

Linux Workshop

Spring 2021

Jack Leightcap¹², Connor Northway²

¹IEEE – nuieeeofficers@gmail.com

²Wireless Club – nuwirelessclub@gmail.com

February 7, 2022

What is Linux?

- Free and open source – <https://github.com/torvalds/linux>
- Source code makes debugging and extending (comparatively!) easy
- Modular, configurable: small low power systems to large complex systems
- 10,000+ contributors, regular release cycle
- Linus's Law - “given enough eyeballs, all bugs are shallow”

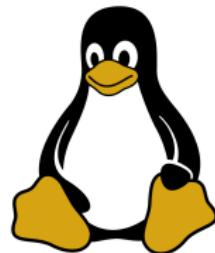


Figure: Tux, Linux Mascot

The UNIX Philosophy

Peter H. Salus, *A Quarter-Century of Unix*, from Doug McIlroy;

- Write programs that do one thing and do it well.
- Write programs that work together.
- Write programs to handle text streams, because that is the universal interface.

Opposed to Zawinski's Law:

- Every program attempts to expand until it can read [e]mail. Those programs which cannot so expand are replaced by ones which can.

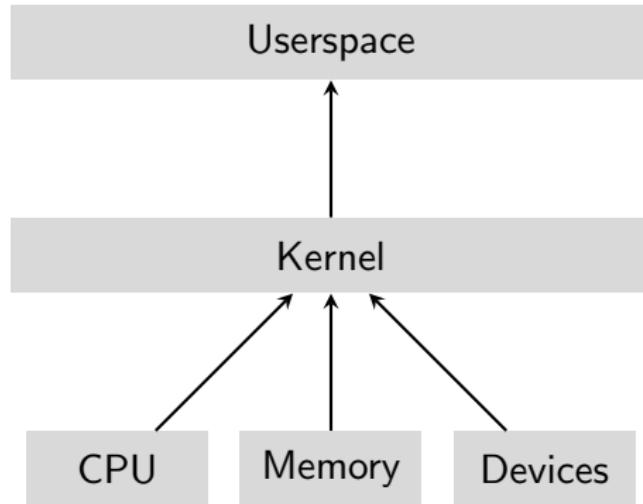


Figure: General System Hierarchy

Linux/x86 5.8.8 Kernel Configuration

Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ---). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [] excluded <M> module < > module capable

```
|| General setup --->
[*] 64-bit kernel (NEW)
    Processor type and features --->
    Power management and ACPI options --->
    Bus options (PCI etc.) --->
    Binary Emulations --->
    Firmware Drivers --->
[*] Virtualization (NEW) --->
    General architecture-dependent options --->
[*] Enable loadable module support --->
--> Enable the block layer --->
    IO Schedulers --->
    Executable file formats --->
    Memory Management options --->
[*] Networking support --->
    Device Drivers --->
    File systems --->
```

v(+)

<Select> < Exit > < Help > < Save > < Load >

Figure: menuconfig – Linux configuration

What is Linux Used For?

From 'big' to 'small':

- Servers ('The Cloud')
- Supercomputers
- Personal computers
- Android
- IoT Devices
- Embedded Systems

And almost everything in between

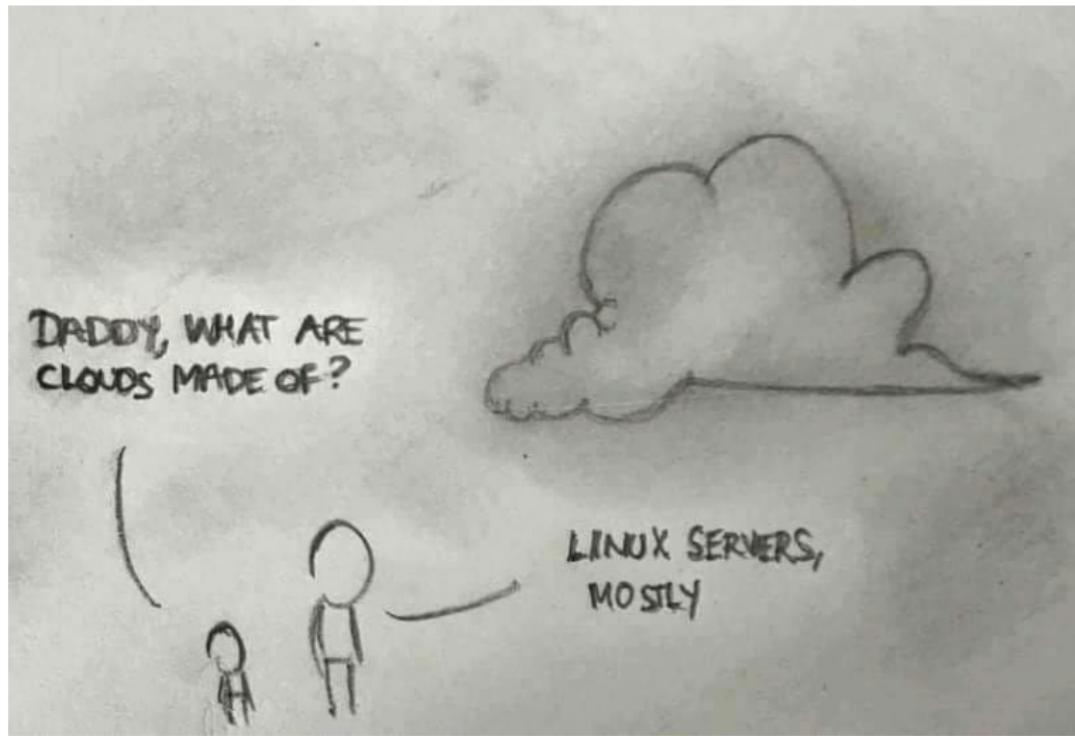


Figure: Source



Figure: Source

```
1 2 3 4 5 6 7 8 www []= uxterm
  checking whether gcc accepts -g... (cached) yes
  checking for gcc option to accept ISO C89... (cache >
d) none needed
  checking dependency style of gcc... (cached) gcc3
  checking if RANDR is defined... yes
  checking if RENDER is defined... yes
  checking if XV is defined... yes
  checking for pkg-config... /usr/bin/pkg-config
  checking pkg-config is at least version 0.9.0... yes
  checking for XORG... yes
  checking for ANSI C header files... (cached) yes
./configure: line 21341: XORG_MANPAGE_SECTIONS: com
mand not found
./configure: line 21342: XORG_RELEASE_VERSION: comm
and not found
configure: creating ./config.status
/bin/sh ./config.status
config.status: creating Makefile
config.status: creating src/Makefile
config.status: creating man/Makefile
config.status: creating config.h
config.status: config.h is unchanged
config.status: executing depfiles commands
cd . && /bin/sh /root/xf86-video-cube/missing --run
autoheader
rm -f stamp-h1
touch config.h.in
cd . && /bin/sh ./config.status config.h
config.status: creating config.h
make all-recursive
make[1]: Entering directory `/root/xf86-video-cube'
cd . && /bin/sh /root/xf86-video-cube/missing --ru
n automake-1.10 --foreign Makefile
jleightcap@wii:~$ piifetch
jleightcap@wii:
os          Debian GNU/Linu
host        wii
kernel      2.6.32-isobel-w
uptime      0d 4h 36m
packages    482
memory     20660 kB / 7620
jleightcap@wii:~$ scrot
```

Figure: Source

Booting Linux in Web Browser

Ideally in another window,

`http://copy.sh/v86/?profile=linux26`

Interacting with Linux: the shell

- The *shell* is a text-based interface to the kernel
- a *REPL* (Read → Eval → Print → Loop) of a complete programming language; loops, variables, etc.

After booted:

/root% pwd pwd – “Print Working Directory”

/root

/root% cd / cd – “Change Directory”

/% ls ls – “List”

...

Filesystem Organization

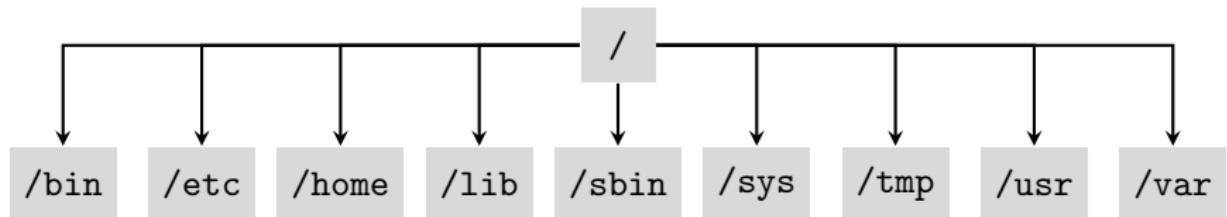


Figure: Common Linux Directory Structure

shorthand	meaning
.	current directory
..	parent (upper) directory
~	home directory

QUESTION: Parent Directory of /

```
/% pwd
```

```
/
```

```
/% cd ..
```

where are we?

Special Directories: /dev, /proc, and /tmp

“[text streams are] the universal interface“ – everything is a file!

- /dev/: devices
 - Random numbers: /dev/urandom
 - Zero: /dev/zero (surprisingly useful)
 - Physical storage: /dev/hda, /dev/sda, ...
 - RAM: /dev/ram
- /proc/: processes
 - CPU info: cat /proc/cpuinfo
 - Linux version info: cat /proc/version
 - Processes: ps PIDs compared to ls /proc
- /tmp/: temporary (sometimes cleared on reboot)

/bin, /sbin, /usr/bin, and /usr/sbin: Programs

- ls /bin — see ls there?
- How does the system know where to look for these? Similar to other programming languages, a *variable*:
 - FOO=hello, get contents of variable with echo \$FOO
 - echo \$PATH
 - Have programs in /root? PATH=\$PATH:/root
- Layout has standards, but in the end up to user
 - *symlinks* – “Symbolic Links” have one file or directory ‘point’ to another
 - /usr/local/bin, programs will change default \$PATH, plenty of others...

Shell Extras

- [COMMAND] > file
write output of [COMMAND] to file
- [COMMAND]₁ | [COMMAND]₂ | ...
pipe output of one command to the input of the next
- [COMMAND] &
run [COMMAND] in the background.
- foo() { [COMMAND] }
define a function foo which does [COMMAND].

Piping examples:

- ls /bin | sort | head -n 1
first program in bin, alphabetically
- cat /root/tests/reference.test | uniq | wc -l
last program in bin, alphabetically

NOTE: What Do These Do?

```
/% fork() { fork | fork & }
```

```
/% fork
```

```
/% rm -r /
```

Power and Responsibility...

Linux gives you the power to shoot yourself in the foot.

General precautions:

- Don't copy paste a shell command without understanding what it's doing.
- Don't run a script from an untrusted source without verifying it.
- Easy mistakes that can permanently delete files:
 - Moving file over another
 - Writing over a file
 - Over-reliance on tab completion
 - There is no recycling bin in the shell!