

Virtual Machines

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Why You Need to Care

- Because someday you'll have to:
 - Use a particular piece of software that only runs on an OS you don't easily have available
 - Deploy a robust, easily-maintainable production environment
 - Do something dangerous
 - Recover from a horrible, heinous disaster after which 3 people will go to jail except you



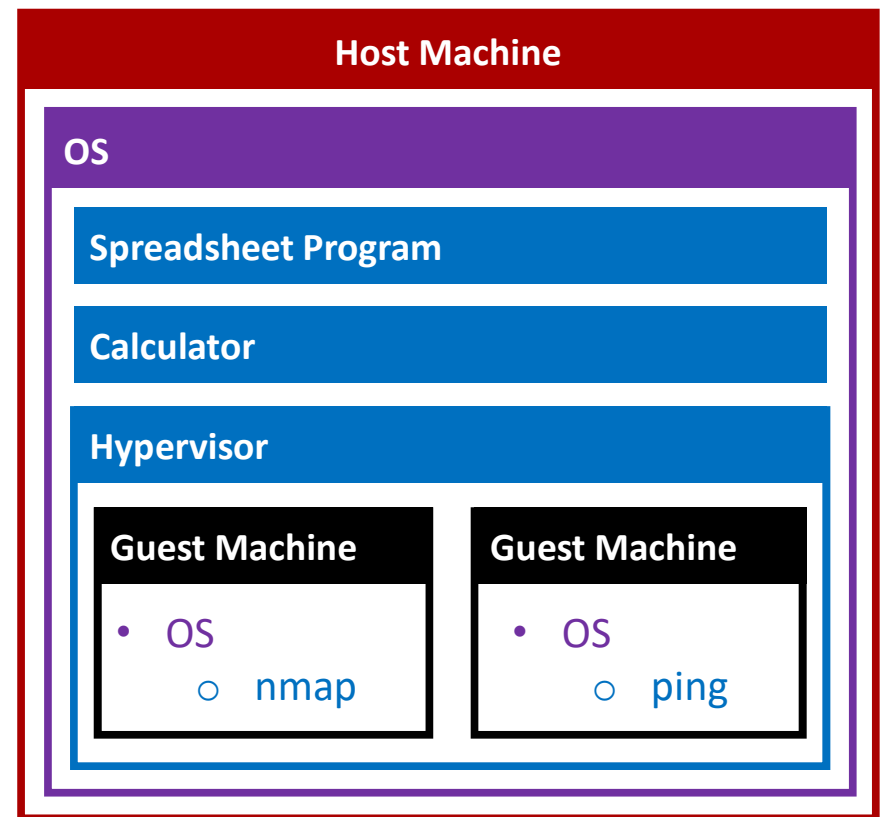
Virtualization

- A System Virtual Machine is an emulated instance of an operating system running on a supportive Host
- The OS thinks it's running on hardware, but it's just accessing software hooks provided to it that *appear* as hardware
- A HDD in a VM is stored as a single file on the Host
- Network adapters in the VM transfer data to the Host, which handles the actual network traffic



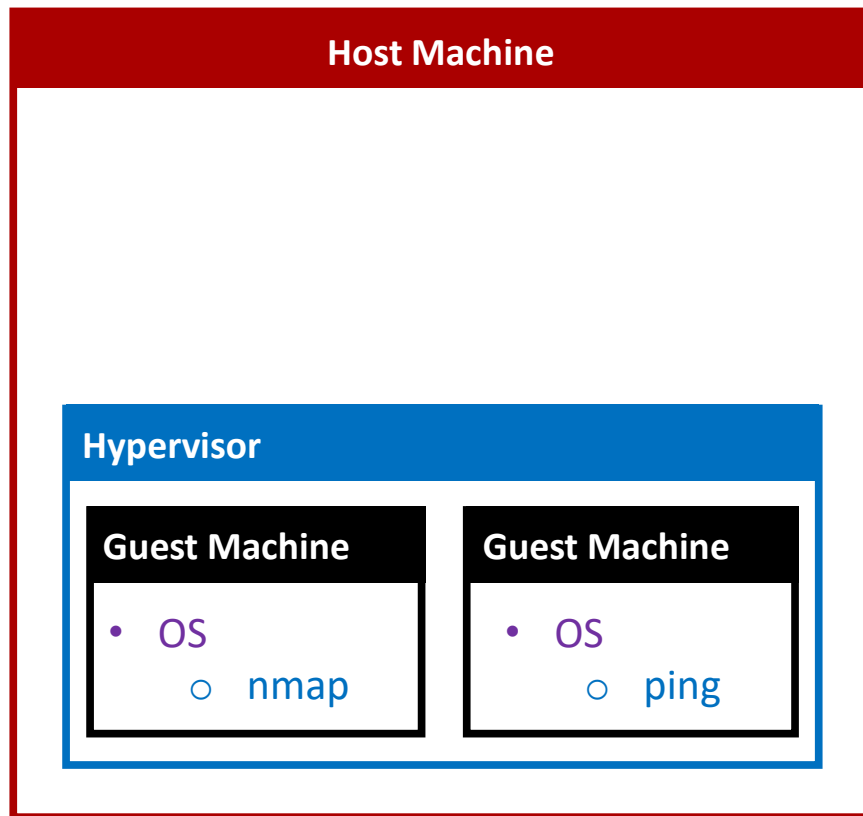
Hosts and Guests and Hypervisors

- A *hypervisor* is a program that runs virtual machines
- A *host machine* is the system that runs the hypervisor
- The individual virtual machines running on the hypervisor are called *guest machines*

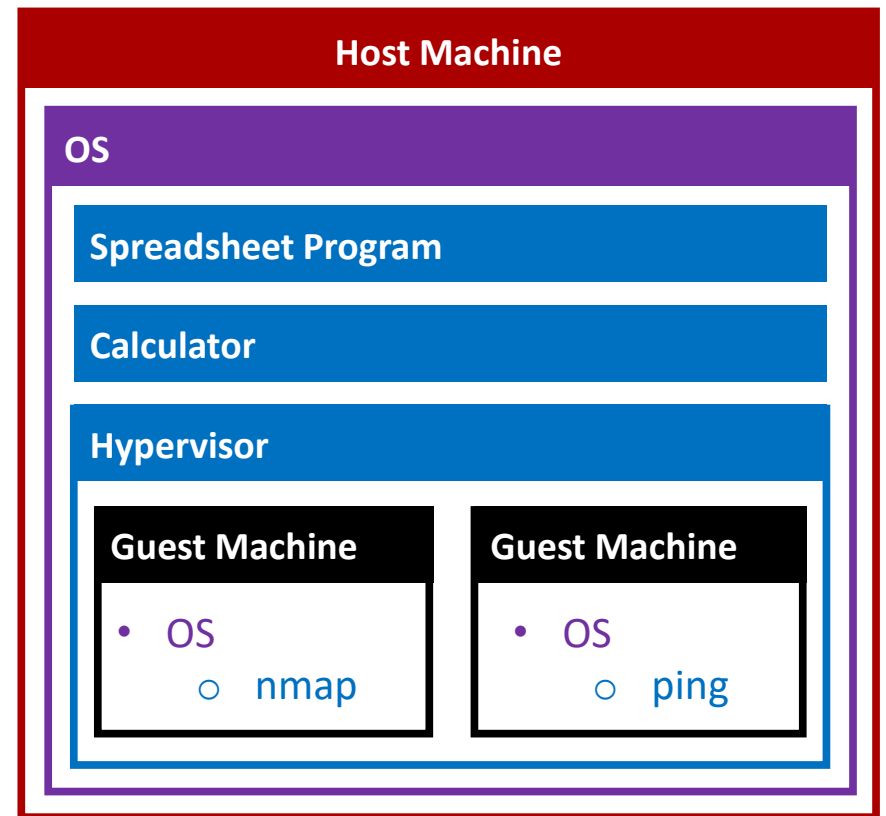


Hypervisor Types

Type 1, Bare-metal, Native



Type 2, Hosted



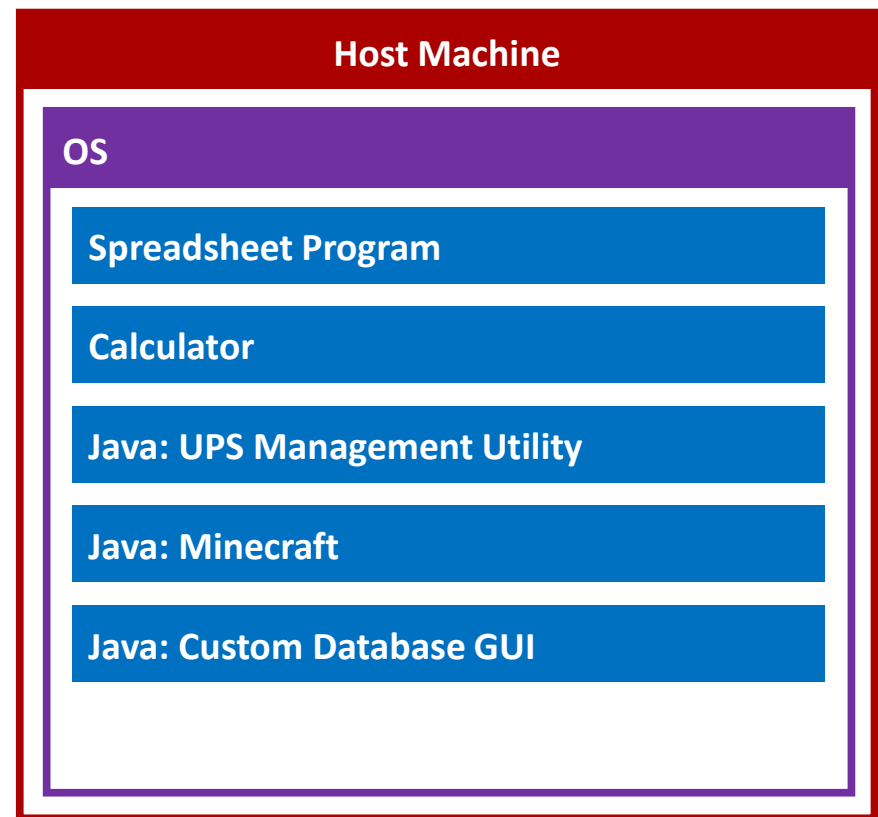
Why Virtualize?

- Makes experimentation and prototyping easy
 - No need to get a bunch of hardware: your desktop PC/server can run it all, even multiple VMs all simultaneously
 - Set up and teardown is much faster with software than hardware
- Increasingly complex applications, running on diverse OSs, can all be easily managed from one place: the supporting Host
- Improved security and robustness of the VM/snapshot/hypervisor ecosystem
- More easily manage massively large-scale deployment with tremendous efficiency gains as servers are scaled up and down as needed



Process Virtual Machines

- A software machine, easily adaptable to any target host OS, that is able to run applications written in an intermediate language
- The “Java Virtual Machine” (JVM) is the most common example
- The JVM executable itself has been ported to run on countless operating systems, enabling Java programs to run unchanged anywhere the JVM does



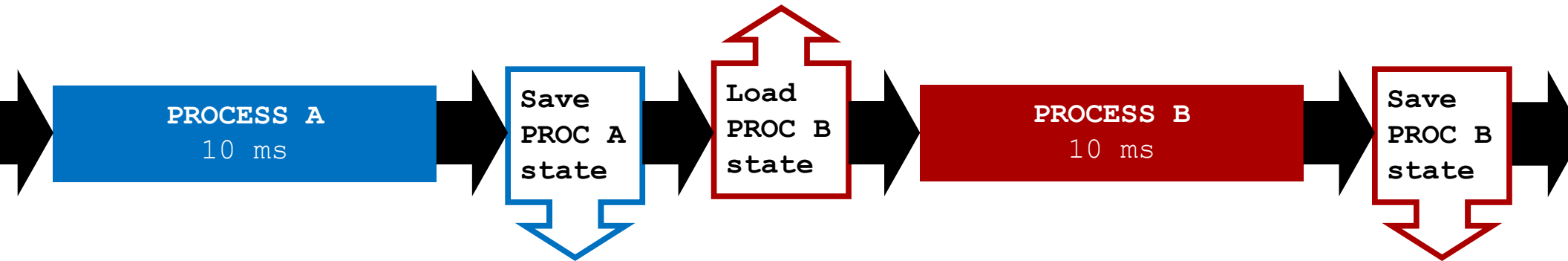
Full vs. Partial Virtualization

- Full Virtualization means that there is enough hardware being simulated by the host that the guest virtual machine can be unmodified - it doesn't necessarily know that it's contained as merely a process elsewhere
- If you have to modify the guest virtual machine to get it to run, then it is not fully virtualized
- Hardware-Assisted Virtualization:
 - The hardware doesn't have to be fully *emulated* on the host: the host may have actual hardware designed for the guest virtual machines to use



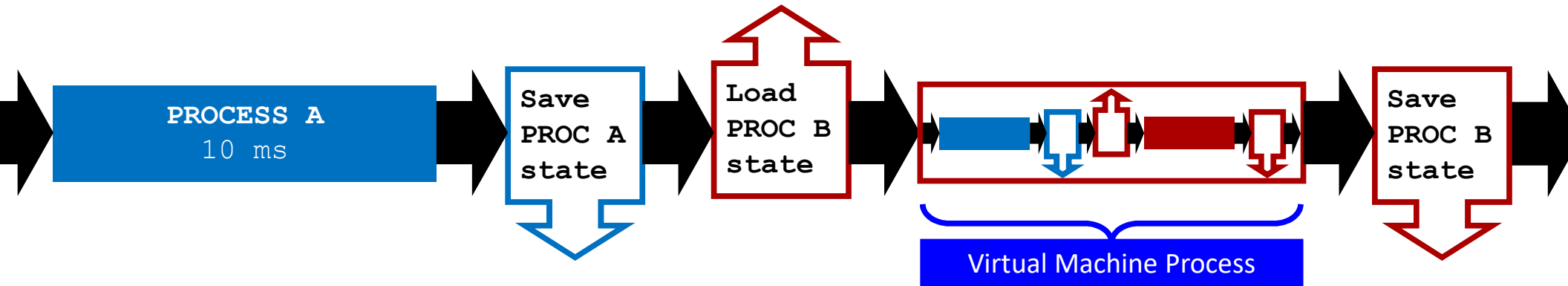
Origins

- Historically, virtual machines grew from time-sharing:



Origins

- If it works with set of processes, then why not with a process that emulates hardware sufficiently well to run an OS in it?



Configuring VirtualBox

SAY

- Set the VM folder somewhere useful

DEMONSTRATE

- File -> Preferences -> General -> Default Machine Folder



Creating a CentOS CLI-Only VM Template - 1

SAY

DEMONSTRATE

- Start up VirtualBox
- Click the New button
- Name it whatever you like
- Change Type to Linux, and Version to Other Linux (64-bit)
- Set Memory Size to 1024MB
- Make sure “Create a virtual hard disk now” is selected
- Click Create



Creating a CentOS CLI-Only VM Template - 2

SAY

- Necessary, because otherwise CentOS will think the drive is too small to be installed onto

DEMONSTRATE

- Pick a location for the VM
- Set VHD size to 8GB
- Make sure VDI is selected
- Select Fixed Size
- Click Create



Creating a CentOS CLI-Only VM Template - 3

SAY

DEMONSTRATE

- Select the new VM you just created
- Click Start (Normal Start)
- Select the CentOS7 .iso file for the Start Up Disk
- Click Start



Creating a CentOS CLI-Only VM Template - 4

SAY

- The install will do some set up, and then requires a few more things to be checked.

DEMONSTRATE

- When the machine starts, select Install CentOS Linux 7 and hit Enter
- Select English and click Continue
- Click NETWORK & HOST NAME
- Turn Ethernet on by clicking the toggle button in the upper right
- Click Done



Creating a CentOS CLI-Only VM Template - 5

SAY

- Network time prevents you from toggling between AM/PM to and 24-hour time

DEMONSTRATE

- Click DATE & TIME
- Change Timezone by clicking the map itself
- Turn Network Time off, if it's on
- Change to AM/PM
- Turn Network Time on
- Click Done
- Click INSTALLATION DESTINATION
- Then just click Done
- Click Begin Installation
- Click ROOT PASSWORD, set something complicated and random, then save it into a file (you won't be using it much, if ever)
- Click Done



Creating a CentOS CLI-Only VM Template - 6

SAY

- Optionally, skip ahead here to the “Fresh Install” snapshot already created

DEMONSTRATE

- Click USER CREATION
- Type Full Name
- Pick a username (I recommend you use your ONID username)
- Check the “Make this user administrator” box
- Type in a real password
- Click Done
- Click Finish Configuration
- When it appears, click Reboot



Creating a CentOS CLI-Only VM Template - 7

SAY

- You could shutdown now with "`$ sudo shutdown`" to get a truly blank VM, but I like to instead first customize it with my `~/.bashrc` file
- "`.`" is another way to use the `source` command

DEMONSTRATE

- Let it auto-select and boot
- At the prompt, login
- `$ curl http://web.engr.oregonstate.edu/~brewsteb/.bashrc > .mybashrc`
- `$ vi .bash_profile`
- Add this to the end of the file:
`. ./mybashrc`
- Save and exit vi



Creating a CentOS CLI-Only VM Template - 8

SAY

- This enables the stuff in `~/ .mybashrc`.
- More importantly - and this is critical for deploying new systems - it tests your recall/storage of the username & password
- Shut the VM down
- In Settings, set the VM to use 2 CPUs
- Now your VM is ready to be duplicated - don't use this one again!
- The duplicate allows us to have a ready-made starting point if/when our production VM gets borked

DEMONSTRATE

- Log out and back in
- `$ sudo halt`
- Click the X in the corner, select "Power Off The Machine."



Creating a CentOS CLI-Only VM Template - 9

SAY

- CentOSU, Centaur, one of the Hobbit's Dwarven names, a Tolkien placename, a city name, etc.
- Now you've got a stable clone to play around with! Make clones like this for whatever CentOS project you'd like.

DEMONSTRATE

- Right-click on the CentOS Template VM, and click Clone
- Type a new name
- Check the "Reinitialize MAC address box"
- Click Next
- Select Full Clone to create a complete 8GB+ duplicate
- Select Linked Clone to create a snapshot of the original VM and link the new VM to that state; copying in the future requires both VMs
- Click Clone
- Start Clone



Start Windows VM

SAY

- Takes a LOT longer to start; we'll come back to this later

DEMONSTRATE

- Start up Windows VM



Snapshots

- A snapshot is a file that contains the current state of a virtual machine, including memory, at a specific moment in time
- You can then *return* to this state, as needed!
- Examples for why you'd want to do this:
 - To duplicate the VM at this point in time
 - To reset a computer lab PC back to a certain point at the end of the day
 - As a backup or archive: you can go back and get the contents of the files as of the snapshot, when your "lets try this" idea/virus destroys everything
- You can take unlimited snapshots
- We can do this easily in VirtualBox, which we'll play with in the coming slides



Causing Havoc and Saving the World

SAY

- Verify you're in the VB VM!

DEMONSTRATE

- Start up CentOS Clone
- Machine -> Take Snapshot
- `$ rm -rf /`
- `$ rm --no-preserve-root -rf /`
- `$ ls`
- File -> Close
- In right pane of VirtualBox, right-click Snapshot name, then hit Restore
- Click Restore
- See the restored VM



Web Browsing in our Windows VM

SAY

- Your connections with this web browser will still be tracked back to this Host, since the originating IP address in the next upstream device's connection logs will be that of this Host
- Page requests are all made in plain HTML, since the protocol is text-based
- This is a good way to sandbox your browsing so you don't get infected

DEMONSTRATE

- Log in and fire up Edge



Shared Drag'n'Drop & Clipboard

SAY

- Drag and drop files
- Share whiteboard between the host and guest

DEMONSTRATE

- Machine -> Settings -> General -> Advanced
- Set Shared Clipboard to Bidirectional
- Enable Drag'n'Drop to Bidirectional
- Show copy/paste and drag'n'drop between Host and Guest VM



Install Guest Additions into Guest VM

SAY

- Installing Guest Additions allows us to:
 - Mount a shared folder
 - Run in Seamless mode, which just removes the window features
- Try Seamless Mode
- Get out with RCTRL+L

DEMONSTRATE

- Devices -> Insert Guest Additions CD Image...
- D:\VBoxWindowsAdditions.exe
- Click Next a billion times
- Reboot the VM when asked
- View -> Seamless Mode



Mount a Shared Folder

SAY

- Pick the folder in the Host that will actually hold the data.
- The Guest VM will have access to this via a network share.

- Map a network drive to this share

DEMONSTRATE

- Machine -> Settings -> Shared Folders
- Click the Add Share button on the right
- In Folder Path, choose the path on the Host VM that will actually hold the data. Choose Auto-mount, then give it a name
- Click OK
- Access the shared folder from the Guest VM by accessing:

`\\vboxsvr\<folder share name>`

- In Guest VM, open Windows Explorer
- Click Map Network Drive up above
- Pick drive letter, browse to share, mark "Reconnect at sign-in checkbox", click Finish



Start Up MacOS VM

SAY

- Instructions for making your own image:
 - <https://www.howtogeek.com/289594/how-to-install-macos-sierra-in-virtualbox-on-windows-10/>
- Various aspects of this Mac VM will not work, namely TimeMachine, Messages, FaceTime, etc.: things that use the Apple hardware specifically or are otherwise deeply tied to the Apple ecosystem

DEMONSTRATE

- Fire up VM, log in to “macuser” account
- Start Safari and browse the web



Conclusion

- Virtual Machines are here to stay - get used to spinning them up, then spinning them down as needed
- Hypervisor software changes and updates frequently, so stay on top of it
- Employers LOVE your VM experience

