

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"

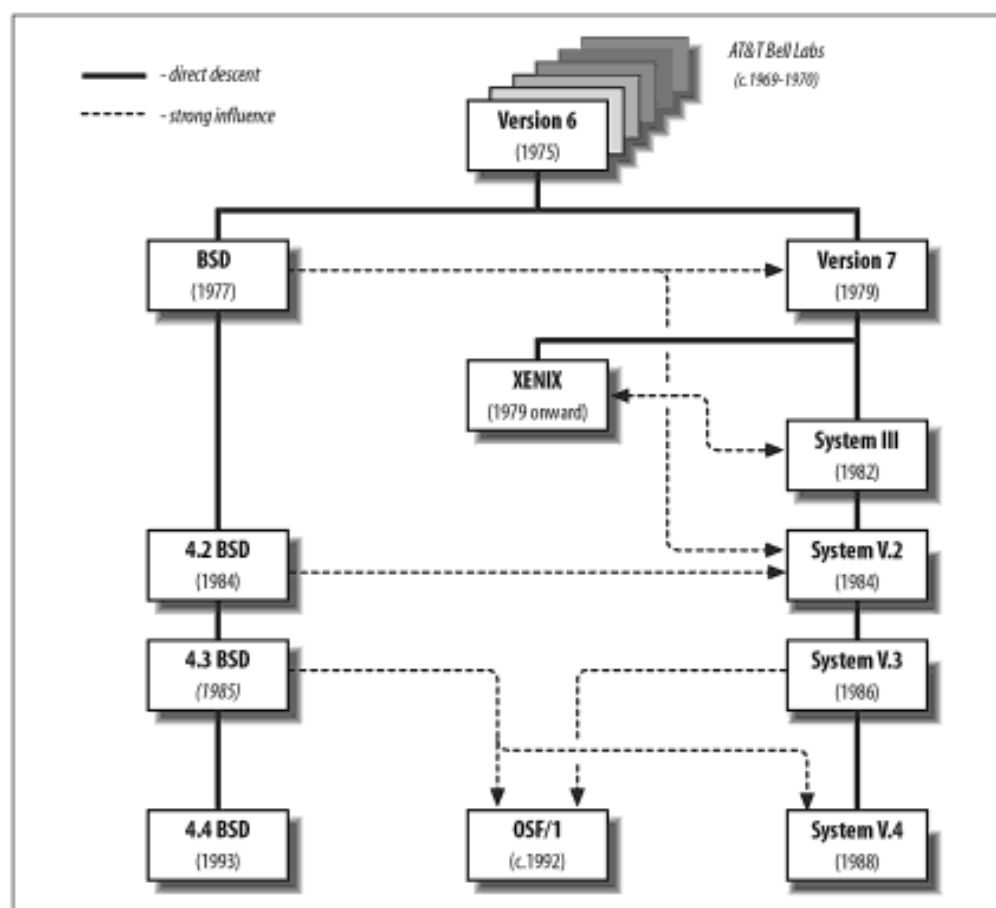
The Unix Philosophy

- 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

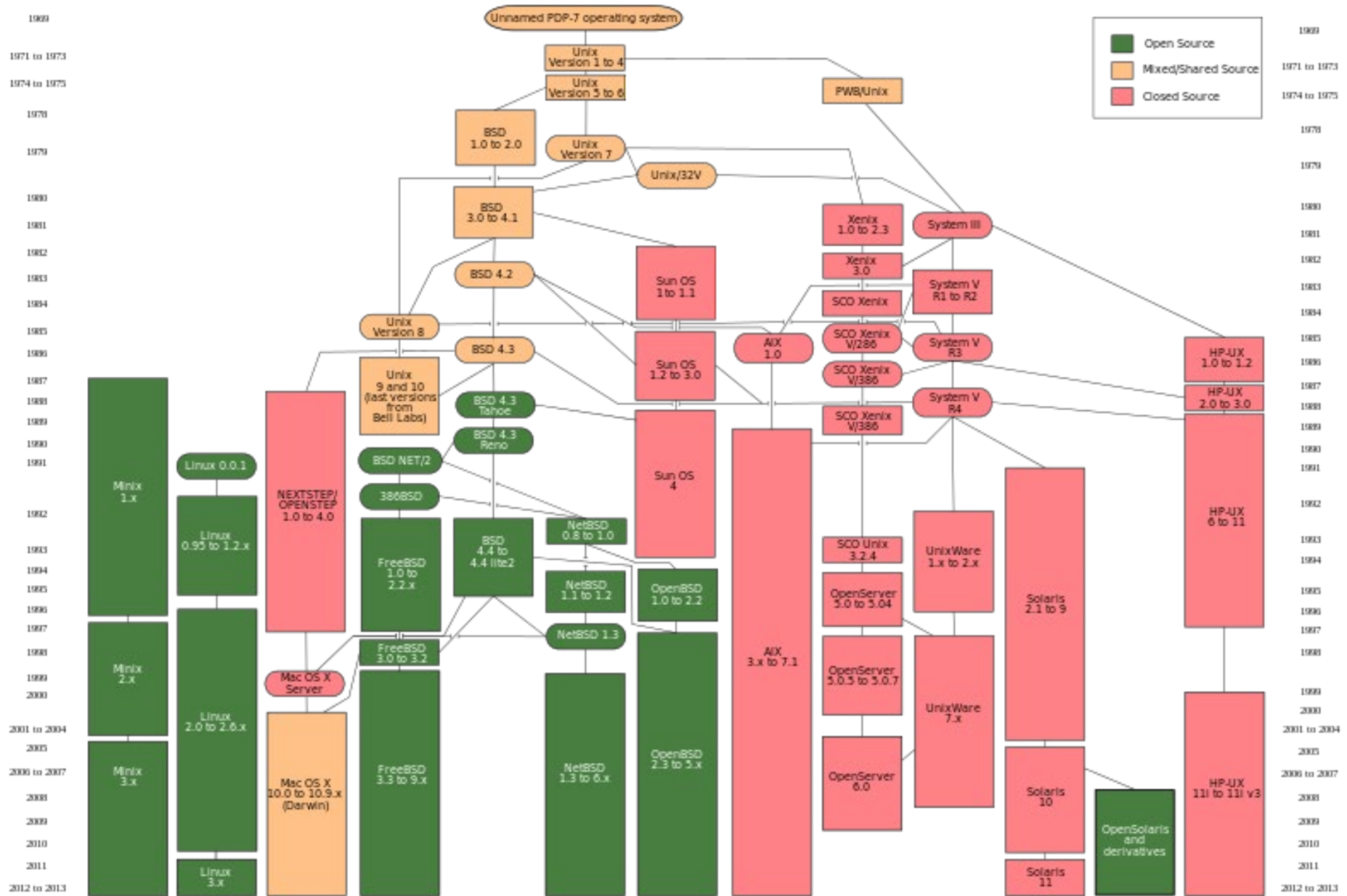
UC Berkeley
free
“BSD”



AT&T labs
commercial
“Sys V”

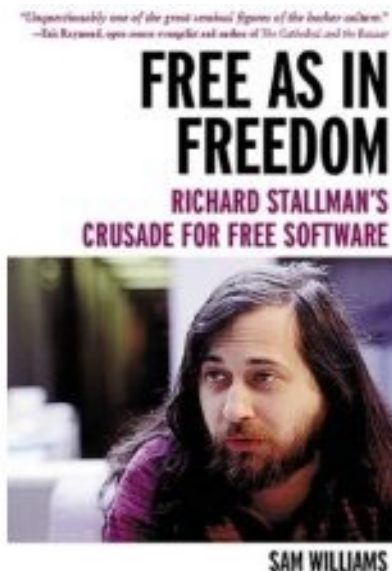
Figure P-1. Unix genealogy (simplified)

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

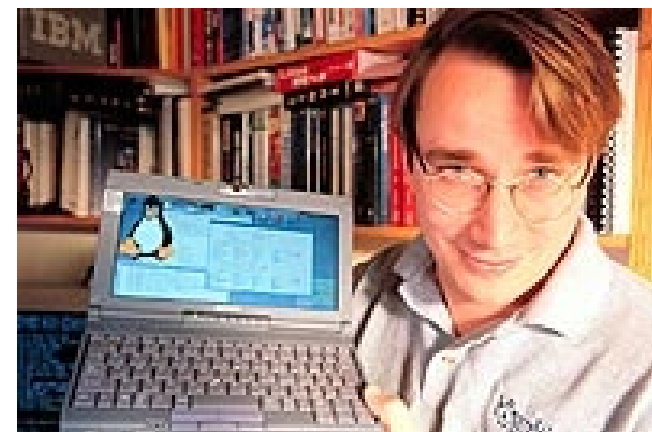
- In April 1991, Linus Torvalds, a 21-year-old student at the University of Helsinki, Finland started working on some simple ideas for an operating system. He started with a task switcher in Intel 80386 assembly language and a terminal driver. On 25 August 1991, Torvalds posted the following to comp.os.minix,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

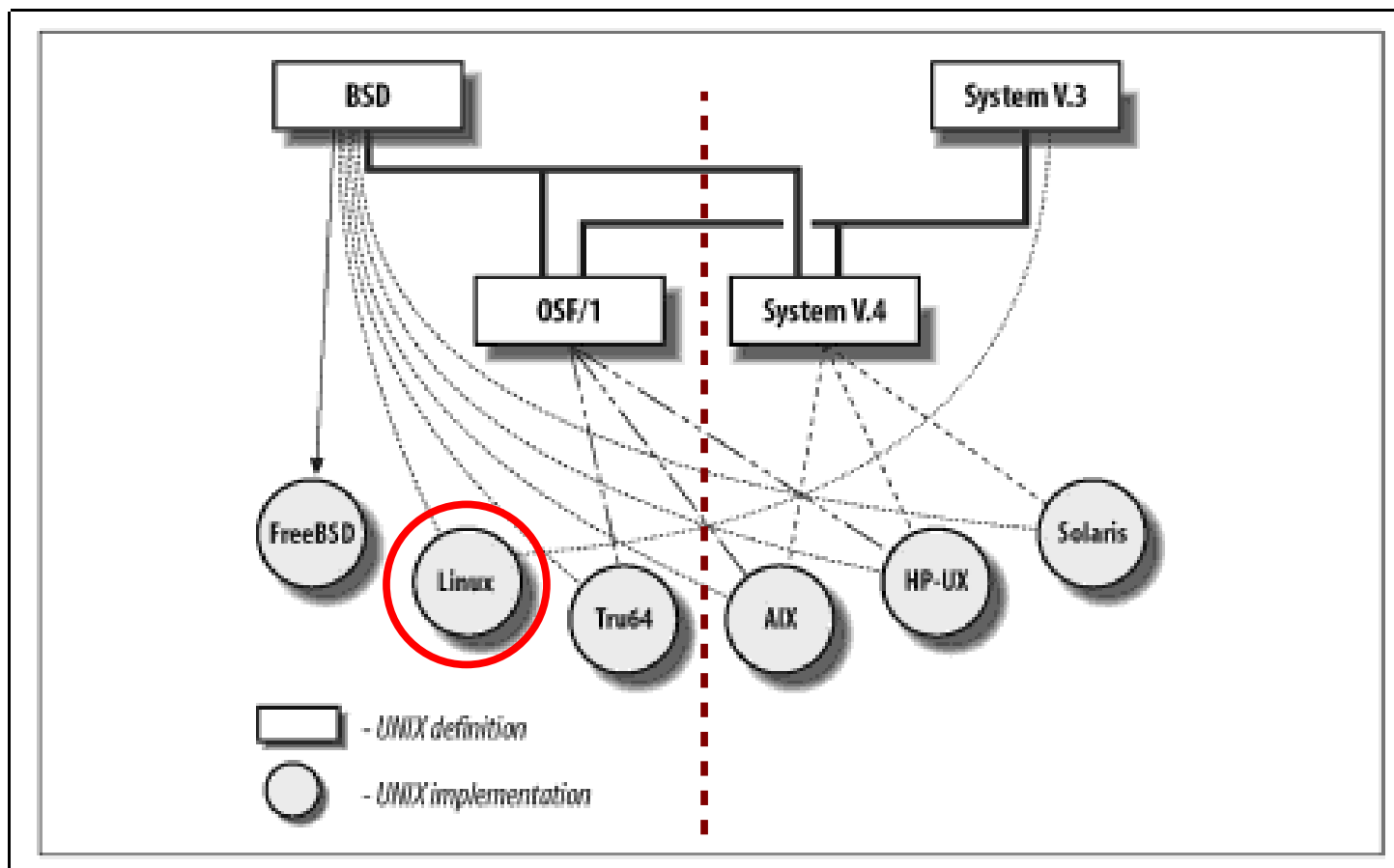
Hello everybody out there using minix -
I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles 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, and I'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)

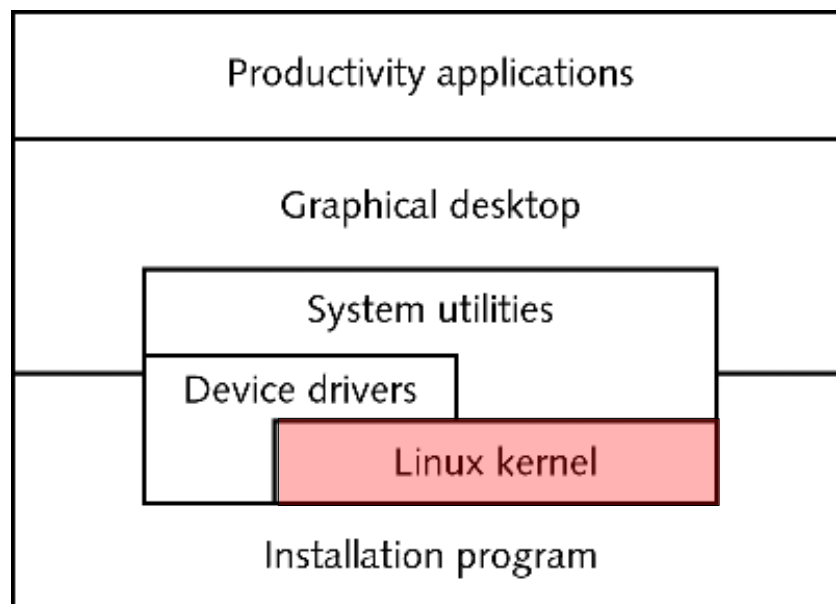
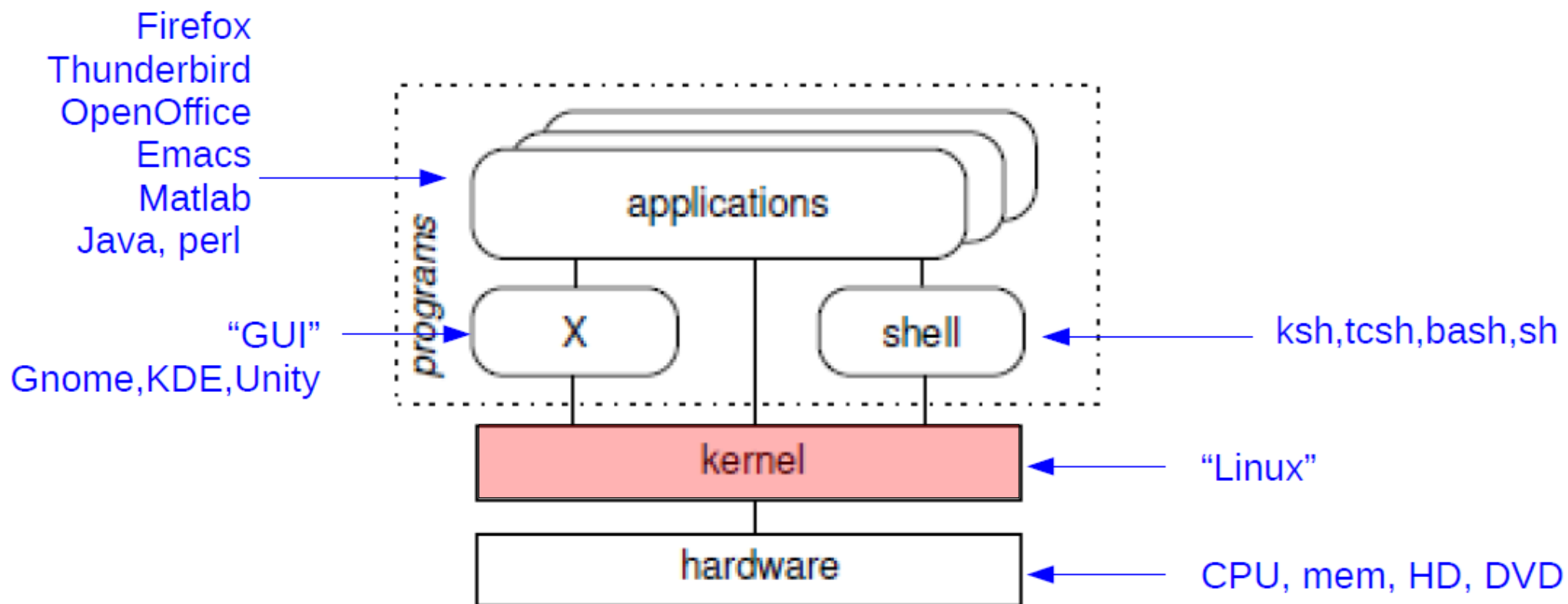


Figure 1-3 Many components together create a Linux distribution

Unix OS components



What part is “linux?”

Synaptic Package Manager

File Edit Package Settings Help

Reload Mark All Upgrades Apply Properties Quick filter Search

All	S	Package	Installed Version	Latest Version	Description
LP-PPA-atareao-atareao/now		linux-generic	3.8.0.25.43	3.8.0.25.43	Complete Generic Linux kernel and headers
LP-PPA-atareao-atareao/raring		linux-generic-pae	3.8.0.25.43	3.8.0.25.43	Transitional package.
LP-PPA-recoll-backports-recoll-1		linux-headers-3.8.0-19	3.8.0-19.30	3.8.0-19.30	Header files related to Linux kernel version 3.8.0
LP-PPA-recoll-backports-recoll-1		linux-headers-3.8.0-19-generic	3.8.0-19.30	3.8.0-19.30	Linux kernel headers for version 3.8.0 on 32 bit x86 SMP
LP-PPA-shutter/now		linux-headers-3.8.0-21	3.8.0-21.32	3.8.0-21.32	Header files related to Linux kernel version 3.8.0
LP-PPA-shutter/raring		linux-headers-3.8.0-21-generic	3.8.0-21.32	3.8.0-21.32	Linux kernel headers for version 3.8.0 on 32 bit x86 SMP
LP-PPA-stebbins-handbrake-rele		linux-headers-3.8.0-22	3.8.0-22.33	3.8.0-22.33	Header files related to Linux kernel version 3.8.0
LP-PPA-stebbins-handbrake-rele		linux-headers-3.8.0-22-generic	3.8.0-22.33	3.8.0-22.33	Linux kernel headers for version 3.8.0 on 32 bit x86 SMP
Local		linux-headers-3.8.0-23	3.8.0-23.34	3.8.0-23.34	Header files related to Linux kernel version 3.8.0
Local/IBM (morbo.linux.ibm.com)		linux-headers-3.8.0-23-generic	3.8.0-23.34	3.8.0-23.34	Linux kernel headers for version 3.8.0 on 32 bit x86 SMP
Local/free (packages.medibuntu)		linux-headers-3.8.0-25	3.8.0-25.37	3.8.0-25.37	Header files related to Linux kernel version 3.8.0
Local/main (archive.canonical.co)		linux-headers-3.8.0-25-generic	3.8.0-25.37	3.8.0-25.37	Linux kernel headers for version 3.8.0 on 32 bit x86 SMP
Local/main (dl.google.com)		linux-headers-generic	3.8.0.25.43	3.8.0.25.43	Generic Linux kernel headers
Local/main (morbo.linux.ibm.co)		linux-headers-generic-pae	3.8.0.25.43	3.8.0.25.43	Transitional package
Local/main (security.ubuntu.com)		linux-image-3.8.0-19-generic	3.8.0-19.30	3.8.0-19.30	Linux kernel image for version 3.8.0 on 32 bit x86 SMP
Local/main (us.archive.ubuntu.co)		linux-image-3.8.0-21-generic	3.8.0-21.32	3.8.0-21.32	Linux kernel image for version 3.8.0 on 32 bit x86 SMP
Local/multiverse (security.ubuntu)		linux-image-3.8.0-22-generic	3.8.0-22.33	3.8.0-22.33	Linux kernel image for version 3.8.0 on 32 bit x86 SMP

Graphical Environments

- Popular desktops

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

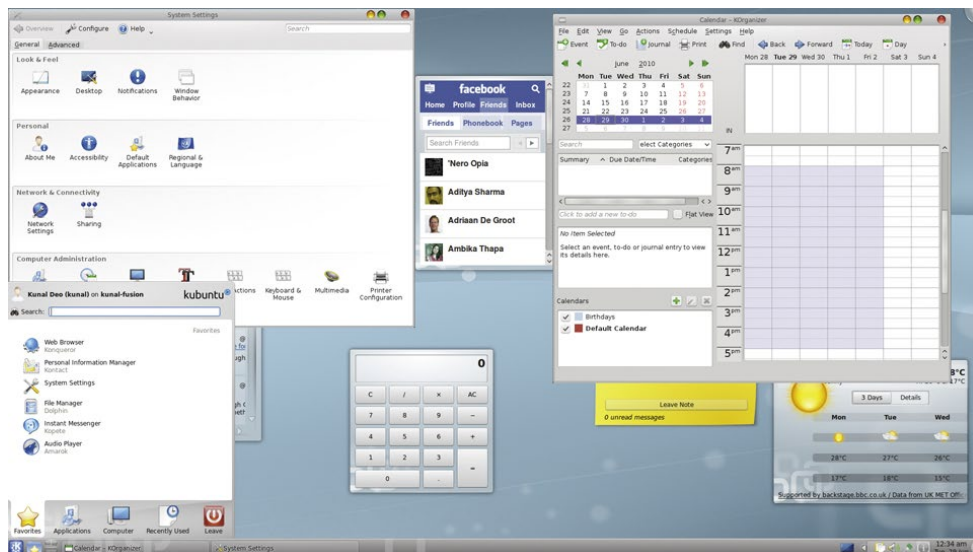


- Features

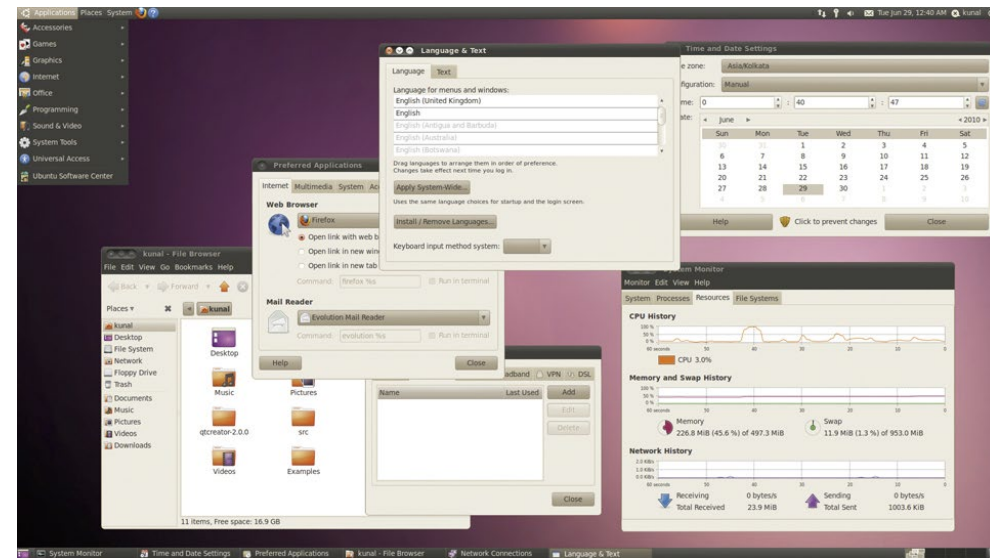
- Main menu / Taskbar / Dashboard
- Themes: Desktop icons / fonts / backgrounds
- Multiple overlapping windows
- Widgets

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.



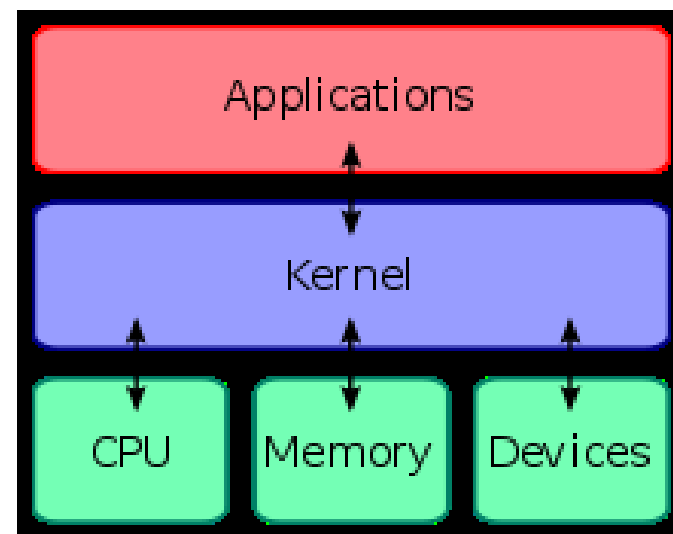
KDE Desktop



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.

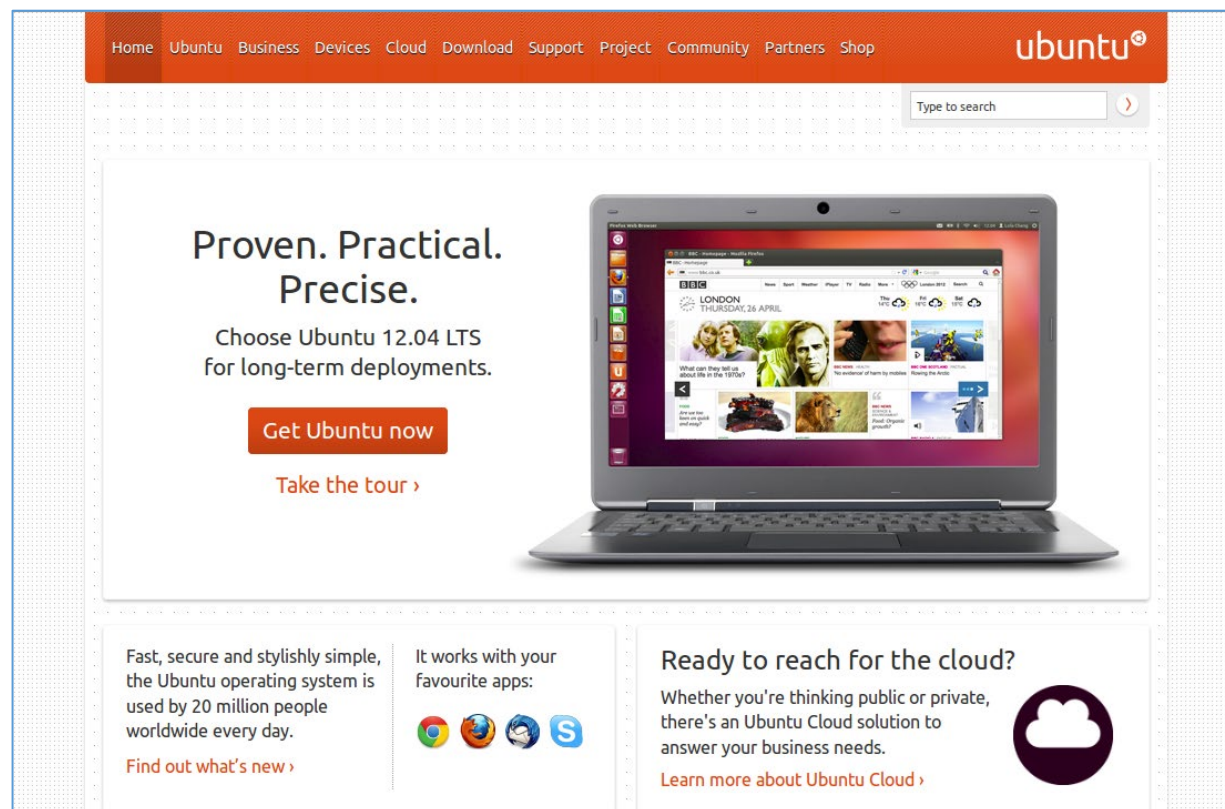
Kernel Version Numbering

- 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

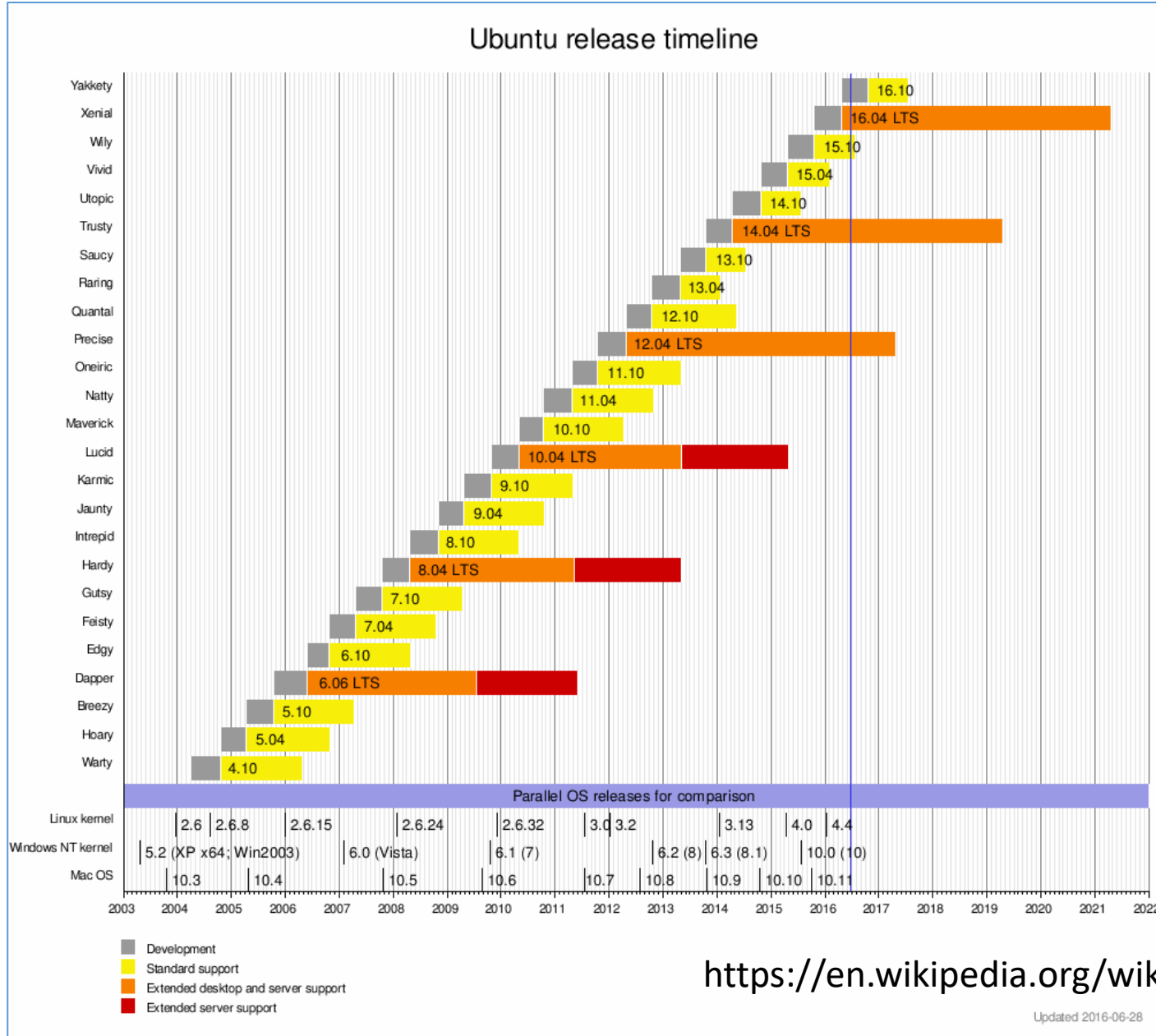
- What patterns do you notice?
- What is LTS?
- 17.04 – Zesty Zapus
- 17.10 – Artful Aardvark
- 18.04 LTS - ?

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

<https://wiki.ubuntu.com/DevelopmentCodeNames>

Ubuntu releases

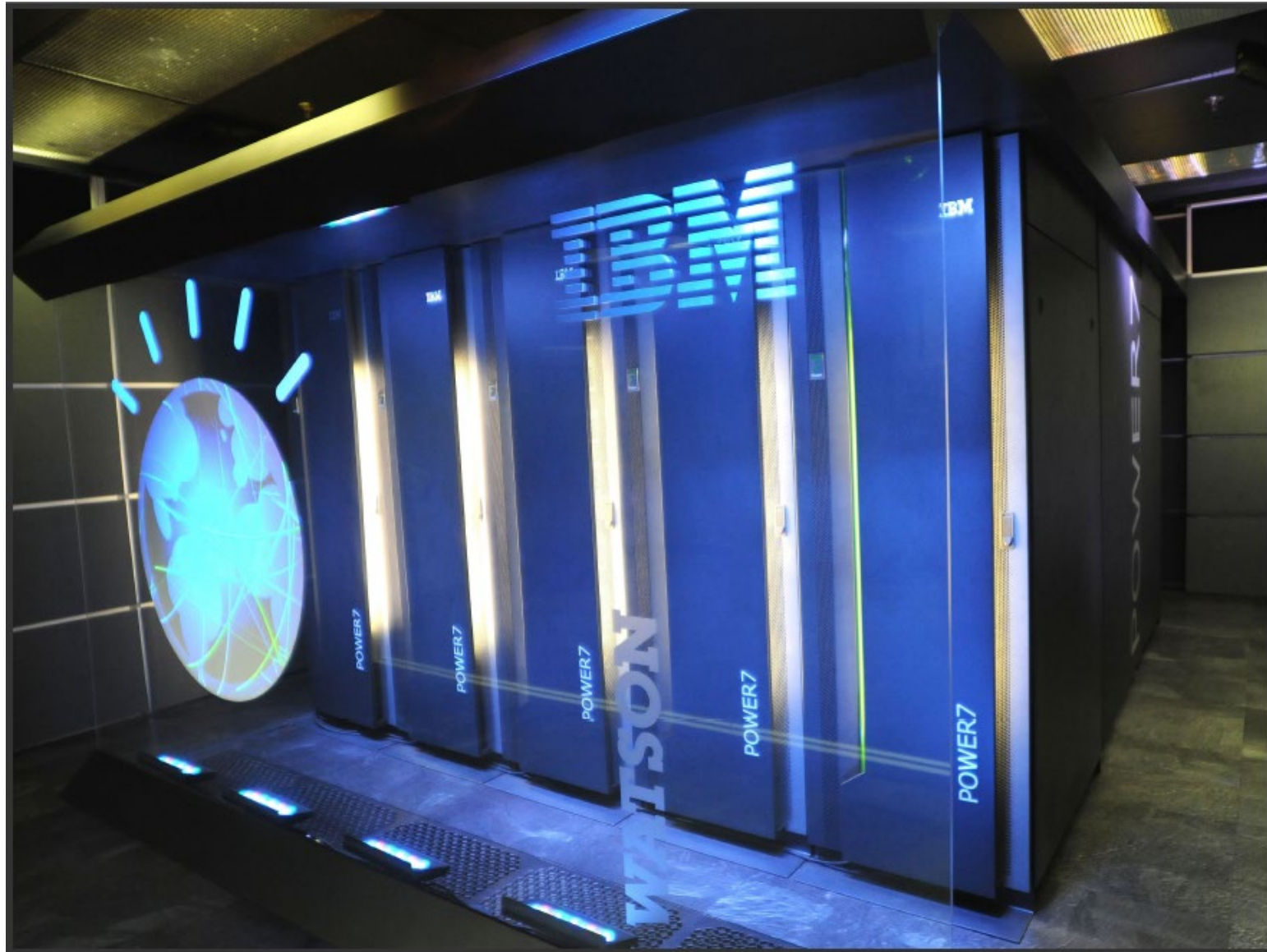


https://en.wikipedia.org/wiki/List_of_Ubuntu_releases

Careers in Linux

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

Linux has 'grown up'



Watson runs Linux



The image shows the Jeopardy! game show set. On the left is the Jeopardy! board with categories: TECHNOLOGY, CLASSIC MOVIE LINES, THE GREAT OUTDOORS, MIND YOUR MANNERS, SPEAK OF THE DUCKS, and BEFORE & AFTER. The board has five rows of dollar amounts: \$200, \$400, \$600, \$800, and \$1000. In the center, a large screen displays the IBM logo. To the right, a banner reads "JEOPARDY! The IBM Challenge". Below the banner, text identifies Brad Rutter as the biggest all-time money winner and Ken Jennings as the record holder for the longest championship streak. In the foreground, three contestant podiums are visible, labeled KEN, WATSON, and BRAD. At the bottom right, a scoreboard shows the progress of three contestants: Emily Dickinson (99%), Walt Whitman (60%), and Barnard (10%).

IBM

Jeopardy! – The Next Grand Challenge

JEOPARDY! The IBM Challenge

Brad Rutter, the biggest all-time money winner on Jeopardy!
Ken Jennings, the record holder for the longest championship streak

Contestant	Progress	Percentage
Emily Dickinson	99%	99%
Walt Whitman	60%	60%
Barnard	10%	10%

Watson runs Linux



“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 (10¹² – trillion floating point ops / sec)
<would have been 94th in Top500 HPC list at that time>



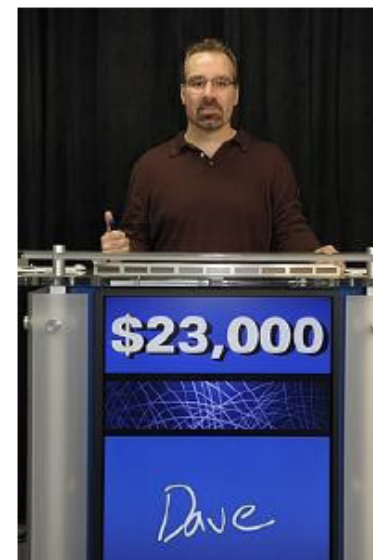
16 TB memory and 4 TB clustered storage

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:

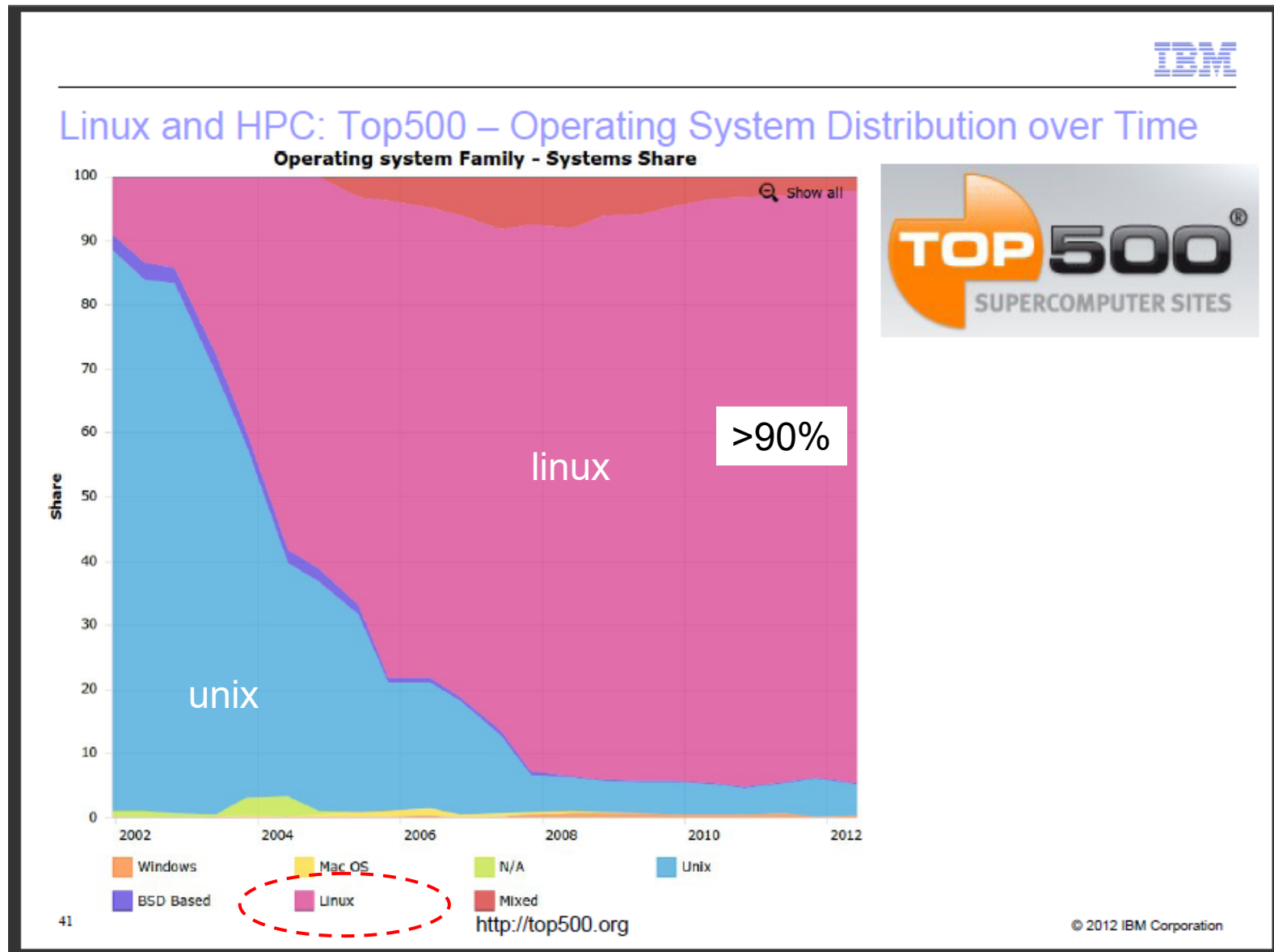
A bowl - size 100 m² - double floor
80 kWh power
Cabling
20 tons of cooling devices
200 million pages of information

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

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

The screenshot shows the 'Services from Canonical' page. The header includes navigation links: Home, Ubuntu, Business, Devices, Cloud, Download, Support, Project, Community, Partners, Shop. Below the header is a search bar and a secondary navigation bar with links: Desktop, Server, Landscape, Services, Case studies, Contact Canonical. The main content area has a dark purple background with the heading 'Services from Canonical'. Below this, a paragraph states: 'Ubuntu is backed by Canonical, the number-one Ubuntu services provider. Our Ubuntu Advantage support programme provides real peace of mind, while our consulting services are used by organisations worldwide to solve complex IT issues.' A 'Contact Canonical' button is on the right. Further down, a section titled 'Whether you're already running Ubuntu or you're thinking of making the switch, our advice and support can help you make the most of your infrastructure.' contains three columns: 'Desktop services', 'Server services', and 'Cloud services', each with a photo and a brief description of the services offered.

The screenshot shows the Red Hat website. The header includes the Red Hat logo and a 'LOG IN' button. Below the header is a navigation bar with links: United States, Customer Portal, Resource library, Find a partner, Buy online, Contact sales. A search bar is also present. The main content area features a large banner with the heading 'BUILD A CLOUD' and the text 'One step at a time using the technology you already own. Red Hat Open Hybrid Cloud.' A 'LEARN MORE' button is on the right. Below the banner is a 'RECENT NEWS' section with a news item dated July 26, 2012. At the bottom, there is a navigation bar with links: PRODUCTS, SOLUTIONS, SUPPORT, TRAINING, CONSULTING. Below this are four sections: 'LEARN ABOUT RED HAT', 'ENGAGE WITH PARTNERS', 'EXPLORE COMMUNITIES', and 'ACCESS MY ACCOUNT', each with a photo and a brief description.

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/>

Linux Professional Institute

HOME LINUX CERTIFICATIONS EXAM PREPARATION INTERNATIONAL AFFILIATES TRAINING

Home » Linux Essentials

Linux Certifications Overview

Introductory Programs

Linux Essentials

Professional Certifications

- › LPIC-1
- › LPIC-2
- › LPIC-3

Linux Essentials

The Linux Professional Institute (LPI) is proud to announce an innovative "Linux Essentials" program for the next generation to acquire the advanced skills needed to fill the IT sector, youth and others new to the world of Linux and Open Source technology.

Created in partnership with a community of teachers, trainers and experts, the Linux Essentials program prepares the next generation to acquire the advanced skills needed to fill the IT sector, youth and others new to the world of Linux and Open Source technology. It supports government and educational authorities in the classroom at much younger ages. Supporting learning and fun through skill development and supporting international collaboration and the development of teacher-tes...

Please Note: This Certificate of Achievement is not delivered through VUE testing centers, please visit the [Affiliate Locations page](#) and request localized Test Center availability from your closest Master Affiliate.

www.nongnu.org/lpi-manuals/manual/

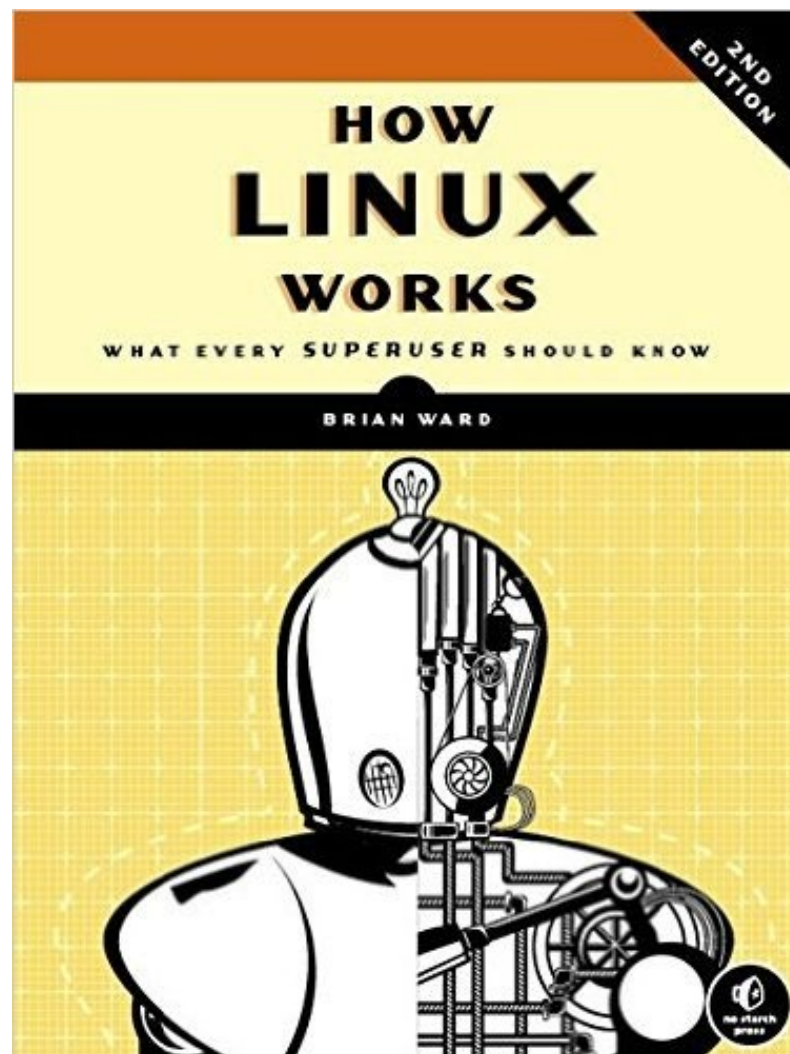
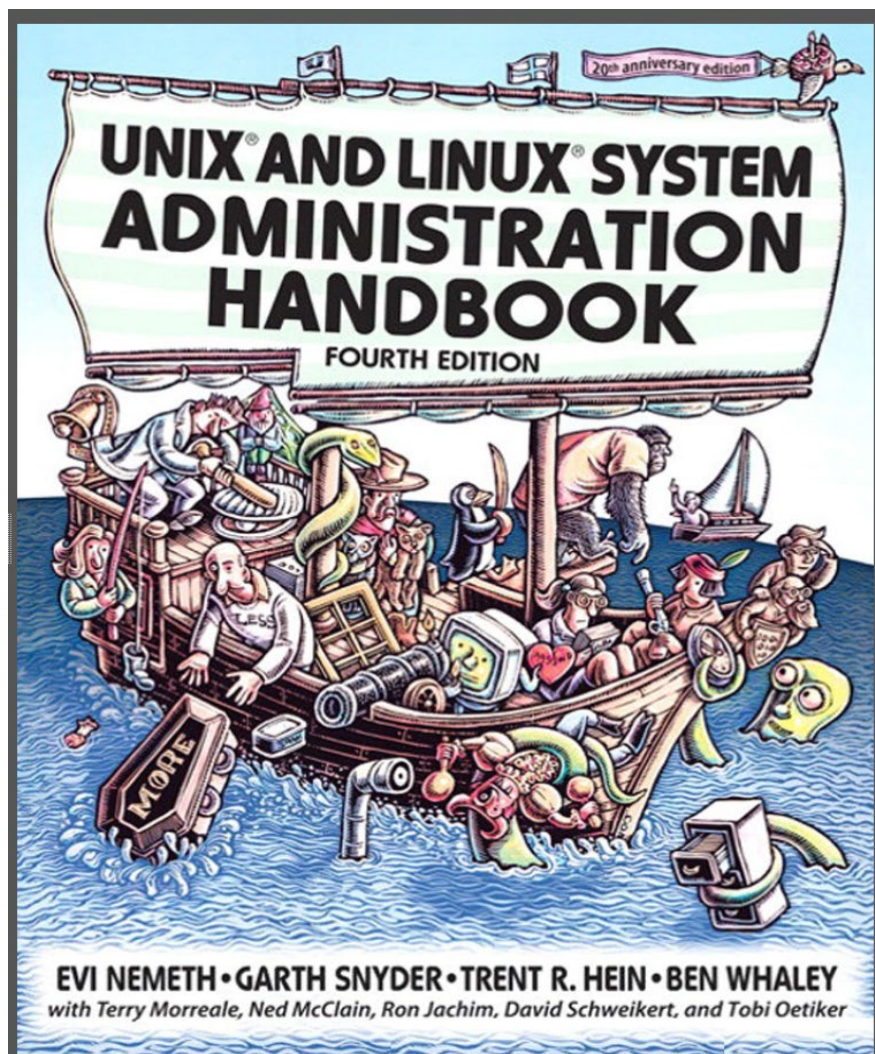
GNU/Linux Administration Manuals

[LPI Manuals Project on Savannah](#)
Last updated October 19, 2010

Available for download are the study guides for LPIC-1 and LPIC-2, in OpenOffice Writer format (.sxw) and PDF. With new releases currently under development, this page shall contain the 2005 versions until the new manuals are "release ready". At the moment, the estimated completion for the document set is December 2011.

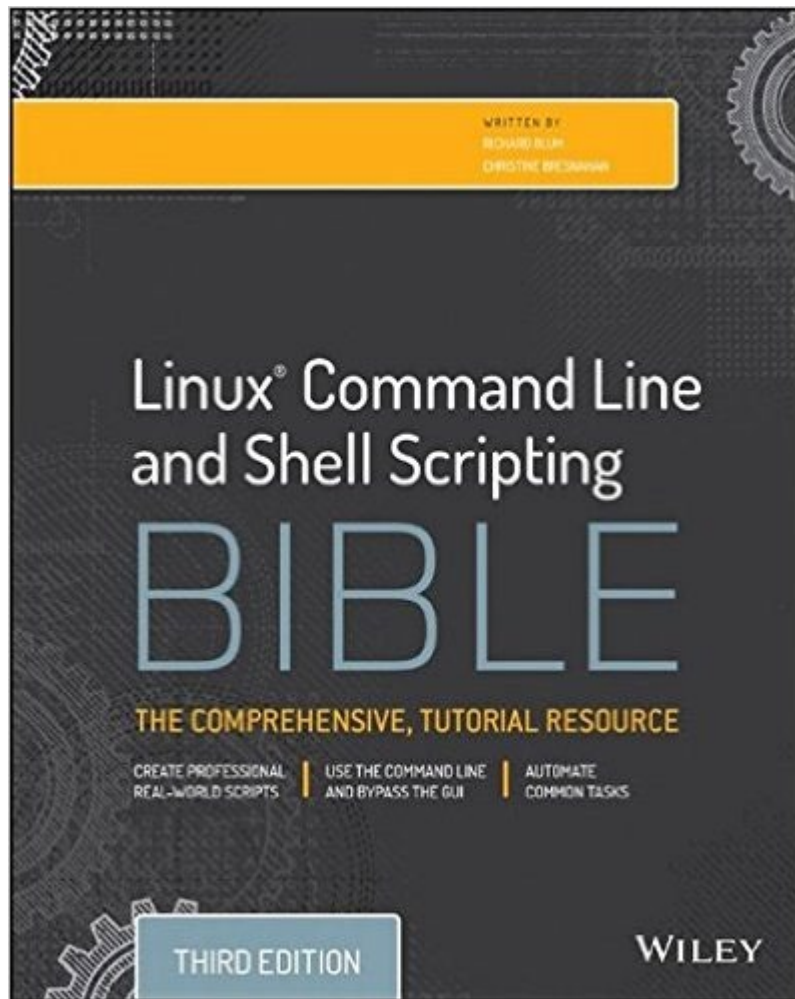
- Study Guide for Linux Administration 1 (Lab work for LPI 101) | [SXW](#) - [PDF](#)
- Study Guide for Linux Administration 1 (Lab work for LPI 102) | [SXW](#) - [PDF](#)
- Study Guide for Advanced Linux Administration 2 (Lab work for LPI 201) | [SXW](#) - [PDF](#)
- Study Guide for Advanced Linux Administration 2 (Lab work for LPI 202) | [SXW](#) - [PDF](#)

My favorite books right now

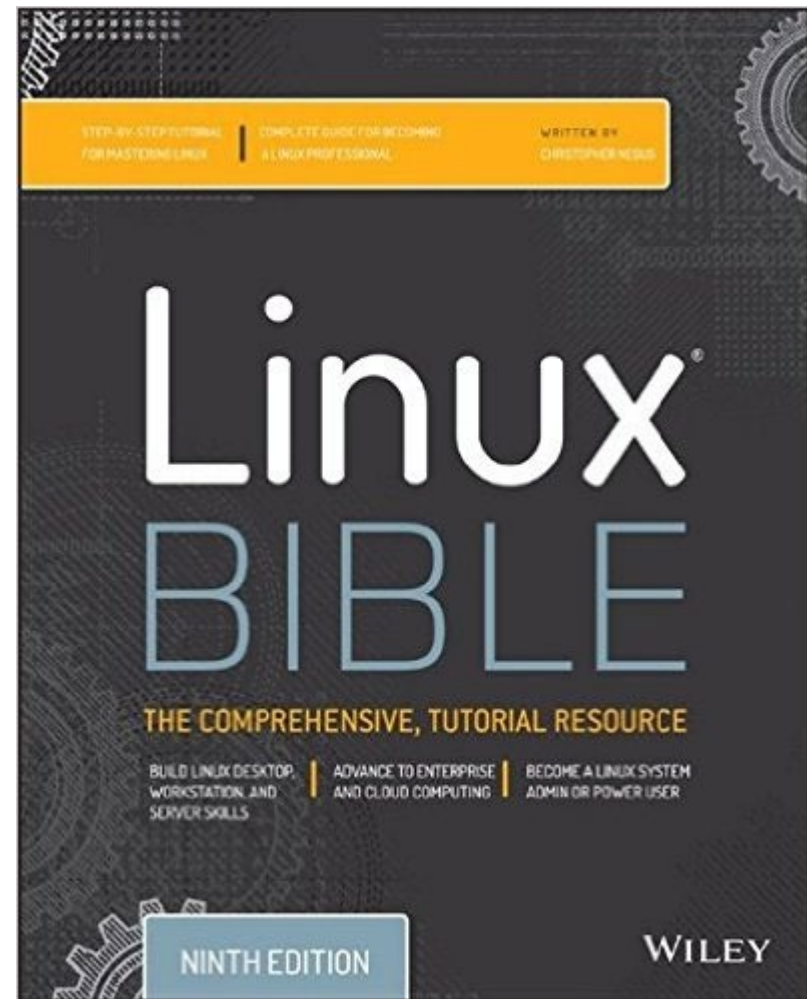


Another set of Favorite books

Great for this Intro course



Great for the Adv course



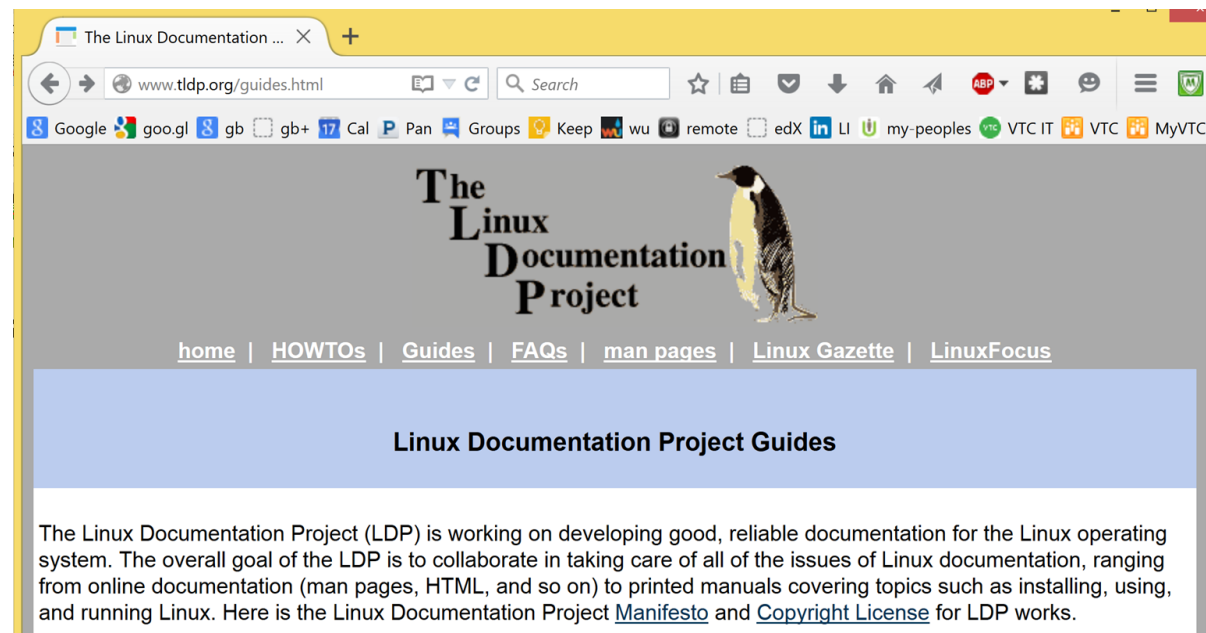
An online text

- TLDP – The Linux Documentation Project

- Recommended Guides:

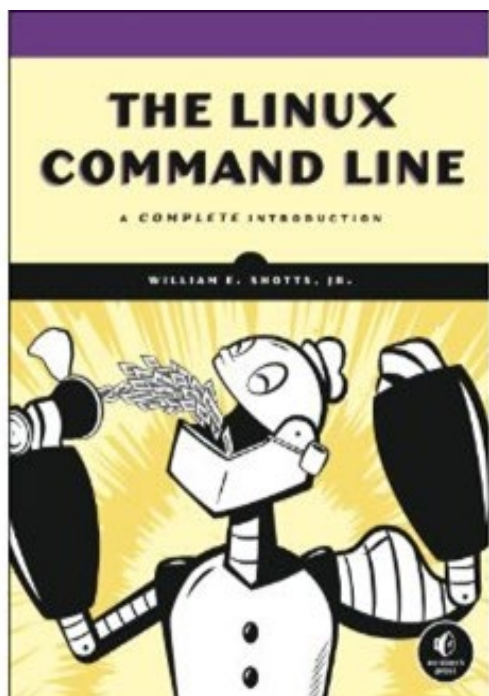
`http://www.tldp.org/guides.html`

- 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.

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