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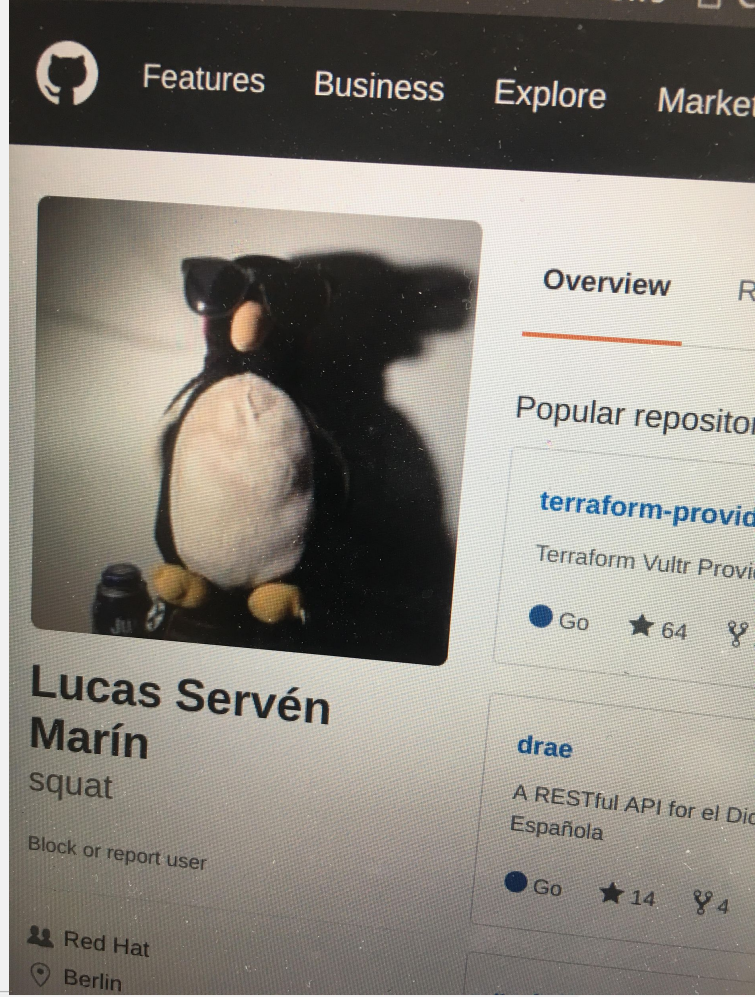
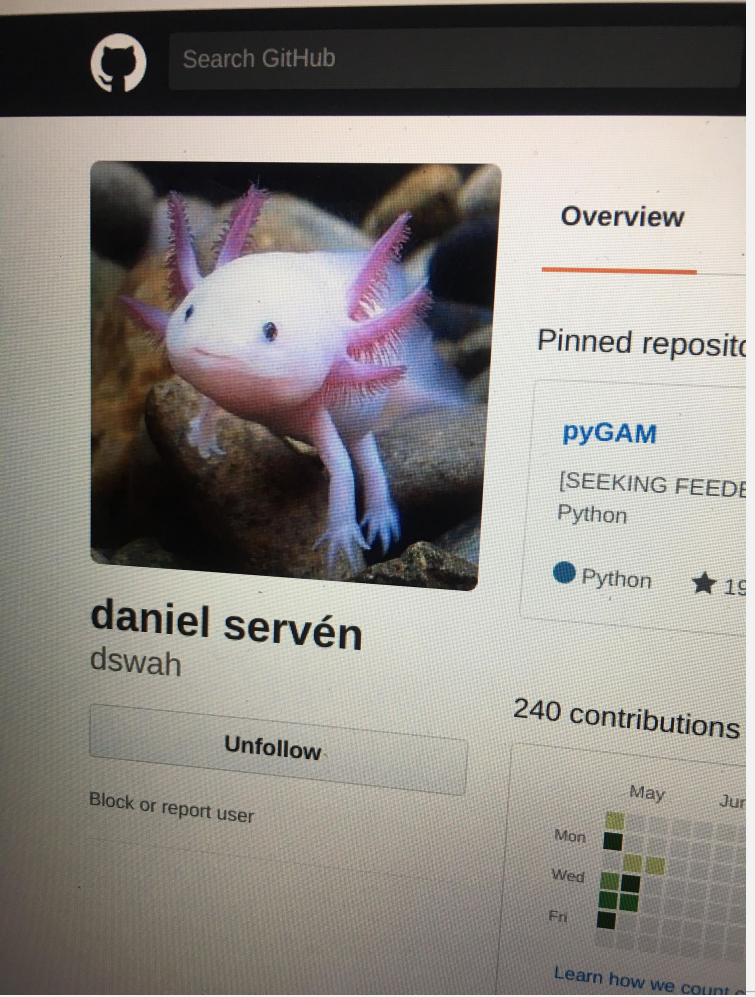
AUTOMATING GPU INFRASTRUCTURE FOR KUBERNETES & CONTAINER LINUX

Lucas Servén Marín
Senior Software Engineer
4/5/2018


CoreOS
redhat.

ABOUT ME

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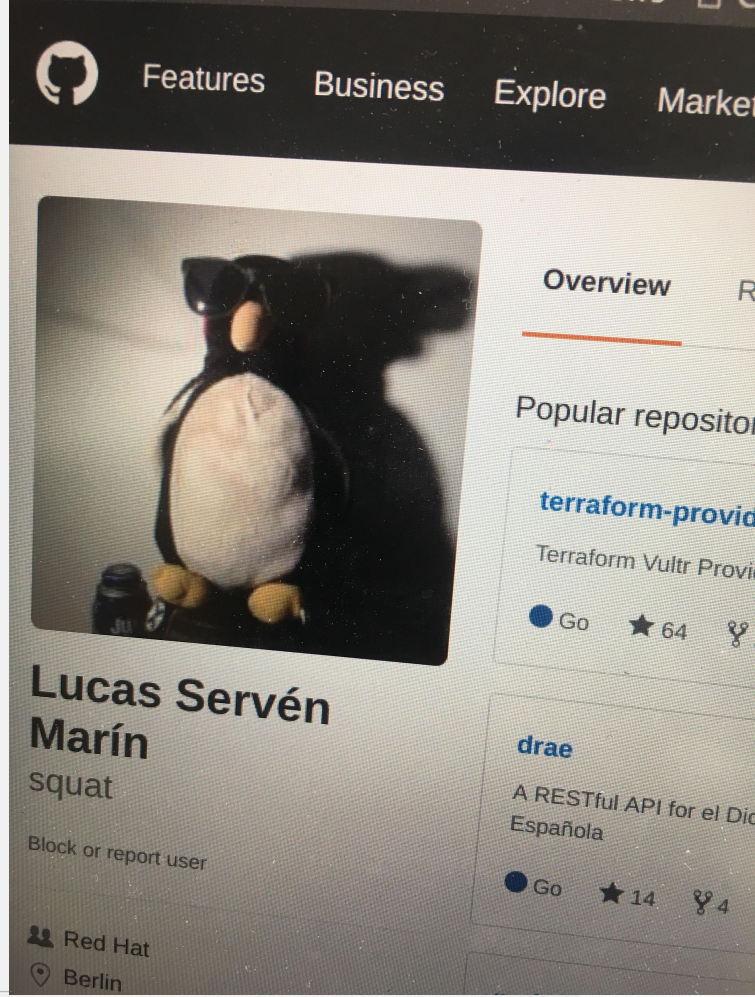
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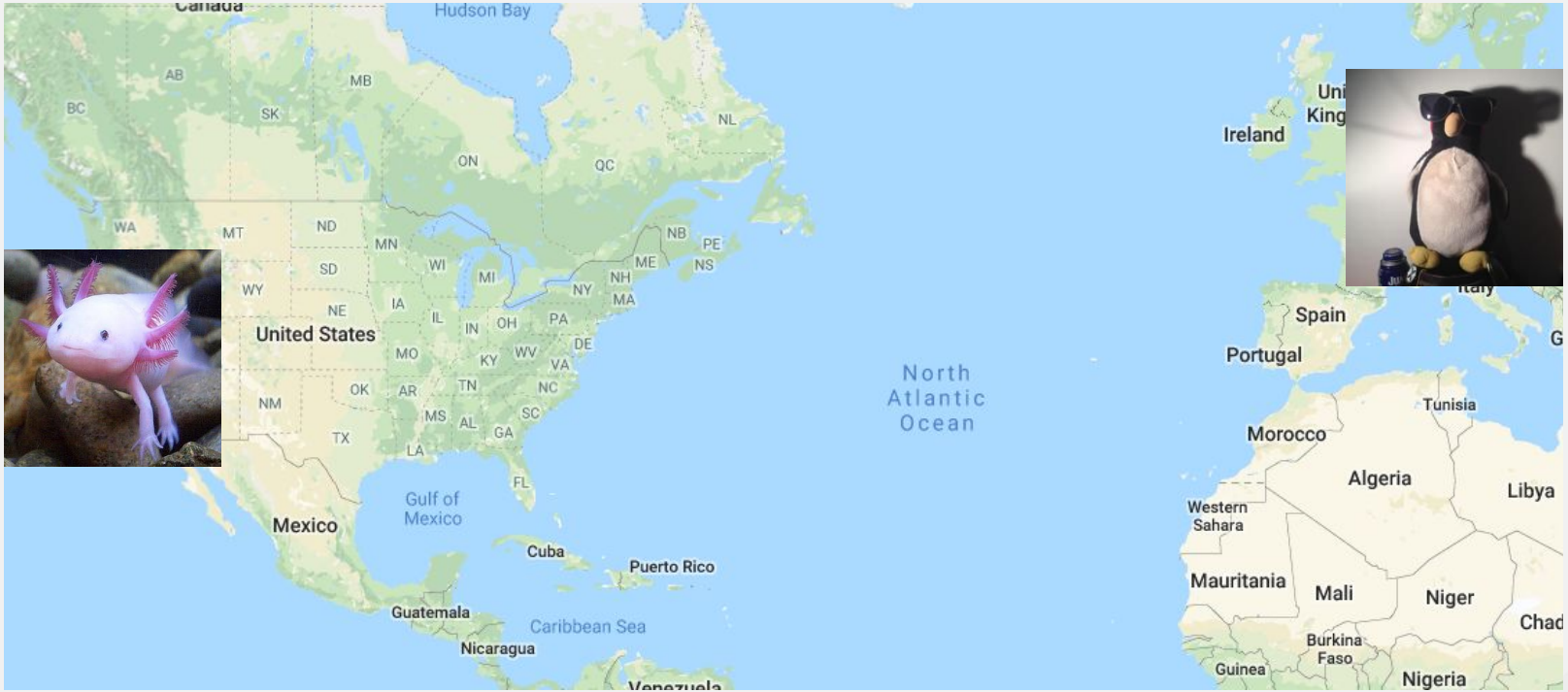
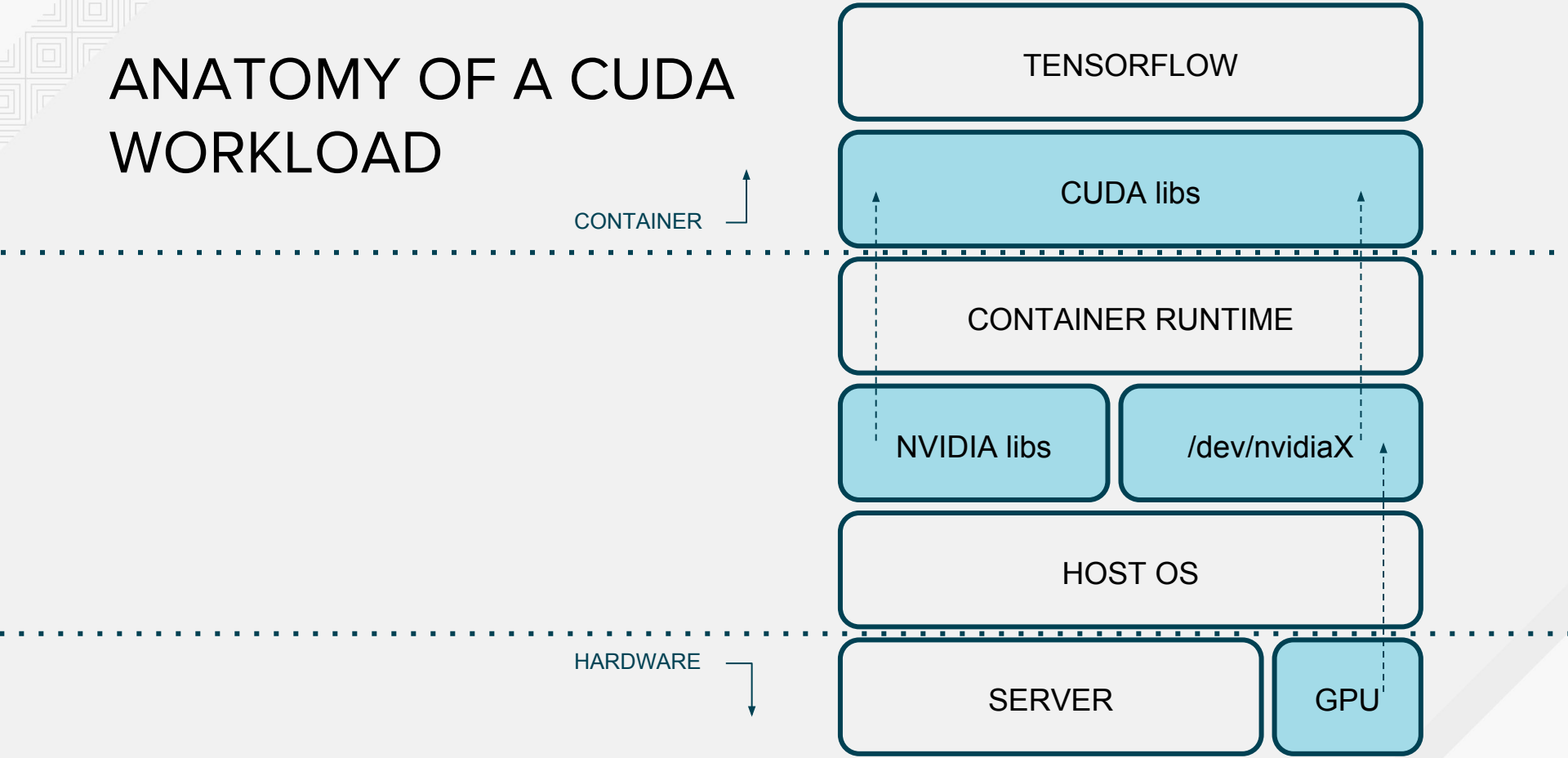
DISTRIBUTED COLLABORATION



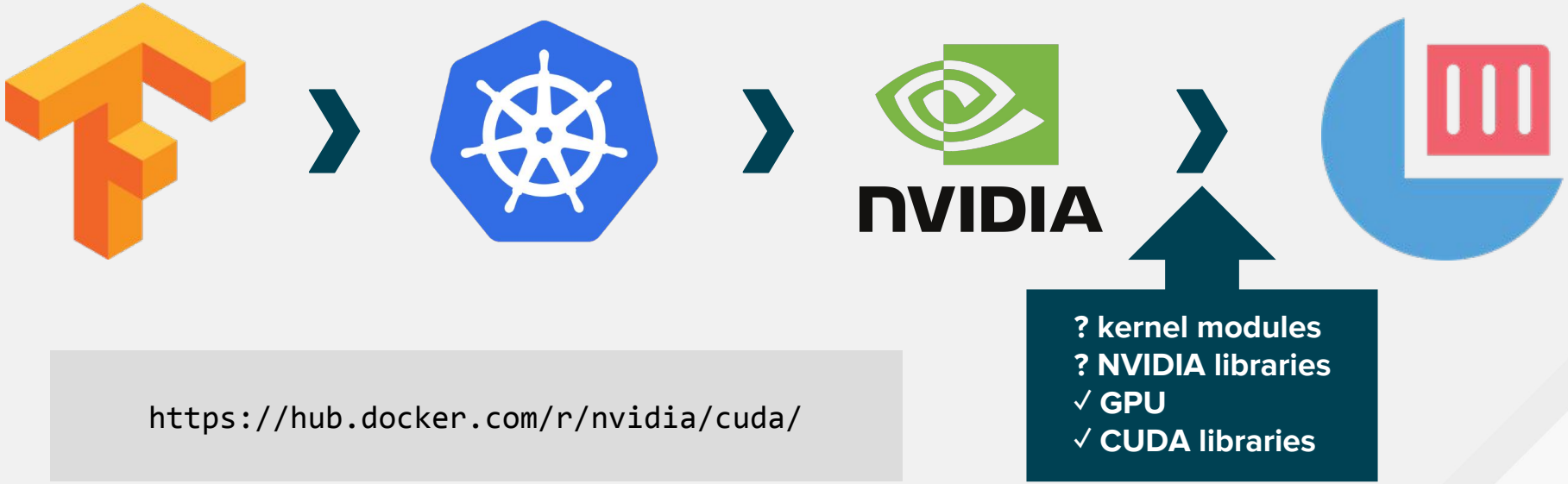
RUNNING ML on K8s

POP QUIZ: NVIDIA ON LINUX?

ANATOMY OF A CUDA WORKLOAD



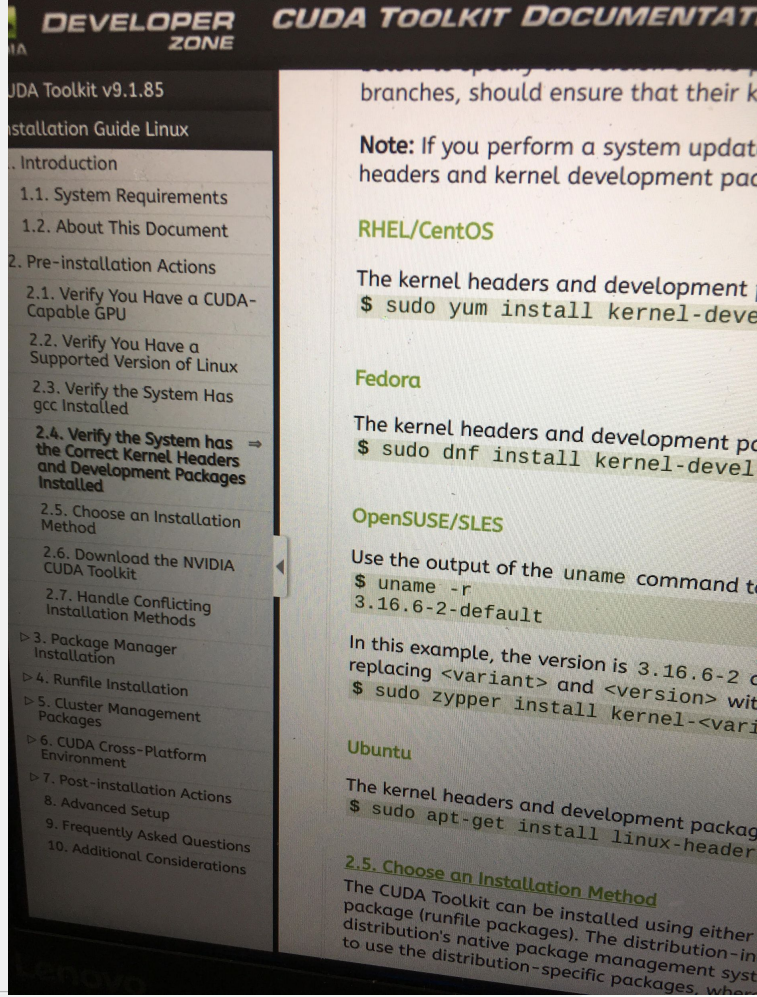
RUNNING ML on K8s



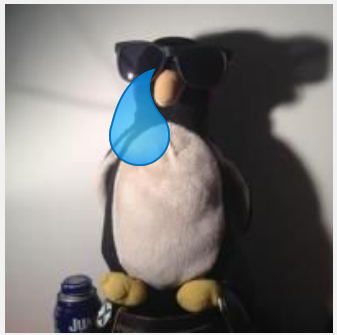

```
https://hub.docker.com/r/nvidia/cuda/
```

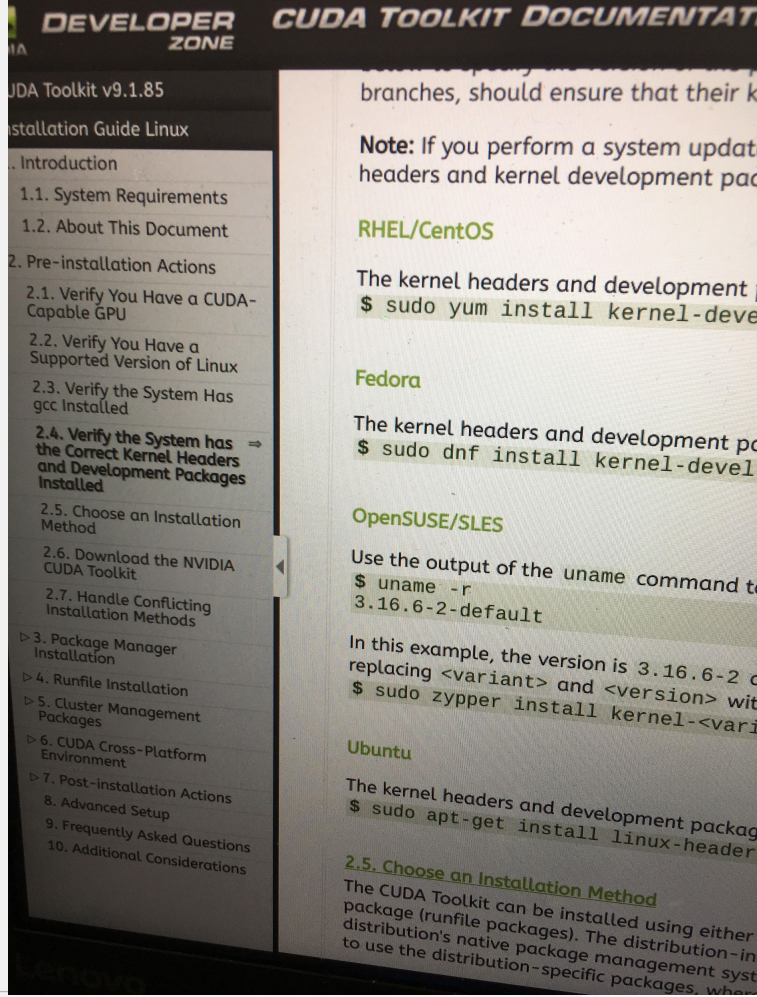
RUNNING ML on K8s

INSTALLING NVIDIA FOR K8s



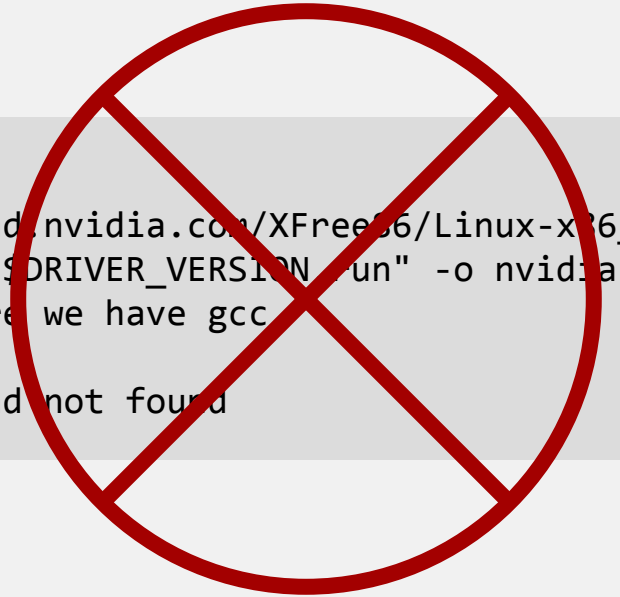
INSTALLING NVIDIA FOR K8s





COMPILING NVIDIA FOR CL

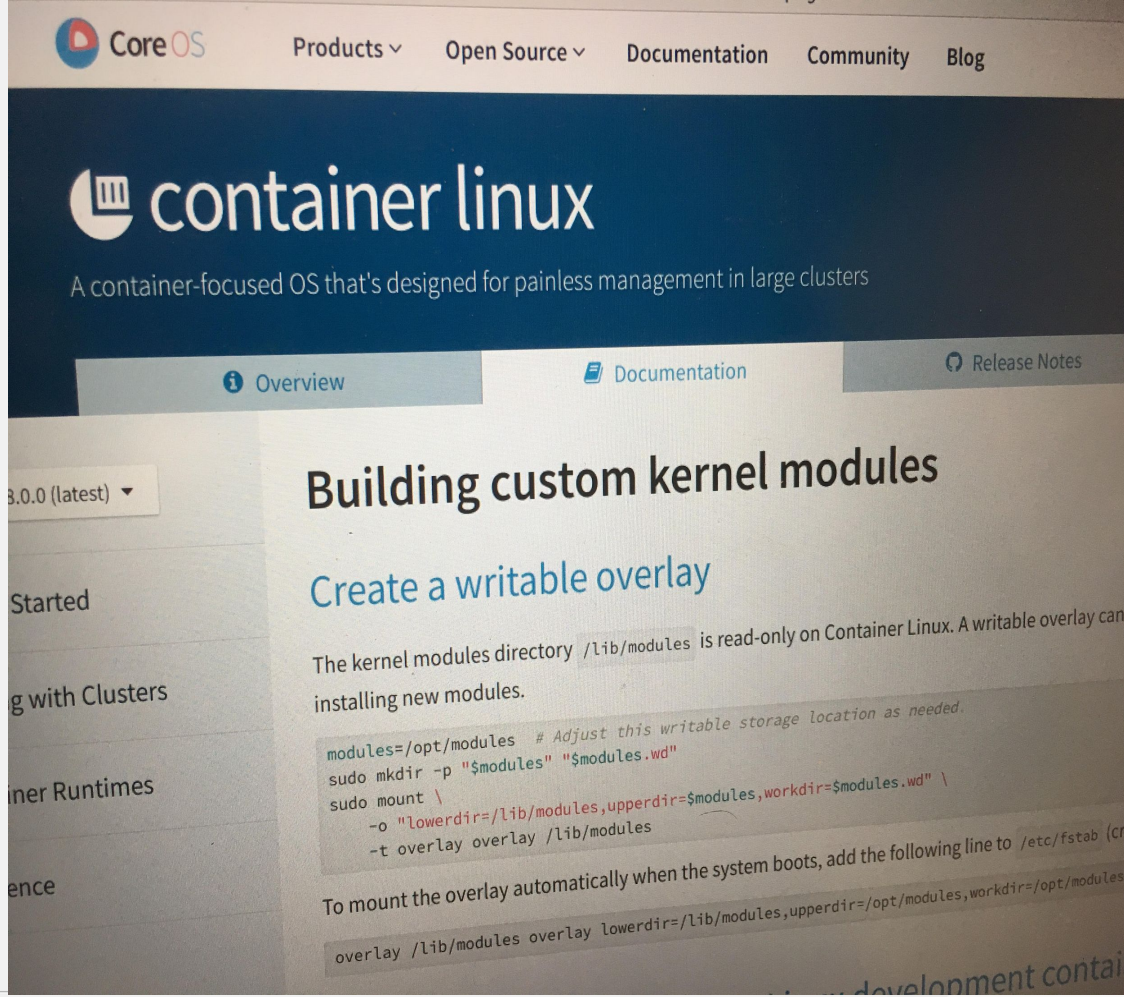
```
$ curl -Ls
"http://us.download.nvidia.com/XFree86/Linux-x86_64/$DRIVER_VERSION/NV
IDIA-Linux-x86_64-$DRIVER_VERSION.run" -o nvidia.run
$ # Let's make sure we have gcc
$ gcc -v
-bash: gcc: command not found
```



COMPILING NVIDIA FOR CL

```
$ docker run --rm -it gcc
# curl -Ls
"http://us.download.nvidia.com/XFree86/Linux-x86_64/$DRIVER_VERSION/NV
IDIA-Linux-x86_64-$DRIVER_VERSION.run" -o nvidia.run
…
# ./nvidia-installer -s -n --kernel-source-path=???
```

COMPILING KERNEL MODULES FOR CL



PRIOR ART

```
https://github.com/Clarifai/coreos-nvidia
```

```
https://github.com/GoogleCloudPlatform/cos-gpu-installer
```

DEVELOPER CONTAINER IN A POD

```
$ gdisk -l coreos_developer_container.bin

Disk coreos_developer_container.bin: 6451200 sectors, 3.1 GiB
Sector size (logical): 512 bytes
Disk identifier (GUID): 00000000-0000-0000-0000-000000000001
Partition table holds up to 128 entries
Main partition table begins at sector 2 and ends at sector 33
First usable sector is 34, last usable sector is 6451166
Partitions will be aligned on 2048-sector boundaries
Total free space is 159677 sectors (78.0 MiB)

Number  Start (sector)    End (sector)  Size       Code  Name
   9            4096         6295551   3.0 GiB     8304  ROOT
```

COMPILING NVIDIA FOR CL

```
$ kubectl apply -f gpu-installer.yaml
```

RUNNING A CUDA CONTAINER

```
$ docker run --device=/dev/nvidiactl --device=/dev/nvidia-uvm
--device=/dev/nvidia0 -v=/opt/nvidia/387.34:/usr/local/nvidia:ro
--entrypoint=nvidia-smi nvidia/cuda
```

MOUNTING NVIDIA FILES

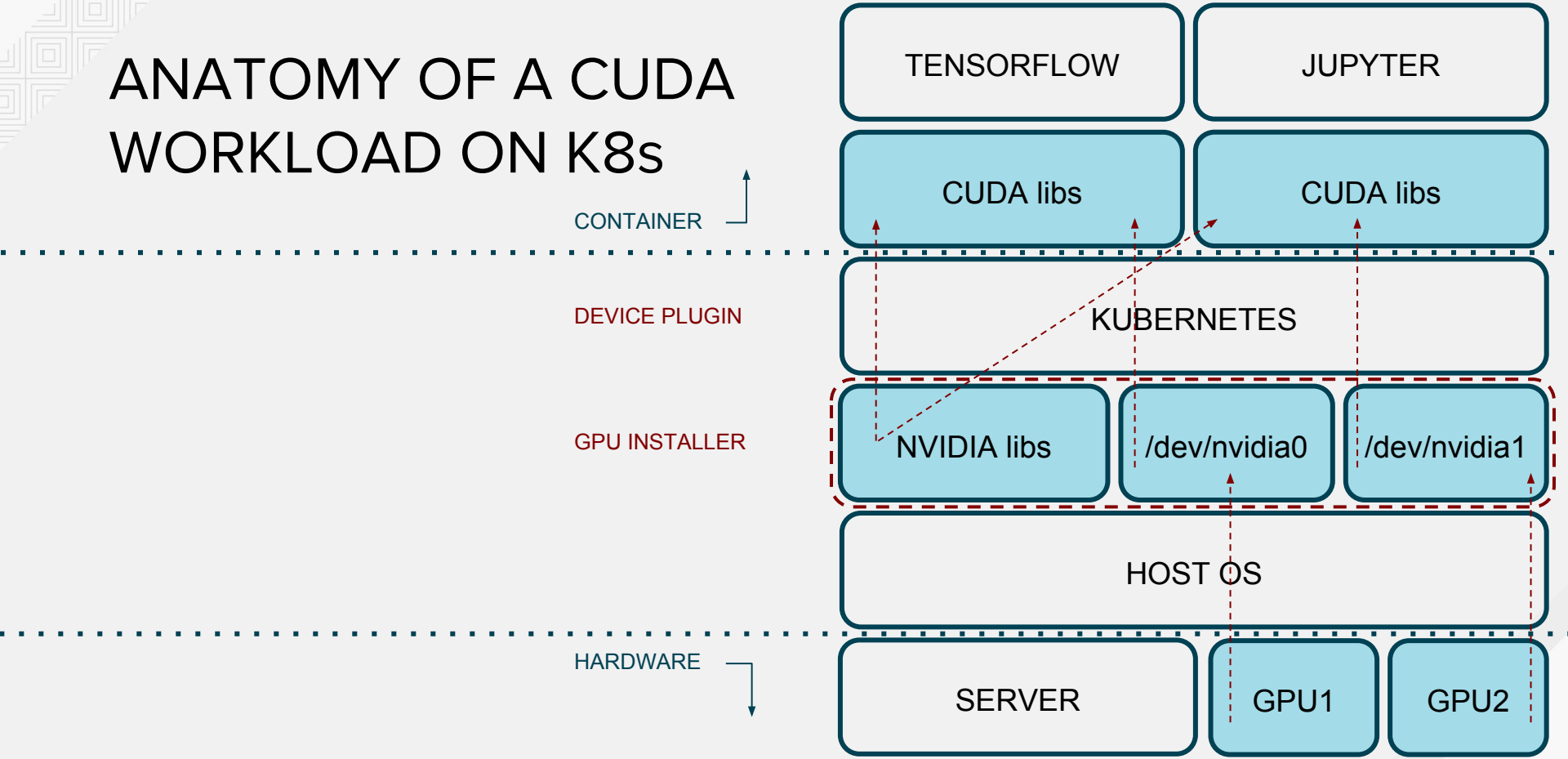
```
$ kubectl apply -f device-plugin.yaml
```

MOUNTING NVIDIA FILES

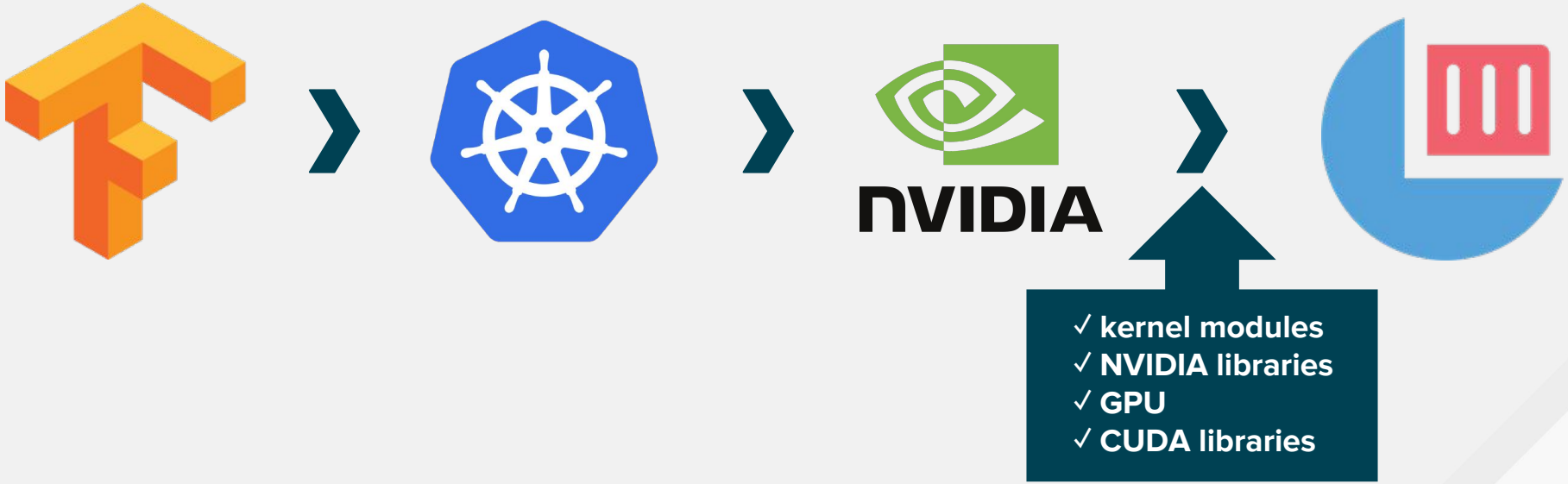
```
# https://github.com/GoogleCloudPlatform/container-engine-accelerators

for _, d := range s.ngm.defaultDevices {
     resp.Devices = append(resp.Devices, &pluginapi.DeviceSpec{
          HostPath:      d,
          ContainerPath: d,
          Permissions:   "mrw",
     })
}
resp.Mounts = append(resp.Mounts, &pluginapi.Mount{
     ContainerPath: s.ngm.containerPathPrefix,
     HostPath:      s.ngm.hostPathPrefix,
     ReadOnly:      true,
})
```

ANATOMY OF A CUDA WORKLOAD ON K8s



RUNNING ML on K8s



DEMO TIME

DEMO COMPONENTS

RESOURCE	URL
overview	https://github.com/squat/kubeconeu2018
K8s installer	https://github.com/poseidon/typhoon
GPU installer	https://github.com/squat/modulus
device plugin	https://github.com/kubernetes/kubernetes/blob/master/cluster/addons/device-plugins/nvidia-gpu/daemonset.yaml
sample workload	https://github.com/pjreddie/darknet

GOING FORWARD

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linkedin.com/company/red-hat

twitter.com/RedHatNews

youtube.com/user/RedHatVideos

FAQ

- Will this change now that Red Hat acquired CoreOS?
- How is this different from the COS GPU installer?
- How can I do this for _____ distribution?
- What about GPU sharing?
- How can I avoid compiling on every node?

My first bare metal K8s GPU node

PROJECTS MENTIONED

- https://github.com/Clarifai/coreos-nvidia
- https://github.com/GoogleCloudPlatform/cos-gpu-installer
- https://github.com/GoogleCloudPlatform/container-engine-accelerators
- https://github.com/poseidon/typhoon
- https://github.com/squat/modulus
- https://github.com/pjreddie/darknet
- https://github.com/squat/darkapi

ADDITIONAL RESOURCES

- https://github.com/shelmangroup/coreos-gpu-installer
- https://github.com/coreos/docs/blob/master/os/kernel-modules.md
- https://github.com/kubernetes/kubernetes/blob/master/cluster/addons/device-plugins/nvidia-gpu/daemonset.yaml
- https://schd.ws/hosted_files/cnkc16/84/StateOfTheGPUnion.pdf