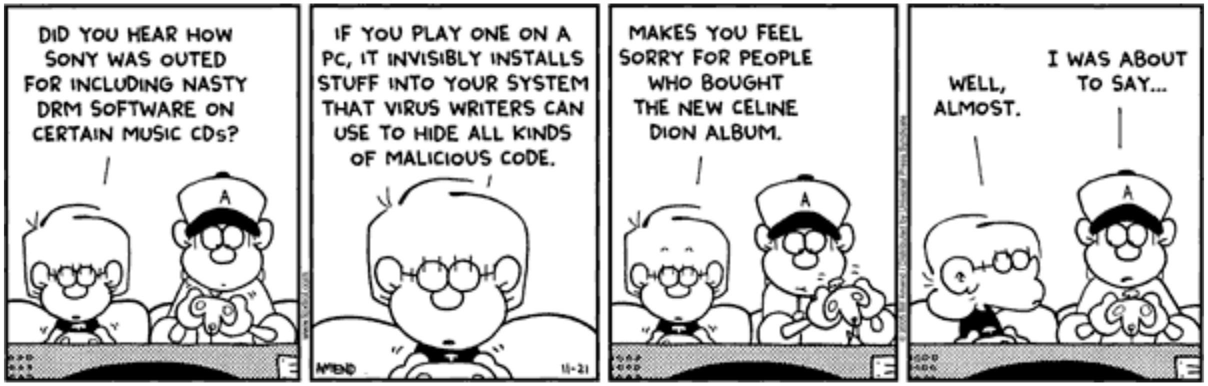
Lecture 14

Part I: Programming Tools

Rootkit

- Tools used to cover up tracks of a hacker
- Word has origins in UNIX, but applies to other systems
- At the center of the Sony DRM controversy


DID YOU HEAR HOW SONY WAS OUTED FOR INCLUDING NASTY DRM SOFTWARE ON CERTAIN MUSIC CDs?
IF YOU PLAY ONE ON A PC, IT INVISIBLY INSTALLS STUFF INTO YOUR SYSTEM THAT VIRUS WRITERS CAN USE TO HIDE ALL KINDS OF MALICIOUS CODE.
AMEND
11-21
MAKES YOU FEEL SORRY FOR PEOPLE WHO BOUGHT THE NEW CELINE DION ALBUM.
WELL, ALMOST.
I WAS ABOUT TO SAY...

Security Needs Trust

- Ken Thompson Turing Award Speech “Reflections on Trust”
  - How do you know if a program is secure?
    - Look at the source code
  - How do you know if the compiler is secure?

```
if (recognize-special-code)
        compile-hacked();
else
        compile-normal();
```

    - Look at assembly code
  - How do you know assembly is secure?
  - ... until lowest levels of hardware

tar: Tape ARchiver

- **tar**: general purpose archive utility (not just for tapes)
  - Usage: `tar [options] [files]`
  - Originally designed for maintaining an archive of files on a magnetic tape.
  - Now often used for packaging files for distribution
  - If any files are subdirectories, **tar** acts on the entire subtree.

tar: archiving files options

- **`c`** creates a tar-format file
- **`f filename`** specify filename for tar-format file,
  - Default is `/dev/rmt0`.
  - If **`-`** is used for filename, standard input or standard output is used as appropriate
- **`v`** verbose output
- **`x`** allows to extract named files

tar: archiving files (continued)

- **t** generates table of contents
- **r** unconditionally appends the listed files to the archive files
- **u** appends only files that are more recent than those already archived
- **L** follow symbolic links
- **m** do not restore file modification times
- **l** print error messages about links it cannot find

cpio: copying files

- **cpio:** copy file archives in from or out of tape or disk or to another location on the local machine
- Similar to **tar**
- Examples:
  - **Extract:** `cpio -idtu [patterns]`
  - **Create:** `cpio -ov`
  - **Pass-thru:** `cpio -pl directory`

cpio (continued)

- **`cpio -i [dtum] [patterns]`**
  - Copy in (extract) files whose names match selected patterns.
  - If no pattern is used, all files are extracted
  - During extraction, older files are not extracted (unless **`-u`** option is used)
  - Directories are not created unless **`-d`** is used
  - Modification times not preserved with **`-m`**
  - Print the table of contents: **`-t`**

cpio (continued)

- **`cpio -ov`**
  - Copy out a list of files whose names are given on the standard input. **`-v`** lists files processed.
- **`cpio -p [options] directory`**
  - Copy files to another directory on the same system. Destination pathnames are relative to the named directory
  - Example: To copy a directory tree:
    - `find . -depth -print | cpio -pdumv /mydir`

pax: replacement for cpio and tar

- **P**ortable **A**rchive e**X**change format
- Part of POSIX
- Reads/writes **cpio** and **tar** formats
- Union of **cpio** and **tar** functionality
- Files can come from standard input or command line
- Sensible defaults
  - `pax -wf archive *.c`
  - `pax -r < archive`

Distributing Software

- Pieces typically distributed:
  - Binaries
  - Required runtime libraries
  - Data files
  - Man pages
  - Documentation
  - Header files
- Typically packaged in an archive:
  - e.g., **`perl-solaris.tgz`** or **`perl-5.8.5-9.i386.rpm`**

Packaging Source: autoconf

- Produces shell scripts that automatically configure software to adapt to UNIX-like systems.
  - Generates configuration script (configure)
- The configure script checks for:
  - programs
  - libraries
  - header files
  - typedefs
  - structures
  - compiler characteristics
  - library functions
  - system services

  and generates makefiles

Installing Software From Tarballs

```
tar xzf <gzipped-tar-file>
cd <dist-dir>
./configure
make
make install
```

Debuggers

- The **GDB** or **DBX** debuggers let you examine the internal workings of your code while the program runs.
  - Debuggers allow you to set *breakpoints* to stop the program's execution at a particular point of interest and examine variables.
  - To work with a debugger, you first have to recompile the program with the proper debugging options.
  - Use the **`-g`** command line parameter to **cc, gcc,** or **CC**
    - Example: **`cc -g -c foo.c`**

Using the Debugger

- Two ways to use a debugger:
  1. Run the debugger on your program, executing the program from within the debugger and see what happens
  2. Post-mortem mode: program has crashed and core dumped
     - You often won't be able to find out exactly what happened, but you usually get a stack trace.
     - A stack trace shows the chain of function calls where the program exited ungracefully
     - Does not always pinpoint what caused the problem.

GDB, the GNU Debugger

- Text-based, invoked with:

```
gdb [<programfile> [<corefile>|<pid>]]
```

- Argument descriptions:

<programfile>	executable program file
<corefile>	core dump of program
<pid>	process id of already running program

- Example:

```
gdb ./hello
```

- Compile *<programfile>* with *-g* for debug info

Basic GDB Commands

- General Commands:

file [<file>]	selects *<file>* as the program to debug
run [<args>]	runs selected program with arguments *<args>*
attach <pid>	attach gdb to a running process *<pid>*
kill	kills the process being debugged
quit	quits the gdb program
help [<topic>]	accesses the internal help documentation

- Stepping and Continuing:

c[ontinue]	continue execution (after a stop)
s[tep]	step one line, entering called functions
n[ext]	step one line, without entering functions
finish	finish the function and print the return value

GDB Breakpoints

- Useful breakpoint commands:

b[reak] [<where>]	sets breakpoints. *<where>* can be a number of things, including a hex address, a function name, a line number, or a relative line offset
[r]watch <expr>	sets a watchpoint, which will break when *<expr>* is written to [or read]
info break[points]	prints out a listing of all breakpoints
clear [<where>]	clears a breakpoint at *<where>*
d[elete] [<nums>]	deletes breakpoints by number

Playing with Data in GDB

- Commands for looking around:

list [<where>]	prints out source code at *<where>*
search <regexp>	searches source code for *<regexp>*
backtrace [<n>]	prints a backtrace *<n>* levels deep
info [<what>]	prints out info on *<what>* (like local variables or function args)
p[rint] [<expr>]	prints out the evaluation of *<expr>*

- Commands for altering data and control path:

set <name> <expr>	sets variables or arguments
return [<expr>]	returns *<expr>* from current function
jump <where>	jumps execution to *<where>*

Tracing System Calls

- Most operating systems contain a utility to monitor system calls:
  - Linux: **strace**, Solaris: **truss**, SGI: **par**

```
   27mS[  1]                 : close(0) OK
   27mS[  1]                 : open("try.in", O_RDONLY, 017777627464)
   29mS[  1]                 : END-open() = 0
   29mS[  1]                 : read(0, "1\n2\n|/bin/date\n3\n|/bin/sleep 2", 2048) = 31
   29mS[  1]                 : read(0, 0x7fff26ef, 2017) = 0
   29mS[  1]                 : getpagesize() = 16384
   29mS[  1]                 : brk(0x1001c000) OK
   29mS[  1]                 : time() = 1003207028
   29mS[  1]                 : fork()
   31mS[  1]                 : END-fork() = 1880277
   41mS[  1]                (1864078): was sent signal SIGCLD
   31mS[  2]                 : waitsys(P_ALL, 0, 0x7fff2590, WTRAPPED|WEXITED, 0)
   42mS[  2]                 : END-waitsys(P_ALL, 0, {signo=SIGCLD, errno=0,
code=CLD_EXITED, pid=1880277, status=0}, WTRAPPED|WEXITED, 0) = 0
   42mS[  2]                 : time() = 1003207028
```

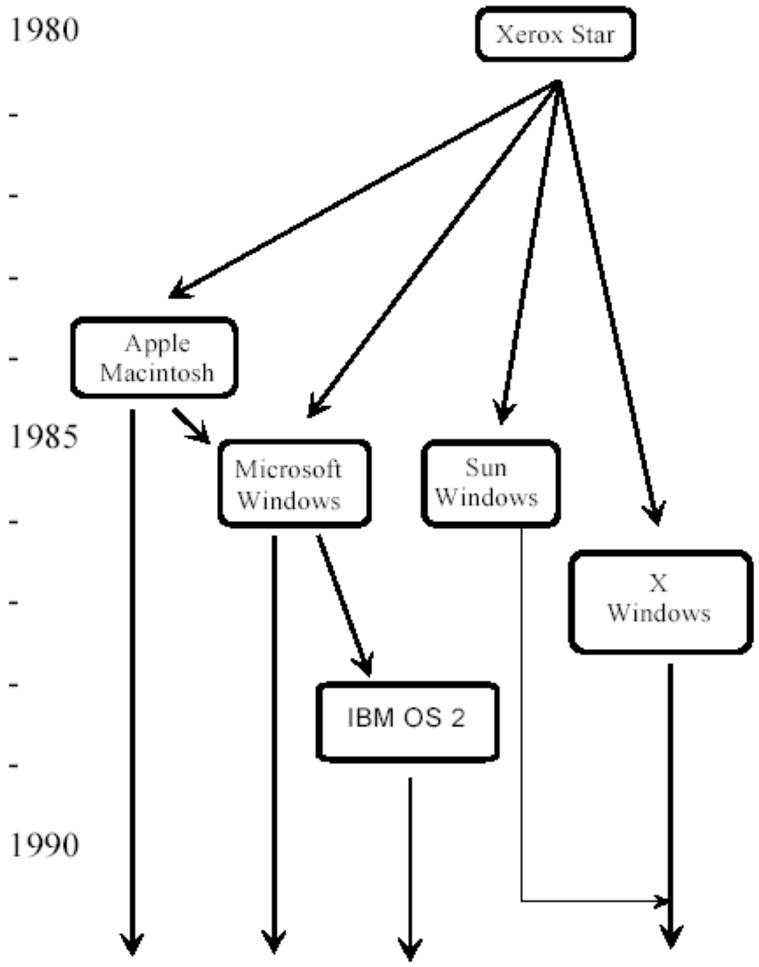
Lecture 14

Part II: User Interface

The Early Days

- The **curses** library allowed programs to take advantage of terminal features (e.g. vt100)
  - Special escape sequences to go to given position
  - Clear the screen
  - Font and color changes
- Examples:
  - vi, emacs, pine, lynx
  - More sophisticated: screen, w3m

Window System History



History of X

- Developed at MIT in 1984
- Derived from Stanford project called W
- X is now freely distributable, and available for UNIX, Windows, and Mac.

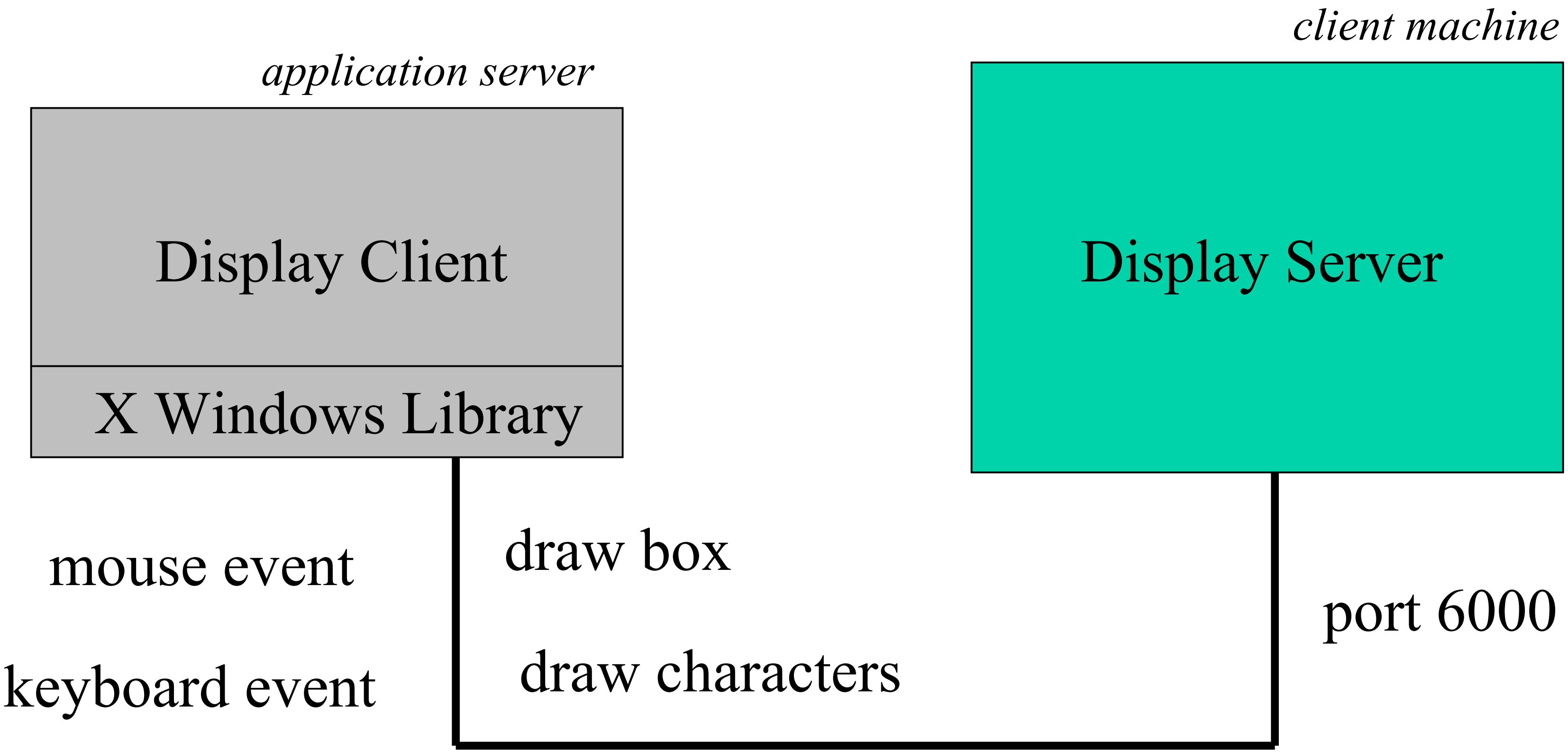
X Windows

- The X Windows system is the standard graphical interface for UNIX
- Distinguishing features:
  - Allows multiple virtual terminals to be opened at once
  - Highly Customizable and extensible
  - Highly Portable
  - Works over networks

X Windows Architecture

- Separation of display and programs
- Connected by TCP/IP
- Your display is the X ***server***
- Programs that run are ***clients***
- *Confusing because backwards from what we are used to*

X Windows Architecture



Setting the display

- The DISPLAY environment variable is used by X clients to decide which server to contact
- Format ***server:display***
  - One host can have multiple displays
  - Display corresponds to port 6000 + display
- Default server: localhost
- Examples:
  - :0
  - mymachine.cs.nyu.edu:0
  - 128.112.13.3:2

Security

- X Servers only accept commands from authorized hosts
- The command **xhost** is used to enable/disable
  - **xhost +mymachine**
  - **xhost -mymachine**
  - **xhost +** : Allow all hosts (*dangerous*!)
- X connections are not encrypted and therefore insecure
  - SSH tunneling solves this

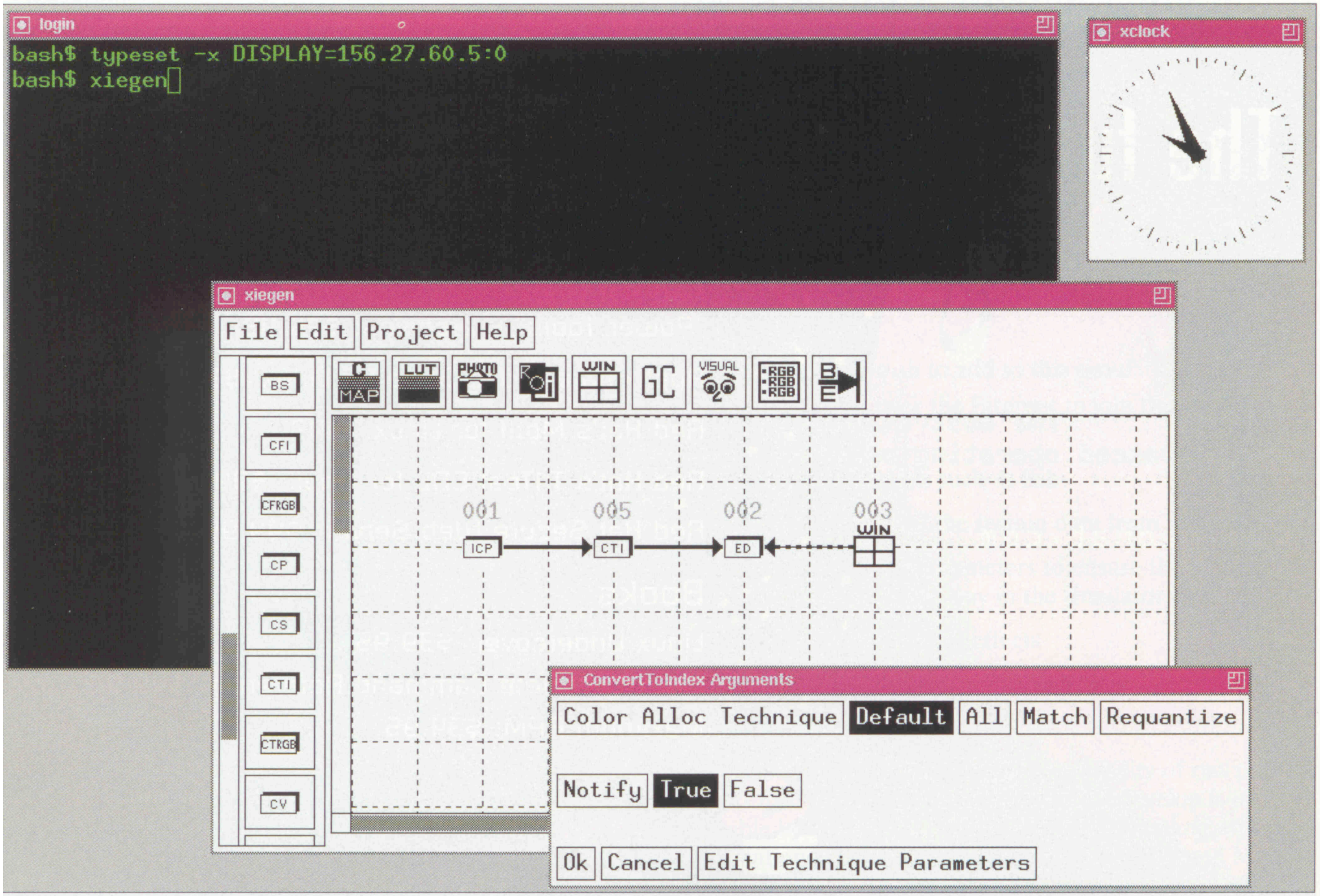
Configuration

- X windows allows most things to be configured:
  - Colors
  - Fonts
  - Positions
  - Decorations
  - Borders
  - Mouse bindings
  - Key bindings
- Stored in **`~/.Xdefaults`**

Window Managers

- Provide the look and feel of X Windows.
- In charge of:
  - The placement of windows
  - UI for moving/resizing/iconifying windows
  - Window decorations
- Because window managers are separate from X Windows, there are many to choose from:
  - twm (tom's)
  - fvwm (free/fast virtual window manager)
  - mwm (Motif)
  - olvwm (Open Look)

twm

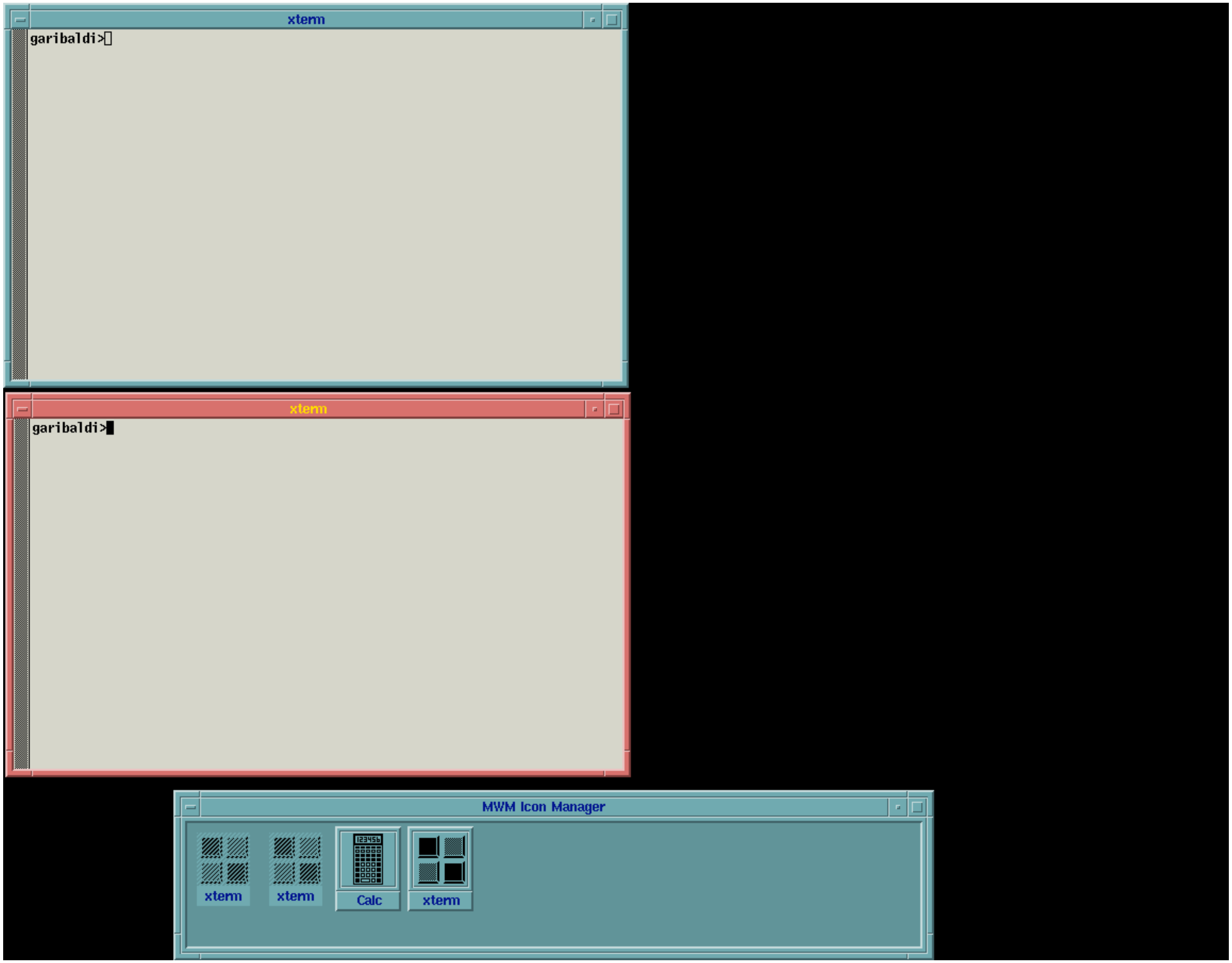


```
bash$ typeset -x DISPLAY=156.27.60.5:0
bash$ xiegen
```

Color Alloc Technique [✓ Default] All Match Requantize

Notify [✓ True] False

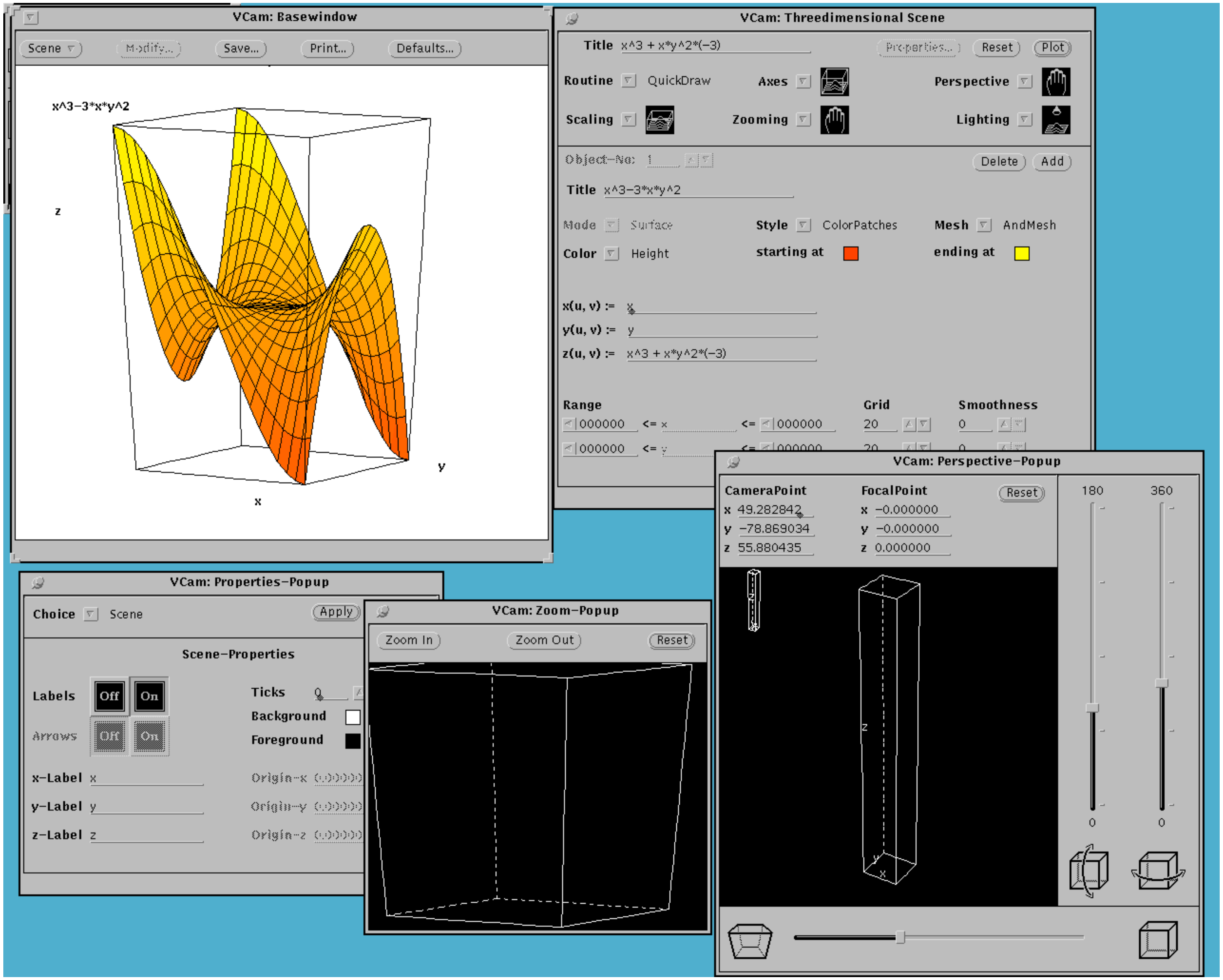
Motif



```
garibaldi>
```

```
garibaldi>
```

OpenLook



VCam: Threedimensional Scene

Title x^3 + x*y^2*(-3)

Routine QuickDraw

Axes

Perspective

Scaling

Zooming

Lighting

Object-No: 1

Title x^3-3*x*y^2

Mode Surface

Style ColorPatches

Mesh AndMesh

Color Height

starting at 🟥

ending at 🟨

x(u, v) := x

y(u, v) := y

z(u, v) := x^3 + x*y^2*(-3)

Range				Grid	Smoothness
000000	<= x	<=	000000	20	0
000000	<= y	<=	000000	20	0

VCam: Perspective-Popup

CameraPoint		FocalPoint	
x	49.282842	x	-0.000000
y	-78.869034	y	-0.000000
z	55.880435	z	0.000000

VCam: Properties-Popup

Choice Scene

Scene-Properties

Labels Off On

Arrows Off On

Ticks 0

Background □

Foreground ■

x-Label x

y-Label y

z-Label z

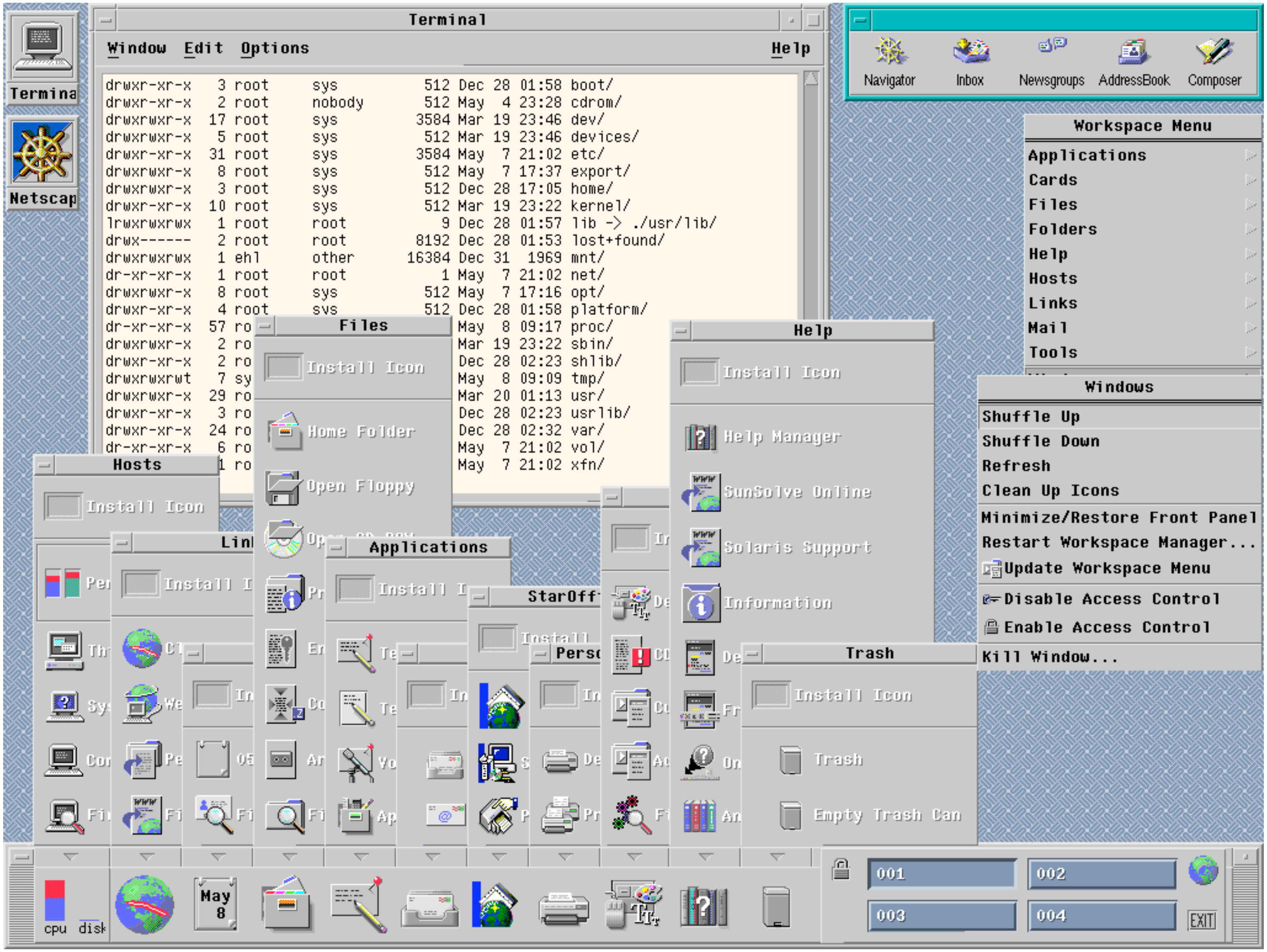
Origin-x 0.00000

Origin-y 0.00000

Origin-z 0.00000

CDE

- Common Desktop Environment
- Combines functionality of
  - Motif
  - OpenLook
- Response to threat of MS Windows



```
drwxr-xr-x   3 root     sys          512 Dec 28 01:58 boot/
drwxr-xr-x   2 root     nobody       512 May  4 23:28 cdrom/
drwxrwxr-x  17 root     sys         3584 Mar 19 23:46 dev/
drwxrwxr-x   5 root     sys          512 Mar 19 23:46 devices/
drwxr-xr-x  31 root     sys         3584 May  7 21:02 etc/
drwxrwxr-x   8 root     sys          512 May  7 17:37 export/
drwxrwxr-x   3 root     sys          512 Dec 28 17:05 home/
drwxr-xr-x  10 root     sys          512 Mar 19 23:22 kernel/
lrwxrwxrwx   1 root     root           9 Dec 28 01:57 lib -> ./usr/lib/
drwx------   2 root     root        8192 Dec 28 01:53 lost+found/
drwxrwxrwx   1 ehl      other      16384 Dec 31  1969 mnt/
dr-xr-xr-x   1 root     root           1 May  7 21:02 net/
drwxrwxr-x   8 root     sys          512 May  7 17:16 opt/
drwxr-xr-x   4 root     sys          512 Dec 28 01:58 platform/
dr-xr-xr-x  57 ro                        May  8 09:17 proc/
drwxrwxr-x   2 ro                        Mar 19 23:22 sbin/
drwxr-xr-x   2 ro                        Dec 28 02:23 shlib/
drwxrwxrwt   7 sy                        May  8 09:09 tmp/
drwxrwxr-x  29 ro                        Mar 20 01:13 usr/
drwxr-xr-x   3 ro                        Dec 28 02:23 usrlib/
drwxr-xr-x  24 ro                        Dec 28 02:32 var/
dr-xr-xr-x   6 ro                        May  7 21:02 vol/
             1 ro                        May  7 21:02 xfn/
```

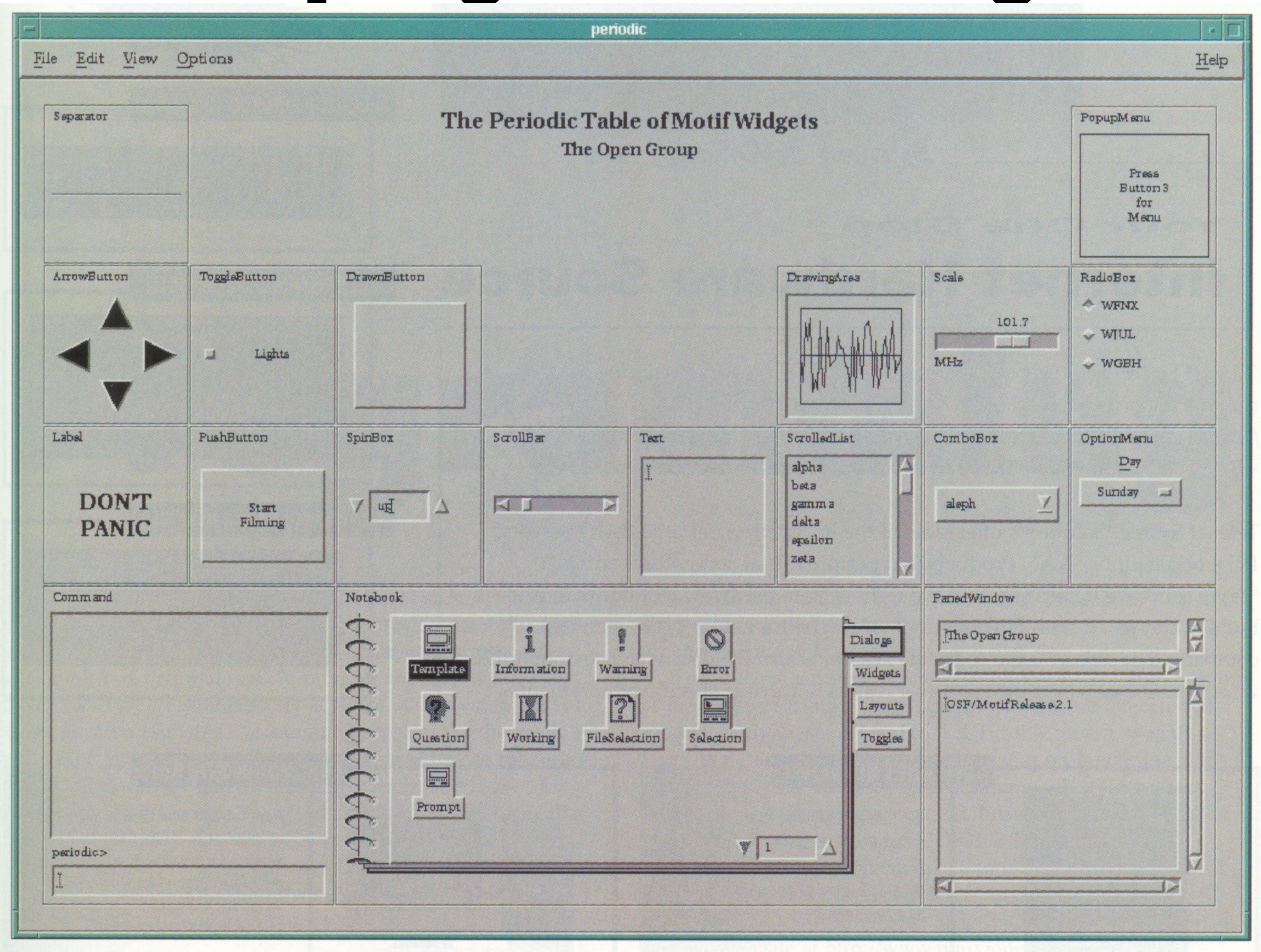
Disadvantages of X

- X is a resource hog
  - On an 80x86 machine, 16 MB is the minimum amount of memory for decent performance
- X has a large disk footprint
  - OpenLook, Sun’s window manager, takes up 30+ MB of disk space for the binaries and libraries
- On older, less powerful workstations, X also takes a performance hit
  - But this isn’t a big deal on reasonably modern machines (386 and better, for PCs)

X Toolkits

- X windows provides an API for doing low level graphics functionality (Xt)
  - Too cumbersome to use for many applications
- Motif
  - Higher level widgets
  - Examples: buttons, scrollbars, menus, etc.
- Even higher level: portability outside X
  - gtk
  - Qt

A Sampling of Motif Widgets



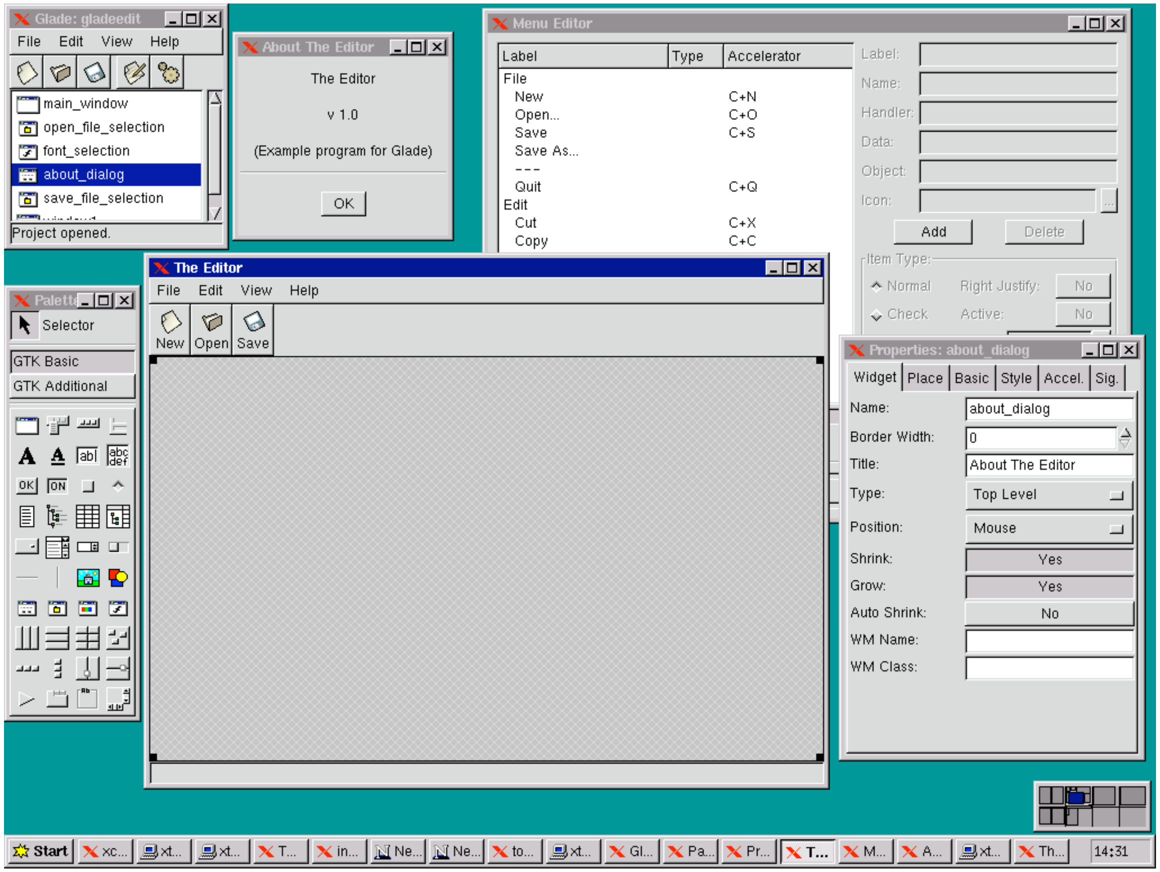
Example X Windows Program

```
#include <Xm/PushB.h>

main(int argc, char *argv[]) {
    Widget        toplevel, button;
    XtAppContext  app;
    XmString      label;

    XtSetLanguageProc (NULL, NULL, NULL);

    toplevel = XtVaAppInitialize (&app, "Hello", NULL, 0,
        &argc, argv, NULL, NULL);

    label = XmStringCreateLocalized ("Push here to say hello");
    button = XtVaCreateManagedWidget ("pushme",
        xmPushButtonWidgetClass, toplevel,
        XmNlabelString, label,
        NULL);
    XmStringFree (label);
    XtAddCallback (button, XmNactivateCallback, button_pushed, NULL);

    XtRealizeWidget (toplevel);
    XtAppMainLoop (app);
}

void button_pushed(Widget widget, XtPointer client_data, XtPointer call_data) {
    printf ("Hello Yourself!\n");
}
```

Gtk and Qt

- Make it possible to write applications that work on X, Windows and MacOS
  - Even PDAs
- **Gtk**: GNU license. C API
- **Qt**: Property of Trolltech, free to use. C++ API
- **wxWindows**: common API

User Interface Builders



main_window
open_file_selection
font_selection
about_dialog
save_file_selection

Project opened.

The Editor

v 1.0

(Example program for Glade)

Label	Type	Accelerator
File		
New		C+N
Open...		C+O
Save		C+S
Save As...		

Quit		C+Q
Edit		
Cut		C+X
Copy		C+C

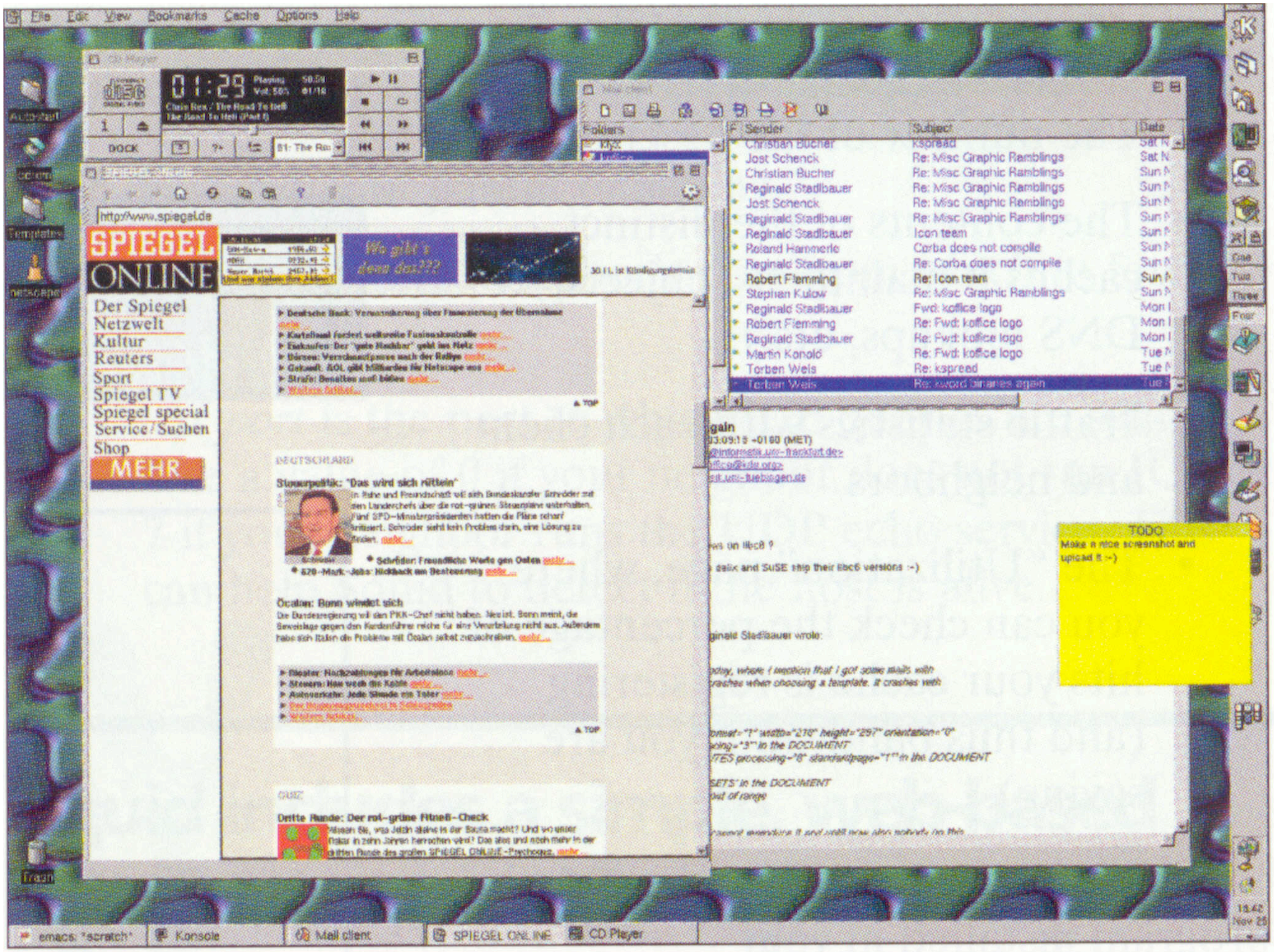
Name: about_dialog
Border Width: 0
Title: About The Editor
Type: Top Level
Position: Mouse
Shrink: Yes
Grow: Yes
Auto Shrink: No
WM Name:
WM Class:

glade

Linux Window Managers

- Trying to complete with MS Windows, advanced window managers have been developed:
  - KDE
  - Gnome
- Also include more advanced programming APIs for inter-program communication

KDE



Sender	Subject	Date
Christian Bucher	kspread	Sat N
Jost Schenck	Re: Misc Graphic Ramblings	Sat N
Christian Bucher	Re: Misc Graphic Ramblings	Sun N
Reginald Stadlbauer	Re: Misc Graphic Ramblings	Sun N
Jost Schenck	Re: Misc Graphic Ramblings	Sun N
Reginald Stadlbauer	Re: Misc Graphic Ramblings	Sun N
Reginald Stadlbauer	Icon team	Sun N
Roland Hammerle	Corba does not compile	Sun N
Reginald Stadlbauer	Re: Corba does not compile	Sun N
Robert Flemming	Re: Icon team	Sun N
Stephan Kulow	Re: Misc Graphic Ramblings	Sun N
Reginald Stadlbauer	Fwd: koffice logo	Mon N
Robert Flemming	Re: Fwd: koffice logo	Mon N
Reginald Stadlbauer	Re: Fwd: koffice logo	Mon N
Martin Konold	Re: Fwd: koffice logo	Tue N
Torben Weis	Re: kspread	Tue N
Torben Weis	Re: kword binaries again	Tue N

gain
03:09:15 +0100 (MET)
@informatik.uni-frankfurt.de>
koffice@kde.org>
st.uni-tuebingen.de

ws on libc6 ?

delix and SuSE ship their libc6 versions :-)

ginald Stadlbauer wrote:

oday, where I mention that I got some mails with
crashes when choosing a template. It crashes with

ormat="1" width="210" height="297" orientation="0"
cing="3"" in the DOCUMENT
TES processing="0" standardpage="1"" in the DOCUMENT

SETS' in the DOCUMENT
out of range

cannot reproduce it and still now also nobody (in this

Make a nice screenshot and
upload it :-)

- Deutsche Bank: Verunsicherung über Finanzierung der Übernahme mehr...
- Kartellamt fordert weltweite Fusionskontrolle mehr...
- Einkaufen: Der "gute Nachbar" geht ins Netz mehr...
- Börsen: Verschnaufpause nach der Rallye mehr...
- Gekauft: AOL gibt Milliarden für Netscape aus mehr...
- Strafe: Benetton muß büßen mehr...
- Weitere Artikel...

▲ TOP

DEUTSCHLAND

Steuerpolitik: "Das wird sich rütteln"

In Ruhe und Freundschaft will sich Bundeskanzler Schröder mit den Länderchefs über die rot-grünen Steuerpläne unterhalten. Fünf SPD-Ministerpräsidenten hatten die Pläne scharf kritisiert. Schröder sieht kein Problem darin, eine Lösung zu finden. mehr...

Schröder

- Schröder: Freundliche Worte gen Osten mehr...
- 620-Mark-Jobs: Rückzieher bei Besteuerung mehr...

Öcalan: Bonn windet sich

Die Bundesregierung will den PKK-Chef nicht haben. Wer ist. Bonn meint, die Beweislage gegen den Kurdenführer reiche für eine Verurteilung nicht aus. Außerdem habe sich Italien die Probleme mit Öcalan selbst zuzuschreiben. mehr...

- Riester: Nachzahlungen für Arbeitslose mehr...
- Steuern: Nun wech die Kohle mehr...
- Autoverkehr: Jede Stunde ein Toter mehr...
- Der Regierungsumzug in [illegible]
- Weitere Artikel...

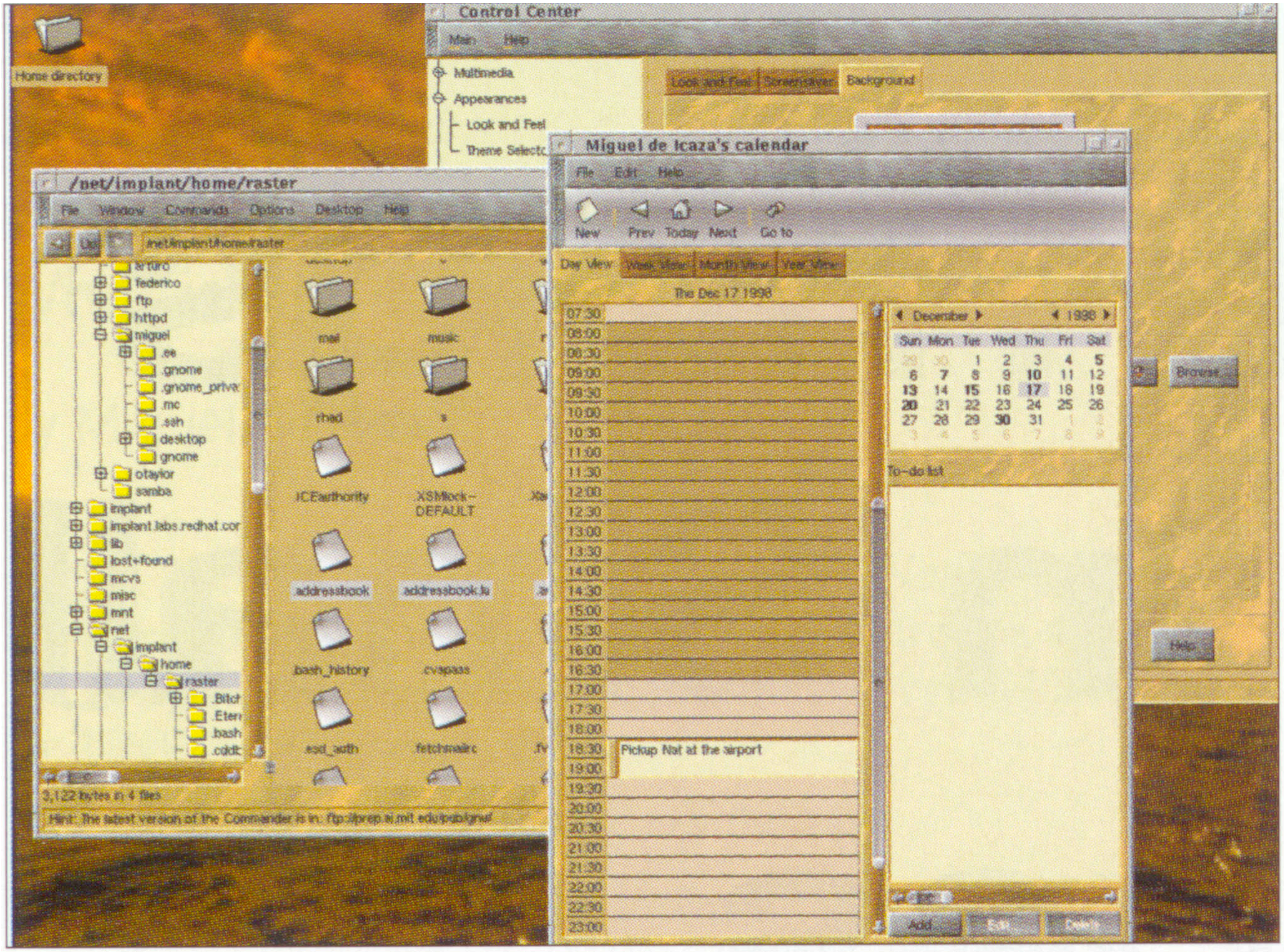
▲ TOP

QUIZ

Dritte Runde: Der rot-grüne Fitneß-Check

Wissen Sie, was Jetzt alles in der Sauna macht? Und wo unser Fiskus in zehn Jahren herrschen wird? Das alles und noch mehr in der dritten Runde des großen SPIEGEL ONLINE-Psychogramms mehr...

GNOME



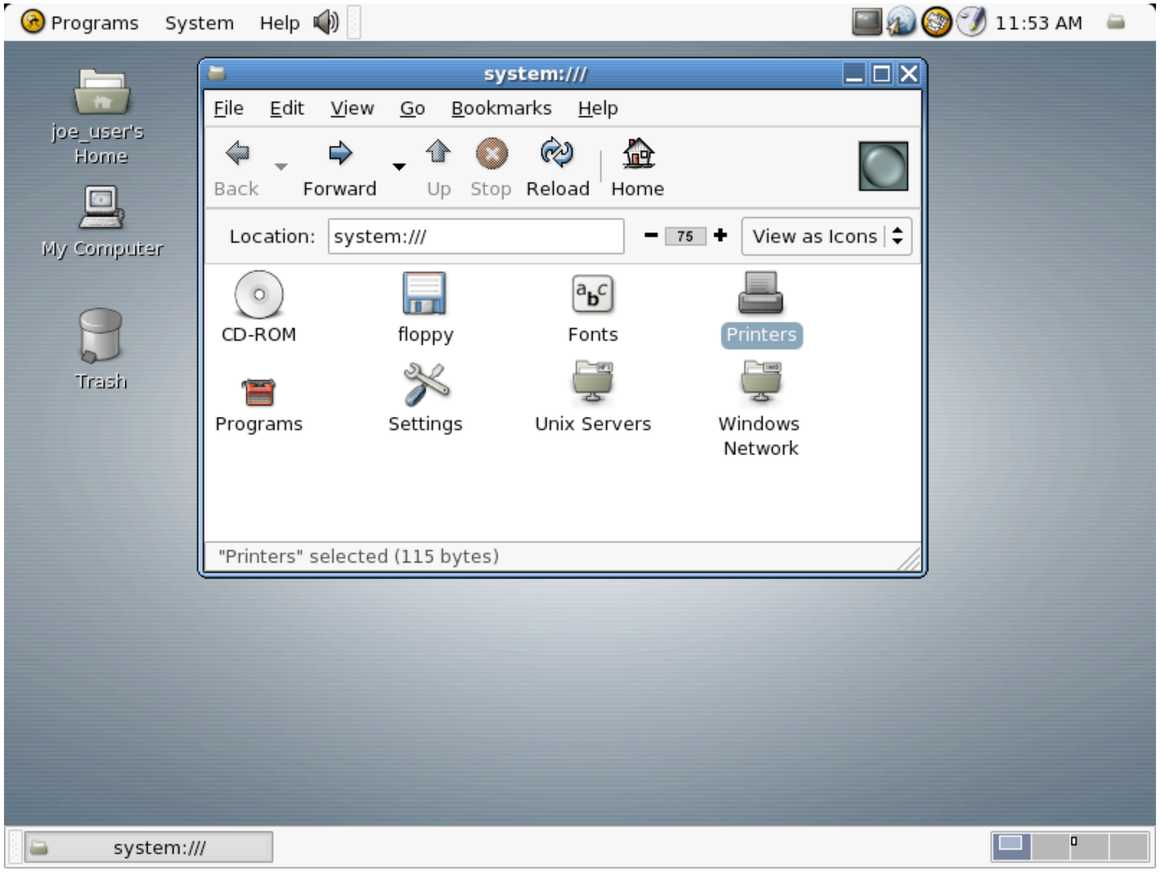
3,122 bytes in 4 files

Hint: The latest version of the Commander is in: ftp://prep.ai.mit.edu/pub/gnu/

Pickup Nat at the airport

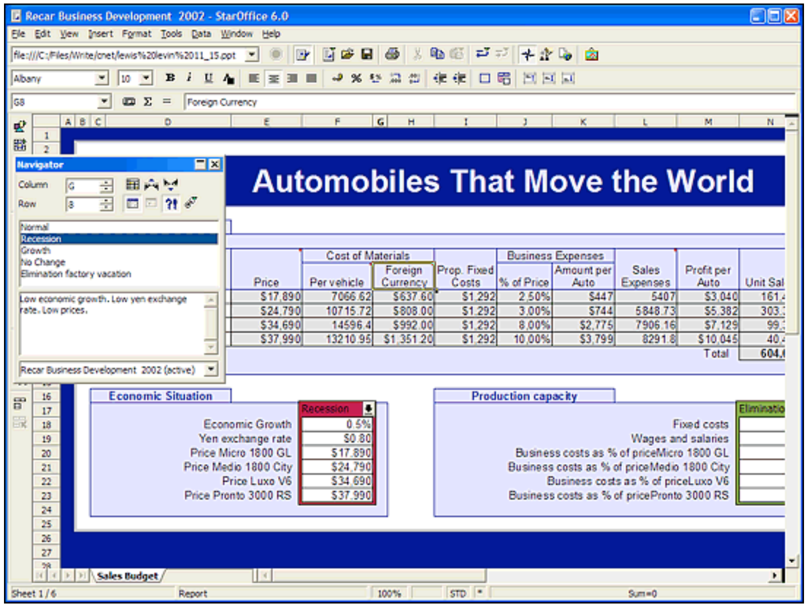
Sun	Mon	Tue	Wed	Thu	Fri	Sat
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9

Ximan Desktop



"Printers" selected (115 bytes)

Star Office / Open Office


Recar Business Development 2002 - StarOffice 6.0
File Edit View Insert Format Tools Data Window Help
file:///C:/Files/Write/cnet/lewis%20levin%2011_15.ppt
Albany
10
G8
Foreign Currency
Navigator
Column
Row
Normal
Recession
Growth
No Change
Elimination factory vacation
Recar Business Development 2002 (active)
Sales Budget
Sheet 1 / 6
Report
100%
STD
Sum=0

Low economic growth. Low yen exchange rate. Low prices.

Automobiles That Move the World

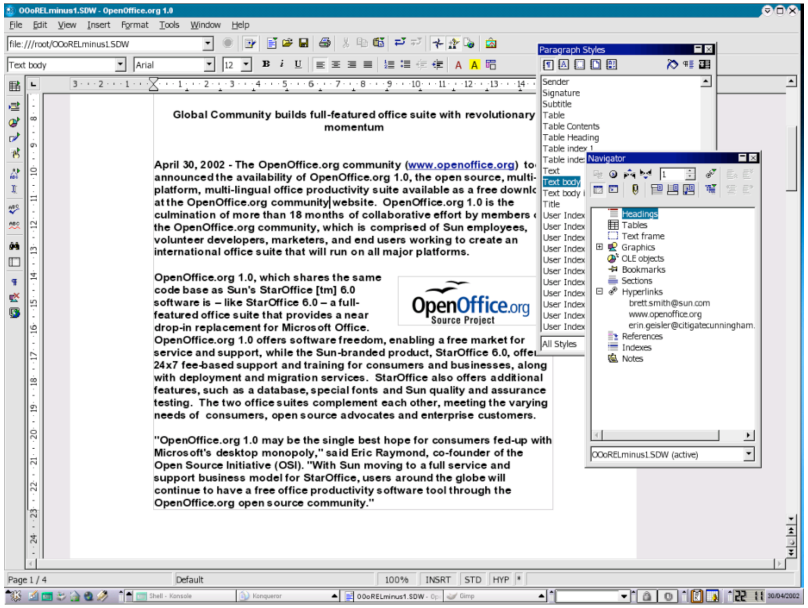
	Cost of Materials			Business Expenses				
Price	Per vehicle	Foreign Currency	Prop. Fixed Costs	% of Price	Amount per Auto	Sales Expenses	Profit per Auto	Unit Sal
$17,890	7066.62	$637.60	$1,292	2.50%	$447	5407	$3,040	161.
$24,790	10715.72	$808.00	$1,292	3.00%	$744	5848.73	$5,382	303.
$34,690	14596.4	$992.00	$1,292	8.00%	$2,775	7906.16	$7,129	99.
$37,990	13210.95	$1,351.20	$1,292	10.00%	$3,799	8291.8	$10,045	40.
							Total	604,

Economic Situation

	Recession
Economic Growth	0.5%
Yen exchange rate	$0.80
Price Micro 1800 GL	$17,890
Price Medio 1800 City	$24,790
Price Luxo V6	$34,690
Price Pronto 3000 RS	$37,990

Production capacity

	Eliminatio
Fixed costs	
Wages and salaries	
Business costs as % of priceMicro 1800 GL	
Business costs as % of priceMedio 1800 City	
Business costs as % of priceLuxo V6	
Business costs as % of pricePronto 3000 RS	



Global Community builds full-featured office suite with revolutionary momentum

April 30, 2002 - The OpenOffice.org community (www.openoffice.org) to announced the availability of OpenOffice.org 1.0, the open source, multi-platform, multi-lingual office productivity suite available as a free downlo at the OpenOffice.org community website. OpenOffice.org 1.0 is the culmination of more than 18 months of collaborative effort by members o the OpenOffice.org community, which is comprised of Sun employees, volunteer developers, marketers, and end users working to create an international office suite that will run on all major platforms.

OpenOffice.org 1.0, which shares the same code base as Sun's StarOffice [tm] 6.0 software is – like StarOffice 6.0 – a full-featured office suite that provides a near drop-in replacement for Microsoft Office. OpenOffice.org 1.0 offers software freedom, enabling a free market for service and support, while the Sun-branded product, StarOffice 6.0, offer 24x7 fee-based support and training for consumers and businesses, along with deployment and migration services. StarOffice also offers additional features, such as a database, special fonts and Sun quality and assurance testing. The two office suites complement each other, meeting the varying needs of consumers, open source advocates and enterprise customers.

"OpenOffice.org 1.0 may be the single best hope for consumers fed-up with Microsoft's desktop monopoly," said Eric Raymond, co-founder of the Open Source Initiative (OSI). "With Sun moving to a full service and support business model for StarOffice, users around the globe will continue to have a free office productivity software tool through the OpenOffice.org open source community."

The Gimp

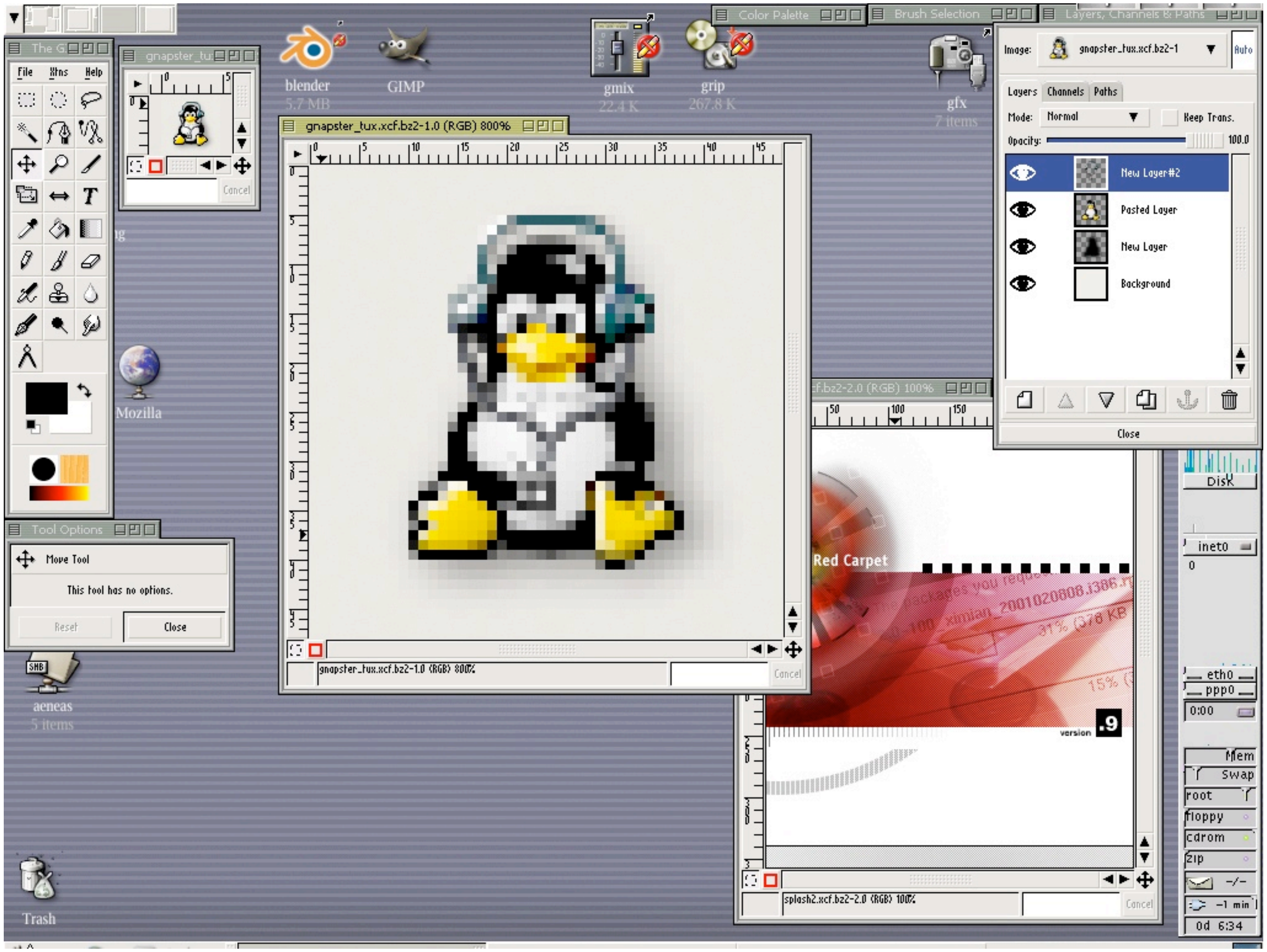


Image: gnapster_tux.xcf.bz2-1

Mode: Normal

Keep Trans.

Opacity: 100.0

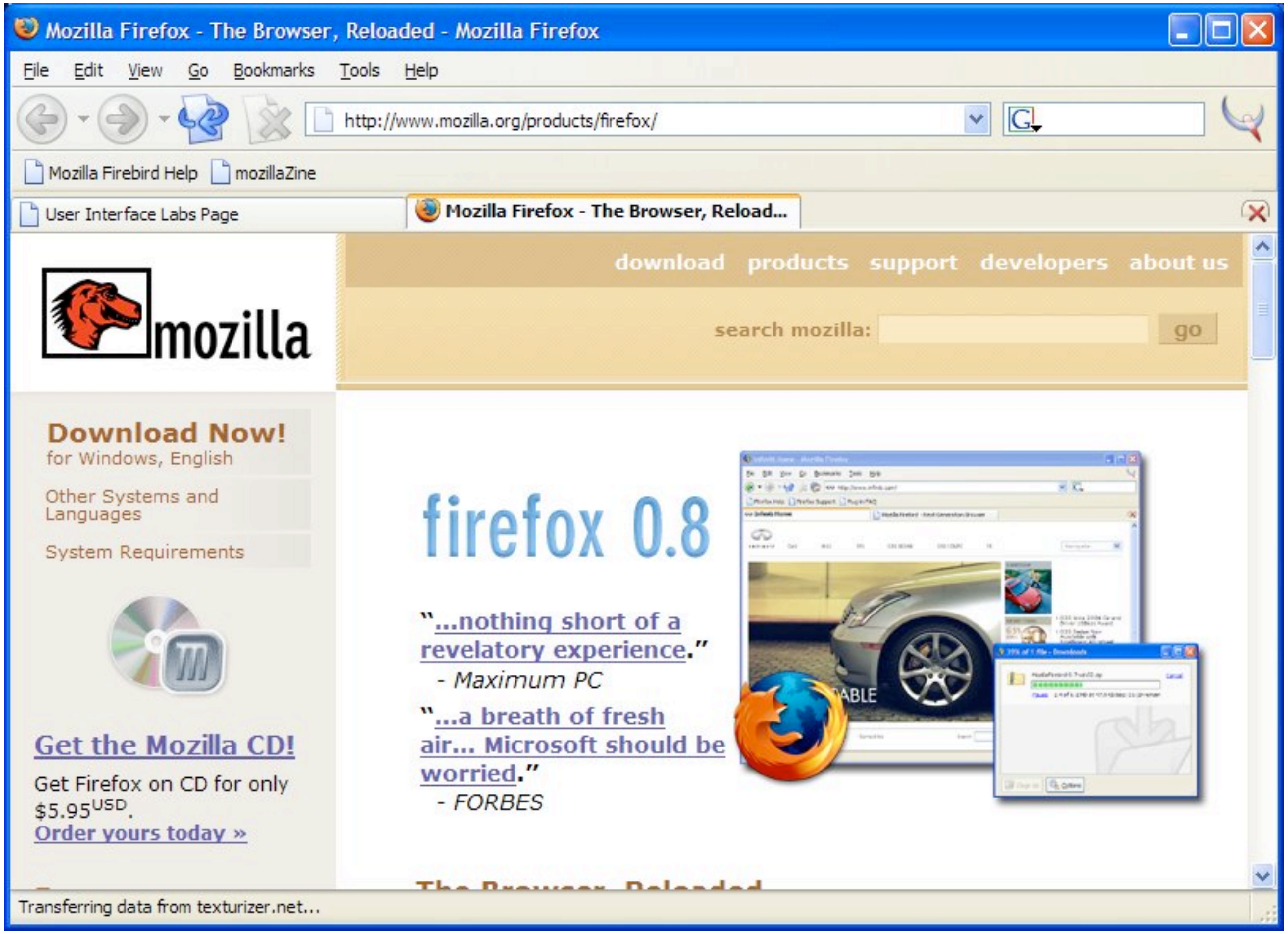
Move Tool

This tool has no options.

gnapster_tux.xcf.bz2-1.0 (RGB) 800%

splash2.xcf.bz2-2.0 (RGB) 100%

Mozilla/Firefox



Download Now!
for Windows, English

Other Systems and Languages

System Requirements

Get the Mozilla CD!

Get Firefox on CD for only $5.95USD.
Order yours today »

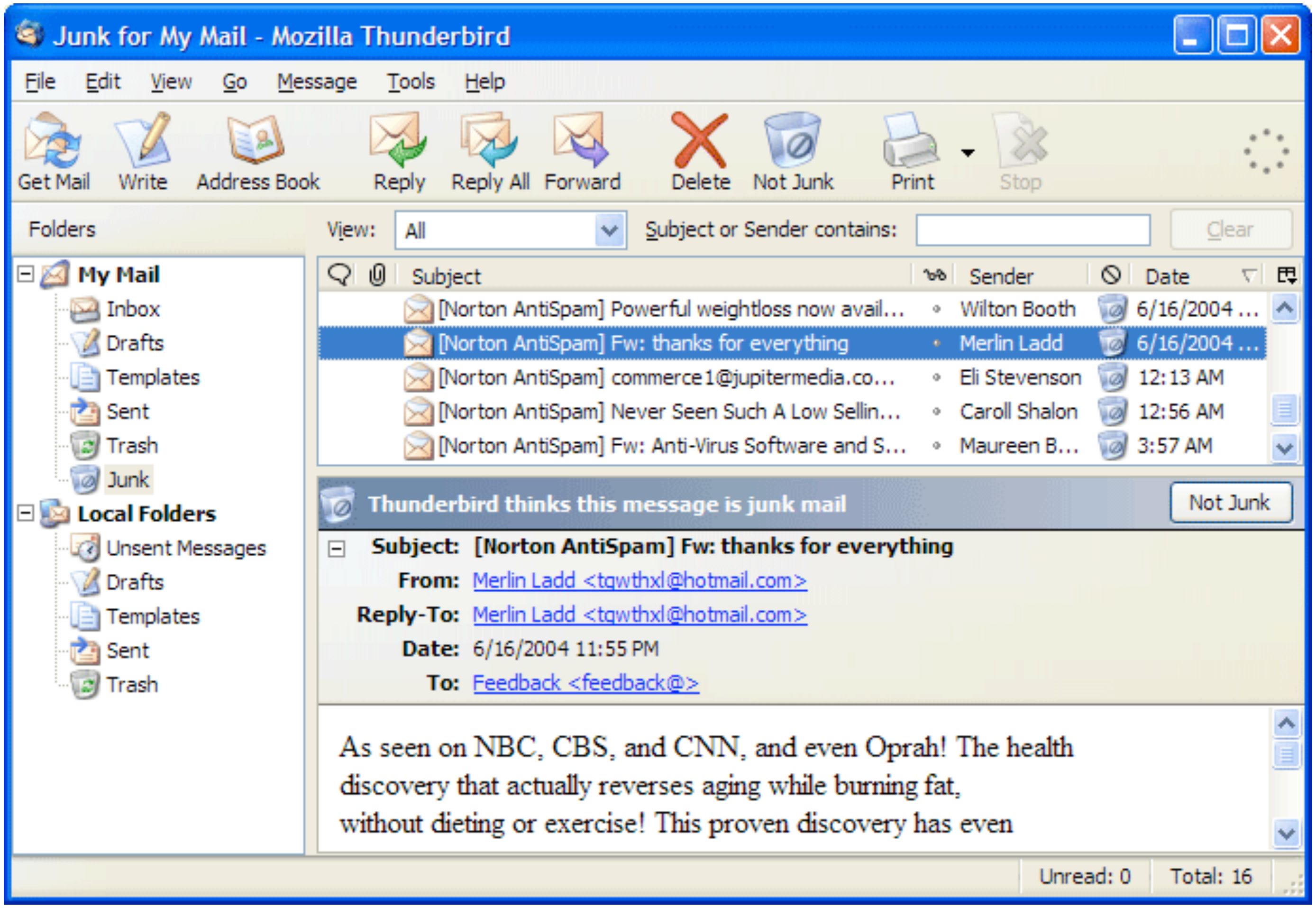
"...nothing short of a revelatory experience."
- *Maximum PC*

"...a breath of fresh air... Microsoft should be worried."
- *FORBES*

The Browser, Reloaded

Transferring data from texturizer.net...

Thunderbird



Subject	Sender	Date
[Norton AntiSpam] Powerful weightloss now avail...	Wilton Booth	6/16/2004 ...
[Norton AntiSpam] Fw: thanks for everything	Merlin Ladd	6/16/2004 ...
[Norton AntiSpam] commerce1@jupitermedia.co...	Eli Stevenson	12:13 AM
[Norton AntiSpam] Never Seen Such A Low Sellin...	Caroll Shalon	12:56 AM
[Norton AntiSpam] Fw: Anti-Virus Software and S...	Maureen B...	3:57 AM

Subject: **[Norton AntiSpam] Fw: thanks for everything**
From: Merlin Ladd <tqwthxl@hotmail.com>
Reply-To: Merlin Ladd <tqwthxl@hotmail.com>
Date: 6/16/2004 11:55 PM
To: Feedback <feedback@>

As seen on NBC, CBS, and CNN, and even Oprah! The health
discovery that actually reverses aging while burning fat,
without dieting or exercise! This proven discovery has even

Graphical Scripting

- Several scripting languages exist with graphical primitives
- The first widely used example was Tcl/Tk
  - Tcl: scripting language
  - Tk: built-in routines for graphics
- Very good for quick prototypes
  - Similar to Visual Basic

Other Languages

- The graphics part of Tcl/Tk has been ported to many other scripting languages:
  - tkperl
  - tkpython
  - tksh

Other Scripting Extensions

- tcl/tk led the way for scripting languages to allow user extended builtin commands.
  - Perl, Python, Kornshell all allow compiled C-libraries to be plugged into the interpreter
  - SWIG: tool to wrap up any library
  - Examples
    - Database access
    - OpenGL

Terminal Windows Still Alive!

- Popular terminal-oriented programs
  - pine
  - w3m
  - screen

MySQL

- Open source database developed on Linux (GPL)
  - Others available include: berkeleydb, postgress
  - Easy to administer:

```
mysqladmin -uroot create guestbookdb

mysql -uroot -e" CREATE TABLE guestbook (
name char(255) not null,
age int(3) unsigned,
email char(255) not null,
website char(255),
comments blob,
time int(10) unsigned
);" guestbookdb
```

MySQL Perl Example

```
use DBI;

$dbh = DBI->connect("DBI:mysql:database=$serverDb;host=$serverName;
                  port=$serverPort",$serverUser,$serverPass);

$sth = $dbh->prepare("SELECT name,age,email,website,comments,time
                         FROM $serverTabl ORDER BY time");

$sth->execute;

print "Existing Entries",hr;

while(@row = $sth->fetchrow_array) {
   $row[5] = scalar(localtime($row[5]));
   print "Name: ", $row[0], br;
   print "Age: ", $row[1], br;
   print "E-Mail Address: ", $row[2], br;
   print "Web Site Address: ", $row[3], br;
   print "Comments: ", $row[4], br;
   print "Added on ", $row[5], hr;
}

$sth->finish;

$dbh->disconnect;
```

MySQL PHP Example

```
<?
    $username="username";
    $password="password";
    $database="your_database";

    mysql_connect(localhost,$username,$password);
    @mysql_select_db($database) or die( "Unable to select database");
    $query="SELECT * FROM contacts";
    $result=mysql_query($query);
    $num=mysql_numrows($result);
    mysql_close();

    echo "<b><center>Database Output</center></b><br><br>";

    $first=mysql_result($result,$i,"first");
    $last=mysql_result($result,$i,"last");
    $phone=mysql_result($result,$i,"phone");
    $mobile=mysql_result($result,$i,"mobile");
    $fax=mysql_result($result,$i,"fax");
    $email=mysql_result($result,$i,"email");
    $web=mysql_result($result,$i,"web");

    <tr>
    <td><font face="Arial, Helvetica, sans-serif"><? echo $first." ".$last;
    ?></font></td>
    <td><font face="Arial, Helvetica, sans-serif"><? echo $phone; ?></font></td>
    <td><font face="Arial, Helvetica, sans-serif"><? echo $mobile; ?></font></td>
    <td><font face="Arial, Helvetica, sans-serif"><? echo $fax; ?></font></td>
    <td><font face="Arial, Helvetica, sans-serif"><a href="mailto:<? echo $email;
    ?>">E-mail</a></font></td>
    <td><font face="Arial, Helvetica, sans-serif"><a href="<? echo $web;
    ?>">Website</a></font></td>
    </tr>

    ?>
```

Recent Directions in UNIX

- DotGNU / Mono
  - Application framework for network services
  - Extensive use of XML for data exchange (XML-RPC)
  - Web-safe languages (C#), GUI, etc.
- XML tools
  - libxml (developed by GNOME)
  - Tools similar to grep, sed, cut, etc.
  - Good for processing formats like RSS/RDF, config files, etc.
- Embedded UNIX
  - Stripped down versions of UNIX to work on portable devices

Final Review

The UNIX Philosophy

- Small is beautiful
- Make each program do one thing well
  - More complex functionality by combining programs
  - Make every program a filter
  - Good for reuse
- Avoid captive interfaces
- Portability over efficiency
- Use ASCII

The UNIX Philosophy

..continued

- Scripting increases leverage and portability

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

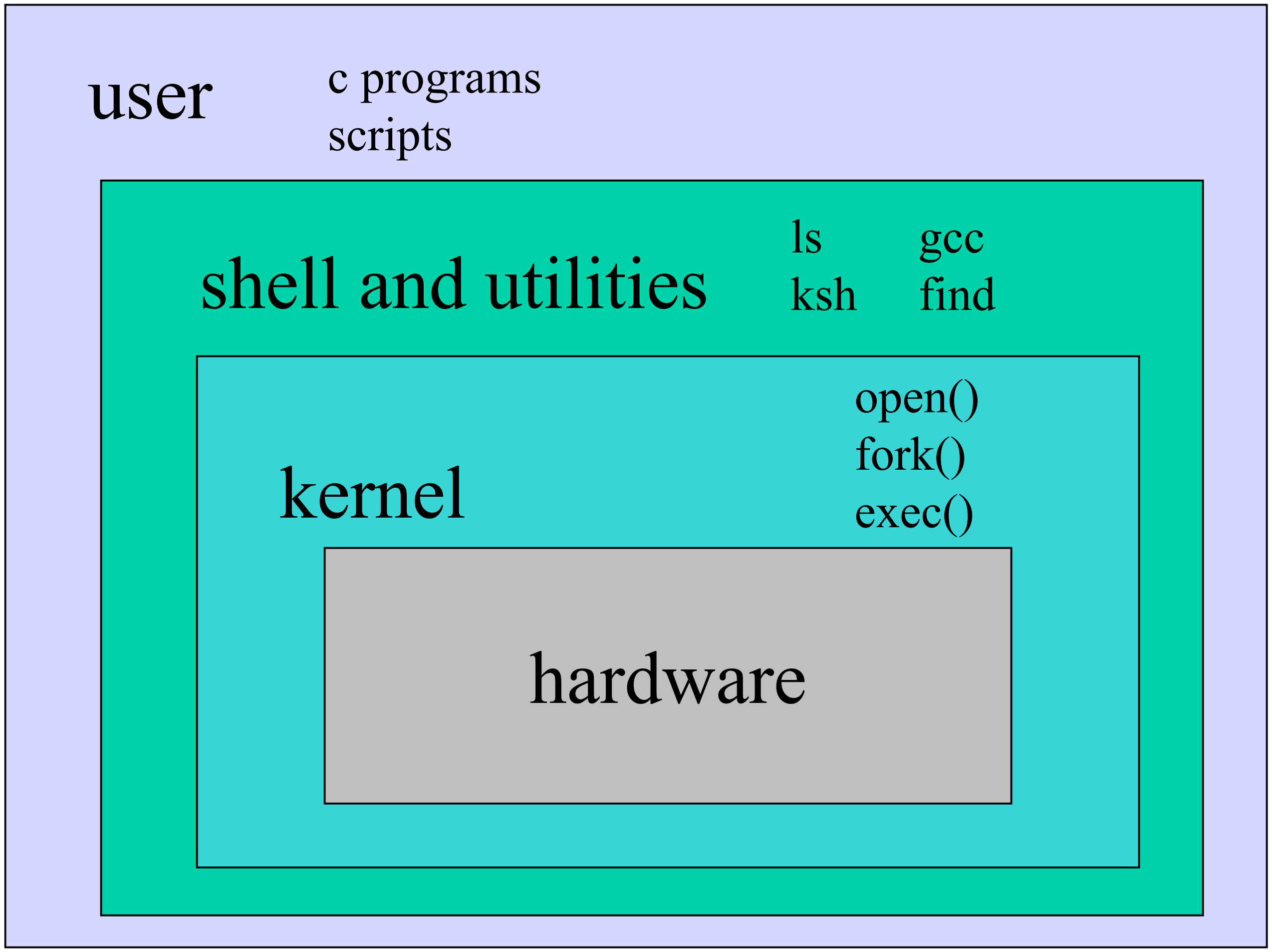
List the logins of a system’s users on a single line.

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

9,176 lines

- Build prototypes quickly (high level interpreted languages)

Unix System Structure

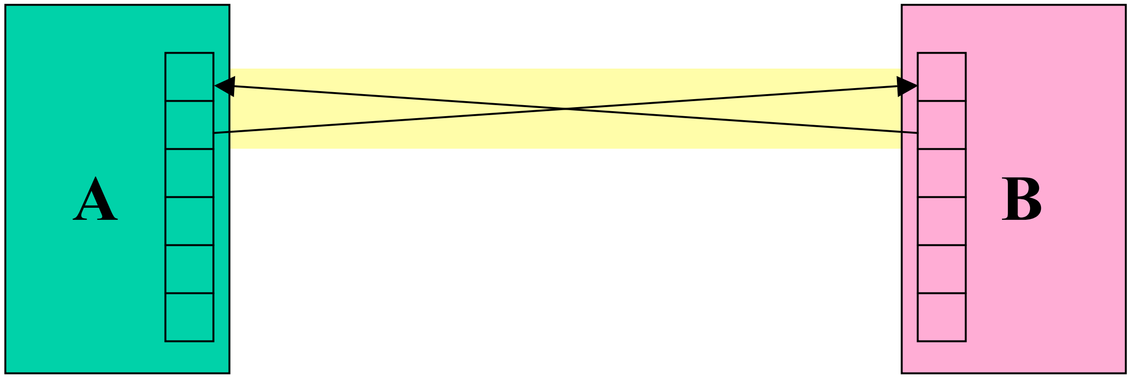


UNIX Concepts

- File System
- Standard in, out, error
- Users and groups
- Permissions
- The shell
- Pipes

Pipes

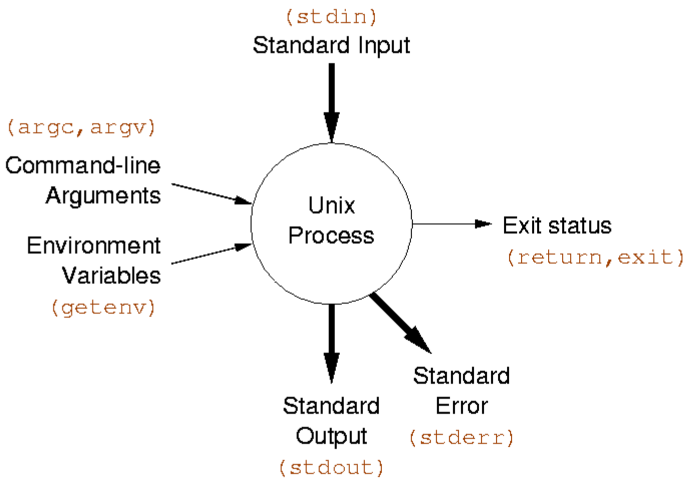
- General idea: The input of one program is the output of the other, and vice versa



- Both programs run at the same time

UNIX Programs

- **Means of input**:
  - Program arguments [control information]
  - Environment variables [state information]
  - Standard input [data]



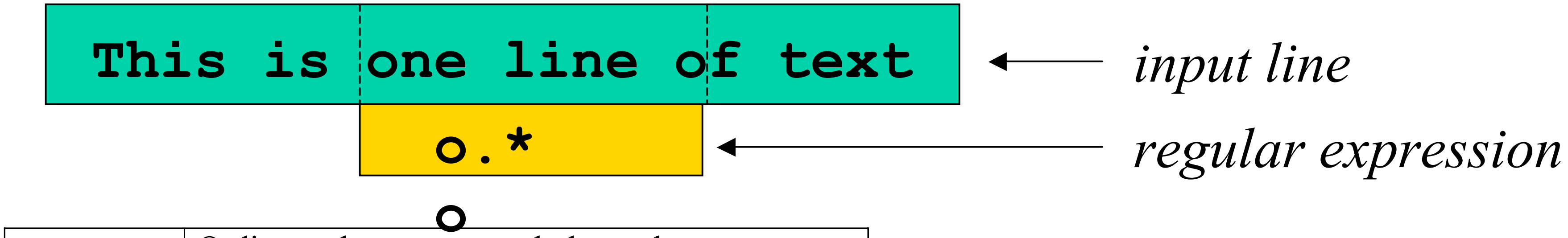
- **Means of output**:
  - Return status code [control information]
  - Standard out [data]
  - Standard error [error messages]

Commands and Filters

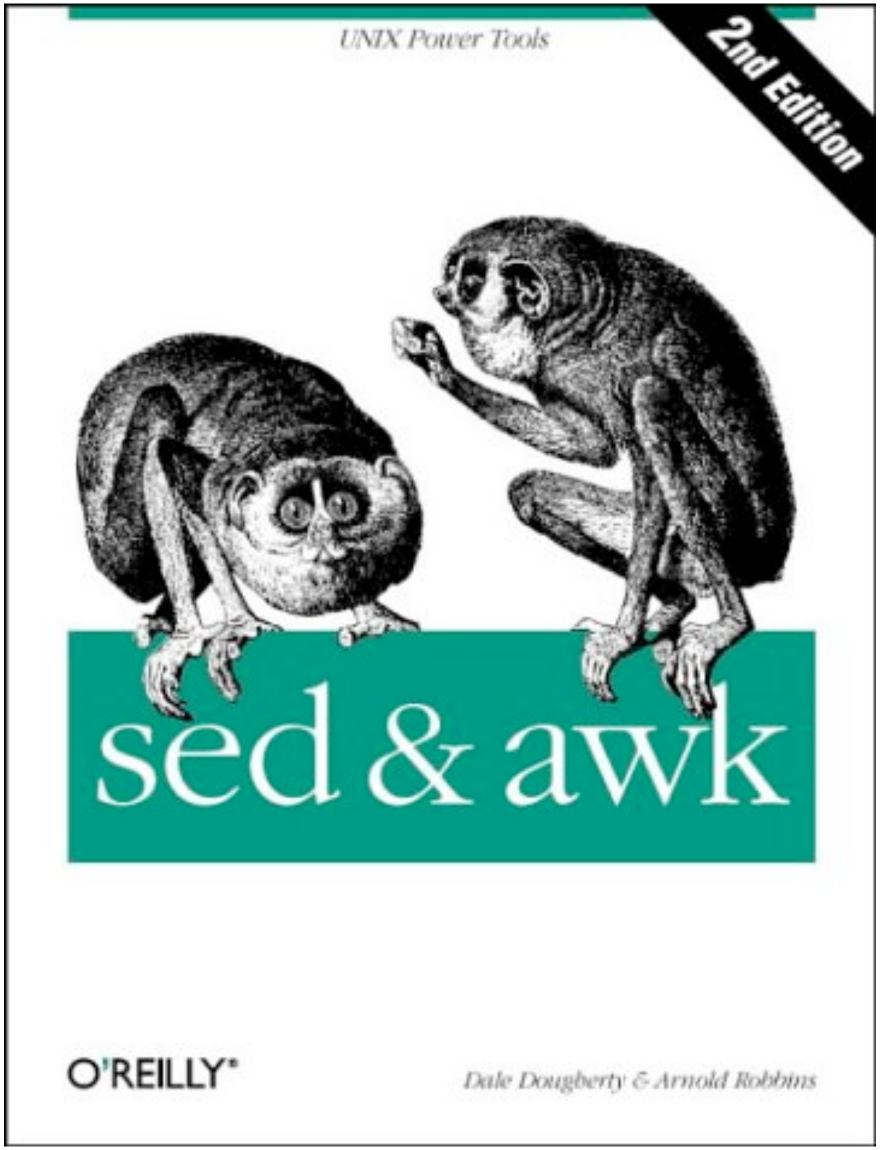
- Basic UNIX Commands
  - rm, cp, mv, ls
  - ps, kill
- Unix Filters
  - cat, head, tail, tee, wc
  - cut, paste, tr
  - grep, egrep, fgrep
  - find, xargs
  - diff, cmp, comp

Regular Expressions

- A regular expression (*regex*) describes a set of possible input strings.
- *Regular expressions* are endemic to Unix
  - **vi**, **ed**, **sed**, and **emacs**
  - **awk**, **tcl**, **perl** and **Python**
  - **grep**, **egrep**, **fgrep**



x	Ordinary characters match themselves (NEWLINES and metacharacters excluded)	*fgrep, grep, egrep*
xyz	Ordinary strings match themselves	
\m	Matches literal character *m*	*grep, egrep*
^	Start of line	
$	End of line	
.	Any single character	
[xy^$x]	Any of x, y, ^, $, or z	
[^xy^$z]	Any one character other than x, y, ^, $, or z	
[a-z]	Any single character in given range	
r*	zero or more occurrences of regex r	
r1r2	Matches r1 followed by r2	
\(r\)	Tagged regular expression, matches r	*grep*
\n	Set to what matched the *n*th tagged expression (n = 1-9)	
\{n,m\}	Repetition	
r+	One or more occurrences of r	*egrep*
r?	Zero or one occurrences of r	
r1|r2	Either r1 or r2	
(r1|r2)r3	Either r1r3 or r2r3	
(r1|r2)*	Zero or more occurrences of r1|r2, e.g., r1, r1r1, r2r1, r1r1r2r1,…)	
{n,m}	Repetition	



UNIX Power Tools

2nd Edition

sed & awk

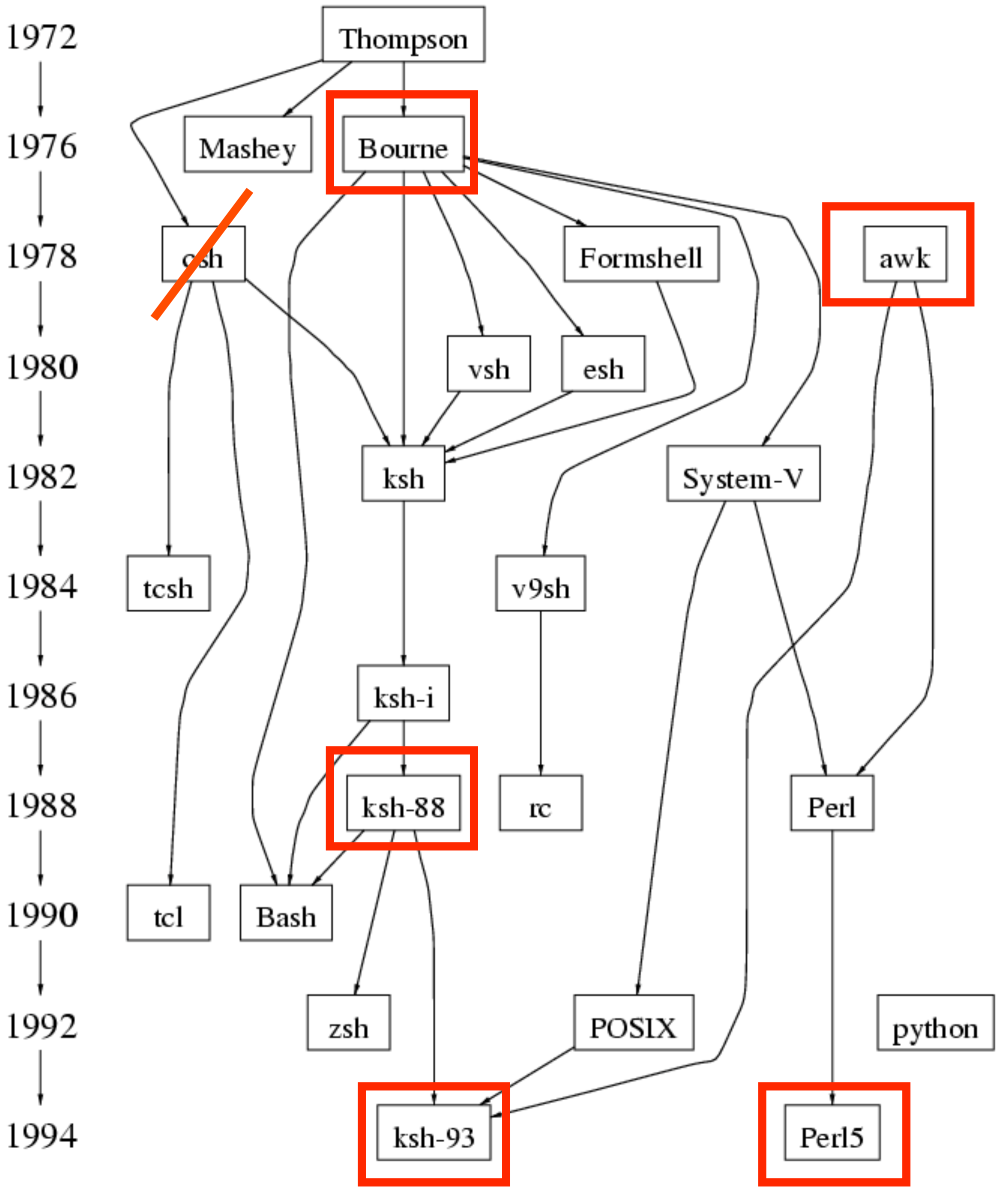
O'REILLY®

Dale Dougherty & Arnold Robbins

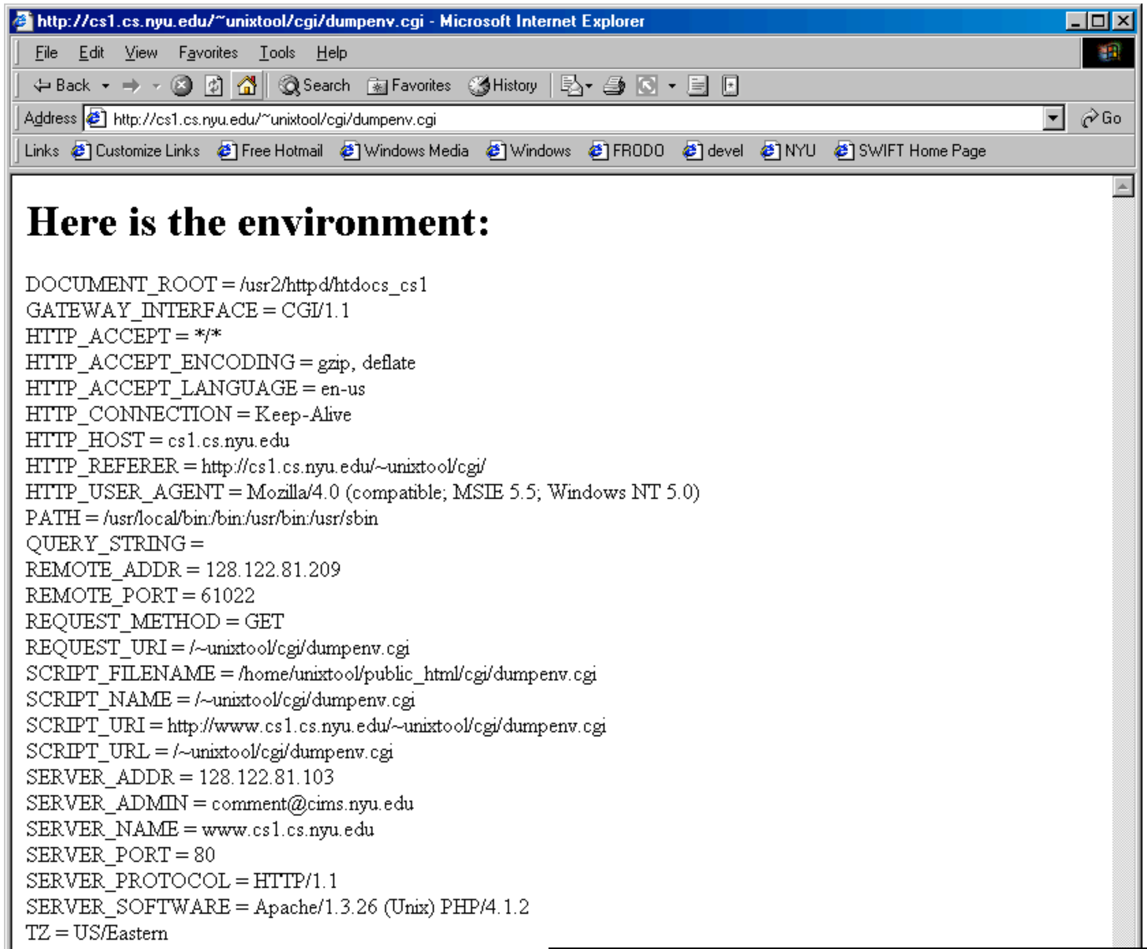
UNIX Scripting Languages

- There are many choices for shells

- Shell features evolved as UNIX grew



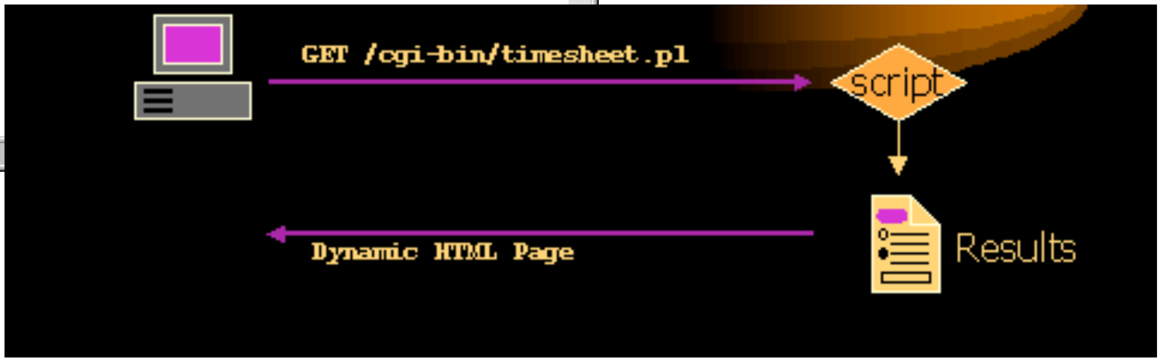
CGI Scripting


http://cs1.cs.nyu.edu/~unixtool/cgi/dumpenv.cgi - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
Address
Go
Links Customize Links Free Hotmail Windows Media Windows FRODO devel NYU SWIFT Home Page
Done

Address: http://cs1.cs.nyu.edu/~unixtool/cgi/dumpenv.cgi

Here is the environment:

```
DOCUMENT_ROOT = /usr2/httpd/htdocs_cs1
GATEWAY_INTERFACE = CGI/1.1
HTTP_ACCEPT = */*
HTTP_ACCEPT_ENCODING = gzip, deflate
HTTP_ACCEPT_LANGUAGE = en-us
HTTP_CONNECTION = Keep-Alive
HTTP_HOST = cs1.cs.nyu.edu
HTTP_REFERER = http://cs1.cs.nyu.edu/~unixtool/cgi/
HTTP_USER_AGENT = Mozilla/4.0 (compatible; MSIE 5.5; Windows NT 5.0)
PATH = /usr/local/bin:/bin:/usr/bin:/usr/sbin
QUERY_STRING =
REMOTE_ADDR = 128.122.81.209
REMOTE_PORT = 61022
REQUEST_METHOD = GET
REQUEST_URI = /~unixtool/cgi/dumpenv.cgi
SCRIPT_FILENAME = /home/unixtool/public_html/cgi/dumpenv.cgi
SCRIPT_NAME = /~unixtool/cgi/dumpenv.cgi
SCRIPT_URI = http://www.cs1.cs.nyu.edu/~unixtool/cgi/dumpenv.cgi
SCRIPT_URL = /~unixtool/cgi/dumpenv.cgi
SERVER_ADDR = 128.122.81.103
SERVER_ADMIN = comment@cims.nyu.edu
SERVER_NAME = www.cs1.cs.nyu.edu
SERVER_PORT = 80
SERVER_PROTOCOL = HTTP/1.1
SERVER_SOFTWARE = Apache/1.3.26 (Unix) PHP/4.1.2
TZ = US/Eastern
```

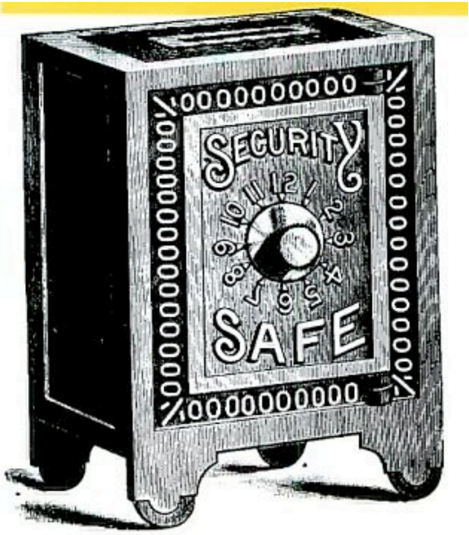


Development Tools

- Compilation and building: **make**
- Managing files: **RCS**, **SCCS**, **CVS**
- Editors: **vi**, **emacs**
- Archiving: **tar**, **cpio**, **pax**, **RPM**
- Configuration: **autoconf**
- Debugging: **gdb**, **dbx**, **prof**, **strace**, **purify**
- Programming tools: **yacc**, **lex**, **lint**, **indent**

Important Aspects of Security

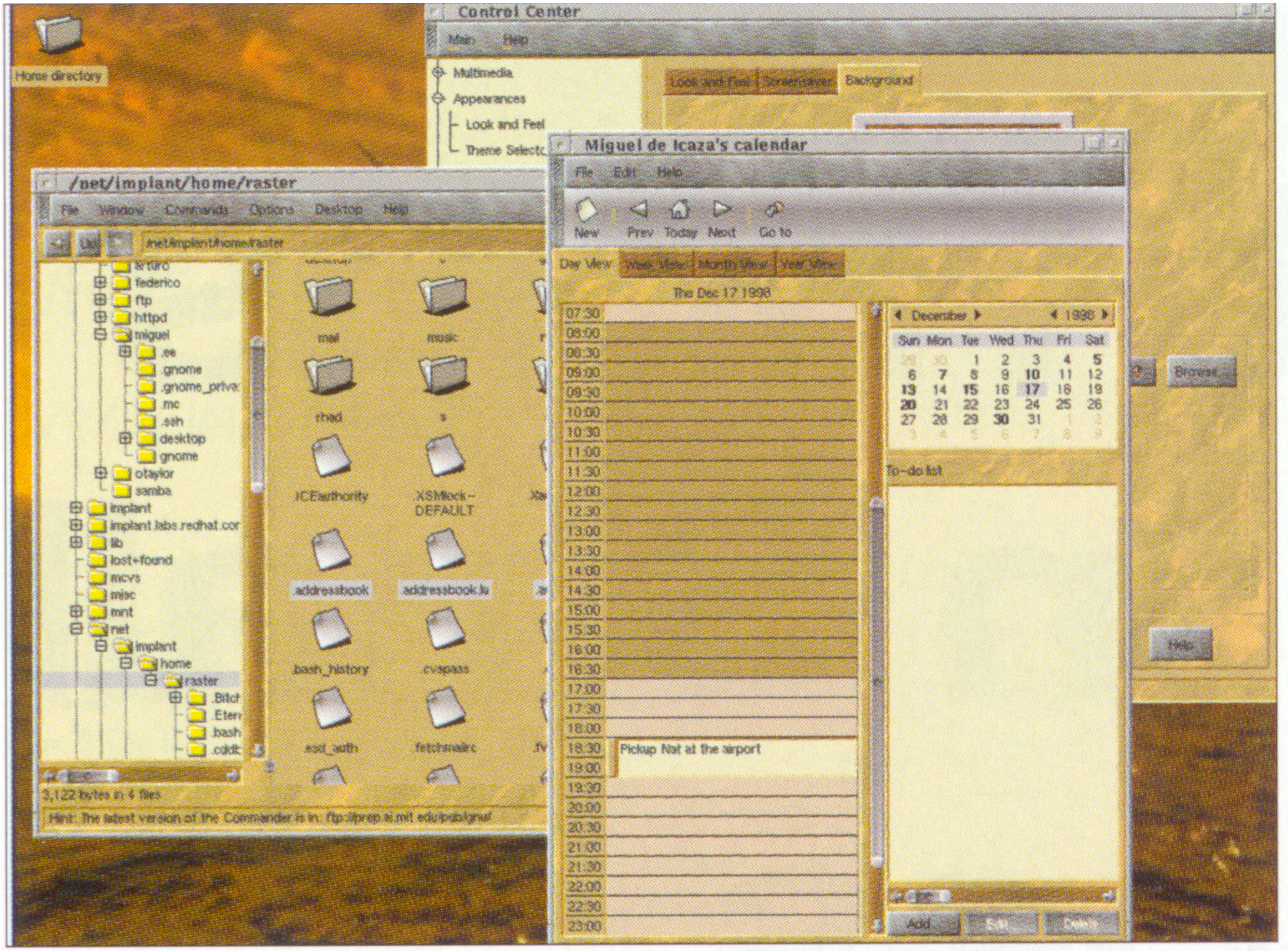
- Make sure data is accessible to only those authorized to see it
- Make sure people can’t do things they’re not supposed to do
- Make sure data is protected against corruption or loss



System Administration

- Install, update and configure software
- Define user accounts
- Configure peripherals (disks, printers, etc)
- Allocate disk storage
- Back-up files and data, recover lost data
- Monitor performance
- Communication with users
- Maintain system integrity (**security**, hardware)

Graphical Interfaces



Pickup Nat at the airport

3,122 bytes in 4 files

Hint: The latest version of the Commander is in: ftp://prep.ai.mit.edu/pub/gnu/

Final Exam

- Mostly material that was on midterm (75%)
  - Should be more familiar now
- Basic questions about:
  - Administration
  - Development tools
  - Security
  - Windowing Systems
  - Kernel