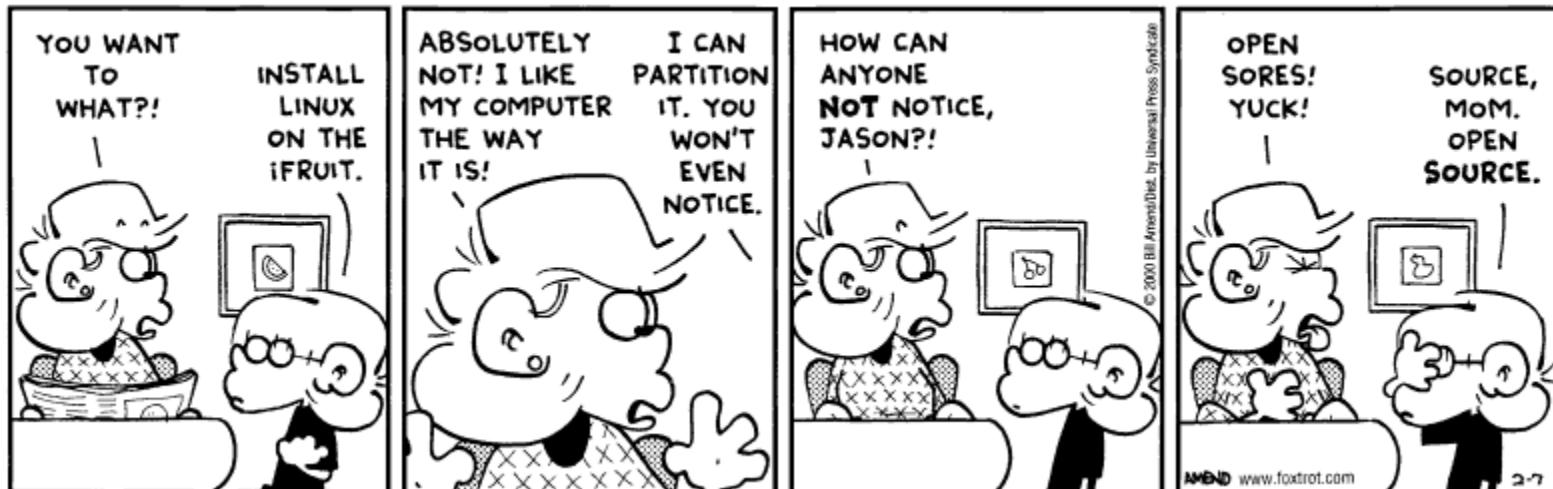


Open Source Tools 2014

Lecture 1

Jeffrey Korn



What will we cover?

- Operating system overview
- Utilities
- Scripting languages
- Programming tools
- Administration
- Security
- Networking (web, xml)

Schedule

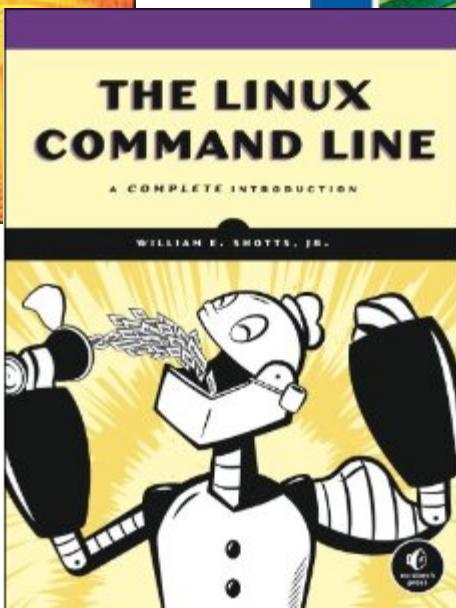
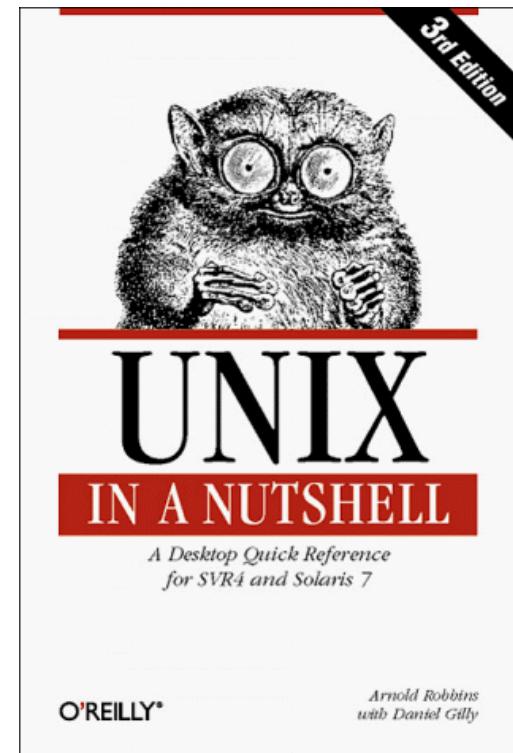
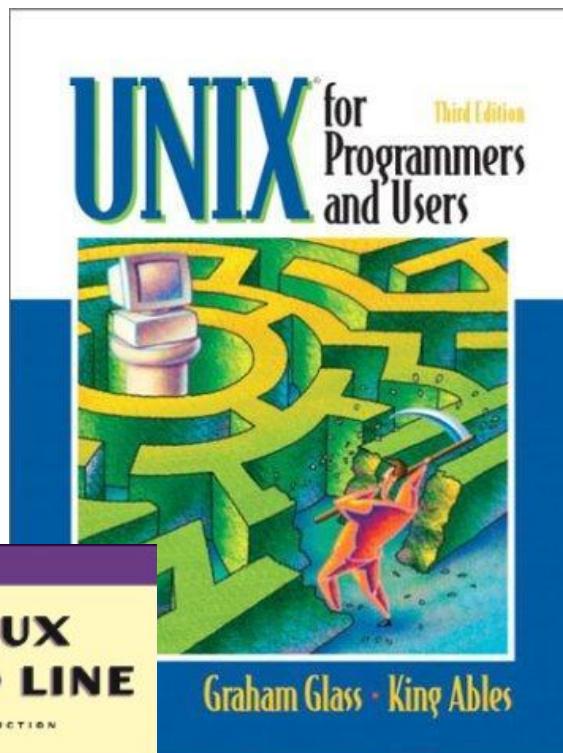
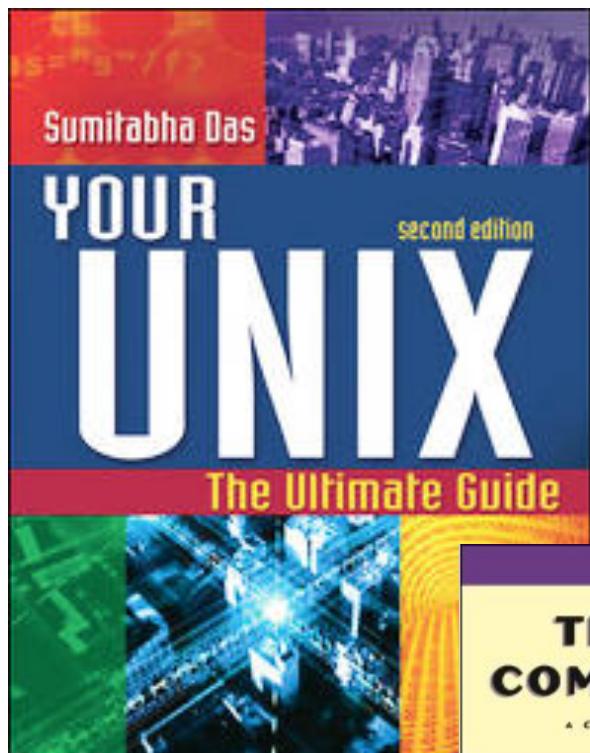
- Lectures Mondays 7:10-9:00 with short break
- Midterm: In class 10/27
- Final: In class 12/10
- Project due 12/15
- Office Hour: Before class (6:30) + after

Who cares, how do I get an A?

- Assignments: 30%
- Project: 35%
- Midterm: 15%
- Final: 20%



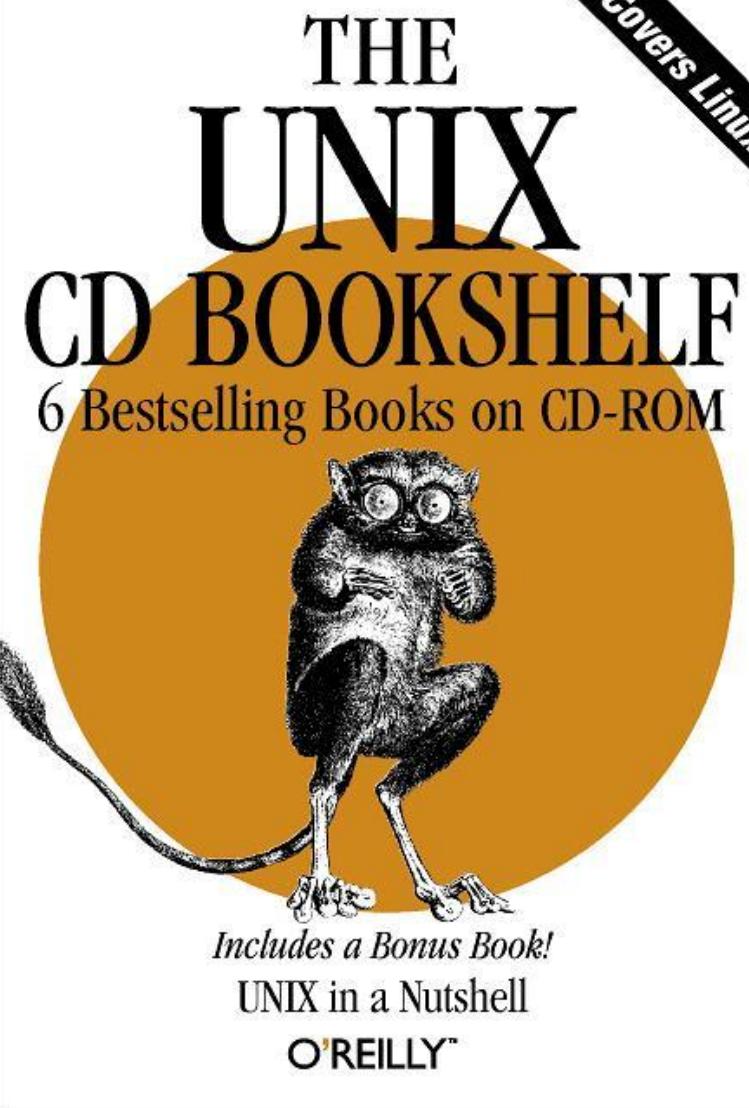
Generally Recommended Books



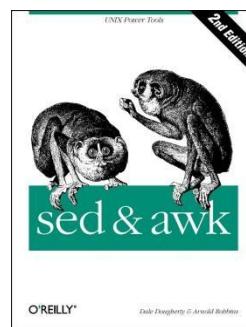
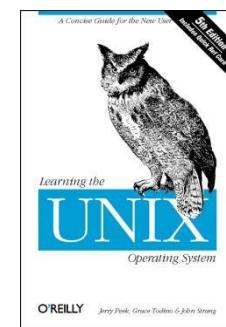
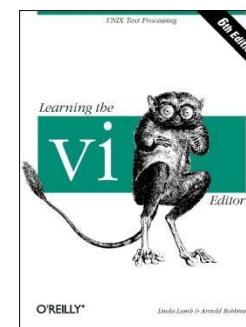
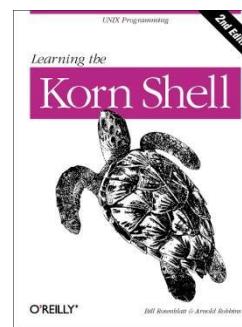
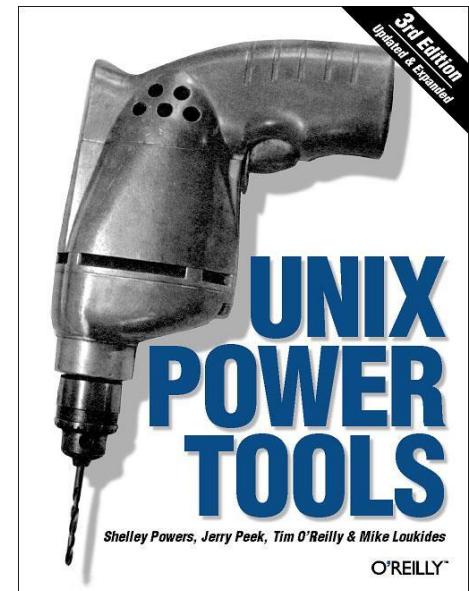
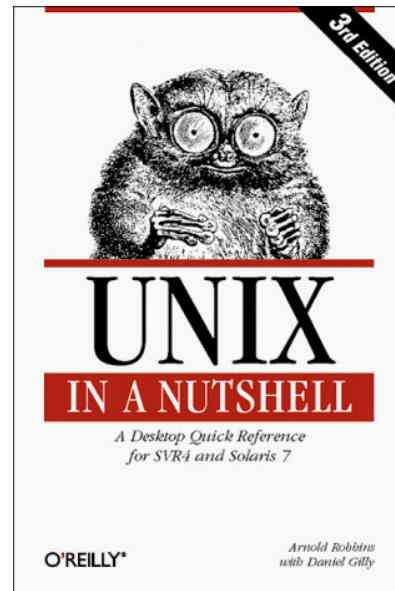
Available Free Online

**THE
UNIX
CD BOOKSHELF**
6 Bestselling Books on CD-ROM

Covers Linux

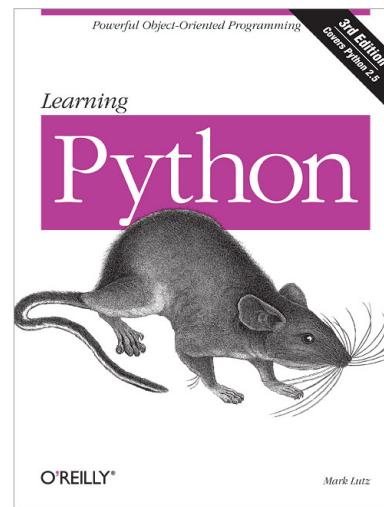
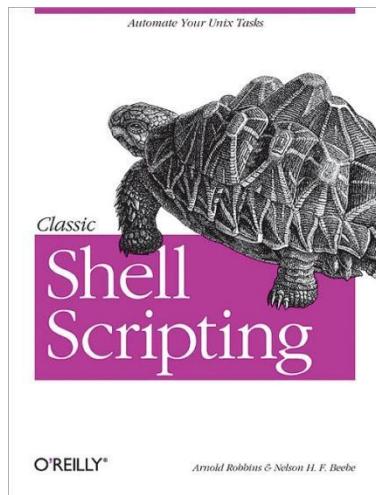


Includes a Bonus Book!
UNIX in a Nutshell
O'REILLY™



<http://proquest.safaribooksonline.com>

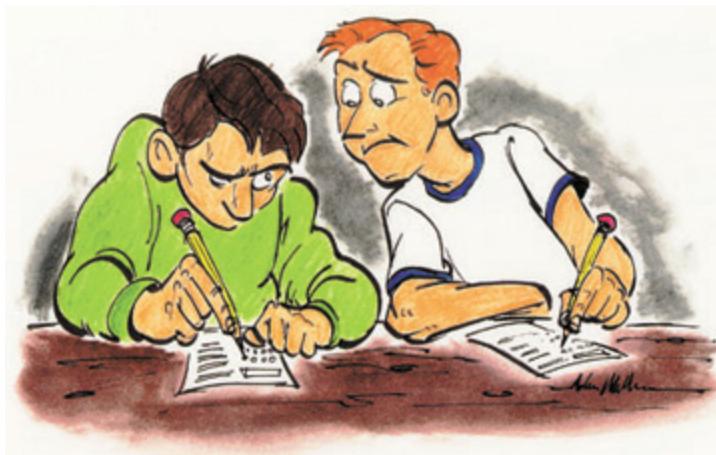
Recommended Books for Coding



Administrivia

- Make sure you have an account
- Sign up for the mailing list
- Check the website regularly:
CS homepage -> Courses -> CSCI-GA.2246-001
<http://nyuos.com>
- Graders: listed on site, office hours TBA
- Assignment 0 is due before class next week

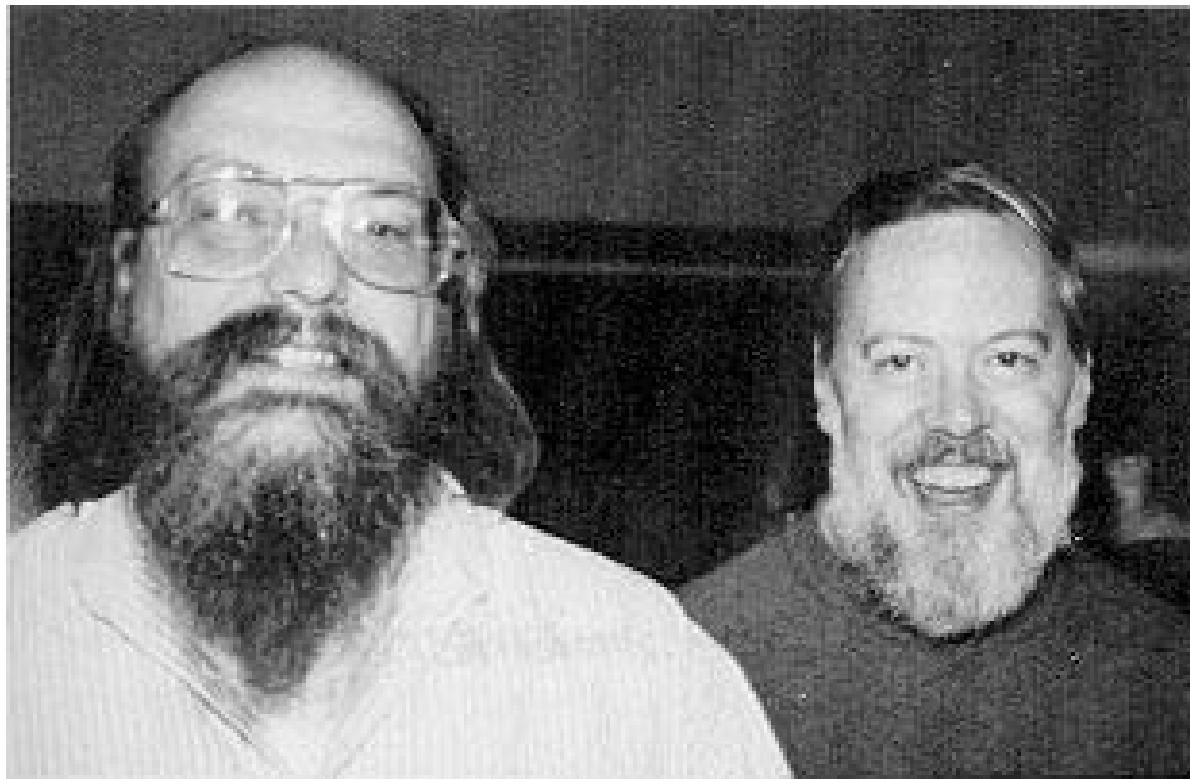
Cheating



- Don't



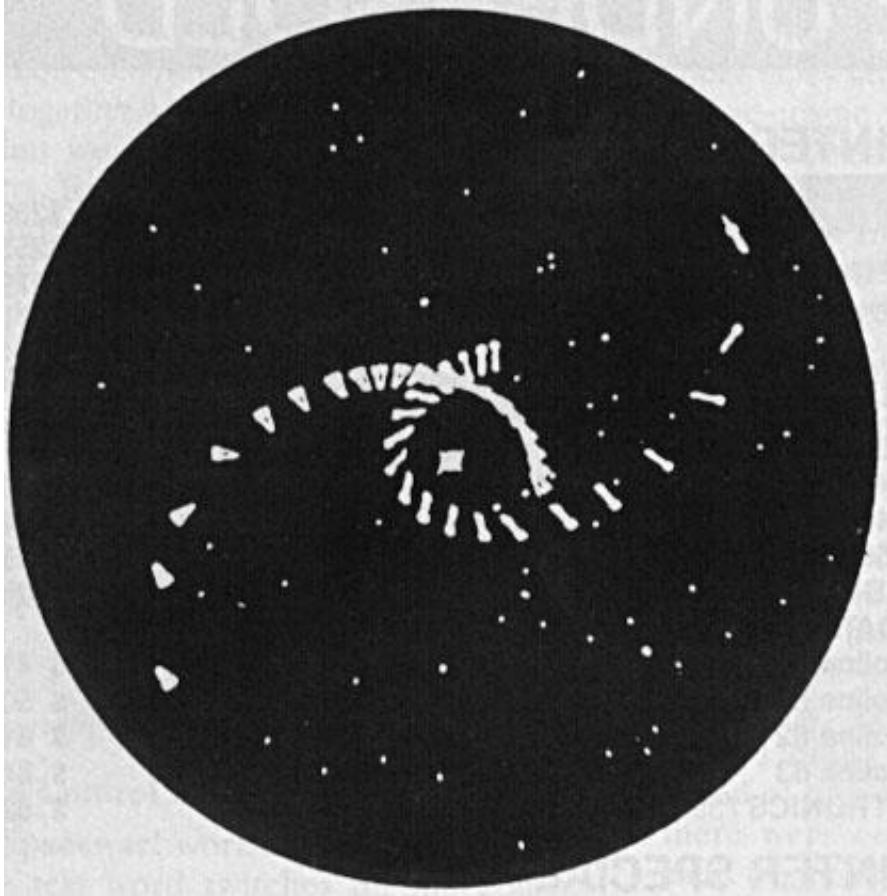
Our Heroes



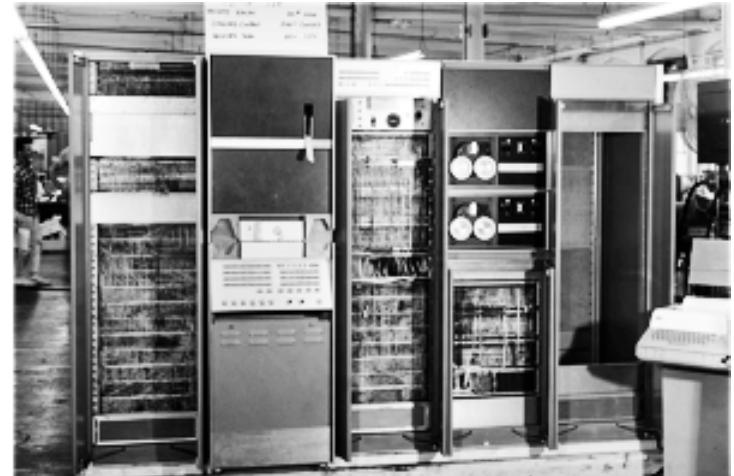
Ken Thompson

Dennis Ritchie

Video Games Spark Innovation



Space Travel



PDP-7



In the Beginning

- UNICS: 1969 – PDP-7 minicomputer
- PDP-7 goes away, rewritten on PDP-11 to “help patent lawyers”
- V1: 1971
- V3: 1973 (pipes, C language)
- **V6**: 1976 (rewritten in C, base for BSD)
- V7: 1979 (Licensed, portable)

PDP-11



Big Reason for V6 Success

"After 20 years, this is still the best exposition of the workings of a 'real' operating system."

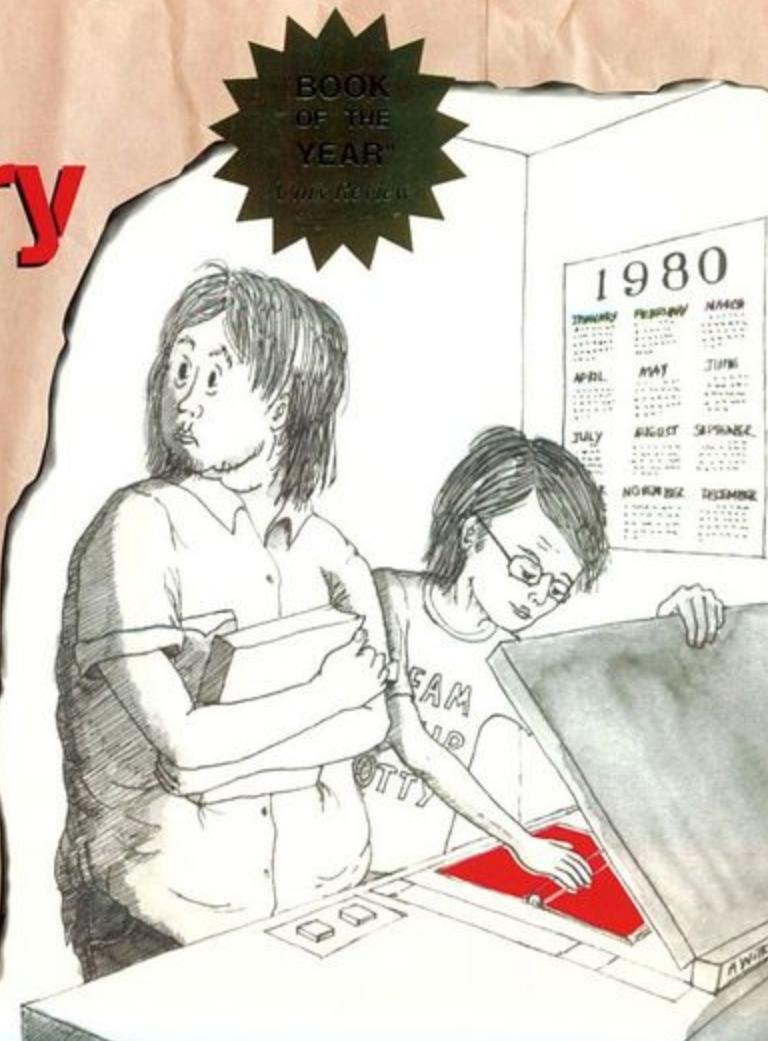
Ken Thompson

Lions' Commentary on UNIX® 6th Edition

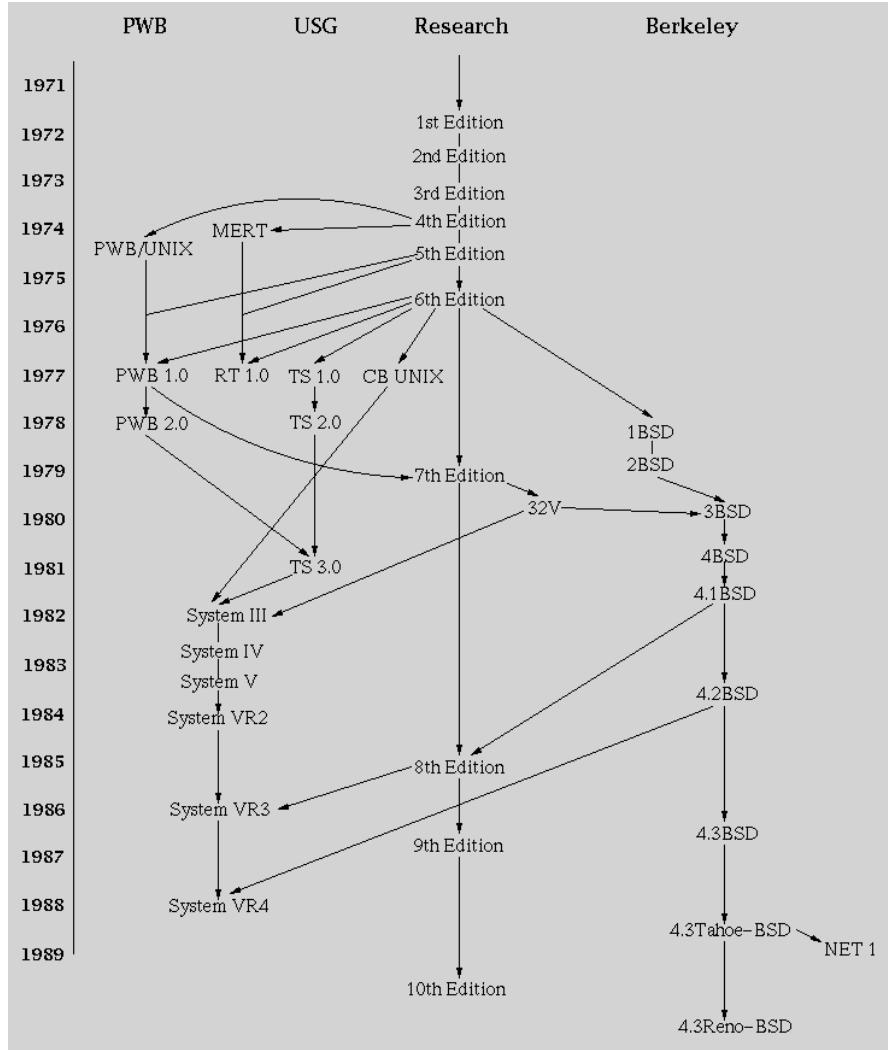
with Source Code

John Lions

Foreword by Dennis Ritchie



Derivative Systems

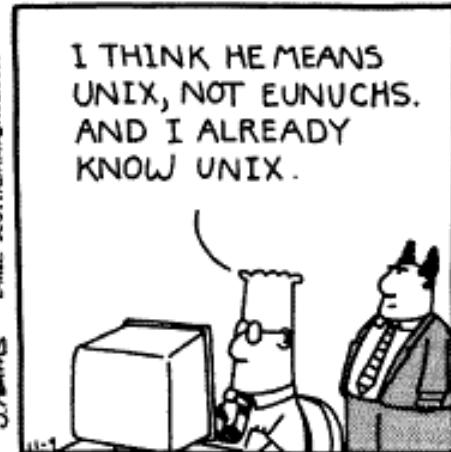
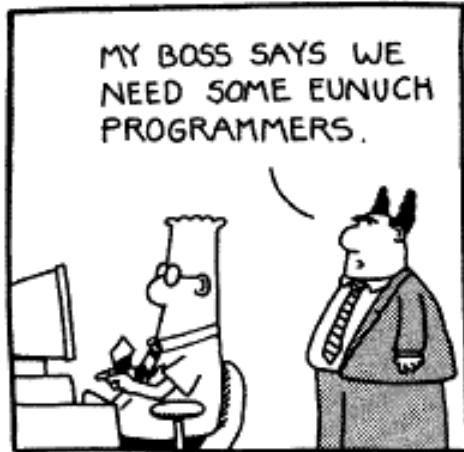


- PWB, MERT
- BSD: Adds many important features (networking, job control).
- AT&T enters the computer business with System III, V

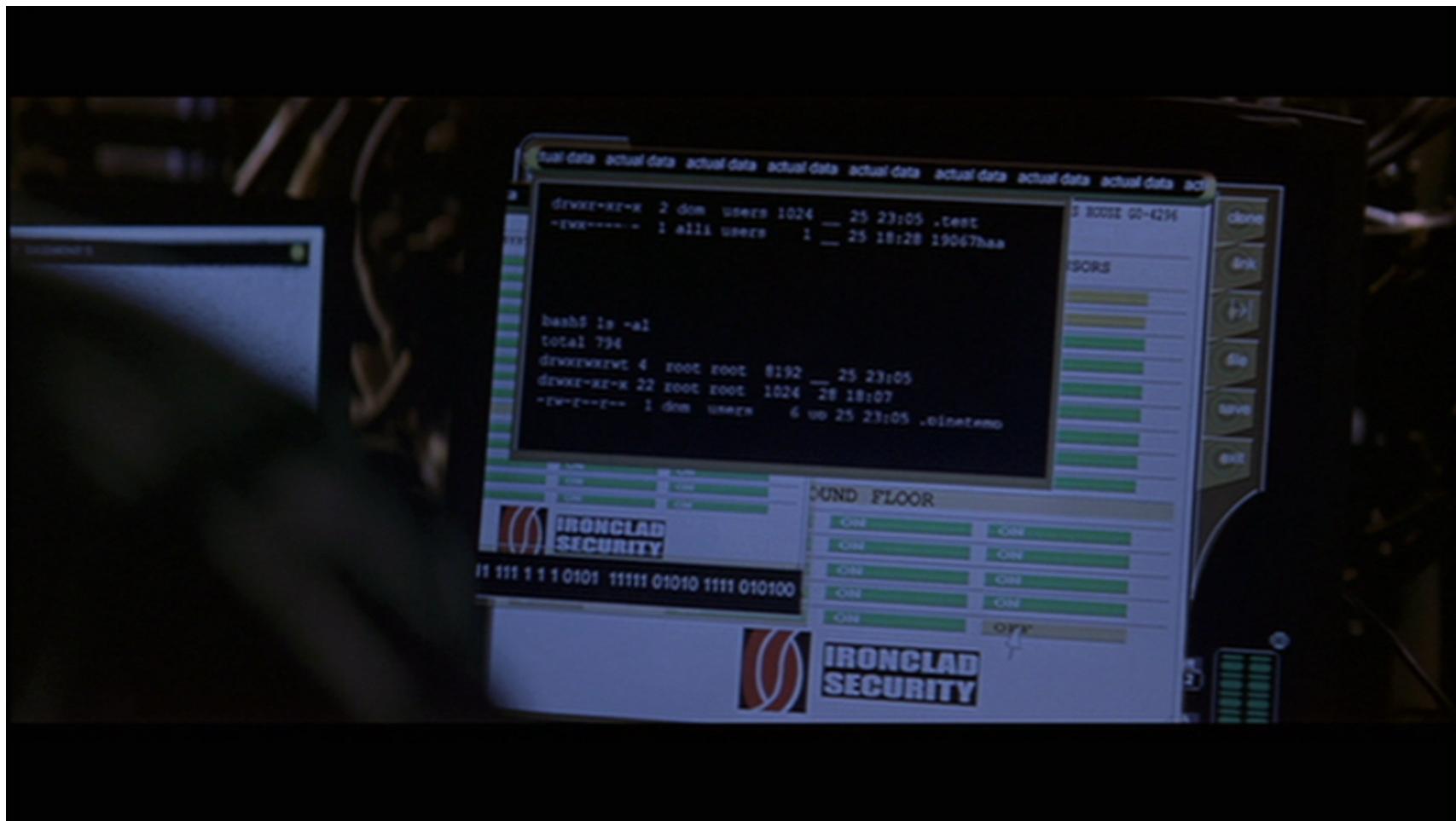
Commercial Success

- AIX 
- SunOS, Solaris 
- Ultrix, Digital Unix 
- HP-UX 
- Irix 
- UnixWare → Novell → SCO → Caldera → SCO
- Xenix:  → SCO
- Standardization (Posix, X/Open)

Popular Success!



The Score

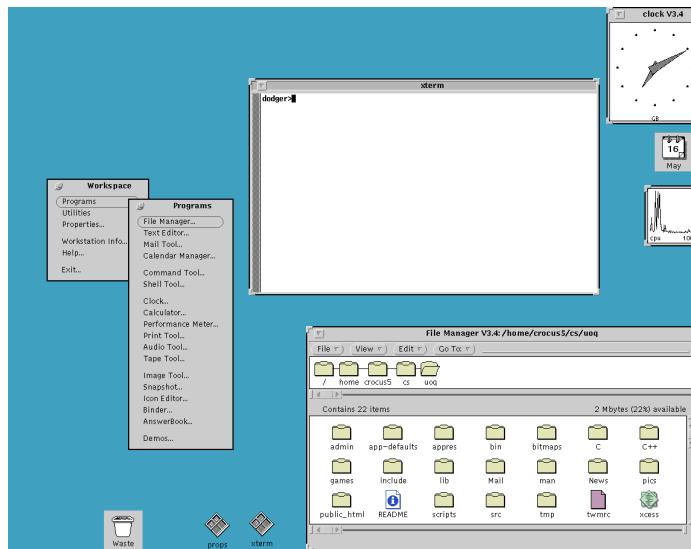


Matrix Reloaded

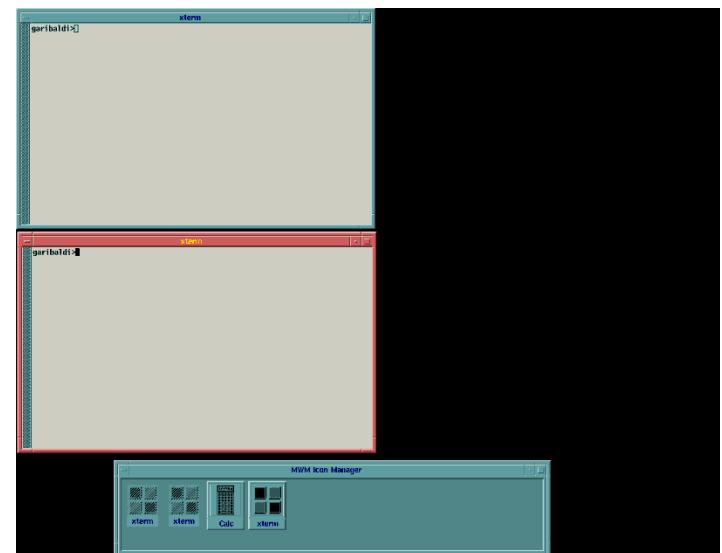


Standards and Wars

- 1988: POSIX Standard
- *Unix International* vs. *Open Software Foundation* (to compete with desktop PCs)
- Battle of the Window Managers



Openlook



Motif

- Threat of Windows NT resolves battle with COSE/CDE

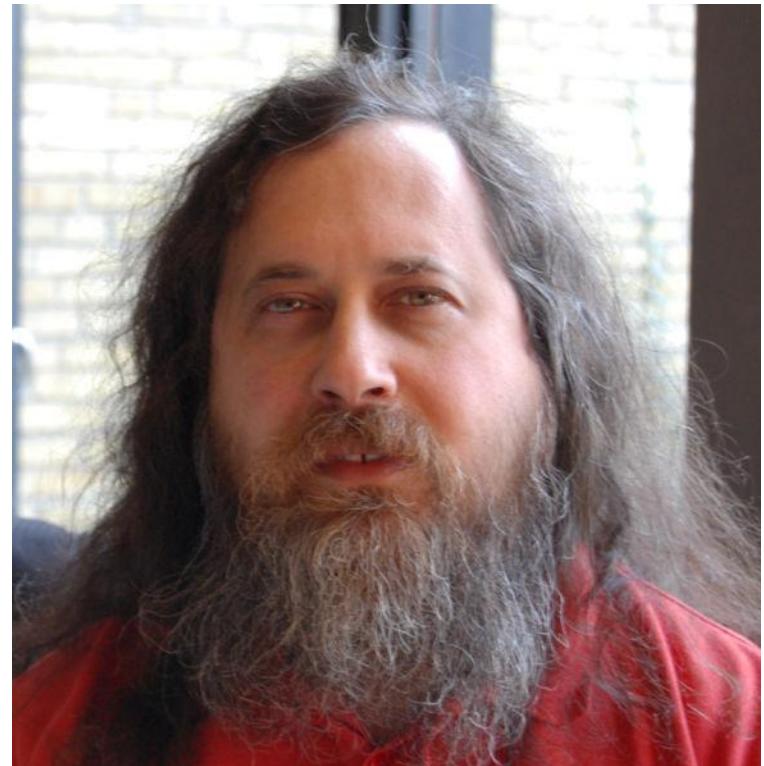
Commercial Backlash

- Not everyone was happy with proprietary UNIX
- 1983: GNU Project starts
 - No UNIX code (**GNU's Not UNIX**)
 - Initial focus on utilities
 - Later compiler, shell, kernel

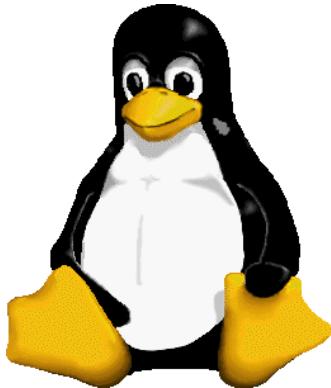


The Free Software Foundation

- Established in 1985 by Richard Stallman
- Grew out of GNU
- GNU License (1989)
 - *Copyleft*: Derived works subject to same license as original work.



Send in the Clones



- **Linux**
 - Written in 1991 by Linus Torvalds
 - Most popular UNIX variant
 - Free with GNU license
-



- **BSD Lite**
 - FreeBSD (1993, focus on PCs)
 - NetBSD (1993, focus on portability)
 - OpenBSD (1996, focus on security)
 - Free with BSD license
 - Development less centralized

Darwin

- Apple abandoned old Mac OS for UNIX
 - Purchased NeXT in December 1996
 - Unveiled in 2000
 - Based on 4.4BSD-Lite
 - Aqua UI written over Darwin
 - Open Source





IBM to spend \$1 billion on Linux in 2001

By [Joe Wilcox](#)

Staff Writer, CNET News.com

December 12, 2000, 8:50 a.m. PT

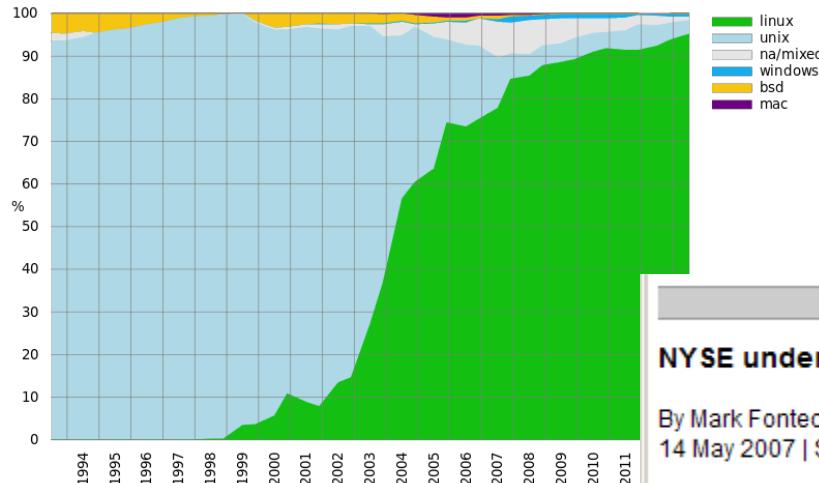
Lou Gerstner gives his keynote address at the eBusiness Conference and Expo in New York.

update IBM chief executive Louis Gerstner said Tuesday that his company will spend \$1 billion on Linux next year.

Gerstner made the announcement at the eBusiness Conference and Expo in New York, where IBM also revealed a Linux supercomputer win with Shell Oil.



Android Nears 80% Market Share



Linux Success

Info appliance makers adopt Linux

Just buzz or actual benefits? More info appliance makers are choosing Linux.

Intel To use Linux for Intel-branded Web appliances

TiVo Runs personal video recorder services on Linux

National Semiconductor Offers Linux choice for its Web Pad platform

Sony PlayStation 2 development system based on Linux

Transmeta Bundling Linux for mobile applications with new chip

Lineo Offers Linux development system for embedded info devices

SOURCE: Company announcements



NYSE undertakes IBM mainframe migration to Unix and Linux

By Mark Fontecchio, News Writer
14 May 2007 | SearchDataCenter.com

RSS FEEDS: [IT infrastructure news](#)



The New York Stock Exchange (NYSE) is migrating off a 1,600 [millions of instructions per second \(MIPS\)](#) mainframe to IBM System p servers running AIX and x86 Hewlett-Packard Co. (HP) servers running Linux, with the first part of the move going live today.

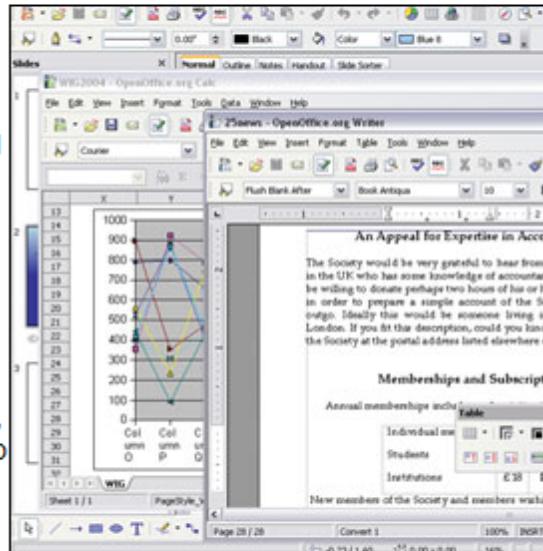
Some Desktop Success

Open Office 2.0 Kicks MS Office Around the Block

August 28, 2005

MAJOR UPDATE: By Alice Hill
RealTechNews

We asked our contributing writer David Johnston to do a full review of OpenOffice 2.0. He has been a longtime user of the product (and in fact an earlier version lost some of his important data.) In the meantime, we pointed to a review that PC Magazine did which is also comprehensive (see below), but for RealTechNews readers, please take a look at what David has to report, because this is no try it for a few days and write something up review. This is a complete **hands-on review** from someone who has used the product religiously for years. And I think you'll see why OpenOffice 2.0 truly Kicks MS Office around the block.



Open Office 2.0

By David Johnston

Contributing Writer, RealTechNews

[Features](#)[Chromebooks](#)[Business & Education](#)[Support](#)[Buy Now](#)

English ▾

Nothing but the web.

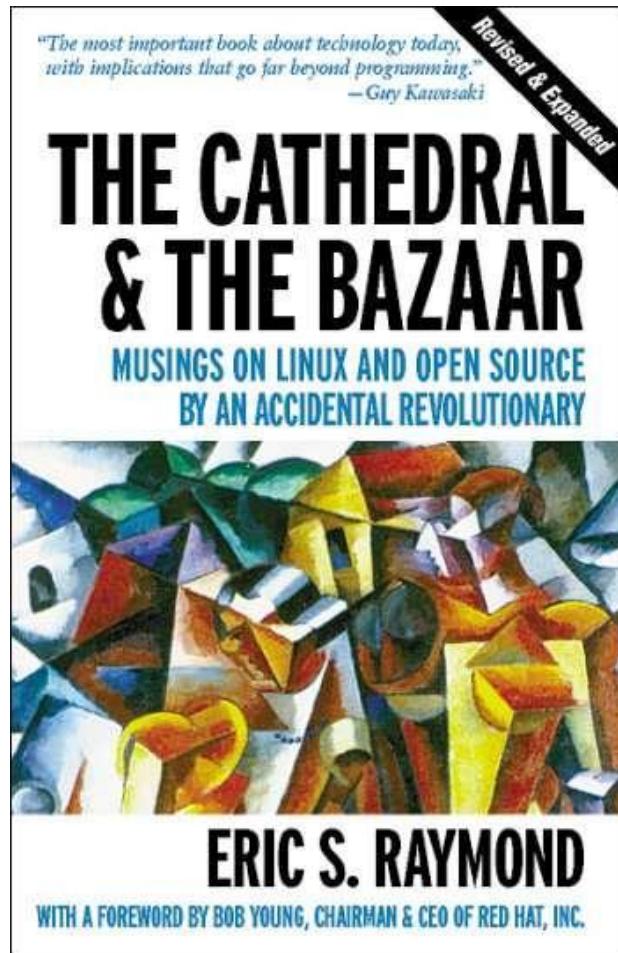
Chromebooks are built and optimized for the web, where you already spend most of your computing time. So you get a faster, simpler and more secure experience without all the headaches of ordinary computers.

[Buy Now](#)

Why did UNIX succeed?

- Technical strengths!
- Research, not commercial
- PDP-11 was popular with an unusable OS
- AT&T's legal concerns
 - Not allowed to enter computer business but needed to write software to help with switches
 - Licensed cheaply or free

The CatB Essay (1997)



Compared two models of free software development:

- *Cathedral Model*: Code developed between releases restricted to developers (*gcc*).
- *Bazaar Model*: Code developed in public over the internet with frequent releases (*Linux*).

Sparked the Open Source movement.

Open Source Principles

- Start with a working prototype
- Have a good coordinator
- Use well defined interfaces
- Reuse is important
- Treat users like developers
- Do frequent releases (but have a stable branch)

Success largely due to the internet

Open Source Projects

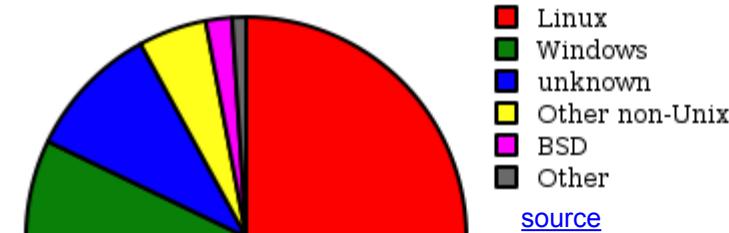
- 1998: Netscape (Mozilla project)
 - Led to formation of OSI to promote the idea
 - Rocky start due to use of Motif
 - Success with Firefox
- 2001: Open Office
- 2004: Open Solaris
- 2005: WebKit (Apple)



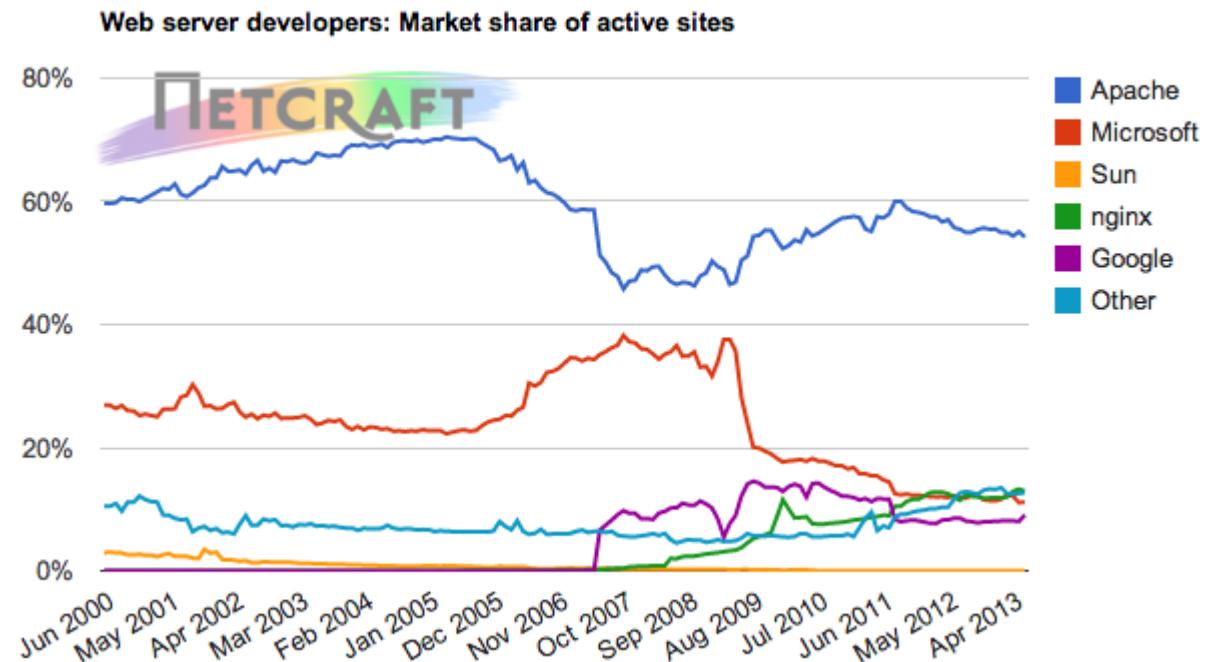
LAMP

- Commonly used acronym to refer to open-source web stack:
 - **L**inux
 - **A**pache
 - **M**ySQL
 - **P**HP (or **P**erl or **P**ython)

LAMP Market share



[source](#)



washingtonpost.com

The Open Source Threat

By Cynthia L. Webb

washingtonpost.com Staff Writer

Tuesday, September 7, 2004; 9:54 AM

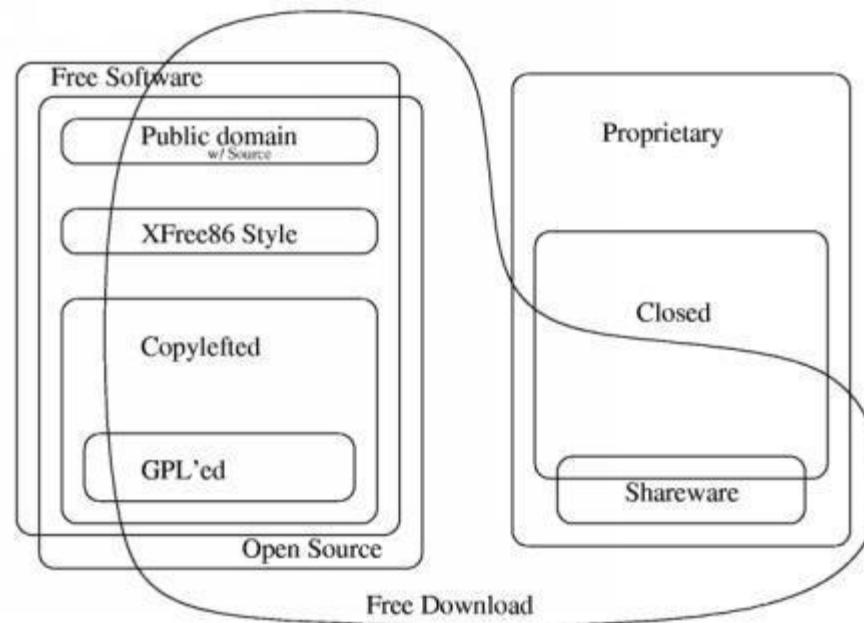
Open-source software, namely **Linux**, is nipping more sharply at the heels of **Microsoft**, leading the software giant to defend itself more fiercely than ever against the insurgent rise of freely distributed, collaboratively coded programs.

The Redmond, Wash.-based software giant acknowledged Linux is a growing challenge to its business in its [10-K filing](#) with the **Securities and Exchange Commission**. Microsoft "is facing growing pressure from open-source software across every segment of its business -- a competitive threat that could have significant consequences for its financial future going forward," eWeek reported. "While Microsoft often mentions Linux and open-source software as a potential threat to its business, it seems to be treating the threat far more seriously and describing it as more pervasive than in previous official filings."

Linux "is making inroads in servers and PCs," Australian IT said in its coverage of the filing. Here's what Microsoft had to say: "To the extent open source software products gain increasing market acceptance, sales of our products may decline, which could result in a reduction in our revenue and operating margins." More from the filing: "We continue to watch the evolution of open-source software development and distribution and continue to differentiate our products from competitive products, including those based on open-source software. We believe that Microsoft's share of server units grew modestly in fiscal 2004, while Linux distributions rose slightly faster on an absolute basis." And Microsoft's filing also offers this survey of its competitors: "**IBM**'s endorsement of Linux has accelerated its acceptance as an alternative. ... Linux's competitive position has also benefited from the large number of compatible applications now produced by many leading commercial software developers as well as non-commercial software developers." Microsoft said.

FSF and OSI

- Key difference: Values
 - Open source: development methodology
 - Free software: social movement
 - Stallman rejects the term “open source”
- FOSS: Free and Open Software



SCO vs. Linux

- **Jan 2002:** SCO releases *Ancient Unix* : BSD style licensing of V5/V6/V7/32V/System III
- **March 2003:** SCO sues IBM for \$3 billion. Alleges contributions to Linux come from proprietary licensed code
 - AIX is based on System V r4, now owned by SCO
 - Does Linux borrow from Ancient UNIX or System V R4?
- **Aug 2003:** Evidence released
 - Code traced to Ancient UNIX
 - Isn't in 90% of all running Linux distributions
 - Already dropped from Linux in July
- **Aug 2005:** Linux Kernel Code May Have Been in SCO
- **Aug 2007:** About that UnixWare purchase...
- **Sep 2007:** SCO files chapter 11

Further Reading

- <http://www.reddit.com/r/opensource>
- <http://slashdot.org/tag/opensource>
- <http://news.google.com/news?q=open+source>

The UNIX Philosophy

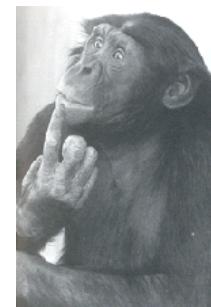
- Small is beautiful
 - Easy to understand
 - Easy to maintain
 - More efficient
 - Better for reuse
- Make each program do one thing well
 - More complex functionality by combining programs
 - Make every program a filter



The UNIX Philosophy

..continued

- Portability over efficiency
 - Most efficient implementation is rarely portable
 - Portability better for rapidly changing hardware
- Use flat ASCII files
 - Common, simple file format (yesterday's XML)
 - Example of portability over efficiency
- Reusable code
 - Good programmers write good code;
great programmers borrow good code



The UNIX Philosophy

..continued

- Scripting increases leverage and portability

```
print $(who | awk '{print $1}' | sort | uniq) | sed 's/ /,/g'
```

List the logins of a system's users on a single line.

- Build prototypes quickly (high level interpreted languages)

who	755
awk	3,412
sort	2,614
uniq	302
sed	2,093

9,176 lines

The UNIX Philosophy

..continued

- Avoid captive interfaces
 - The user of a program isn't always human
 - Look nice, but code is big and ugly
 - Problems with scale
- Silence is golden
 - Only report if something is wrong

UNIX Highlights / Contributions

- Portability (variety of hardware; C implementation)
- Hierarchical file system; the file abstraction
- Multitasking and multi-user capability for minicomputer
- Inter-process communication
 - Pipes: output of one programmed fed into input of another
- Software tools
- Development tools
- Scripting languages
- TCP/IP

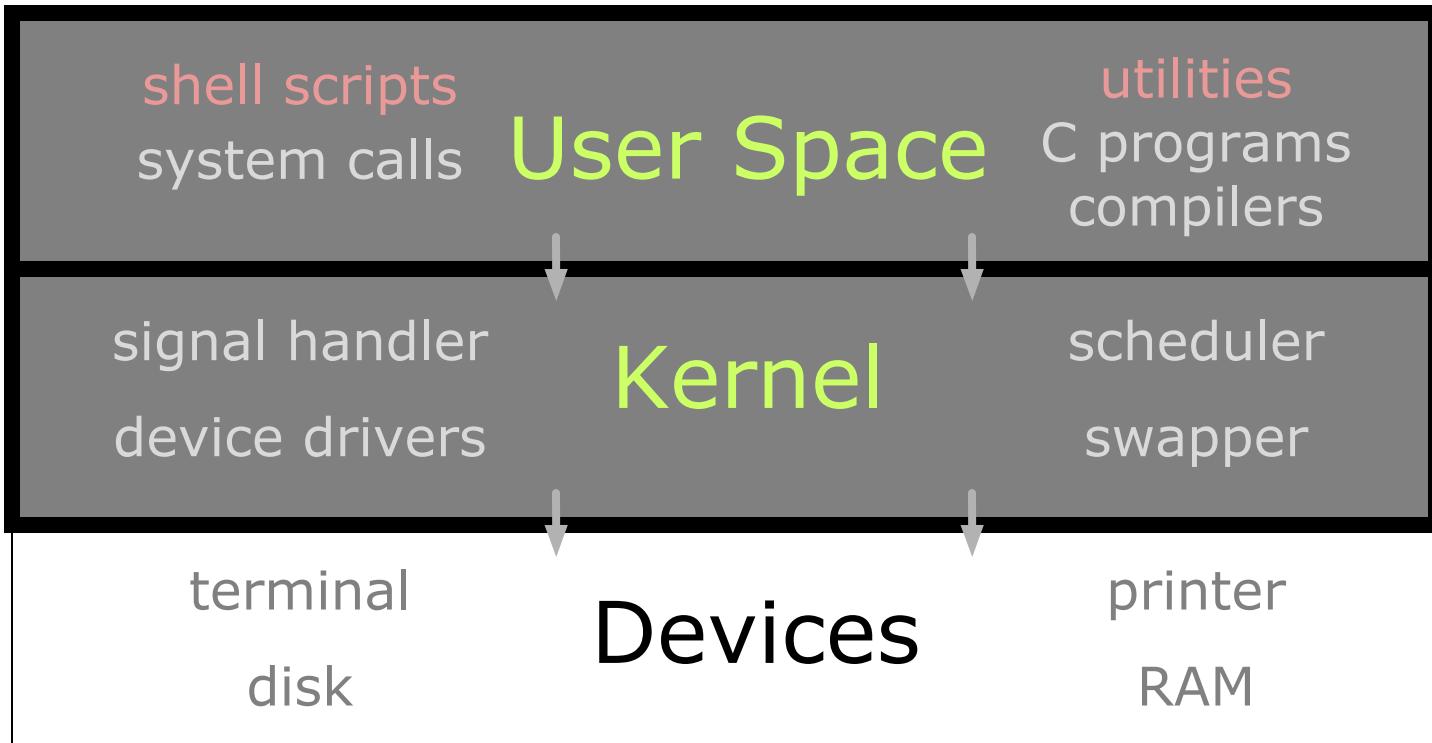
The Operating System

- The government of your computer
- **Kernel:** Performs critical system functions and interacts with the hardware
- **Systems utilities:** Programs and libraries that provide various functions through systems calls to the kernel

Kernel Basics

- The kernel is ...
 - a program loaded into memory during the boot process, and always stays in physical memory.
 - responsible for managing CPU and memory for processes, managing file systems, and interacting with devices.

UNIX Structural Layout



Kernel Subsystems

- Process management
 - Schedule processes to run on CPU
 - Inter-process communication (IPC)
- Memory management
 - Virtual memory
 - Paging and swapping
- I/O system
 - File system
 - Device drivers
 - Buffer cache

System Calls

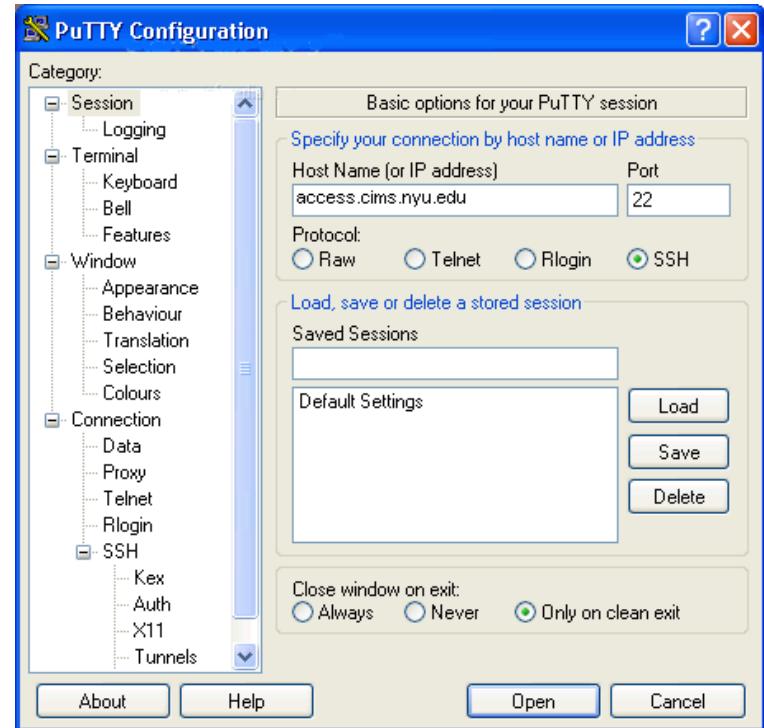
- Interface to the kernel
- Over 1,000 system calls available on Linux
- 3 main categories
 - File/device manipulation
 - e.g. `mkdir()`, `unlink()`
 - Process control
 - e.g. `fork()`, `execve()`, `nice()`
 - Information manipulation
 - e.g. `getuid()`, `time()`

Logging In

- Need an account and password first
 - Enter at **login**: prompt
 - Password not echoed
 - After successful login, you will see a shell prompt
- Entering commands
 - At the shell prompt, type in commands
 - Typical format: **command options arguments**
 - Examples: **who**, **date**, **ls**, **cat myfile**, **ls -l**
 - Case sensitive
- **exit** to log out

Remote Login

- Use Secure Shell (SSH)
- Windows
 - e.g. PuTTY
- Mac, UNIX-like OS
 - `ssh name@access.cims.nyu.edu`



UNIX on Your Machine

You can run Linux alongside Windows/Mac. See

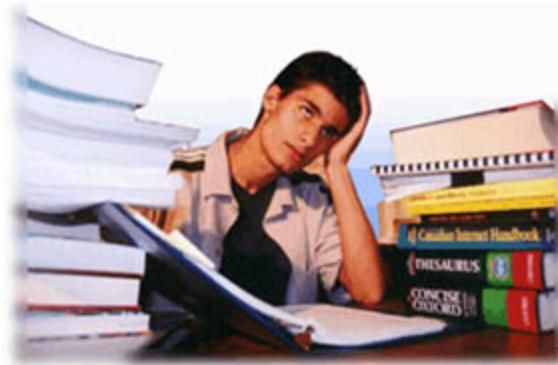
<http://ubuntu.com/download>

Alternatively, three recommended UNIX emulation environments:

- **UWIN for Windows (AT&T)**
 - <http://www.research.att.com/sw/tools/uwin>
- **Cygwin for Windows (GPL)**
 - <http://www.cygwin.com>
- **VMWare**
 - <http://www.vmware.com/download/player/>

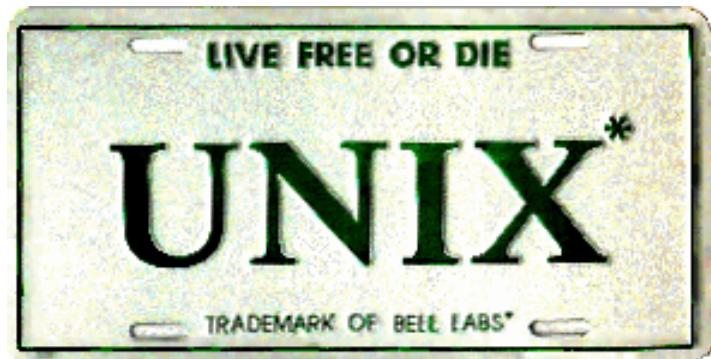
Assignment 0

- Get an account
- Log in and run a program
- Join the mailing list
- Submit a text file



Next Time

- Basic UNIX concepts
- Introduction to the shell
- Introduction to basic commands

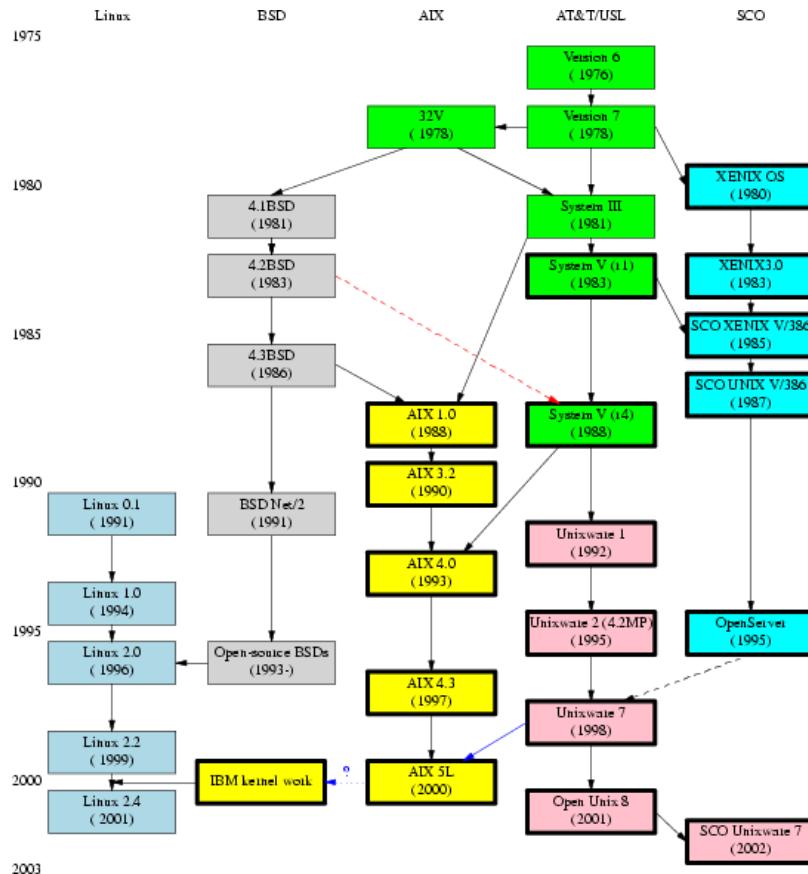


Bonus Slides

Linux Distributions

- Slackware – the original
- Debian – collaboration of volunteers
- Red Hat / Fedora – commercial success
- Ubuntu – currently most popular, based on Debian. Focus on desktop
- Gentoo – portability
- Knoppix – live distribution

UNIX vs. Linux





- In the 90's, Thompson/Ritchie developed Plan 9 which applied UNIX ideas to distributed systems
- Plan 9 evolved into Inferno, used for set top boxes
- Lucent had problems, many people left
- Thompson retired, now at Google (author of Go)
- Ritchie retired from Lucent, passed away 2011.