

# Welcome to Intro to Unix

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## OVERVIEW

This document outlines the course content for the Summer/Fall ‘Intro to Unix’ series of seminars.

In these seminars, I assume that you have several years of experience as a system administrator supporting Windows desktops or servers. In general, I review briefly how you might perform a given function under Windows ... and then I offer you an opportunity to explore how you might perform the same function under Unix.

We spend most of our time on hands-on practice – I walk around answering questions. When you arrive in class, get started, (see the instructions below), and work through the exercises. Depending on the average rhythm, I’ll propose a break every twenty minutes or so for discussion and Q&A.

## PREPARE

Please prepare your workstation as follows:

- Log into Windows using the usernames & passwords posted on the white board
- Open a Windows CMD prompt (Start, Run, type “cmd”, hit Enter)
- Launch the Ganesh<sup>1</sup> icon on your desktop, enter your Active Directory<sup>2</sup> username and password, click “Login”. When the ‘Warning: Power Manager’ dialogue box appears, click ‘Close’.<sup>3</sup>
- Launch the Putty application, enter “ganesh.fhrc.org” in the ‘Host Name’ field, click “Open”. When told that “The server’s host key is not cached in the registry ...”, click Yes. At the ensuing prompts, enter your Active Directory username and password.

The ‘root’ password on ganesh.fhrc.org is: “foozle” – use it as you see fit.

## INTRO TO UNIX I

### File system

Play around with the GUI inside the NX application. Figure out how to look at files and folders, how to copy, move, and delete files, how to create new folders. How do you look at the properties (size, creation date, owner) of a file?

---

<sup>1</sup> This is the FreeNX, or NX, application from a company called NoMachine.

<sup>2</sup> This username/password combination is also called your ‘HutchNet’ ID; it is the username/password you use to make health plan choices in the spring of each year. If you don’t know your HutchNet username/password, try using your first name plus the password “1fhrc1” ... if that doesn’t work, tell me; and I’ll create a local account for you.

<sup>3</sup> I don’t know what this means.

In a CMD window, and in a Putty window, try the following:

### Windows (via CMD window)

```
dir
dir /os

echo This is my first file > foo
dir
type foo
copy foo foozle
move foozle fozle
rename fozle foozle
del foo
dir
help dir
```

### Unix (via Putty)

```
ls # Show files
ls -l # Show details
ls -ls # Sort by size
l # Same as "ls -al"
ls -lh # Different units for file sizes
echo This is my first file > foo
ls # Can you see foo?
cat foo # Display contents of file
cp foo foozle # Copy to another file
mv foozle fozle # Rename a file
mv fozle foozle # Rename a file
rm foo # Delete a file
ls # Where is foo? Where is foozle?
man ls or ls --help # Get help on commands
```

## Permissions

Who owns what files? Do you have permission to read or write to a given file? Permissions, or, more generally, Access Control Lists (ACLs) are a rich subject. Here is an introduction.

### Windows

```
Full Control
Modify
Read & Execute
Read
Write
```

### Unix Command Line

```
no equivalent
r--
r-x
r--
-w-
```

### Unix GUI

```
No equivalent
Read
Read, Execute
Read
Write
```

## WINDOWS GUI

Try right-clicking on any document in your Home drive (H:), choose Properties, and then select the Security tab. The 'permissions' choices on a file under Windows includes Full Control, Modify, Read & Execute, Read, and Write.

## WINDOWS COMMAND LINE

In a CMD prompt, copy "foo" to your home directory and then run "cacls" on it:

```
C:\temp>copy foo h:
        1 file(s) copied.
C:\temp>cacls h:
H:\ BUILTIN\Administrators:(OI)(CI)F
    FHCRC\Train14:(OI)(CI)F
    FHCRC\Domain Admins:(OI)(CI)F
    FHCRC\ADM_IT_DTS_ADMIN:(OI)(CI)C

C:\temp>
```

In this case, we can see that the objects BUILTIN\Administrators, FHCRC\Train14, and FHCRC\Domain Admins have Full Control (F) over this file, while the object FHCRC\ADM\_IT\_DTS\_ADMIN has Change (C) (aka Write) permissions over this file.<sup>4</sup>

## UNIX GUI

In the FreeNX GUI, right-click on the file 'foo' and choose 'Properties'. Then, select the 'Permissions' tab.

## UNIX COMMAND LINE

In PuTTY, perform the following:

```
skendric@ganesh:~> l foo
-rw-r--r-- 1 skendric Domain Users 22 2006-09-05 08:58 foo
skendric@ganesh:~>
```

The first character of the "l foo" output tells us what kind of file 'foo' is ... a dash means a "regular" file, a "d" means "directory", an "l" (el) means a "soft link" (analogous to a Shortcut under Windows), and so forth.

The three characters following tell us what permissions the file's owner has, chosen from three (Read, Write, and eXecute). In this case, the file's owner has both Read and Write permission.

```
-rW-r--r-- 1 skendric Domain Users 22 2006-09-05 08:58 foo
```

The next three characters tell us what permissions the primary group (for file 'foo', the primary group is 'Domain Users') associated with this file has; in this case, Read.

```
-rw-r--r- 1 skendric Domain Users 22 2006-09-05 08:58 foo
```

And the last three characters tell us what permissions "everyone else" (called 'world' or 'others' in Unix-speak) have; in this case, Read.

```
-rw-r--r- 1 skendric Domain Users 22 2006-09-05 08:58 foo
```

We can change permissions using the "chmod" utility. In this case, we are asking chmod to 'add' (+) the 'Write' (w) permission for the primary Group (g) on file 'foo'.

```
skendric@ganesh:~> chmod g+w foo
skendric@ganesh:~> l foo
-rw-rw--r-- 1 skendric Domain Users 22 2006-09-05 08:58 foo
skendric@ganesh:~>
```

Notice that change in permissions for the primary group.

```
-rw-rW--r-- 1 skendric Domain Users 22 2006-09-05 08:58 foo
```

---

<sup>4</sup> I don't know why the GUI calls the Write permission 'Write' while the command-line calls the same permission 'Change'.

## UNIX COMMAND LINE / MORE

So that's a rough introduction to the original Unix permissions model for a file system. More complex access-control choices are available via the 'acl' commands, using utilities like 'getfacl' and 'setfacl'.

```
skendric@ganesh:~> getfacl foo
# file: foo
# owner: skendric
# group: Domain Users
user::rw-
group::rw-
other::r-
skendric@ganesh:~>
```

See "man acl" for details.

## Control Panels

Find the Services Control Panel under Windows<sup>5</sup>, practice stopping and starting a service. In a CMD Window, how would you stop and start a service? Under Unix (GUI), go to Applications, System, YAST ... and then, inside YAST, go to 'System', Run Level Editor, and start/stop apache2.

### Windows

```
net stop "automatic updates"
net start "automatic updates"
```

### Unix

```
cd /etc/init.d      # Change directories
./apache2 stop     # Run the apache2 script: stop
./apache2 start    # Run the apache2 script: start
rcapache2 restart  # Stop and then start apache
```

Notice that you can run the GUI YAST from FreeNX ... and the CUI (character user interface) version of YAST from Putty

```
/sbin/yast
```

## Examine Configuration Files

Under Windows, Start, Run, "regedit" ... look for interesting keys. Use Notepad to open your "foozle" text file. In a CMD Window, type "edit fozzle". How would you look at keys from a CMD Window?

### Windows

```
cd \windows
type system.ini | more
edit system.ini
```

### Unix

```
cd /etc/apache2
less httpd.conf
less vishnu.conf
pico vishnu.conf
head vishnu.conf
tail vishnu.conf
```

Read the comments in the configuration files.

---

<sup>5</sup> Under Windows, Start, Settings, Control Panels, Administrative Tools, Services.

## System Monitoring Tools

In Windows, hit Ctrl-Alt-Del, choose Task Manager, and poke around. In Unix, poke around for the list of system monitoring utilities (hint: look for Gnome System Monitor ... and try out other utilities in that list.)

### Windows

### Unix

```
ps -ef | less    # List running processes
top              # Dynamic display of resources
```

In “top”, type ‘h’ for help and ‘q’ for quit

Who is logged on?

### Windows

### Unix

```
who or w
```

## INTRO TO UNIX II

### Change IP Address

How do you know what IP address your machine is using?

### Windows

```
ipconfig
ipconfig /all
```

### Unix

```
/sbin/ifconfig    # ‘if’ is short for ‘interface’
no equivalent
```

Under Windows, go to Settings, Control Panels, double-click on Network Connections, and right click on the icon representing your machine’s NIC. How do you change IP addresses?

Under Unix, load YAST, go to ‘Network Devices’, choose ‘Network Card’. How do you change IP addresses? Subnet masks? Default gateways? DNS servers?

From a Putty window, let’s figure out how to change IP addresses. First, let’s find all the places where the IP address is written:

What is ganesh’s IP address?

```
ganesh:/ # host ganesh
ganesh.fhcrc.org has address 140.107.74.84
```

Configuration files live in /etc, let’s go there

```
ganesh:/ # cd /etc
```

Look for the string “140.107.74.84” in all the files in this directory and all the files in all subdirectories:

```
ganesh:/etc # grep -r 140.107.74.84 *
./hosts:140.107.74.84    ganesh.fhcrc.org ganesh
```

```
./sysconfig/network/ifcfg-eth-id-00:13:72:88:ed:ea:IPADDR='140.107.74.84'  
./hosts.YaST2save:140.107.74.84 ganesh.fhccrc.org ganesh  
ganesh:/etc #
```

Aha! If we want to do this manually, then we would edit `/etc/hosts` and `/etc/sysconfig/network` and make changes there.

Let's look at the results of our work:

Windows  
`ipconfig /all`

Unix  
`ifconfig`

## Finding Files

Under Windows, choose Start, Search, For Files or Folders.

Windows

```
cd \  
dir winword.exe /s
```

Unix

```
cd /  
find . | grep httpd.conf          # Search the file  
                                  # system for this file  
locate httpd.conf                 # Faster
```

OK, let's say that we want to find a file based on its contents rather than its name.

Windows

Unix

```
cd /  
grep -r foozle *
```

## File System and Mapped Drives

Under Windows, we see drive letters (C:, D: ... H: ... Z:) Without being clever, you cannot tell which drives are local to your machine and which are connected to some remote server. Under Unix, all file systems are mounted under `"/` ... and without being clever, you cannot tell which directories are local to your machine and which are connected to a remote server.

Windows

```
net use  
net use z: \\server1\share1  
net use y: \\server1\share1  
?
```

Unix

```
df -kh          # What is local and what is remote?  
mount -t smbfs -o username=foo,password=fozle //server1/share1 /mnt  
# SMB protocol  
mount dolomite:/dist /mnt    # NFS protocol
```

## Typical Directories

What kind of files typically go into C:\Windows? C:\Windows\System32?  
C:\Windows\System32\Spool\Drivers?

What kind of files typically go into these Unix directories?

```
/dev          # Device drivers
/etc          # Config files
/bin         # End-user command-line binaries
/sbin       # Super-user command-line binaries
/lib         # Libraries (called 'DLLs' in Windows)
/home       # End-user home directories
/root       # Root's home directory
/var        # Log files
```

## Changing Credentials

Under Windows, we can run a command as 'administrator' using the 'runas' GUI option.

Under Unix, we can run a command as another user (possibly root) using the 'sudo' command.  
Or, we can lose our previous identity and become root itself, using the 'su' command.

<u>Windows</u>	<u>Unix</u>	
?	su -	# Become root and run root's login script

See /home/example/sudoers for an example /etc/sudoers file

## Log Files

Under Windows, go to Start, Control Panels, Administrative Tools, Event Viewer and examine recent entries in the three Event Logs.

<u>Windows</u>	<u>Unix</u>	
?	less /var/log/syslog	# Look at the unified log
	tail -f /var/log/syslog	# Watch additions to the
		# unified log in real time
	grep ganesh /var/log/syslog	# Look for 'ganesh' in the log

## INTRO TO UNIX III

### Printing

How do we add printers under Windows? The 'Printers' Control Panel offers a GUI interface for doing this.

And under Unix? In the GUI, go to Applications, Utilities, Printing, Printers and add a printer.

What is going on under the hood (i.e. under the GUI)?

Poke around `/etc/cups/printers.conf` – that GUI tool you were employing is just editing this file ... you could have edited it manually, with the same results. Poke around `/etc/cups/cupsd.conf` – this is the config file which controls the printing daemon itself. What do you think of the idea of requiring X.509 certificates in order to print? Or the ‘classified’ rating system for printers?

I modified this file ... you can see the original in `/opt/local/config/root/etc/cups`. What modifications did I make? [Hint: “`diff {filename1} {filename}`”]<sup>6</sup>  
How would you kick the printing service (i.e. stop/start it)?

### Windows

```
net stop "Print Spooler"  
net start "Print Spooler"  
  
fc file1 file2
```

### Unix

```
rccups stop  
rccups start  
rccups restart  
diff cupsd.conf.0 cupsd.conf.1
```

## Remote Control

### Windows

```
Remote Desktop Connection  
VNC
```

### Unix

```
VNC
```

### VNC

Point a browser at `http://ganesh.fhcrc.org:5801`, enter the root password, and then login with your HutchNet credentials (or local ganesh credentials).

### RDP

I’m assuming that you already know how to control one Windows box from another, using RDP. So let’s do it from Unix. In the FreeNX GUI, open a command window and type:

```
ganesh:/home/skendric/> rdesktop -g 1024x768 {name or IP address of your PC}
```

Assuming that your PC permits RDP connections, you should see the familiar Windows prompt.

## Run Levels

If a Windows box crashes, it will sometimes give you the opportunity to re-load Windows in ‘Safe Model’, a mode in which less of the operating system loads, in particular fewer hardware drivers.<sup>7</sup> Alternatively, the person sitting in front of the keyboard can hold down the ‘F8’ key while the machine is booting and select Safe Mode from the resulting menu. While in Safe

---

<sup>6</sup> Notice that I’m illustrating is a configuration control mechanism here ... as root, I created a directory called “`/opt/local/config/root`” ... and under that directory, I’m recreating the file structure of this Unix box. Here, I record the original version of a config file ... and then I record each changed version of a config file ... appending “.1”, “.2”, “.3” ... as I continue to make changes. This allows me to roll back to a previous (working!) version of a configuration file.

<sup>7</sup> <http://computer.howstuffworks.com/question575.htm>

Mode, the machine offers limited functionality, but the operator has a chance to debug a range of problems.

This is what the Windows 'Safe Mode' menu looks like (to see this for yourself, reboot your Windows machine and hold the F8 key down once POST appears on the screen):

#### Windows Advanced Options Menu

Please select an option:

- Safe Mode
- Safe Mode with Networking
- Safe Mode with Command Prompt
  
- Enable Boot Logging
- Enable VGA mode
- Last Known Good Configuration (your most recent settings that worked)
- Directory Services Restore Mode (Windows domain controllers only)
- Debugging Mode
  
- Start Windows Normally
- Reboot
- Return to OS Choices Menu

A rough parallel in the Unix environment are 'Run Levels'.<sup>8</sup>

- rc1.d - Single User Mode
- rc2.d - Single User Mode with Networking
- rc3.d - Multi-User Mode - boot up in text mode
- rc4.d - Not yet Defined
- rc5.d - Multi-User Mode - boot up in X Windows
- rc6.d - Shutdown

Poke around the /etc/init.d/rcX.d directories to see which scripts get run with which run-level: the scripts starting with 'K' (for Kill) are run when the machine is shutting down; the scripts starting with 'S' are run when the machine is starting up. Are there more scripts in /etc/init.d/rc1.d than there are in /etc/init.d/rc5.d? Why or why not? Compared to run-level 1, what additional services load in run-level 2?

#### Windows

Safe Mode w/Command Prompt  
Safe Mode  
-  
Safe Mode with Networking  
Start Windows Normally

#### Unix

Single User Mode  
-  
Multi-User Mode – boot up in text mode  
Single User Mode with Networking (but no graphics)  
Multi-user Mode – boot up in X Windows

---

<sup>8</sup> <http://www.networkclue.com/os/Linux/run-levels.aspx>

Many Unix servers run in ‘Multi-User Mode – boot up in text mode’, because their administrators see no reason to load a graphics subsystem, as, typically, no one will be sitting at the console. If Windows has an equivalent mode, I haven’t found it – Windows seems to tie its graphics subsystem to its multi-user capabilities.

Historically, Unix spent the first few decades of its existence primarily as a ‘server’ or ‘multi-user’ operating system, whereas Windows spent the first decade or so of its existence primarily as a ‘desktop’ or ‘single-user’ operating system.

Traditionally, Unix administrators run their servers “head-less”, meaning that they have no monitor or keyboard attached – all tasks (except those involving hardware and recovery from certain types of crashes) – can be performed remotely. Traditionally, Windows administrators attach a monitor and keyboard to their servers and, in fact, sit in front of them physically to perform some tasks (or employ the single-user Remote Desktop Connection, which ‘owns’ the console). I’m unclear whether or not there are any tasks which Windows requires be performed from the console.

A Windows box with Windows Terminal Services installed is roughly equivalent to a Unix box with the X Windows system installed.

## Installing Pre-Compiled Software

### YAST

Run YAST and navigate the menus to install BIND (Berkeley Internet Name Daemon ... aka ‘DNS’, the software which handles most name-to-IP-address look-ups. Compare this to using the Windows ‘Add/Remove Programs’, which is visible from the Control Panels folder.

### RPM

All well and good. But what if you want the software package Pine? For licensing reasons, SuSE distributes Pine on a separate CD, meaning that you don’t see it, by default, in YAST. Or, perhaps you want to install software which SuSE doesn’t bundle with their distribution. The Red Hat people invented a scheme for packaging software which they call RPM (Red hat Package Manager); many Linux distributions ship with RPM.

```
ganesh:~ # pwd
/root
ganesh:~ # rpm -q pine
package pine is not installed
```

So, Pine is not installed. Let’s go get it.

```

ganesh:~ # ftp ftp.cac.washington.edu
Trying 140.142.15.201...
Connected to ftp.cac.washington.edu.
220 (vsFTPd 1.2.1)
Name (ftp.cac.washington.edu:root): ftp
331 Please specify the password.
230 Login successful.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> cd pine
250 Directory successfully changed.
ftp> ls
229 Entering Extended Passive Mode (||||37520|)
150 Here comes the directory listing.
drwxrwx--x    2 5131    350      4096 Jan 07  2006 Private
-rw-rw-r--    1 172     350      4522 Sep 29  2005 README
drwxrwxr-x    2 172     350      4096 Nov 18  2005 bin
drwxrwxr-x    4 172     350      4096 Aug 31 09:00 docs
drwxrwxr-x   56 172     350      8192 Nov 18  2005 old
drwxrwxr-x    3 172     350      4096 Aug 31 09:00 pcpine
-rw-rw-r--    1 172     350    3125693 Sep 28  2005 pine-4.64-1.i386.rpm
-rw-rw-r--    1 172     350    4216742 Sep 28  2005 pine-4.64-1.src.rpm
drwxrwxr-x    2 172     350      8192 Nov 18  2005 pine-info
lrwxrwxrwx    1 172     350         14 Nov 18  2005 pine.intro ->
pine.intro
.txt
-rw-rw-r--    1 172     350     2910 Sep 05  2000 pine.intro.txt
lrwxrwxrwx    1 172     350         14 Nov 18  2005 pine.tar.Z ->
pine4.64.t
ar.Z
lrwxrwxrwx    1 172     350         16 Nov 18  2005 pine.tar.bz2 ->
pine4.64
.tar.bz2
lrwxrwxrwx    1 172     350         15 Nov 18  2005 pine.tar.gz ->
pine4.64.
tar.gz
-rw-rw-r--    1 172     350    6333254 Sep 28  2005 pine4.64.tar.Z
-rw-rw-r--    1 172     350    3110790 Sep 28  2005 pine4.64.tar.bz2
-rw-rw-r--    1 172     350    4218629 Sep 28  2005 pine4.64.tar.gz
-rw-rw-r--    1 172     350    3072650 Sep 28  2005 pine_4.64_i386.deb
lrwxrwxrwx    1 172     350         13 Nov 18  2005 uw -> ../..uw/pine
226 Directory send OK.
ftp>

```

Let's get the README file, and see what it says.

```

ftp> get README
local: README remote: README
229 Entering Extended Passive Mode (||||20507|)
150 Opening BINARY mode data connection for README (4522 bytes).
100% |*****| 4522      1.90 MB/s      00:00
ETA

```

```
226 File send OK.
4522 bytes received in 00:00 (1.84 MB/s)
ftp> quit
221 Goodbye.
skendric@ganesh:~> less README
Revised 2005-09-28
```

-----  
The PINE Message System  
-----

LATEST PINE VERSION = 4.64, released 2005-09-28

For the latest info on Pine, see: <http://www.washington.edu/pine/>.

Unix Pine, Pico, Pilot, imapd, rpload, rpdump, and mailutil  
\_binaries\_ are only accessible from <http://www.washington.edu/pine/>.

The PC-Pine distribution is in the pcpine subdirectory. See pcpine/README  
for more information.

-----  
What you'll find in this directory:

```
README          - This file.
pine.tar.Z      - Pine/Pico/IMAPd source distribution for latest version
pine4.64.tar.Z  - Same as above
README lines 1-23/113 18%
```

```
lrwxrwxrwx    1 172    350          16 Nov 18  2005 pine.tar.bz2 ->
pine4.64
.tar.bz2
lrwxrwxrwx    1 172    350          15 Nov 18  2005 pine.tar.gz ->
pine4.64.
tar.gz
-rw-rw-r--    1 172    350    6333254 Sep 28  2005 pine4.64.tar.Z
-rw-rw-r--    1 172    350    3110790 Sep 28  2005 pine4.64.tar.bz2
-rw-rw-r--    1 172    350    4218629 Sep 28  2005 pine4.64.tar.gz
-rw-rw-r--    1 172    350    3072650 Sep 28  2005 pine_4.64_i386.deb
lrwxrwxrwx    1 172    350          13 Nov 18  2005 uw -> ../..uw/pine
```

```
226 Directory send OK.
ftp> get README
local: README remote: README
229 Entering Extended Passive Mode (|||16937|)
150 Opening BINARY mode data connection for README (4522 bytes).
100% |*****| 4522      4.06 MB/s    00:00
ETA
```

```
226 File send OK.
4522 bytes received in 00:00 (3.81 MB/s)
ftp> quit
221 Goodbye.
ganesh:~ # less README
```

Revised 2005-09-28

-----  
The PINE Message System  
-----

LATEST PINE VERSION = 4.64, released 2005-09-28

For the latest info on Pine, see: <http://www.washington.edu/pine/>.

Unix Pine, Pico, Pilot, imapd, rpload, rpdump, and mailutil  
\_binaries\_ are only accessible from <http://www.washington.edu/pine/>.

The PC-Pine distribution is in the pcpine subdirectory. See pcpine/README  
for more information.

-----  
What you'll find in this directory:

```
README           - This file.
pine.tar.Z       - Pine/Pico/IMAPd source distribution for latest version
pine4.64.tar.Z   - Same as above
pine.tar.gz      - Same as above but compressed with gnu zip
pine4.64.tar.gz  - Same as above
pine.tar.bz2     - Same as above but compressed with bzip2
pine4.64.tar.bz2 - Same as above
pine.intro.txt   - Standard short introduction to Pine
pine-4.64-1.i386.rpm - RPM built on Red Hat Enterprise Server release 3
pine-4.64-1.src.rpm - Source RPM built on Red Hat Enterprise Server release3
pine_4.64-1_i386.deb - Debian package built on Debian GNU/Linux 3.0
[...]
```

Aha! Notice the “pine-4.64.1.i386.rpm - RPM built on Red Hat ...” entry. That’s the file we want. Let’s go get it.

```
ganesh:~ # ftp ftp.cac.washington.edu
Trying 140.142.15.201...
Connected to ftp.cac.washington.edu.
220 (vsFTPd 1.2.1)
Name (ftp.cac.washington.edu:root): ftp
331 Please specify the password.
Password:
230 Login successful.
Remote system type is UNIX.
Using binary mode to transfer files.
ftp> cd pine
250 Directory successfully changed.
ftp> bin
200 Switching to Binary mode.
ftp> get pine-4.64-1.i386.rpm
local: pine-4.64-1.i386.rpm remote: pine-4.64-1.i386.rpm
229 Entering Extended Passive Mode (|||57317|)
```

```

150 Opening BINARY mode data connection for pine-4.64-1.i386.rpm (3125693
bytes)
.
100% |*****| 3052 KB 9.85 MB/s 00:00
ETA
226 File send OK.
3125693 bytes received in 00:00 (9.85 MB/s)
ftp> quit
221 Goodbye.
ganesh:~ # ls
.ICEauthority      .gconfd          .lesshst         .viminfo
.Xauthority        .gnome           .metacity        .wapi
.bash_history      .gnome2          .mozilla         .xsession-errors
.beagle            .gnome2_private .nautilus        Desktop
.dmrc              .gnupg           .qt              README
.esd_auth          .gstreamer-0.10 .recently-used   bin
.exrc              .gtkrc           .skel            fozzle
.fonts.cache-2    .gtkrc-1.2-gnome2 .ssh             pine-4.64-1.i386.rpm
.fvwm              .kbd             .suse_register.log
.gconf             .kde             .tomboy

```

Now, let's install it.

```

ganesh:~ # rpm -i pine-4.64-1.i386.rpm
error: Failed dependencies:
    libcrypto.so.4 is needed by pine-4.64-1.i386
    libldap.so.2 is needed by pine-4.64-1.i386
    libssl.so.4 is needed by pine-4.64-1.i386
ganesh:~ #

```

Darn. This particular RPM doesn't include the cryptographic and directory (LDAP) libraries which Pine wants before it can function.

OK, point a Web browser at <http://www.opensuse.com>. Click 'Package Repositories'. Find the "For SUSE Linux 10.1:" link (<http://download.opensuse.org/distribution/SL-10.1/non-oss-inst-source/>). Click the 'suse' directory (very bottom of the screen). Which directory now? (Hint: you have to know the CPU architecture of your machine ... ganesh is a GX620 ... which means that it contains an 64 bit Intel CPU.) Find the 'pine' rpm and download it to your PC.

Now, if you did this from a browser running on ganesh, the 'pine' rpm is somewhere in your home directory. But if you used a browser from your Windows PC ... how will you upload it to ganesh? (Hint, try opening a Windows CMD prompt and using 'sftp' or 'scp' to copy this file to ganesh.)

OK, now, type "man rpm" or "rpm -help" and figure out how to use the 'rpm' command-line tool to install Pine. Once you have it installed, try running it!

Here's how I did it:

```

ganesh:~ # cd /opt/local/archive

```

```
ganesh:/opt/local/archive # ls
pico-4.64N-1.x86_64.rpm  pine-4.64N-10.x86_64.rpm
pilot-4.64N-1.x86_64.rpm  pine4.64.tar.gz
ganesh:/opt/local/archive # rpm -q pine
package pine is not installed
ganesh:/opt/local/archive # rpm -i pine-4.64N-10.x86_64.rpm
ganesh:/opt/local/archive # rpm -q pine
pine-4.64N-10
```

yay! now try running 'pine'  
and now I uninstall 'pine'

```
ganesh:/opt/local/archive # rpm -e pine
ganesh:/opt/local/archive # rpm -q pine
package pine is not installed
ganesh:/opt/local/archive #
```

## Compiling Software

OK, but let's say that we want to modify the source code itself: we want to add a feature ... how does one do this?

Go back to [ftp.cac.washington.edu](http://ftp.cac.washington.edu) and copy the "pine4.64.tar.gz" file into your home directory. Then, uncompress and untar it.

```
skendric@ganesh:~> ls
pine4.64.tar.gz
skendric@ganesh:~> tar xvfz pine4.64.tar.gz
./pine4.64/
./pine4.64/contrib/
./pine4.64/contrib/bitmaps/
[...]
skendric@ganesh:~> cd pine*
skendric@ganesh:~/pine4.64> ls
build      buildcyg  COPYRIGHT  imap      packages  pine
build.cmd  contrib   doc        makefile  pico      README
skendric@ganesh
skendric@ganesh:~/pine4.64>
```

Pine is kind of weird ... it doesn't have a 'configure' script, which is the typical way to go. Instead, it has a 'build' script:

```
skendric@ganesh:~/pine4.64> ./build help
Usage: build <make-options> <target-platform>
```

<target-platform> may be one of the ports listed in doc/pine-ports or  
clean Clean up object files and such.  
Also, a good way to rebuild Pine/Pico from scratch.

See the README file for more information.

```
skendric@ganesh:/opt/local/src/pine4.64>
```

If I were serious, I would read the README file. But I'm in a hurry, so I'll just look at the pine-ports document:

```
skendric@ganesh:~/pine4.64> cd doc
skendric@ganesh:~/pine4.64/doc> less pine-ports
Here is the full list of Pine ports:
```

```
    AIX
    a41      IBM RS/6000 running AIX 4.1 or 4.2
    ga4      IBM RS/6000 running AIX 4.1 or 4.2 using gcc compiler
    a32      IBM RS/6000 running AIX 3.2 or earlier
    aix      IBM S/370 AIX
```

```
[..]
```

Notice the challenges faced by developers in a Unix environment ... how many flavors of Unix does this package support? (Microsoft's version of this problem is far, far smaller ... "With age comes both maturity and baggage".) Which argument to 'build' shall we use?

Here's the one I chose:

```
skendric@ganesh:~/pine4.64/doc> cd ..
skendric@ganesh:~/pine4.64> ./build lsu
make args are CC=cc  lsu
```

```
Directory /usr/share/ssl/certs is missing
```

```
Including SSL functionality
```

```
[...]
```

At the end, the compilation procedure complains about being unable to find certificates. If we wanted to perform X.509 authentication (as opposed to merely encrypting traffic), we would of course need to create and install certificates.

OK, let's try running the copy of Pine which we compiled.

```
skendric@ganesh:~/pine4.64> cd bin
skendric@ganesh:~/pine4.64/bin> ./pine
```

```
PINE 4.64  MAIN MENU                                Folder: INBOX  No Messages

?  HELP                - Get help using Pine
C  COMPOSE MESSAGE     - Compose and send a message
I  MESSAGE INDEX       - View messages in current folder
L  FOLDER LIST         - Select a folder to view
```

```

A    ADDRESS BOOK    - Update address book
S    SETUP           - Configure Pine Options
Q    QUIT            - Leave the Pine program

```

```

Copyright 1989-2005. PINE is a trademark of the University of Washington.
                [Folder "INBOX" opened with 0 messages]
? Help                P PrevCmd                R RelNotes
0 OTHER CMDS > [ListFldrs] N NextCmd          K KBlock

```

Notice, however, the string ‘MAIN MENU’ at the top of the screen.

Type “q” to quit.

Ahhh, but remember, we wanted to modify Pine and add a feature before we compiled it. Let’s go back and do that.

```

skendric@ganesh:~/pine4.64/bin> cd ../pine
skendric@ganesh:~/pine4.64/pine> pico pine.c

```

Search for the string “MAIN MENU”. [Hint: type Ctrl-W] Find the following section:

```

/* paint the titlebar if needed */
if(ps->mangled_header){
    set_titlebar("MAIN MENU", ps->mail_stream, ps->context_current,
                ps->cur_folder, ps->msgmap, 1, FolderName, 0, 0, NULL);
    ps->mangled_header = 0;
}

```

And change the string “MAIN MENU” to read “FOOZLE”:

```

/* paint the titlebar if needed */
if(ps->mangled_header){
    set_titlebar("FOOZLE", ps->mail_stream, ps->context_current,
                ps->cur_folder, ps->msgmap, 1, FolderName, 0, 0, NULL);
    ps->mangled_header = 0;
}

```

Exit and save. [Hint: type Ctrl-X] Now, recompile Pine.

```

skendric@ganesh:~/pine4.64/pine> cd ..
skendric@ganesh:~/pine4.64> ./build lsu
[...]

```

Run your modified version of Pine.

```

skendric@ganesh:~/pine4.64> cd bin
skendric@ganesh:~/pine4.64/bin> ./pine

```

PINE 4.64 FOOZLE

Folder: INBOX No Messages

```
?   HELP           - Get help using Pine
C   COMPOSE MESSAGE - Compose and send a message
I   MESSAGE INDEX  - View messages in current folder
L   FOLDER LIST    - Select a folder to view
A   ADDRESS BOOK   - Update address book
S   SETUP          - Configure Pine Options
Q   QUIT           - Leave the Pine program
```

Copyright 1989-2005. PINE is a trademark of the University of Washington.

[Folder "INBOX" opened with 0 messages]

```
? Help           P PrevCmd           R RelNotes
0 OTHER CMDS > [ListFldrs] N NextCmd       K KBlock
```

Notice, the string 'FOOZLE' at the top of the screen.

Let's copy your copy of bin to a location where everyone can find it.

```
skendric@ganesh:~/pine4.64/bin> mkdir /opt/local/bin
skendric@ganesh:~/pine4.64/bin> cp pine /opt/local/bin
skendric@ganesh:~/pine4.64/bin>
```

OK, so that's Pine. Now, take the skills you've developed and tackle a major package, like BIND or Sendmail, and compile it from scratch.

## BIND

Poke around <http://www.isc.org>. Or copy it directly from <ftp.isc.org>. The Berkeley Internet Name Daemon is the program which resolves most of the DNS look-ups performed on the planet: this is the software which runs on the root name servers, typically handling tens of thousands of look-ups per second. It also runs on [dns1.fhrc.org](http://dns1.fhrc.org), [dns2.fhrc.org](http://dns2.fhrc.org), and [dns3.fhrc.org](http://dns3.fhrc.org), the name servers which service most DNS look-ups performed here at FHCRC.

Untar/uncompress the source file into your home directory. Poke thru the README and CHANGES files. Type `./configure --help`. When you're ready:

```
ganesh%:/home/skendric/bind-9.3.2> ./configure --prefix=/opt/local
[...] # Figure out what operating system we're running on, what CPU
architecture, and where the various system libraries are located.
ganesh%:/home/skendric/bind-9.3.2> ./make
[...] # This is where BIND is actually compiled
ganesh%:/home/skendric/bind-9.3.2> ./make test
[...] # Various tests performed to verify that the compilation was a success.
```

```
ganesh%:/home/skendric/bind-9.3.2>./make install
[...] Copy the binaries, related libraries, and related documentation to the
relevant directories.
```

Can you see the results of your work? [Hint: poke around /opt/local/bin and /opt/local/sbin, looking for ‘named’, which is the executable that comprises BIND.]

Actually creating config files and loading BIND would, of course, take a little more time ... :)

## SENDMAIL

Poke around <http://www.sendmail.org>, or just grab the source code directly from <ftp.sendmail.org>. Sendmail is the “mail relay” software<sup>9</sup> (kind of like a USPS or FedEx sorting station) which routes most of the e-mail sent on the planet. This is the software running on FHCRC’s mail relays (mx1.fhrc.org and mx2.fhrc.org) as well as on the SCCA’s mail relays (astro.seattlecca.org and elroy.seattlecca.org).

Untar/uncompress the source file into your home directory. Poke through the RELEASE\_NOTES file ... look for the names of the people who have reported bugs and who have contributed fixes ... this gives you a feel for the global reach of the community supporting this package.<sup>10</sup> Skim README and INSTALL ... this gives you a feel for the range of features available in this package. If you’ve paid close enough attention, you’ll realize that you need to create a “site.config” file before you can compile sendmail.

I’ve created one for you ... but you have to copy it into place:

```
skendric@ganesh:/opt/local/src/sendmail-8.13.8> cp /var/tmp/site.config devtools/Site>
```

OK, but don’t be blind about it ... go look at it. [Basically, all this does is to move the destination directories from the Sendmail defaults to /opt/local.]

```
skendric@ganesh:/opt/local/src/sendmail-8.13.8> less devtools/Site/site.config
[...]
```

Now, compile and install sendmail.

```
ganesh%:/home/skendric/sendmail-8.13.8>./Build -c
[...] # This configures and compiles all in one step
ganesh%:/home/skendric/sendmail-8.13.8>./Build -install
[...] # This copies the binaries to various locations
```

---

<sup>9</sup> “Mail relay” software is very different from “post office” software ... Microsoft Exchange, UW IMAP (Snap and Hydra), Cyrus IMAP (many big sites, possibly HotMail and Yahoo), Courier IMAP (Jade) are examples of “post office” software. And of course, “mail user agents” are another category entirely, e.g. Microsoft Outlook, Thunderbird, and Web-based clients like IMP (Hydra, Jade, and commercial e-mail providers, possibly HotMail and Yahoo).

<sup>10</sup> How many times does Steve Hubert from the University of Washington appear? ... answering this question is a problem for ‘grep’ ... try “grep -c REL\*”

Can you see the results of your work? [Hint: poke around /opt/local/bin and /opt/local/sbin looking for the 'sendmail' executable.]

Actually creating config files and loading Sendmail would, of course, take a little more time ... :)

## Installing Patches

Under Windows, load Internet Explorer and choose 'Windows Update' from the 'Tools' menu. If your PC is running a newer flavor of Windows, choose 'Microsoft Update' from the 'Start' menu. Navigate the buttons and menus to identify and install the latest Microsoft patches on your PC.

Under Unix, run YAST, go to 'Online Update', and navigate the buttons to identify the latest patches. (Please don't install them! We'll do this together, as a group.)

## CONTINUED PRACTICE

After class has ended, please feel free to log back into ganesh and play around – I will keep it running into September. Don't worry about breaking it ... this is a machine which exists to support you performing your own *research into operating systems*. If you do break it, drop me a note, and I'll wipe the box and reinstall – this is not a big deal.

You can acquire a copy of the FreeNX<sup>11</sup> client from <https://vishnu.fhcrc.org/unix>

---

<sup>11</sup> This is the version 1.5 client, which works with ganesh. The newer 2.x clients do not work with ganesh ... I don't know why not.