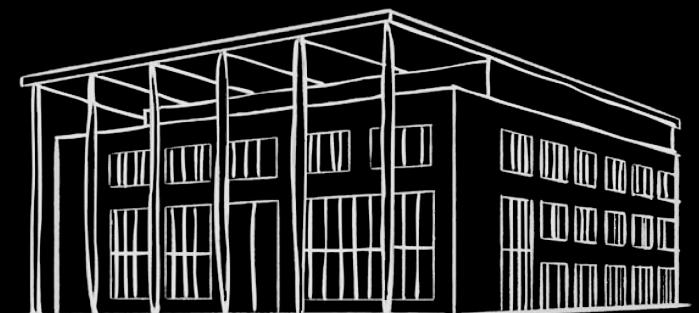


Cloud Computing in AWS

DS6051

NEAL MAGEE
SCHOOL OF DATA SCIENCE
UNIVERSITY OF VIRGINIA



 UVA Data Science

Introduction & Concepts

Neal Magee

nem2p@virginia.edu

Positions

Associate Professor, UVA School of Data Science

Lecturer, UVA Computer Science 2020-2023

Solution Architect, UVA Research Computing 2016-2023

Director of Internet Operations 2007-2016

Web/Software Developer 1997-2007

Certifications

AWS Solution Architect Professional

AWS Solution Architect Associate

AWS Developer Associate

Agenda

Background
Concepts
Practical Skills



PARKED 95% OF THE TIME

IDLE 95% OF THE TIME

```

1 [          0.6%] 9 [ ||          2.6%] 17 [          0.0%] 25 [          0.0%
2 [          0.7%] 10 [          0.0%] 18 [          0.0%] 26 [          0.0%
3 [          0.0%] 11 [          0.0%] 19 [          0.0%] 27 [          0.0%
4 [          0.7%] 12 [          1.3%] 20 [          0.6%] 28 [          0.0%
5 [          0.7%] 13 [          0.0%] 21 [          0.0%] 29 [          0.0%
6 [          0.0%] 14 [          0.0%] 22 [          0.0%] 30 [          0.0%
7 [          0.0%] 15 [          0.0%] 23 [          0.0%] 31 [          0.0%
8 [          0.6%] 16 [          0.0%] 24 [          0.0%] 32 [          0.0%
Mem[|||||14.5G/62.8G] Tasks: 116, 606 thr; 1 running
Swp[          431M/63.9G] Load average: 1.20 0.64 0.45
                           Uptime: 300 days(!), 12:21:01

```

PID	USER	PRI	NI	VIRT	RES	SHR	S	CPU%	MEM%	TIME+	Command
1	root	20	0	38204	5988	3908	S	0.0	0.0	41:50.67	/lib/systemd/systemd --system --deserialize 38
186098	root	20	0	270M	4288	3712	S	0.0	0.0	0:00.39	└─ /usr/lib/policykit-1/polkitd --no-debug
186105	root	20	0	270M	4288	3712	S	0.0	0.0	0:00.20	└─ /usr/lib/policykit-1/polkitd --no-debug
186102	root	20	0	270M	4288	3712	S	0.0	0.0	0:00.00	└─ /usr/lib/policykit-1/polkitd --no-debug
162305	clamav	20	0	905M	668M	15892	S	0.0	1.0	9:04.55	└─ /usr/sbin/clamd --foreground=true
169345	clamav	20	0	905M	668M	15892	S	0.0	1.0	0:00.00	└─ /usr/sbin/clamd --foreground=true
161057	clamav	20	0	129M	11820	9320	S	0.0	0.0	1:12.69	└─ /usr/bin/freshclam -d --foreground=true
160514	root	20	0	44148	3268	2740	S	0.0	0.0	0:01.23	└─ /lib/systemd/systemd-udevd
156666	neal	20	0	26052	2912	2304	S	0.0	0.0	0:00.01	└─ SCREEN -R
156667	neal	20	0	21840	5648	3232	S	0.0	0.0	0:00.04	└─ /bin/bash
156694	root	20	0	69884	4344	3708	S	0.0	0.0	0:00.00	└─ sudo su
156695	root	20	0	69332	4120	3524	S	0.0	0.0	0:00.00	└─ su
156696	root	20	0	21308	5124	3244	S	0.0	0.0	0:00.02	└─ bash
156860	root	20	0	11244	3024	2816	S	0.0	0.0	0:00.00	└─ /bin/bash ./update-rivanna.sh
156861	root	20	0	46988	5376	4704	S	0.0	0.0	0:00.79	└─ ssh -tt -i /root/.ssh/nem2p_rivanna nem2p@rivanna.hpc.virginia.edu
144361	root	20	0	21824	2912	2728	S	0.0	0.0	0:00.11	└─ /usr/sbin/incron
140705	syslog	20	0	250M	4128	2792	S	0.0	0.0	2:41.15	└─ /usr/sbin/rsyslogd -n
140711	syslog	20	0	250M	4128	2792	S	0.0	0.0	1:25.87	└─ /usr/sbin/rsyslogd -n
140710	syslog	20	0	250M	4128	2792	S	0.0	0.0	0:00.00	└─ /usr/sbin/rsyslogd -n
140709	syslog	20	0	250M	4128	2792	S	0.0	0.0	1:15.18	└─ /usr/sbin/rsyslogd -n
136291	root	10	-10	5720	3660	2456	S	0.0	0.0	1:24.13	└─ /sbin/iscsid
136290	root	20	0	5220	1724	1596	S	0.0	0.0	0:17.12	└─ /sbin/iscsid
127469	root	20	0	65512	5512	4972	S	0.0	0.0	0:00.06	└─ /usr/sbin/sshd -D
71057	root	20	0	106M	7504	6400	S	0.0	0.0	0:00.00	└─ sshd: neal [priv]
71158	neal	20	0	106M	3316	2216	S	0.0	0.0	0:00.00	└─ sshd: neal@pts/0
71159	neal	20	0	21832	5648	3272	S	0.0	0.0	0:00.08	└─ -bash
71191	neal	20	0	25600	4668	3100	R	2.0	0.0	0:00.88	└─ htop
123780	ntp	20	0	108M	3360	2772	S	0.0	0.0	33:36.02	└─ /usr/sbin/ntpd -p /var/run/ntpd.pid -g -u 115:123
11605	ntp	20	0	108M	3360	2772	S	0.0	0.0	0:00.12	└─ /usr/sbin/ntpd -p /var/run/ntpd.pid -g -u 115:123
87930	root	20	0	55840	11316	3780	S	0.0	0.0	0:30.26	└─ python /usr/sbin/denyhosts --daemon --purge --config=/etc/denyhosts.conf

F1Help F2Setup F3Search F4Filter F5Sorted F6Collapse F7Nice - F8Nice + F9Kill F10Quit





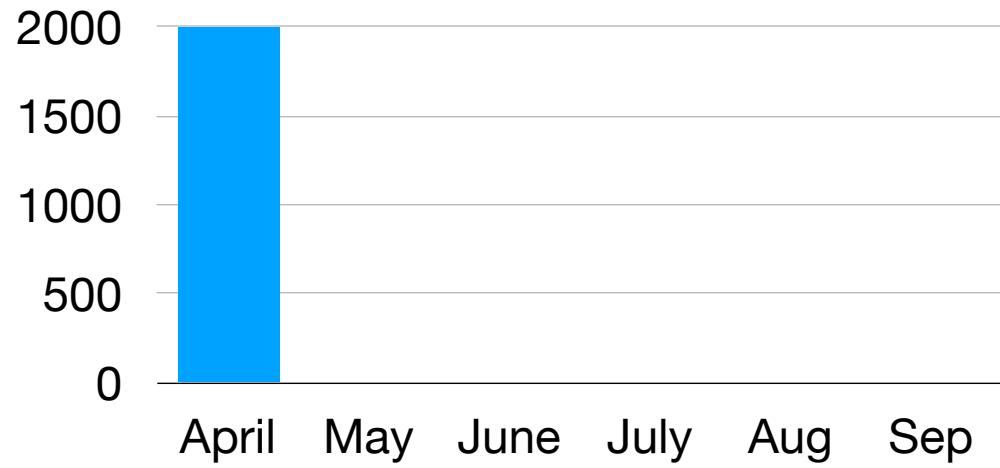


Capital Expenses

Order
Ship
Fixed CPU
Fixed RAM
Fixed Storage

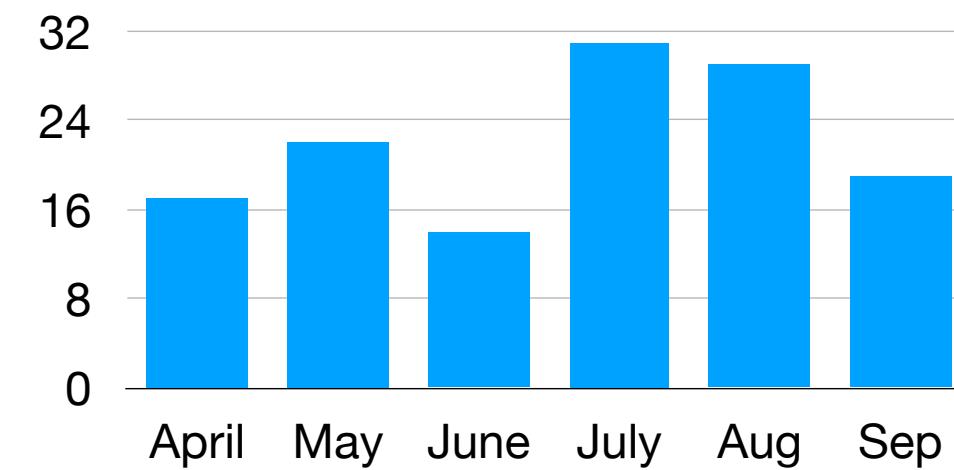
Operational Expenses

Power
Connectivity
Cooling
Engineering



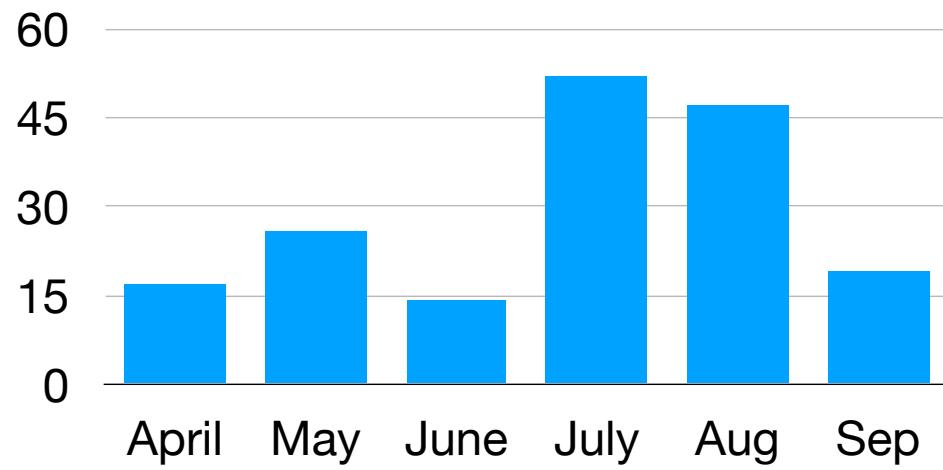
Capital Expenses

Order
Fixed CPU
Fixed RAM
Fixed Storage
Ship



Operational Expenses

Power
Connectivity
Cooling
Engineering



Cloud = Pay As You Go

Abstractions

Event-driven architecture

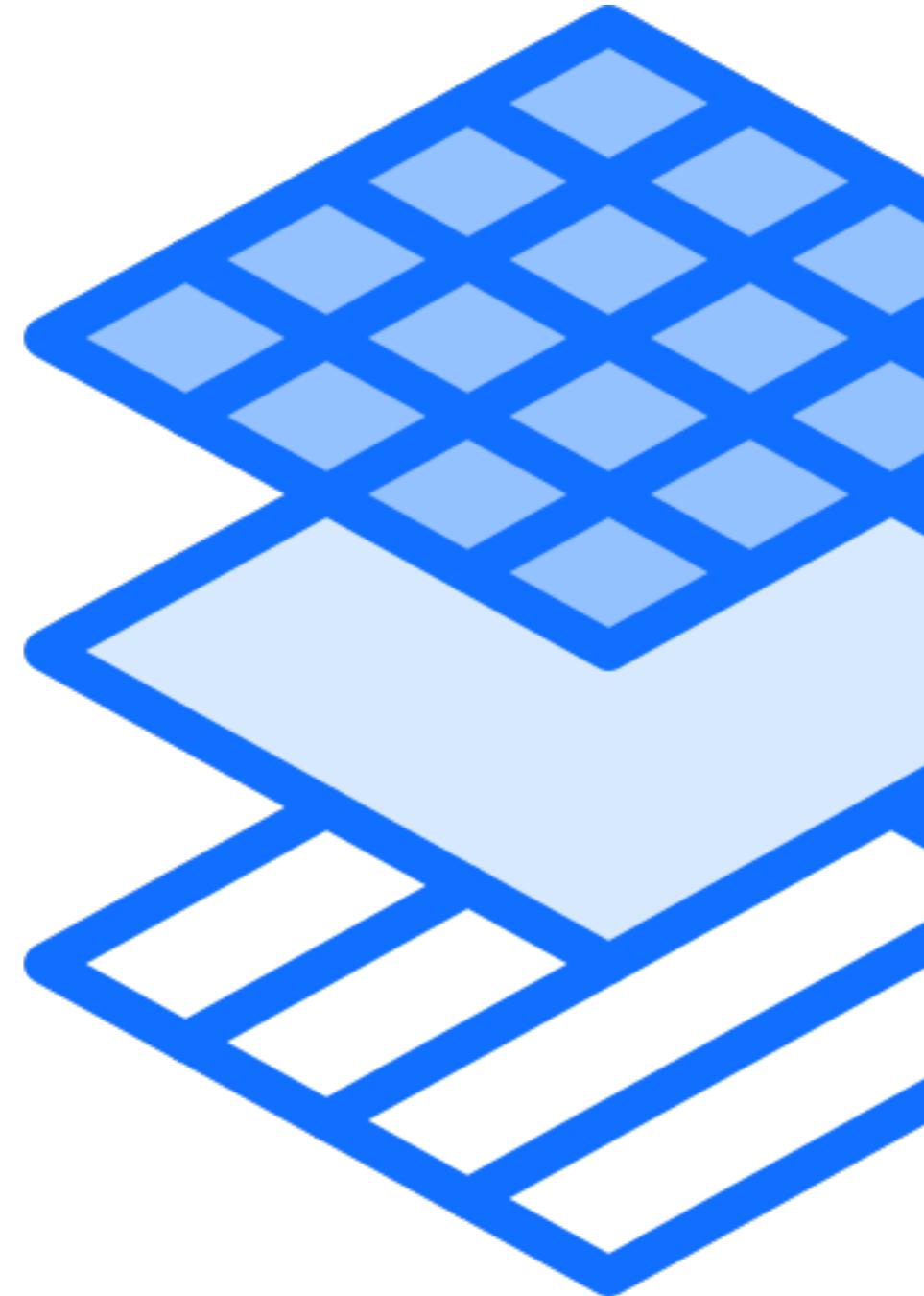
CICD / Orchestration

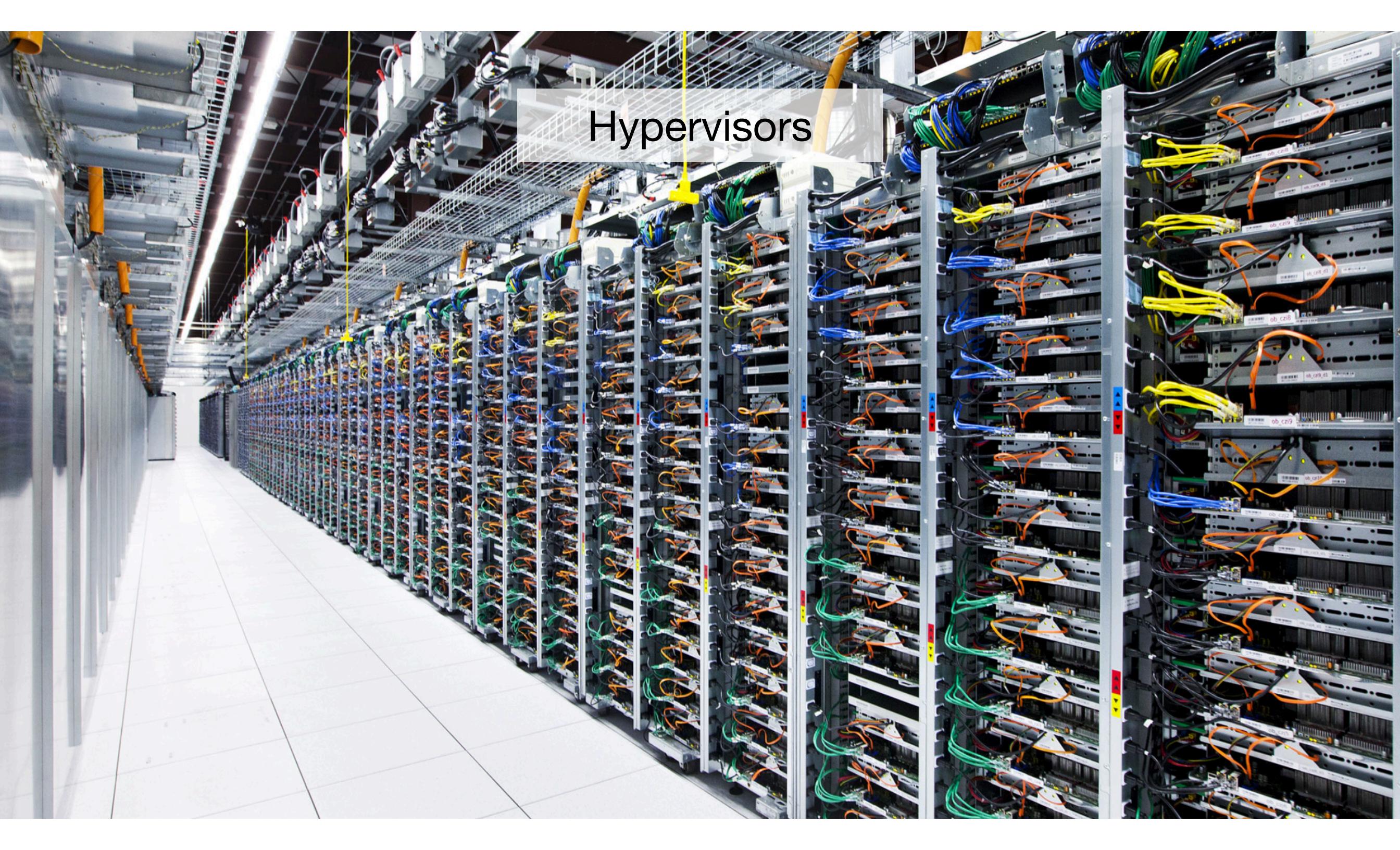
API interfaces

Managed Services

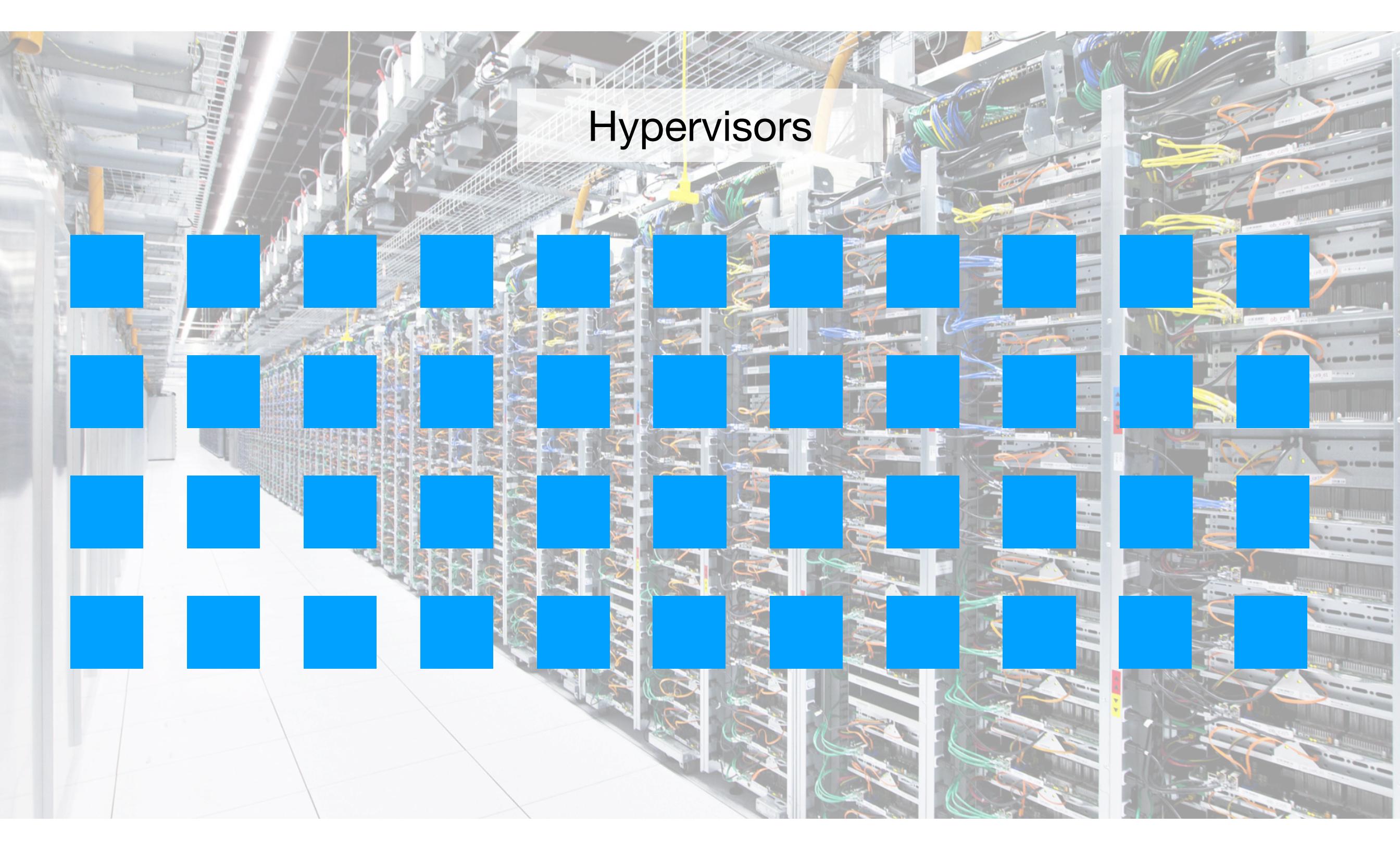
Virtual Machines / SDNs

Bare metal



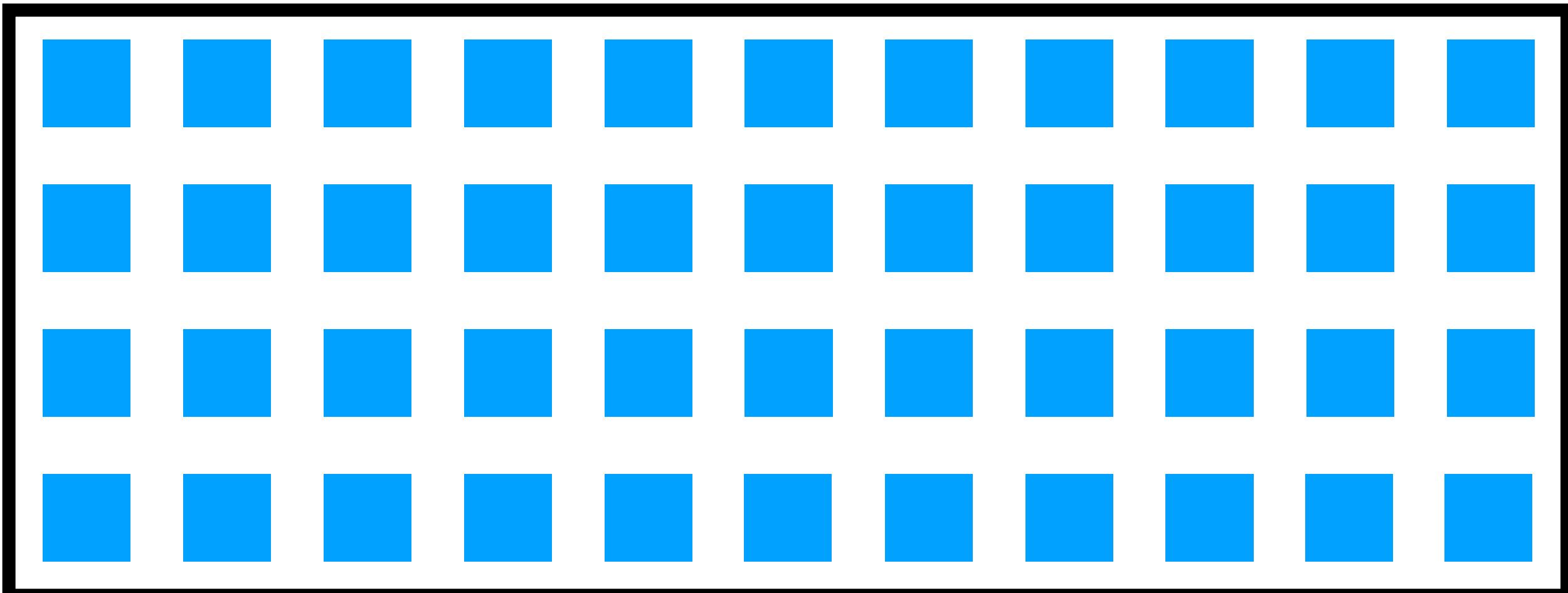


Hypervisors

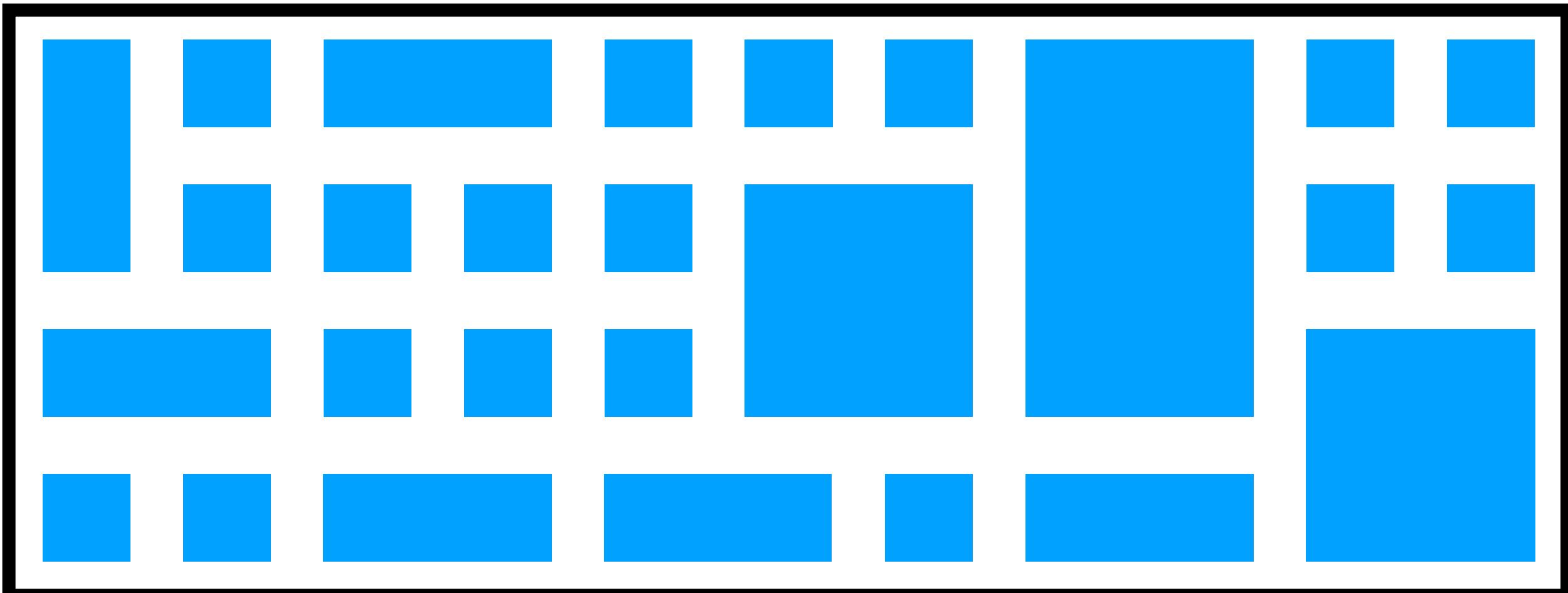


Hypervisors

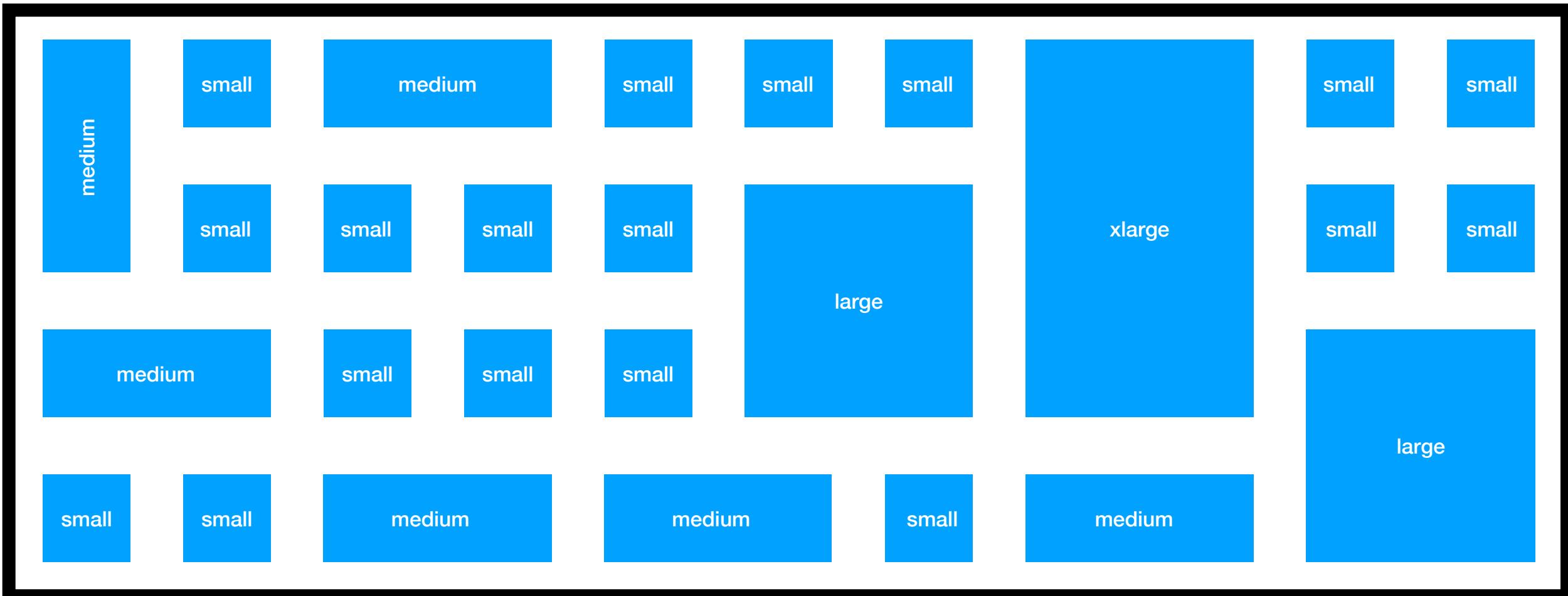
Host Machine



Host Machine



Host Machine



Processors

Memory



Storage

Networking

AWS Global Regions (26+)



AWS North America Regions

- us-east-1 - N. Virginia
- us-east-2 - Ohio
- us-west-1 - N. California
- us-west-2 - Oregon
- GovCloud us-east
- GovCloud us-west



us-east-1 - N. Virginia

Availability Zone (AZ)



Ten EC2 Launch Ingredients

AMI	What operating system to run?
Instance Type	What resources should it have?
Quantity	How many?
VPC/Subnet	Network placement?
IAM Role	What AWS permissions should it have?
Monitoring	How is it performing?
User Data	What to run upon creation?
Storage	How much capacity?
Security Group	What IPs/port communication is allowed?
User Key	Who can authenticate?

INSTANCE TYPES

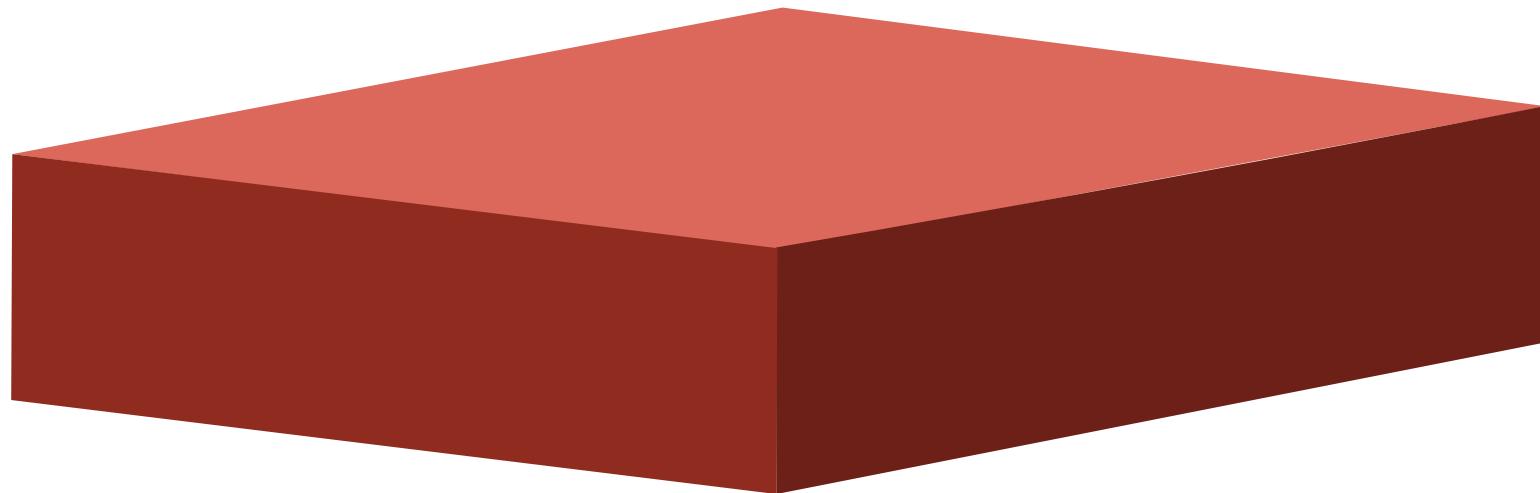
t2.nano:



- 1 vCPU
- 0.5GB RAM
- \$0.0058/hr.

u-12tb1.112xlarge:

- 448 vCPU
- 12288 GB RAM
- \$109.20/hr.



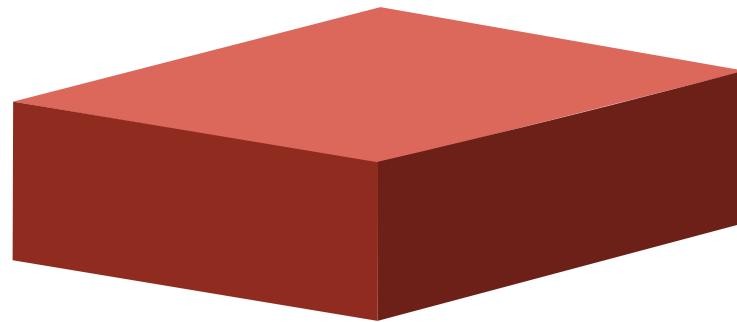
INSTANCE TYPES

T	M	X / R
Burstable Class <ul style="list-style-type: none">• Base RAM/CPU• Can burst briefly• Free tier	General Class <ul style="list-style-type: none">• Balanced RAM/CPU• Moderate networking	Memory Optimized <ul style="list-style-type: none">• More RAM• Less CPU• High networking
C	P / G / F	I / D / H
CPU Optimized <ul style="list-style-type: none">• More CPU• Less RAM• High networking• Clustering	GPU Class <ul style="list-style-type: none">• K80 GPUs• P class for ML• G class for graphics	Storage Optimized <ul style="list-style-type: none">• 25+ Gbps Networking• High IOPS• Local storage

INSTANCE TYPES

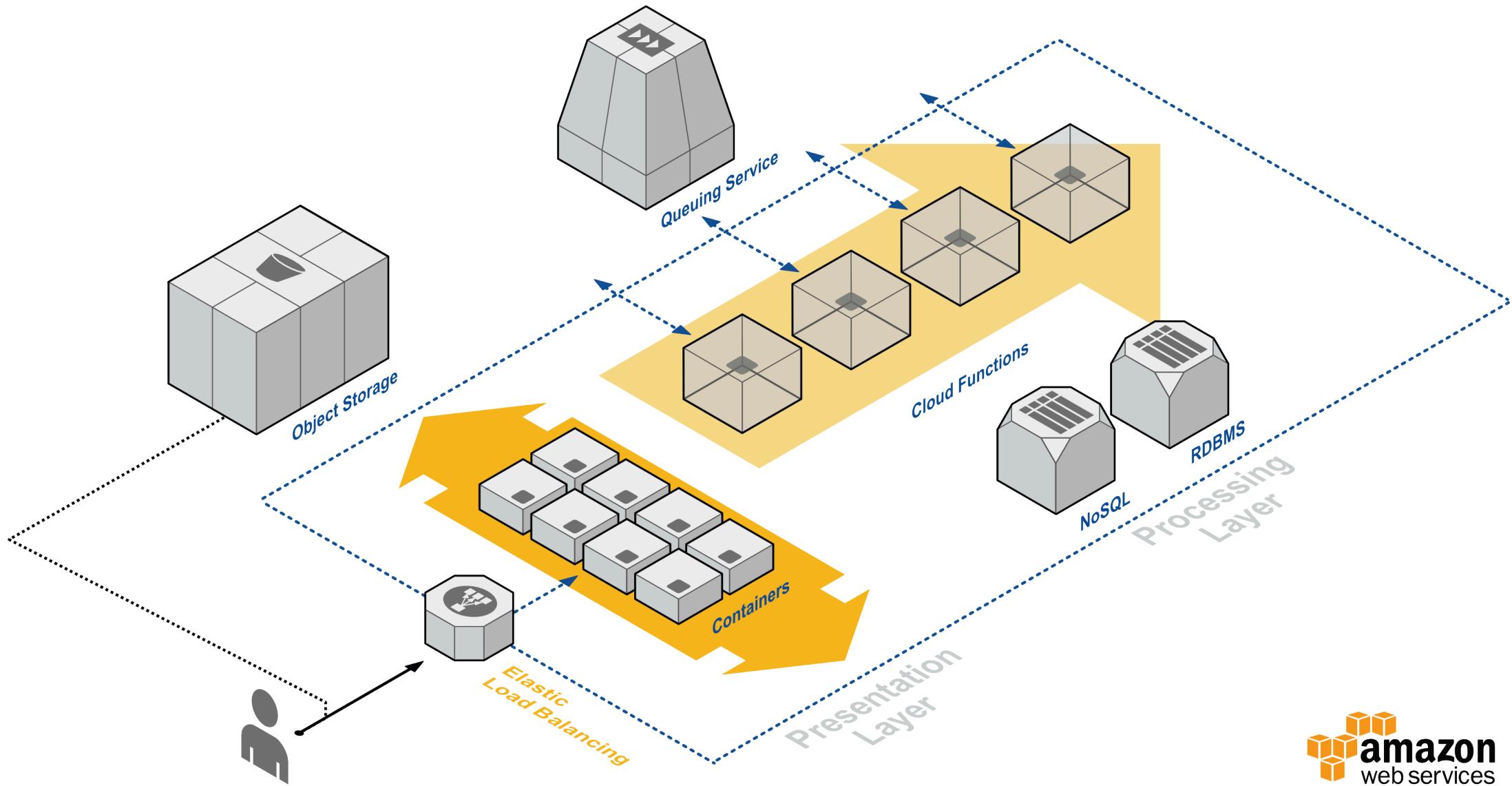
t1.micro:

- 1 vCPU
- 1.0 GB RAM
- \$0.0116/hr.



trn1.2xlarge:

- 8 vCPU
- 32 GB RAM
- 1 Trainium GPU
- \$1.344/hr.



Questions?