Introduction

CIS 2230 Linux System Administration

Lecture 1

Steve Ruegsegger

Very first stuff

- About me
- About you
- About the course
  - Moodle
  - Syllabus
  - Calendar
  - Expectations – my view of course objective
  - Example lab 0
  - The best way to participate / prep for exams
- Lecture 2

Brief history of Unix

- 1940-1950 – *single* user machines – *single* process – huge in size
- 1960 – batch systems
  - Automated sequential processing
  - Time-consuming process of entering punch card, debugging, etc.
- MULTICS
  - *Multiplexed* Information and Computing Service
  - 1960s
  - MIT, AT&T Bell Labs, & GE – for-profit companies
  - experimental operating system
  - Key invention was time-sharing
    - Multiple processes sharing hardware resources

Brief history, cont'd

- UNICS
  - 1970's, AT&T
  - While MULTICS was HW specific, UNICS was meant to be "HW agnostic" – or run on various platforms
  - C language was developed and then the OS was rewritten to make it portable
  - AT&T, at first, shared with Universities, then began to protect their copyrights

"...the number of UNIX installations has grown to 10, with more expected..."
- Dennis Ritchie and Ken Thompson, June 1972

"... When BTL withdrew from the project, they needed to rewrite an operating system (OS) in order to play space war on another smaller machine (a DEC PDP-7 with 4K memory for user programs). The result was a system which a punning colleague called UNICS (Uniplexed Information and Computing Service)--an 'emasculated Multics'; no one recalls whose idea the change to UNIX was"

The Unix Philosophy

- Everything is a file
- Build small programs: One well-defined function and do it very well
- All programs accept input from stdin, write to stdout and stderr
- Pipes connect program IO like plumbing, data flows like "water"
- Strict separation between privileged (kernel) and user modes
- Programs share resources (time-slicing) governed by priorities
- Quote:
  - This is the Unix philosophy: Write programs that do one thing and do it well. Write programs to work together. Write programs to handle text streams, because that is a universal interface.
- This is usually abridged to
  - "Write programs that do one thing and do it well."

The UNIX breakup

- Late 1980s – two version of UNIX
  A. 4.3BSD -- UC Berkeley (free)
  B. System V Release 3 -- commercial

UC Berkeley
free
"BSD"

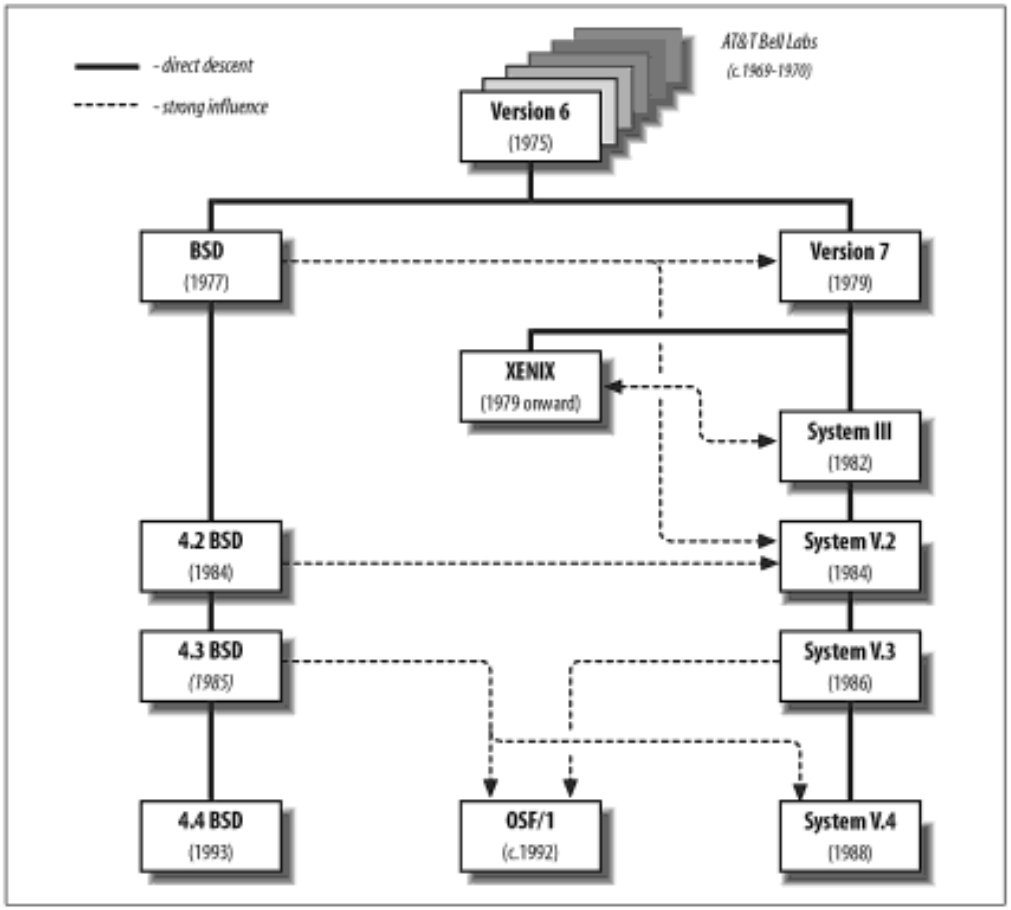
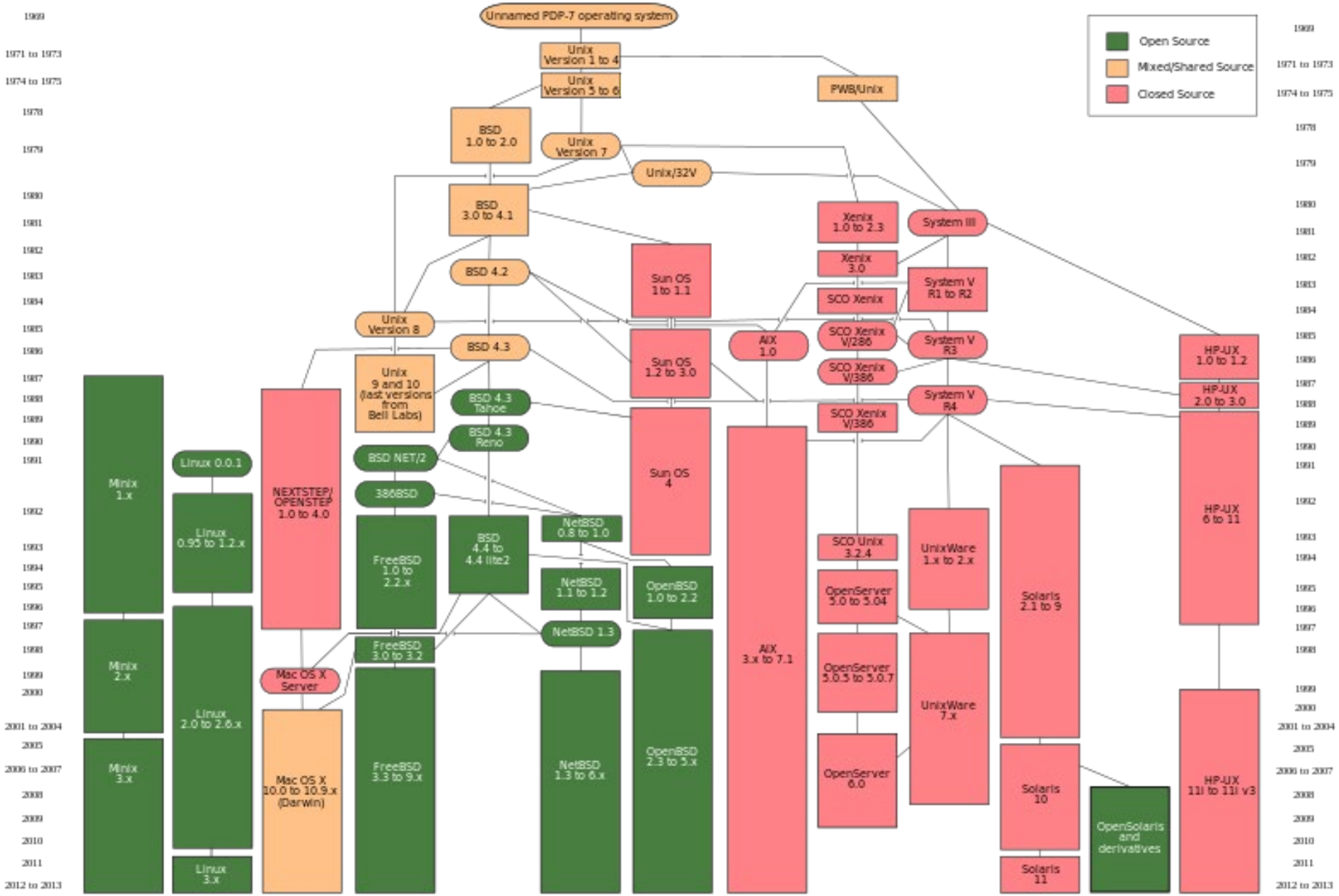


Figure P-1. Unix genealogy (simplified)

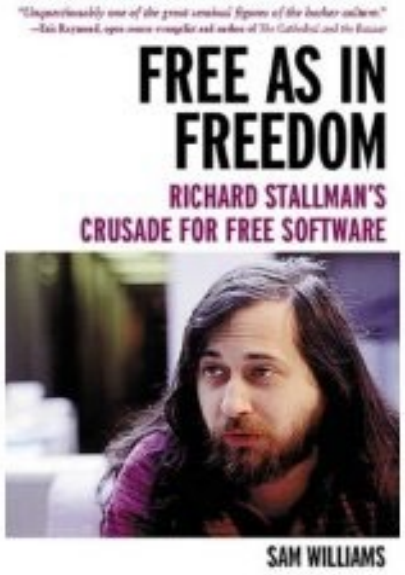
AT&T labs
commercial
"Sys V"

The Unix Wars



GNU project

- Established in 1984 – Richard Stallman
- “software should be free from restrictions of copying or modification in order to make better and efficient computer programs”
- He's frustrated that new, great ideas can't get into software
  - If they do, only the original company makes money
- Sees single-company monopoly as stifling quality; sees 'open' as promoting quality



GNU is a recursive acronym for “GNU's Not Unix”

Aim at developing a complete Unix-like operating system which is free for copying and modification

Stallman built the first free GNU C Compiler in 1991. But still, an OS was yet to be developed

Types of Licenses

- What is a Software license
  - Legal definition of who can use software and how it can be used
- "Typical" commercial copyright license
  - You cannot change or even distribute the IP
  - IP protected for commerce (i.e. $$$)
- GNU General Public License (GPL)
  - Author agrees to make source code available
  - Anyone is licensed to redistribute it in any form
  - Restrictions:
    - Cannot sell
    - Any modifications to the source code must also be licensed under the GPL
    - Credit to authors must be given
  - IP protected from commerce
  - Sometimes called **copyleft**

… History continued

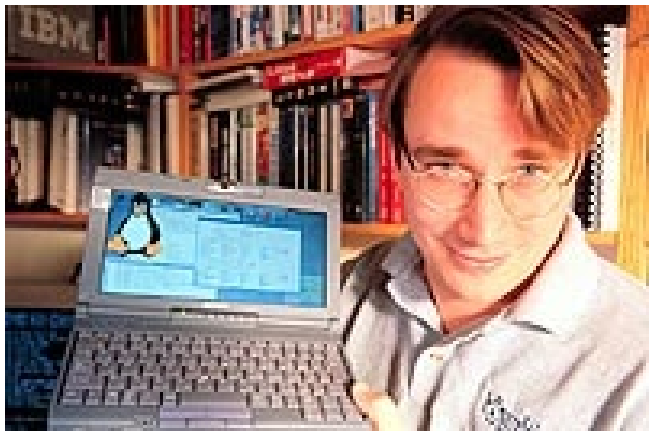
- MINIX
  - 1990s
  - Andrew Tanenbaum, professor in Holland
  - created a microkernel version of UNIX®
  - called MINIX (for minimal UNIX)
  - ran on small personal computers (80x86)
  - Kernel was *still copyrighted*
- Linux
  - Linus Torvalds @ U of Helsinki (Finland)
  - Personal project of writing a new kernel
    - Thought he'd replace the kernel in Minix and add new features
  - Posted on Usenet group
  - He put Linux under GNU General Public License (GPL).

Usenet post

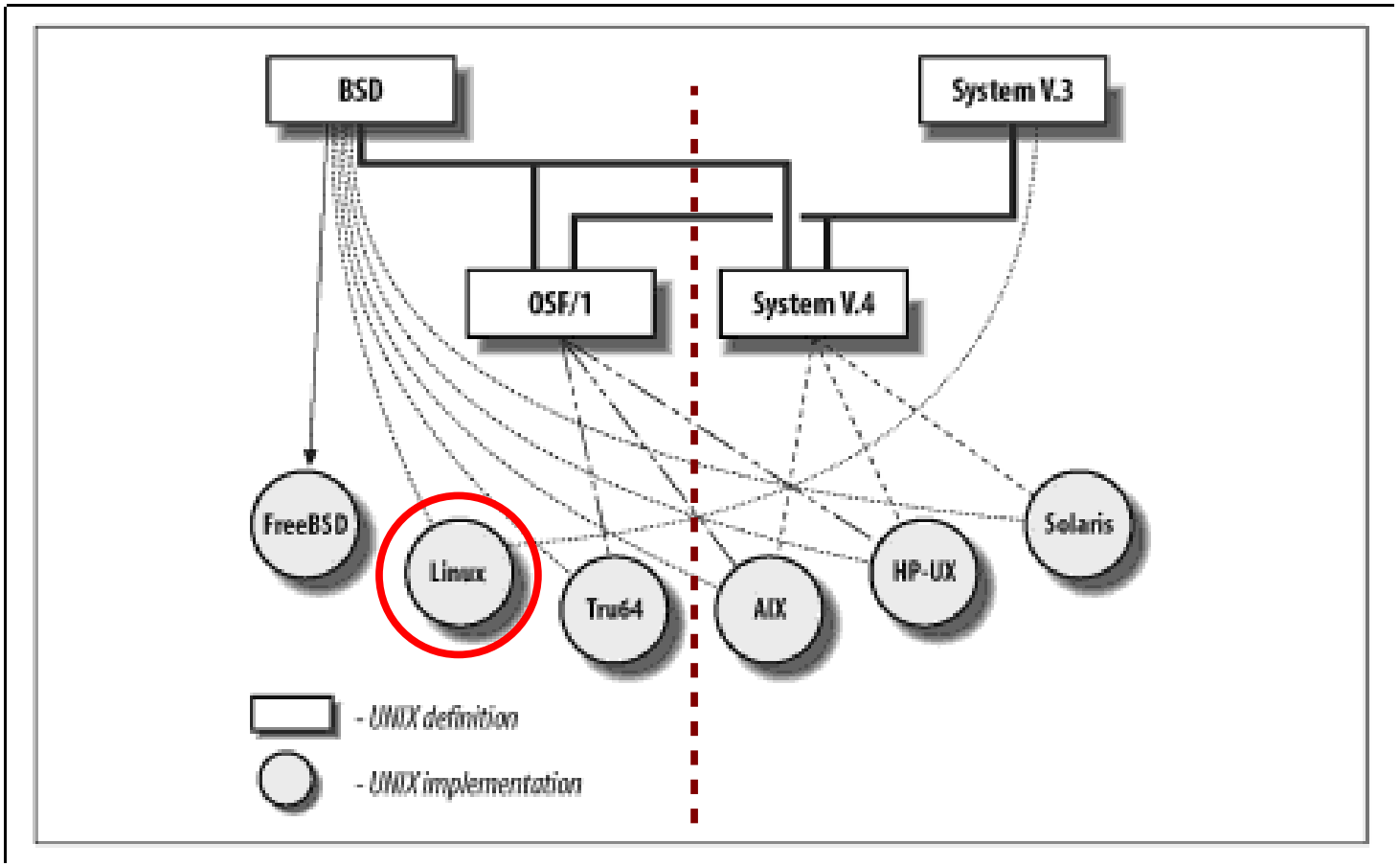
- In April 1991, Linus Torvalds, a 21-year-old student at the University of Helsinki, Finland started working on some simple ideas for an operating system. He started with a task switcher in Intel 80386 assembly language and a terminal driver. On 25 August 1991, Torvalds posted the following to comp.os.minix, a newsgroup on Usenet:

From: torvalds@klaava.Helsinki.FI (Linus Benedict Torvalds)
Newsgroups: comp.os.minix
Subject: What would you like to see most in minix?
Summary: small poll for my new operating system
Message-ID: <1991Aug25.205708.9541@klaava.Helsinki.FI>
Date: 25 Aug 91 20:57:08 GMT
Organization: University of Helsinki

Hello everybody out there using minix -
I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready.I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system(due to practical reasons) among other things). I've currently ported bash(1.08) and gcc(1.40),and things seem to work.This implies that I'll get something practical within a few months, andI'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)
Linus (torvalds@kruuna.helsinki.fi)
PS. Yes - it's free of any minix code, and it has a multi-threaded fs.
It is NOT protable (uses 386 task switching etc), and it probably never will support anything other than AT-harddisks, as that's all I have :-(.



These 2 flavors have really mixed their features



Focusing on Linux in this class, is great preparation for any flavor of Unix, even commercial versions

Linux Distributions

- Over 200 linux distributions:
- **Debian** (BSD)
  - **Ubuntu**
    - maintained by Canonical Ltd..
    - **Mint**, a distribution based on and compatible with Ubuntu.
    - **Kubuntu**, the KDE version of Ubuntu.
    - **Xubuntu** is the Xfce version of Ubuntu. (**Lubuntu** = LXDE version)
- **Fedora**, a community distribution sponsored by Red Hat (more System V)
    - **RHEL** – maintained and commercially supported by Red Hat.
    - **CentOS** – the 'free' unsupported version of RHEL
    - Oracle Enterprise Linux, which is a derivative of Red Hat Enterprise Linux, maintained and commercially supported by Oracle.
    - Mandriva, a Red Hat derivative popular in France and Brazil.
- **Gentoo**, a distribution targeted at power users
- **openSUSE**
  - Novell. (European)
  - SUSE Linux Enterprise, maintained and commercially supported by Novell.
- **Slackware**, 1993, and maintained by Patrick J. Volkerding.
- **Arch**

Operating System Components

- Major operating system components:
  - Kernel
  - Device drivers
  - Shell
  - Utility programs
  - Graphical user interface (GUI)

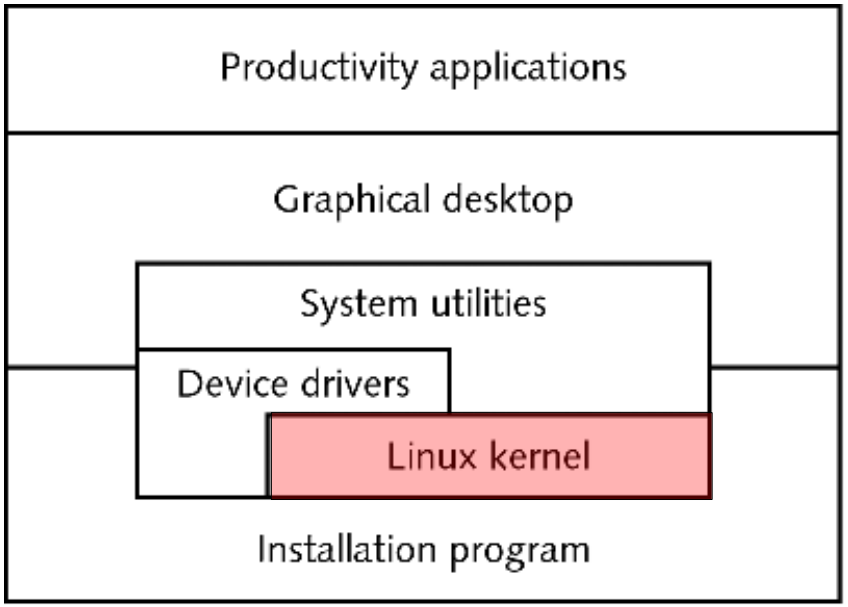
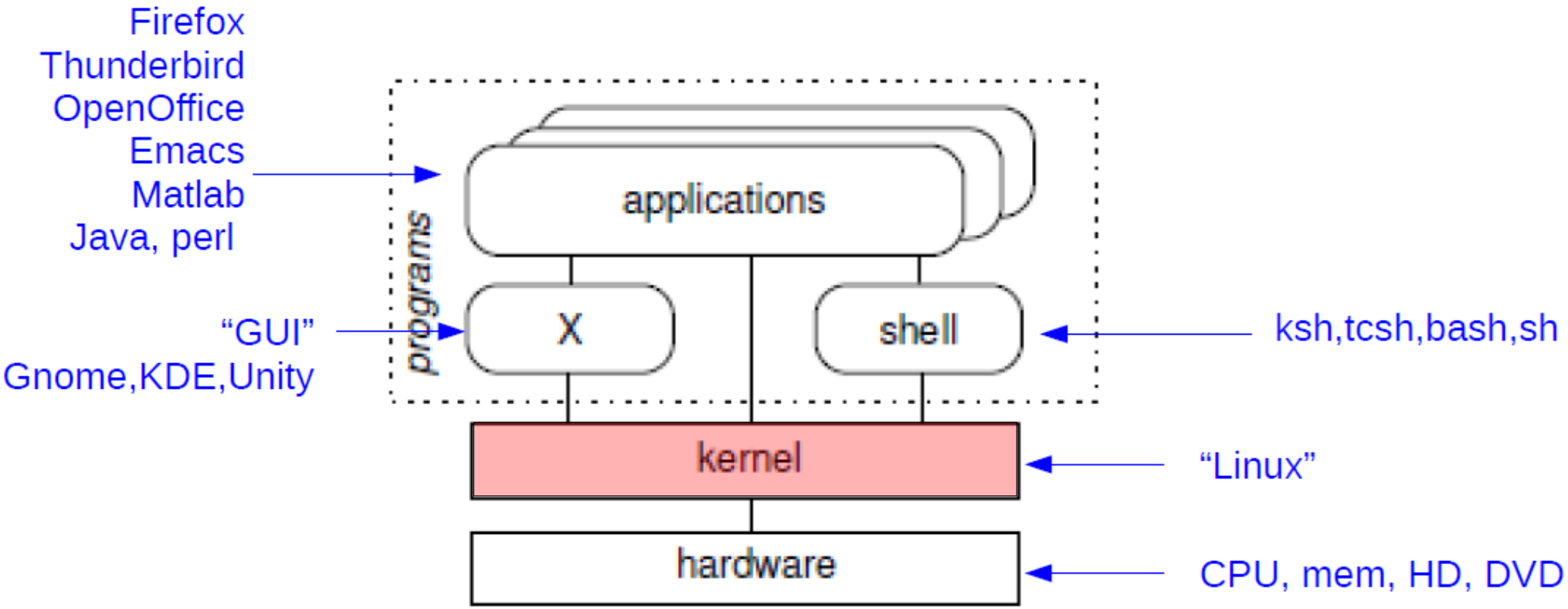
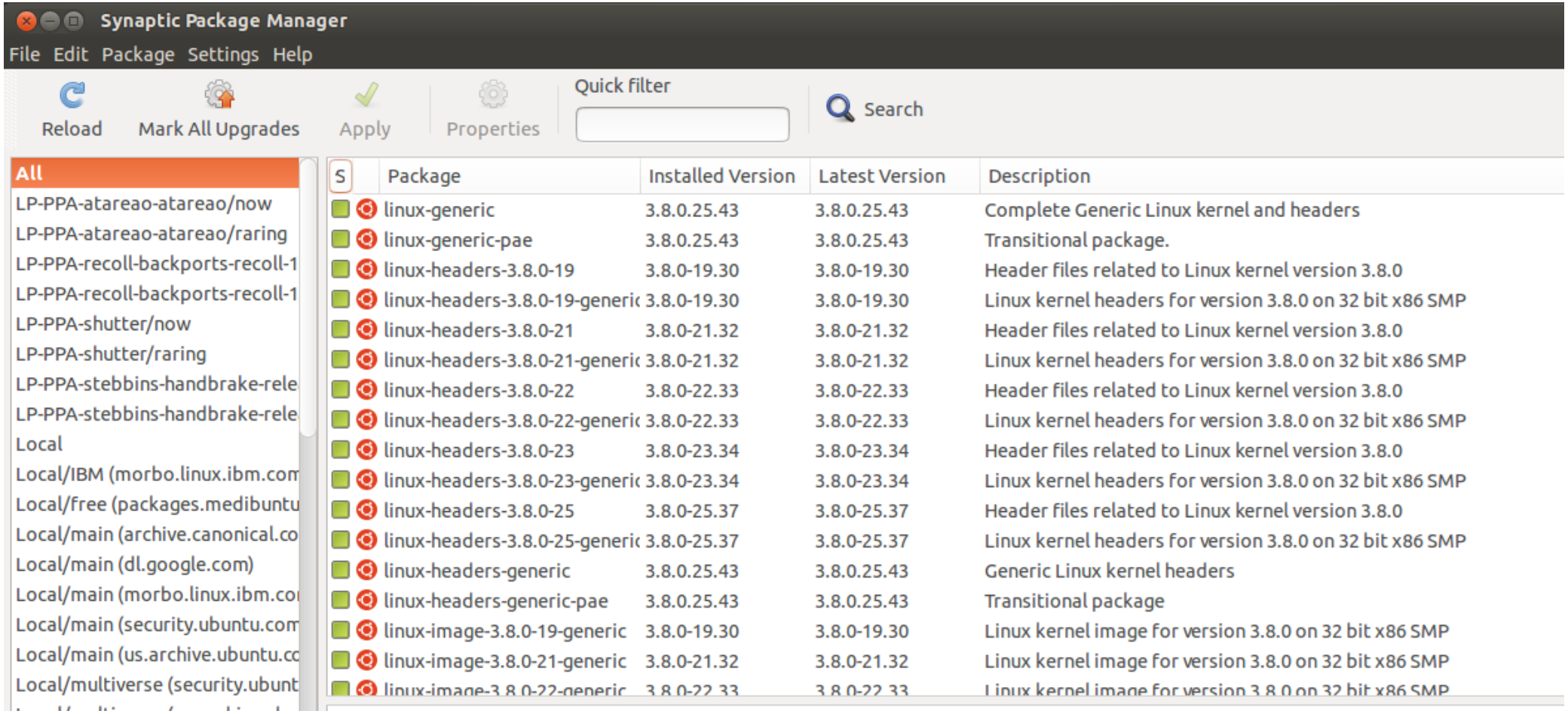


Figure 1-3 Many components together create a Linux distribution

Unix OS components



What part is “linux?”



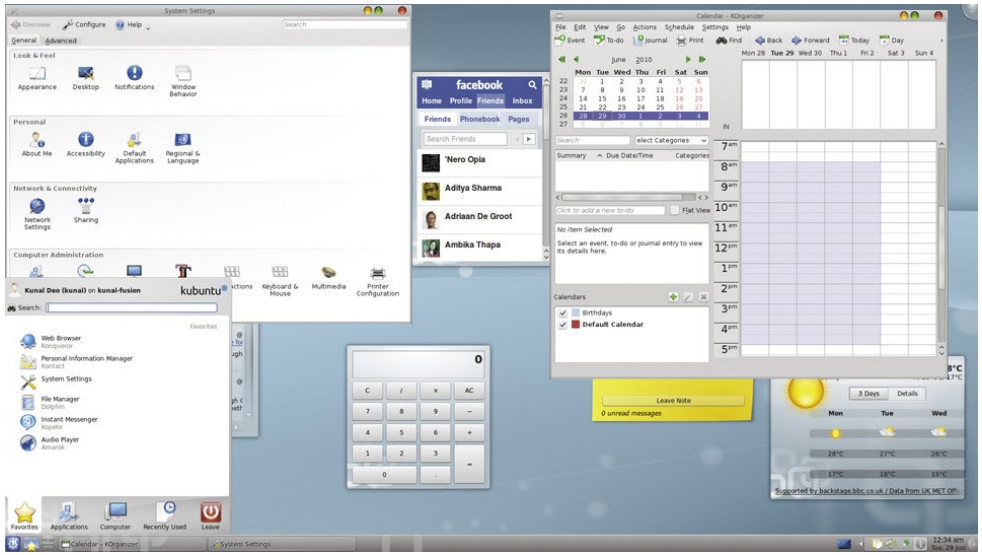
Graphical Environments

- Popular desktops
  - GNOME (2 & 3)
  - Unity
  - KDE (Plasma)
  - Xfce
  - LXDE
  - MATE
  - Enlightenment

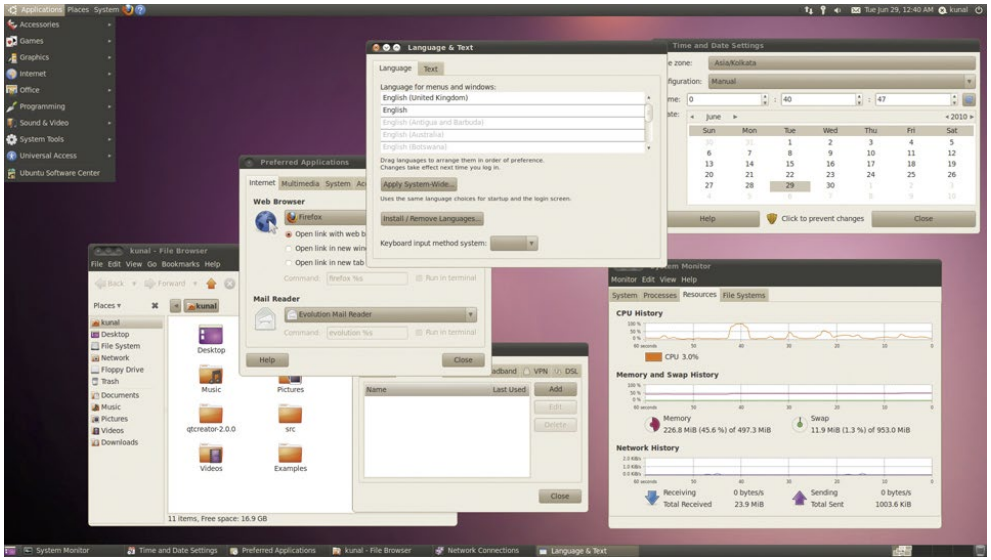
- Features
  - Main menu / Taskbar / Dashboard
  - Themes: Desktop icons / fonts / backgrounds
  - Multiple overlapping windows
  - Widgets

Different GUIs

- The GUI's simply provide the shell commands and outputs in a graphical format.
- For this class, we are not going to 'study' any particular GUI, but rather, focus on sys admin, mostly through command line and files.



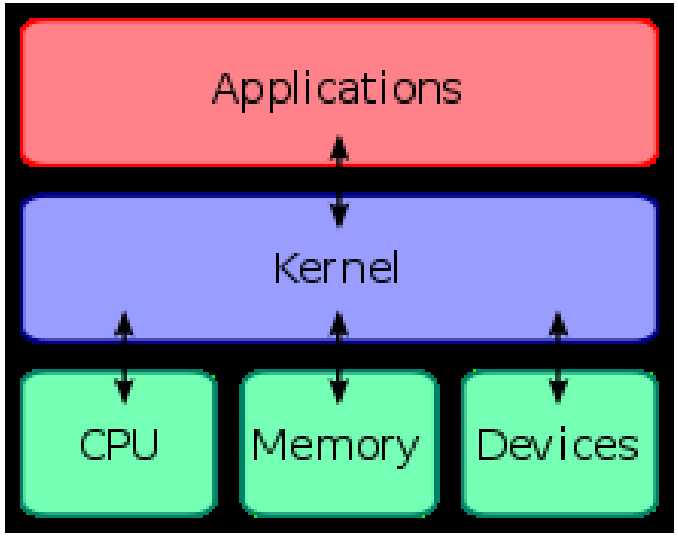
KDE Desktop



GNOME Desktop

Linux Kernel – What does it do?

- from German word “kern” which means nucleus or core
- It is a bridge
  - the communication *between* hardware and software components
- The kernel's primary function is to manage the computer's resources
- Allows other programs to run and use these resources efficiently
- If a computer feels sluggish – it might be the kernel not managing the resources well



Liunux Kernel Hardware Requirements

- Can run on *very minimal* hardware – Woo Hoo!
- Recommend that computer have minimum of:
  - 500MB of free disk space
  - 64 MB of RAM
- Most computers today have 100's of GB of disk space and 4-8 GB of RAM.
- Computers from 1990's run linux well.

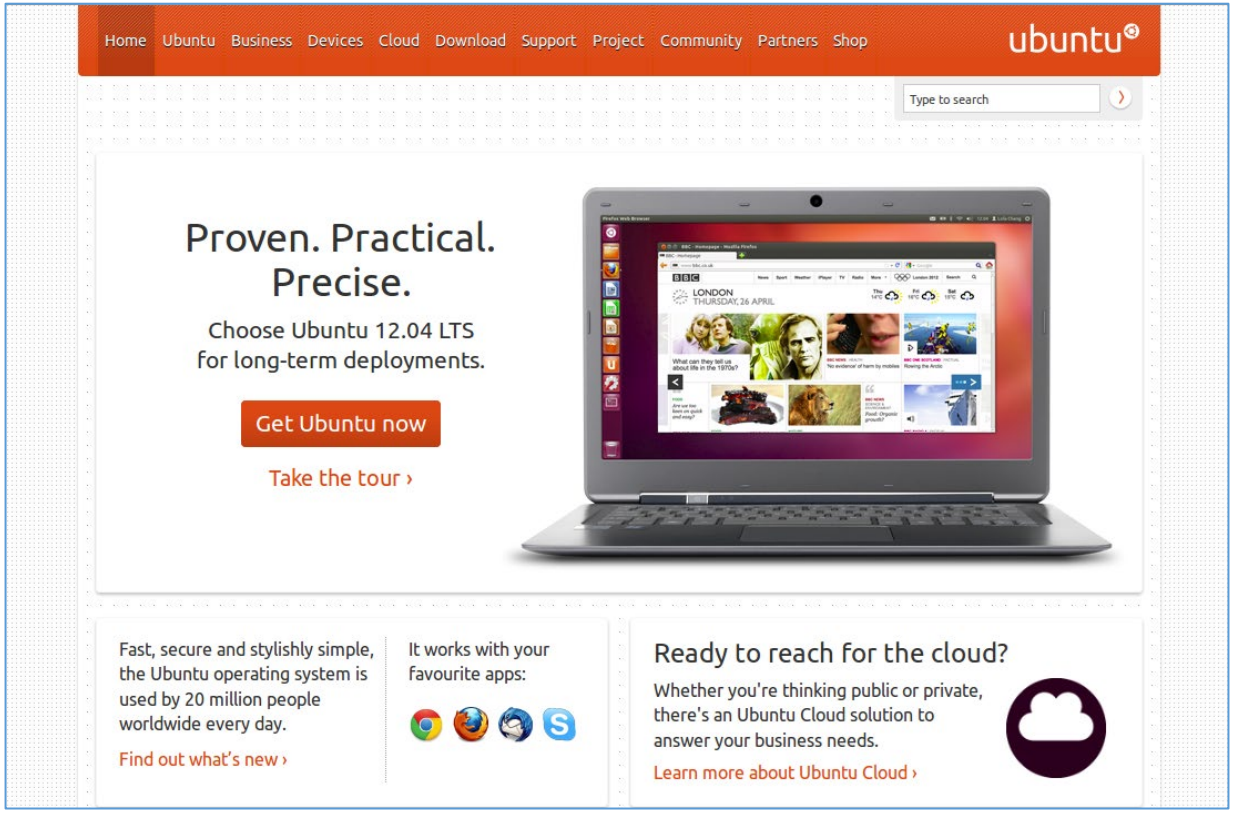
Kernel Version Numbering

- Each kernel released numbered based on the changes in that release
  - a.b.c-d --> “kernel.major.minor-patch”
  - Kernel v3 released early 2012
  - Kernel v4 released early 2015
  - `$ uname -r`

```
steve@ubuntu:~$ uname -r
4.2.0-16-generic
steve@ubuntu:~$
```

Ubuntu Linux Distro

- Canonical Ltd. is a private company
- founded (and funded) by South African entrepreneur (billionaire) Mark Shuttleworth
- Why?
- Its main offices are in London, its support office in Montreal, Massachusetts and Taiwan



Ubuntu releases

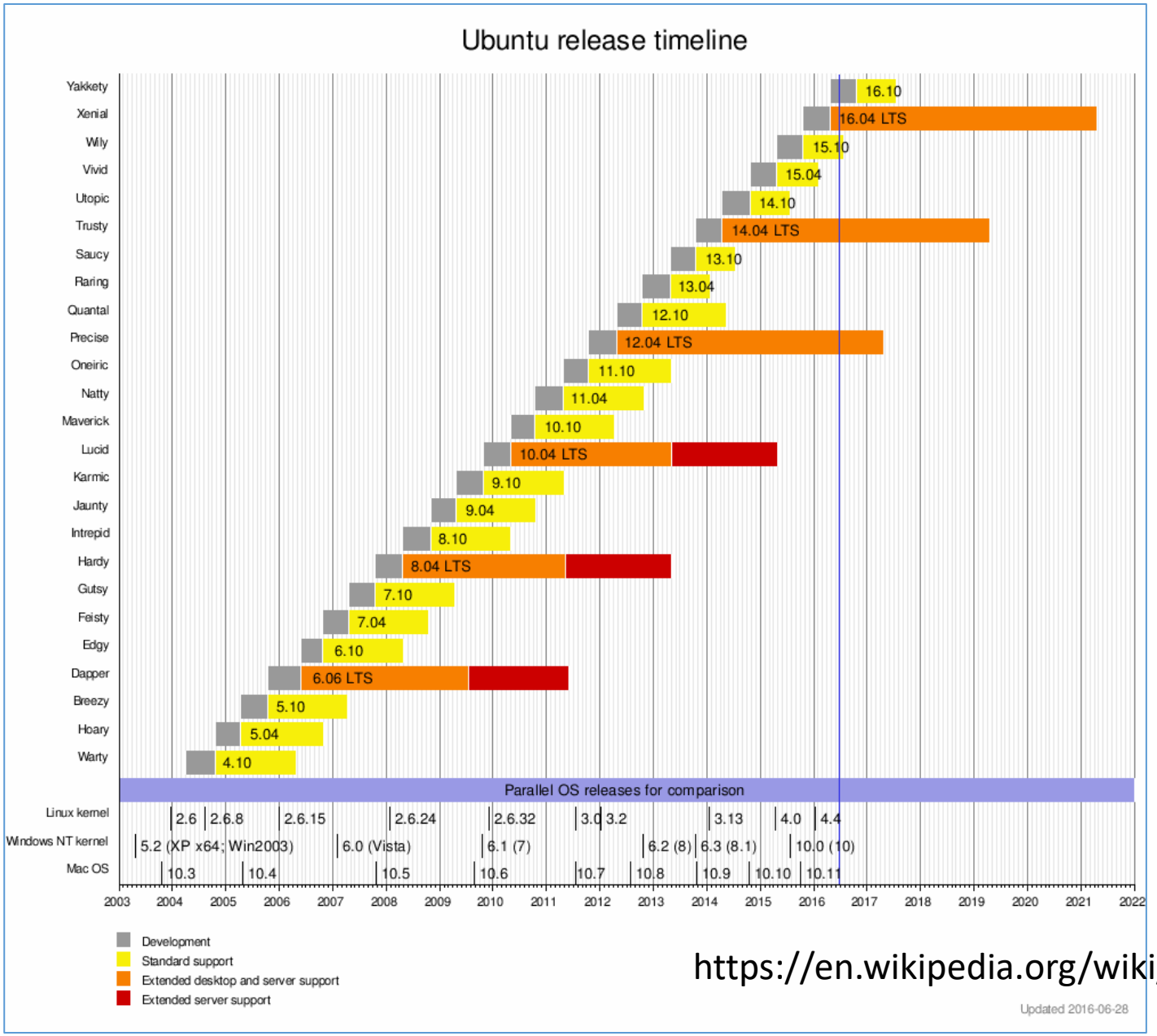
- What patterns do you notice?
- What is LTS?
- 17.04 – Zesty Zapus
- 17.10 – Artful Aardvark
- 18.04 LTS - ?

https://wiki.ubuntu.com/DevelopmentCodeNames

Version	Code name	Release date	Supported until		Kernel version
			Desktops	Servers	
4.10	Warty Warthog	2004-10-20	2006-04-30		2.6.8
5.04	Hoary Hedgehog	2005-04-08	2006-10-31		2.6.10
5.10	Breezy Badger	2005-10-13	2007-04-13		2.6.12
6.06 LTS	Dapper Drake	2006-06-01	2009-07-14	2011-06-01	2.6.15
6.10	Edgy Eft	2006-10-26	2008-04-25		2.6.17
7.04	Feisty Fawn	2007-04-19	2008-10-19		2.6.20
7.10	Gutsy Gibbon	2007-10-18	2009-04-18		2.6.22
8.04 LTS	Hardy Heron	2008-04-24	2011-05-12	2013-05-09	2.6.24
8.10	Intrepid Ibex	2008-10-30	2010-04-30		2.6.27
9.04	Jaunty Jackalope	2009-04-23	2010-10-23		2.6.28
9.10	Karmic Koala	2009-10-29	2011-04-30		2.6.31
10.04 LTS	Lucid Lynx	2010-04-29	2013-05-09	2015-04-30	2.6.32
10.10	Maverick Meerkat	2010-10-10	2012-04-10		2.6.35
11.04	Natty Narwhal	2011-04-28	2012-10-28		2.6.38
11.10	Oneiric Ocelot	2011-10-13	2013-05-09		3.0.0
12.04 LTS	Precise Pangolin	2012-04-26[252]	2017-04-26[142]		3.2.0[253]
12.10	Quantal Quetzal	2012-10-18	2014-05-16[254]		3.5.0[255]
13.04	Raring Ringtail	2013-04-25	2014-01-27[8]		3.8.0[256]
13.10	Saucy Salamander	2013-10-17[257]	2014-07-17[190]		3.11.0
14.04 LTS	Trusty Tahr	2014-04-17[194]	2019-04		3.13.0[258]
14.10	Utopic Unicorn	2014-10-23[209]	2015-07-23[259]		3.16.0[260]
15.04	Vivid Vervet	2015-04-23[217]	2016-02-04[261]		3.19[262]
15.10	Wily Werewolf	2015-10-22[228]	2016-07		4.2[263]
16.04 LTS	Xenial Xerus	2016-04-21[236]	**2021-04**		4.4[264]
16.10	Yakkety Yak	2016-10-20	2017-07		4.4+

Legend: Old version | Older version, still supported | **Latest version** | Future release

Ubuntu releases

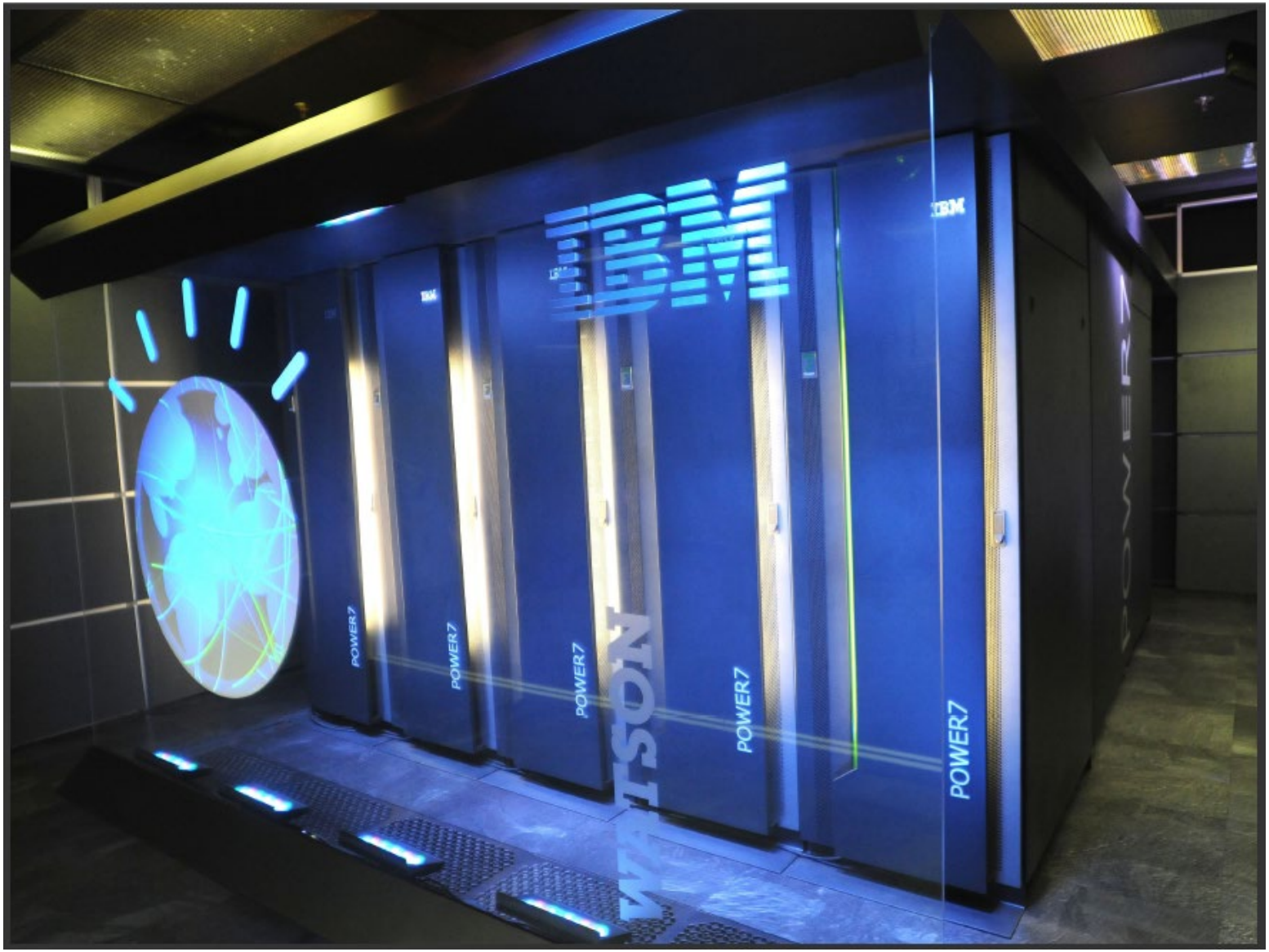


https://en.wikipedia.org/wiki/List_of_Ubuntu_releases

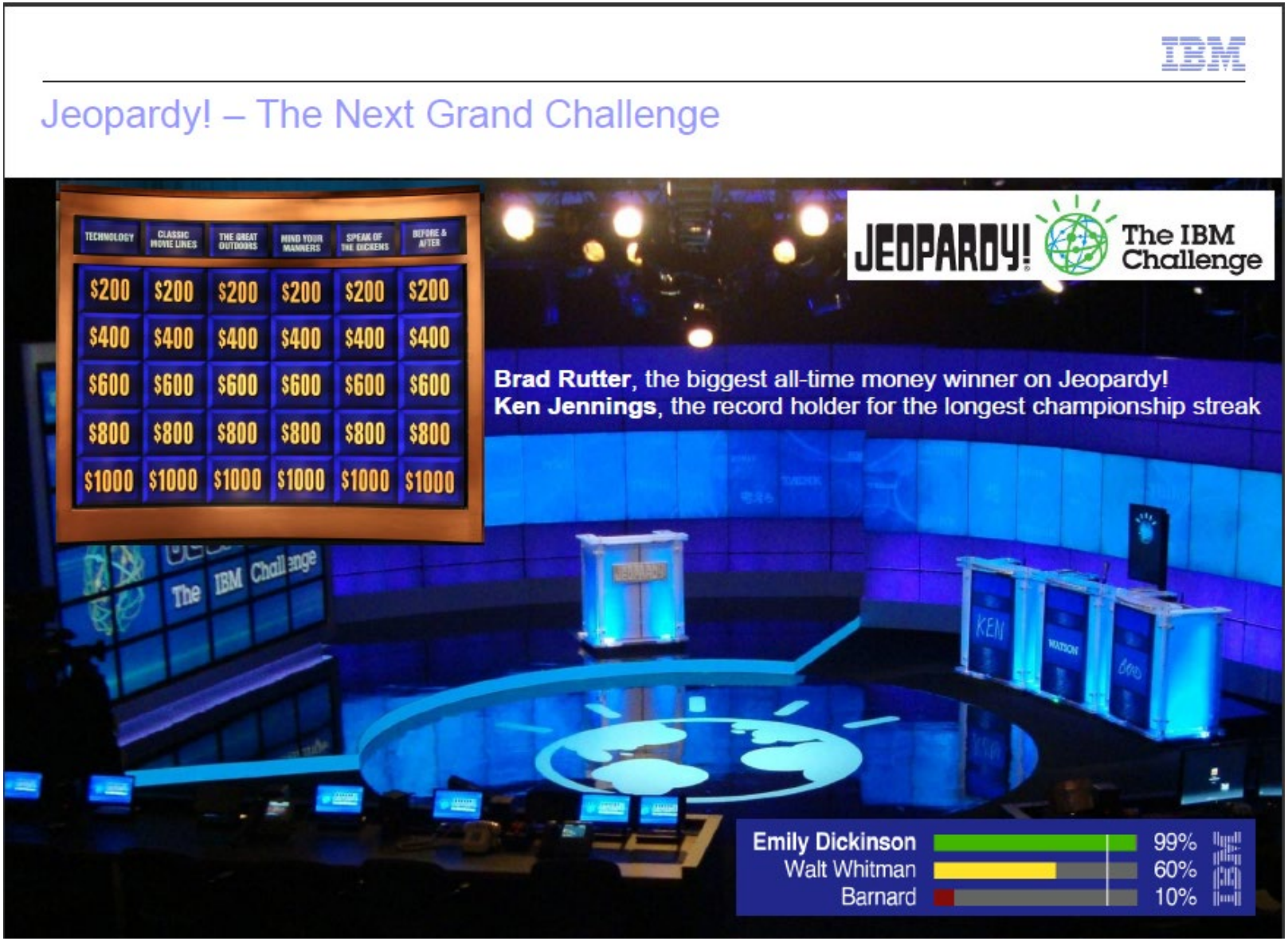
Careers in Linux

- System administrator
- Network administrator
- Software engineer
- Trainer
- Technical writer
- Product marketing
- Business consultant

Linux has 'grown up'



Watson runs Linux



Watson runs Linux

IBM

"Baking" Watson
by Dr. David Ferrucci

Ingredients:
90 IBM POWER p750™ Express servers in 9 racks
(10th rack for 10 GB Ethernet networking equipment)
each p750 with 4 x 'octo'-core chips
provides in total 2880 POWER7 cores
with max. 11520 parallel threads (per 4-way SMT)
P7 chips of p750 Express runs with 3.55 GHz
results in ~ 80 teraFLOPS (10^{12} – trillion floating point ops / sec)
<would have been 94th in Top500 HPC list at that time>
16 TB memory and 4 TB clustered storage
Linux Platform (Novell SUSE)
IBM standard software: InfoSphere DataWarehouse,
Cognos, SPSS, IBM Omnifind (Text Analytics and UIMA)
IBM Content Analytics
IBM 'secret' sauce: DeepQA

Cooking devices:
A bowl - size 100 m^2 - double floor
80 KwH power
Cabling
20 tons of cooling devices
200 million pages of information

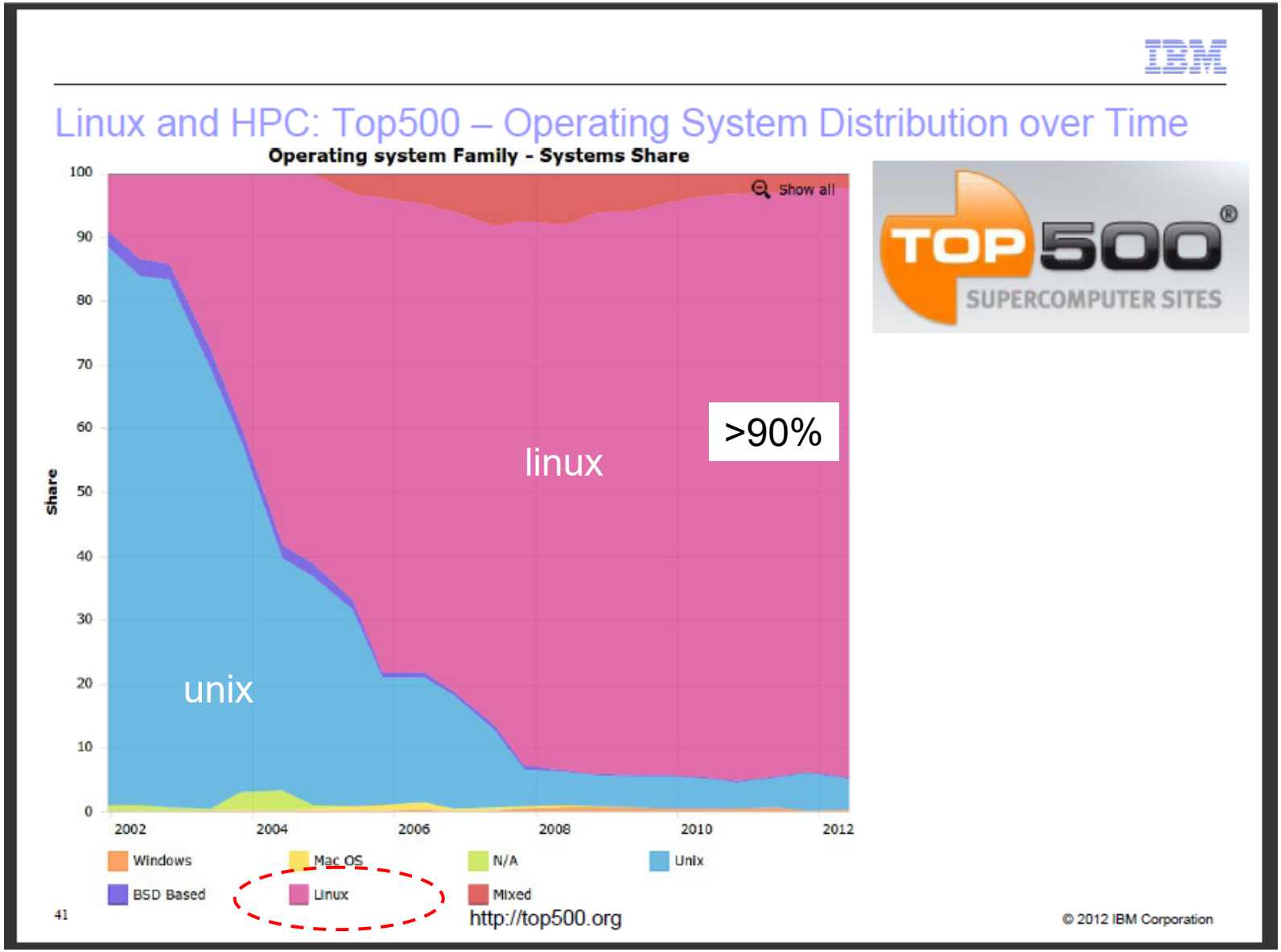
Cooking guidelines:
Apply 25 scientists and have them cautiously and patiently blend the ingredients. Continuously flavor, test and adjust the dish to perfect the result!

Time estimate: 4 years

38

http://www.research.ibm.com/deepqa/principal_investigator.shtml

Top 500 supercomputers



More recently

IBM Teams With Canonical To Put Ubuntu Linux On Mainframes

Posted Aug 16, 2015 by Ron Miller (@ron_miller)

5,940 SHARES

IBM makes biggest ever commitment to Linux

no comment *Richard Wilson* *21st August 2015* *Get news by email*

Open source software is set to dominate the enterprise server market, says IBM.

Fifteen years after first running Linux on a mainframe, IBM said it is now ready to contribute "the single largest amount of mainframe code to open source community."

"We are betting big on open source in the enterprise," said IBM which has introduced two Linux mainframe servers.

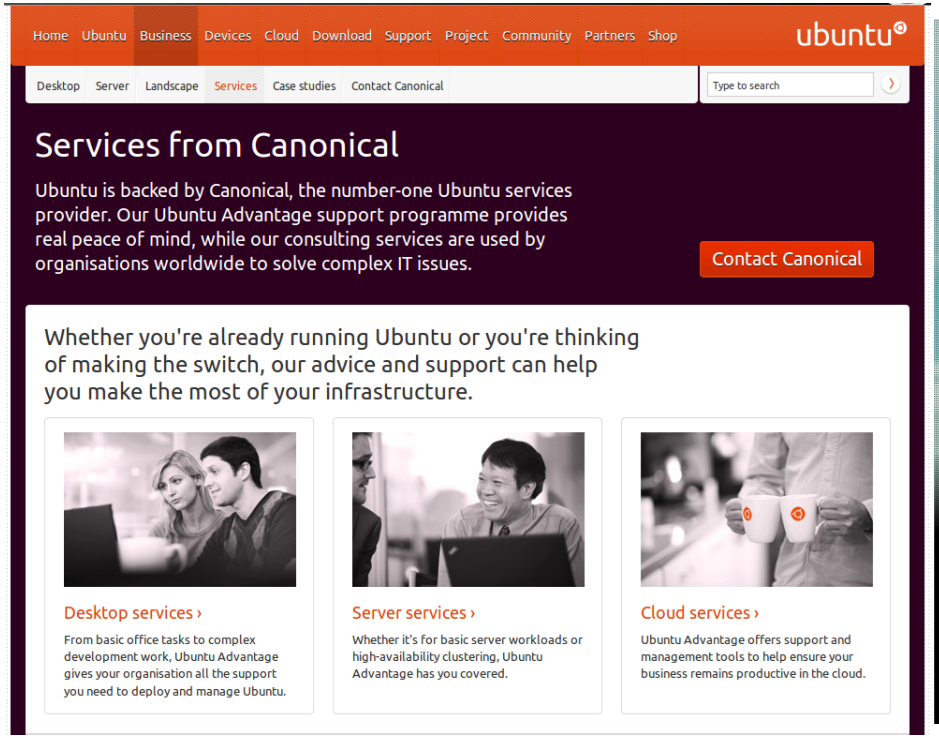
IBM is also working with Canonical to create an Ubuntu distribution for the new Linux servers called LinuxONE and the z Systems cloud computing platform.

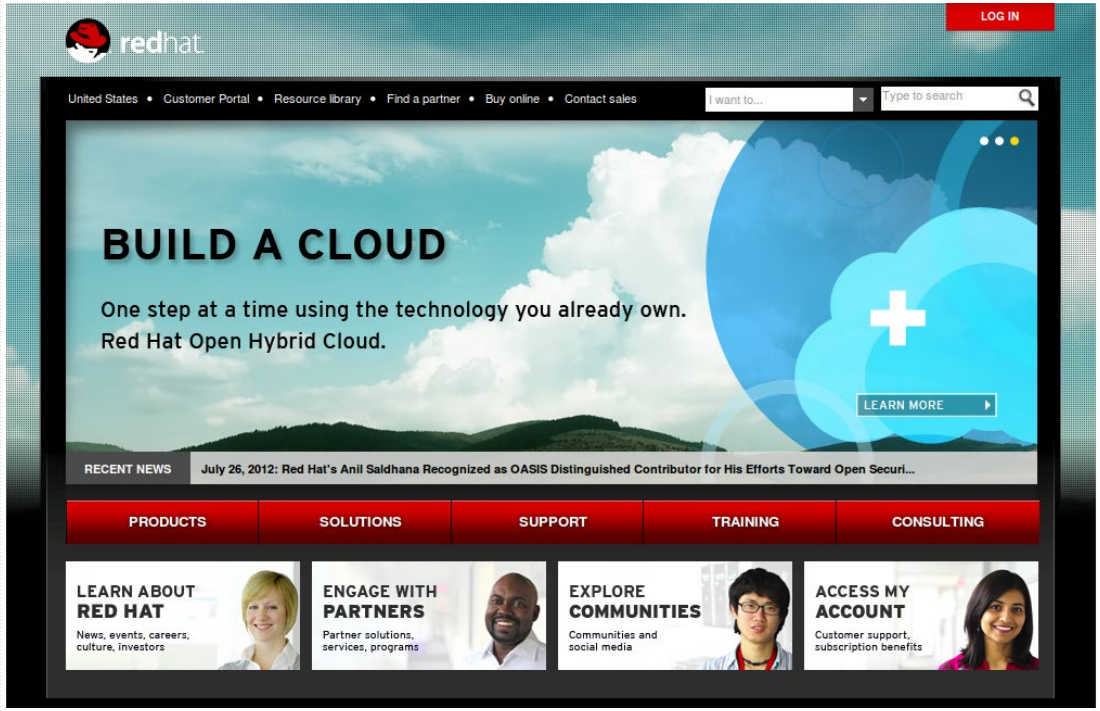
Question to you:

- How do Linux companies make money?
- I mean, Linux is free

How do Linux companies make money?

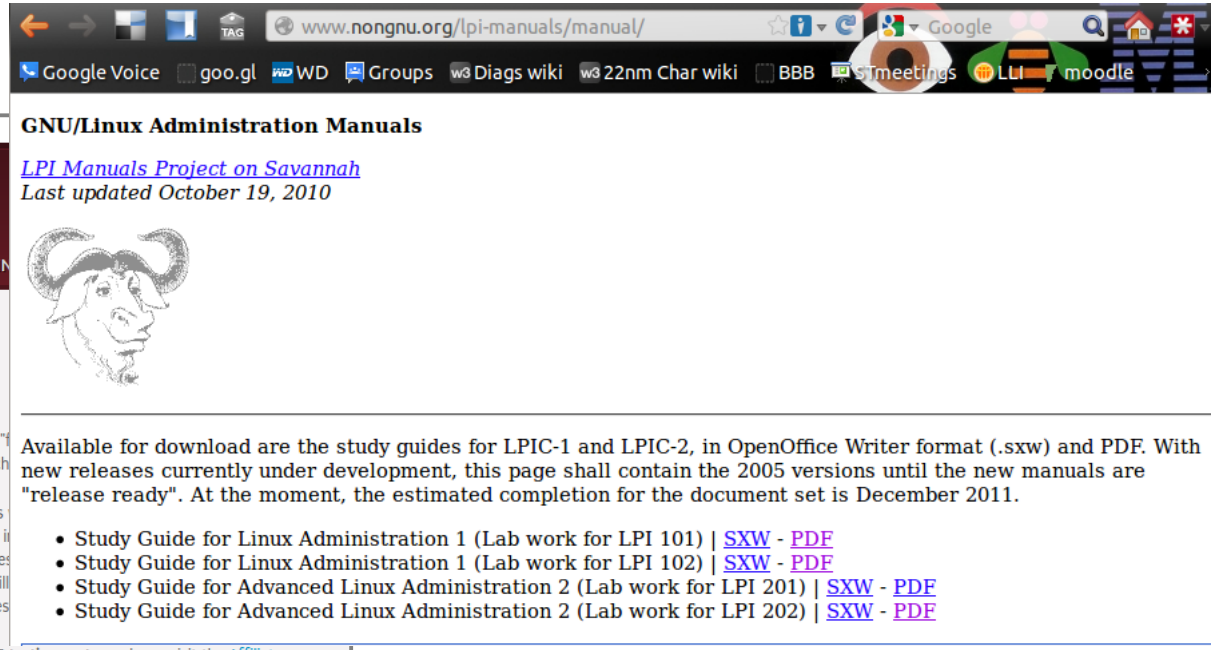
- "Give away the razor, make money on the blades"
- Answer: ***Enterprise services***
- Same as all freeware: Google Search, Gmail, Dropbox (5G)
- Canonical (Ubuntu) and Red Hat



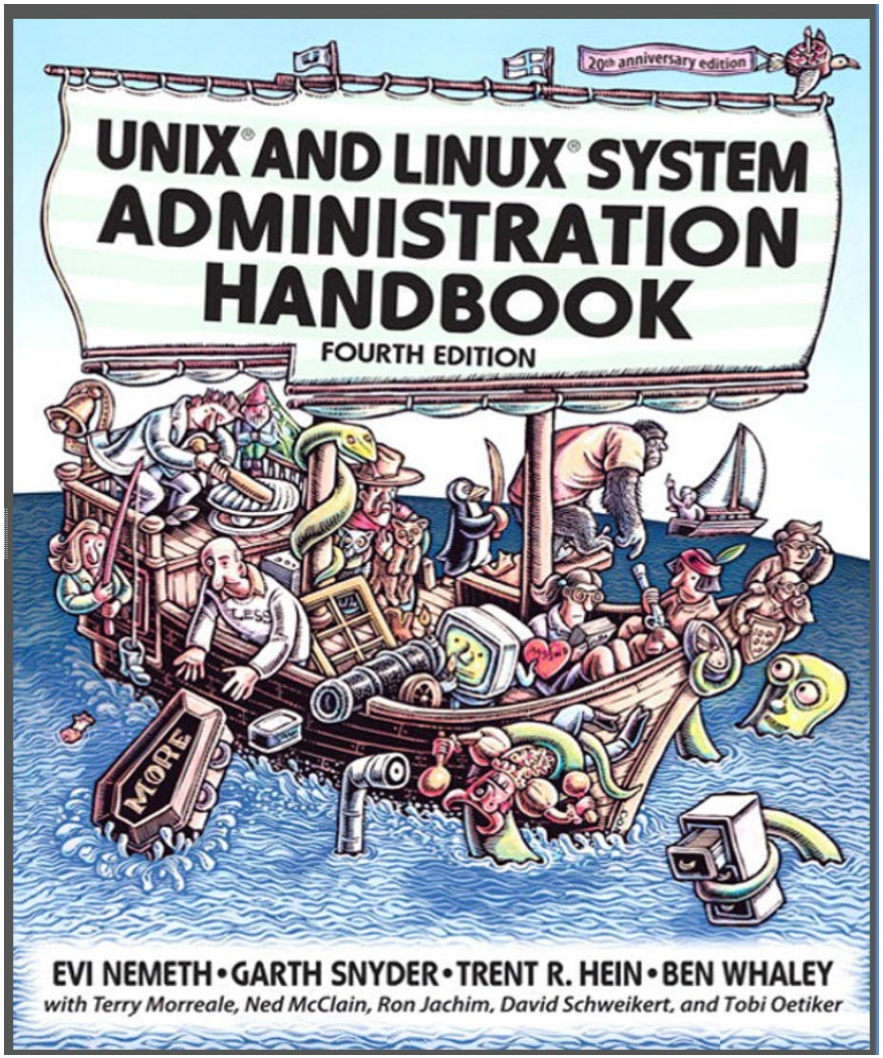


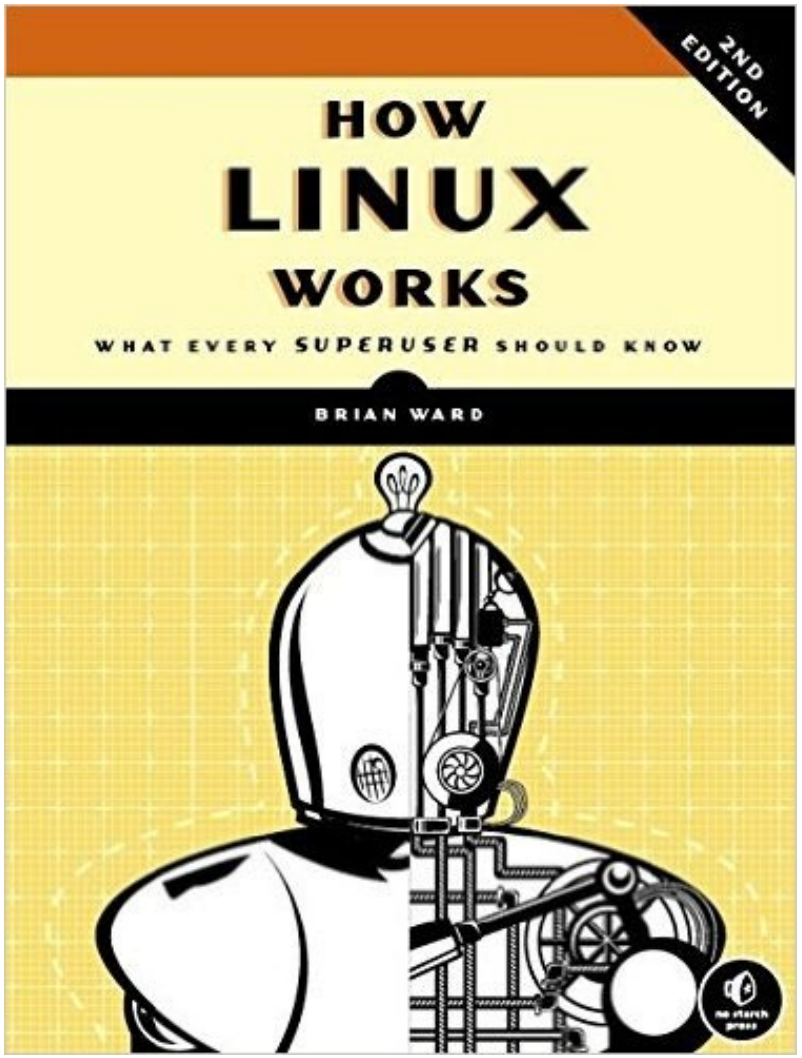
Linux Standards

- LPI – Linux Professional Institute
  - http://www.lpi.org, http://wiki.lpi.org
  - Intro level: “Linux Essentials”
  - Professional levels: LPIC-1 – 3
- Training courses in PDF
  - http://www.nongnu.org/lpi-manuals/manual/



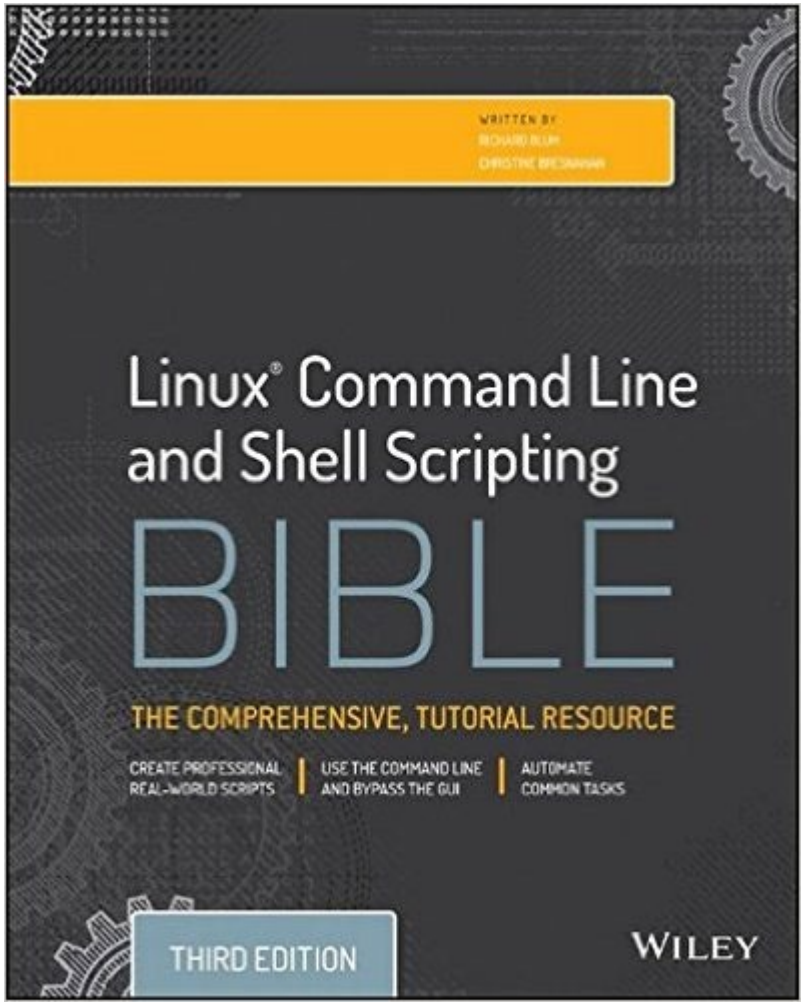
My favorite books right now



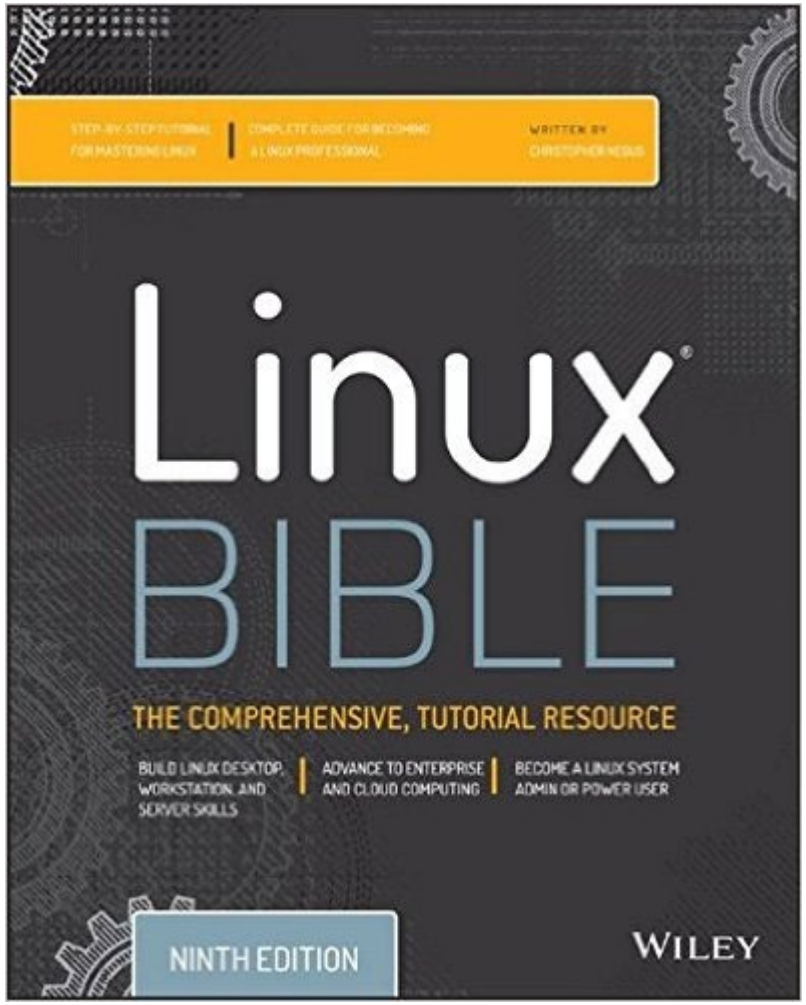


Another set of Favorite books

Great for this Intro course

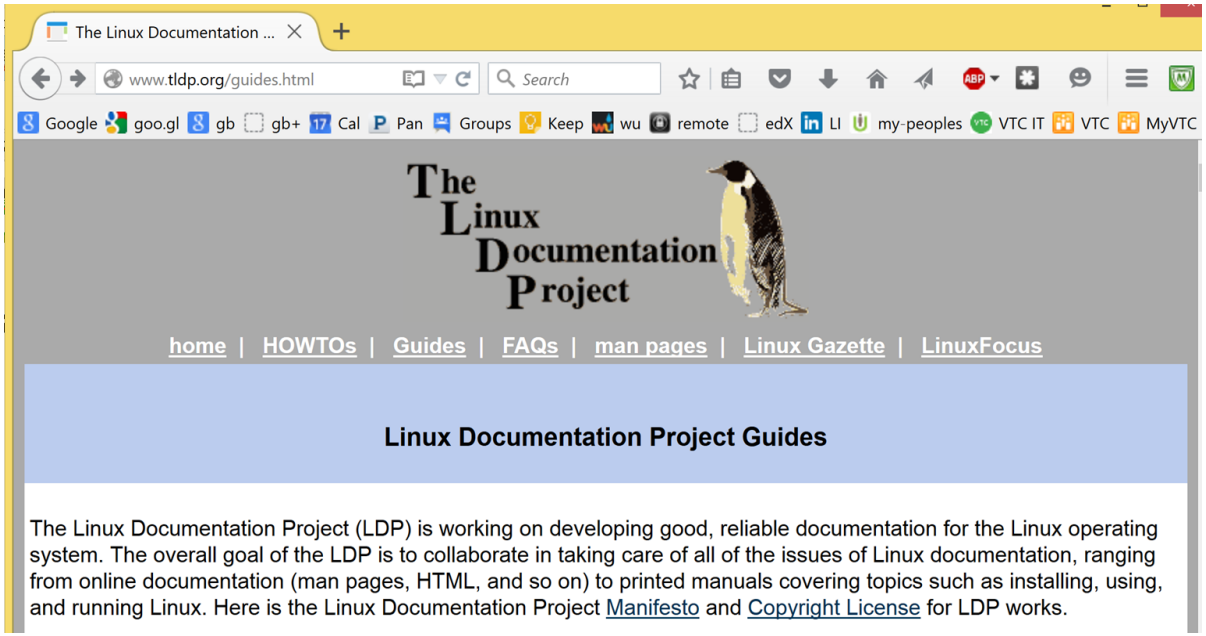


Great for the Adv course



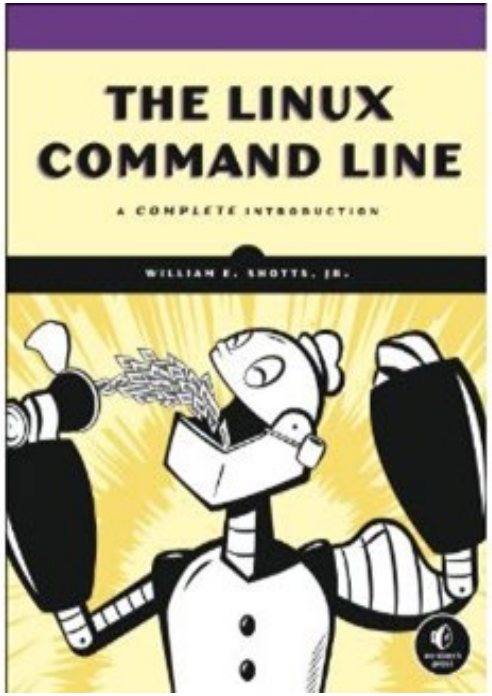
An online text

- TLDP – The Linux Documentation Project
- Recommended Guides:
  `http://www.tldp.org/guides.html`
  - Bash Guide for Beginners
  - Advanced Bash-Scripting Guide ★
  - Introduction to Linux - A Hands on Guide
  - The Linux System Administrators' Guide ★



Another one of our texts

- TLCL – the linux command line
- Free on-line. Or order it.
- Focuses on the commands, not the GUI or apps
- http://linuxcommand.org



The Linux Command Line

A Book By William Shotts

Second Internet Edition Available Now!

Designed for the new command line user, this 537-page volume covers the same material as LinuxCommand.org but in much greater detail. In addition to the basics of command line use and shell scripting, *The Linux Command Line* includes chapters on many common programs used on the command line, as well as more advanced topics.

- **Released under a Creative Commons license, this book is available for free download in PDF format.** Download it here.
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