

CS242: Systems Software Lab

Overview of Unix System

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Overview

- Unix, its family tree and Unix like distributions.
- Basic Terminologies used in Unix/Linux
- What happens when an Unix/Linux OS powers on
- Some basic commands

What is Unix?

- Unix is an Operating System and set of tools which provide a development environment.
- Developed around 1970s at the Bell Labs research center by Ken Thompson, Dennis Ritchie, and others.
- Recommended reading: https://en.wikipedia.org/wiki/History_of_Unix

The chart illustrates the lineage of operating systems, categorized by source type: Open source (green), Mixed/shared source (orange), and Closed source (pink). The timeline spans from 1969 to 2017.

Legend:

- Open source (Green)
- Mixed/shared source (Orange)
- Closed source (Pink)

Key Operating System Lineages:

- Unix-like systems (Green):**
 - Minix 1.x (1971-1973)
 - Linux 0.0.1 (1991)
 - Linux 0.95 to 1.2.x (1992-1994)
 - Linux 2.x (1995-2000)
 - Linux 3.x (2001-2004)
 - Linux 4.x (2005-2007)
 - Minix 2.x (1996-1997)
 - Minix 3.1.0-3.4.0 (2008-2010)
 - FreeBSD 3.3-11.x (2001-2004)
 - FreeBSD 4.4-Lite & Life Release 2 (2005-2007)
 - FreeBSD 5.0 to 9.2 (2008-2010)
 - FreeBSD 10.0 to 10.12 (Darwin 1.2.1 to 1.7) (2011-2015)
 - FreeBSD 11.0-11.3 (2016-2017)
 - OpenBSD 1.0 to 2.2 (2001-2004)
 - OpenBSD 2.3-6.1 (2005-2007)
 - OpenBSD 7.x (System V R5) (2008-2010)
 - OpenBSD 10.x (2011-2015)
 - OpenBSD 11.0-11.3 (2016-2017)
- BSD (Orange):**
 - BSD 1.0 to 2.0 (1971-1973)
 - BSD 3.0 to 4.1 (1974-1975)
 - BSD 4.2 (1976-1978)
 - BSD 4.3 (1979-1981)
 - BSD 4.3 Tahoe (1982-1984)
 - BSD 4.3 Reno (1985-1987)
 - BSD Net/1 (1988-1990)
 - BSD Net/2 (1991-1993)
 - 386BSD (1994-1996)
 - NetBSD 0.6 to 1.0 (1997-1999)
 - NetBSD 1.1 to 1.2 (2000-2002)
 - NetBSD 1.3 (2003-2005)
 - NetBSD 1.3-7.1 (2006-2007)
 - DragonFly BSD 1.0 to 4.8 (2008-2010)
- Other (Pink):**
 - Unix Version 1 to 4 (1971-1973)
 - Unix Version 5 to 6 (1974-1975)
 - Unix Version 7 (1976-1978)
 - Unix Version 8 (1979-1981)
 - Unix Version 9 and 10 (last versions from Bell Labs) (1982-1984)
 - Unix Version 11 (1985-1987)
 - Unix Version 12 (1988-1990)
 - Unix Version 13 (1991-1993)
 - Unix Version 14 (1994-1996)
 - Unix Version 15 (1997-1999)
 - Unix Version 16 (2000-2002)
 - Unix Version 17 (2003-2005)
 - Unix Version 18 (2006-2007)
 - Unix Version 19 (2008-2010)
 - Unix Version 20 (2011-2015)
 - Unix Version 21 (2016-2017)
 - HP-UX 1.0 to 1.2 (1982-1984)
 - HP-UX 2.0 to 3.0 (1985-1987)
 - HP-UX 6 to 11 (1988-1990)
 - HP-UX 11+ (1991-1993)
 - HP-UX 11+ (2001-2004)
 - HP-UX 11+ (2005-2007)
 - HP-UX 11+ (2008-2010)
 - HP-UX 11+ (2011-2015)
 - HP-UX 11+ (2016-2017)
 - HP-UX 11+ (2018-2020)
 - HP-UX 11+ (2021-2023)
 - HP-UX 11+ (2024-2026)
 - HP-UX 11+ (2027-2029)
 - HP-UX 11+ (2030-2032)
 - HP-UX 11+ (2033-2035)
 - HP-UX 11+ (2036-2038)
 - HP-UX 11+ (2039-2041)
 - HP-UX 11+ (2042-2044)
 - HP-UX 11+ (2045-2047)
 - HP-UX 11+ (2048-2050)
 - HP-UX 11+ (2051-2053)
 - HP-UX 11+ (2054-2056)
 - HP-UX 11+ (2057-2059)
 - HP-UX 11+ (2060-2062)
 - HP-UX 11+ (2063-2065)
 - HP-UX 11+ (2066-2068)
 - HP-UX 11+ (2069-2071)
 - HP-UX 11+ (2072-2074)
 - HP-UX 11+ (2075-2077)
 - HP-UX 11+ (2078-2080)
 - HP-UX 11+ (2081-2083)
 - HP-UX 11+ (2084-2086)
 - HP-UX 11+ (2087-2089)
 - HP-UX 11+ (2090-2092)
 - HP-UX 11+ (2093-2095)
 - HP-UX 11+ (2096-2098)
 - HP-UX 11+ (2099-2101)
 - HP-UX 11+ (2102-2104)
 - HP-UX 11+ (2105-2107)
 - HP-UX 11+ (2108-2110)
 - HP-UX 11+ (2111-2113)
 - HP-UX 11+ (2114-2116)
 - HP-UX 11+ (2117-2119)
 - HP-UX 11+ (2120-2122)
 - HP-UX 11+ (2123-2125)
 - HP-UX 11+ (2126-2128)
 - HP-UX 11+ (2129-2131)
 - HP-UX 11+ (2132-2134)
 - HP-UX 11+ (2135-2137)
 - HP-UX 11+ (2138-2140)
 - HP-UX 11+ (2141-2143)
 - HP-UX 11+ (2144-2146)
 - HP-UX 11+ (2147-2149)
 - HP-UX 11+ (2150-2152)
 - HP-UX 11+ (2153-2155)
 - HP-UX 11+ (2156-2158)
 - HP-UX 11+ (2159-2161)
 - HP-UX 11+ (2162-2164)
 - HP-UX 11+ (2165-2167)
 - HP-UX 11+ (2168-2170)
 - HP-UX 11+ (2171-2173)
 - HP-UX 11+ (2174-2176)
 - HP-UX 11+ (2177-2179)
 - HP-UX 11+ (2180-2182)
 - HP-UX 11+ (2183-2185)
 - HP-UX 11+ (2186-2188)
 - HP-UX 11+ (2189-2191)
 - HP-UX 11+ (2192-2194)
 - HP-UX 11+ (2195-2197)
 - HP-UX 11+ (2198-2200)
 - HP-UX 11+ (2201-2203)
 - HP-UX 11+ (2204-2206)
 - HP-UX 11+ (2207-2209)
 - HP-UX 11+ (2210-2212)
 - HP-UX 11+ (2213-2215)
 - HP-UX 11+ (2216-2218)
 - HP-UX 11+ (2219-2221)
 - HP-UX 11+ (2222-2224)
 - HP-UX 11+ (2225-2227)
 - HP-UX 11+ (2228-2230)
 - HP-UX 11+ (2231-2233)
 - HP-UX 11+ (2234-2236)
 - HP-UX 11+ (2237-2239)
 - HP-UX 11+ (2240-2242)
 - HP-UX 11+ (2243-2245)
 - HP-UX 11+ (2246-2248)
 - HP-UX 11+ (2249-2251)
 - HP-UX 11+ (2252-2254)
 - HP-UX 11+ (2255-2257)
 - HP-UX 11+ (2258-2260)
 - HP-UX 11+ (2261-2263)
 - HP-UX 11+ (2264-2266)
 - HP-UX 11+ (2267-2269)
 - HP-UX 11+ (2270-2272)
 - HP-UX 11+ (2273-2275)
 - HP-UX 11+ (2276-2278)
 - HP-UX 11+ (2279-2281)
 - HP-UX 11+ (2282-2284)
 - HP-UX 11+ (2285-2287)
 - HP-UX 11+ (2288-2290)
 - HP-UX 11+ (2291-2293)
 - HP-UX 11+ (2294-2296)
 - HP-UX 11+ (2297-2299)
 - HP-UX 11+ (2300-2302)
 - HP-UX 11+ (2303-2305)
 - HP-UX 11+ (2306-2308)
 - HP-UX 11+ (2309-2311)
 - HP-UX 11+ (2312-2314)
 - HP-UX 11+ (2315-2317)
 - HP-UX 11+ (2318-2320)
 - HP-UX 11+ (2321-2323)
 - HP-UX 11+ (2324-2326)
 - HP-UX 11+ (2327-2329)
 - HP-UX 11+ (2330-2332)
 - HP-UX 11+ (2333-2335)
 - HP-UX 11+ (2336-

https://upload.wikimedia.org/wikipedia/commons/7/77/Unix_history-simple.svg

Software Licences

A **software license** is a legal instrument governing the use or redistribution of software.

Recommended Reading: <https://choosealicense.com/licenses/>

Common Licences of popular softwares:

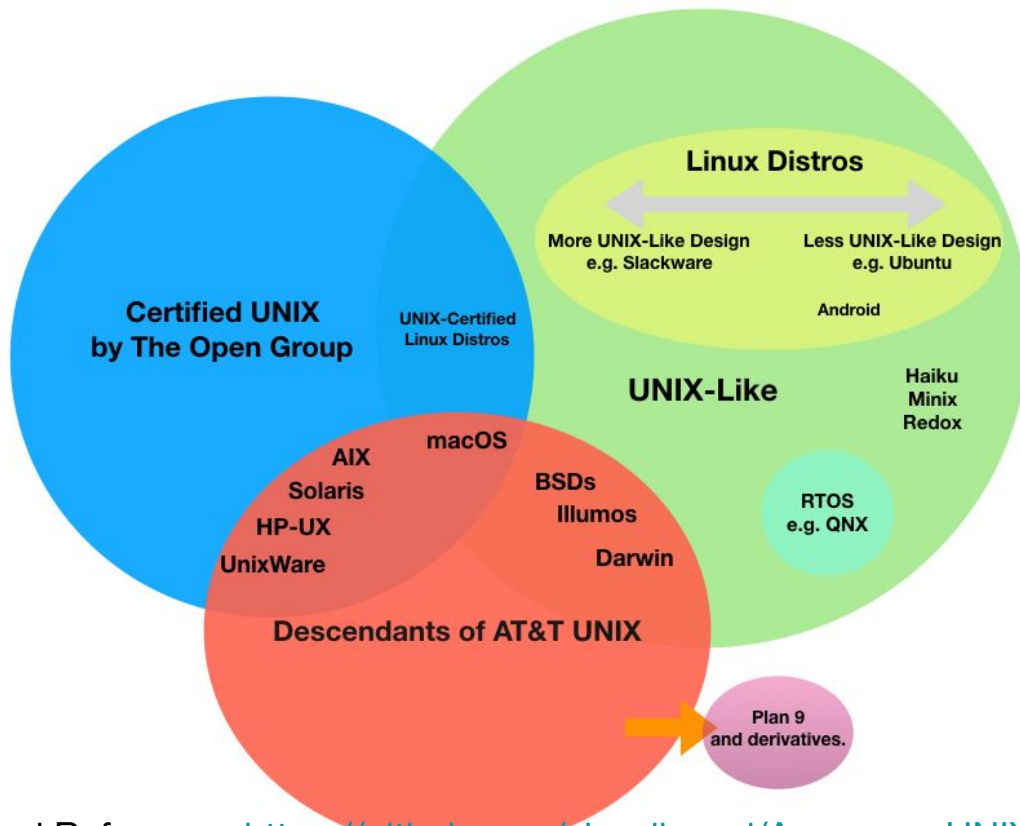
GPL: Linux Kernel, MySQL, Notepad++, OpenJDK

MIT: Ruby on Rails, Node.js, jQuery, X Window System

Apache: Android, Hadoop

Proprietary freeware: Google Chrome

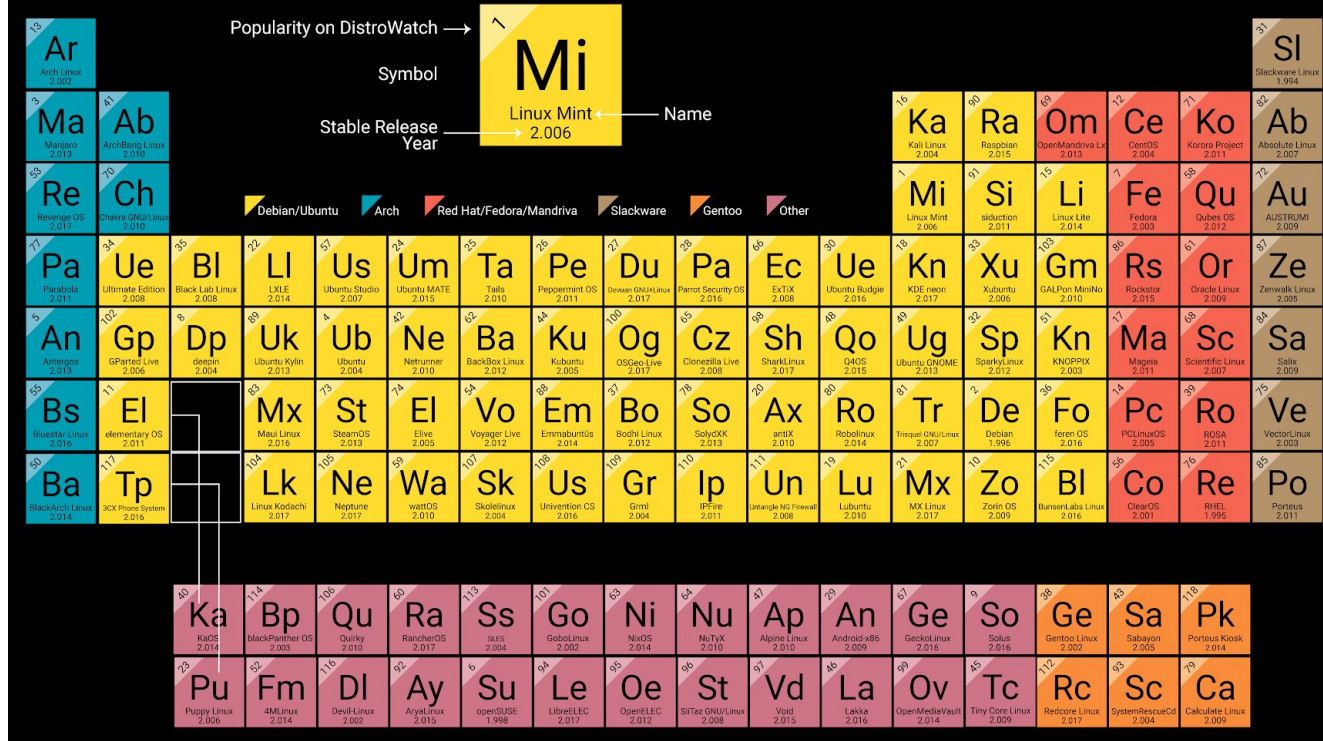
Disambiguation: AT&T UNIX®, UNIX® Certification, UNIX®-Like, and Linux®



Recommended reading and Reference: <https://github.com/sirredbeard/Awesome-UNIX>

Popular Linux Distributions

Periodic Table of Linux Distros

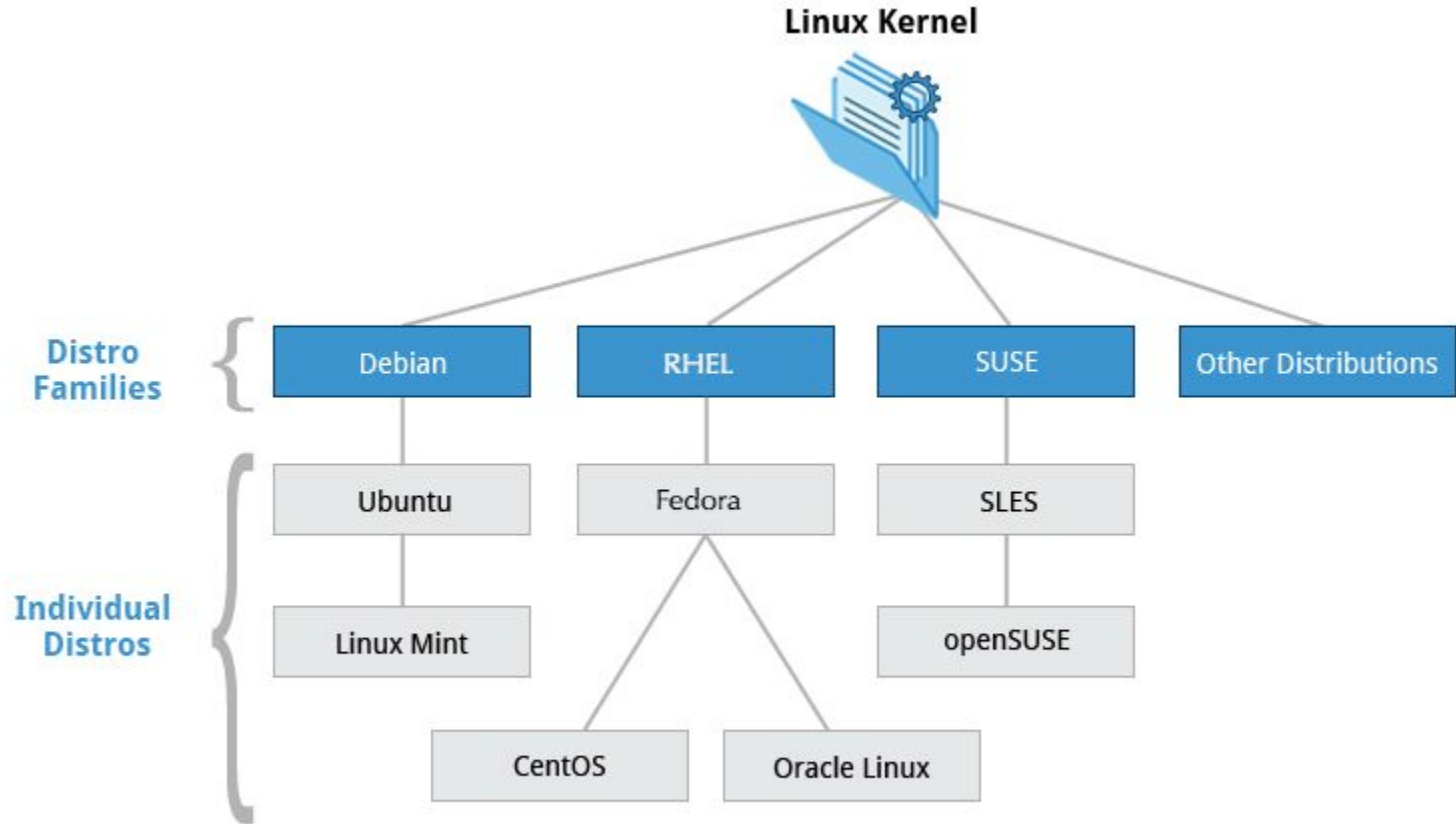


Reference: <https://distrowatch.com/images/other/periodic-table-of-distro.png>

Some Facts about Linux

- More than 300 Linux distributions available.
- Started in 1991 by Linus Torvalds for his own use.
- Linux kernel: Over 2000 developers from 500 companies contribute every year.
- Largest single software project in the history of mankind!
- 20 millions line of code.
- More than 90% of supercomputers use Linux.
- Android is powered by Linux kernel.
- Linux is used in every major space program.
- Google, amazon, twitter, facebook, instagram are all powered by Linux.

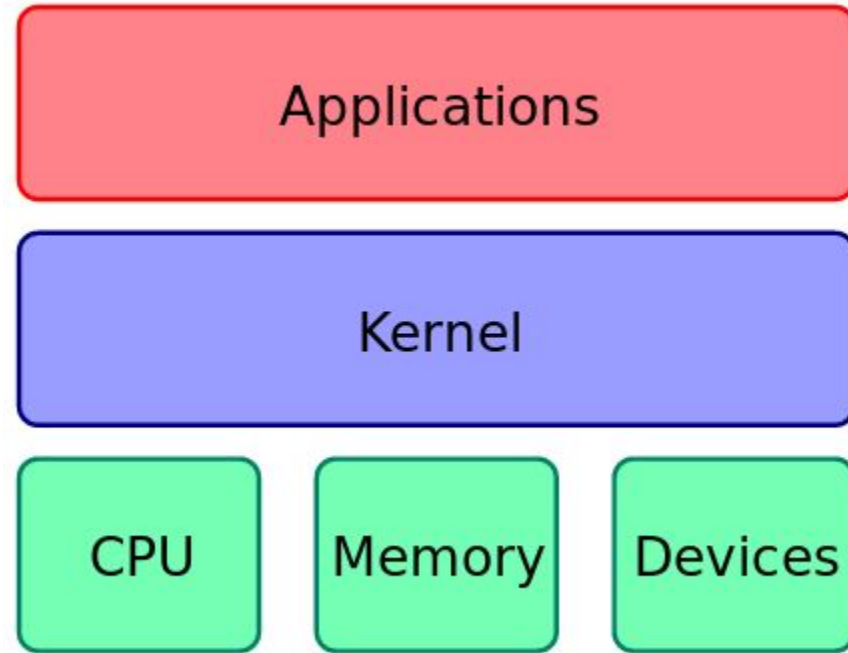
Major Linux Distribution Families



Basic Terminologies Unix/Linux

- Kernel
- Distribution
- Bootloader
- Service
- Filesystem
- X window
- Desktop environment
- Command line
- Shell
- Terminal

Kernel: The Glue between hardware and Software Applications



Examples: Linux Kernel, GNU Hurd.

Distribution: Collection of software combined with kernel to make a Operating System

Some popular Unix-based Distributions:

- MacOS
- FreeBSD
- OpenBSD
- Solaris

Some popular Linux Distributions:

- Red had
- Fedora
- Ubuntu
- Gentoo
- Arch Linux
- Linux Mint

Bootloader: The program that loads the OS when a computer is powered on

Example: GRUB, Syslinux, BOOTMGR

Recommended reading: <https://en.wikipedia.org/wiki/Booting>

Service: It is program that runs as a background process

Example: httpd, named, nfsd, ntpd, ftpd, dscpd

Also known as **daemon**.

Recommended reading: [https://en.wikipedia.org/wiki/Daemon_\(computing\)](https://en.wikipedia.org/wiki/Daemon_(computing))

Filesystem: A method for storing and organizing files.

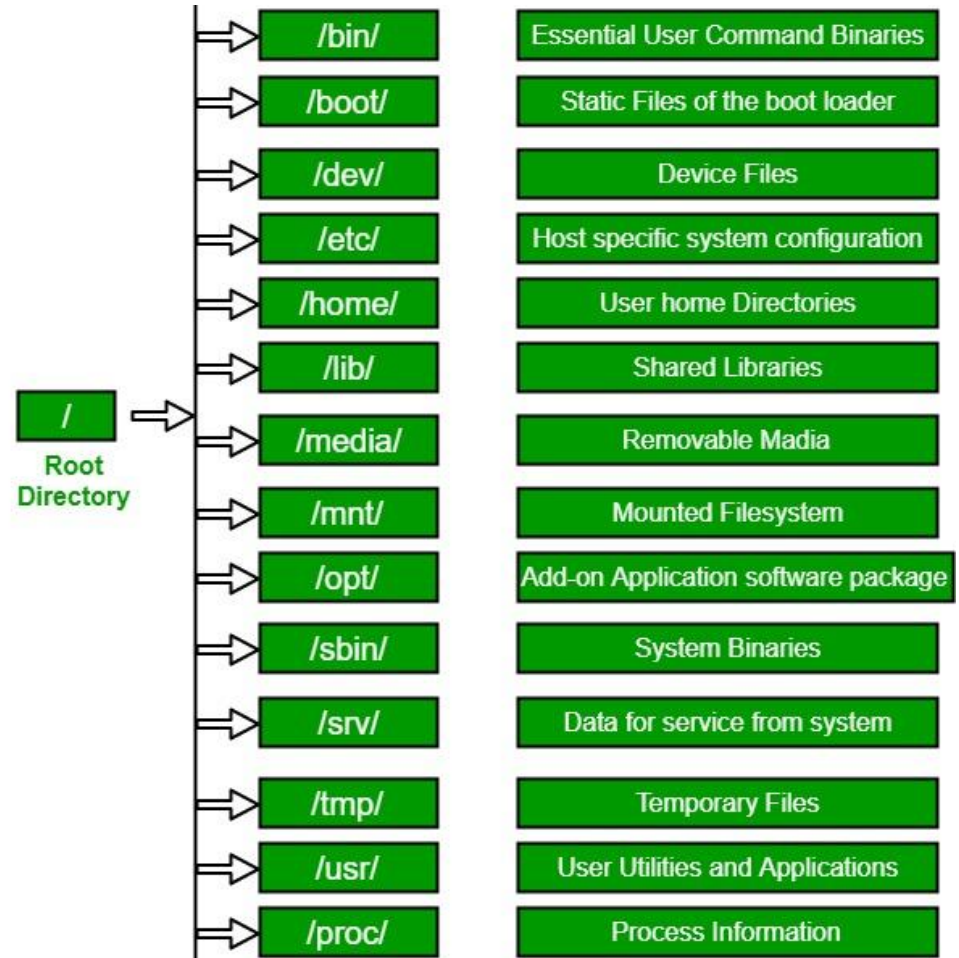
Examples: ext3, ext4, FAT, NTFS, BRTFS, XFS

Filesystem Hierarchy Standard (FHS)

Recommended Reading:

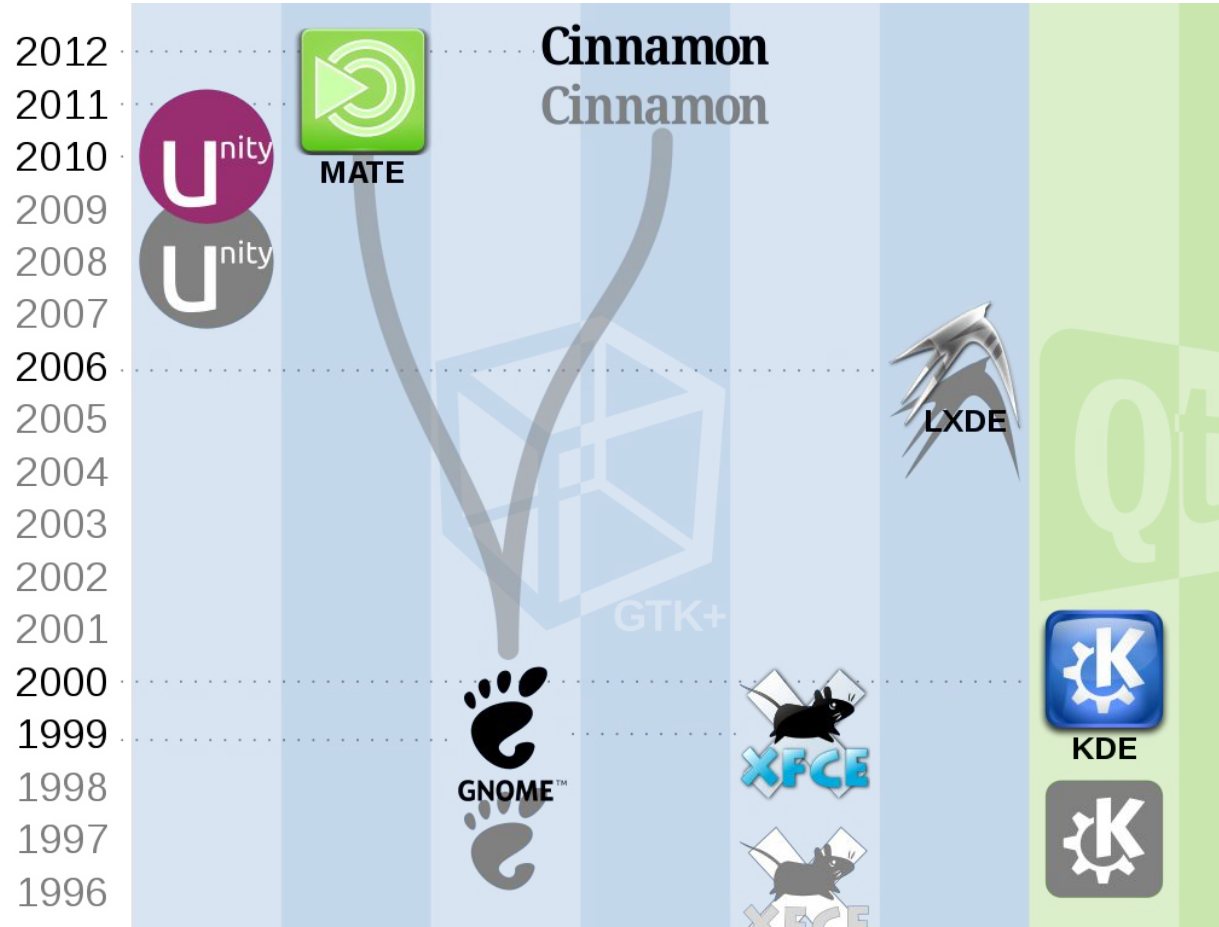
Wikipedia:

[Filesystem Hierarchy Standard](https://en.wikipedia.org/wiki/Filesystem_Hierarchy_Standard)



X Window System: Provide toolkit and protocols to build graphical interface systems.

Desktop Environment: Provides GUI on top of OS



The image shows a Linux desktop environment, likely Ubuntu MATE, running on a Raspberry Pi 4. The desktop background is a scenic mountain landscape. The top panel displays the time as 09:38 on Tuesday, August 1, 2017. A dock at the bottom contains icons for various applications, including the Dash, Home Folder, Files, Mail, Calendar, Music, Videos, Web Browser, Settings, System Monitor, Network Manager, and Power. A sidebar on the right side of the desktop provides navigation options, including Home, Recent, and Favorites. The system is running on a Raspberry Pi 4, as indicated by the boot logo in the top right corner.

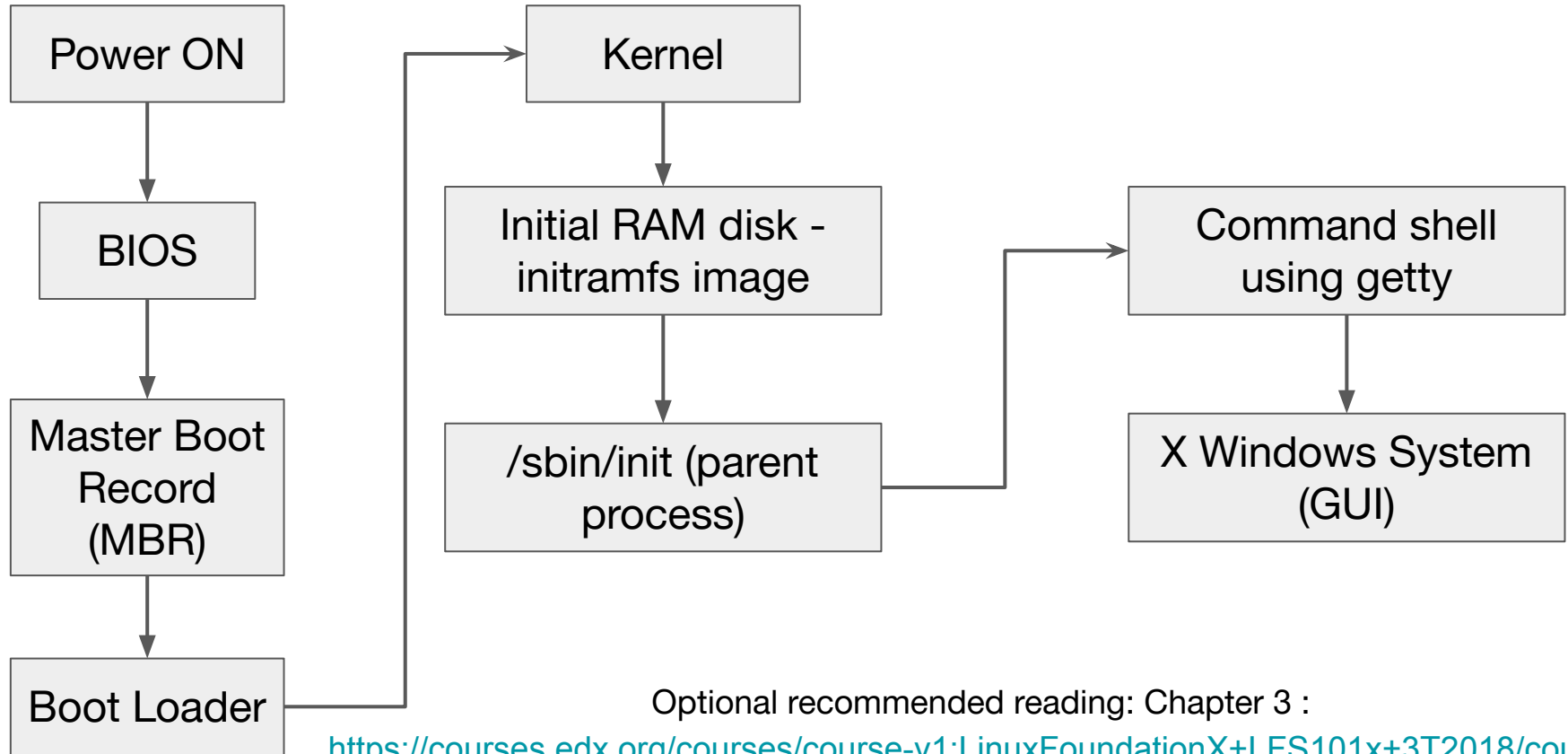
Command line, Shell and Terminal

Command line: It is an interface for typing commands on top of OS

Shell: It is a command line interpreter that interprets the command line input and instruct OS to perform any necessary task.

Terminal: It is a computer program that emulates a video terminal within some other display architecture.

What Happens when we power on a computer?



Optional recommended reading: Chapter 3 :

<https://courses.edx.org/courses/course-v1:LinuxFoundationX+LFS101x+3T2018/course/>

Choosing a Linux Distribution

- What is the main function of the system (server or desktop)?
- What types of packages are important to the organization? For example, web server, word processing, etc.
- How much hard disk space is required and how much is available? For example, when installing Linux on an embedded device, space is usually constrained.
- How often are packages updated?
- How long is the support cycle for each release? For example, LTS releases have long-term support.
- Do you need kernel customization from the vendor or a third party?
- What hardware are you running on? For example, it might be X86, ARM, etc.
- Do you need long-term stability? Can you accept (or need) a more volatile cutting edge system running the latest software?

Source: <https://courses.edx.org/courses/course-v1:LinuxFoundationX+LFS101x+3T2018/course/>

Recommended OS for CS242: Ubuntu 18.04

Other options:

- Fedora
- Linux Mint
- Arch Linux
- Manjaro
- Kali Linux
- Elementary OS
- Deepin OS

Basic Unix/Linux Commands

- Open a terminal emulator.
- Type: whoami
- Type: w
- Type: date
- Type: cal
- Type: uname -a
- Type: ls
- Type: cat a_file_path

Recommended practice commands:

<http://jatinga.iitg.ernet.in/~asahu/cs241/linuxcommands.pdf>

Lab Session: 31/07

- Ensure that any Linux OS is installed on your desktops.
- Assignment will be emailed few minutes before Lab session.
- Not a evaluation lab.
- Internet will be available.
- Objective: Make students familiar with basic and advance linux commands.