

# What's missing?

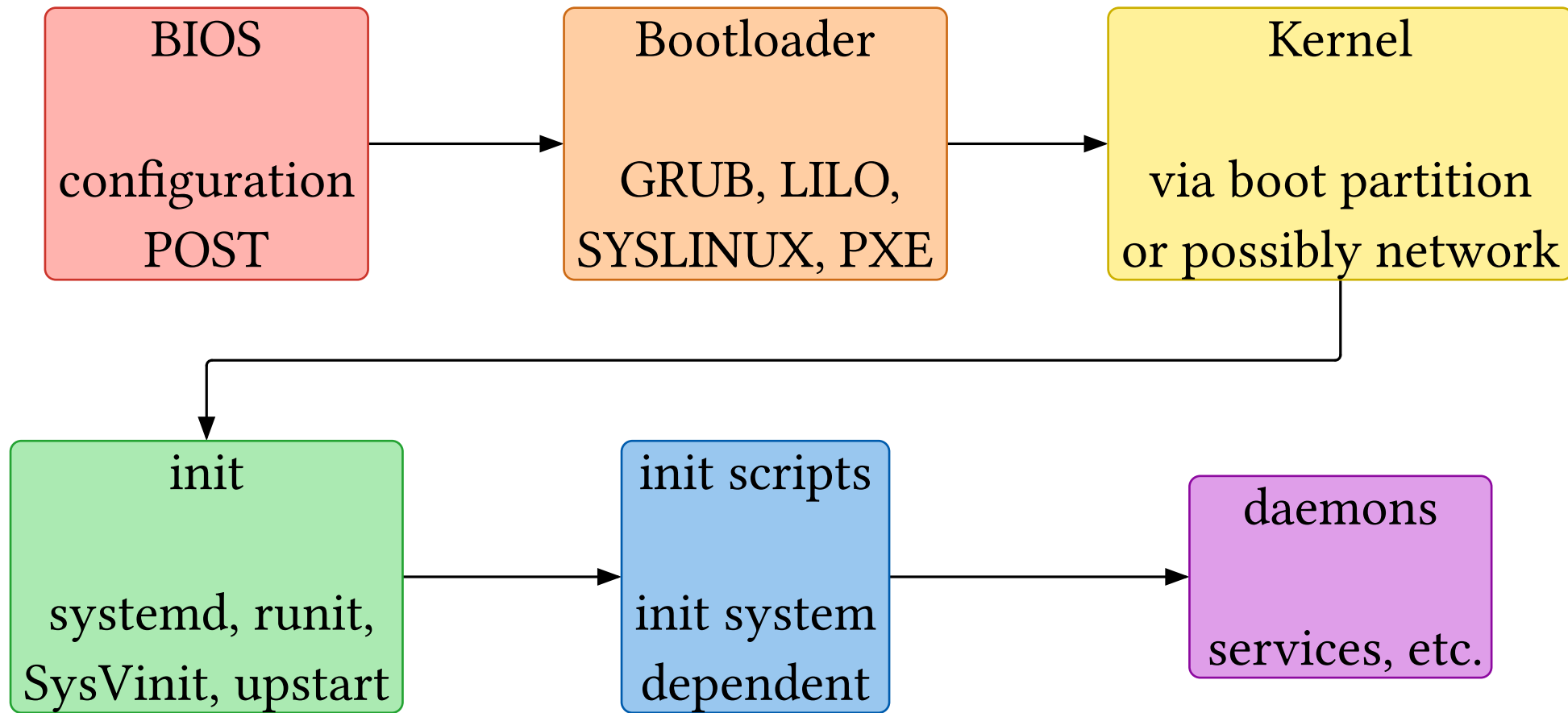
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We've been learning in a virtualized environment. What haven't we had a chance to work with?

# The Boot Process



# Init System



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- PID 1
- SysV was the old way of doing it
- Most modern systems run systemd (it's contentious)
- The init system brings up and monitors daemon processes

# Basic systemctl Commands

- `systemctl list-units --type=service`
- `systemctl start <servicename>`
- `systemctl stop <servicename>`
- `systemctl restart <servicename>`
- `systemctl enable <servicename>`



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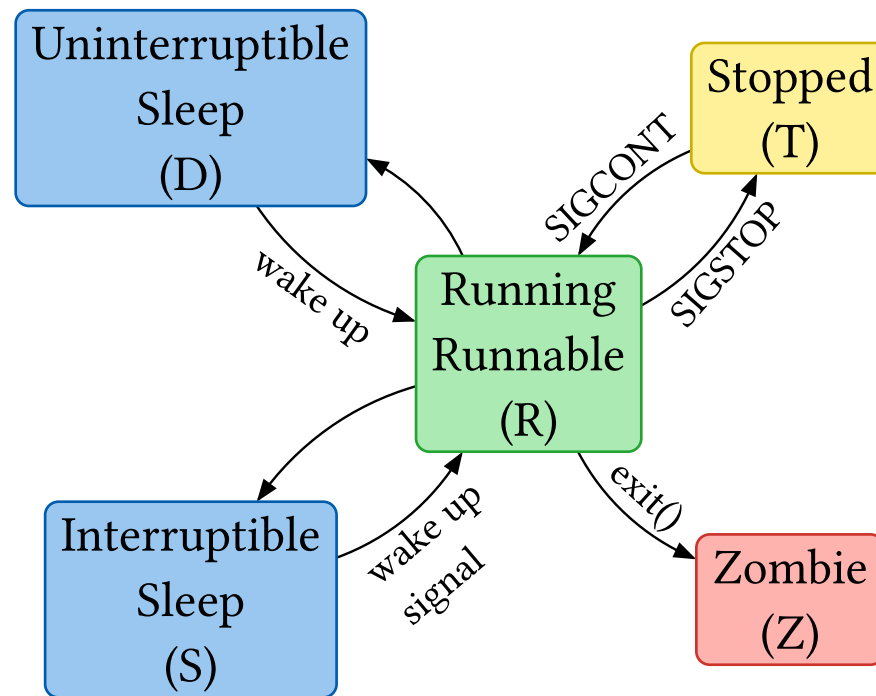
# Processes

```
guest-mm2x7k@support21: ~$ ps aux
USER      PID %CPU %MEM    VSZ   RSS TTY      STAT START   TIME COMMAND
root         1  0.0  0.0 185352  5984 ?        Ss   08:39   0:01 [systemd]
root         2  0.0  0.0      0     0 ?        S    08:39   0:00 [kthreadd]
root         4  0.0  0.0      0     0 ?        I<   08:39   0:00 [kworker/0:0H]
root         5  0.0  0.0      0     0 ?        I    08:39   0:00 [kworker/u8:0]
root         6  0.0  0.0      0     0 ?        I<   08:39   0:00 [mm_percpu_wq]
root         7  0.0  0.0      0     0 ?        S    08:39   0:00 [ksoftirqd/0]
root         8  0.1  0.0      0     0 ?        I    08:39   0:02 [rcu_sched]
root         9  0.0  0.0      0     0 ?        I    08:39   0:00 [rcu_bh]
root        10  0.0  0.0      0     0 ?        S    08:39   0:00 [migration/0]
root        11  0.0  0.0      0     0 ?        S    08:39   0:00 [watchdog/0]
root        12  0.0  0.0      0     0 ?        S    08:39   0:00 [cpuhp/0]
root        13  0.0  0.0      0     0 ?        S    08:39   0:00 [cpuhp/1]
root        14  0.0  0.0      0     0 ?        S    08:39   0:00 [watchdog/1]
root        15  0.0  0.0      0     0 ?        S    08:39   0:00 [migration/1]
root        16  0.0  0.0      0     0 ?        S    08:39   0:00 [ksoftirqd/1]
root        18  0.0  0.0      0     0 ?        I<   08:39   0:00 [kworker/1:0H]
root        19  0.0  0.0      0     0 ?        S    08:39   0:00 [cpuhp/2]
root        20  0.0  0.0      0     0 ?        S    08:39   0:00 [watchdog/2]
root        21  0.0  0.0      0     0 ?        S    08:39   0:00 [migration/2]
root        22  0.0  0.0      0     0 ?        S    08:39   0:00 [ksoftirqd/2]
root        24  0.0  0.0      0     0 ?        I<   08:39   0:00 [kworker/2:0H]
root        25  0.0  0.0      0     0 ?        S    08:39   0:00 [cpuhp/3]
```

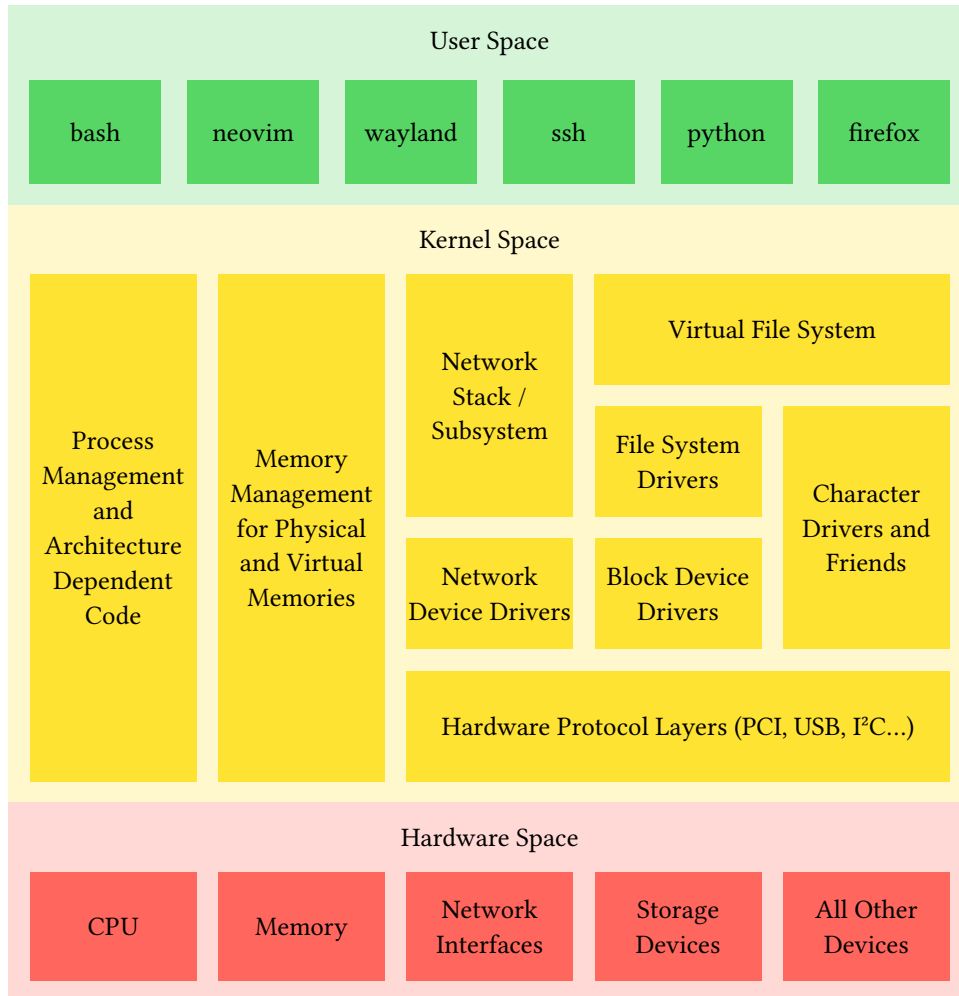
- OS kernel allows for multiple things to run at once
- A process is one of those things
- The kernel scheduler splits time between them
- [This can be adjusted!](#)

# Tuning the Process Scheduler

- `/proc/sched_debug` shows all tunable variables
- `sysctl` (not `systemctl`!) can be used to adjust them
- `chrt` shows the real-time attributes of a running process
- If you make changes, don't forget to make them permanent! (`/etc/sysctl.conf`)



# Devices



- Real systems have real devices
- I/O is a typical bottleneck in production systems
- [Sysfs allows for tuning of I/O devices](#)
- I/O also has schedulers



- A list of rules that determines what to do/create when a device is added
- Devices can have persistent names through devfs (can be very useful for USB)
- Initialization can take place automatically

[/lib/udev/rules.d/80-usb.rules](#)

```
KERNEL=="sd*", SUBSYSTEMS=="scsi", ATTRS{model}=="USB 2.0 Storage Device", SYMLINK+="usbhd%n"
```

# General Advice for Tuning Linux

- Determine your metric in advance!
- Take slow steps and monitor changes
- Be prepared to walk-back changes



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