Let's Lose the Shock-Mystery of Linux - A Pain-free Intro

RVA Linux Users Group

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About D.J.

- Background:

  Ops, Dev, Mainframe Eng, Network Eng, WAN Design Eng, IT Integration, Sustaining Eng, Computer Security

- Locale:

  Live/work/play in Washington DC region

- My humble beginnings… …

  COBOL/CICS, EasyTrieve Plus, Business BASIC (Electronic Cash Register PC, police/dispatch Midrange)

- Alma Mater:

  Virginia Commonwealth University - Go Rams!!

  BS Business, Info Sys; MS Business, Info Sys - IT Management

Purpose

- Overview
- Awareness
- General understanding

We will talk a little about:

- Microsoft Windows OS vs Linux
- Linux Distributions
- Command line
- Files, file systems
- Processes

We will not go "heavy" into comparing distributions

Some Differences Between Linux commands and MS Windows commands

clear vs cls

ls vs dir

traceroute vs tracert

find vs grep

format, parted vs diskpart

ps vs tasklist

Filepath: / vs \

cp vs copy

date vs date / time

man vs help

(*) read vs pause

Device: null vs NUL:

rm vs del, erase

mv vs rename

cd vs cd

mkfs vs format

Linux Live vs MS doesn't have USB-bootable version except 3rd-party Live11

(*) To implement functionality of Microsoft's pause command, we use: read -n 1 -s -r -p "Press any key to continue . . . " ; echo

Other Differences Between Linux and MS Windows (1)

- Linux commands are case-sensitive; Windows is not
- Linux unified file system has one root directory for the computer system
- Microsoft OSes have a root directory for each disk drive
- Amount of work in GUI vs CLI: Linux – more CLI, Windows – more GUI
- Free utilities and languages available: free, unlimited and ubiquitous in Linux
- Linux GUIs can vary notably. Windows GUI is fairly standard across versions
- Command-line interpreters: bash, several others vs only MS-DOS style, Powershell
- Scripting: bash scripts vs MS-DOS-style Batch files, Powershell scripts

Other Differences Between Linux and MS Windows (2)

- Languages installed by default in Linux: tcl, python, bash, perl
- File systems: ext2/ext3/ext4 + FAT32, NTFS vs NTFS, FAT32
- Super-user account: root vs Administrator
- CLIs installed by default in Linux (Ubuntu): dash sh tclsh bash rbash
- Daemon vs Service

- Command General Format:

  Linux: <command> <switches e.g. -s -p -sp --max> <value 1> <value 2> ...

  Windows: <command> <value 1> <value 2> ... <switches e.g. /s /p >

Where did Linux come from?

- In 1969, AT&T / Bell Labs begins to write Unix for use in the Bell (telephone) system
- December 1969 Linus Torvalds is born
- In 1972 Unix is rewritten in C. It was written in Assembly language
- In late 1970s, AT&T begins to license Unix for use in universities and commercially
- In 1987 Andrew Tanenbaum releases MINIX with its complete source code made available to universities for study in courses and research
- In 1987: Operating Systems: Design and Implementation is a computer science textbook written by Andrew S. Tanenbaum, with help from Albert S. Woodhull. The book describes the principles of operating systems and demonstrates their application in the source code of Tanenbaum's MINIX, a free Unix-like operating system designed for teaching purposes
- In 1988 Linus starts University of Helsinki, interrupts in 1989 for Military Service, returns to the University around 1990
- In 1991 Linus: buys 80386 clone, acquires a copy of GTS MINIX, works on Linux kernel
- The first Linux prototypes are released publicly in late 1991
- Linux Version 1.0 is released on 14 March 1994
- Torvalds first encounters the GNU Project in fall of 1991 when another Swedish-speaking computer science student, Lars Wirzenius, took him to the University of Technology to listen to free software guru Richard Stallman's speech. Torvalds would ultimately switch his original license (which forbade commercial use) to Stallman's GNU General Public License version 2 (GPLv2) for his Linux kernel after complaints of distributors being unable to recoup their costs due to a non-commercial clause

What is Linux

- OS - software... makes use of a box of HW... run programs... communicate with it
- Free, open-source, freely changable, great for learning computers, software dev, hacking

- Kernel
- File System - EXT3 EXT4 FAT32 FAT64 NTFS
- Package Manager - RedHat Package Manager (rpm, yum, dnf) or Debian/APT (apt get)
- Command-line Interpreter (CLI) - sh, ksh, Bourne, bash
- Graphical User Interface (GUI) - GNOME, KDE

- Which packages are installed by the distribution
- Gnome is simpler, easier. KDE is more configurable
- Debian/APT vs RedHat/RPM

What the Kernel Is; What the Kernel Does

Central, core of operating system. Low-level functions:

- Memory - allocation / Deallocation
- CPU scheduling
- I/O - communication with hardware via Device Drivers
- Inter-process communication
- Date/Time services, Timers
- Resource protection - file and process permissions
- System Call interface (counted 638 system calls)

Kernel functions:

- Allocates memory to programs
- Allocates CPU time to programs
- Implements a security model to protect/isolate programs, users, the OS
- Provides a programming interface (APIs, System Calls) so programs can use the resources on the computer (ex. memory, CPU, hardware, files, system clock)

Or… … What is NOT in the Kernel

- CLI, GUI
- Commands
- User programs
- Sometimes hardware drivers, file system drivers, other software modules

Partial List of Linux Distributions … … …

- Puppy Linux Kali Ubuntu Debian CentOS Linux
  CentOS Stream Red Hat Enterprise Linux (RHEL) Gentoo
  Fedora OpenSUSE Scientific Linux CloudLinux
  Elementary OS Linux Mint Arch Linux Manjaro Oracle Linux Slackware Mageia Clear Linux Rocky Linux
  AlmaLinux Asahi Linux Lubuntu SUSE Linux Knoppix
  VzLinux Peppermint OS Zorin OS BlackArch Linux
  SUSE Liberty Linux Navy Linux Tizen

How to Log In

- We log in to the GUI or text command line depending on computer's Run Level
  - Runlevel 0 - Shutdown / Power-off / Halt
  - Runlevel 1 – Text-based Rescue mode / Operator console only
  - Runlevel 2 – Multi-user without networking
  - Runlevel 3 - Text-based Command-line Multi-user with networking
  - Runlevel 4 – (Undefined, User definable)
  - Runlevel 5 - GUI Multi-user with networking
  - Runlevel 6 – Reboot

- Runlevel 3 - Text-based, local or network (ssh) Enter Username / Password
- Runlevel 5 – GUI (log in via GUI or ssh). Select/enter Username. Enter Password
- In Debian, Ubuntu, Runlevels 2 thru 5 are the same as runlevel 5 (GUI)

What's Available in the GUI

- Productivity programs - Libre Office (documents, spreadsheets, presentation, drawing)
- Calc (Calculator by The GOME Project -U)Files browser (Files, The GNOME Project -U)
- E-mail / (Mozilla Thunderbird -U)
- Calendar (Calendar by The GNOME Project -U)
- Software Center / software updater
- Games (AilseRiot Solitaire, Mines, -U)
- Text Editor (gedit -F) / Text Editor (Text Editor The GNOME Project -U)
- Terminal (GNOME Terminal -U)
- Settings (typical settings like MS-Windows, Android, iOS)
- System Utilities (Trash, Drivers, Sys Monitors, Image/Doc viewers, Music player / Video player (Videos/Totem -U)
- Web browser (Firefox -U)
- Help
- Remote Desktop Client (Remmina)
- Camera app (Cheese GNOME -U)

In Linux, everything is a File

- What about Windows – Windows uses APIs. A good example is Powershell applets. Billions of them … …
- Files in Linux: keyboard, terminal display, disk partitions, entire disk drives, OS parameters
- Most system operations can be performed by opening, reading/writing, and closing something

How Linux uses all available memory

- Linux will use all available memory
- Slowly, over time, Linux allocates free memories to Buffers, Cache
- This behavior strongly improves disk performance
- How …
- adage: Unused memory is WASTED memory

Commands: top, free

Starting / Using the Terminal…

date

uptime

clear

exit

top

press q to exit the "top" program

whoami

who

who –a

free

runlevel

time

time date time uptime time free

Starting / Using the Terminal…

echo

echo "This is a message“

echo "My Commands" ; date ; uptime ; whoami ; who –a

top

Intro to the Linux (unified) File System Organization

- / - root of Linux file system
- /boot - Linux kernel files, boot files
- /etc - System config files including password/shadow file
- /home - home directories of users/root - home directory for root superuser
- /media - mount point for temporary devices such as USB drives/dev - system devices (terminals, disk names, null device, etc)
- /tmp - directory to store temporary files
- /usr - system-wide, read-only files incl programs, libraries, documentation
- /usr/bin - regular, non-privileged commands (binary programs)
- /usr/sbin - superuser commands (binary programs)
- /usr/lib lib32 lib64 - 32-bit and 64-bit program library files/bin - link to /usr
- /bin/sbin - link to /usr
- /sbin/var - logs, spool files, backups, etc/proc - readonly information on running processes, system data
- /sys - parameters for the Linux kernel (can read and set)

Moving around the filesystem (1)

pwd ls cd

Files

. Files

.. and .

cd absolute vs cd relative

Placement of parameters and switches

File Permissions. Ls -l Explain the code

--time=WORD change the default of using modification times; access time (-u): atime, access, use; change time (-c): ctime, status; birth time: birth, creation;

-u last access-c = change time; last time changed or the time the file is placed on this system

none = birth time when file is first created; possibly diff computer

Moving around the filesystem (2)

chmod

chown

Note: You can change your file to someone else and losing ownership of it

priv/root cmds won't work when you are not root

stat

root@hp1:~# stat /etc/passwd File: /etc/passwd Size: 2717 Blocks: 8 IO Block: 4096 regular fileDevice: 179,2 Inode: 2099909 Links: 1Access: (0644/-rw-r--r--) Uid: (0/ root) Gid: (0/ root)Access: 2024-03-23 10:44:44.969604232 -0400Modify: 2023-09-13 14:45:15.399999846 -0400Change: 2023-09-13 14:45:15.399999846 -0400 Birth: 2023-09-13 14:45:15.399999846 -0400

More On Using the Terminal

Command-line editing - up-arrow, backspacing and typing

Ctrl-C

Ctrl-S, Q

Ctrl-D

Ctrl-Z

fg bg

Copy/paste in CLI vs Graphical editor

/proc Files (1)

- There is a sub-directory (PID number) for every process, and then these informational files …
- acpi
- asound
- bootconfig
- buddyinfo
- cgroups
- cmdline
- consoles
- cpuinfo
- crypto
- devices
- diskstats
- dma
- execdomains
- fb
- filesystems
- fs
- interrupts
- iomem
- Ioports
- kallsyms
- kcore
- keys
- key-users
- kmsg
- kpagecgroup
- kpagecount
- kpageflags
- loadavg
- Locksmdsta
- meminfo
- miscmodules
- mounts
- mtrrpage
- typeinfo
- partitions
- schedstat
- slabinfo
- softirqsstat
- swapssys
- rq-trigger
- timer_list
- uptime
- version
- version_signature
- vmallocinfo
- vmstat
- zoneinfo

/proc Files (2)

- cmdline - bootstrap / bootloader command-line, parameters from system start
- cpuinfo - detailed data on system CPUs and their feature set
- loadavg - system 1 min, 5 min, 15 min load averages for top, uptime commands
- meminfo - sizes of memory allocation by category
- mounts - mountable file systems
- swaps - info on swap files
- timer_list - system timers
- uptime - system uptime data that is displayed with the uptime command
- version - version info of running OS
- version_signature - version info of running OS
- vmallocinfo - detailed virtual memory allocations
- vmstat - memory info that is displayed with vmstat command

What If Our System Doesn't Have a Command that We Desire ?

root@hp1:/home/user5/Pgm# iostat

Command 'iostat' not found, but can be installed with:

apt install sysstat

root@hp1:/home/user5/Pgm#

TCP/IP, Network Commands / Utilities

- ss tunip check IP/ports are open for listening on localhost
- nc -zv 10.10.0.1 80 check if TCP port is open on addr -u for UDP
- ip br address show check if valid IP addr is assg to pri int
- ping 10.10.0.1 ping commnand
- traceroute 10.10.0.1
- ip route show check the setup of routes and the def gw
- dig www.yahoo.com query your default DNS server
- arp-scan -i eth0 -i check for IP addr conflict on local network segment
- ip neighbor-show check what is in the ARP cache
- tcpdump -i eth0 -nn -e
- ip -br link show check is phy link is up
- ip -s link show eth0 examine pkt count stats
- ethtool eth0 display link properties

What can be a Command (file) in Linux?

- Program... compiled, interpreted, or a script. Run from the command line / CLI (not usually run from GUI)
- Can be a file on disk
- Can be Built into shell/CLI (e.g type: man builtins)
- Generally available system-wide (from any directory, by most/all users)
- Can be restricted to certain users

Things that are Awkward or Buggy in Linux

- Different distros have different commands
- Linux Office vs MS-Office
- Mouse pointer occasionally disappears in Ubuntu
- mount command and parameter options can be difficult for unusual disk formats
- If you pull out a USB without unmounting the filesystem, Linux can get nasty with you regarding that filesystem
- Formatting a disk drive can be somewhat "involved“
- udev rules are buggy for custom VMs and hardware
- Fedora: Upgrade only 1 or 2 versions at a time. eg. V37 to 39 then to 40
- Fedora: Apply same-version updates BEFORE upgrading to new version!

Summary

- Linux comes from Minix (educational look-alike of Unix), kernel by Linus, Other OS software by GNU
- We have discussed several easy differences between Linux and Windows
- We have looked at some core factors that go into a Linux Distribution
- We have listed some programs available in a Linux GUI
- We have looked at some command-line features and various Linux commands

q & a

Now GO PLAY with it!!!

Thank you!

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https://github.com/ipv3/DC31-BIC/

< Slide deck - Set up, back up, restore Linux - Other resources />