

# OS X All the Best of Unix

*by Graham J. Ellis*

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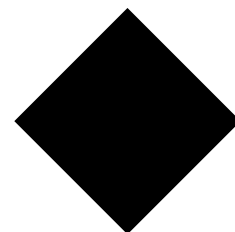
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# OS X - All the best of Unix

## A Soothing talk for the petrified

*Unix has a reputation of being an old operating system designed by computer scientists now in their 40s or 50s with long beards and long hair, wearing cleverly worded geek tee-shirts, shorts and open-toed sandals ... for use by similar "types".*

*There is some truth in the reputation (who **wants** to wear a shirt and tie?) but it turns out that these designing computer scientists really knew their stuff, and came up with an operating system structure that's so correctly structured that it provides the best software engine to run in the background on modern computers.*

*In this talk, we'll have a quick look at what Unix is (and what it isn't) and see how Apple have used it as the basis for their OS X, and how the short-term pains for existing Mac users as they switch will be more than compensated by long-term gains.*

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## 1.1 Core values of an operating system

What would you like as the software engine in your computer, the one that provides the bedrock on which your applications run?

- Something that was designed to fit a multi process and perhaps multi-user environment
- Something that's well tested and reliable
- Something that doesn't burn up vast amounts of memory and computer power out of proportion to what it's doing
- Something that is accessible to the user at a "bits and bytes" level, a programming level, a command-based level, and a GUI applications level
- Something that's non-proprietary
- Something that doesn't cost very much
- Something that has a big user base

Unix is all of these.

You would also like it to be:

- Easy to use
- Easy to learn
- Difficult to screw up
- Plug and play straight out of the box

And, that's where, in common wisdom, it is said to fall over. But it needn't be that way, since these last features all relate very much to how the operating system is presented to the user. This presentation layer can be tailored to meet the extra criteria. Apple have done this very cleverly, giving you OS X which is an easy-to-use, easy-to-learn Unix which you'll be enjoying the same evening you install it.

You don't need to be a fully qualified motor mechanic to enjoy driving your BMW, but isn't it a comfort to know that the engine is based on sound technology, and, with the occasional oil change, it will go on running for many years beyond other cars built at the same time? OS X is a BMW, based on the Unix engine. (I'll leave you to draw other parallels to cars which are built down to a manufacturing price to maximise profit, and to cars which are so rare and specialist that they cost a fortune and it's then very hard to find spares or experts to fix them.)

## 1.2 What is Unix?

Unix derived from the Multics project in the late 1960s – a project developing an operating system independent of hardware. But it was growing out of hand. "Unix" is a created word, not an acronym, and is a bit of a pun on Multics. At some point Brian Kernighan, one of the creators, was asked to explain it, and he said approximately, "Maybe 'Unix' is one of whatever Multics is many of." The UNIX spelling as opposed to Unix stems from the desire of the trademark overseers (originally in AT&T, now in Open Group), to mark it distinctly in written text.

The very first implementation of UNIX, by Ken Thompson of Bell Labs in 1970, ran on a DEC PDP-7 minicomputer with only 8KB of RAM and a magnetic tape drive. Subsequent versions shortly thereafter ran on other Bell Labs computers, allowing their users to move away from proprietary operating systems that tied them to a single hardware vendor for each new generation of computer, on pain of recurring software redevelopment costs.

The UNIX system evolved over a twenty-year period, and a distinctive philosophy emerged among the programmers who developed it. Unlike previous operating systems, the UNIX system was designed to be consistent; while it may initially look complex, once you understand the interrelation between the components, and learn to reason along the same lines as the developers, you will find the UNIX system straightforward to use. This is because the consistency of design was pursued at all levels, and the same general design philosophy was applied to virtually all the components of the system.

Let's look at some of the elements of Unix.

### **A Process Manager**

Unix provides a multi-process system that can manage a large number of processes all at the same time, separated from one another. All processes except one or two of the operating system's own run in a virtual machine environment. This means that any reasonable combination of user processes can run at the same time, with no conflicts occurring as they require the same piece of physical memory. If memory runs out, processes are simply swapped onto the disk as necessary.

The process manager includes not only the memory manager, but also a processor manager that shares the time of the processor(s) between each of the processes that is available to run, ensuring fair play.

Here's a process list, taken from the OS X system on which I'm writing this set of notes, this very minute:

USER	PID	%CPU	%MEM	VSZ	RSS	TT	STAT	TIME	COMMAND
graham	475	6.0	13.7	1451416	35932	??	S	145:06.94	/System/Library/CoreServices/C
graham	74	3.0	5.3	88104	13776	??	Ss	40:18.74	/System/Library/CoreServices/W
graham	333	1.8	0.1	5484	148	??	Ss	75:22.77	/System/Library/Frameworks/Ker
graham	301	0.2	0.5	725524	1220	??	S	65:25.49	/Applications/Palm/Palm Deskto
root	76	0.0	0.0	1276	76	??	Ss	0:36.92	update
root	79	0.0	0.0	1296	88	??	Ss	0:00.00	dynamic_pager -H 40000000 -L 1
root	102	0.0	0.1	2332	192	??	Ss	0:00.26	/sbin/autodiskmount -va
root	126	0.0	0.3	3912	752	??	Ss	10:41.86	configd
root	127	0.0	0.1	1812	204	??	S	0:00.12	/usr/sbin/blued
root	170	0.0	0.0	1288	128	??	Ss	0:01.79	syslogd
root	176	0.0	0.2	1604	508	??	Ss	0:00.02	/usr/libexec/CrashReporter
root	198	0.0	0.2	1836	556	??	Ss	0:04.56	netinfod -s local
root	205	0.0	0.2	2448	580	??	Rs	0:04.72	lookupd
root	215	0.0	0.1	1528	244	??	S<s	0:40.57	ntpd -f /var/run/ntp.drift -p
root	223	0.0	0.2	8952	404	??	S	0:42.80	AppleFileServer
root	228	0.0	0.2	2848	508	??	Ss	0:00.70	/System/Library/CoreServices/c
root	237	0.0	0.0	1288	84	??	Ss	0:00.01	inetd
root	241	0.0	0.0	3748	120	??	S	0:00.14	DirectoryService
root	249	0.0	0.0	1276	48	??	S	0:00.00	nfsiod -n 4
root	250	0.0	0.0	1276	48	??	S	0:00.00	nfsiod -n 4
root	251	0.0	0.0	1276	48	??	S	0:00.00	nfsiod -n 4
root	252	0.0	0.0	1276	48	??	S	0:00.00	nfsiod -n 4
root	257	0.0	0.1	2192	244	??	Ss	0:00.03	automount -m /Network/Servers
root	265	0.0	0.1	19156	160	??	Ss	0:26.87	/usr/sbin/httpd
root	273	0.0	0.0	2136	68	??	Ss	0:00.76	/System/Library/CoreServices/S
www	281	0.0	0.6	19412	1700	??	S	0:00.29	/usr/sbin/httpd
root	282	0.0	0.0	1560	120	??	Ss	0:01.15	cron
graham	286	0.0	1.4	752680	3660	??	Ss	0:14.10	/System/Library/CoreServices/l
root	288	0.0	0.1	5108	356	??	Ss	1:10.82	slpd -f /etc/slpsa.conf
graham	293	0.0	0.3	20656	856	??	Ss	0:02.76	/System/Library/CoreServices/p
graham	297	0.0	5.0	750308	13084	??	S	0:13.57	/System/Library/CoreServices/F
graham	298	0.0	1.3	729988	3484	??	S	0:29.70	/System/Library/CoreServices/D
graham	299	0.0	0.8	733576	2100	??	S	16:12.47	/System/Library/CoreServices/S
graham	300	0.0	0.3	710676	708	??	S	0:00.40	/Applications/iTunes.app/Conte
graham	302	0.0	0.3	725356	836	??	S	0:00.82	/Applications/Palm/Transport M
graham	303	0.0	0.4	725988	1124	??	S	0:00.56	/Applications/Extras/Bluetooth
graham	304	0.0	13.5	832996	35340	??	S	119:57.18	/Applications/Internet Explore
www	305	0.0	0.6	19412	1676	??	S	0:00.22	/usr/sbin/httpd
www	306	0.0	0.6	19412	1688	??	S	0:00.24	/usr/sbin/httpd
www	307	0.0	0.7	19412	1752	??	S	0:00.27	/usr/sbin/httpd
www	308	0.0	0.6	19412	1480	??	S	0:00.23	/usr/sbin/httpd
graham	314	0.0	2.6	739172	6760	??	S	2:46.70	/Applications/Utilities/Termin
graham	948	0.0	0.4	5876	948	std	Ss	0:00.16	-tcsh (tcsh)
root	956	0.0	0.1	1344	300	std	R+	0:00.00	ps aux
root	1	0.0	0.1	1292	168	??	SLs	0:00.00	/sbin/init
root	2	0.0	0.0	1300	120	??	SL	0:19.25	/sbin/mach_init
root	41	0.0	0.0	3604	48	??	Ss	0:01.60	kextd
graham	72	0.0	1.1	18552	2808	??	Ss	0:06.10	/System/Library/Frameworks/App

## A user manager

This is a multi-user operating system. It was designed like that. I'm writing away hard at the keyboard of this computer whilst, at the same time, Lisa might be editing our web site, and the computer might be acting as a web server too. I don't want my work to affect Lisa, nor does she want her work to affect me, even if we should accidentally run something that conflicts. Thus, each of us has our own separate account (user name) and resources, with the operating system keeping us apart as necessary.

Look at the previous report and you'll see that the machine I'm using to write these notes has processes running under users *graham*, *www*, and *root*. My computer is a web server as well as being my desktop, and I'm not affected by it one little bit. There are plenty of resources and I can open the bonnet and read the gauge if I wish:

```
8:27AM up 5 days, 23:43, 3 users, load averages: 0.30, 0.43, 0.46
```

At Well House Consultants, we write and run training courses, and many of our machines are running Unix-flavoured operating systems such as OS X and Linux. The user and process manager are so good, so beautiful and robust, that we can use one of our trainee workstations as a server throughout a course. At the same time, we have a trainee actually seated at the machine, using it as their personal console for the course. This happens so transparently that the student concerned isn't aware of any difference, and we've done this on courses with up to 16 trainees, where we happened to use one of our least powerful boxes as the server.

You saw my comment "robust"? Look at the report just above. I haven't had to restart my machine for six days. Why did I have to restart it even then? Because I presented a training course using it in Mannheim, Germany, the week before last and I had to shut it down and pack it up for the 500-mile drive home!

## A device manager

Unix also provides you with a device manager, with devices being owned by users, and with the ability for device ownership to change as necessary. Screen, keyboard, CD writer, and so on, are all managed via the OS with no danger of a CD being written with half of your files mixed with half of mine. The computer I'm writing on tells me that it has 99 devices at present, ranging from a Bluetooth modem through to "null" - the Unix drainpipe into which you can tip infinite quantities of unwanted output.

## A file system manager

All access to the disk is through the operating system, and Unix provides a structure for this. Like all modern operating systems, a hierarchal structure is used, where files (leaves) are held within directories.<sup>1</sup> Directories in turn are grouped together in other directories, until eventually you reach a single master directory called the *root*, or */*.

In Unix, the */* separator is used between elements of a directory path and file name, as opposed to a *\* on Windows and a *:* in Mac Classic. All files have an ownership associated with them, and a set of permissions that specify what the owner, his friends, and any other user can do to those files.

In another window on this computer, I was looking back at some files I was using late last year and updating some file content. I'm in directory:

```
/Users/graham/road/rmcs/data
```

---

<sup>1</sup> you may be more familiar with the name "folders" instead of "directories"

and the information about my files is as follows

```
-rw-r--r--  1 graham  staff  430 Oct  5 08:54 chinese.inc
-rw-r--r--  1 graham  staff  413 Oct 21  2002 chippie.inc
-rw-r--r--  1 graham  staff  278 Oct 21  2002 logout.inc
-rw-r--r--  1 graham  staff  539 Oct 21  2002 passchange.inc
-rw-r--r--  1 graham  staff  468 Oct 21  2002 threebells.inc
-rw-r--r--  1 graham  staff  536 Oct 21  2002 welcome.inc
```

Although these files happen to have a "." in their name, there's no need for this. Extensions to files that describe the file type are not mandatory in the operating system, although they do provide a convenience.

At this point, you probably see a geek, dressed just as I described when I opened my talk, going on and on (you fear) about operating system design, and you're wondering "how much longer" and "is this really for me".

No longer - I'm about to move on to show you Unix at its various levels within OS X, and you'll see that, yes, this sound bedrock really is for you!

### 1.3 Classic Unix

Unix was written in the days of 10-character-per-second teletypes, and provides a command-line interface with which you can issue terse yet powerful commands that come back with similarly terse answers. Here's the sort of thing:

```
% pwd
/Users/graham
% du -sk .
10928284  .
% rm /Users/graham/demofile
% mv h.tar ho.tar
% mv h.tar ho.tar
mv: rename h.tar to ho.tar: No such file or directory
%
```

- What's my current directory?
- How many Kbytes does it occupy, including subdirectories?
- Delete the file **/Users/graham/demofile**
- Rename the file *h.tar* into a file called *ho.tar*

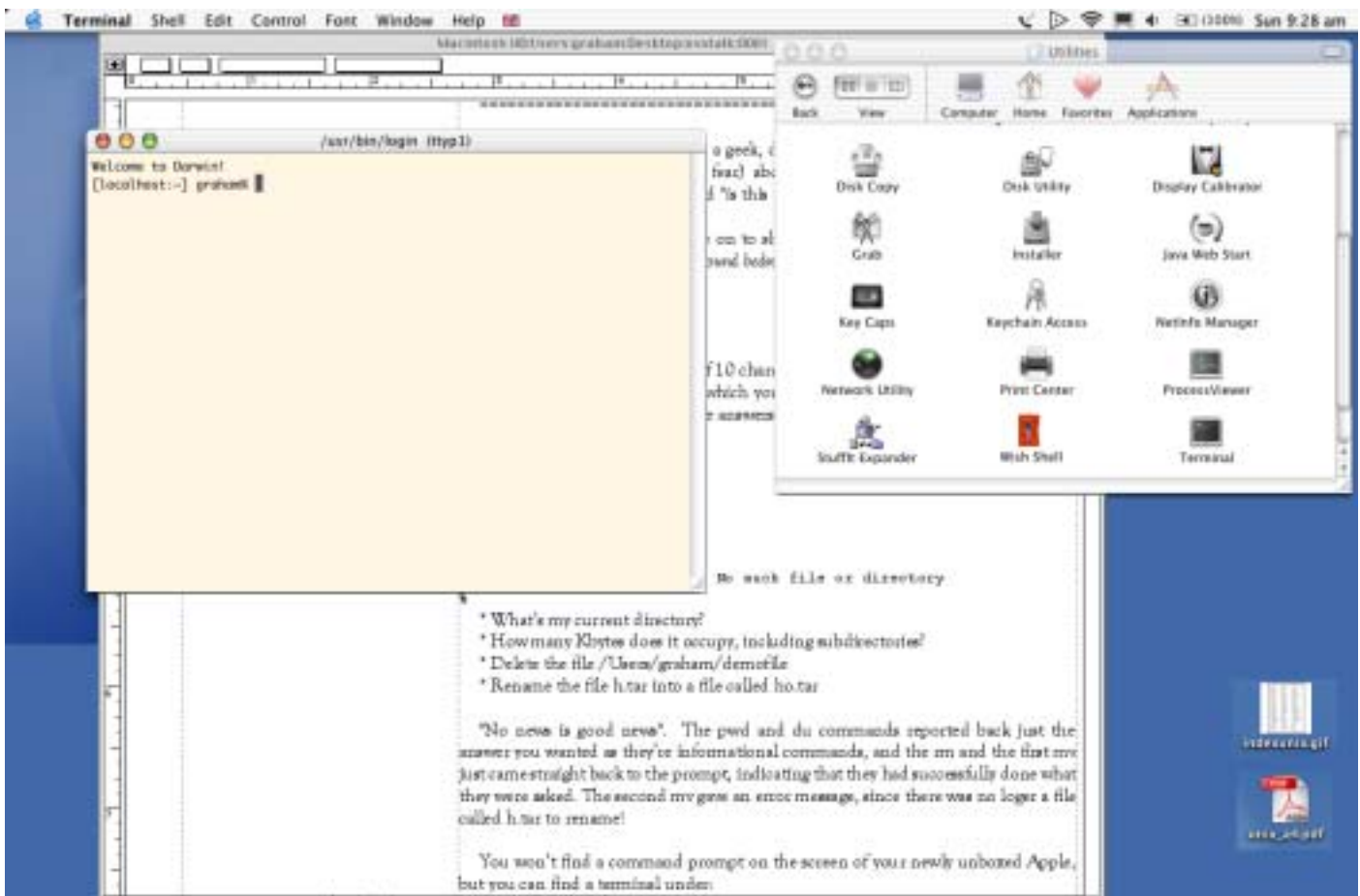
"No news is good news". The **pwd** and **du** commands reported back just the answer you wanted as they're informational commands, and the **rm** and the first **mv** just came straight back to the prompt, indicating that they had successfully done what they were asked. The second **mv** gave an error message since there was no longer a file called *h.tar* to rename!

You won't find a command prompt on the screen of your newly unboxed Apple, but you can find a terminal under:

Finder -> Applications -> Utilities -> Terminal



Figure 1 Finding the command prompt in Terminal



Not everyone likes the Unix interface, with its standard text editor called "vi" that many people will tell you stands for "virtually inoperable" but it has its place and niche for systems and application developers and for administrators of larger systems.

### Open Source

Open Source software - written by a large team of enthusiastic specialists, each making a small contribution in their own areas of expertise, and encouraging other to contribute by distributing the software in source format. Linux, Gnu, Apache, Tomcat, Ant, Perl, PHP and MySQL are all examples of Open Source distributions, which are by definition available at no charge and are usually innovative and reliable - after all, they're written by enthusiasts, and any bugs get quickly ironed out by other enthusiasts who can design source code patches.

### 1.4 Unix Server

Do you want site server? That will be £3617.82.<sup>1</sup> And SQL Server? That will be £1979.87. And perhaps you want an alternative way of getting your computer to provide a full, professional set of services that isn't going to cost you an arm and a leg.

Unix has the concept of daemons built into it. A daemon is a process that starts when the computer starts, provides service throughout the time the computer is up and running, and shuts down cleanly when you shut your computer down. A wide range of daemons is provided at no extra charge with Unix. Some of these daemons are a part of Unix itself, others are Open Source distributions. Further daemons, also at no cost, are available through the Open Source route. Because OS X is Unix, most of these Open Source services run excellently on your Mac.

Perhaps you don't think you want to run your own web server. Perhaps you prefer to run your web server with an ISP, where there are staff on duty 24 hours a day to deal with any issues, and where the outgoing bandwidth is high enough to support all the interest that your site is bound to generate. You're right to place your web site with an ISP, but you can also run a local server to test, to check, and validate the operation at your home or place of work by using the same software that your ISP is running!

<sup>1</sup> prices for Microsoft software offered by Dabs direct, October 2003

Some daemons are controllable through:  
System preferences -> Sharing



Figure 2 Turning file sharing on and off

And others are controllable elsewhere.

Applications such as Dreamweaver MX interface to your local test web server to allow easy development of new pages on your fully functional test server.

## 1.5 Programmer's Unix

Unix is written in C, and you can write code in C. You can also program using scripting languages (batch files) to combine commands, providing a higher level of administration capabilities.

And then there's Perl. And Objective C. And Java. And a host of other languages, each designed for its own niche or application area.

When I started presenting Unix courses in 1990, about a third of our trainees were going to be writing applications, a second third were administrators, and the final third were users. Over the following years, that changed and programmer's training became something of a rarity. As the power of computers increased, so did the ability to provide wider ranging applications. These were developed just once and could then be used by thousands of users.

Chances are that you won't be planning to do any programming. You may surprise me and be inspired by this talk and write a few lines of code. But the operating system structure and facilities are there to let others develop for you, and to contribute further code and applications to both the Open Source and commercial arenas for OS X systems.

## 1.6 Unix plus GUI for the Desktop

You're a Mac user?

You're used to a graphic look and feel – point and click?

You don't like the command line interface?

That's fine; most users feel that way too. You don't have to use the command line!

Sun Microsystems faced the user's desire for a Graphic User Interface back in the 1980s, with their "SunView" – a GUI that used Unix to provide a very fast, slick, proprietary look and feel on top of Unix. Around that same time, Apple had their own system and Microsoft were working along the lines that lead to GUIs such as Windows 3.1

In order to provide a consistent Graphic User Interface across a wide range of devices, MIT (the Massachusetts Institute of Technology) wrote the X11 Windowing System, that in time took over from SunView, and became the standard windowing system used by HP, IBM, Sun on their Unix-based products, and also (being Open Source) became the standard windowing system for Linux.

There's a problem with the X Windows System. "You can do anything" means that YOU can do anything as the programmer. You have to write very large amounts of code to provide any functionality, and the application that John wrote will look utterly different to the application that Jean wrote. When Jeremy and Jenny come along to use the applications, they're likely to get confused by what is a button that they can press, and what is a label that's just providing output information.

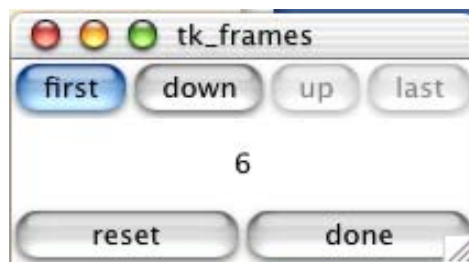
Solution? Extra libraries to provide higher level functionality – the X toolkit, XView, Motif, CDE, KDE, Gnome and the rest. The overall result is many different looks and feels that address the problem somewhat, but remain less than the ideal solution.

Along come Apple. They want to use the bedrock of Unix on their platform, but they're already the experts in GUI design. They feel (correctly) that they can do better, learning from the wide range of libraries just mentioned. The OS X GUI is "Aqua". It runs on top of Unix, but it is not X Windows.

OS X applications are written to use Apple's AQUA GUI. Cross-platform applications use the AQUA GUI on Apple, X Windows on Linux and many flavours of Unix, and the Microsoft Windows GUI on that platform. This means you get the Apple look and feel that you're familiar with from OS 9 on the newer OS X.

Here's an example of a window that we use on our Tcl/Tk course, where we convert some window and GUI design subjects. On a Mac, it looks like this:

Figure 3 Running a Tcl/Tk application



which is exactly the look and feel that you would expect.

### 1.7 And also

My subject is Unix, and all the best of it that's incorporated into OS X, but I subtitled my talk "A soothing talk for the petrified". I have said great things about

Unix, and I hope I have already allayed some of your fears. We all fear the unknown and the new after all. But you may question the word "soothing". You may now understand why Apple went to Unix but not be totally soothed. There is one further step.

Apple have added a Graphic User Interface to all the core tools and facilities of Unix, so that you don't have to use the command line, and so that you don't have to be a geek of any form in order to use your Mac. After all, they're now selling boxes based on this powerful operating system to the home market. And they have done quite a superb job.

## 1.8 Conclusion

I admit it, I'm a core Unix geek, never quite so happy as when I'm at the command line. Until 2002, I saw Apple as a specialist supplier to the high performance graphics industry and magazine publishers using software such as Quark, Photoshop and others that use more graphics than I've had hot dinners.

But things have changed with OS X. I bought my first Mac a year ago, straight into OS X and I couldn't put it down. I had to start off with my "fix" and the first window I had to find was a command prompt, but more and more that becomes an accessory and I work, on the Unix box, using Apple's tools to increase my productivity.

At the talk this evening, I'll have two laptop Macs - neither the most powerful current versions - and they're networked. The tiny white iBook is my test web server. It runs the Well House Consultants web site of around 2,000 pages, all the Perl scripts that are used for its maintenance, all the interactive PHP content in the web pages that allow for searches of our relational database of technical books ... and, yes, this is the lowest spec'd machine in the range. The slightly larger machine is the one I carry around with me as I train, allowing me to project up training notes from PDF documents, sometimes 400 pages long, to write those documents in FrameMaker, to connect on line via our cable link or, when away, via Modem or Bluetooth and AOL.

Truth be known, I've only brought two machines along because it helps people understand "server" and "client"; I could just have the little white baby. We've got a nice projector system here and I'll conclude by demonstrating the power it has, and point out some of the Unix bits ;-)

## References:

<http://www.wellho.net>

<http://www.levenez.com/unix/>

[http://osr5doc.ca.caldera.com:457/OSUserG/origins\\_of\\_unix.html](http://osr5doc.ca.caldera.com:457/OSUserG/origins_of_unix.html)

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## Perl

title	edition	author(s)	ISBN
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## Ruby

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Web Design for Dummies	1st	Lisa Lopuck	0-7645-0823-7
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**Apache, IIS, Tomcat and Web Server Admin**

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Apache Server Commentary	1st	Greg Holden, Nicholas Wells, Matthew Keller	1-57610-468-0
Apache, The Definitive Guide	2nd	Ben Laurie, Peter Laurie	1-56592-528-9
Apache, The Definitive Guide	3rd	Ben Laurie, Peter Laurie	0-596-00203-3
Apache Tomcat Bible	1st	Jon Eaves, Warner Godfrey, Rupert Jones	0-7645-2606-5
Apache Tomcat Security	1st	Chopra, Galbraith, Polisetty, Rickabaugh, Turner	1-861008-30-9
HTTP Pocket Reference	1st	Clinton Wong	1-56592-862-8
Mastering Tomcat Development	1st	Peter Harrison, Ian McFarland	0-471-23764-7
Microsoft® IIS 5 Administration	1st	Gerry O'Brien	0-672-31964-0
Professional Apache Tomcat	1st	various authors	1-861007-73-6
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**ASP, .NET, C# etc.**

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C# Programming With the Public Beta	1st	Harvey, Robinson, Templeman, Watson	1-861004-87-7
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XML for the World Wide Web - Visual Quickstart	1st	Elizabeth Castro	0-201-71098-6
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**Web overviews and general subjects**

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The Whole Internet User's Guide & Catalog	2nd	Ed Krol	1-56592-063-5

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## Linux

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Linux!	2nd	Nicholas D. Wells	0-7821-2935-8
Linux in a Nutshell	3rd	Stephen Figgins, Jessica P. Hekman, Ellen Siever, Stephen Spainhour	0-596-00025-1
Linux System Administration Handbook		Mark Komarinski, Cary Collett	0-13-680596-5
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Linux Unleashed	2nd	Kamran Husain, Timothy Parker	0-672-30908-4
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vi Editor Pocket Reference	1st	Arnold Robbins	1-56592-497-5

## Mac OS X

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Mac OS X for Unix Geeks	1st	Brian Jepson, Ernest Rothman	0-596-00356-0
Mac OS X in a Nutshell	1st	Jason McIntosh, Chuck Toporek, Chris Stone	0-596-00370-6
Mac OS X Pocket Guide	2nd	Chuck Toporek	0-596-00458-3
Mac OS X The Missing Manual	8th	David Pogue	0-596-00082-0
Mac OS X Unleashed	1st	John Ray, William Ray	0-672-32229-3
Unix for Mac OS X	1st	Matisse Enzer	0-201-79535-3

## Unix

title	edition	author(s)	ISBN
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The Unix CD Bookshelf, version 2.1	2nd	various	0-596-00000-6
UNIX in a Nutshell: System V Edition	3rd	Arnold Robbins	1-56592-427-4
Unix in a Nutshell: System V & Solaris 2.0	2nd	Daniel Gilly and staff	1-56592-001-5
Unix Primer Plus	1st	Mitchell Waite, Donald Martin, Stephen Prata	0-672-22028-8
Unix System Security	2nd	Rik Farrow	0-201-57030-0
Unix System V Release 4 Administration	2nd	David Fiedler, Bruce Hunter, Ben Smith	0-672-22810-6

## Windows

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Mastering Windows XP Professional	2nd	Mark Minasi	0-7821-4114-5

## Networking

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Samba Black Book	1st	Dominic Baines	1-57610-455-9
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Encyclopedia of Graphics File Formats	2nd	James D. Murray, William vanRyper	1-56592-161-5

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### X Windows and Motif

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Building OSF/Motif Applications: A Practical Introduction	1st	Mark J. Sebern	0-13-122409-3
Introduction to the X Window System	1st	Oliver Jones	0-13-499997-5
The Photoshop Book for Digital Photographers	1st	Scott Kelby	0-7357-1236-0
The X Window System in a Nutshell	1st	O'Reilly staff	0-937175-24-2
X and Motif Quick Reference Guide	2nd	Randi J. Rost	1-5555-8118-8
X Windows System User's Guide Volume 3	2nd	Valerie Quercia, Tim O'Reilly	0-937175-36-6
Xlib Programming Manual Volume 1	1st	Adrian Nye	0-937175-27-7
Xlib Reference Manual Volume 2	1st	Adrian Nye	0-937175-28-5

### Other books

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FileMaker Pro 5 for Windows & Macintosh	4th	Nolan Hester	0-201-70417-X
MP3 The Definitive Guide	1st	Scot Hacker	1-56592-661-7
Palm Pilot: The Ultimate Guide	2nd	David Pogue	1-56592-600-5
Type & Typography	1st	Phil Baines, Andrew Haslam	1-85669-244-2
Wired Style: Principles of English Usage in the Digital Age	1st	Constance Hale, Jessie Scanlon	0-7679-0372-2