Start Here

You can make your Mac work

harder if you understand the

basic hardware and software

technologies powering that

deceptively simple desktop.

What's more, you can horrify

your friends.

By Tony Smith

Photography by Garry Hunter

I t's very easy – if you know how. But why should
you? After all, you bought your Mac to do a
specific task, to lay out pages, design graphics,
organise a business, write – or rewrite – essays, not
to investigate the deep structure of a page descrip-
tion language.

In a perfect world, the technology underlying
those tasks would be utterly transparent. In fact an
understanding of the basic technologies can help
make your Mac work harder – and make it a lot
simpler to decipher new developments and assess
whether they are relevant for you. People don't buy
Macs to learn about hard disk technology, or 24-bit
colour, or aliasing, but because they need to store
documents safely and retrievably (on a hard disk),
display graphics at high resolution (24-bit defines
this), or organise a chaotic desk life (when aliasing
could be very useful).
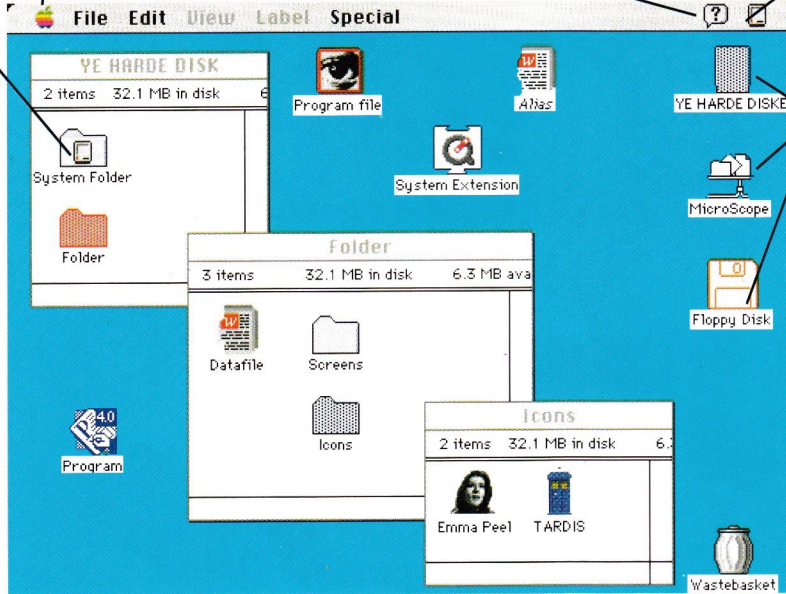
THE DESKTOP: FIND YOUR WAY AROUND THE FINDER
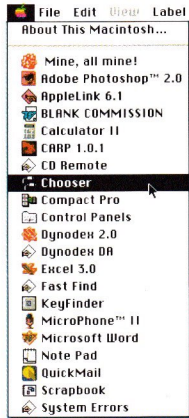
The Apple menu allows desk accessories and aliases as well as programs, folders and files to be easily accessed.

From the System folder, Control Panels allows you to adjust the way different facets of your Mac – for instance, file sharing or virtual memory – work.
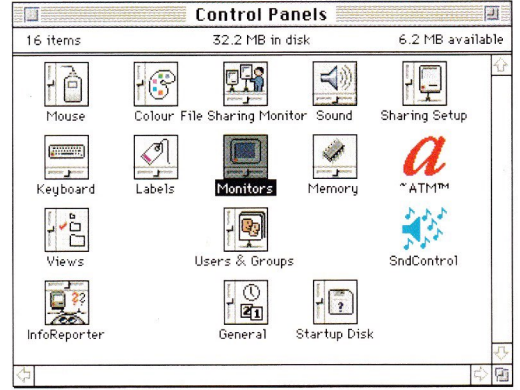
Balloon Help offers basic advice on your system. When you put the cursor over an object, information about it is shown in a balloon.

The Applications menu allows you to jump between the applications you have open and to return to the Finder.

The System folder contains all the essential controls of your system software, such as the Control Panels. Handle with care.

Each hard disk is represented by a different icon. Top is a hard disk, middle a server volume and bottom a floppy disk.
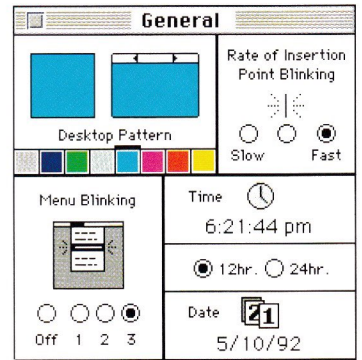
The Wastebasket allows you to trash files and eject disks.

From the System folder, items which are dropped into the Apple Menu items folder will appear in the Apple menu.

From the Control Panels folder, the General Control Panel allows you to change which background colour you have on your desktop, and how the internal clock and calendar work.
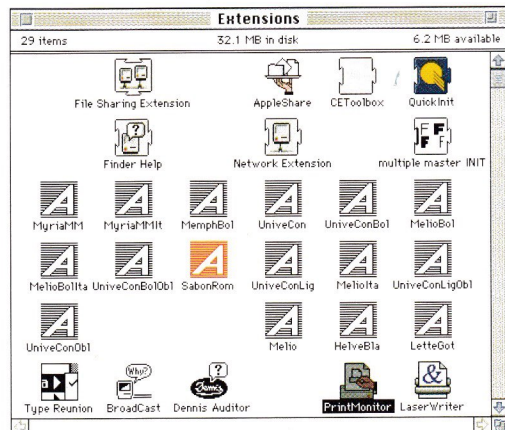
System extensions, such as fonts and links to peripherals, are put in the Extensions folder in the System folder.
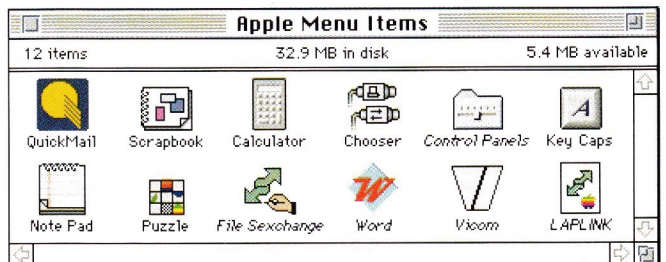
Macs are renowned for their ease of use, with an interface based on a graphical rather than textual metaphor, and a coherent set of commands – command-a for select all, for example – has been adopted across the vast majority of Mac applications. This consistency is also true of hardware. A chip is a chip is a chip so far as it goes.

The happy result of this is that a very little knowledge goes far further than it has any business too and the technology basics we provide in this article should provide a reasonable grounding. Finally, for practical advice on setting up a system, get hold of *The Absolute Beginner's Guide*. For details see the end of this article.

Hardware

The CPU

At the centre of every Mac is its microprocessor chip, also known as the CPU (Central Processing Unit). This is the machine's brain – it interprets the instructions listed in programs and works out any necessary maths calculations.

Computers also have a heart, a tiny crystal of quartz that beats many millions of times per second. The CPU uses each pulse to determine the amount of time it spends on each program instruction. So the higher the number of pulses the crystal, also known as the CPU clock, produces per second, the faster the computer. Computer manufacturers use the megahertz (MHz) unit to measure the clock's speed.

The Mac LCII, for example, contains a 68030 chip running at 16MHz. The Quadra 950, on the other hand, uses the more advanced 68040 CPU, running at 25MHz.

The Maths Co-Processor

The CPU is designed to perform a wide range of general tasks, all of them relatively simple. For more complex instructions, particularly those involving large numbers, a more specialised chip is necessary – the maths co-processor. Any calculations that would take the CPU a great many clock cycles to work out are handed over to the co-processor.

The result is a faster system, but only in cases when the CPU needs to offload work, such as graphics, computer aided design (CAD) or number-crunching applications. In less maths-intensive situations, the CPU isn't overstretched, and the co-processor remains idle.

Not all Macs are sold with a maths co-processor, though most of those that don't can have one added at a later date.

HOW TO MAKE AN ALIAS

1 An alias allows you to create a dummy file of a file, folder, or application which acts as a pointer to the original. Select the file for which you want to create an alias...
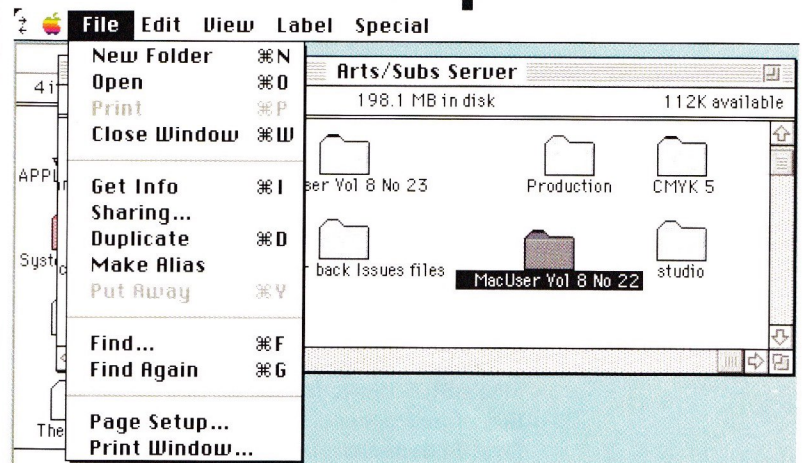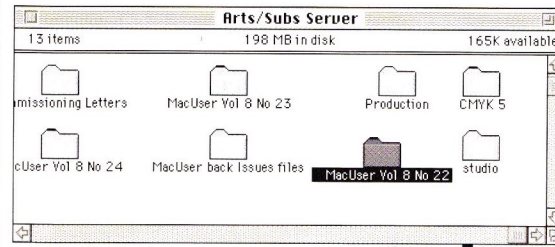
2 ...and select the Make Alias command from the File menu.
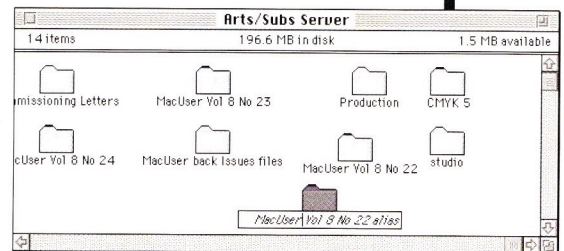
3 The alias appears with a name in italics.

4 The alias can be dropped into the Apple Menu Items folder so that it appears in the Apple menu, or it can be left on the desktop to allow you easy access to the file or folder.

◀ Memory: RAM and ROM

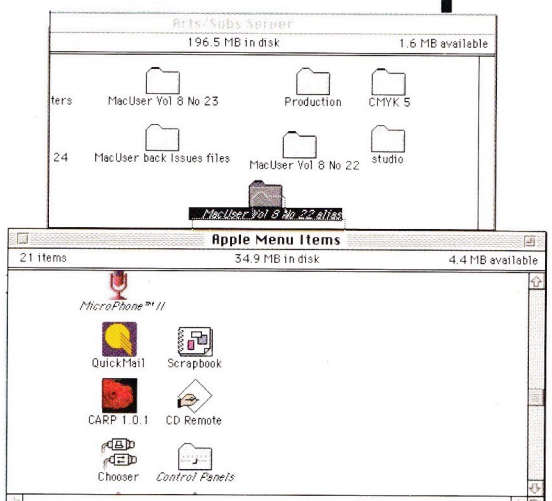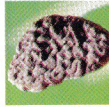If the CPU is to run a program, say, a word processor, it needs somewhere to store the instructions and the data (that is, a document) they work upon. It also needs somewhere to put the results of calculations. That is the role of the computer's memory, of which there are two basic types. RAM (Random Access Memory) is known as volatile memory – information stored in a RAM chip can be erased or changed. However, when the Mac is switched off, the RAM is wiped, which is why it's vital to save any work you want to keep before pulling the plug.

Macs are classified by the amount of RAM they contain: a Classic 4/20, for example, is thus named because it has four megabytes of RAM and a 20 megabyte hard disk.

ROM (Read Only Memory) differs from RAM in that the contents are fixed at manufacture and can't be erased. For that reason, ROM chips are used to contain programs and data that are vital for a computer to work properly. Apple stores the Mac's BIOS (Basic Input/Output System), a collection of instructions that tells the CPU how to perform fundamental operations like write information to a disk or draw a window on the screen.
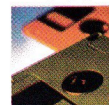
The Hard Disk
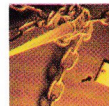
If a Mac's RAM is cleared when the power is turned off, a more permanent method of storing programs and data is vital – you don't want to have to install all the applications and information you're likely to want every time you switch your Mac on, after all. To save you the trouble, computers come with a hard disk.

The hard disk is basically a spinning rigid (hence 'hard') disk of glass covered with a magnetic substance, as used on cassette tape. Tiny read/record heads skate across the disk's surface to allow the very precise positioning of information, stored in complete units called files.

That precision is necessary to produce very high storage capacities in a very small space, which is why hard disks are so useful. However, it also means they are susceptible to physical damage. For that reason, hard disks are sealed in airtight containers – even something as tiny as a speck of dust can dislodge the heads from a data track, preventing the information from being read.

Floppy Disks

Floppies are essentially the same as hard disks, only cruder. Instead of glass, a flexible plastic is used (hence the name) which is why they can withstand physical shocks without damaging the information stored on them. The downside is that information is more easily corrupted by the floppy drive's

mechanics. It also means that floppies can hold only about one-and-a-half megabytes of programs and data – hard disks can hold between 20 and 500 times that.

Floppies, then, are best for distributing information and hard disks are better for storing it permanently.

Virtual Memory
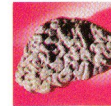
If you're running a large program to work on lots of data, it's quite possible that the CPU will find it no longer has enough memory to perform calculations. One way around this problem is to store data or sections of the application that are used infrequently in a temporary file on the hard disk, thus freeing memory.

The CPU is fooled into thinking that these files are real RAM, so such storage is called 'virtual memory'.

SIMMs

It's possible to run System 7.0 and a single application (and associated data) on a Mac with two megabytes of RAM. That's fine if you just use a word processor or a spreadsheet. Start using complex programs like Photoshop when you're working with large image files and two megabytes will not be enough. That's why four megabytes of RAM is generally considered the minimum for most users.

You can add more memory to your Mac by inserting SIMMs (single in-line memory modules) into the slots provided on the machine's circuit board. Some Macs use specific memory chip configurations, for example, PowerBooks, so always check with your dealer before buying and installing SIMMs.

Ports

These days, the word 'port' refers to any connector that allows the Mac to be wired into some other device, be it a keyboard, printer or scanner (collectively called peripherals) – the interfaces between the computer and the rest of the world.

Macs have a number of ports. All models have the ADB (Apple Desktop Bus) port for the keyboard and mouse. They also have a SCSI (Small Computer System Interface) port, either a standard linear connector (all desktop Macs) or a proprietary square one (PowerBooks), into which most devices like external hard disks are connected.

There are also two serial (that is, data is transmitted one bit at a time rather than in groups as SCSI does) ports, one for modems, the other for printers or AppleTalk networks. ▶

The Monitor

The Mac's display screen, also called a monitor or VDU (Visual Display Unit), builds up an image out of tiny dots, or pixels, like a domestic TV. The level of image detail that a screen possesses is called its resolution and is measured in the number of pixels per inch of screen. Most Mac monitors have a resolution of 72 dots per inch (dpi); by comparison most PC screens are about 60dpi.

Colour screens have one further level of detail – the colour depth – which indicates the range of colours that can be displayed. Colour depth is measured by the number of bits (digits) required to define the colour of each pixel. The greater the number of bits per pixel, the more shades a screen can show. A 24-bit screen, for example, means that each pixel can be one of 16.7 million shades, but an 8-bit screen can only display 256 colours.

The image itself is stored (before conversion to a video signal) in its own bank of RAM, the size of which determines the number of bits available to define the colours. For this reason, graphics cards have been limited in the number of colours they can display. A 24- or 16-bit image can still be displayed on Mac with an 8-bit screen – the computer uses a process called Dithering to mimic the missing colours with combinations of those available – but the results aren't too impressive.

Cards

Cards are small circuit boards that slot into connectors on the Mac's main board. Apple uses two types of connector – NuBus and those found in the IIsi and the LC, both of which are incompatible.

The add-in cards themselves come in a number of different types. Apart from graphics boards, there are accelerator boards, such as Radius' Rocket, which add an extra CPU to share the Mac processor's workload, so speeding up the whole system. Other cards boost the performance only of specific tasks. SuperMac's Thunder, for example, is designed to make Photoshop's special effects filters work more quickly.

Software

Programs And Data
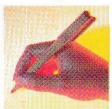
The information stored in a computer can comprise either programs or data. Programs, often called applications, are essentially lists of instructions that will cause the CPU to perform certain functions. Data, on the other hand, can be the contents to a letter, a spreadsheet, a photograph or a graphic.

Programs should always be run from the hard disk – never floppies because they can become corrupted too easily. The licence you automatically agree to when you buy some software allows the program to be copied onto your own hard disk. But be warned, it's illegal to copy it again to a second machine unless you erase the first copy.

The Operating System

System 7.0, the Mac's operating system (OS), is basically just another computer program. What separates it from software like KidPix or Microsoft Excel is that it's designed to handle all the general functions of the Mac. So, for example, it handles all the memory management tasks, all the file manipulation functions, and controls the screen output. Hardware is also controlled by the operating system by calling up the simple programs that make up the Mac BIOS. In the same way, applications often call up parts of the OS software to perform certain functions. So every time you save a file that you have, say, created in QuarkXPress, XPress doesn't do the job, it delegates the task to System 7.0.

The advantage of doing things this way is that it becomes possible to standardise all the fundamental tasks that a computer needs to perform. So you do the same things to print a graphic file in Adobe Illustrator as you do to print an Excel spreadsheet.

System Extensions

System 7.0 was designed by Apple to be modular, so that extra functions can be bolted on to the basic operating system if you need them. There's a special folder kept in the System folder where such extensions are stored, and when the Mac is switched on and System 7.0 copied into RAM and run, these are copied ready for use. Apple's QuickTime is one such extension, providing the means to handle moving images.

System extensions were originally called INIT files (because they're loaded when you initialise the system). Some software writers haven't yet changed their programs, so if you come across an INIT file, treat it just like an extension.

The Finder

The operating system can be controlled by the user through the Finder. Through the Mac's use of a mouse and its graphical user interface (GUI), all the basic file manipulation tasks are available to the user at the Finder's 'desktop' view, which simulates your desk and work area.

It does this through the use of icons. These are small pictures that represent data files, program files, certain OS functions and items of hardware. The icons are more than just visual names. Put the mouse pointer in front of a datafile icon, double-click and that icon will 'open' – it will be loaded into RAM alongside the application used to create it, which will then be run. Place the pointer in front of

THE ESSENTIAL JARGON-BUSTER

ADB (Apple Desktop Bus) Connects keyboards, mice and other input devices to Macs.

Bit (BInary digiT) Most basic item of data a computer can handle.

Byte Group of (usually 8 or 16) bits.

Control Panels Used to set certain Mac options, such as sound.

Extension A file that adds functionality to the operating system. Also called an INIT.

External Adjective applied to any peripheral not built in to the computer.

Finder Mac's user interface and filing system.

Font A set of numbers, symbols and letters in a given style.

Hard disk High density storage system for all programs. Doesn't need power to hold information.

Icon Pictorial representation of a file.

INIT See Extension.

Kilobyte (K) 1024 bytes.

Megabyte (M) Approximately one million bytes.

Menu A list of program command options.

Operating system Fundamental Mac control program.

Pointer Controlled by the mouse, allows the user to select icons and command the Mac. Also called the cursor.

RAM (Random Access Memory) Computer memory that can be changed. Erased when power supply is cut.

ROM (Read Only Memory) Memory which can't be erased.

SCSI (Small Computer Systems Interface) Port on the back of a Mac for peripherals such as hard disks or scanners.

Serial port Connector for peripherals such as printers, modems or other Macs on a network.

THE ABSOLUTE BEGINNER'S GUIDE

The step-by-step guide to getting started on your Mac is available free to *MacUser* readers. Turn to page 138.

from one of the pull-down menus located in the menu-bar at the top of the screen. The Apple menu is slightly different in that you can decide what you want to appear in it, and that includes data files and applications, such as Chooser, used to select printers.

The System Folder contains a second folder, called Apple Menu Items – any icon dropped in there will also appear in (and can be run from) the Apple menu.

The Apple menu contains an alias of the Control Panel folder. Selecting this displays the various programs that can be used to set up the way your Mac behaves. The Sound Control Panel, for example, lets you choose which noise you want the operating system to use as a prompt for information and allows you to set the speaker volume. If your Mac has a microphone, the Control Panel will also let you record new sounds.

In the right-hand corner is the applications icon. Clicking on this shows what programs are running. One of the advantages of System 7.0 is that it can load and run more than one application at once – what the jargon fiends call multi-tasking. This has the particular benefit that you can copy or move (cut) information from one type of document and place that copy (paste) into another.

Fonts

Time was when the Mac had only one method of using different typestyles, or fonts. Adobe devised a system comprising fonts for printers and separate ones for displaying on screen. The latter were somewhat crude, so the company created Adobe Type Manager (ATM) to allow the much more detailed printer typefaces (often called Type 1 or PostScript fonts) to be used on-screen, too.

Then Apple decided it wanted in on the act and launched its TrueType fonts as part of System 7.0, offering the same level of print and screen quality as ATM. Fortunately, both formats are compatible and they will co-exist on your Mac. Both are installed the same way – drop the font files on the *unopened* System Folder and the Mac will put them where they need to be. Restart the machine and away you go.

Removing them is a little more involved. Type 1 fonts are stored in the Extensions folder, so are removed in the usual way. TrueType fonts are actually part of the System file, so you double-click on the System icon which will open up to display a list of fonts, sounds and other files. Locate the TrueType fonts and move them to the Wastebasket. Adobe still uses screen fonts, and you'll find them here too – remove them just as you would a TrueType font.

When you've finished, close the System window by clicking the exit box in the window's top left-hand corner and Restart your Mac.

an icon and hold the mouse button down, and the icon can be moved from one part of the screen to another. Let go of the mouse button over a floppy disk's icon and a copy of the original file will be made and saved on the floppy.

Files can be removed from the hard disk by dropping them in the Wastebasket. To prevent accidents, files aren't erased immediately – you have to select the Empty Wastebasket option from the Special menu to perform the real erasure. So it's possible to remove icons from the bin and put them back on the desktop.

To make the organisation of files easier, there are other icons called Folders. These act as storage areas for data and programs, just as real folders contain papers. Double-clicking on a folder will cause it to open and reveal its contents.

Folders can, of course, contain other folders. If you've got a file at the bottom of such a stack of Folders, one way of accessing it without opening every single container is to create an alias of that file. An alias is basically a dummy-icon – it's not a copy of the original file, just a note to tell the operating system where its source icon is. So double-clicking on the alias, which is placed somewhere more convenient, opens the original file.

Most operating system functions are available