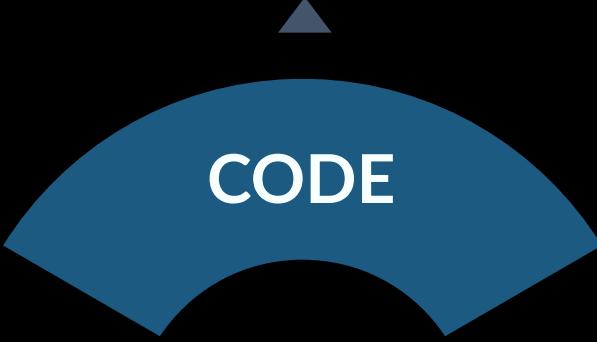
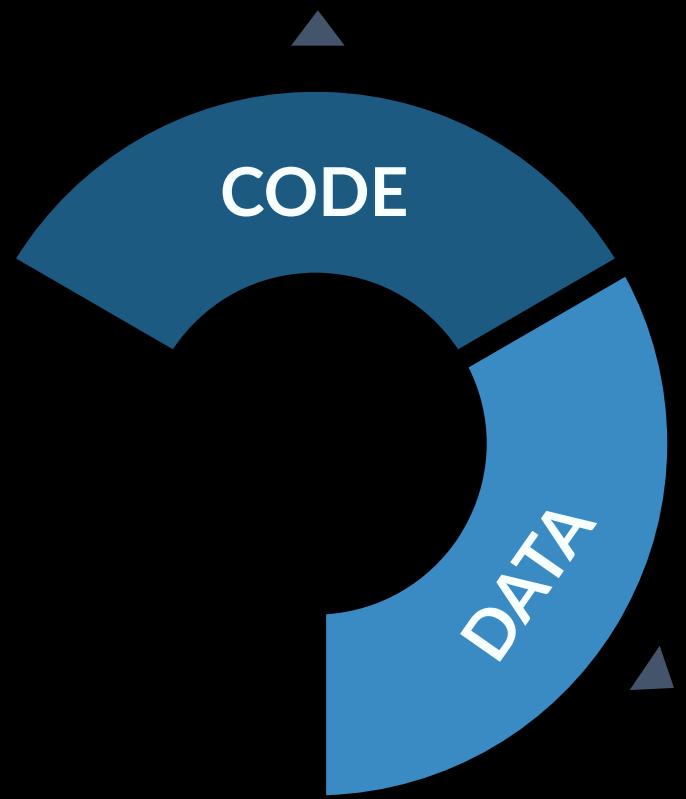


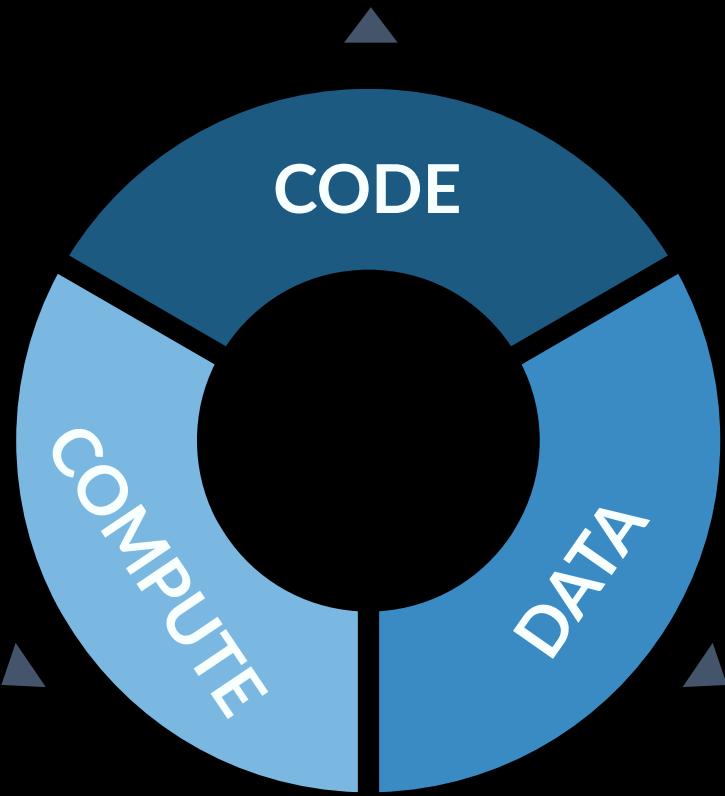
DOCKER + R

Neal E. Magee, Ph.D.
HPC/Cloud Solution Architect
UVA School of Medicine Research Computing



CODE





WHY CONTAINERS?

BREAK BULK CARGO



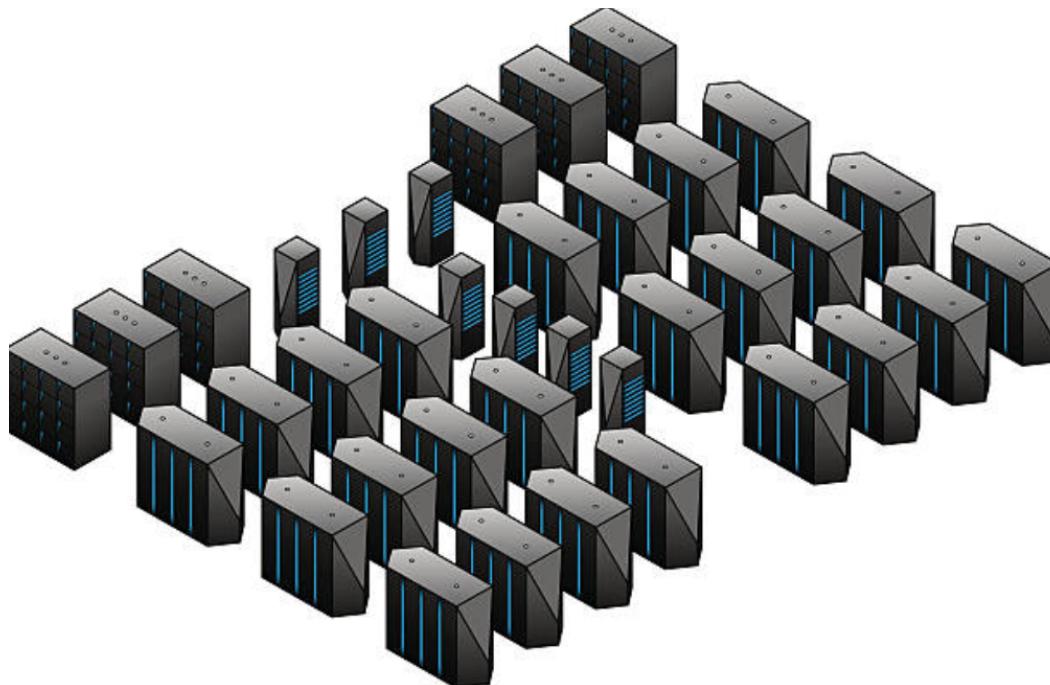


**EFFICIENT
PORTABLE
SCALABLE
SERVICE-BASED
DEV+OPS**

EFFICIENT

CONTAINERS ≠ VIRTUAL MACHINES

UNDER UTILIZED OVER PROVISIONED





Parked 95% of the time



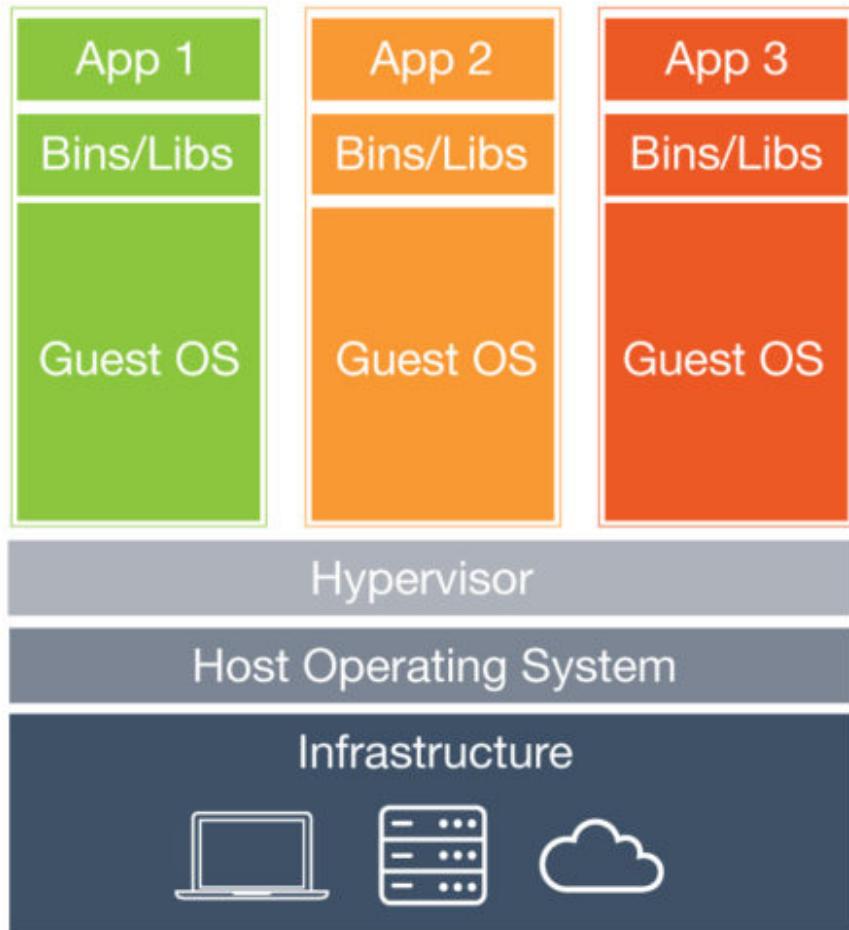
...SOM/dcos-mesosphere/dcos-management-tool/venv/bin/flask run ...dev1: ~ — ssh -i ~/.ssh/id_rsa -p 22 neal@dev1.somrc.virginia.edu ~ — neal@dev1: ~ — bash

1 [|] 9 [|] 17 [|] 25 [|]
2 [|| |] 10 [|] 18 [|] 26 [|]
3 [|| |] 11 [|] 19 [|] 27 [|]
4 [|| |] 12 [|] 20 [|] 28 [|]
5 [|| |] 13 [|] 21 [|] 29 [|]
6 [|| |] 14 [|] 22 [|] 30 [|]
7 [|| |] 15 [|] 23 [|] 31 [|]
8 [|| |] 16 [|] 24 [|] 32 [|]
Mem[|||||] Tasks: 79, 466 thr; 1 running
Swp[Load average: 0.05 0.08 0.08
Uptime: 23:35:40

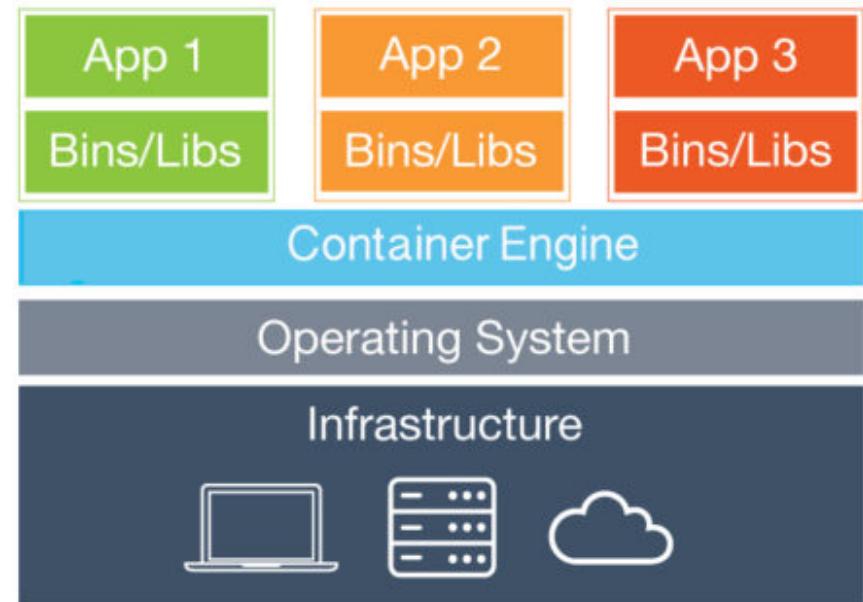


| PID | USER | PRI | NI | VIRT | RES | SHR | S | CPU% | MEM% | TIME+ | Command |
|-------|------|-----|-----|-------|-------|------|---|------|------|---------|---|
| 1 | root | 20 | 0 | 38176 | 6204 | 4016 | S | 0.0 | 0.0 | 0:14.41 | /sbin/init |
| 73536 | neal | 20 | 0 | 45392 | 4756 | 3864 | S | 0.0 | 0.0 | 0:00.03 | └ /lib/systemd/systemd --user |
| 73537 | neal | 20 | 0 | 79956 | 2460 | 4 | S | 0.0 | 0.0 | 0:00.00 | └ (sd-pam) |
| 24692 | | 20 | 0 | 45540 | 4772 | 3876 | S | 0.0 | 0.0 | 0:00.61 | └ /lib/systemd/systemd --user |
| 24693 | | 20 | 0 | 79824 | 2392 | 4 | S | 0.0 | 0.0 | 0:00.00 | └ (sd-pam) |
| 2000 | | 20 | 0 | 55980 | 11708 | 4096 | S | 0.0 | 0.0 | 0:02.30 | └ python /usr/sbin/denyhosts --daemon --purge --con |
| 1990 | | 20 | 0 | 65408 | 4540 | 4064 | S | 0.0 | 0.0 | 0:00.23 | └ /usr/lib/postfix/sbin/master |
| 73208 | | 20 | 0 | 67476 | 4412 | 3944 | S | 0.0 | 0.0 | 0:00.00 | └ pickup -l -t unix -u -c |
| 1992 | | 20 | 0 | 67524 | 4556 | 4108 | S | 0.0 | 0.0 | 0:00.05 | └ qmgr -l -t unix -u |
| 1866 | | 20 | 0 | 107M | 5252 | 4556 | S | 0.0 | 0.0 | 0:06.33 | └ /usr/sbin/ntpd -p /var/run/ntpd.pid -g -u 115:123 |
| 73890 | | 20 | 0 | 107M | 5252 | 4556 | S | 0.0 | 0.0 | 0:00.00 | └ /usr/sbin/ntpd -p /var/run/ntpd.pid -g -u 115: |
| 1855 | | 20 | 0 | 19596 | 2204 | 1864 | S | 0.0 | 0.0 | 0:17.62 | └ /usr/sbin/irqbalance --pid=/var/run/irqbalance.pi |
| 1701 | | 20 | 0 | 35368 | 2856 | 2308 | S | 0.0 | 0.0 | 0:00.00 | └ /sbin/rpc.statd --no-notify |
| 1644 | | 20 | 0 | 43304 | 4708 | 2884 | S | 0.0 | 0.0 | 0:00.05 | └ /usr/sbin/rpc.mountd --manage-gids |
| 1639 | | 20 | 0 | 270M | 5964 | 5308 | S | 0.0 | 0.0 | 0:00.16 | └ /usr/lib/polkit-1/polkitd --no-debug |
| 1643 | | 20 | 0 | 270M | 5964 | 5308 | S | 0.0 | 0.0 | 0:00.10 | └ /usr/lib/polkit-1/polkitd --no-debug |
| 1641 | | 20 | 0 | 270M | 5964 | 5308 | S | 0.0 | 0.0 | 0:00.00 | └ /usr/lib/polkit-1/polkitd --no-debug |
| 1617 | | 10 | -10 | 5720 | 3508 | 2428 | S | 0.0 | 0.0 | 0:06.44 | └ /sbin/iscsid |
| 1616 | | 20 | 0 | 5220 | 152 | 40 | S | 0.0 | 0.0 | 0:01.28 | └ /sbin/iscsid |
| 1606 | | 20 | 0 | 47624 | 3452 | 3052 | S | 0.0 | 0.0 | 0:00.11 | └ /sbin/rpcbind -f -w |
| 1574 | | 20 | 0 | 65508 | 6136 | 5428 | S | 0.0 | 0.0 | 0:00.02 | └ /usr/sbin/sshd -D |
| 73534 | | 20 | 0 | 106M | 7392 | 6296 | S | 0.0 | 0.0 | 0:00.01 | └ sshd: neal [priv] |
| 73807 | neal | 20 | 0 | 106M | 3556 | 2464 | S | 0.0 | 0.0 | 0:00.00 | └ sshd: neal@pts/0 |
| 73808 | neal | 20 | 0 | 21404 | 5096 | 3260 | S | 0.0 | 0.0 | 0:00.05 | └ -bash |
| 73827 | neal | 20 | 0 | 25396 | 4696 | 3288 | R | 2.6 | 0.0 | 0:02.65 | └ htop |
| 24690 | | 20 | 0 | 106M | 7148 | 6048 | S | 0.0 | 0.0 | 0:00.00 | └ sshd: nathan [priv] |
| 24998 | | 20 | 0 | 106M | 3540 | 2444 | S | 0.0 | 0.0 | 0:00.91 | └ sshd: nathan@pts/1 |
| 24999 | | 20 | 0 | 23052 | 7028 | 3388 | S | 0.0 | 0.0 | 0:00.73 | └ -bash |
| 1570 | | 20 | 0 | 4504 | 688 | 624 | S | 0.0 | 0.0 | 0:00.00 | └ /bin/sh -e /etc/rc.local start |

F1 Help F2 Setup F3 Search F4 Filter F5 Sorted F6 Collap F7 Nice - F8 Nice + F9 Kill F10 Quit



Hypervisor-based Virtualization

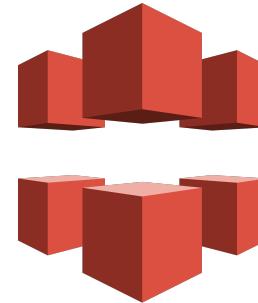


Container virtualization

EFFICIENT

CONTAINERS ≠ VIRTUAL MACHINES
LONG-RUNNING SERVICES
SHORT-LIVED JOBS
DISPOSABLE

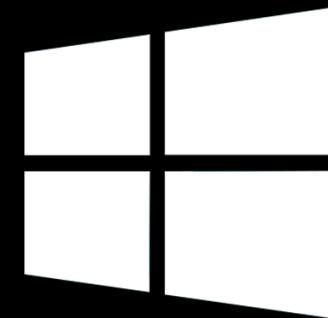
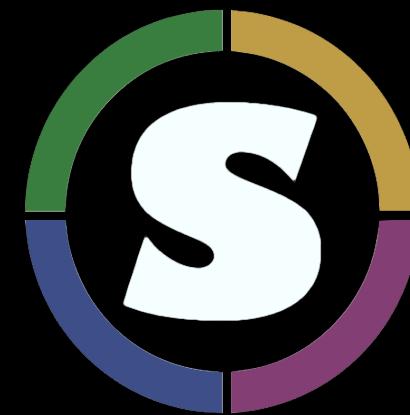
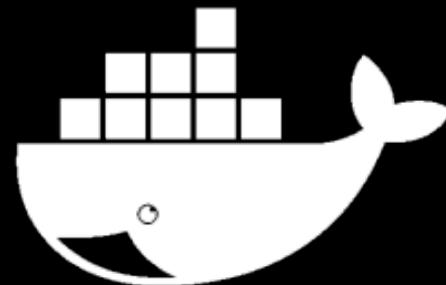
CI/CD PIPELINE



PORTABLE

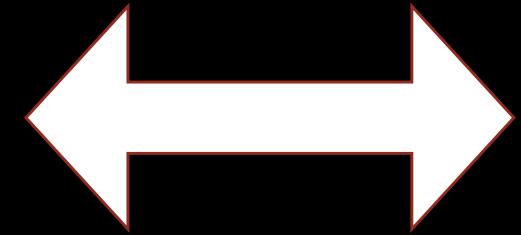
**SELF-CONTAINED
PLATFORM-AGNOSTIC**

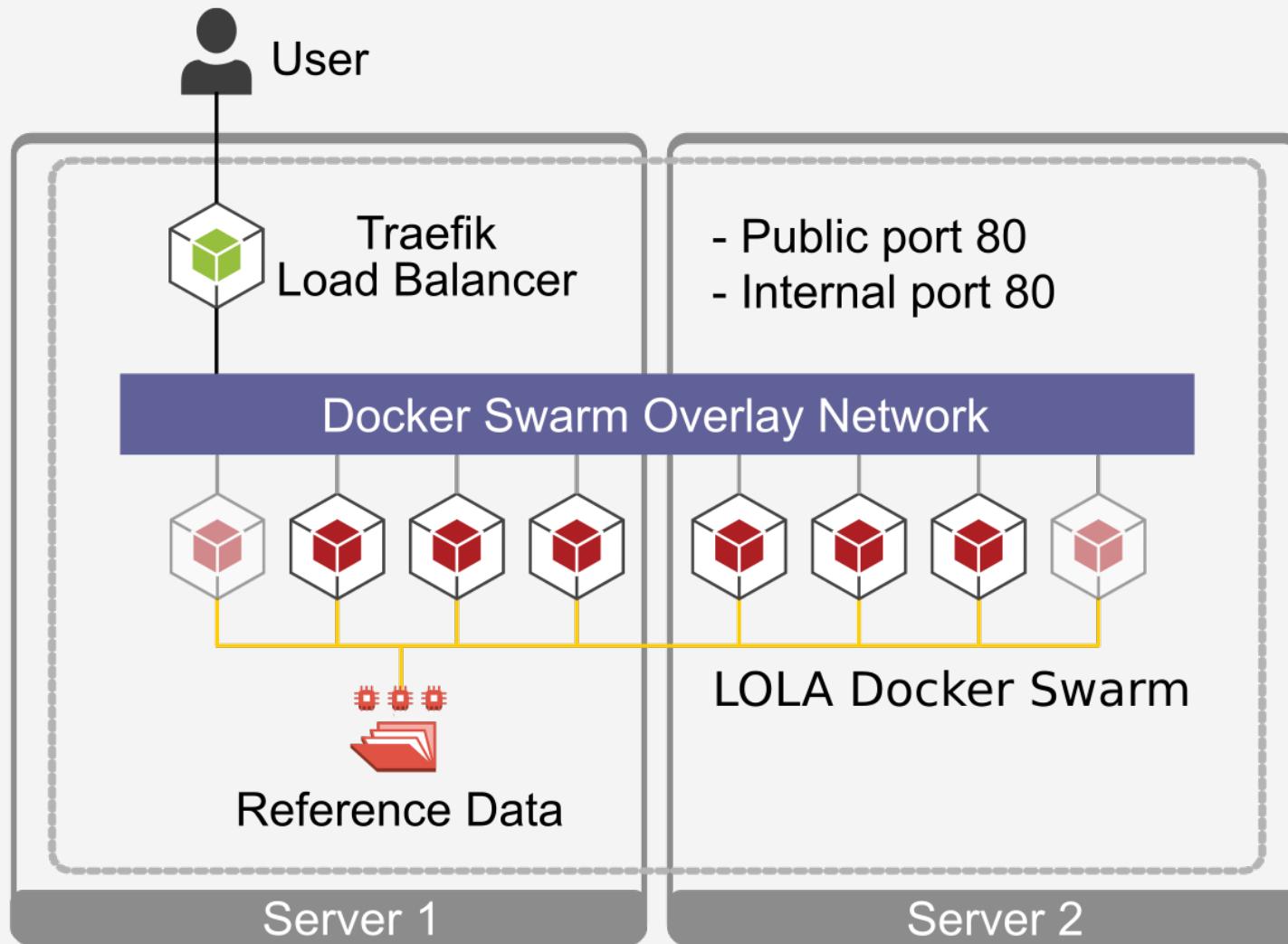
PORTABLE



SCALABLE

SCALE HORIZONTALLY,
NOT VERTICALLY
IDENTIFY BOTTLENECKS



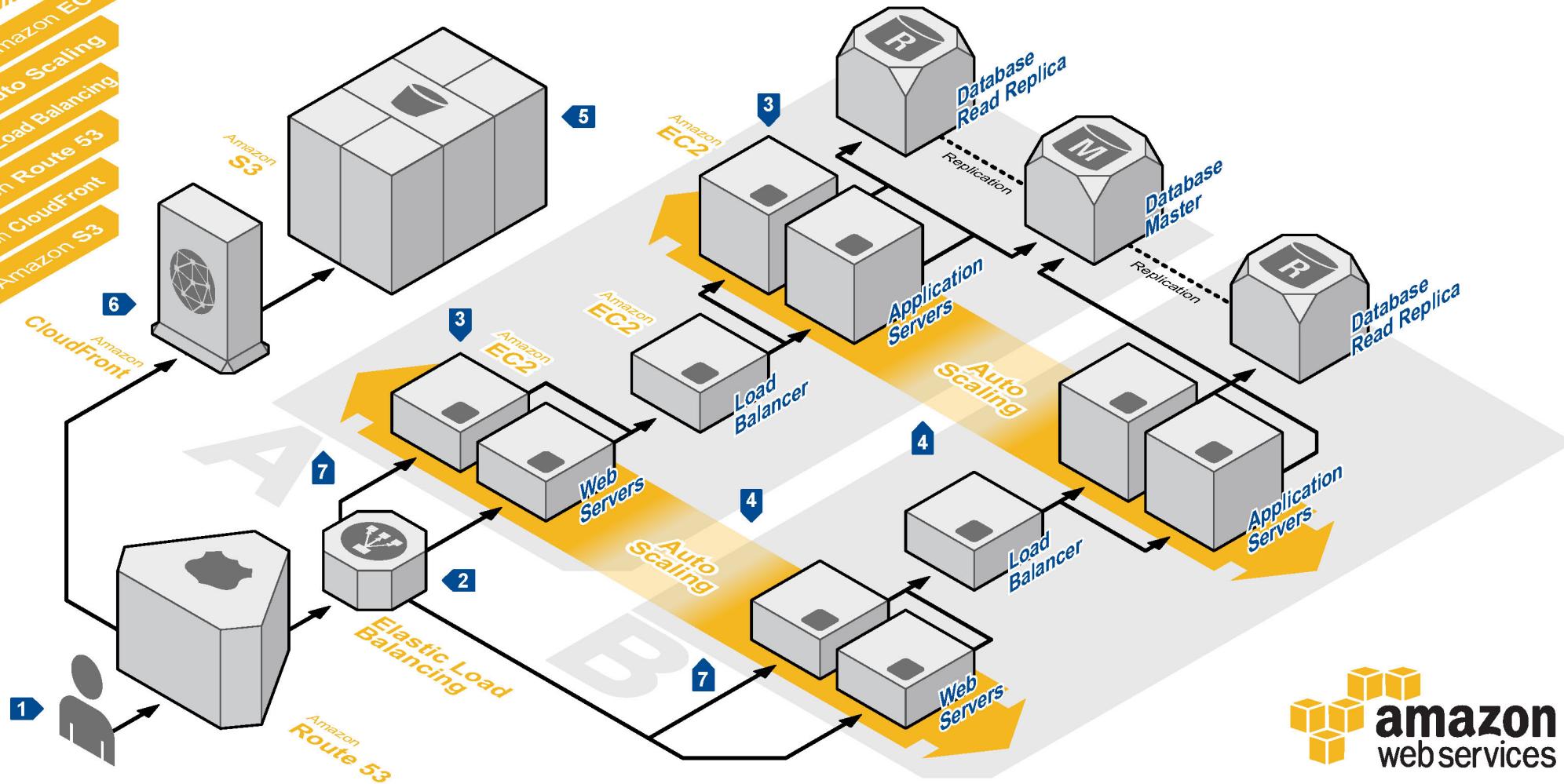


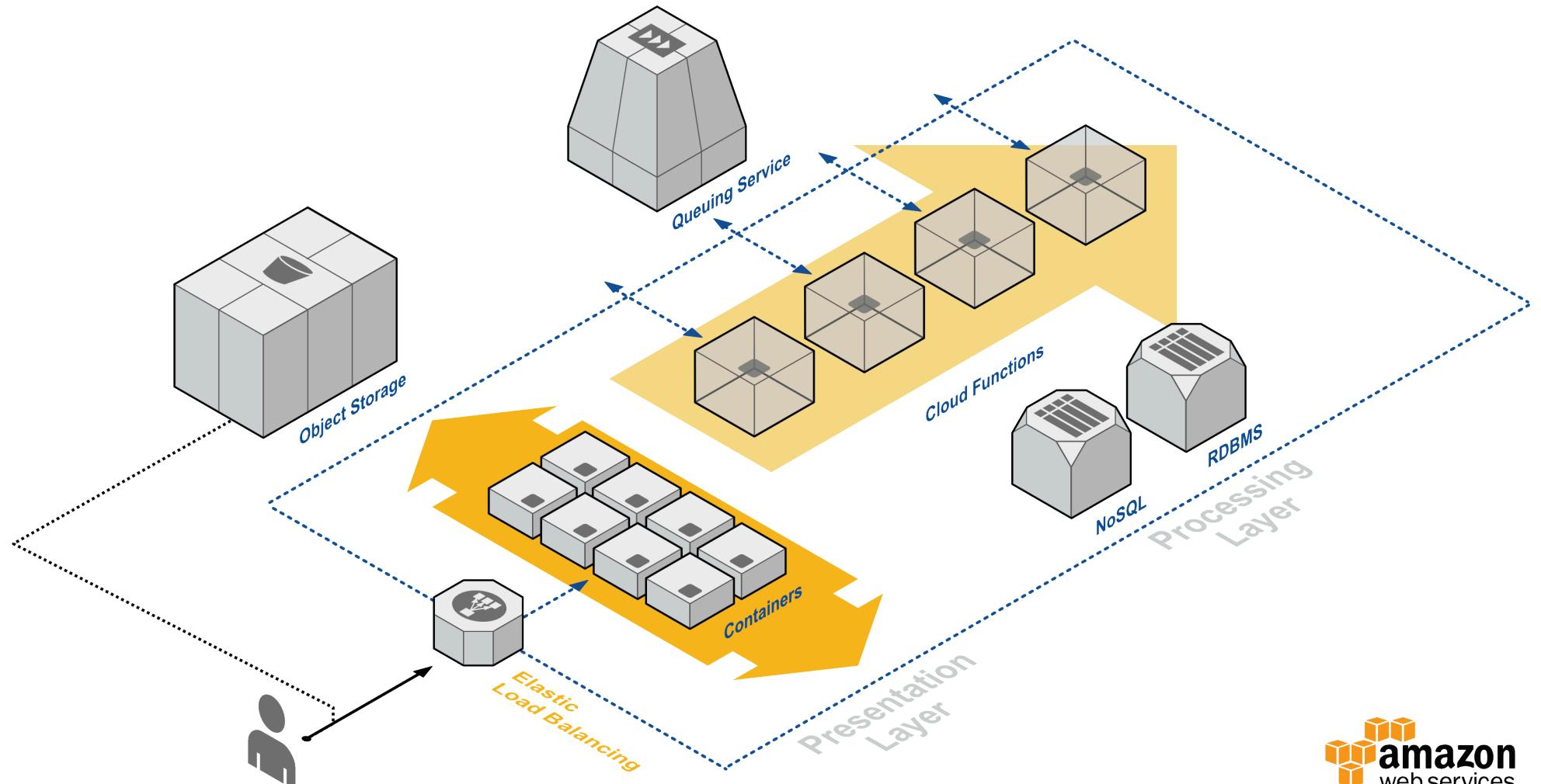
SERVICE-BASED

**FORCES SOA
DEDICATED PROCESSES
ISOLATED RUNTIME**

WEB APPLICATION HOSTING

Highly available and scalable web hosting can be complex and expensive. Dense peak periods and wild swings in traffic patterns result in low utilization rates of expensive hardware. Amazon Web Services provides the reliable, scalable, secure, and high-performance infrastructure required for web applications while enabling an elastic, scale out and scale down infrastructure to match IT costs in real time as customer traffic fluctuates.

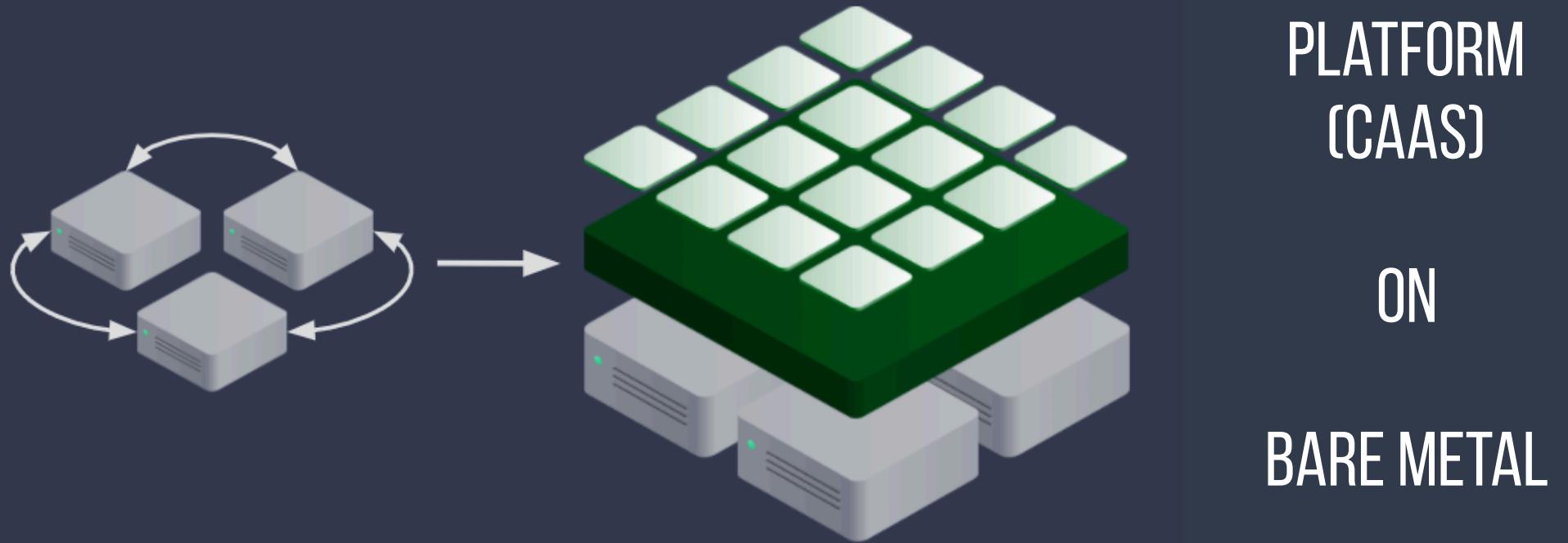




DEV+OPS

**DEVELOPERS CREATE DEPLOYMENTS
DESIGNED WITH OPS IN MIND
ORCHESTRATION / MANAGEMENT**

DOCS / KUBERNETES / SWARM



INFRASTRUCTURE PLATFORM (IaaS)

OpenStack
vSphere
Azure Stack VMs

AWS EC2
GCE
Azure VMs

CONTAINER PLATFORM (CaaS)

Kubernetes
DC/OS
Docker Datacenter

GKE
ECS
ACS

APPLICATION PLATFORM (PaaS / aPaaS)

CloudFoundry
OpenShift
WaveMaker RAD

Heroku
PCF
Jelastic

FUNCTION PLATFORM (FaaS)

OpenWhisk
Fission
Iron.io

Lambda
GCF
Azure Functions

SOFTWARE PLATFORM (SaaS)

BYO

Salesforce
Oracle
SAP

HOSTED

FINDING CONTAINERS

PULL FROM DOCKER HUB
BUILD YOUR OWN

CREATING CONTAINERS

BUILD IMAGES BY HAND
AUTOMATE YOUR BUILDS

CREATING CONTAINERS

BY HAND

```
docker pull ubuntu:latest
docker run -it ubuntu:latest /bin/bash
root@12345abcde: ~
```

CREATING CONTAINERS

FROM A DOCKERFILE

```
FROM alpine:latest
MAINTAINER mst3k@virginia.edu

WORKDIR /root
COPY script.sh .

RUN apk --no-cache add curl jq

CMD ["sh", "script.sh"]
```

CREATING CONTAINERS

BUILD

```
docker build -t account/container-name .
```

PUSH

```
docker push account/container-name
```

RUNNING CONTAINERS

DETACHED MODE

INTERACTIVE MODE

CREATING CONTAINERS

DETACHED MODE (DAEMON)

```
docker run -d -p 80:80 nginx
```

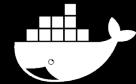
CREATING CONTAINERS

INTERACTIVE MODE (TERMINAL)

```
docker run -it ubuntu:latest /bin/bash
```

```
root@12345abcde: ~
```

LEARN MORE



training.play-with-docker.com



discuss.rc.virginia.edu



somrc.virginia.edu