influences and constrains your access to it. You can modify many of these characteristics.

Ethernet: A standard network communications specification generally using a type of coaxial cable to connect computers in a local area network. The Ethernet specification was developed by Digital Equipment Corporation, Intel Corporation, and Xerox Corporation.

EtherTalk: Apple's data-link product that allows an **AppleTalk** network to be connected by **Ethernet** cables.

file system: A logical device (such as a disk partition) that contains the data structures that implement all or part of the **directory hierarchy.**

file: For UNIX operating systems, an array of bytes; no other structure is implied by UNIX systems, which even treat peripheral devices like files.

filter: A utility that transforms its input in some way and writes this transformed data to the standard output. Lines submitted as input to the `sort` command, for example, are reordered so that the lines in the output are arranged alphabetically or numerically.

Finder: A Macintosh program that helps you manage the file system and finds appropriate applications to read files.

FIPS: Federal Information Processing Standard, an operating system definition promulgated by the National Institute of Standards and Technology. A/UX complies with FIPS 151-1.

flag option: An argument included on the command line that instructs a program to alter its output or to change its mode of execution. A flag option is usually a hyphen followed by one or more characters. For example, the `-l` flag option to the `ls` command makes this utility print extra information, such as the date a file was last saved.

folder: (1) A holder of documents and applications on the Macintosh desktop. Macintosh folders, like UNIX file system directories, allow you to organize information in a hierarchical fashion. (2) For the BSD `mailx` program, a file that you create for saving similar mail messages.

font: A collection of print characters unified by a distinctive look. Times Roman, for example, is the default font for `troff`.

format: (1) To divide a disk into tracks and sectors where information can be stored. Blank disks must be formatted before you can save information on them. (2) To process a text file for output with a utility such as `nroff` or `troff`. See also **formatter.**

formatter: A utility that processes text for output to a device. The `nroff` and `troff` utilities, for example, are formatters that justify the margins, center the titles, number the pages, and perform other enhancements that improve the printed appearance of text files.

Fortran-77: A high-level programming language especially useful for mathematical and scientific applications.

graphical user interface: A way of interacting with a computer in which the user manipulates graphical symbols (such as **icons**) and uses pull-down **menus** instead of writing command lines.

group: A collection of A/UX users defined by a single name.

guide: A book in the A/UX library that teaches a particular subject or group of subjects in its entirety. Compare **reference.**

guru: An advanced UNIX expert, capable of performing sophisticated administration tasks and repairing obscure system faults.

home directory: The directory assigned to a user at the end of the login process.

hypermedia: Any of various techniques for presenting information electronically, using a variety of media—displayed text, synthesized sounds, video, and so on.

hypertext: A method of presenting text electronically in which the reader can choose to jump from certain words or passages to other, logically-related words or passages.

icon: An image that graphically represents an object, a concept, or a message.

IEEE: Institute of Electrical and Electronic Engineers.

initialize: To force software into a known, consistent configuration, usually at startup time.

International Standards Organization (ISO): A standards organization composed of representatives from the national standards bodies of 63 member countries. A/UX complies with ISO standard 9945-1.

internet: (1) A group of networks interconnected by bridges or gateways. (2) The Internet, used as a proper noun, usually refers to the Defense Data Network (DDN), descendent of the DARPA (Defense Advanced Research Projects Agency) Internet (also called the ARPANET). (3) When the proper noun is used as an adjective (for example, Internet domain) this refers to a networking standard used by the DDN.

interprocess communication: A mechanism for transmitting information between processes. Interprocess communication mechanisms supported by A/UX include **messages, semaphores, shared memory, signals, sockets,** and **Streams.**

ISO: See **International Standards Organization.**

Kermit: A remote terminal and file-transfer software program used for connecting **microcomputers** and **mainframe computers** across modems and serial lines.

kernel: A UNIX program that manages the system hardware. For example, the kernel manages files, communicates with peripherals, and handles other low-level resource management tasks.

keyboard configuration: The relationship between the physical locations of keys on a keyboard and their character meanings.

Korn shell: A command interpreter that combines many of the best features found in the standard System V shell (the Bourne shell) and the standard BSD shell (the C shell). See also **shell.**

library: A collection of related functions or declarations available to a program for linking at compile time.

line editor: A utility for entering and manipulating text. The commands to add or change text are entered from a command prompt, they only operate on the lines you specify, and you cannot always see the results of your changes right away. The `ed` and `ex` utilities are line editors. See also **screen editor.**

link: (1) To give an alternative name to a file. (2) In programming, to collect one or more routines into an executable program.

link editor: The `ld` utility, which brings together code modules to form a complete program.

list: To display on a monitor, or print on a printer, the contents of memory or of a file.

local system administration: Management of a single computer. This includes such functions as starting up and shutting down the system, adding and removing user accounts, and backing up and restoring data. See also **network administration.**

LocalTalk: Apple's low-cost connectivity product consisting of cables, connector modules, and other equipment for connecting computers and other devices.

log in: To identify yourself to the system by entering the login name of your account and your account password.

logical disk: A disk partition that is treated by the operating system as a separate disk. See also **partition.**

login name: The name of a user's account. Used for identification purposes.

Macintosh Operating System (Macintosh OS): The lowest-level software in the Macintosh. It does basic tasks such as I/O, memory management, and interrupt handling.

Macintosh User Interface: The standard conventions for interacting with Macintosh computers. The interface ensures users a consistent means of interacting with all Macintosh computers and the applications designed to run on them.

macro: A collection of instructions or requests invoked by a single name.

MacX: Display server software that runs with both the **Macintosh Operating System** and the **X Window System for A/UX.**

mail: Text messages received from other users on the same or other A/UX systems.

mainframe computer: A large computing system, designed to handle great quantities of data from many sources at high speed.

Maintosh OS: See **Macintosh Operating System**

makefile: A file containing a collection of operations used by the `make` utility to construct related files.

menu: A list of choices presented by an application, from which you can select an action. With Macintosh-style applications, menus appear when you use the mouse to point to and press on titles in the menu bar at the top of the screen. Dragging through the menu and releasing the mouse button while a command is highlighted chooses that command.

messages: A group of system calls that allow processes to communicate by sending formatted data streams to each other.

microcomputer: A computer, such as any of the Macintosh family, whose processor is a **microprocessor.**

microprocessor: A **central processing unit** contained on a single integrated circuit.

modem: From *modulator/demodulator,* a peripheral device that converts digital data into a form suitable for telephone or other transmission media, and back again into digital form.

monitor: The viewing screen part of a **console.**

mount: To install a file system onto the directory hierarchy. See also **unmount.**

mouse button: The button on the top of the mouse. In general, pressing the mouse button initiates some action on whatever is under the pointer, and releasing the button confirms the action.

mouse: A small device you move around on a flat surface next to your computer. The mouse controls a pointer on the screen whose movements correspond to those of the mouse. You use the pointer to select operations, to move data, and to draw with in graphics programs.

move: Of a file, to relocate it from one directory to another.

MS-DOS: An operating system used in IBM microcomputers.

multi-user: A mode or ability of an operating system to support several people using the same computer simultaneously.

multitasking: The ability of an operating system like A/UX to execute multiple processes simultaneously by sharing its central processor and peripherals among processes.

network file system (NFS): A protocol suite developed and licensed by Sun Microsystems that allows different makes of computers running different operating systems to share files and disk storage.

network administration: Management of the software and hardware that connects computers in a network. This includes such functions as assigning addresses to hosts, maintaining network data files across the network, and setting up internetwork routing. See also **local system administration.**

network: A collection of interconnected, individually-controlled computers, along with the hardware and software used to connect them. A network allows users to share data and peripheral devices and to exchange electronic mail.

node: In a network, equipment capable of taking data out or putting data in.

object file: The form of a routine produced by a language translator such as a compiler or assembler. An object file can be linked to other object files to build a program. See also **source file.**

online documentation: Documentation that is read from the console monitor, as opposed to *print documentation.*

Open System Interconnection (OSI): A logical structure for network operations standardized by the ISO. OSI provides a network design framework to allow equipment from different vendors to be able to communicate.

open: Of a file, to make its contents accessible to application software. Of an application, to put it into operation.

operating system: Low-level software that controls a computer by performing such basic tasks as I/O, memory management, and interrupt handling.

OS/2: An operating system used in IBM microcomputers.

OSI: See **Open System Interconnection.**

page: In A/UX, a 4-kilobyte portion of a program that is defined by the kernel for transfer between main memory and disk storage. See **paging.**

paging: A method by which some operating systems (including A/UX) use secondary memory to store inactive portions of processes while active portions are held in main memory. While a process is executing, a portion of its code and data resides in main memory. Other portions, divided into pages, are automatically read in from disk storage as needed. When the system runs low on free main memory, the kernel makes more available by writing unneeded pages back out to disk. The kernel shuffles pages in and out of main memory and disk storage until the process has executed. Also called *page swapping.*

partition: A set of contiguous blocks on a physical disk.

password: An arbitrary string of characters, known only to one or a limited number of users, that must be entered before certain system capabilities become available.

peripheral device: A piece of hardware, such as a disk drive, modem, printer, or terminal, that is connected to a computer and used for reading or writing data.

pipe: (n.) (1) A special character used to connect two or more commands in a series so that the output of one command becomes the input to the next. (2) An intermediate file in which data is passed from one process to another. (v.) To connect two or more commands in a series so that the output of one command becomes the input to the next.

pipeline: A **command line** that contains one or more **pipes.**

plotter: A peripheral device that creates drawings by moving electronically-controlled pens over paper.

plug-in card: A printed-circuit card that can be installed inside a computer of the Macintosh II family to give it new capabilities.

port: (n.) (1) A socket on the back panel of a computer where you plug in a cable for connection to a network or a peripheral device. (2) A connection between the central processor unit and main memory or a device (such as a terminal) for transferring data. (v.) To move software from one computer environment to another.

portability: A characteristic of software by which it can easily be installed and operated on many different kinds of computers.

POSIX: Portable Operating System Interface for Computer Environments, a standard developed by the IEEE. It defines a standard operating system interface and environment that supports application portability. A/UX complies with its current embodiment, POSIX 1003.1-1988 FUS.

postprocessor: A utility used to perform final processing of data.

preprocessor: (1) A utility used to transform data that is then written to another utility. For example, `tbl` is a preprocessor that formats tables from properly coded text files; the output of this processor is usually piped to a more general text formatter like `troff`. (2) A function of certain compilers that provides file inclusion, comment deletion, and macro substitution.

print spooler: A utility that writes a representation of a document's printed image to disk or to memory, schedules it to print in a queue of other jobs, and then prints it.

process: An instance of a program in execution. Usually one copy of a program is stored on a UNIX system like A/UX, but multiple instances of the program—each having its own address space—can be executed simultaneously as separate processes.

program development: The process of designing, writing, assembling or compiling, and debugging a piece of software.

program regeneration: A computer-aided process by which a program is brought together from separate pieces in response to an overall set of instructions.

program: A file containing coded instructions to the computer. A compiled program is a file created first in source code, then transformed by the compiler or assembler into object code. A **shell script** is a program that does not need to be compiled because it is interpreted by the shell.

pull-down menu: A menu that is hidden until you move the pointer to its title and press the mouse button.

QuickDraw: The part of the Macintosh User Interface Toolbox that performs all graphic operations on the Macintosh screen.

Read Me file: A file supplied with A/UX containing last-minute information about the current release.

reference: A book in the A/UX library that constitutes an encyclopedic resource for looking up information about a subject or group of related subjects. Compare **guide.**

regular expression: A notation that uses a special set of metacharacters for specifying a text pattern. For example, the `vi` and `ex` editors use the `^` metacharacter at the beginning of a regular expression to stand for the beginning of a line; therefore the regular expression `^A` stands for the set of all lines that begin with an uppercase A.

Release Notes: A set of loose pages supplied with A/UX containing last-minute information and change pages for the regular documentation.

remote system: On a network, any computer other than the local system.

rename: Of a file or other named entity, to change its name without copying it or altering its content.

resource: (1) Synonymous with **device driver.** A *printing resource* is a system file that lets you print on a corresponding printer attached to the computer. (2) Data or code stored in a Macintosh resource and managed by the Resource Manager.

restricted shell (`rsh`): A program that confines a user to a subset of the A/UX system commands.

ROM: An acronym for *read-only memory,* which is memory whose contents can be read, but not changed, and is used for storing permanent information. For example, the ROM in the Macintosh II contains the routines for the Macintosh User Interface.

root: (1) The top directory in a UNIX directory hierarchy. Written as a slash (/), it is the first element in every absolute pathname. (2) The user with unlimited system privileges. Also called the *superuser.*

SCC: See **Serial Communications Controller.**

SCCS: See **Source Code Control System.**

screen editor: A utility for entering and manipulating text. A screen editor displays the contents of a file by a full screen at a time. The commands to add or change text are entered anywhere on the screen, and the screen changes immediately to reflect the changes. The `vi` utility, for example, is a screen editor. See also **line editor.**

script: A file containing commands. See also **shell script.**

SCSI: See **Small Computer System Interface.**

select: (v.) To designate where the next action will take place. To select using a mouse, you click an icon or drag across information. In some applications, you can select items in menus by typing a letter or number at a prompt, by using a combination keypress, or by using arrow keys. (n.) A command to a device such as a printer to place it into a condition to receive data.

semaphores: A group of system calls that allow processes to synchronize execution.

Serial Communications Controller (SCC): The chip on the Macintosh main logic board that handles serial I/O through the modem and printer ports.

Serial Line Interface Protocol (SL/IP): A data transmission protocol that lets your A/UX system connect to a TCP/IP network through a serial line.

serial communication: Data communicated over a single-path communication line, one bit at a time.

serial lines: Data transmission lines over which information is transmitted sequentially, one bit at a time.

server: A computer that provides a particular service across a network. The service may be file access, login access, file transfer, printing, and so on. Computers from which users initiate the service are called **clients.**

shared library: A collection of routines and utilities that can be accessed and used by multiple programs.

shared memory: A mechanism that allows processes to share parts of their virtual address space with each other.

shell command: See **built-in shell command.**

shell layer: An instance of a shell, invoked by the `shl` program. Through this program, you can simultaneously run up to seven shell layers.

shell program: A series of commands to be executed by the shell. A shell program may be entered at the shell prompt or stored in a file. Shell programs that are stored in files are referred to as **shell scripts.** Shell programs are sometimes called *user-defined commands.*

shell script: A shell program contained in a text file. Entering the name of the shell script from the command line executes the commands listed in the shell script.

shell: A utility that accepts your commands, interprets them, and passes them on to the appropriate programs for execution. A/UX provides three shells: Bourne, C, and Korn. Each can be used as an interpreted programming language.

signal: A software interrupt that causes a program to be temporarily diverted from its normal execution sequence. A/UX uses both System V and BSD signals. Signals can be issued, handled, and otherwise manipulated via a set of **system calls.**

slot: One of the connectors inside any computer of the Macintosh II family that accepts a **plug-in card.**

Small Computer System Interface (SCSI): A specification of mechanical, electrical, and functional standards for connecting small computers with intelligent peripherals such as hard disks, printers, and optical disks.

socket: On a network, a communication mechanism originally implemented on the BSD version of the UNIX operating system. Sockets are used as endpoints for sending and receiving data between computers.

Source Code Control System (SCCS): A collection of commands used to control changes to text files, such as source code and documentation. SCCS protects files by controlling access and update privileges, and by preventing more than one user at a time from updating a file. SCCS also maintains an audit trail of revisions.

source file: A text file containing coded instructions to the computer. A source file generally cannot be executed by the computer; instead, the source file must be compiled and linked to produce an executable **program.**

spool: To place a job in a queue, particularly a printing job in the **print spooler.**

spreadsheet: An application in which financial or other data are placed in cells in a two-dimensional array. The cells are connected by formulas, so that when a quantity is changed in one cell other cells also change.

stack: A document created by HyperCard.®

stream editor: An editor that operates automatically on a quantity of text, editing it in accordance with preprogrammed instructions.

Streams: A collection of tools that assist programmers to modularize data transfer between device drivers and processes.

string: An ordered collection of characters.

System V Interface Definition (SVID): AT&T's formal specification for compatibility with the UNIX operating system. A/UX adheres fully to the SVID.

System V: The AT&T standard UNIX operating system. System V Release 2 forms the foundation of the A/UX system.

system accounting: The process of getting certain information about system usage, such as the number of users logged on and the length of time each has used the system.

system administrator: A person charged with setting up and maintaining an A/UX system.

system call: A kernel-level procedure that can be invoked by any application. System calls are documented in Section 2 of *A/UX Programmer's Reference.*

tape backup: A copy of files made on magnetic tape so they can be restored if the originals are inadvertently erased.

TCP/IP: See **Transmission Control Protocol/Internet Protocol.**

terminal: A device through which you interact with the computer; namely, the keyboard, mouse, or other input device and the monitor. See also **console.**

text file: A file containing information expressed in text form and whose contents are interpreted as characters using the American Standard Code for Information Interchange (ASCII) format.

text formatting: The process of adding to text certain computer-readable codes that instruct a printer how to set the text in type and place it on the page.

TextEditor: A program included with A/UX Release 2.0 that lets the user edit text with the mouse and pull-down menus.

toolbox: See **A/UX toolbox.**

Transmission Control Protocol/Internet Protocol (TCP/IP): A suite of networking protocols developed initially for the U.S. Department of Defense.

Trash icon: The image of a trash can that appears in the lower right corner of the Macintosh desktop, used for deleting files.

tree structure: The layout of a UNIX directory hierarchy. Organized like an inverted tree, the directory hierarchy begins with the root directory at the top. Branching downward from the root are the rest of the directories and files in the system.

UNIX: A general-purpose, time-sharing **operating system** and related set of utilities, originally developed at AT&T Bell Laboratories. **A/UX** is an enhanced version of UNIX.

unmount: To remove a file system from the directory hierarchy. See also **mount.**

user interface: The rules and conventions by which a computer system communicates with the person operating it.

user name: See **login name.**

utility: A software tool used for building or maintaining systems or applications. UNIX provides hundreds of utilities, including compilers, editors, and text formatters.

window: (1) The area that displays information on a desktop; you view a document through a window. You can display or close a window, move it around on the desktop, and sometimes change its size, scroll through it, and edit its contents. (2) The portion of a collection of information (such as a document, picture, or worksheet) that is visible in a viewport on the display screen. Each window is internally represented in a window record.

working directory: See **current directory.**

X Window System for A/UX (X): A network-based user interface and development environment that includes **MacX.**

Yellow Pages: A Network File System (NFS) facility for sharing a common database of user information across a local area network.

Index

A

B

C

D

E

F

G

H

I, J

K

L

M

N

O

P, Q

R

S

T

U

V

W

X

Y, Z

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