

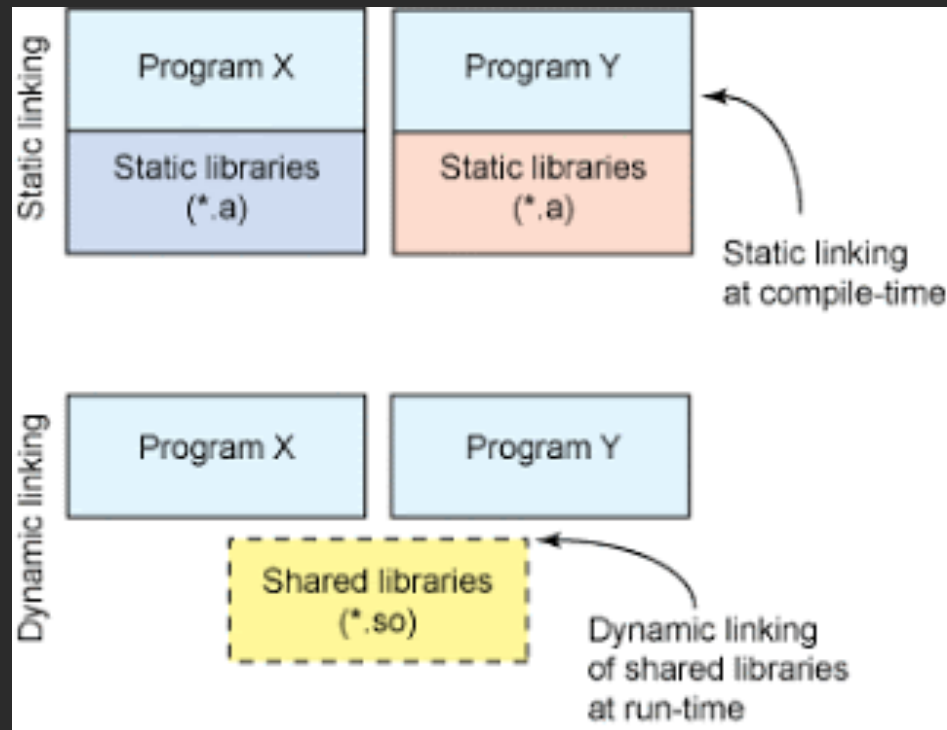
# ***Lesson 3: Managing Software and Processes***

## ***Objectives covered***

- *102.5 Use RPM and YUM package management (weight: 3)*
- *102.4 Manage Debian package management (weight: 3)*
- ***102.3 Manage shared libraries (weight: 1)***
- *103.5 Create, monitor, and kill process (weight: 4)*
- ***103.6 Modify process execution priorities (weight: 2)***

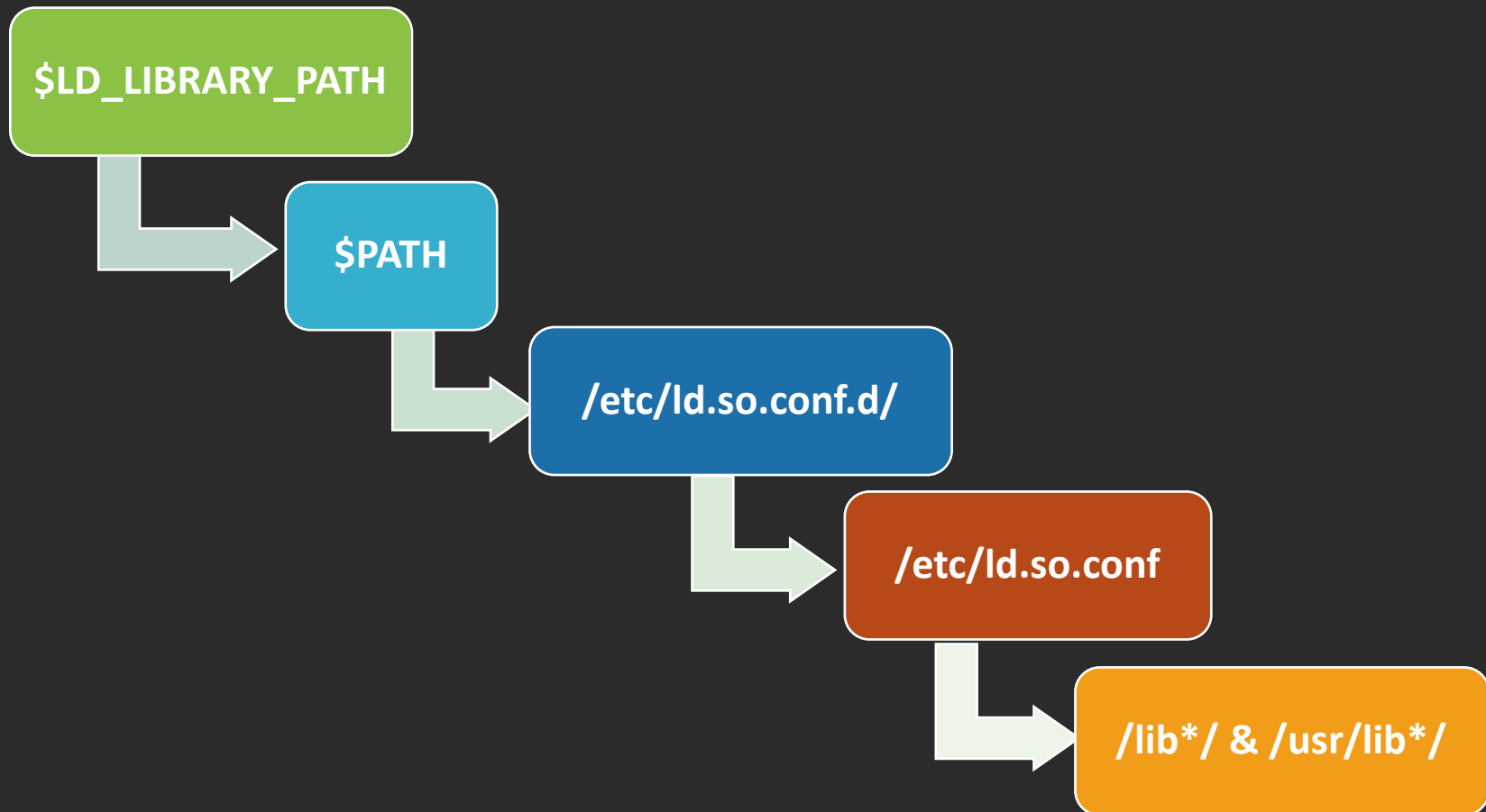
# ***Manage shared libraries***

# Library types

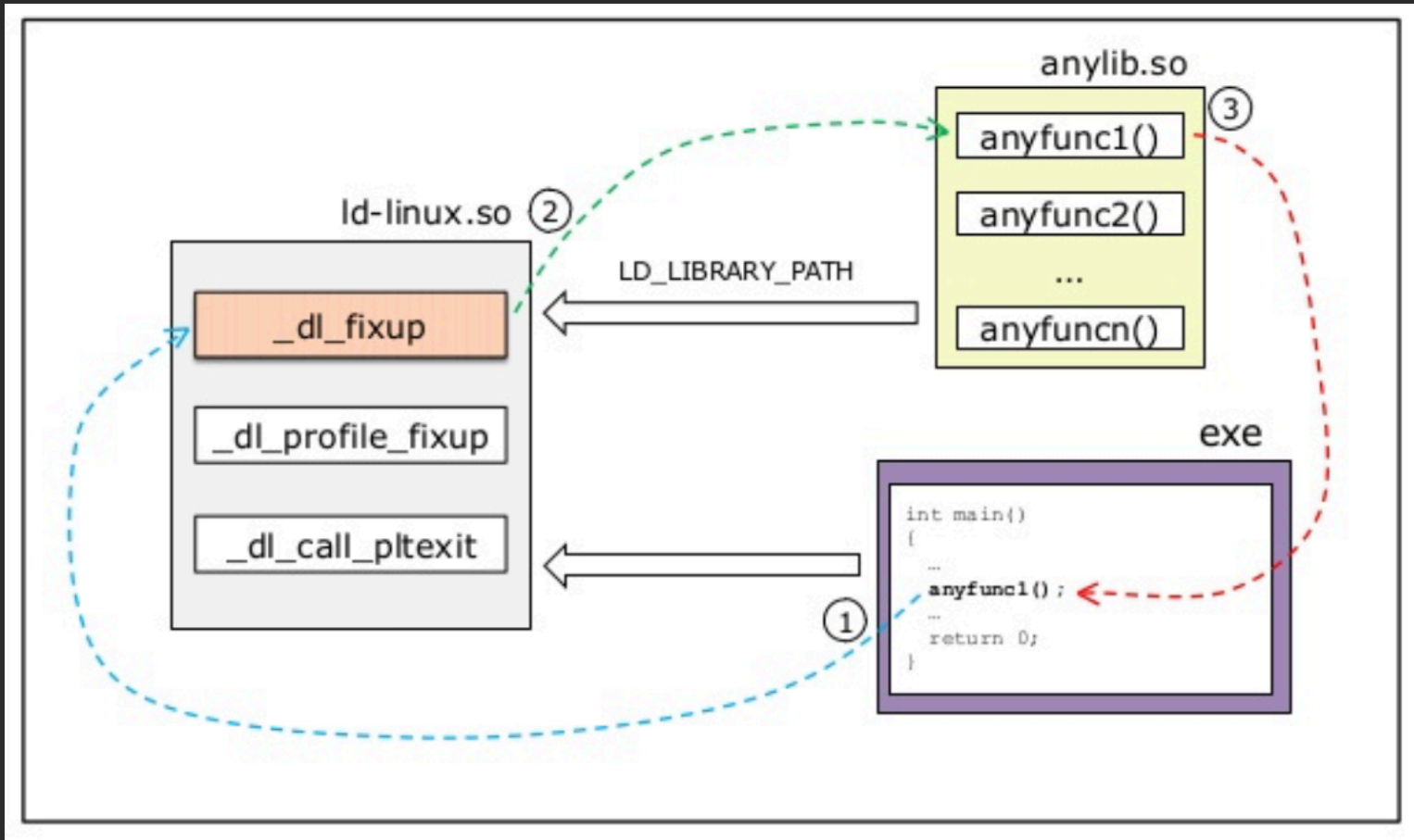


*Shared library naming convention: `libLIBRARYNAME.so.VERSION`*

# *Library files location*



# Dynamic linker/loader (*ld-linux.so* or *ld.so*)



# Working with Library cache (/etc/ld.so.cache)

```
# ldconfig -v | head
/usr/lib/mesa:
    libGL.so.1 -> libGL.so.1.2
/usr/lib/i686-linux-gnu:
    liblouis.so.2 -> liblouis.so.2.2.0
/usr/lib/alsa-lib:
    libasound_module_ctl_oss.so -> libasound_module_ctl_oss.so
    libasound_module_ctl_bluetooth.so -> libasound_module_ctl_bluetooth.so
    libasound_module_pcm_bluetooth.so -> libasound_module_pcm_bluetooth.so
    libasound_module_pcm_vdownmix.so -> libasound_module_pcm_vdownmix.so
    libasound_module_rate_speexrate.so -> libasound_module_rate_speexrate_me
```

```
# ldconfig -p | head -5
916 libs found in cache `/etc/ld.so.cache'
    libzephyr.so.4 (libc6) => /usr/lib/libzephyr.so.4
    libzbar.so.0 (libc6) => /usr/lib/libzbar.so.0
    libz.so.1 (libc6) => /lib/libz.so.1
    libz.so (libc6) => /usr/lib/libz.so
```

```
# ldconfig -n /opt/dummy/lib
```

```
# vi /etc/ld.so.conf
```

```
# ldconfig
```

# *Library dependencies*

```
$ ldd /usr/bin/echo
linux-vdso.so.1 => (0x00007fffd3bd64000)
libc.so.6 => /lib64/libc.so.6 (0x00007f7c39eff000)
/lib64/ld-linux-x86-64.so.2 (0x00007f7c3a2cc000)
```



# *Create, monitor and kill process*

# Viewing processes

```
$ ps -ef
```

UID	PID	PPID	C	STIME	TTY	TIME	CMD
root	1	0	0	10:18	?	00:00:03	/sbin/init splash
root	2	0	0	10:18	?	00:00:00	[kthreadd]
root	4	2	0	10:18	?	00:00:00	[kworker/0:0H]

- **UID:** The user responsible for running the process
- **PID:** The process ID of the process
- **PPID:** The process ID of the parent process (if the process was started by another process)
- **C:** The processor utilization over the lifetime of the process
- **STIME:** The system time when the process was started
- **TTY:** The terminal device from which the process was started
- **TIME:** The cumulative CPU time required to run the process
- **CMD:** The name of the program that was started in the process

# Viewing processes

## *ps [option]*

Option(s)	Description
a	Display every process on the system associated with a tty terminal
-A, -e	Display every process on the system
-C <i>CommandList</i>	Only display processes running a command in the <i>CommandList</i>
-g <i>GIDList</i> , or -group <i>GIDList</i>	Only display processes whose current effective group is in <i>GIDList</i>
-G <i>GIDList</i> , or -Group <i>GIDList</i>	Only display processes whose current real group is in <i>GIDList</i>
-N	Display every process except selected processes
p <i>PIDList</i> , -p <i>PIDList</i> or --pid <i>PIDList</i>	Only display <i>PIDList</i> processes
-r	Only display selected processes that are in a state of running
-t <i>ttyList</i> , or --tty <i>ttyList</i>	List every process associated with the <i>ttyList</i> terminals
-T	List every process associated with the current tty terminal
-u <i>UserList</i> , or --user <i>UserList</i>	Only display processes whose effective user (username or UID) is in <i>UserList</i>
-U <i>UserList</i> , or --User <i>UserList</i>	Only display processes whose real user (username or UID) is in <i>UserList</i>
x	Remove restriction of "associated with a tty terminal"; typically used with the a option

# Viewing processes

## top

```
Christine@Ubuntu1804: ~  
File Edit View Search Terminal Help  
top - 11:19:00 up 1:00, 3 users, load average: 1.06, 0.64, 0.34  
Tasks: 217 total, 2 running, 182 sleeping, 0 stopped, 0 zombie  
%Cpu(s): 99.0 us, 1.0 sy, 0.0 ni, 0.0 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st  
KiB Mem : 4039720 total, 2040584 free, 1020624 used, 978512 buff/cache  
KiB Swap: 483800 total, 483800 free, 0 used. 2722572 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
2966	root	20	0	41700	1924	1484	R	91.8	0.0	1:07.56	stress-ng-m+
2481	Christi+	20	0	2997472	275884	104796	S	3.9	6.8	0:25.75	gnome-shell
2350	Christi+	20	0	457208	102968	68444	S	1.6	2.5	0:09.24	Xorg
3010	Christi+	20	0	799056	36368	27444	S	1.6	0.9	0:00.53	gnome-termi+
2692	Christi+	20	0	903352	57116	40304	S	0.3	1.4	0:03.59	nautilus-de+
3028	Christi+	20	0	51292	4104	3380	R	0.3	0.1	0:00.10	top
1	root	20	0	160076	9252	6620	S	0.0	0.2	0:03.59	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kthreadd
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/0:0H
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	mm_percpu_wq
7	root	20	0	0	0	0	S	0.0	0.0	0:00.49	ksoftirqd/0
8	root	20	0	0	0	0	I	0.0	0.0	0:00.92	rcu_sched
9	root	20	0	0	0	0	I	0.0	0.0	0:00.00	rcu_bh
10	root	rt	0	0	0	0	S	0.0	0.0	0:00.00	migration/0
11	root	rt	0	0	0	0	S	0.0	0.0	0:00.03	watchdog/0
12	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/0
13	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kdevtmpfs

# Employing muliple screen

## screen & tmux

```
top - 18:48:29 up 6:03, 4 users, load average: 2.36, 1.52, 0.93
Tasks: 173 total, 5 running, 136 sleeping, 0 stopped, 0 zombie
%Cpu(s): 98.0 us, 2.0 sy, 0.0 ni, 0.0 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 4039720 total, 2554088 free, 768756 used, 716876 buff/cache
KiB Swap: 483800 total, 483800 free, 0 used, 3041668 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM    TIME+  COMMAND
 12219 Christi+  20   0   41708   1872   1436  R   24.0   0.0   0:11.67 stress-ng-matrl
 12223 Christi+  20   0  128900  88592   1152  R   24.0   2.2   0:11.66 stress-ng-vm
 12224 Christi+  20   0  128900  88592   1152  R   24.0   2.2   0:11.66 stress-ng-vm
 12225 Christi+  20   0  128900  88648   1208  R   24.0   2.2   0:11.66 stress-ng-vm
 10147 Christi+  20   0   51288   4020   3300  S    0.7   0.1   0:13.98 top
 11592 Christi+  20   0   51204   3924   3268  R    0.7   0.1   0:02.94 top
   560 message+  20   0   51720   6184   3988  S    0.3   0.2   0:10.31 dbus-daemon
   7721 root        20   0      0      0      0  I    0.3   0.0   0:33.13 kworker/0:0
      1 root        20   0  160116   9264   6556  S    0.0   0.2   0:05.80 systemd
      2 root        20   0      0      0      0  S    0.0   0.0   0:00.00 kthreadd
 0 bash

Ubuntu1804: Tue Apr 16 18:48:30 2019
USER      FROM      JCPIU
Christin :tty2:S.0    2.99s
Christin :tty2:S.1    0.30s
Christin :tty2:S.2    47.73s
```

1 bash      2 bash

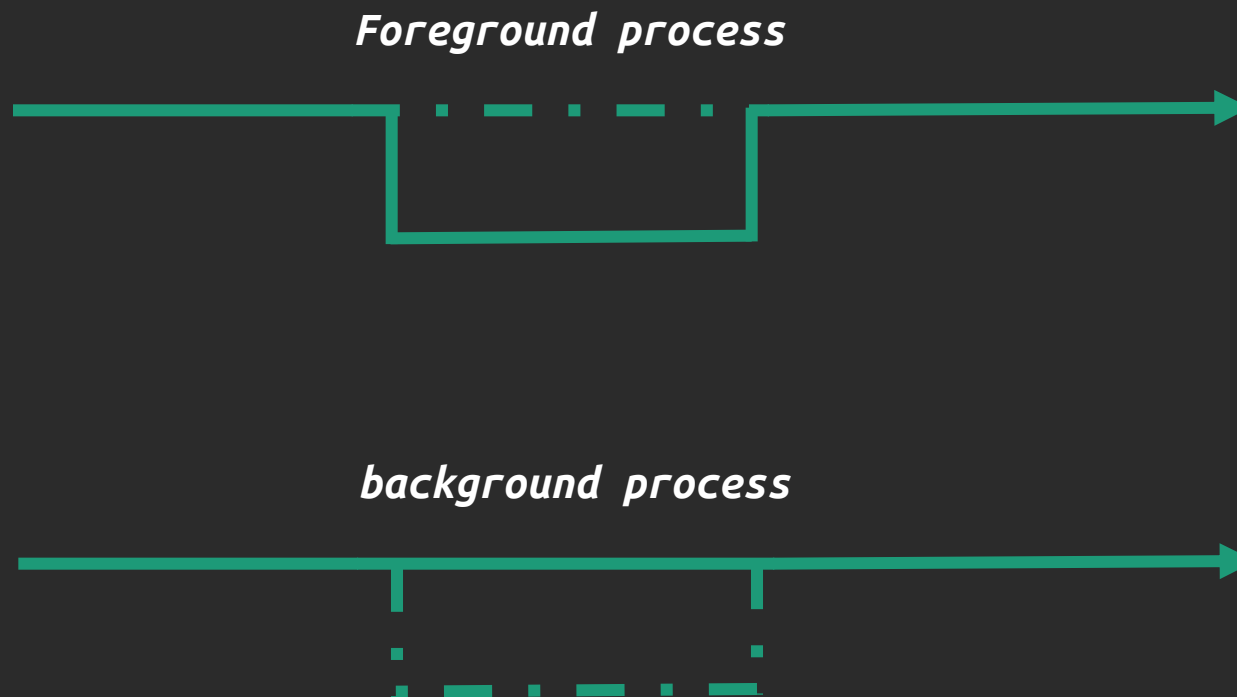
```
root@localhost:~
[root@localhost ~]#

[root@localhost ~]#

[root@localhost ~]#
```

[0] 0:bash\*      "root@localhost:~" 20:25 06-Feb-16

# *Background and Foreground processes*



## *Manage background processes*

# *jobs [option] [job-id]*

```
$ sleep 3000 &  
[1] 1539  
$  
$ jobs  
[1]+  Running                  sleep 3000 &  
$  
$ jobs -l  
[1]+  1539 Running              sleep 3000 &  
$
```

# *Bring jobs to foreground and vice versa*

## *Bring jobs to foreground*

```
$ jobs -l
[1]- 1539 Running          sleep 3000 &
[2]+ 1540 Running          bash CriticalBackups.sh &
$
$ fg %2
bash CriticalBackups.sh
```

## *Send running program to background*

```
$ bash CriticalBackups.sh
^Z
[2]+  Stopped                bash CriticalBackups.sh
$
$ bg %2
[2]+ bash CriticalBackups.sh &
$
$ jobs -l
[1]- 1539 Running          sleep 3000 &
[2]+ 1540 Running          bash CriticalBackups.sh &
$
```



# Process signals

Number	Name	Description
1	HUP	Hangs up
2	INT	Interrupts
3	QUIT	Stops running
9	KILL	Unconditionally terminates
11	SEGV	Segments violation
15	TERM	Terminates if possible
17	STOP	Stops unconditionally, but doesn't terminate
18	TSTP	Stops or pauses, but continues to run in background
19	CONT	Resumes execution after STOP or TSTP

## *Sending signals to process*

# *kill [option] process*

```
$ ps 2285
  PID TTY          STAT       TIME COMMAND
 2285 pts/0        S          0:00 bash SecurityAudit.sh
$
$ kill 2285
[1]+  Terminated                  bash SecurityAudit.sh
$
$ ps 2285
  PID TTY          STAT       TIME COMMAND
$
$ kill -s HUP 2305
$
$ ps 2305
  PID TTY          STAT       TIME COMMAND
 2305 pts/0        T          0:00 vi
$
$ kill -9 2305
[1]+  Killed                        vi
$
$ ps 2305
  PID TTY          STAT       TIME COMMAND
$
```

*Default signal is TERM*

## *Sending signals to process*

# *killall, pkill & pgrep*

```
$ ps
  PID TTY          TIME CMD
 1441 pts/0    00:00:00 bash
 1504 pts/0    00:00:00 stressor.sh
 1505 pts/0    00:00:00 stress-ng
 1506 pts/0    00:00:05 stress-ng-matri
 1507 pts/0    00:00:00 stressor.sh
 1508 pts/0    00:00:00 stress-ng
 1509 pts/0    00:00:02 stress-ng-matri
 1510 pts/0    00:00:00 stressor.sh
[...]
 1517 pts/0    00:00:00 ps
$
$ killall stress-ng
$
$ ps
  PID TTY          TIME CMD
 1441 pts/0    00:00:00 bash
 1519 pts/0    00:00:00 ps
```

```
$ pgrep -t tty3
1716
1804
1828
1829
1831
1832
1836
1837
1838
1839
1840
$
```

```
$ ps 1840
  PID TTY          STAT       TIME COMMAND
 1840 tty3      R+        0:39 stress-ng --class cpu -a 10 -b 5 -t 5m --matrix 0
$
$ sudo pkill -t tty3
$
$ pgrep -t tty3
1846
$
$ ps 1846
  PID TTY          STAT       TIME COMMAND
 1846 tty3      Ss+       0:00 /sbin/agetty -o -p -- \u --noclear tty3 linux
$
```

*Keep job running after log-out*

***nohup program/script &***

```
$ nohup bash CriticalBackups.sh &
```

```
[1] 2090
```

```
$ nohup: ignoring input and appending output to 'nohup.out'
```

# *Modify process execution priorities*

## *Manage process priorities*

# ***nice -n VALUE Command***

```
$ nice -n 10 bash CriticalBackups.sh  
  
$ ps -l 1949  
F S  UID  PID  PPID  C PRI  NI ADDR SZ WCHAN  TTY      TIME CMD  
0 S  1001  1949  1527  0  90  10 -   4998 wait   pts/1    0:00 bash CriticalBac  
$
```

*nice value in scale of -20 → 19 (with higher priority on the left)*

## *Manage process priorities*

***renice [-n] VALUE [PID] [-u Users] [-g Groups]***

```
$ renice 15 -p 1949
1949 (process ID) old priority 10, new priority 15
$
$ sudo renice -n -5 -p 1949
1949 (process ID) old priority 15, new priority -5
$
$ sudo renice -10 -p 1949
1949 (process ID) old priority -5, new priority -10
$
```

*Question...* ■