GNU/Linux 101

Introduction to *nix systems

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- Building blocks (POSIX theory)
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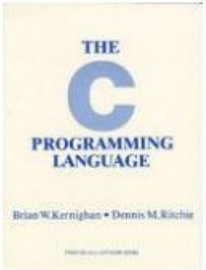
A brief history (1)

1964 →Join Multics
1969 ←Exit Multics

1969
PDP-7 Unix

1971
PDP-11 Unix



1973 (V4)
C rewrite of Unix

*https://papers.freebsd.org/2020/fosdem/losh-hidden_early_history_of_unix/

A brief history 2

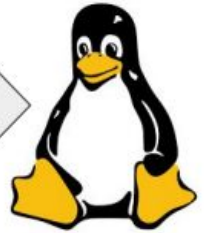
1975 (V6)
Unix in the wild
and ports start

1979 (V7)
Unix explodes

1983 4.2BSD
Unix gets networking

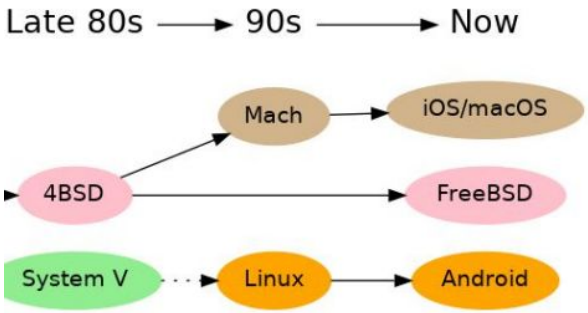
1984 System V
Unix goes Commercial

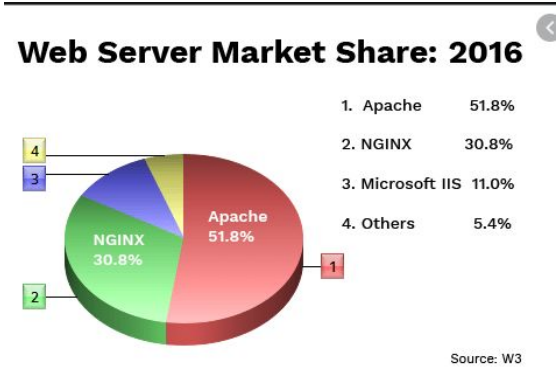
1980s
Unix Wars

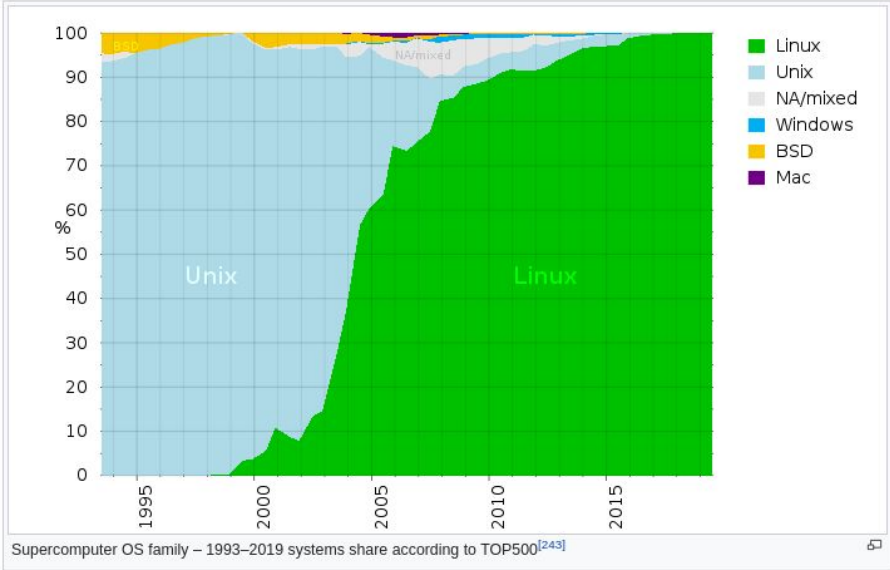


1990s
Rise of Linux
and FOSS

Where is Unix?







Supercomputer OS family – 1993–2019 systems share according to TOP500[243]

Building blocks (1)

POSIX: The POSIX 1003.1 standard is an ISO standard that specifies operating system functionality in a C language interface

Process:

- A process is an abstraction that **represents an executing program.**
- Multiple processes execute independently and **have separate address spaces.**
- Processes can **create, interrupt, and terminate other processes,** *subject to security restrictions.*

Permissions: Each user of a POSIX system has a defined user ID and group ID. User IDs and group IDs are integers; usernames and group names are strings. Permissions are defined in terms of the user ID and group ID.

Building blocks (2)

Signals: A signal is an interruption of a process. Signals can be generated by the operating system; they may also be generated by one process and sent to another (CAUGHT by the proc destiny). Some signals cannot be caught. **The signal SIGKILL can be used to terminate another process without allowing the target process to intercept termination. * AKA kill -9 vs kill -15**

Files: (1) A POSIX file is a **stream of bytes**. (2) A regular file is stored on disk and supports random access. (3) A special file has special properties: ex: a user's terminal. Another example is a **pipe**, **which is a software connection between two processes**; characters written to the pipe by one process can be read by the other process.

Directories: POSIX files are organized into directories. A directory is a file that contains a list of other files and their attributes.

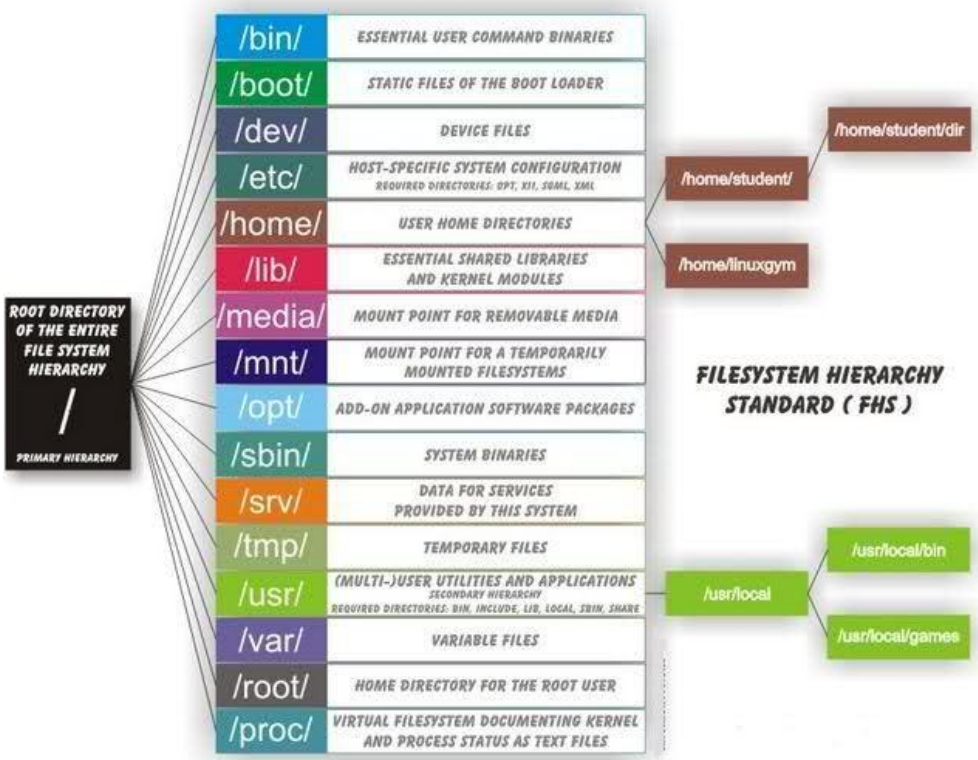
Links: it permits more than one pathname to refer to the same file.

Building blocks (3)

Terminal and sessions: A POSIX terminal is a special file. POSIX provides interfaces that are valid only for terminal files. A controlling terminal is a POSIX terminal that **controls a set of processes called a session.** In a normal UNIX system, **a session is started when a user logs in**; the controlling terminal is the terminal associated with the login.

Shell: The shell is a specialized application that is used to invoke other programs; it implements a scripting language that can be used in a similar fashion to Python*. There are differents types of shells, being bash and shell the more used.*

Directories



Key directories and files:

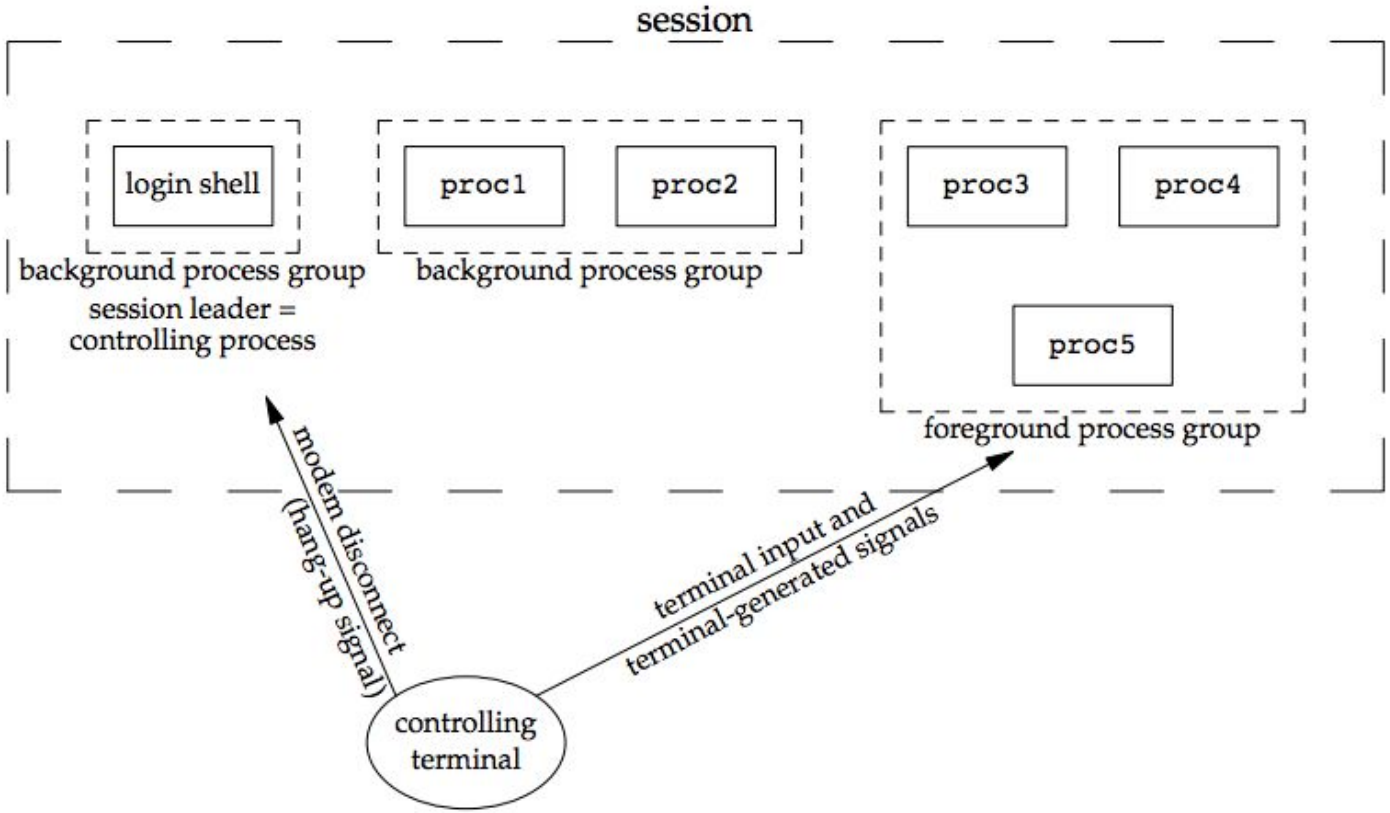
- /etc
  - passwd -> users
  - group -> groups
  - resolv.conf -> dns
  - hosts -> map ip/hosts
  - issue -> distro
- /var/log
  - message / dmesg -> system
  - wtmp * binary -> last
  - mail
- /home/{user}
- /bin /usr/bin /usr/local/bin
- /proc
  - meminfo
  - cpuinfo
- /dev/sd.. -> physical representation of our disk

Permissions / Users

```
nuxion@centinel:~ $ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
```

Número	Binario	Lectura (*r*)	Escritura (*w*)	Ejecución (*x*)
0	000	✗	✗	✗
1	001	✗	✗	✓
2	010	✗	✓	✗
3	011	✗	✓	✓
4	100	✓	✗	✗
5	101	✓	✗	✓
6	110	✓	✓	✗
7	111	✓	✓	✓

Processes and signals (1)



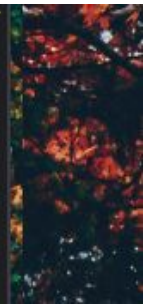
Processes and signals (2)

Signal	Value	Action	Comment
SIGHUP	1	Term	Hangup detected on controlling terminal or death of controlling process
SIGINT	2	Term	Interrupt from keyboard
SIGQUIT	3	Core	Quit from keyboard
SIGILL	4	Core	Illegal Instruction
SIGABRT	6	Core	Abort signal from abort(3)
SIGFPE	8	Core	Floating point exception
SIGKILL	9	Term	Kill signal
SIGSEGV	11	Core	Invalid memory reference
SIGPIPE	13	Term	Broken pipe: write to pipe with no readers
SIGALRM	14	Term	Timer signal from alarm(2)
SIGTERM	15	Term	Termination signal
SIGUSR1	30,10,16	Term	User-defined signal 1
SIGUSR2	31,12,17	Term	User-defined signal 2
SIGCHLD	20,17,18	Ign	Child stopped or terminated
SIGCONT	19,18,25	Cont	Continue if stopped
SIGSTOP	17,19,23	Stop	Stop process
SIGTSTP	18,20,24	Stop	Stop typed at terminal
SIGTTIN	21,21,26	Stop	Terminal input for background process
SIGTTOU	22,22,27	Stop	Terminal output for background process

The signals **SIGKILL** and **SIGSTOP** cannot be caught, blocked, or ignored.

Processes and signals (3)

```
→  signals git:(master) ✗ ps -ef | grep 6990
nuxion     32206   21309  0 14:28 pts/7    00:00:00 /home/nuxion/.pyenv/versions/3.8.6/bin/python3 tcpserver2.py 6990
nuxion     32240   31448  0 14:28 pts/9    00:00:00 socat -d -d - TCP4:localhost:6990
nuxion     32528   21422  0 14:30 pts/8    00:00:00 grep --color=auto --exclude-dir=.bzr --exclude-dir=CVS --exclude-d
ir=.git --exclude-dir=.hg --exclude-dir=.svn --exclude-dir=.idea --exclude-dir=.tox 6990
→  signals git:(master) ✗ pstree -pls 32206
systemd(1)───tmux: server(21308)───zsh(21309)───python3(32206)
→  signals git:(master) ✗
```



```
→  signals git:(master) ✗ ps -ef | grep 6990
nuxion     32991   21309  0 14:35 pts/7    00:00:00 /home/nuxion/.pyenv/versions/3.8.6/bin/python3 tcps
nuxion     33042   31448  0 14:35 pts/9    00:00:00 socat -d -d - TCP4:localhost:6990,fork
nuxion     33043   33042  0 14:35 pts/9    00:00:00 socat -d -d - TCP4:localhost:6990,fork
nuxion     33044   33042  0 14:35 pts/9    00:00:00 socat -d -d - TCP4:localhost:6990,fork
nuxion     33046   33042  0 14:35 pts/9    00:00:00 socat -d -d - TCP4:localhost:6990,fork
nuxion     33047   33042  0 14:35 pts/9    00:00:00 socat -d -d - TCP4:localhost:6990,fork
nuxion     33050   21422  0 14:36 pts/8    00:00:00 grep --color=auto --exclude-dir=.bzr --exclude-dir=
ir=.git --exclude-dir=.hg --exclude-dir=.svn --exclude-dir=.idea --exclude-dir=.tox 6990
→  signals git:(master) ✗ ps -ef | grep 6990
→  signals git:(master) ✗ pstree -pls 33046
systemd(1)───tmux: server(21308)───zsh(31448)───socat(33042)───socat(33046)
→  signals git:(master) ✗
```

Processes and signals (4)

Commands:

- ps
- top
- jobs, bg, fg
- pstree
- netstat -nap
- htop
- kill
- |
- grep
- awk

DEMO

Unix philosophy

Doug McIlroy, the inventor of Unix pipes and one of the founders of the Unix tradition, had this to say at the time [McIlroy78]:

(i) **Make each program do one thing well.** To do a new job, build afresh rather than complicate old programs by adding new features.

(ii) **Expect the output of every program to become the input to another, as yet unknown, program.** Don't clutter output with extraneous information. Avoid stringently columnar or binary input formats. Don't insist on interactive input.

(iii) **Design and build software, even operating systems, to be tried early, ideally within weeks.** Don't hesitate to throw away the clumsy parts and rebuild them.

(iv) **Use tools in preference to unskilled help to lighten a programming task,** even if you have to detour to build the tools and expect to throw some of them out after you've finished using them.

ref: http://www.catb.org/~esr/writings/taoup/html/ch01s06.html

kill -9

Thanks all

References / Copyrights

Images was got from google images, except terminal screenshots.

[Source code] https://gituhub.com/nuxion/linux101

Introduction

- https://medium.com/ingeniouslysimple/philosophy-of-unix-development-aa0104322491
- https://papers.freebsd.org/2020/fosdem/losh-hidden_early_history_of_unix/
- http://www.catb.org/~esr/writings/taoup/html/index.html
- https://lwn.net/Articles/357658/
- https://www.bbc.com/news/technology-18419231
- https://support.sas.com/documentation/onlinedoc/sasc/doc750/html/lr2/zid-6574.htm

Directories

- https://www.pathname.com/fhs/pub/fhs-2.3.html
- https://unix.stackexchange.com/questions/11544/what-is-the-difference-between-opt-and-usr-local
- https://www.howtogeek.com/117435/htg-explains-the-linux-directory-structure-explained/

Process and signals

- https://notes.shichao.io/apue/ch10/