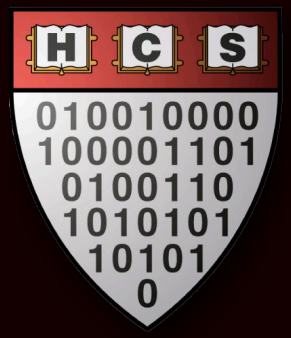
Linux Demystified



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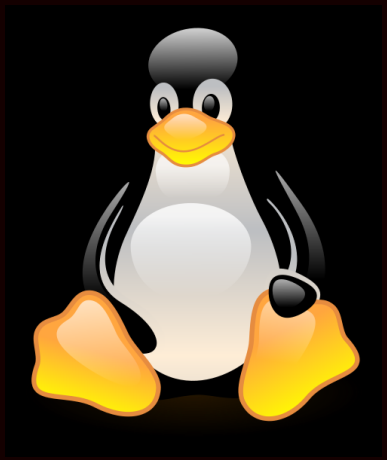

What is Linux?

What is GNU/Linux?

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GNU's Not Unix
It's recursive… get it?

The Free Software Foundation

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Linux is:
$0.00

Linux is:
Free Software

Free as in free speech and free beer

Available in many distributions on many platforms

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Ultimate flexibility and control

Terminal
Info
Terminal
Edit
Windows
Services
Hide h
Quit q

Terminal - beta.malmberg.org:/home/alex/unicode

Katakana:

Hebrew (iw)

Polish (pl)

Pchnąć w tę łódź jeża lub o skrzyń fig

Russian (ru)

В чащах юга жил бы цитрус? Да, но фальшивый экземпляр!

Terminal

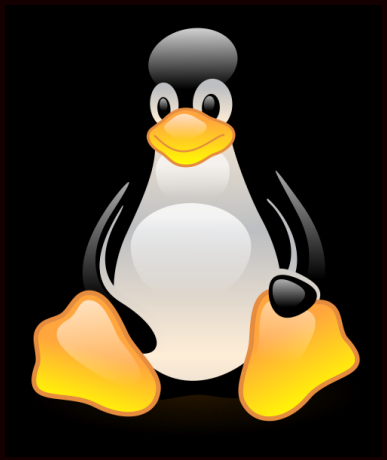
```
 8:10pm  up 11:37,  8 users,  load average: 0.60, 0.45, 0.33
94 processes: 89 sleeping, 5 running, 0 zombie, 0 stopped
CPU states: 14.0% user,  2.1% system,  0.0% nice, 84.2% idle
Mem:  127888K av, 126020K used,   1868K free,  78356K shrd,   6336K buff
Swap: 128484K av,      0K used, 128484K free                 66120K cached

  PID USER     PRI  NI  SIZE  RSS SHARE STAT  LIB %CPU %MEM   TIME COMMAND
  477 root       4   0 32448  31M  4060 S       0  0.3 25.2   2:02 X
  492 alex       0   0 17112  16M  9188 S       0  0.0 13.3   0:14 netscape
15933 alex       4   0 11152  10M  7992 R       0  4.5  8.7   0:43 Terminal
15159 alex       1   0  6464 6272  3212 R       0  0.3  4.9   0:19 xmms
15161 alex       0   0  6464 6272  3212 S       0  0.0  4.9   0:00 xmms
15162 alex       0   0  6464 6272  3212 S       0  0.0  4.9   0:00 xmms
15163 alex       0   0  6464 6272  3212 S       0  0.0  4.9   0:00 xmms
15989 alex       0   0  6464 6272  3212 R       0  0.0  4.9   0:00 xmms
15990 alex      17   0  6464 6272  3212 R       0  9.8  4.9   0:03 xmms
11673 alex       0   0  5800 5800  3724 S       0  0.0  4.5   0:00 gpbs
15967 alex       0   0  3852 3852  1952 S       0  0.0  3.0   0:00 emacs
  493 alex       0   0  3632 3632  3060 S       0  0.0  2.8   0:00 netscape
11671 alex       0   0  3548 3548  2396 S       0  0.0  2.7   0:00 gdnc
  481 alex       0   0  2968 2968  2212 S       0  0.0  2.3   0:03 xfstt
  480 alex       1   0  2452 2452  1704 S       0  0.0  1.9   0:03 wmaker
15995 alex       1   0  2120 2120  1272 S       0  0.0  1.6   0:00 xv
```

Terminal

```
Buffers Files Tools Edit Search Mule ObjC Help

+(NSFont *) terminalFont
{
        NSUserDefaults *ud=[NSUserDefaults standardUserDefa
        if ([ud stringForKey: @"TerminalFont"])
        {
                return [NSFont fontWithName: [ud stringForK
                        size: [ud floatForKey: @"TerminalFo
        }
        return [NSFont userFixedPitchFontOfSize: 0];
}

@end


@interface TerminalWindowController : NSWindowController
{
        TerminalView *tv;
}

--1-:---F1  main.m          (ObjC CVS-1.19)--L1725--88%--
```

Terminal

```
 Left     File     Command     Options     Right
<-~/gstep/Terminal                    v>  <-/usr/local/src/ncurses-5.2/test   v>
     Name        Size    MTime            Name        Size    MTime
/..              1024 Jun  3 23:23   tclock.c          4409 Sep  2  2000
/CVS             1024 Jun  5 20:03   test.priv.h       3987 Sep  2  2000
/English.lproj   1024 Jun  5 01:26  *testaddch       110266 Mar 19 14:37
/Swedish.lproj   1024 Jun  5 01:26   testaddch.c       1266 Oct 18  1997
/Terminal.app    1024 Jun  3 23:24  *testcurs        143818 Mar 19 14:37
~obj               39 Jun  3 23:23   testcurs.c       14721 Jun 18  2000
/shared_obj      1024 Jun  3 23:23  *testscanw        111153 Mar 19 14:37
 COPYING        18009 Jul 15  2001   testscanw.c        779 Sep 20  1997
 ChangeLog       2906 Jun  5 20:02  *tracemunch         2292 Oct  6  1995
 ChangeLog.bak   2515 Jun  5 10:37  *view            114659 Mar 19 14:37
 GNUmakefile      493 Jun  5 20:02   view.c           9320 Sep  2  2000
 Terminal~.tar.gz 20055 Jun  5 03:01 *worm            127758 Mar 19 14:37
 Terminal~.tar.gz 20611 Jun  5 10:35  worm.c           9477 Sep  2  2000
 Terminal~.tar.gz 21054 Jun  5 11:54 *xmas            148819 Mar 19 14:37
 Terminal~.tar.gz 21182 Jun  5 20:03  xmas.c          34053 Sep  2  2000

/Swedish.lproj                       xmas.c

Hint: Want to do complex searchs? Use the External Panelize command.
[alex@beta test]$                                                    [^]
1Help  2Menu  3View  4Edit  5Copy  6RenMov 7Mkdir  8Delete 9PullDn 10Quit
```



Linux General Principles

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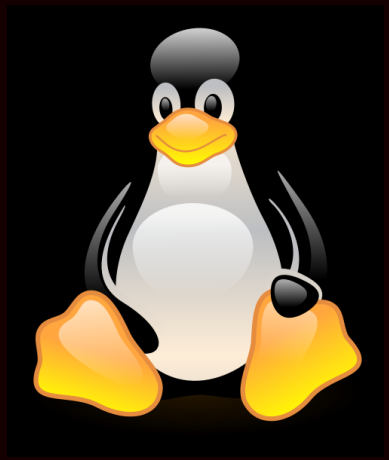
General Principles

- Less is more (no news is good news)
- Small programs that do one thing really well
- (Almost) everything is open-source
- Input and output to programs is plain-text: easy to see what programs do

Principles cont.

- Multi-user computing environment with permissions
- Everything is a file. *Everything.*
- Ctrl-Z, Ctrl-D, Ctrl-C – typical ways to get out of something
- If you don't know, RTFM: `man`



Where is everything?

```
brockman@cato:/$ ls

bin/    etc/         lib/         misc/   oracle@   scratch@   tmp/
boot/   home@        local/       mnt/    proc/     shells/    usr/
cdrom@  initrd/      lost+found/  nfs/    root/     srv/       var/
dev/    initrd.img@  media/       opt/    sbin/     sys/       vmlinuz@
```

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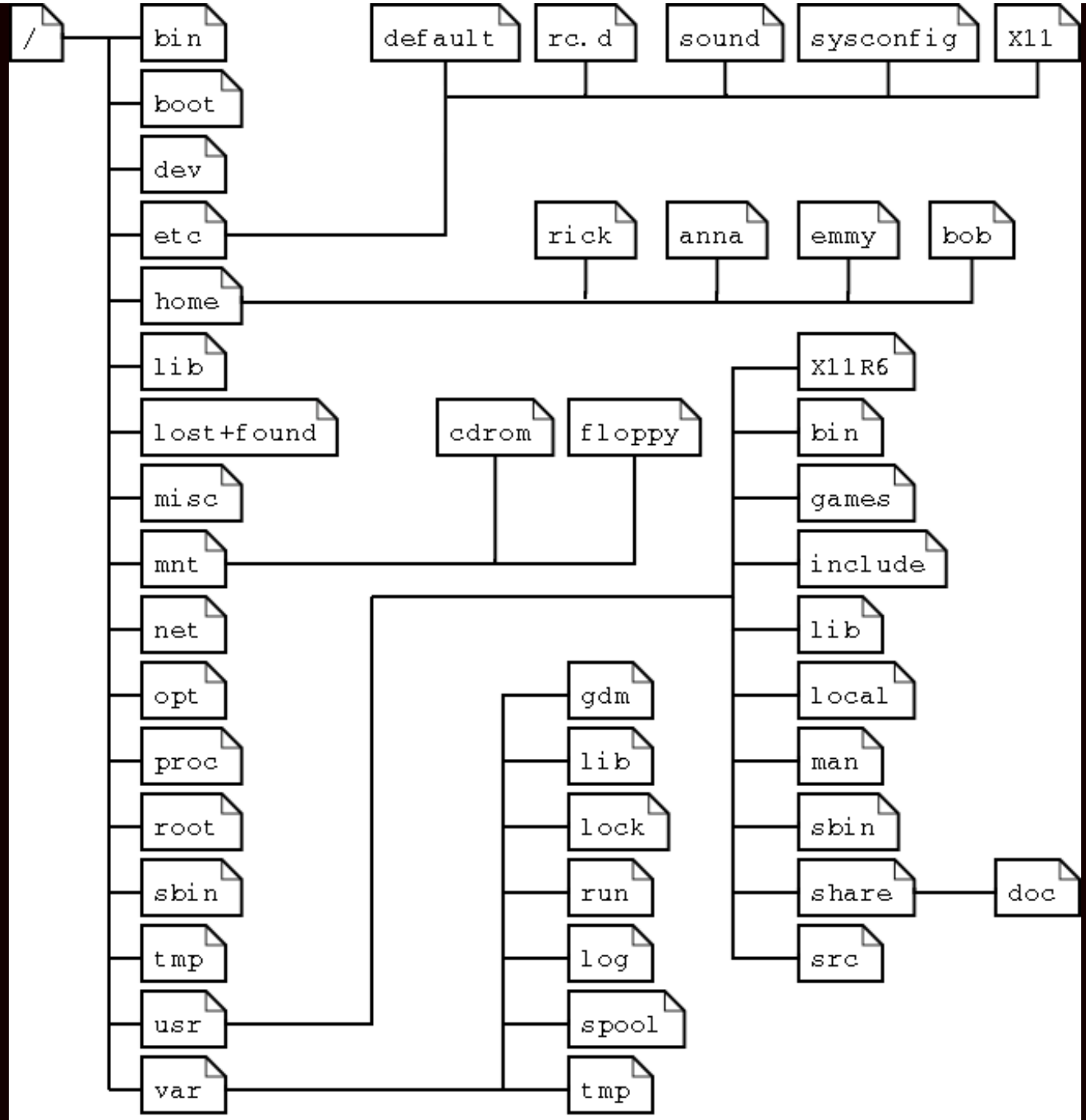

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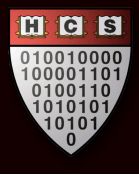
Your Home Directory

~/



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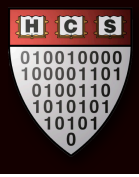
The Linux filetree is flexible.

/ ./ ../

symlinks



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User configurations
Hidden files :

`.hiddenstuff`

Useful programs

Useful Linux Programs

- finger, write
- find, which, whereis
- grep
- ps, kill, killall, top
- jobs, fg, screen
- quota, du, df
- ln
- dig -trace
- ping, wget, curl
- emacs, vim
- echo, cat
- head, tail, less, more
- chown, chmod

Package Manager

- Can install software from centralized repositories
- apt-get install <package>
- Want a webserver?
  - apt-get install apache2
- Want Open Office?
  - apt-get install openoffice.org

So how do I do anything useful?

PIPE

> >> |

stdin stdout/stderr

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Commands & Pipes

- last | less
- find ./ -name “Thumbs.db” -delete
- fortune | cowsay

```
 _____________________________________
< It's all in the mind, ya know. >
 -------------------------------
        \   ^__^
         \  (oo)\_______
            (__)\       )\/\
                ||----w |
                ||     ||
```

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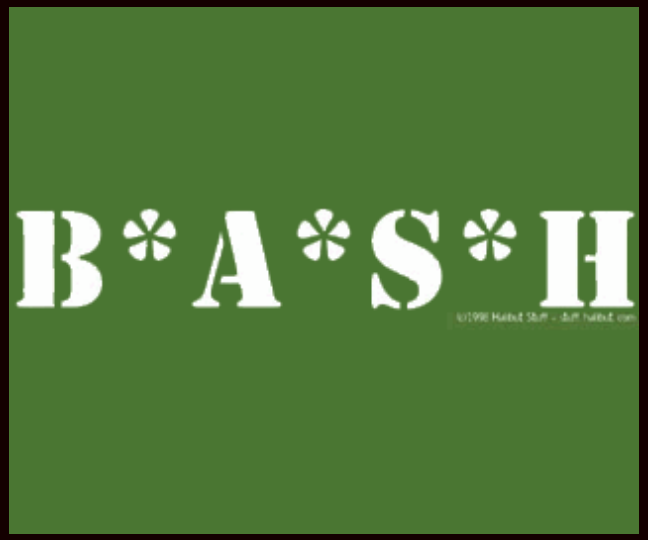

Getting to know your shell

tcsh bash zsh

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Environment variables

- Control the characteristics of the shell
  - View them with `[set]env`, or `$VARIABLE`
  - Set them with `export`
  - Change up your prompt! `export PS1="myCOOLprompt: "`
- But these have to be declared every time you use your shell.
  - Solution: `~/.profile`, `~/.bash_profile`, etc.

But if we have variables…

- And we have all these nifty little programs that can be strung together…
- Can we make our own programs?
- YES.
- Linux is beautiful.

Shell Scripts

- Shell scripts are "programs" that are completely uncompiled, but read and executed by the shell line by line.
- Typically end in .sh
- Must be chmod'ed executable.
- Start with a "shebang" – tells the shell what to use to interpret it. e.g.,
  - `#! /bin/bash` for a bash script.

Quick overview of BASH scripting

- Easy hello world program:

- #! /bin/bash
  echo "Hello World"

BASH vs. C

```bash
#! /bin/bash

number=3
name="bob"
echo "$name is your
   chosen name, $number
   your chosen number."

let "inc=number+1"
if [ "$inc" -eq "4" ]
   then echo "Addition
   works like a charm."
fi
```

```c
#include <stdio.h>
#include <cs50.h>

int number = 3;
string name = "bob";
printf("%s is your chosen
   name, %d your chosen
   number.\n", number,
   name);

int inc = number++;
if ( inc == 4 ) {
   printf("Addition works
   like a charm.\n");
}
```

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BASH vs. C

- All variables are strings
- Variables are accessed with $VAR
- Runs other Linux programs to do its work
- Spacing usually matters.
- No line endings

- Multiple types, must be declared
- Variables do not have prefixes
- Runs subroutines or functions from libraries to do work
- Spacing matters a lot less.
- Lines end in ;

As you can see there are many similarities…

BASH is a programming language in and of itself.

You put all the little pieces of Linux together in the ways that suit *you* best. It's your computer to control.

smartsync

```
#!/bin/bash

event='-e close_write'
inotifywait -mrq --format '%w %f' $event $exclude $1 | \
  while read path file; do
    echo "$(date '+%F %R')   sent ${path}${file} $2"
    rsync -CR ${path}${file} $2 || echo "ERROR"
done
```

- Bash makes for convenient glue code

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Focus on command line,
a GUI is often secondary

Trinity uses Linux.

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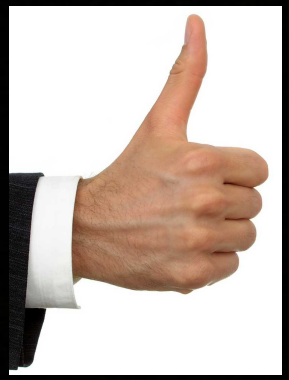
```
[mobile]
Starting nmap V. 2.54BETA25
Insufficient responses for TCP sequencing (3), OS detection may be less
accurate
Interesting ports on 10.2.2.2:
(The 1539 ports scanned but not shown below are in state: closed)
Port        State       Service
22/tcp      open        ssh

No exact OS matches for host

Nmap run completed -- 1 IP address (1 host up) scanneds
# sshnuke 10.2.2.2 -rootpw="Z10N0101"
Connecting to 10.2.2.2:ssh ... successful.
Attempting to exploit SSHv1 CRC32 ... successful.
Reseting root password to "Z10N0101".
System open: Access Level <9>
# ssh 10.2.2.2 -l root
root@10.2.2.2's password:

PRF-CONTROL> disable grid nodes 21 - 48
```



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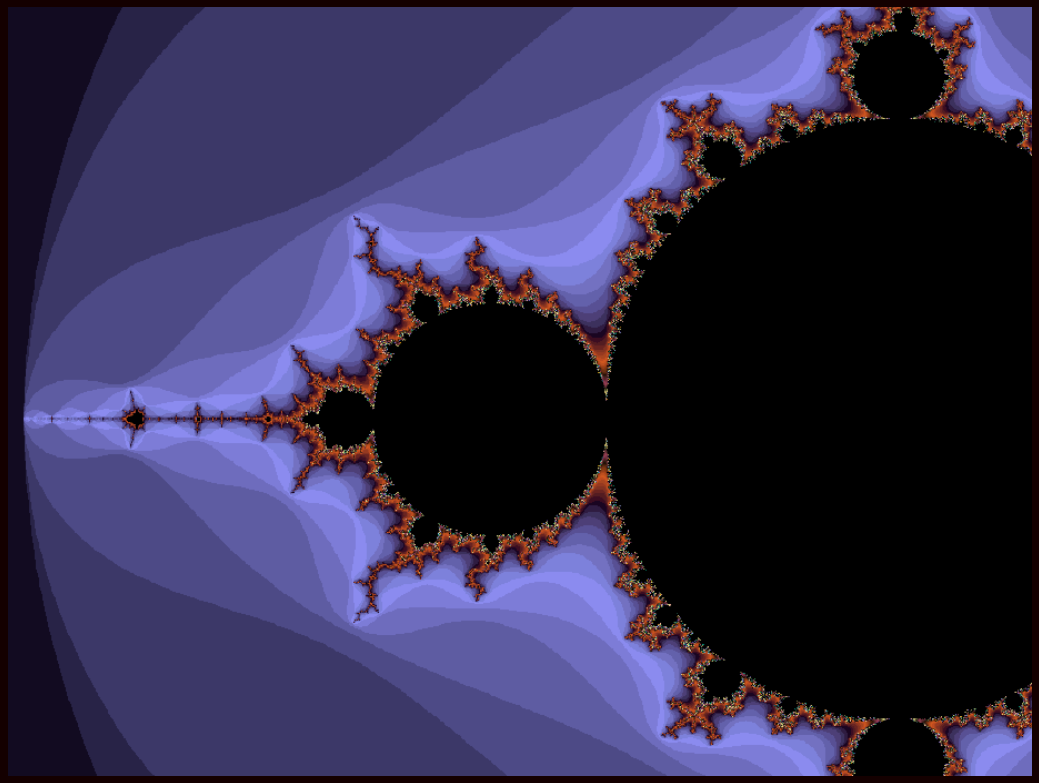
Try doing that by point-and-click... oh wait.

got graphix?

- So far we've been staring a lot at text consoles.
- Linux does allow for the display of graphics:
  - X11 on nice – demo it!
  - Window managers: Gnome, KDE
  - You can see these on the SC Lab computers, or in most desktop Linux distros, e.g., Ubuntu, Suse, Red Hat, etc.

Cool programs with graphics

- Firefox
- Wireshark
- VNC
- XaoS



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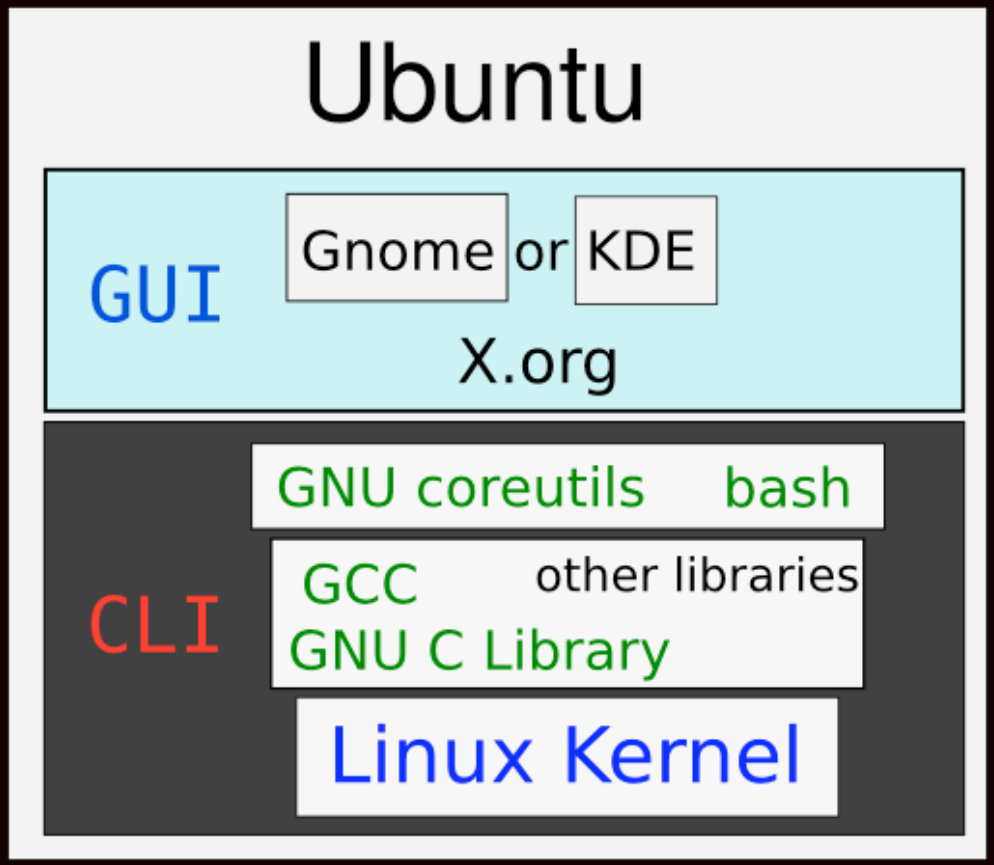
Anatomy of a Distribution

- Building an OS with Linux is complex!



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Try it out!

- You can try Linux in a VM, with a LiveCD, or by installing alongside your current OS (dual booting).
- The internets are your friend: there are lots of forums and email lists
- See Wikipedia for history, etc.
- Read the man pages for details on any particular command (`man ls`)