CSE 451 Section
Autumn 2004

Alex Moshchuk
anm@cs
Office hours: Tue 2-3, Thu 4:30-5:30
Allen 216 (or lab)

Reminders

- Sign up for mailing list
- Read the web site
  - Work through lab information
- Start reading the book
- Do the first homework – due this Monday!
- Read & start project 1

451 Projects

- 3 or 4 projects
- First one – individual, others – groups of 3
- Need basic C and UNIX skills
  - Check links if you need help with this
- Challenging
  - Don't leave until last minute
- Learn a lot of cool stuff

First Project

- Introduces C and Unix skills you'll need
- Teaches how to build and run Linux in VMWare
- Two main parts:
  - Write a simple shell
  - Add a simple system call to Linux kernel
- Due: Thursday, Oct 7
  - 1:00 pm for turnin
  - Bring writeup to section

The shell

- Print out prompt
- Accept input
- Parse input
- Create new process
  - Launch specified program there
- Wait for it to finish
- Repeat

```
CSE451Shell% /bin/date
Fri Jan 16 00:05:39 PST 2004
CSE451Shell% pwd
/root
CSE451Shell% cd /
CSE451Shell% pwd
/
CSE451Shell% exit
```

System Calls

- What's a system call?
- Examples?
- In your shell:
  - Use *fork* to create a child process
  - Use *execve* to execute a specified program
  - Use *wait* to wait until child process terminates

Adding a System Call

- Add *execcounts* system call:
  - Count number of times you call *fork*, *vfork*, *clone*, and *exec* system calls.
- Steps:
  - Modify kernel to keep track of this information
  - Add *execcounts* to return this to the user
  - Write an application to use it (your shell)

Example of execcounts

```
CSE451Shell% execcounts clear
CSE451Shell% cd /
CSE451Shell% pwd
/
CSE451Shell% date
Wed Sep 29 16:52:41 PDT 2004
CSE451Shell% time
Usage: time [-apvV] [-f format] [-o file] [--append] [--
verbose]
       [--portability] [--format=format] [--output=file] [--
version]
       [--help] command [arg...]
CSE451Shell% execcounts
Statistics:
Fork:                   3      27%
Clone:                  0      0%
VFork:                  0      0%
Execve:                 8      72%
CSE451Shell% exit
```

Programming in kernel mode

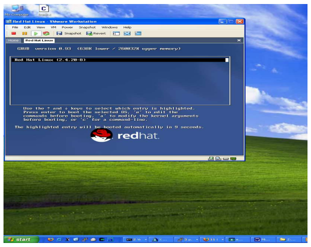
- Can't use application libraries (e.g. libc)
  - E.g. can't use printf
- Use only functions defined by the kernel
  - E.g. use printk instead
- Include files are different in the kernel
- Don't forget you're in kernel space
  - E.g. unsafe to access a pointer from user space directly, use fn's that perform checks
- Good way to learn – look at existing code

Computing Resources

- Develop your code on dedicated 451 Linux hosts:
  - *spinlock, coredump*
- Test your code on VMWare PCs in 006
- Do not use attu

VMWare

- Software simulation of x86 architecture
- Run an OS in a sandbox
  - Easily reset to known good state



My Computer
Red Hat Linux - VMware Workstation
File Edit View VM Power Snapshot Windows Help
Snapshot Revert
Home
Red Hat Linux
redhat
start

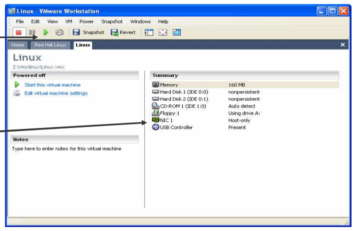
```
GRUB  version 0.93  (638K lower / 260032K upper memory)

Red Hat Linux (2.4.20-8)

Use the ↑ and ↓ keys to select which entry is highlighted.
Press enter to boot the selected OS, 'e' to edit the
commands before booting, 'a' to modify the kernel arguments
before booting, or 'c' for a command-line.

The highlighted entry will be booted automatically in 9 seconds.
```

Using VMWare



Linux - VMware Workstation
File Edit View VM Power Snapshot Windows Help
Snapshot Revert
Home
Red Hat Linux
Linux
Start this virtual machine
Edit virtual machine settings

Linux

Z:\vms\linux\Linux.vmx

Powered off

Summary

Memory 160 MB
Hard Disk 1 (IDE 0:0) nonpersistent
Hard Disk 2 (IDE 0:1) nonpersistent
CD-ROM 1 (IDE 1:0) Auto detect
Floppy 1 Using drive A:
NIC 1 Host-only
USB Controller Present

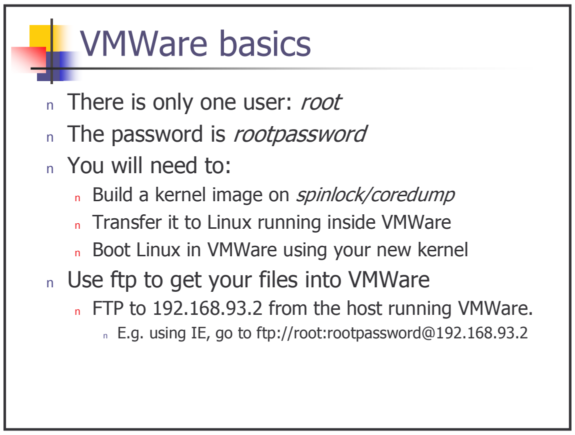
Notes

Type here to enter notes for this virtual machine

Power on/off, reset

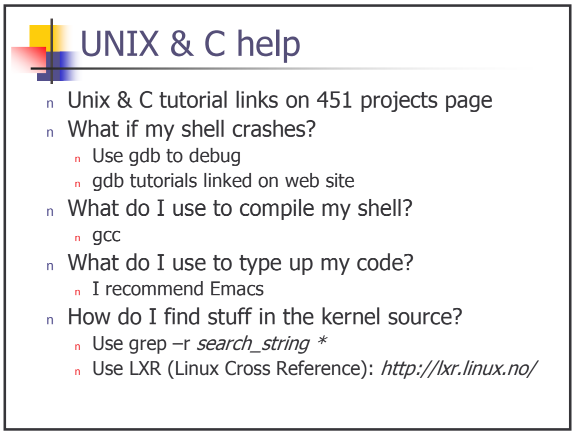
VMWare config
Don't change!

- All disks are nonpersistent
  - *Powering off loses your changes!* Use "shutdown –r now" instead
- Network adapter is host-only



VMWare basics

- There is only one user: *root*
- The password is *rootpassword*
- You will need to:
  - Build a kernel image on *spinlock/coredump*
  - Transfer it to Linux running inside VMWare
  - Boot Linux in VMWare using your new kernel
- Use ftp to get your files into VMWare
  - FTP to 192.168.93.2 from the host running VMWare.
    - E.g. using IE, go to ftp://root:rootpassword@192.168.93.2



UNIX & C help

- Unix & C tutorial links on 451 projects page
- What if my shell crashes?
  - Use gdb to debug
  - gdb tutorials linked on web site
- What do I use to compile my shell?
  - gcc
- What do I use to type up my code?
  - I recommend Emacs
- How do I find stuff in the kernel source?
  - Use grep –r *search_string **
  - Use LXR (Linux Cross Reference): *http://lxr.linux.no/*