NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

SkillsFuture Career Transition Program

Cloud Infrastructure Engineering

Operating System - Linux

Nanyang Technological University
Skills Union

Course Content

- Get an overview of Linux OS
- Differentiate between the different Linux distributions
- Identify structure of drives for installed apps and program files

Recap

Overview of Windows

History of Windows

Hands-on Exploration of Windows Services:

- Environment Variable
- Service Manager

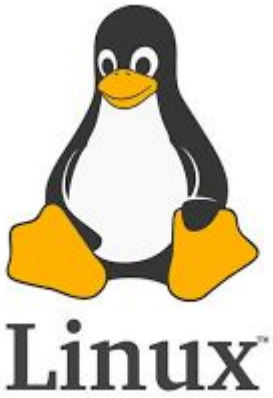
Assignment to further understand Windows

A Summary of Linux

What is Linux?

Just like Windows, iOS, and Mac OS, Linux is an **operating system**. Android, is powered by the Linux operating system.

Created by Linus Torvalds



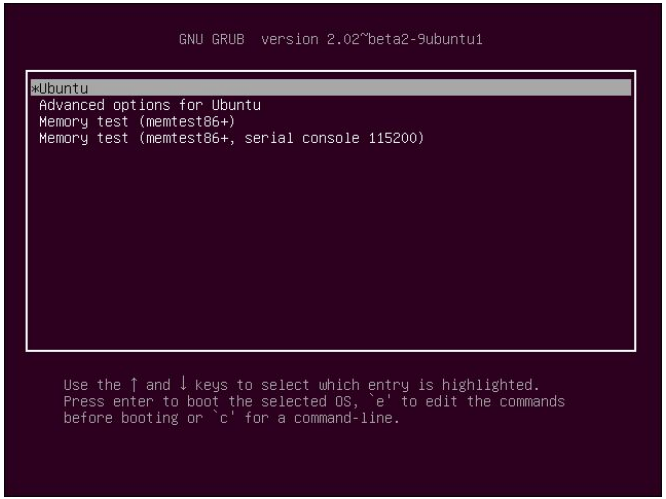
What are the components of Linux?

- Bootloader
- Kernel
- Init System
- Daemons
- Graphical Server
- Desktop Environment
- Applications

Bootloader

The software that manages the **boot process** of your computer.

For most users, this will simply be a splash screen that pops up and eventually goes away to boot into the operating system.



Kernel

This is the one piece of the whole that is actually called ‘Linux’.

The kernel is the **core interface between a computer’s hardware and its processes**. It communicates between the 2, managing resources as efficiently as possible.

Kernel

The kernel has 4 jobs:

Memory management: Keep track of how much memory is used to store what, and where

Process management: Determine which processes can use the central processing unit (CPU), when, and for how long

Device drivers: Act as mediator/interpreter between the hardware and processes

System calls and security: Receive requests for service from the processes

Init System

This is a sub-system that bootstraps the user space and is charged with controlling daemons.

One of the most widely used init systems is **systemd**, which also happens to be one of the most controversial. It is the init system that manages the boot process, once the initial booting is handed over from the bootloader (i.e., GRUB or GRand Unified Bootloader).

Daemons

These are **background services or** utility programs that **run silently in the background** to monitor and take care of certain subsystems to ensure that the operating system runs properly.

Graphical Server

This is the sub-system that **displays the graphics on your monitor.**

It is commonly referred to as the X server or just X.

Desktop Environment/ GUI

This is the piece that the **users actually interact** with.

There are many desktop environments to choose from (GNOME, Cinnamon, Mate, Pantheon, Enlightenment, KDE, Xfce, etc.). Each desktop environment includes built-in applications (such as file managers, configuration tools, web browsers, and games).

Applications

Desktop environments do not offer the full array of apps.

Just like Windows and macOS, **Linux offers thousands of high-quality software titles** that can be easily found and installed.

Most modern Linux distributions include App Store-like tools that centralize and simplify application installation.

For example, Ubuntu Linux has the Ubuntu Software Center (a rebrand of GNOME Software) which allows you to quickly search among the thousands of apps and install them from one centralized location.

Open Source Initiative

Linux is also distributed under an open source license. Open source follows these key tenants:

The freedom to **run the program**, for any purpose.

The freedom to **study how the program works**, and change it to make it do what you wish.

The freedom to **redistribute copies** so you can help your neighbor.

The freedom to **distribute copies of your modified versions** to others

Recap

- Bootloader
- Kernel
- Init System
- Daemons
- Graphical Server
- Desktop Environment
- Applications

Linux History

Linux Founded

The History of Linux began in **1991** with the beginning of a personal project by a Finland student **Linus Torvalds** to create a new free operating system kernel.

Since then, the resulting Linux kernel has been marked by constant growth throughout history.

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Timeline

1991 - Linux was introduced by a Finland student Linus Torvalds

1992 - Hewlett Packard 9.0 was released

1993 - NetBSD 0.8 and FreeBSD 1.0 released

1994 - Red Hat Linux was introduced, Caldera was founded by Bryan Sparks and Ransom Love and NetBSD1.0 Released

Timeline

1995 - FreeBSD 2.0 and HP UX 10.0 were released

1996 - K Desktop Environment was developed by Matthias Ettrich

1997 - HP-UX 11.0 was released

1998 - the fifth generation of SGI Unix i.e IRIX 6.5, Sun Solaris 7 operating system, and Free BSD 3.0 was released

Timeline

2000 - The agreement of Caldera Systems with the SCO server software division and the professional services division was announced

2001 - Linus Torvalds released the Linux 2.4 version source code

2001 - Microsoft filed a trademark suit against Lindows.com

2004 - Lindows name was changed to Linspire

Timeline

2004 - The first release of Ubuntu was released

2005 - The project, openSUSE began a free distribution from Novell's community

2006 - Oracle released its own distribution of Red Hat

2007 - Dell started distributing laptops with Ubuntu pre-installed in it

Timeline

2011 - The Linux kernel 3.0 version was released

2013 - Google Linux-based Android claimed 75% of the smartphone market share, in terms of the number of phones shipped

2014 - Ubuntu claimed 22,000,000 users

Linux Distribution

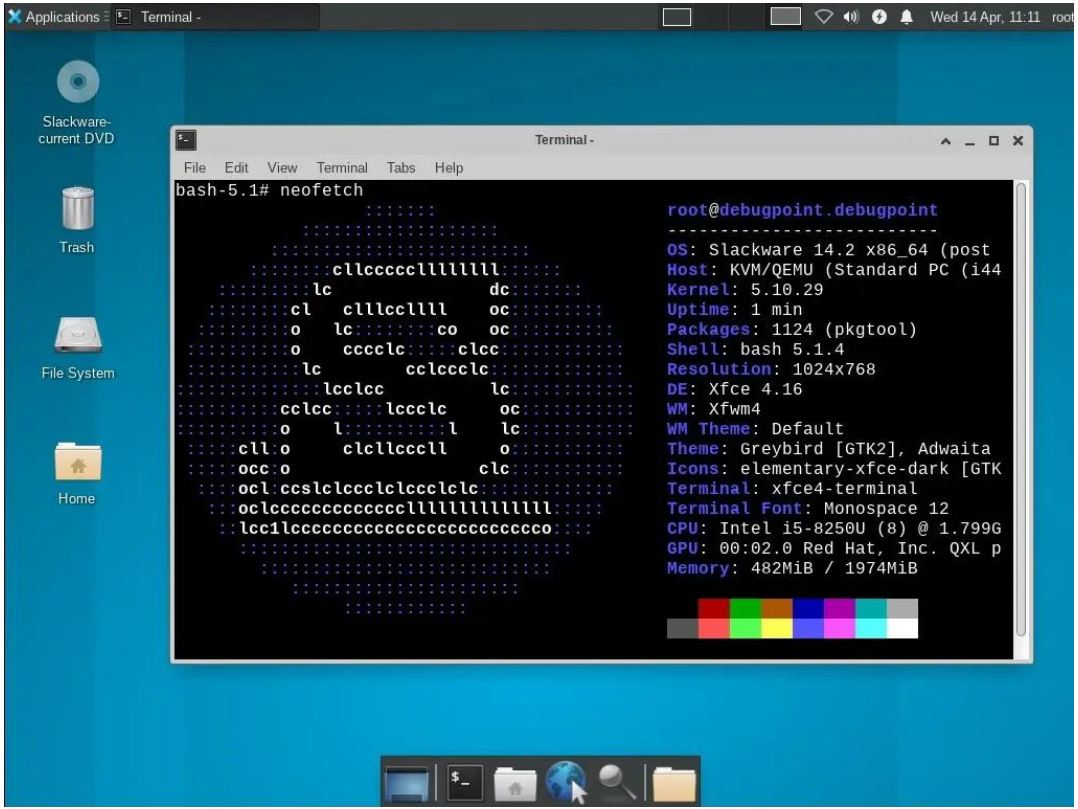
Slackware

Launched in 1992 by Patrick Volkerding, Slackware is the **oldest surviving Linux distro**, and until the mid 1990s, it had about an 80 percent share of the market.

Things changed when Red Hat Linux came on the scene, and today Slackware is nowhere near its past popularity.

The reason isn't that it's bad – on the contrary, it's still a top Linux distro, but since Slackware is **meant to be highly customizable and robust rather than user friendly**, this affected its popularity.

Slackware


Applications
Terminal -
Wed 14 Apr, 11:11
root
Slackware-current DVD
Trash
File System
Home
Terminal -
File Edit View Terminal Tabs Help
bash-5.1# neofetch
root@debugpoint.debugpoint
OS: Slackware 14.2 x86_64 (post
Host: KVM/QEMU (Standard PC (i44
Kernel: 5.10.29
Uptime: 1 min
Packages: 1124 (pkgtool)
Shell: bash 5.1.4
Resolution: 1024x768
DE: Xfce 4.16
WM: Xfwm4
WM Theme: Default
Theme: Greybird [GTK2], Adwaita
Icons: elementary-xfce-dark [GTK
Terminal: xfce4-terminal
Terminal Font: Monospace 12
CPU: Intel i5-8250U (8) @ 1.799G
GPU: 00:02.0 Red Hat, Inc. QXL p
Memory: 482MiB / 1974MiB


slackware
Keep it simple, stupid.

openSUSE

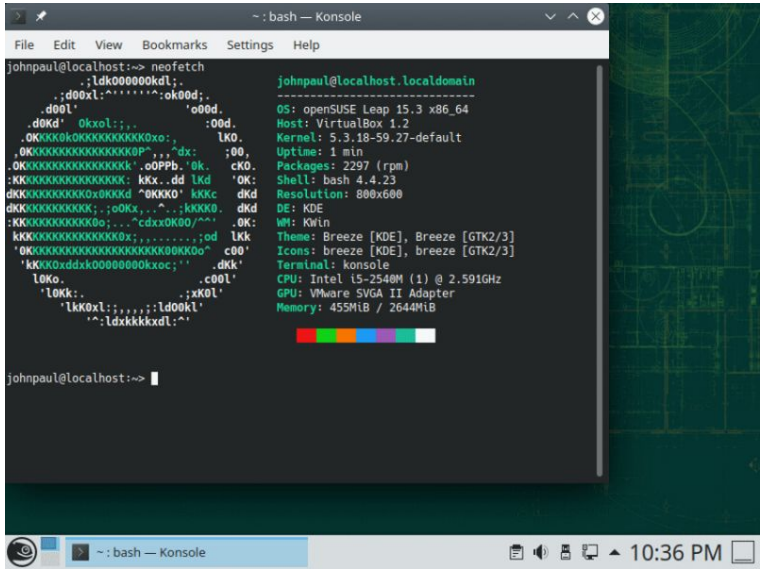
openSUSE Linux got its start back in 1992 when Thomas Fehr, Roland Dyroff, Burchard Steinbild, and Hubert Mantel launched the SUSE project.

Their company began with selling the German version of Slackware on floppy disks. SUSE Linux didn't become its own independent version until 1996.

The company was **acquired by Novell** in 2003 and then **Attachmate in 2010**. After major licensing changes, the code was finally released publicly. It wasn't until 2005 that SUSE Linux split into commercial and open source versions. Novell Linux became SUSE Linux Enterprise Desktop and SUSE Linux Enterprise Server with openSUSE as the base code.

openSUSE

openSUSE went on to become the **free open source version** and is no longer a part of Attachmate. It's available in two versions: **Tumbleweed** with a rolling release update and **Leap**, which includes stable releases with years of support.

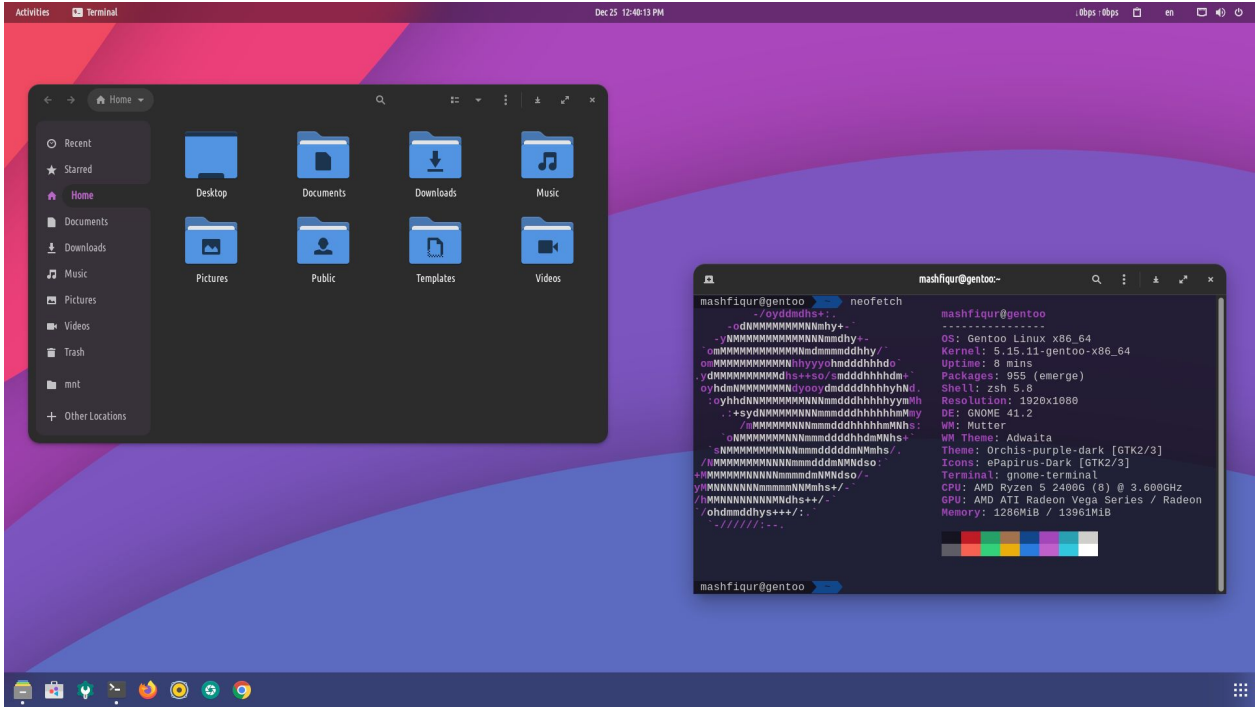


Gentoo Linux

Gentoo Linux was created by Daniel Robbins in 2000, mainly **for developers and enterprise users**. What sets Gentoo apart is the Portage package management system. It follows the BSD port system, but is actually Python-based. It's a much more advanced system to make managing networks easier.

Gentoo is typically installed as a bare bones system with pre-compiled additions being added as needed. It's a **highly flexible and customizable** distro and often used as a website server. It's even the base for the Chrome OS platform.

Gentoo Linux



gentoo linux™

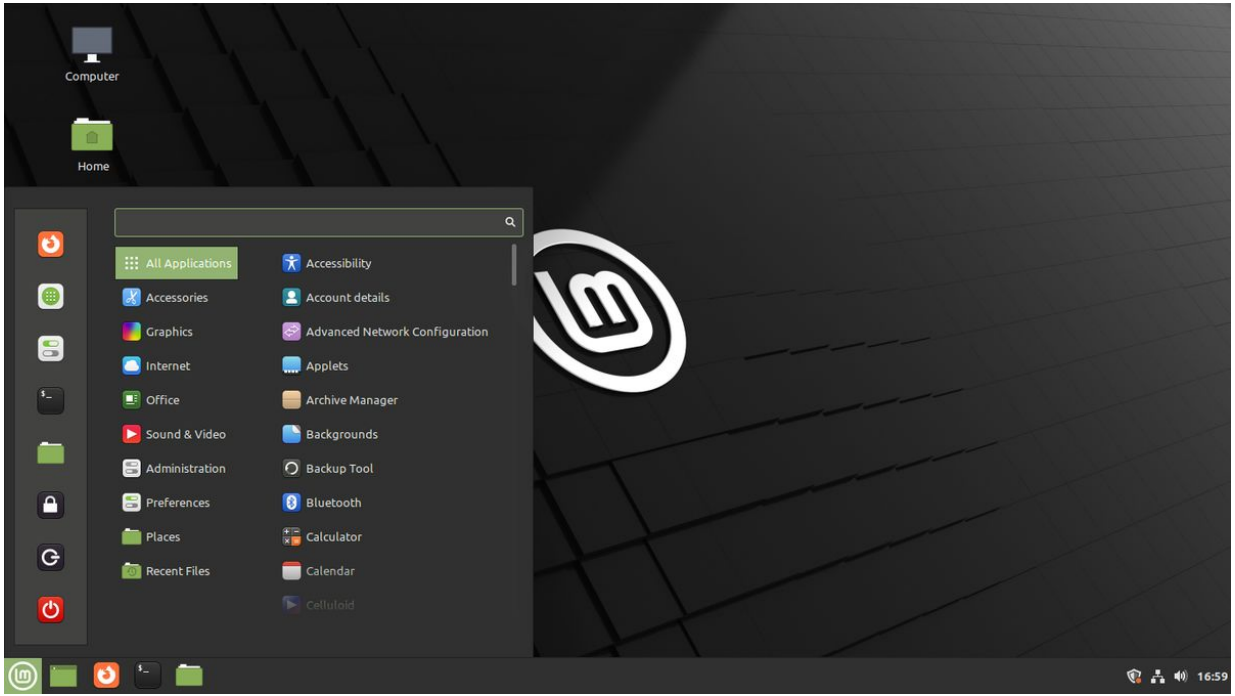
Linux Mint

Linux Mint is another relatively new distro in the **Debian family**. It was started in 2006 by Clément Lefèbvre and is **based on Ubuntu**.

It is intended to be **very user-friendly and is especially good for beginners**. Linux Mint comes with many apps and multimedia functionality, though in recent distros, the default multimedia/codec support has been removed.

One of the main differentiators of Linux Mint is that it **includes proprietary software as well**. This is done because its developers want to provide an easy-to-use distro where users don’t have to install all these apps on their own.

Linux Mint



Linux Mint
from freedom came elegance

Debian

Debian was one of the first and most popular Linux distros.

It was first announced on August 16, 1993, by Ian Murdock, though the first stable version was released in 1996. Basically, the idea was to create a stable distro anyone could download and use for free, instead of having users gather apps one by one and compile them on their own.

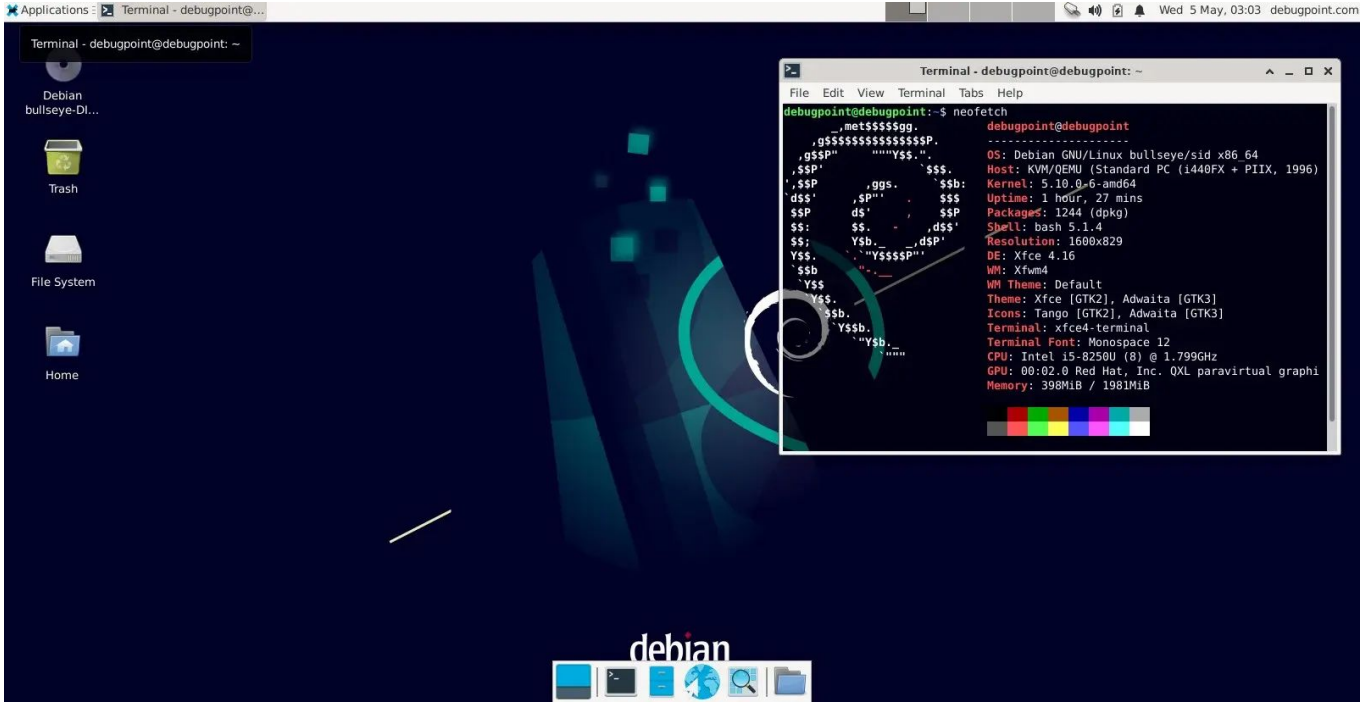
History of Debian: https://www.debian.org/doc/manuals/project-history/

Debian

Debian uses the **.deb package system** – the dpkg package manager and its front-ends (such as **apt-get** or synaptic).

It comes with a huge repository of apps users can download and install. Debian was also one of the first Linux distros to start offering live CDs, which make the entry barrier for a Linux newbie almost nonexistent.

Debian

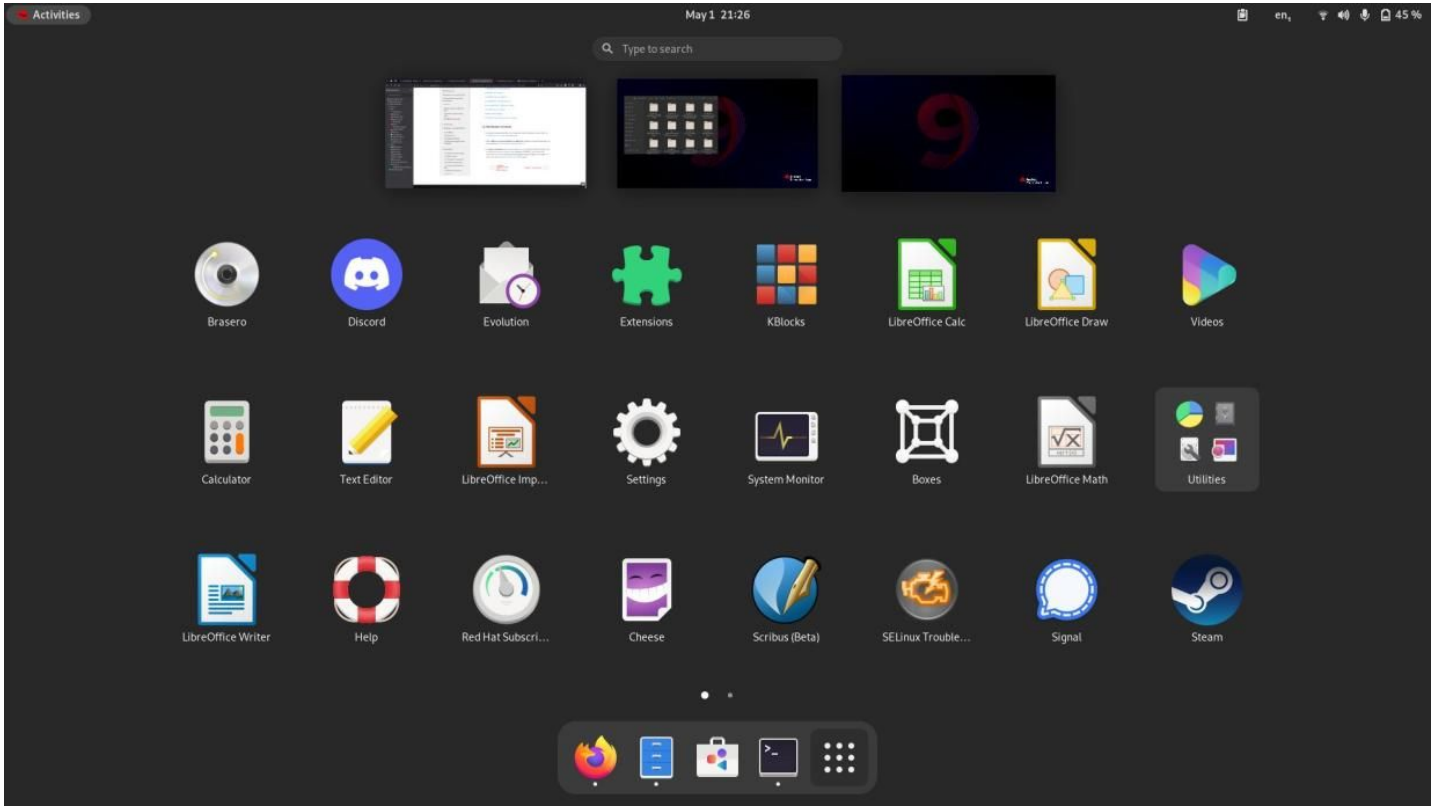

Applications
Terminal - debugpoint@...
Wed 5 May, 03:03 debugpoint.com
Terminal - debugpoint@debugpoint: ~
Debian bullseye-DI...
Trash
File System
Home
Terminal - debugpoint@debugpoint: ~
File Edit View Terminal Tabs Help
debugpoint@debugpoint:~$ neofetch
debugpoint@debugpoint
OS: Debian GNU/Linux bullseye/sid x86_64
Host: KVM/QEMU (Standard PC (i440FX + PIIX, 1996)
Kernel: 5.10.0-6-amd64
Uptime: 1 hour, 27 mins
Packages: 1244 (dpkg)
Shell: bash 5.1.4
Resolution: 1600x829
DE: Xfce 4.16
WM: Xfwm4
WM Theme: Default
Theme: Xfce [GTK2], Adwaita [GTK3]
Icons: Tango [GTK2], Adwaita [GTK3]
Terminal: xfce4-terminal
Terminal Font: Monospace 12
CPU: Intel i5-8250U (8) @ 1.799GHz
GPU: 00:02.0 Red Hat, Inc. QXL paravirtual graphi
Memory: 398MiB / 1981MiB
debian

Red Hat

Red Hat Enterprise Linux (RHEL) is a successor of Red Hat Linux, which is one of the oldest Linux distros.

The original version was published in 1995 and was replaced by RHEL in 2003. It’s a paid distro, and as you can guess from its name, it’s aimed at business users.

Red Hat



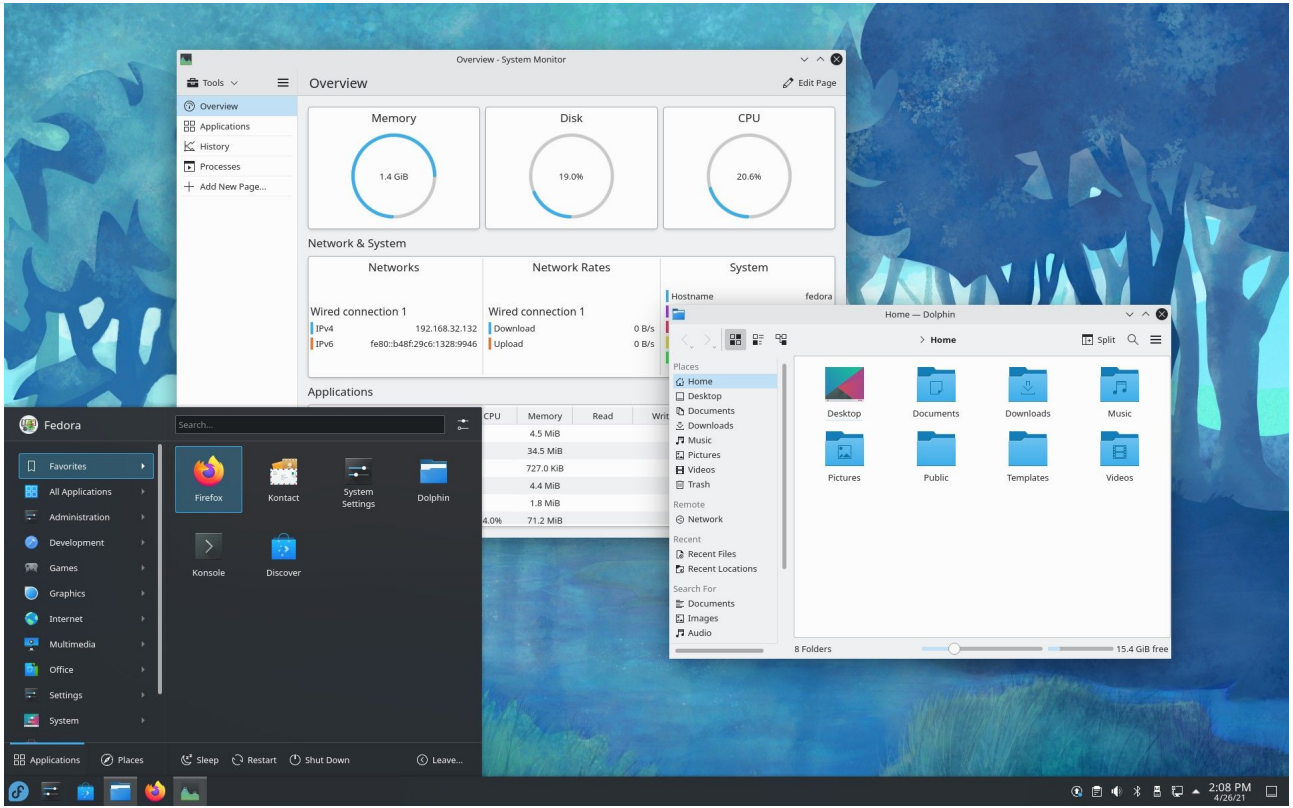
Red Hat
Enterprise Linux

Fedora

Fedora distribution is officially released on 6 November 2003 for the first time. Fedora was a **volunteer project** which was providing extra software for the Red Hat distribution.

When the Red Hat Linux was discontinued, the Fedora Linux project is launched as a Linux distribution. As Red Hat Enterprise Linux sponsors the Fedora Project, Fedora is a trademark of Red Hat Inc. The most recent version of Fedora is Fedora 32 as writing this post which is released on 28 April 2020.

Fedora



fedora

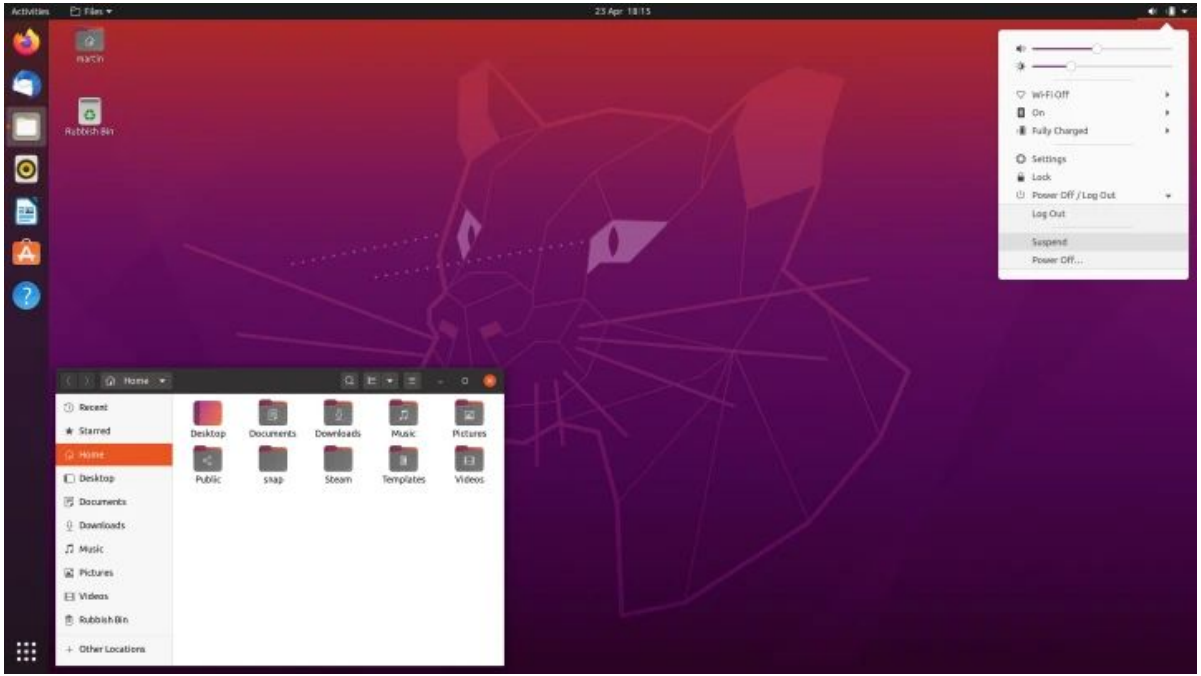
Ubuntu

The first version of Ubuntu – Ubuntu 4.10 (Warty Warthog) – was released in 2004 by the South African Internet mogul Mark Shuttleworth.

In ancient Zulu and Xhosa, “Ubuntu” means “humanity to others.”

Ubuntu is based on the latest Debian distro and uses the same .deb package system, though not all Debian packages can be installed on Ubuntu. A new version is released every six months, and a long-term release comes once every two years.

Ubuntu



ubuntu

Break Time

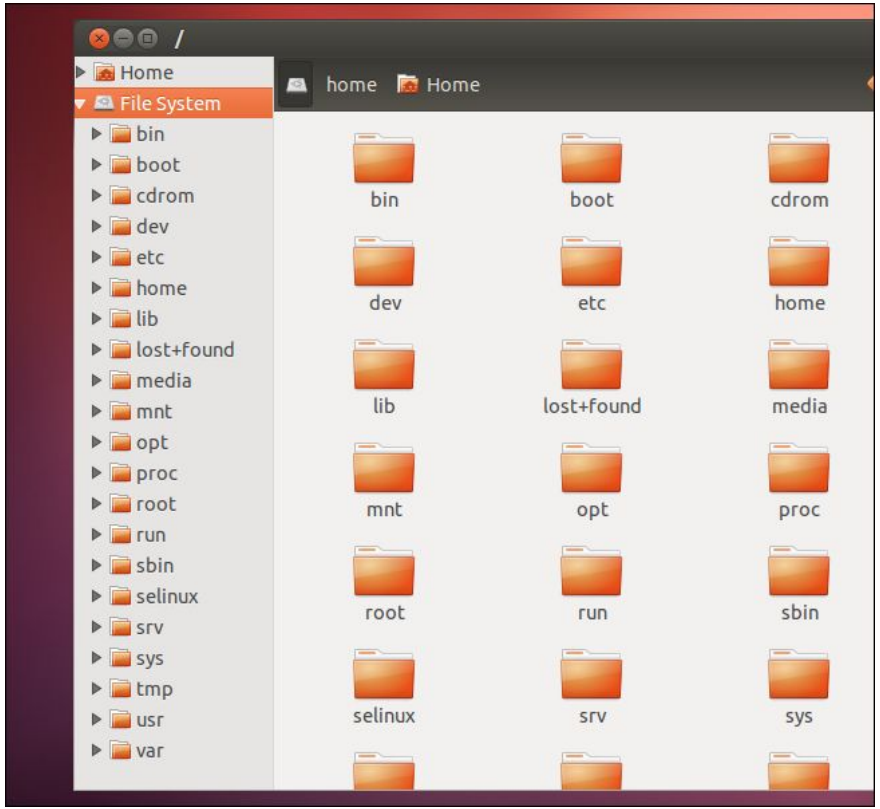
Linux For Programming: What you need to know

Directory Structure

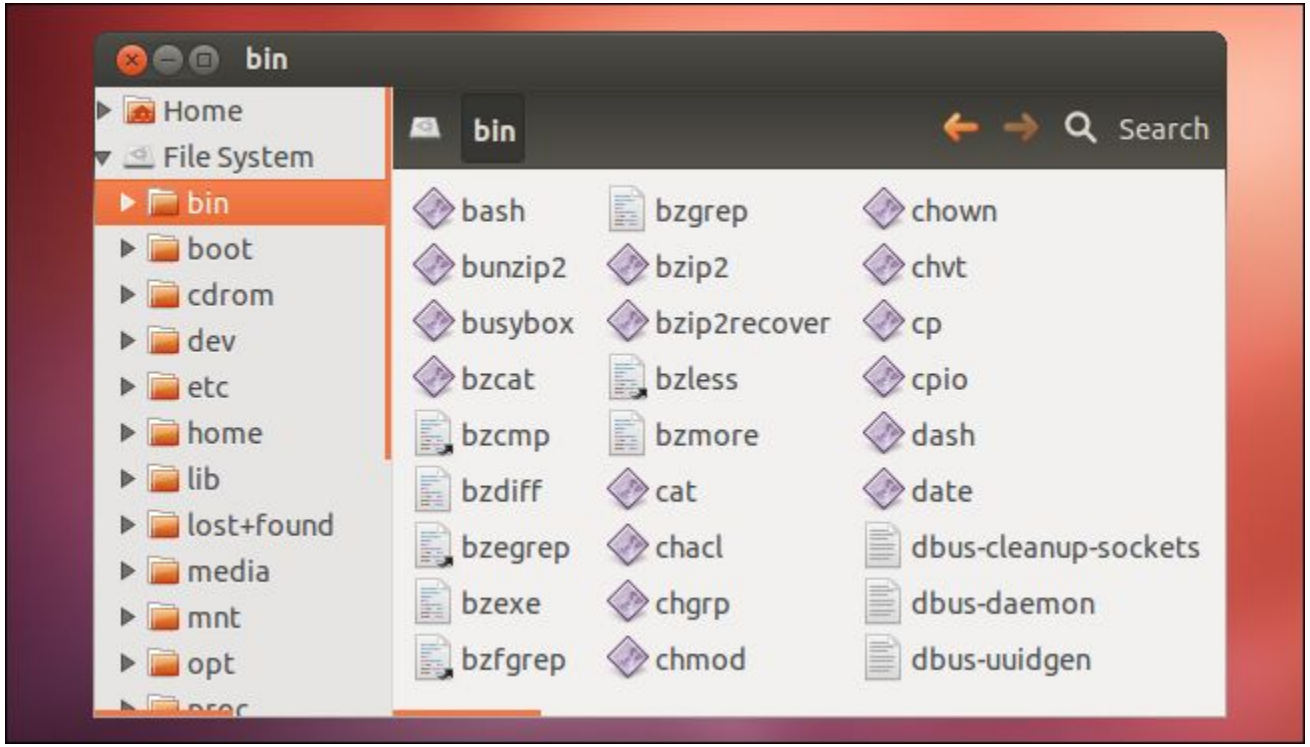
Not like Windows, the Linux file system structure can seem particularly alien. The C:\ drive and drive letters are gone, replaced by a / and cryptic-sounding directories, **most of which have three letter names**.

The Filesystem Hierarchy Standard (FHS) defines the structure of file systems on Linux and other UNIX-like operating systems. However, Linux file systems also contain some directories that aren’t yet defined by the standard.

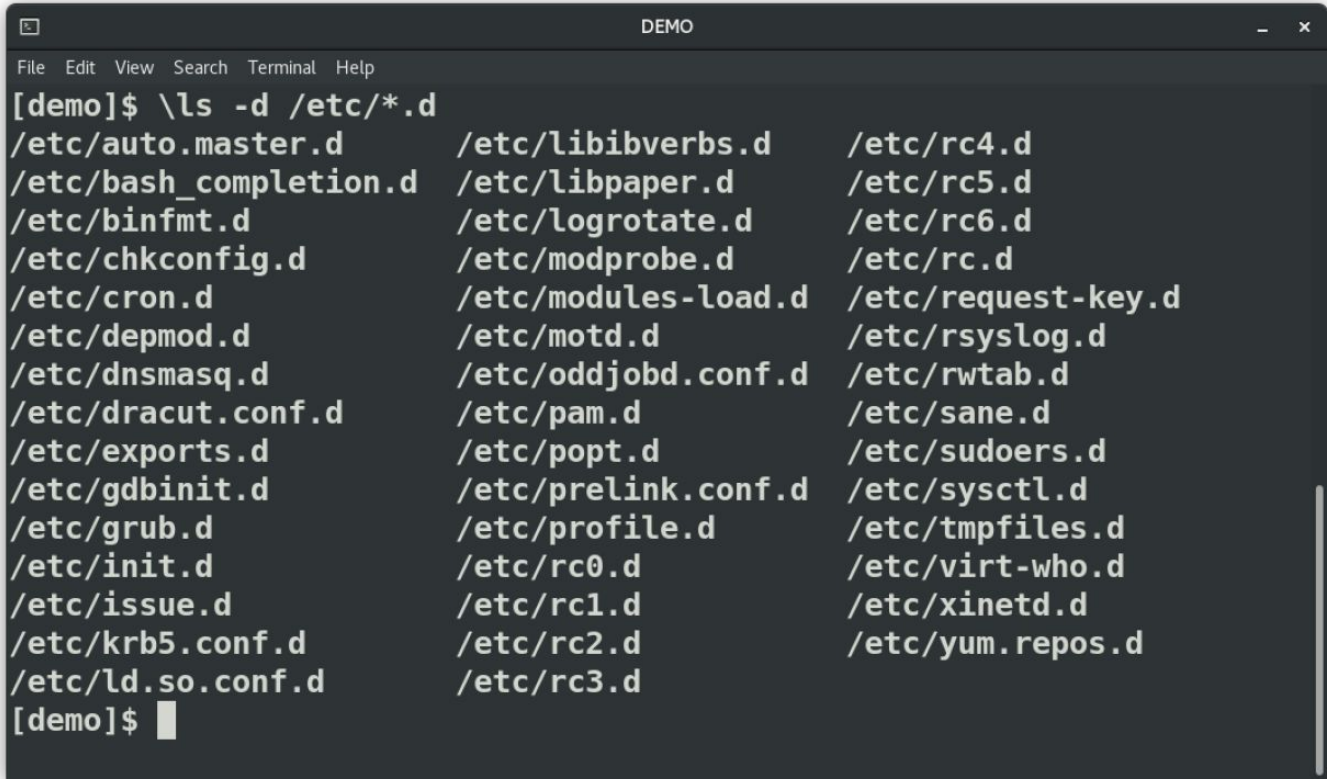
Directory Structure - root or (/)



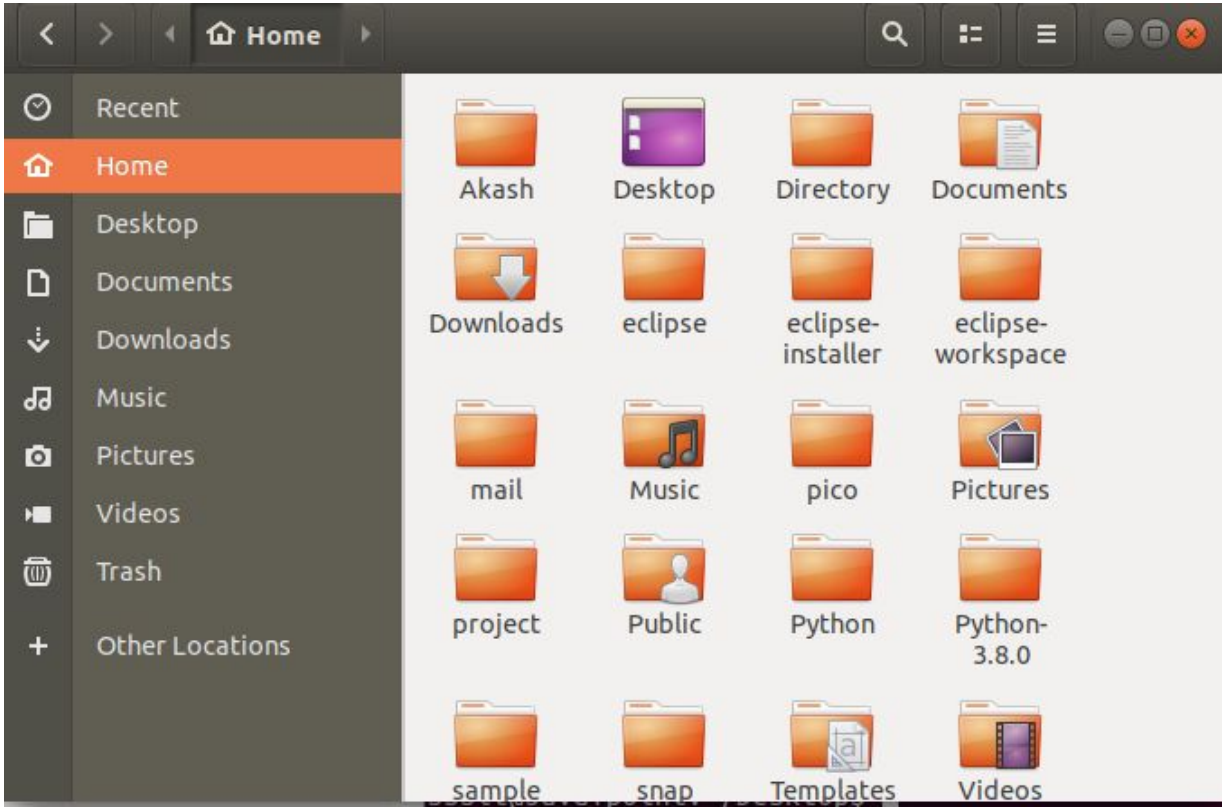
Directory Structure - /bin - essential binaries



Directory Structure - /etc - config files



Directory Structure - /home - home folders



Environment Variables

To set an environment variable the **export** command is used.

We give the variable a name, which is what is used to access it in shell scripts and configurations and then a value to hold whatever data is needed in the variable.

export NAME=VALUE

E.g. **export JAVA_HOME=/opt/openjdk11**

To view env variables:

printenv

Service Manager

systemd is an init system and system manager that has widely become the new standard for Linux distributions.

Due to its heavy adoption, familiarizing yourself with *systemd* is worth the trouble, as it will make administering servers considerably easier.

Please note that although systemd has become the default init system for many Linux distributions, it isn’t implemented universally across all distros.

Service Manager

VIEWING systemd INFORMATION

`systemctl list-dependencies`	Show a unit's dependencies
`systemctl list-sockets`	List sockets and what activates
`systemctl list-jobs`	View active systemd jobs
`systemctl list-unit-files`	See unit files and their states
`systemctl list-units`	Show if units are loaded/active
`systemctl get-default`	List default target (like run level)

WORKING WITH SERVICES

`systemctl stop` *service*	Stop a running service
`systemctl start` *service*	Start a service
`systemctl restart` *service*	Restart a running service
`systemctl reload` *service*	Reload all config files in service
`systemctl daemon-reload`	Must run to reload changed unit files
`systemctl status` *service*	See if service is running/enabled
`systemctl --failed`	Shows services that failed to run
`systemctl reset-failed`	Resets any units from failed state
`systemctl enable` *service*	Enable a service to start on boot
`systemctl disable` *service*	Disable service--won't start at boot
`systemctl show` *service*	Show properties of a service (or other unit)
`systemctl edit` *service*	Create snippit to drop in unit file
`systemctl edit --full` *service*	Edit entire unit file for service
`systemctl -H` *host* `status network`	Run any systemctl command remotely

CHANGING SYSTEM STATES

`systemctl reboot`	Reboot the system (reboot.target)
`systemctl poweroff`	Power off the system (poweroff.target)
`systemctl emergency`	Put in emergency mode (emergency.target)
`systemctl default`	Back to default target (multi-user.target)

VIEWING LOG MESSAGES

`journalctl`	Show all collected log messages
`journalctl -u network.service`	See network service messages
`journalctl -f`	Follow messages as they appear
`journalctl -k`	Show only kernel messages

USING UNIT FILES

Besides **services**, most systemd commands can work with these unit types: **paths**, **slices**, **snapshots**, **sockets**, **swaps**, **targets**, and **timers**

Useful Links

https://www.baeldung.com/linux/

https://access.redhat.com/sites/default/files/attachments/12052018_systemd_6.pdf

What’s next?