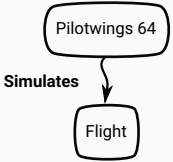
Introduction to OS-Level Virtualization on Linux

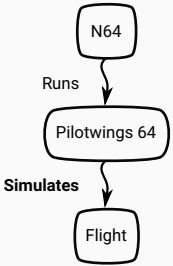
Pedro Bruel
phrb@ime.usp.br

May 25th, 2020

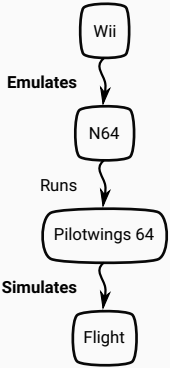
What are Simulation, Emulation, Virtualization?



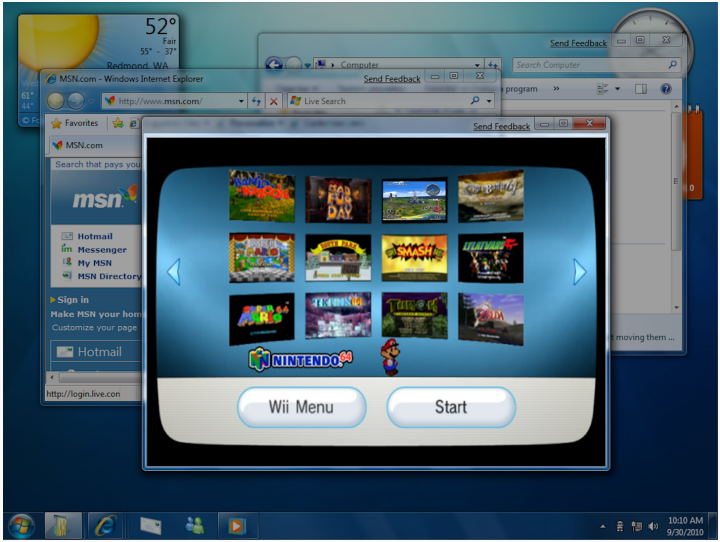
What are Simulation, Emulation, Virtualization?

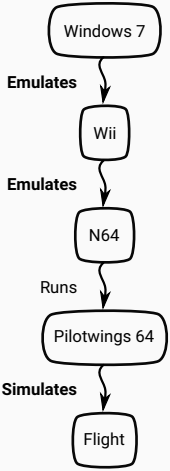


What are Simulation, Emulation, Virtualization?

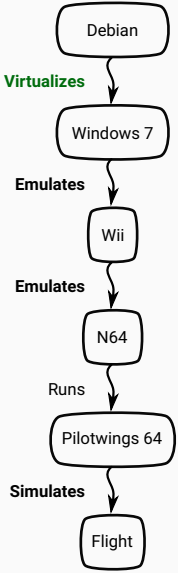


What are Simulation, Emulation, Virtualization?

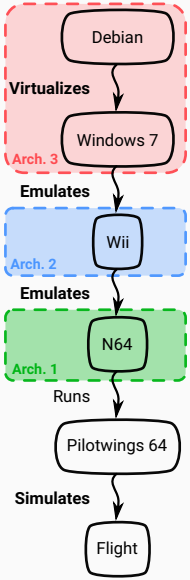




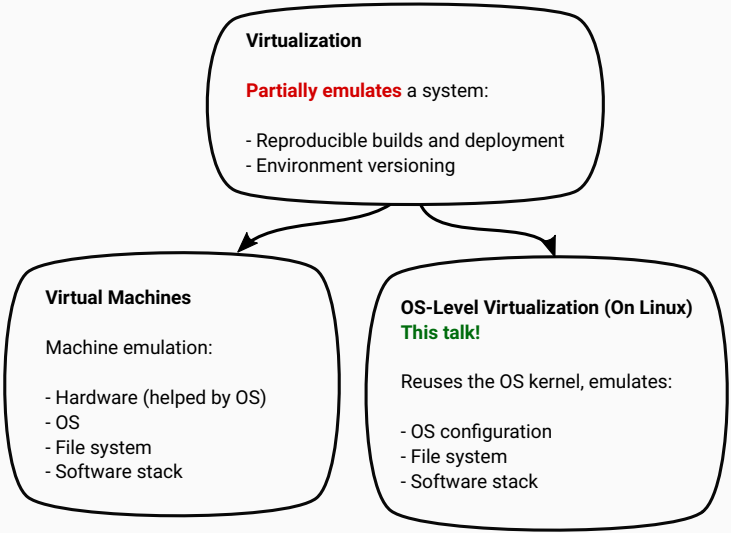
What are Simulation, Emulation, Virtualization?



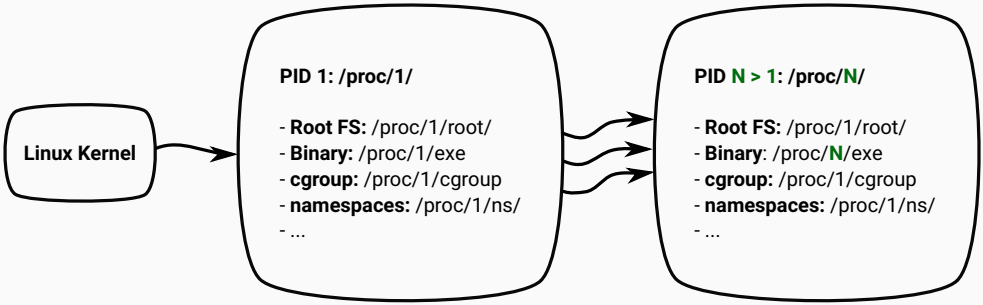
What are Simulation, Emulation, Virtualization?



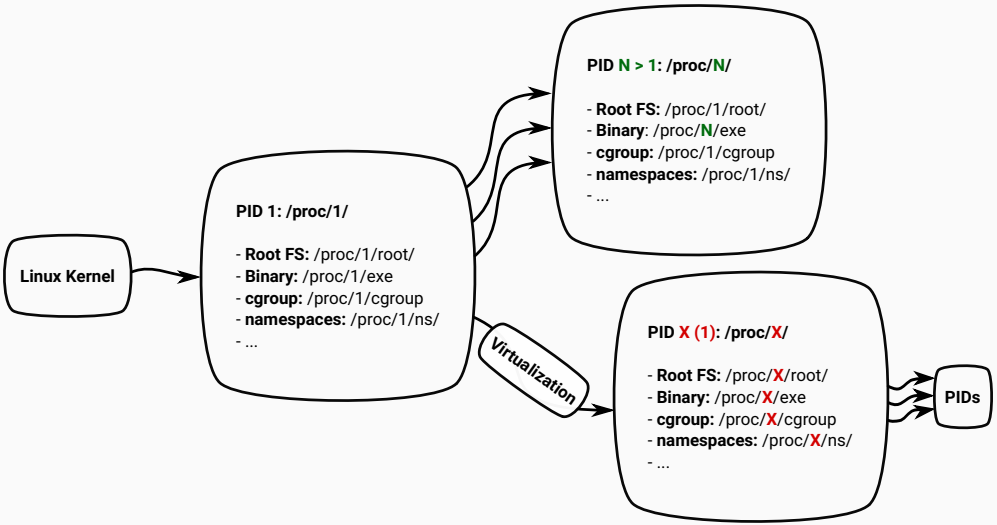
OS-Level Virtualization



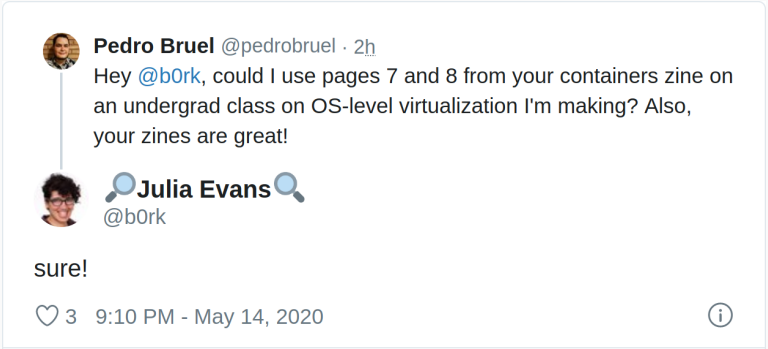
OS-Level Virtualization on Linux



OS-Level Virtualization on Linux

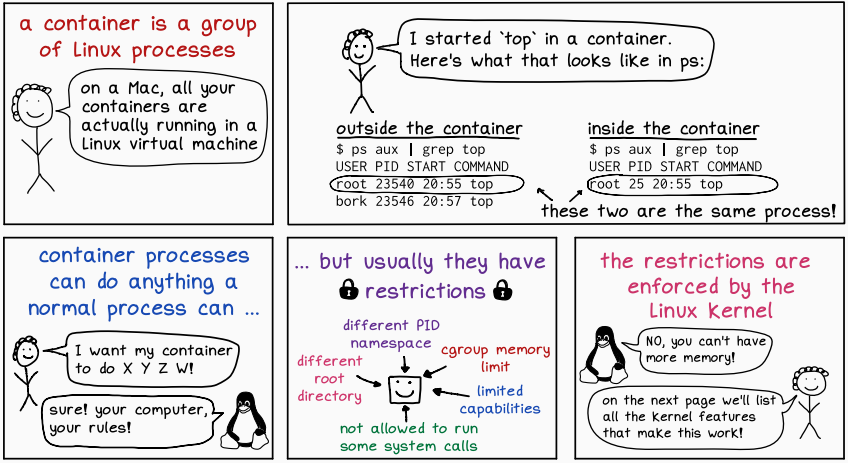


Images used with permission:



containers = processes

7



container kernel features

8

containers use these Linux kernel features

"container" doesn't have a clear definition, but Docker containers use all of these features.

♥ pivot_root ♥

set a process's root directory to a directory with the contents of the the container image

★ cgroups ★

limit memory/CPU usage for a group of processes

♥ namespaces ♥

allow processes to have their own:

- → network
- → mounts
- → PIDs
- → users
- → hostname
- + more

★ capabilities ★

security: give specific permissions

♥ seccomp-bpf ♥

security: prevent dangerous system calls

★ overlay filesystems ★

this is what makes layers work! Sharing layers saves disk space & helps containers start faster

Containers from Scratch: Obtaing an Image

```
IMG_DIR="alpine_img"
IMG_URL="https://us.images.linuxcontainers.org/images/alpine/3.11/amd64/default/20200521_13:00/rootfs.
mkdir -p $IMG_DIR && curl $IMG_URL | tar xJ -C $IMG_DIR
```

Containers from Scratch: Creating cgroups and Setting Limits

```
CGROUP_ID="MAC0475-145"
sudo cgcreate -g "cpu,cpuacct,memory:$CGROUP_ID"
sudo cgset -r cpu.shares=512 "$CGROUP_ID" # 1024 is 100% CPU
sudo cgset -r memory.limit_in_bytes=10000000000 "$CGROUP_ID"
```