UNIX/Linux Fundamentals – Lecture 1

~~*Nick Stiffler*~~
Philip Conrad

```
host # cat rsd.pl
#!/usr/bin/perl
```

```
host # ./rsd.pl
Raul S Dias
host #
```

UNIX PEOPLE ARE HAPPY

What will we cover?

- Operating system overview
- UNIX commands, shell & process mgt.
- Scripting languages
- Programming tools
- Various text editors
- X11 & KDE windows env
- Basic C/C++ programming and other applications (emacs, gcc-g++, gzip, tar, …)

Schedule

Lectures

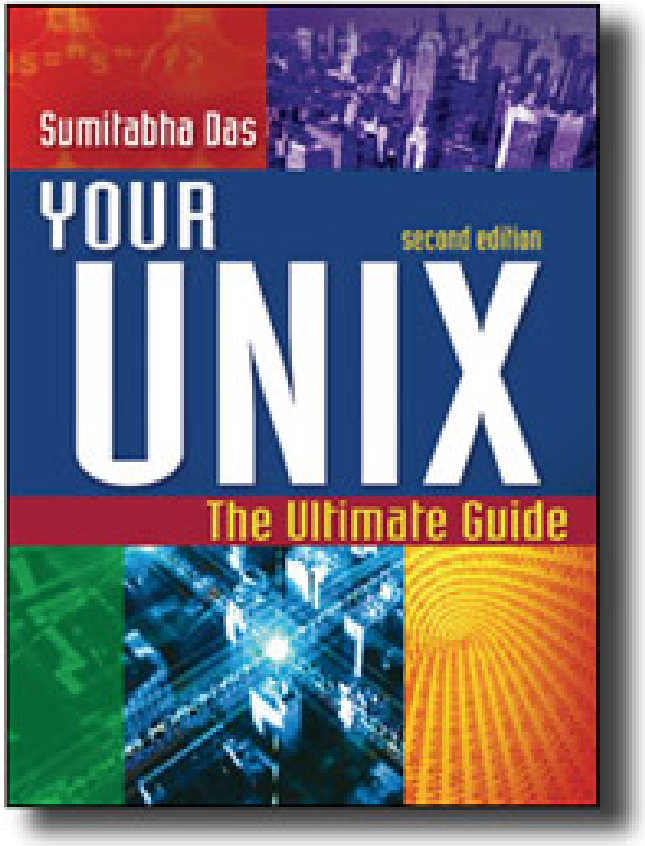
- Mon - Fri 08:30 - 10:10

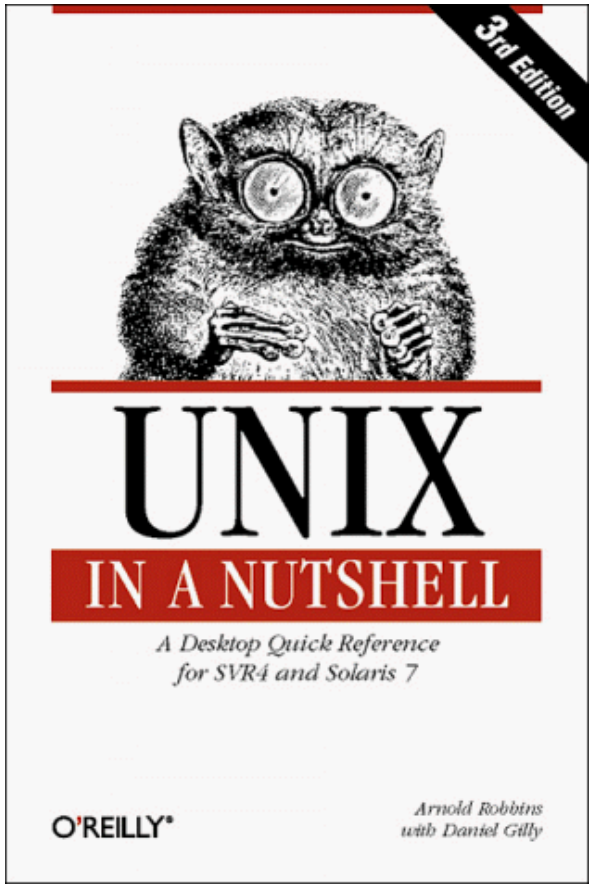
Labs

- Mon – Fri 10:20 - 11:40

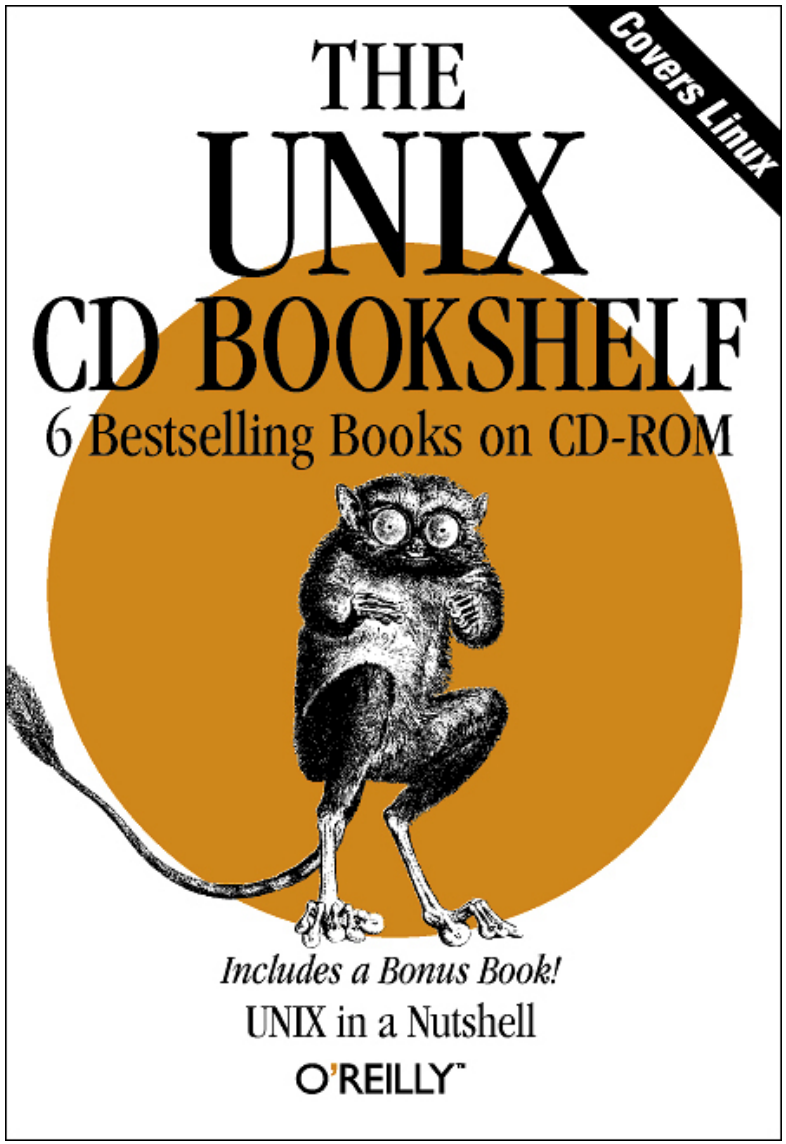
- Quizzes taken at the end of lecture/beginning of lab
- Final: Friday 15th.
- Project due Friday 15th @ 05:00 pm.

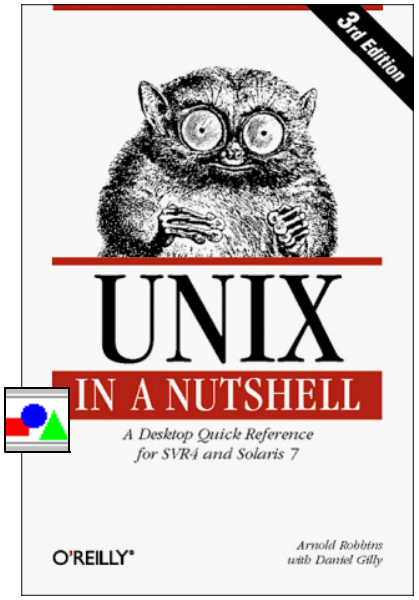
Books

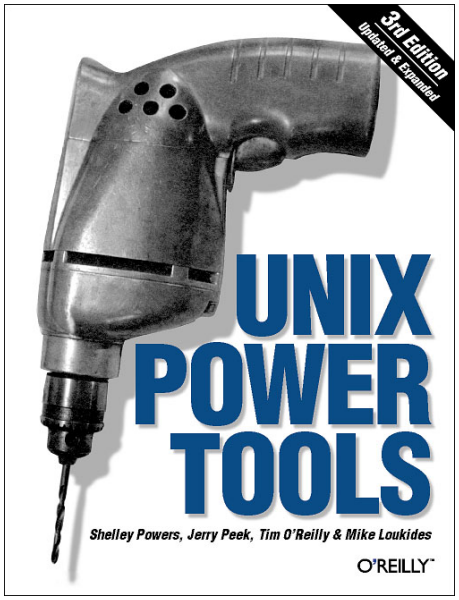

Sumitabha Das
YOUR
second edition
UNIX
The Ultimate Guide

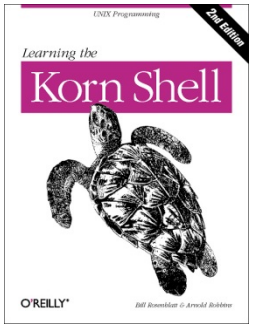

3rd Edition
UNIX
IN A NUTSHELL
A Desktop Quick Reference
for SVR4 and Solaris 7
O'REILLY
Arnold Robbins
with Daniel Gilly

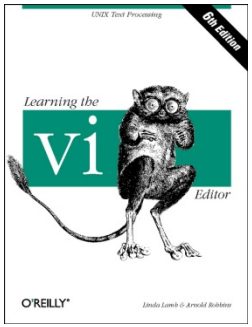
Other helpful resources

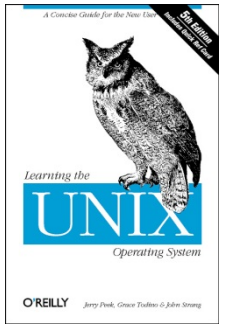


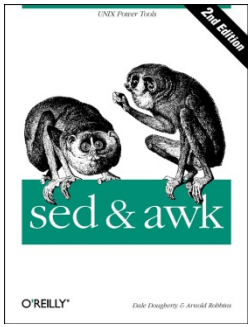












http://safari.oreilly.com

Who cares, how do I get an A?

- Assignments: 40%
- Project: 20%
- Quizzes: 20%
- Final: 20%

Cheating

- Don’t

Cheating

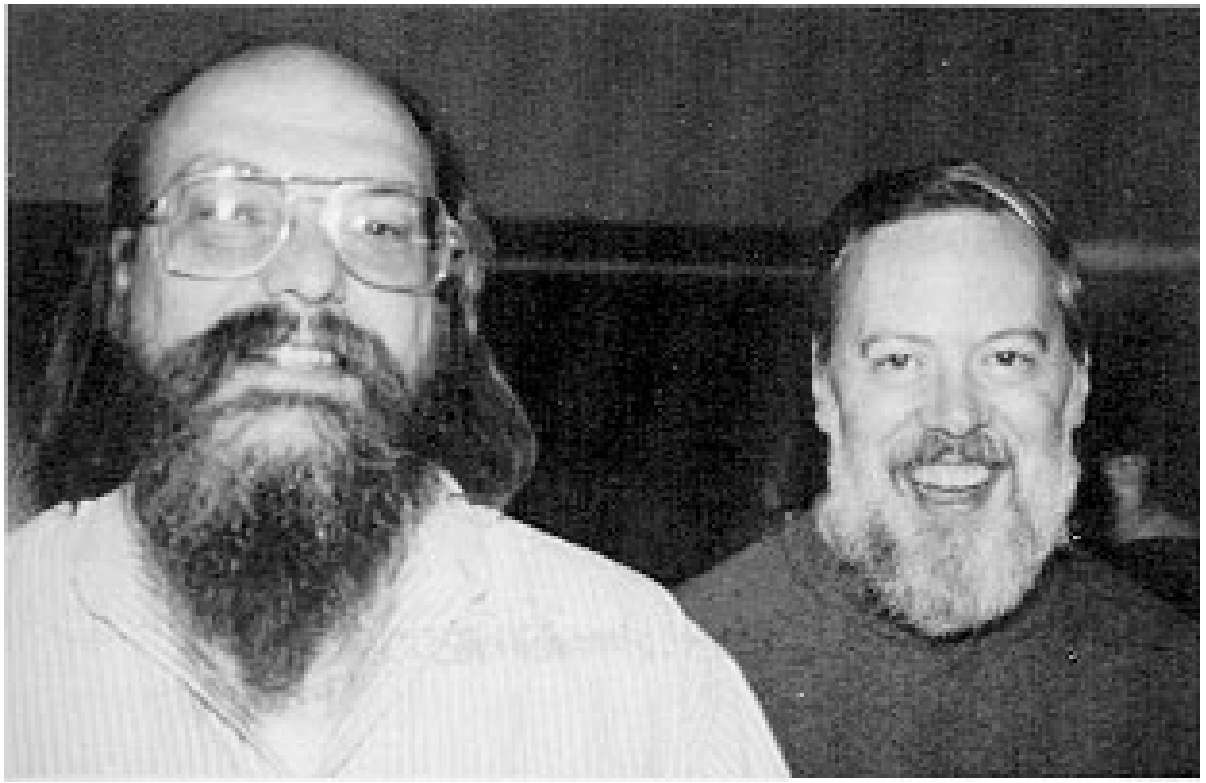
- Don’t
- Seriously, don’t

Individual Effort

- Assignments and quizzes are open book, open notes, open computer/internet!
- This is a hands on course designed to familiarize YOU with the unix/linux environment.
- You will need these skills in future classes.
- Cheat and pay the price later.
- Why not learn this stuff now?

Field Trip to the labs

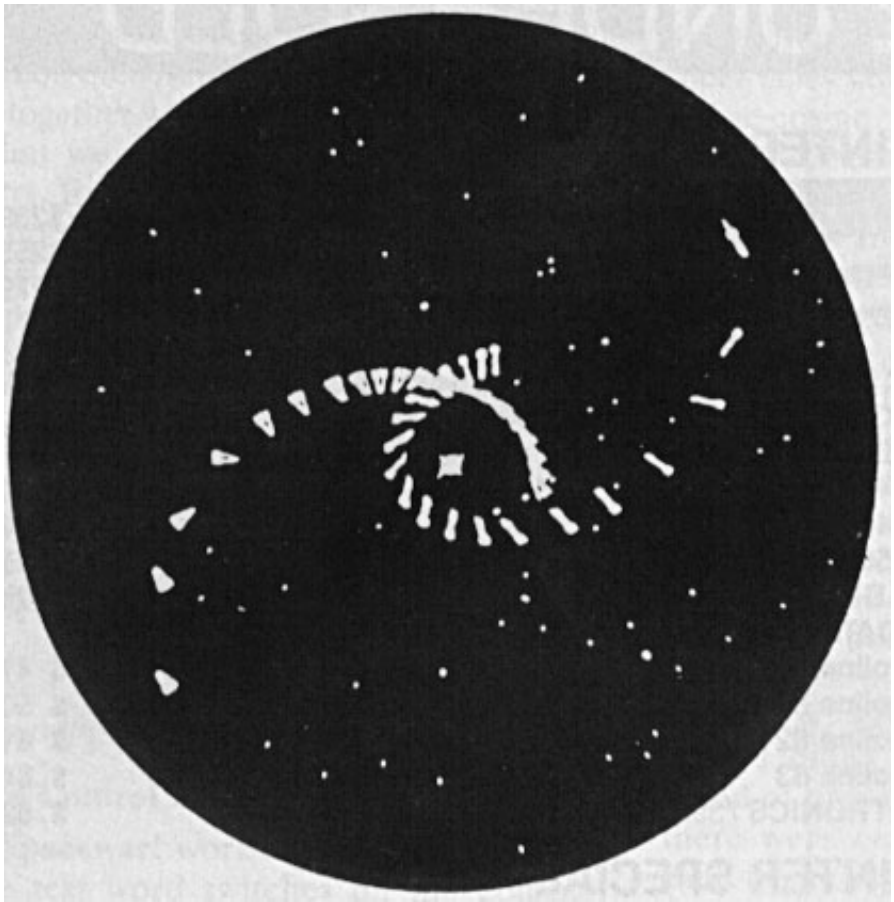
Our Heroes



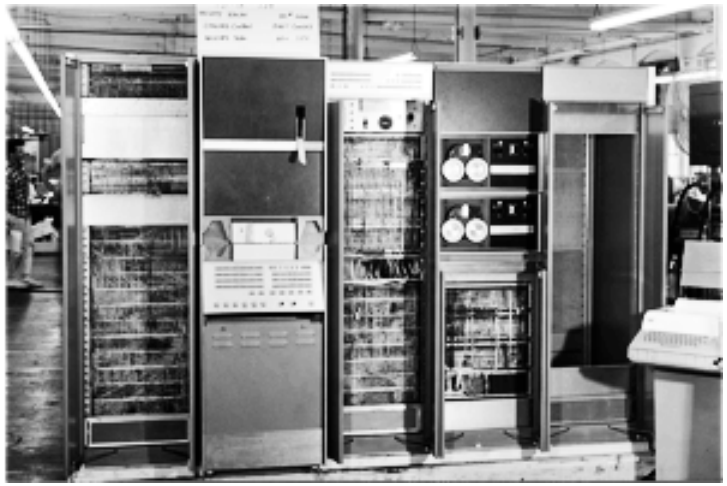
Ken Thompson

Dennis Ritchie

Video Games Spark Innovation



Space Pilot



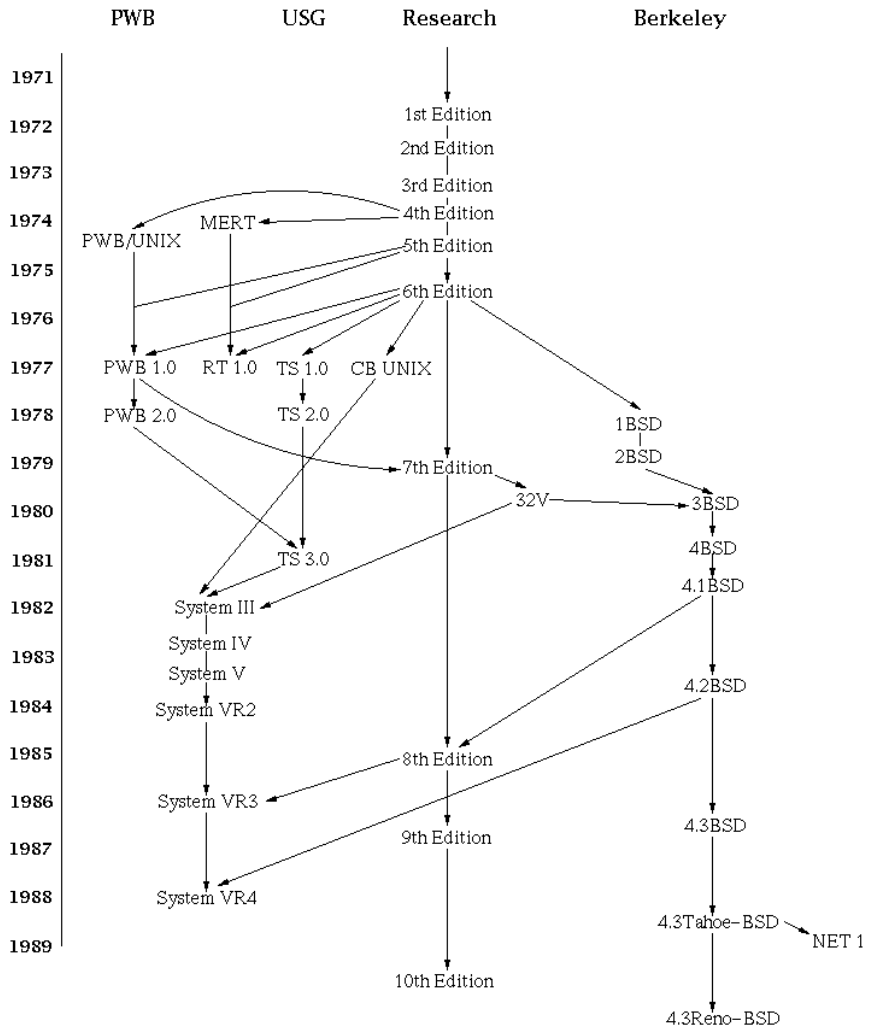
PDP-7

PDP-11

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)

Derivative Systems

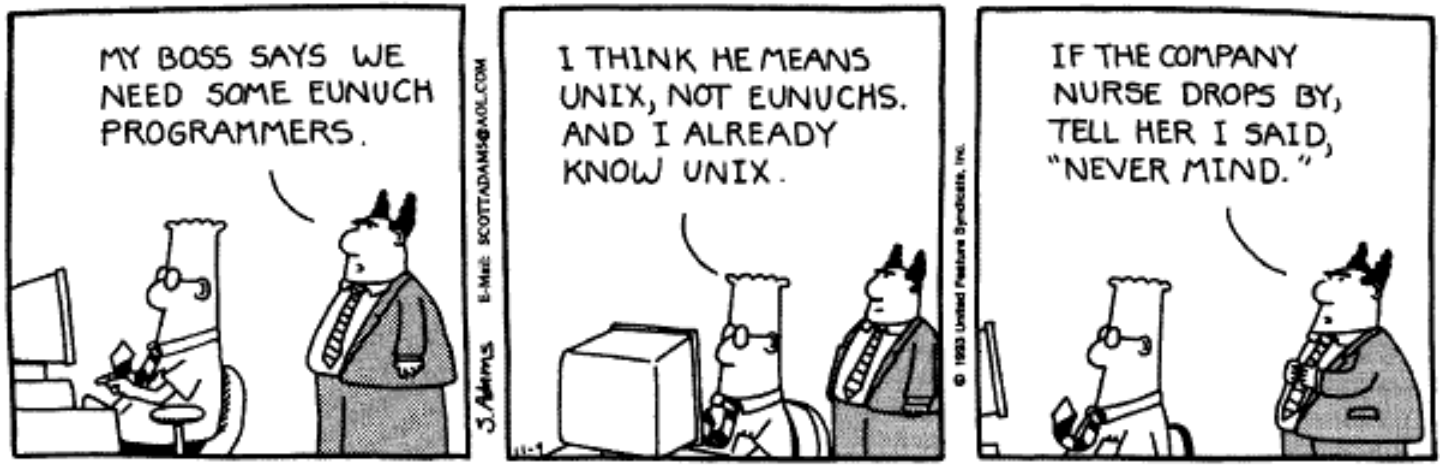


- PWB, MERT
- BSD: Adds many important features (networking, job control).
- AT&T enters the computer business with System III, V

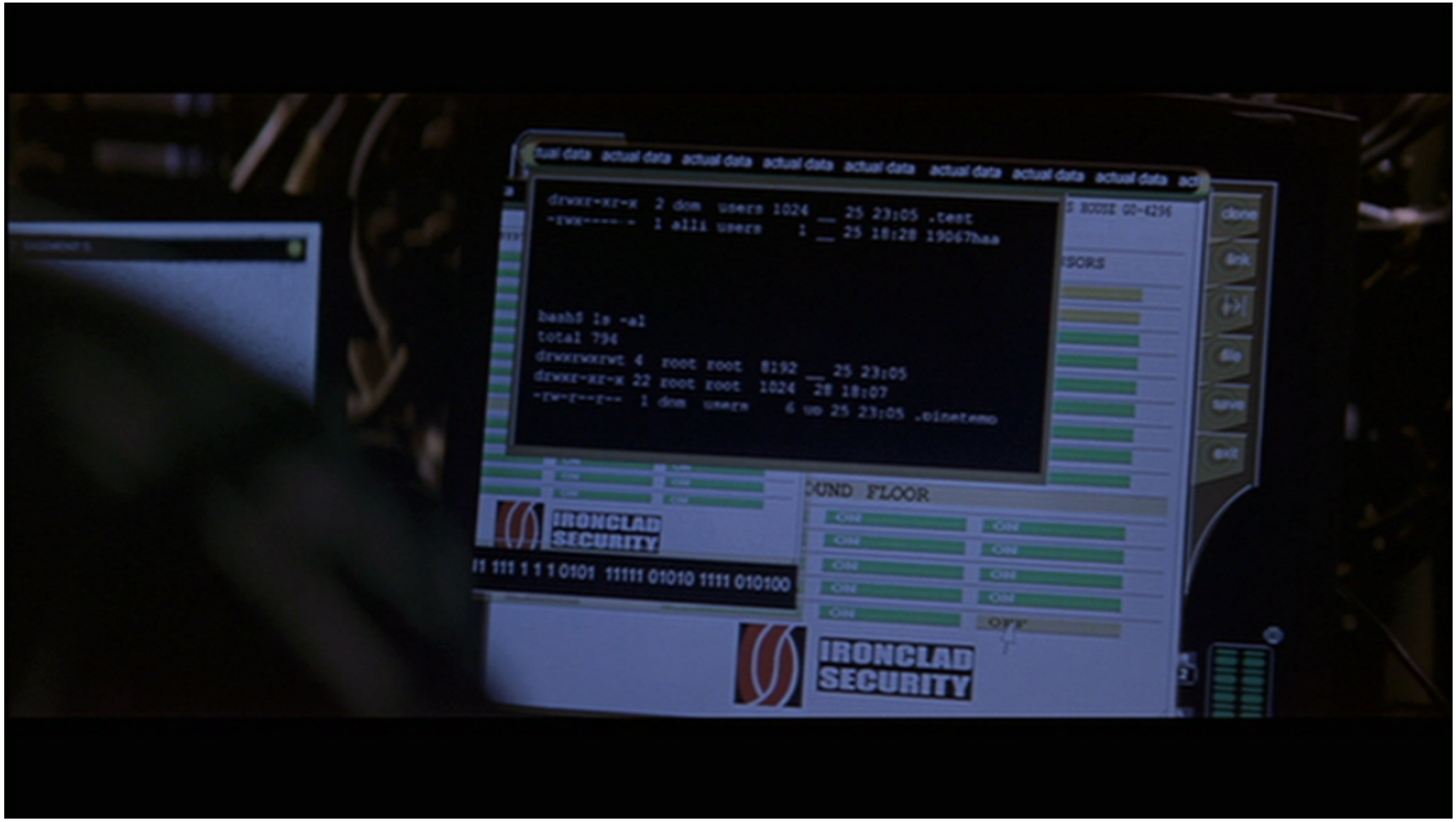
Commercial Success

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

Popular Success!

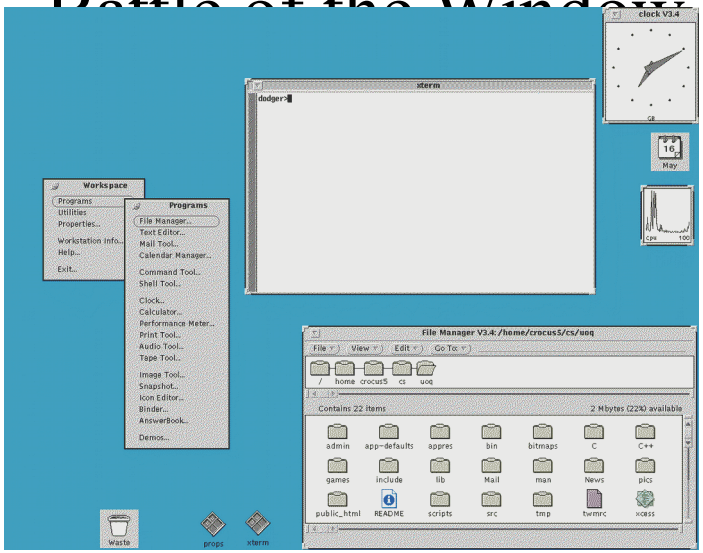


The Score

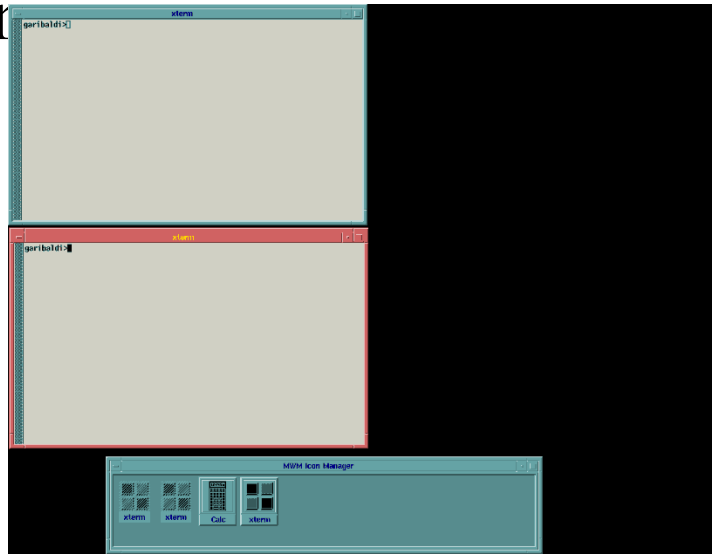


Standards and Wars

- *1998: POSIX Standard*
- *Unix International* vs. *Open Software Foundation* (to compete with desktop PCs)
- Battle of the Window Man



Openlook



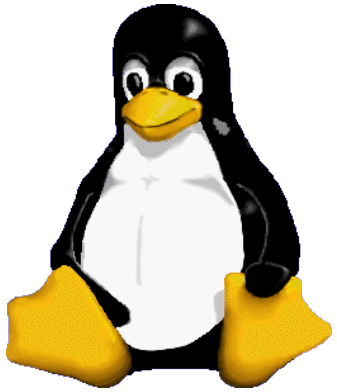
Motif

- Threat of Windows NT resolves battle with CDE

Commercial Backlash

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

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

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

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

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

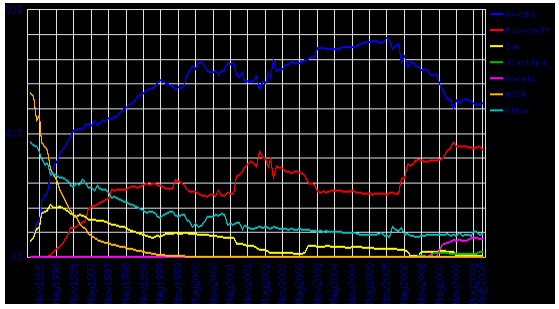
Gerstner made the announcement at the eBusiness Conference and Expo in New York, where IBM also revealed a Linux supercomputer win with Shell Oil.

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



Linux Success

NYSE undertakes IBM mainframe migration to Unix and Linux

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

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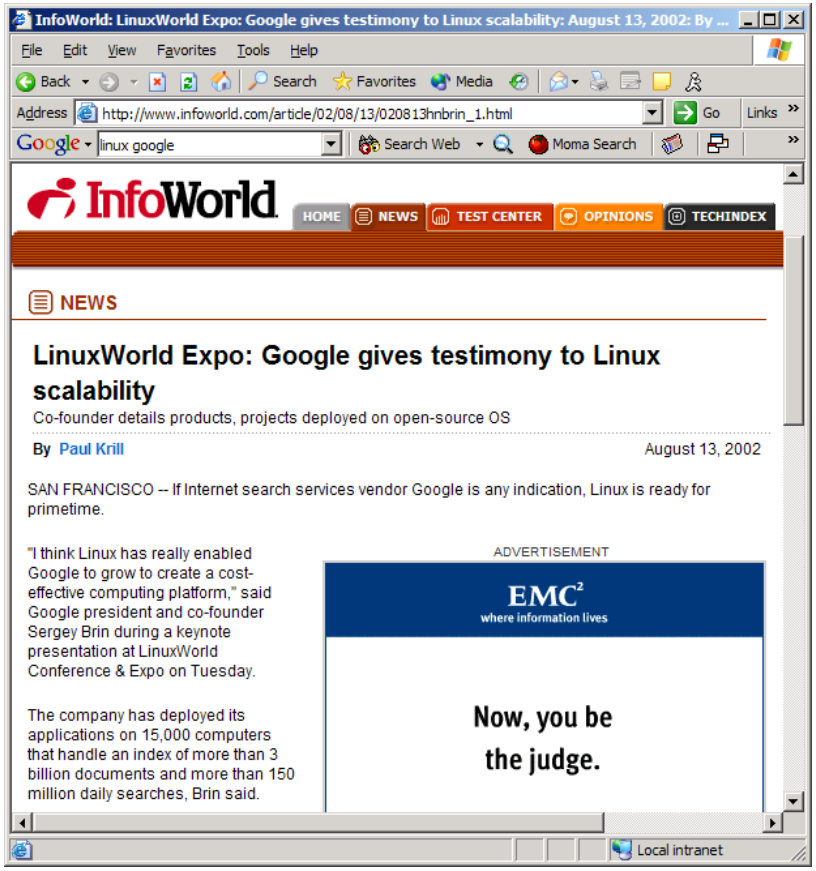
The New York Stock Exchange (NYSE) is migrating off a 1,600 millions of instructions per second (MIPS) mainframe to IBM System p servers running AIX and x86 Hewlett-Packard Co. (HP) servers running Linux, with the first part of the move going live today.

Linux at Google



Some Desktop Success

COMPUTERWORLD

Topics | News | In Depth | Reviews | Blogs | Opinion | Shark Tank

Blogs

Preston Gralla

Seeing Through Windows

More posts | Read bio

October 13, 2008 - 1:43 P.M.

Review of final OpenOffice 3: Why buy Microsoft Office?

126 comments

TAGS: Microsoft office, OpenOffice 3, Review

IT TOPICS: Applications, Desktop Apps, Enterprise Apps, Open Source, Operating Systems, Windows

The final version of OpenOffice 3 is out today, and if you're looking to save yourself plenty of money, download it instead of buying Microsoft Office --- you could save yourself hundreds of dollars, and not lose out on many features.

I put the Windows version through its paces, and am about to download the Linux version as well. The suite has six full-blown applications: the Writer word processor, Calc spreadsheet, Impress presentations program, Base database program, Math equation editor, and Draw graphics program.

Given that the full suite is free, this is one of the best deals you'll find in all of computing. It'll do just about anything you expect from an office suite, whether creating documents, spreadsheets, or presentations. You'll find solid

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 Open Source Movement

- Has fueled much growth in UNIX
  - Keeps up with pace of change
  - More users, developers
    - More platforms, better performance, better code

- Many vendors switching to Linux

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.

SCO vs. Linux

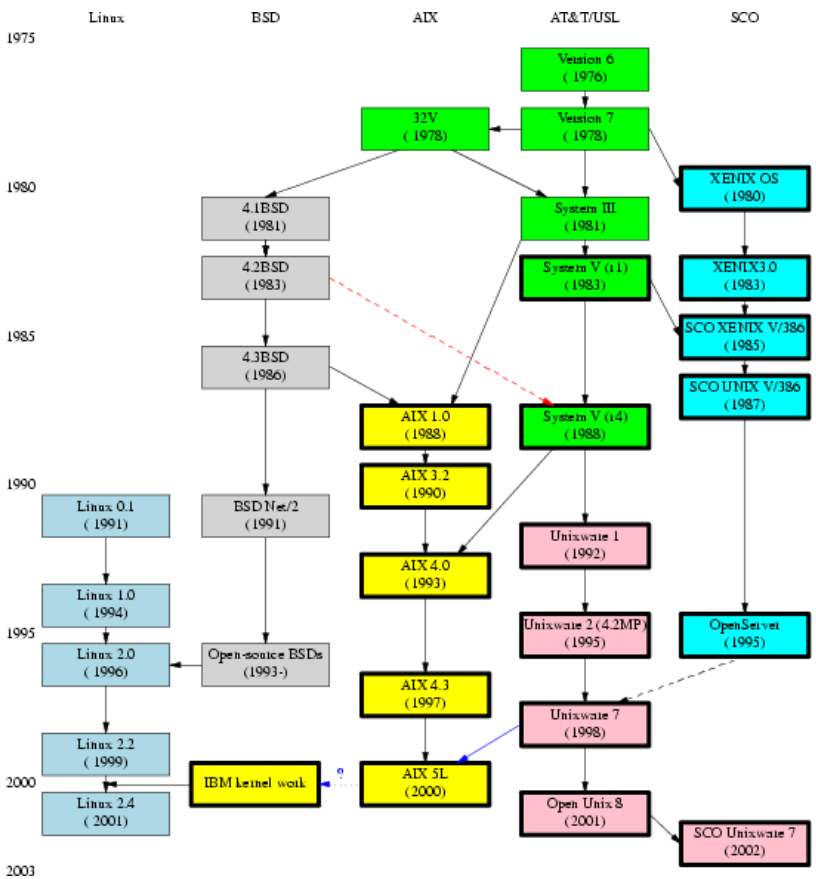
- **Jan 2002**: SCO releases ***Ancient Unix*** : BSD style licensing of V5/V6/V7/32V/System III
- **March 2003**: SCO sues IBM for $3 billion. Alleges contributions to Linux come from proprietary licensed code
  - AIX is based on System V r4, now owned by SCO
- **Aug 2003**: IBM Countersuit: patent and GPL violations
- **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…

* **Sept 2007**: SCO files chapter 11

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 startup
- Ritchie still at Lucent

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.

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

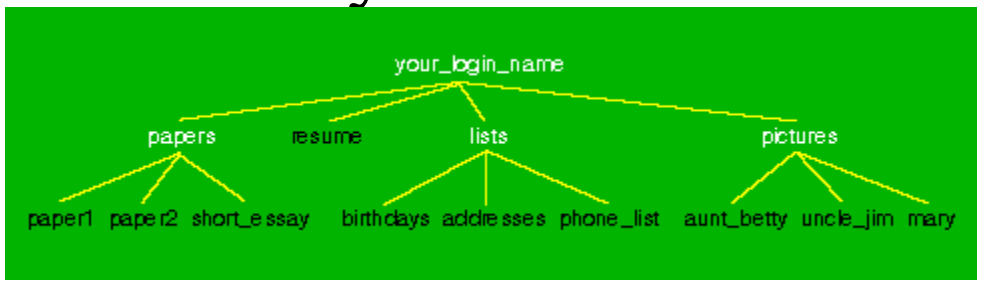
9,176 lines

- Build prototypes quickly (high level interpreted languages)

The UNIX Philosophy

..continued

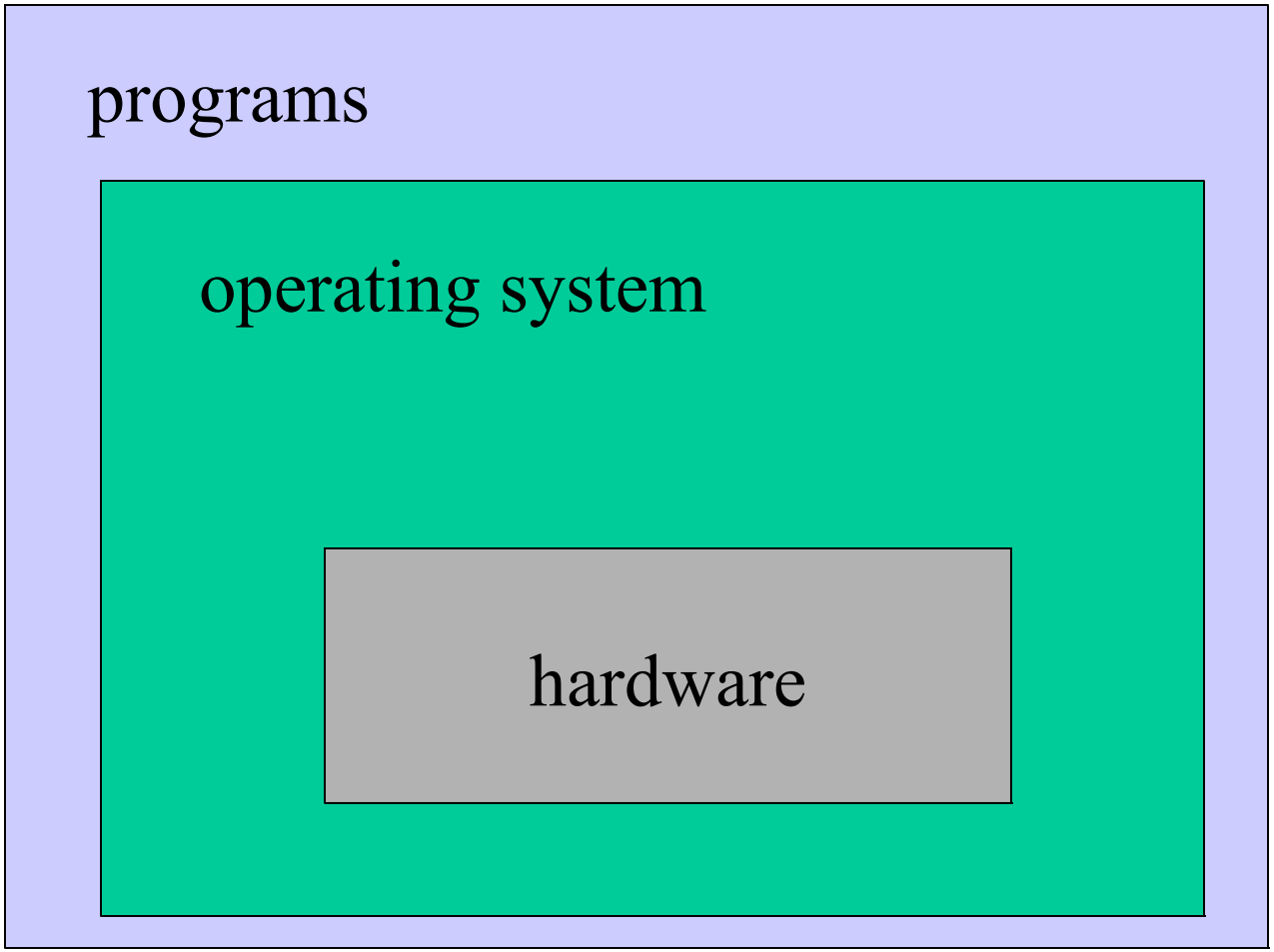
- Avoid captive interfaces
  - The user of a program isn't always human
  - Look nice, but code is big and ugly
  - Problems with scale
- Silence is golden
  - Only report if something is wrong
- Think hierarchically



UNIX Highlights / Contributions

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

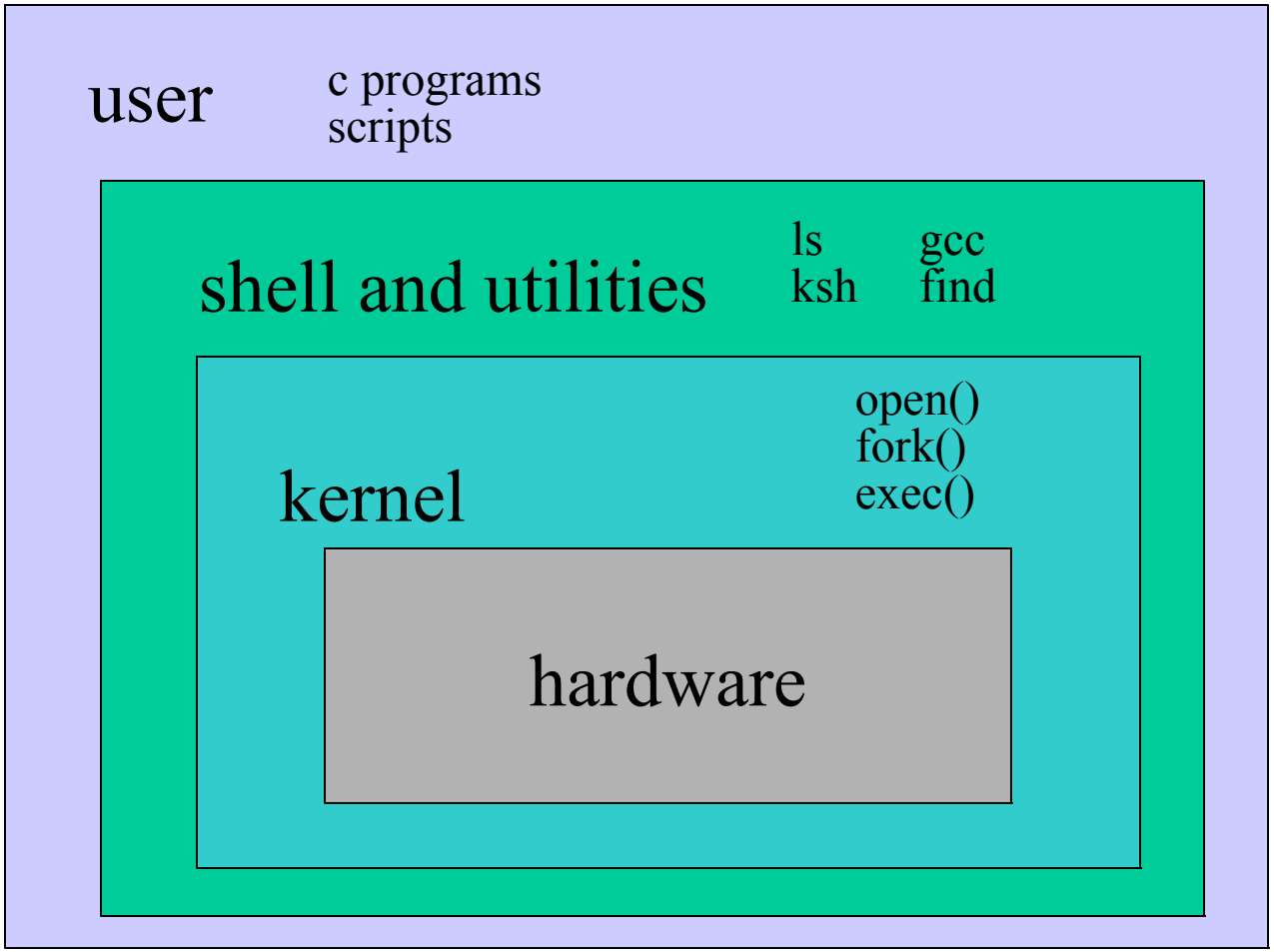
Operating System Structure



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

Unix System Structure

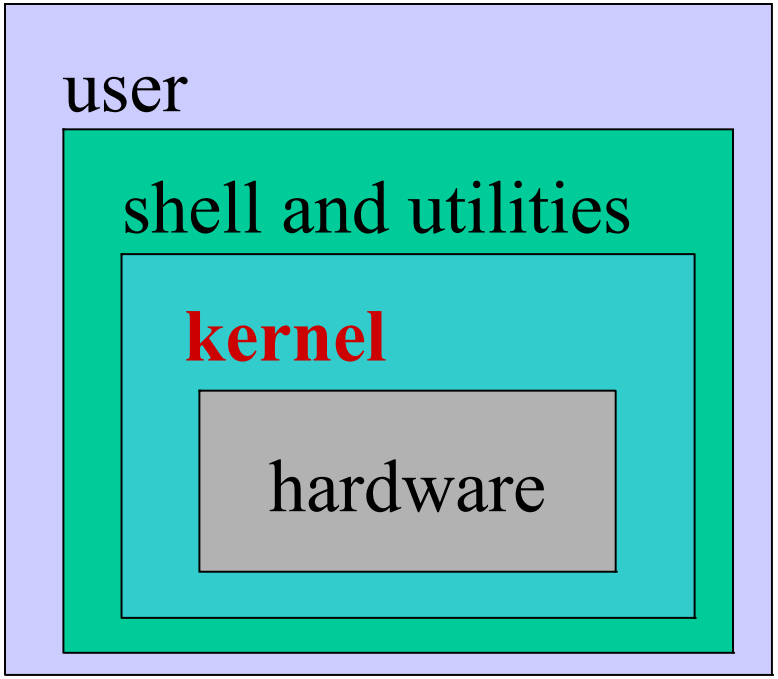


Kernel Basics

- 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.

The Kernel

- Manage resources
  - Storage
  - Memory
  - CPU
  - Display
  - Network
- Sharing
  - Users
  - Tasks
- Communication

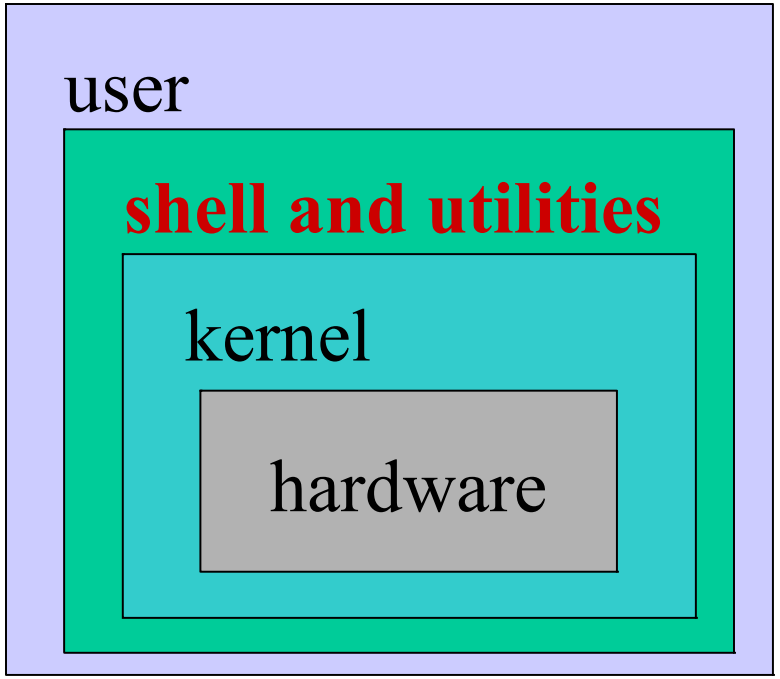


Kernel Subsystems

- File system
  - Directory hierarchy, regular files, peripherals
  - Multiple file systems
  - Input/Output
    - How processes access files, terminal I/O
- Process management
  - How processes share CPU, memory and signals
  - Scheduling
  - Interprocess Communication
  - Memory management
- UNIX variants have different implementations of different subsystems.

Shell & Utilities

- The rest of the operating system
- Focus of this course
- Cause of debate in Linux community

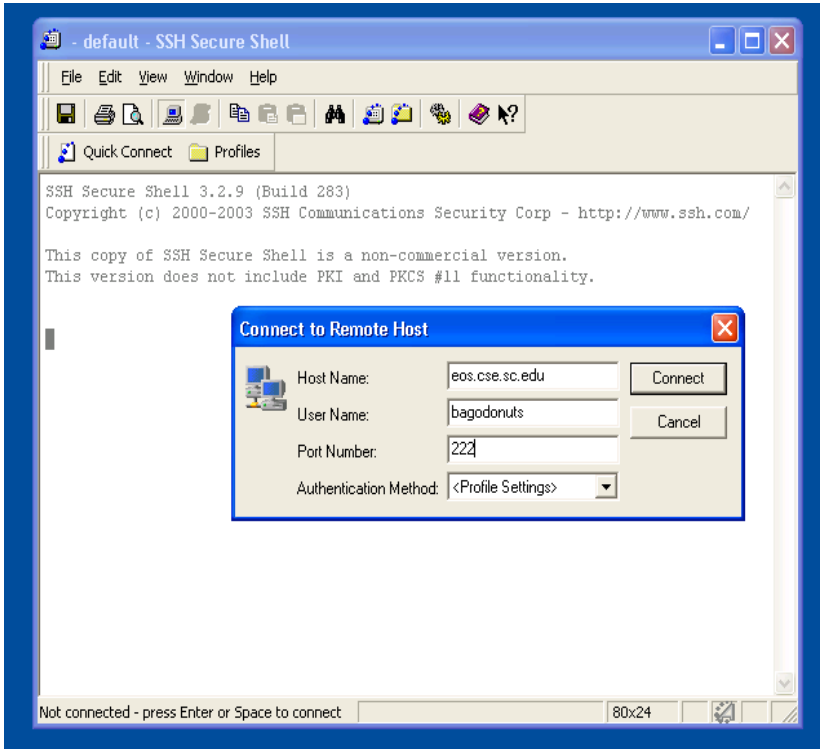


Logging In

- 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
  - SSH Secure Shell Client
- UNIX-like OS
  - ssh -p 222 <userid>@eos.cse.sc.edu



UNIX on Windows

Two recommended UNIX emulation environments:

UWIN (AT&T)

- `http://www.research.att.com/sw/tools/uwin`

Cygwin (GPL)

- `http://sources.redhat.com/cygwin`

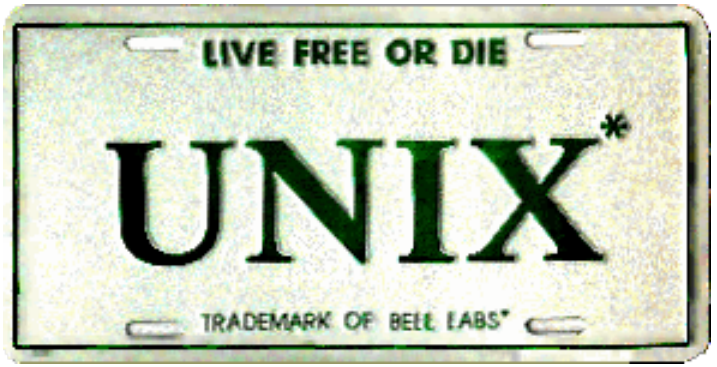
VMWare

- `http://www.vmware.com/download/player/`

Assignment 1

Next Time

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

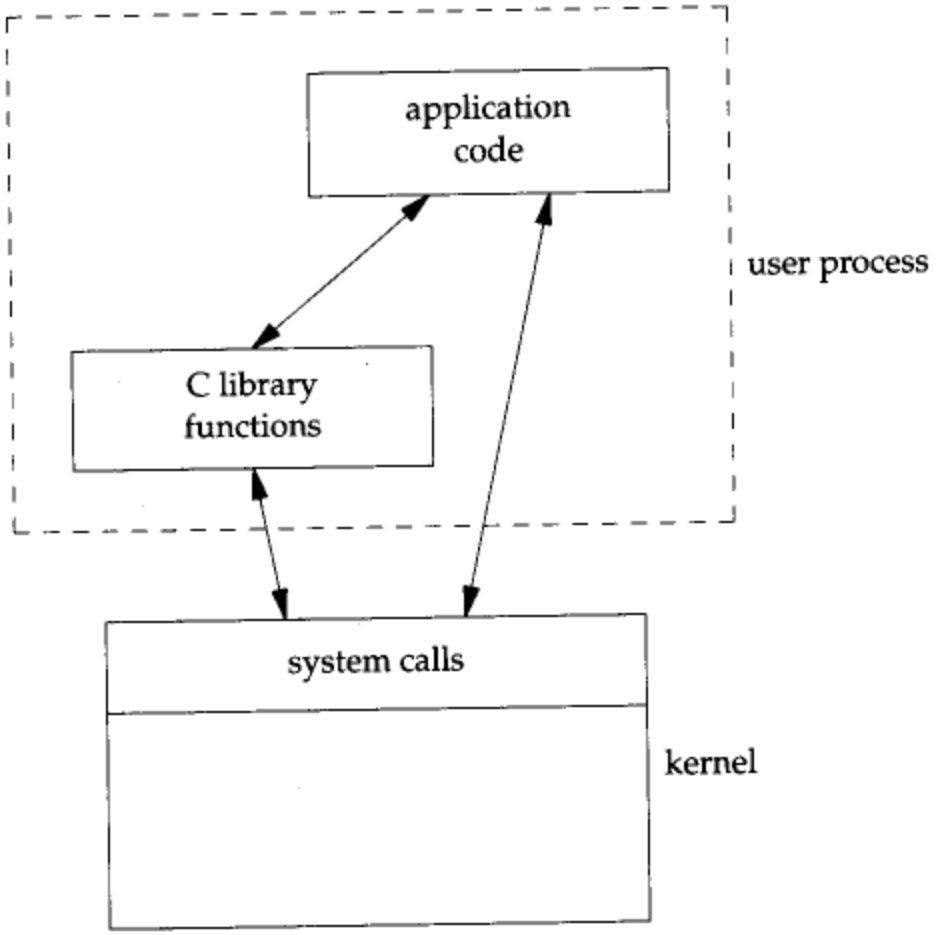


LINUX Tutorials

- http://www.linux-tutorial.info/modules.php?name=Tutorial&pageid=224
- http://www.tldp.org/LDP/intro-linux/html/index.html
- http://www.slackbook.org/html/index.html

System Calls

- The kernel implements a set of special routines
- A user program invokes a routine in the kernel by issuing a hardware TRAP
- The trap switches the CPU into a privileged mode and the kernel executes the system call
- The CPU goes back to user mode
- A C language API exists for all system calls



SCO: Line by Line Copying

System V Code

```
/*
 * Allocate 'size' units from the given map.
 * Return the base of the allocated space.
 * In a map, the addresses are increasing and
the
 * list is terminated by a 0 size.
 * The swap map unit is 512 bytes.
 * Algorithm is first-fit.
 *


∗ Ασ παρτ οφ τηε κερνελ εωολυτιον το
ωαρδ μοδυλαρ ναμινγ, τηε
 ∗ φυνχτιονσ μαλλοχ ανδ μφρεε αρε βε
ινγ ρεναμεδ το ρμαλλοχ ανδ ρμφρεε.
 ∗ Χομπατιβιλιτψ ωιλλ βε μαινταινεδ β
ψ τηε φολλοωινγ ασσεμβλερ χοδε:
 ∗ (αλσο σεε μφρεε/ρμφρεε βελοω)
 ∗/
```

…

Linux Kernel Code

```
/*
 * Allocate 'size' units from the given map.
 * Return the base of the allocated space.
 * In a map, the addresses are increasing and
the
 * list is terminated by a 0 size.
 * Algorithm is first-fit.
 */

ulong_t
atealloc(
      struct map *mp,
     size_t size)
{
     register unsigned int a;
     register struct map *bp;
     register unsigned long s;


…
```