Introduction to OS-Level Virtualization on Linux

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What are Simulation, Emulation, Virtualization?

Pilotwings 64

Simulates

Flight

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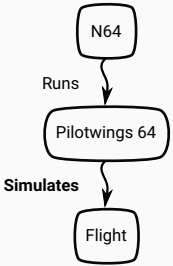

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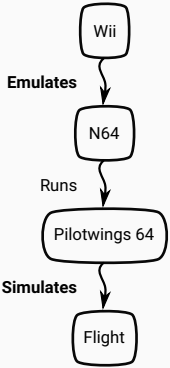

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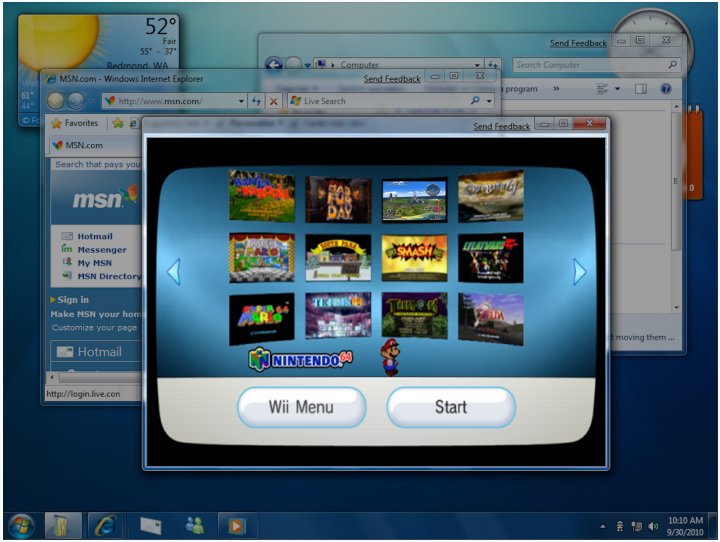

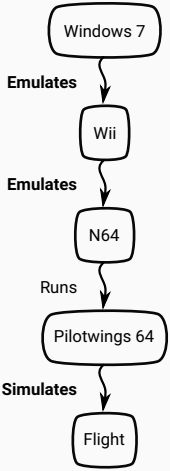

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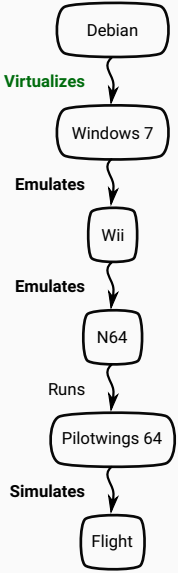

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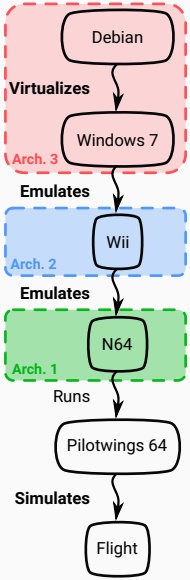
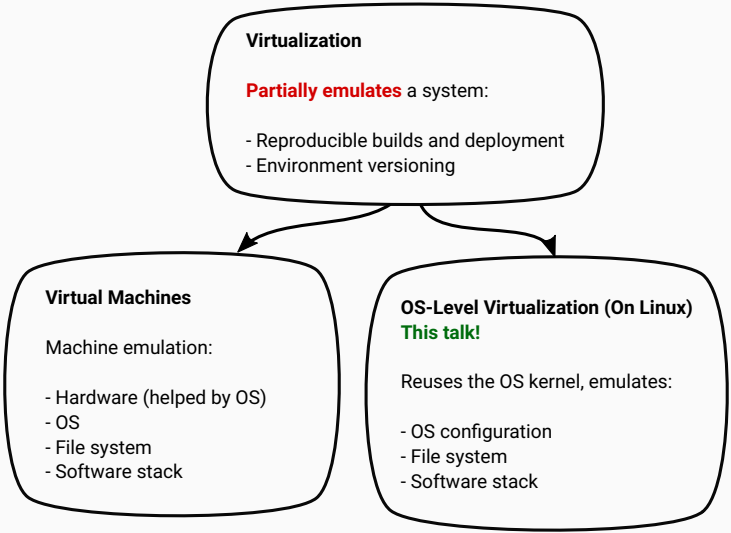
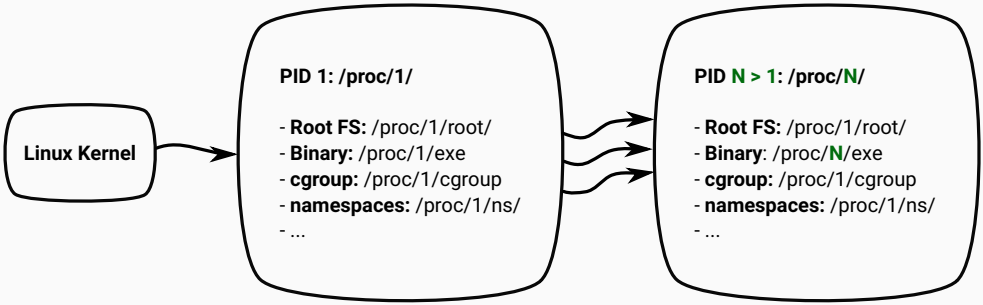


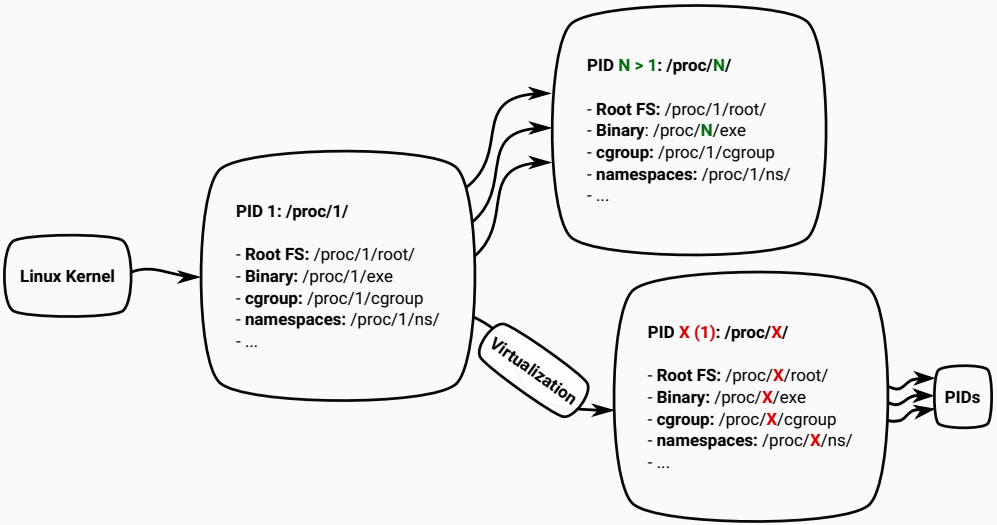
OS-Level Virtualization



OS-Level Virtualization on Linux



OS-Level Virtualization on Linux



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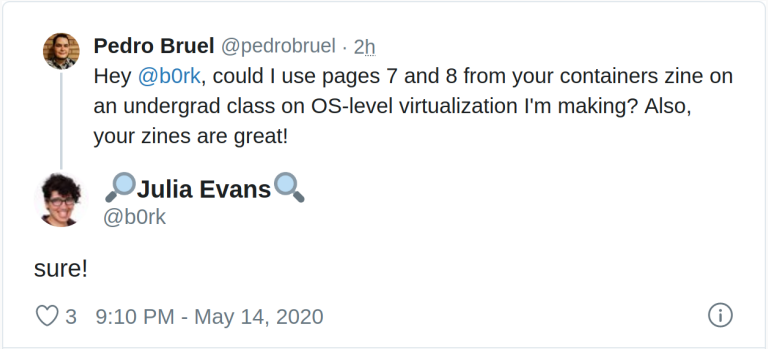

containers = processes

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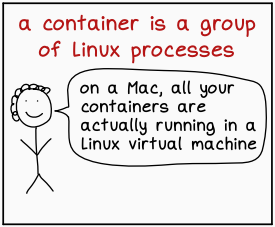

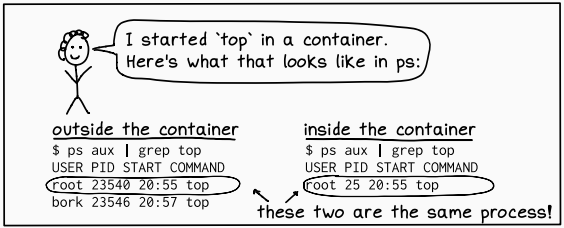

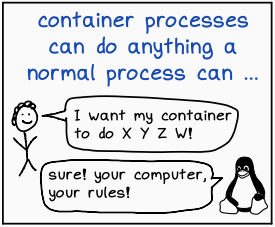

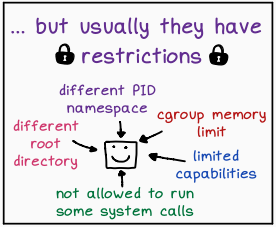

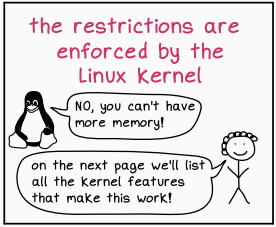

container kernel features

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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"

```
#!/usr/bin/bash

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

Containers from Scratch: Launching an Alpine Container

```
HOSTNAME="alpine-container"
sudo cgexec -g "cpu,cpuacct,memory:$CGROUP_ID" \
     unshare -fmuipn --mount-proc \
     chroot "$PWD/" \
     /bin/sh -c "PATH=/bin && mount -t proc proc /proc && hostname $HOSTNAME && sh"
```