HIGH PERFORMANCE COMPUTING (HPC)

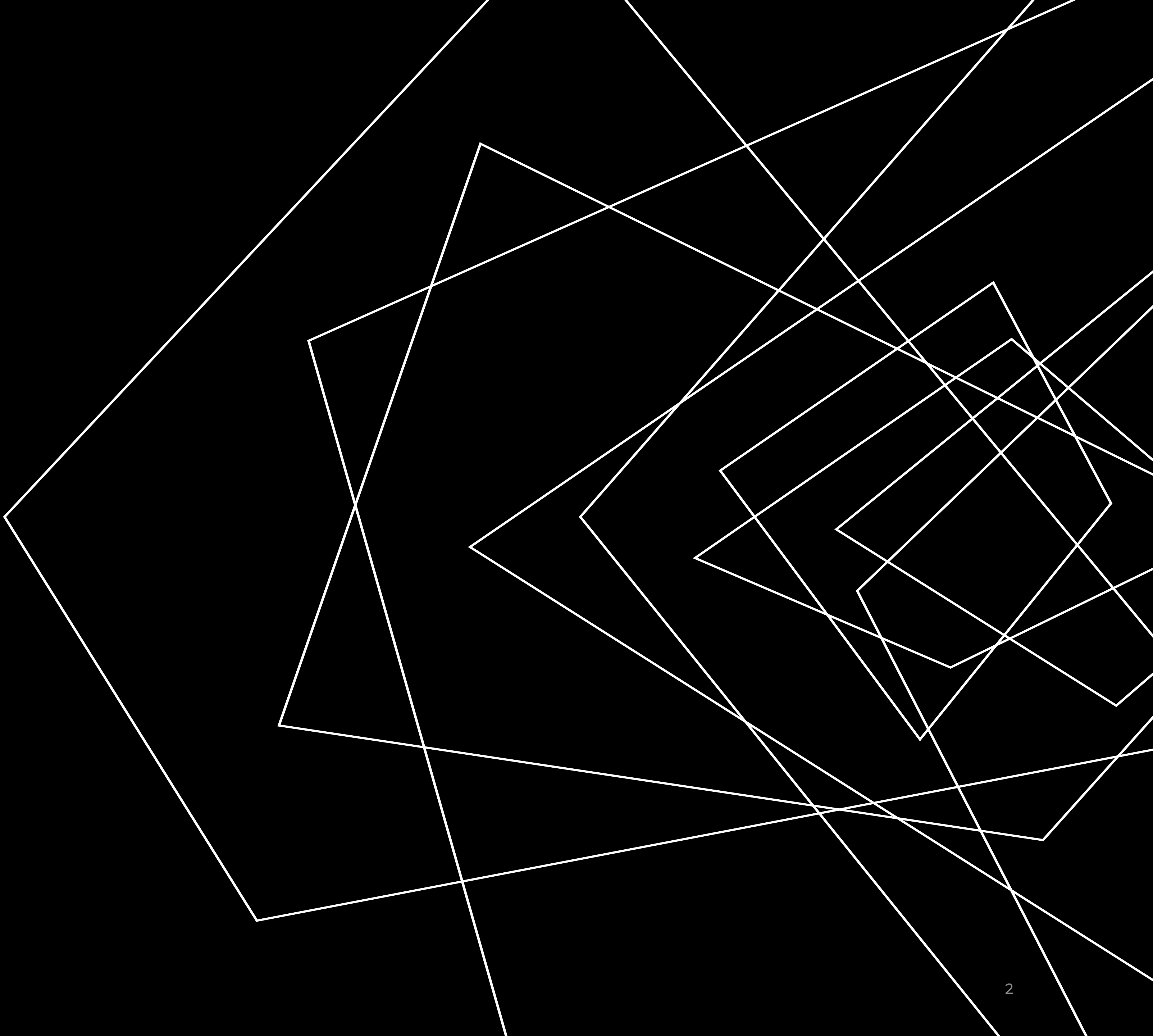
AGENDA

The Problem

Introducing HPC

Workflow Demo

Potential Application



THE PROBLEM

SUPPOSE YOU WANT TO TRAIN YOUR AI MODEL

A typical AI job will take a day or two, or even in weeks(1)

- You might want to test with different optimizer
- You might want to test with different learning rate
- You might want to test with different training dataset
- More often, you need to re-train the model if the model failed to converge

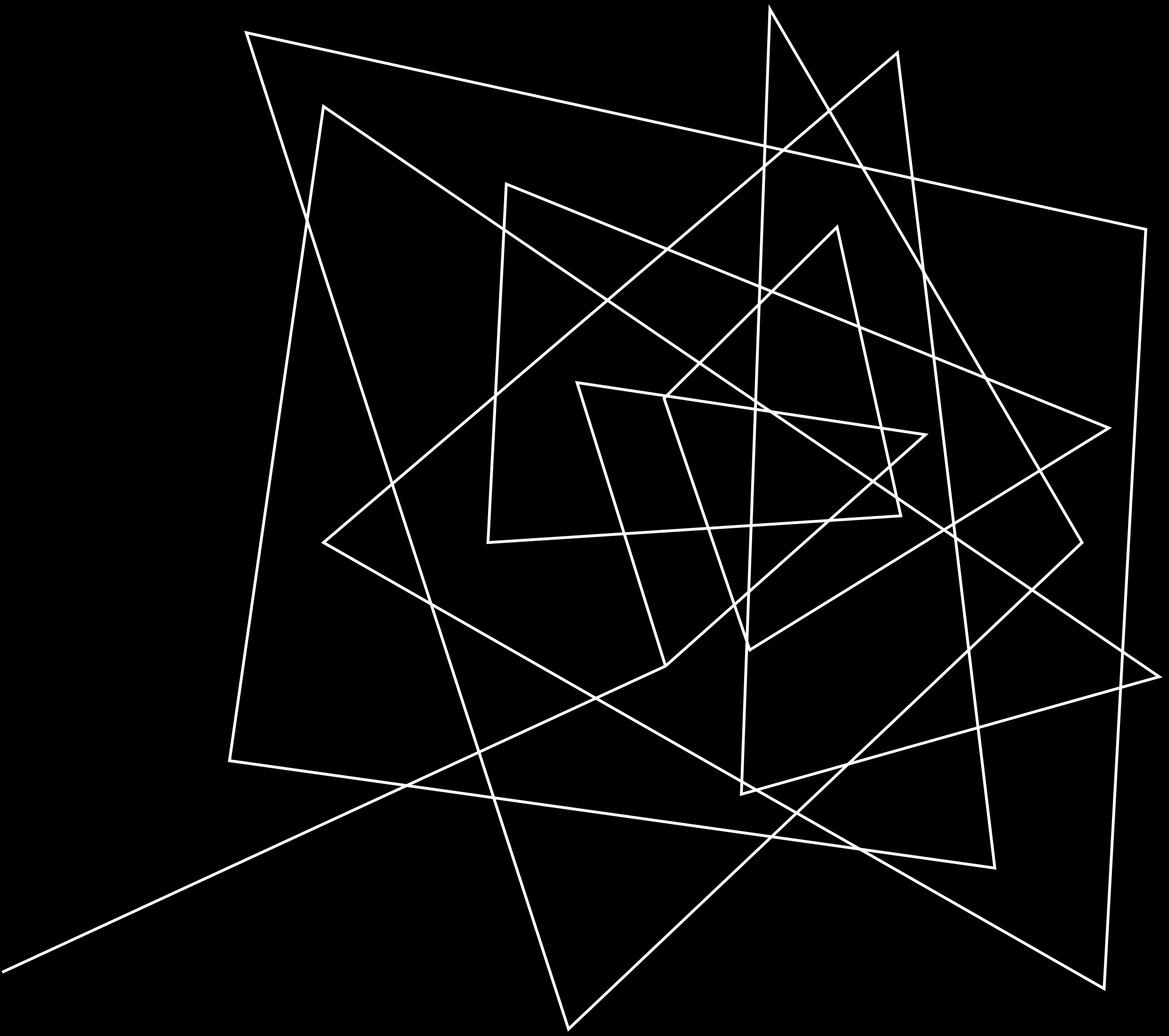
CPU TYPE OF WORKFLOW

Suppose

- You have some jobs which take 1 minute to run, but you want to test over 500,000 combinations
- If you run on single CPU, it will take 500,000 minutes to run → which is close to 1 year
- Even if you re-write the code using 64 CPU core:

it will take 500,000 minutes / 64 to run → which still take 5 days (fully optimized)

It’s not trivial to re-write the legacy code in the multi-processing
64 CPU core is expensive
Lack of job schedular/control

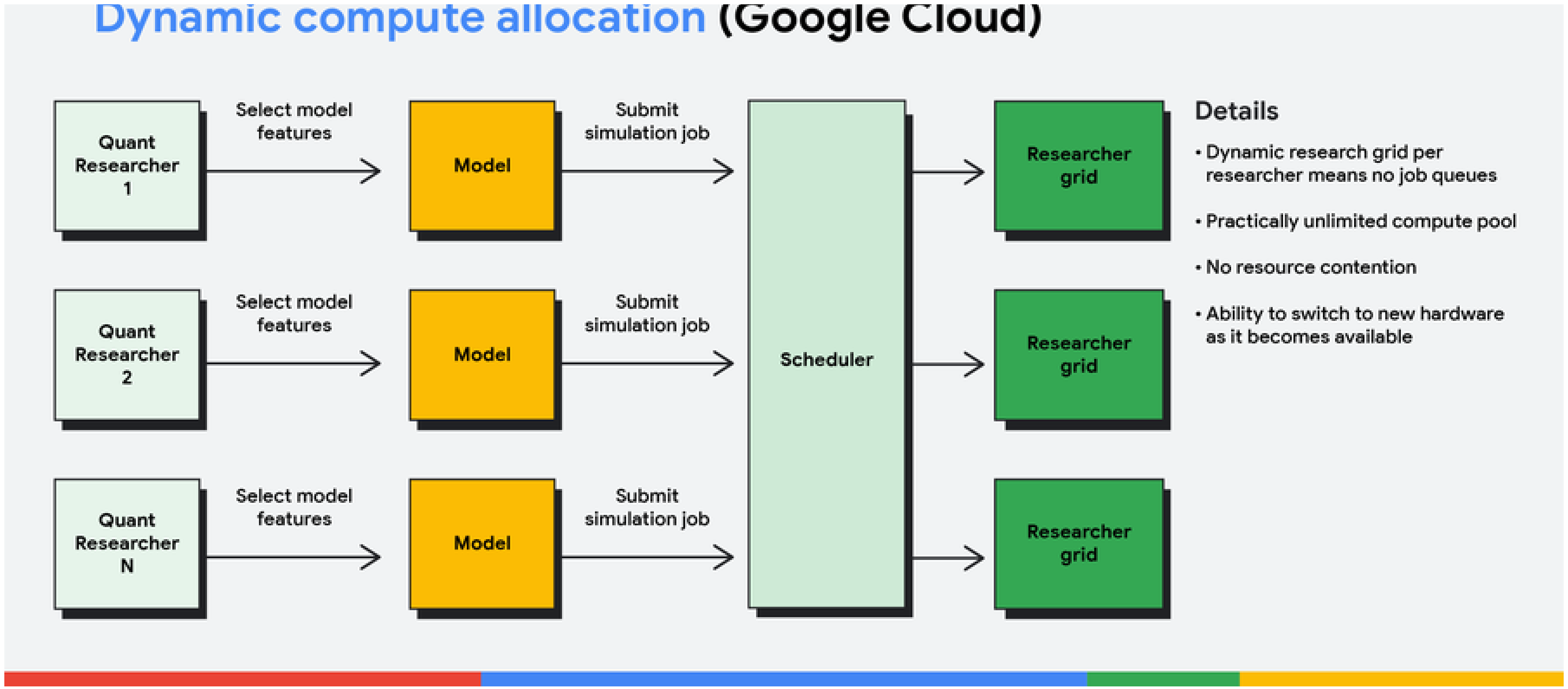


INTRODUCING HPC

Transform with Google Cloud

How Citadel Securities is reimagining quantitative research on the cloud

April 10, 2024



Dynamic compute allocation (Google Cloud)

Quant Researcher 1 → Select model features → Model → Submit simulation job → Scheduler

Quant Researcher 2 → Select model features → Model → Submit simulation job → Scheduler

Quant Researcher N → Select model features → Model → Submit simulation job → Scheduler

Scheduler → Researcher grid

Scheduler → Researcher grid

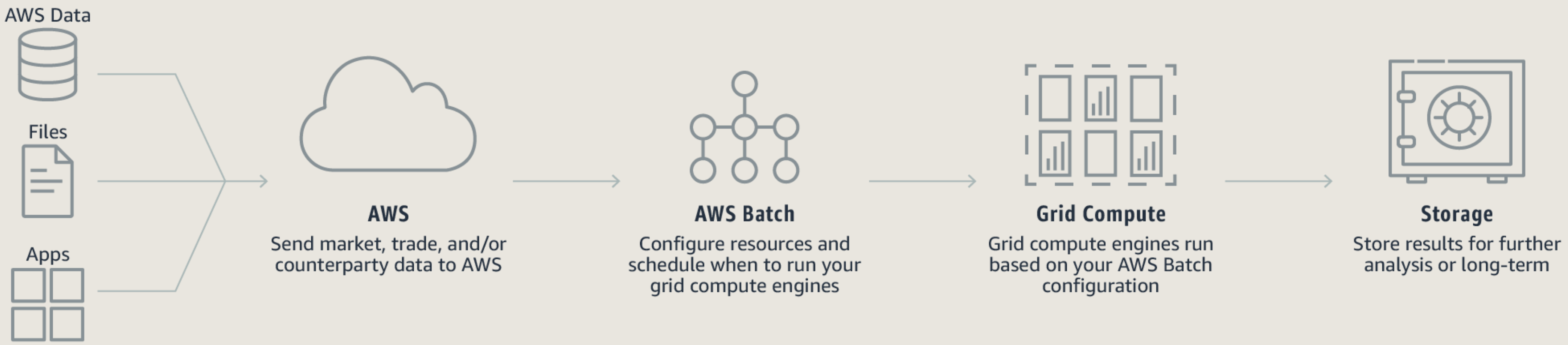
Scheduler → Researcher grid

Details

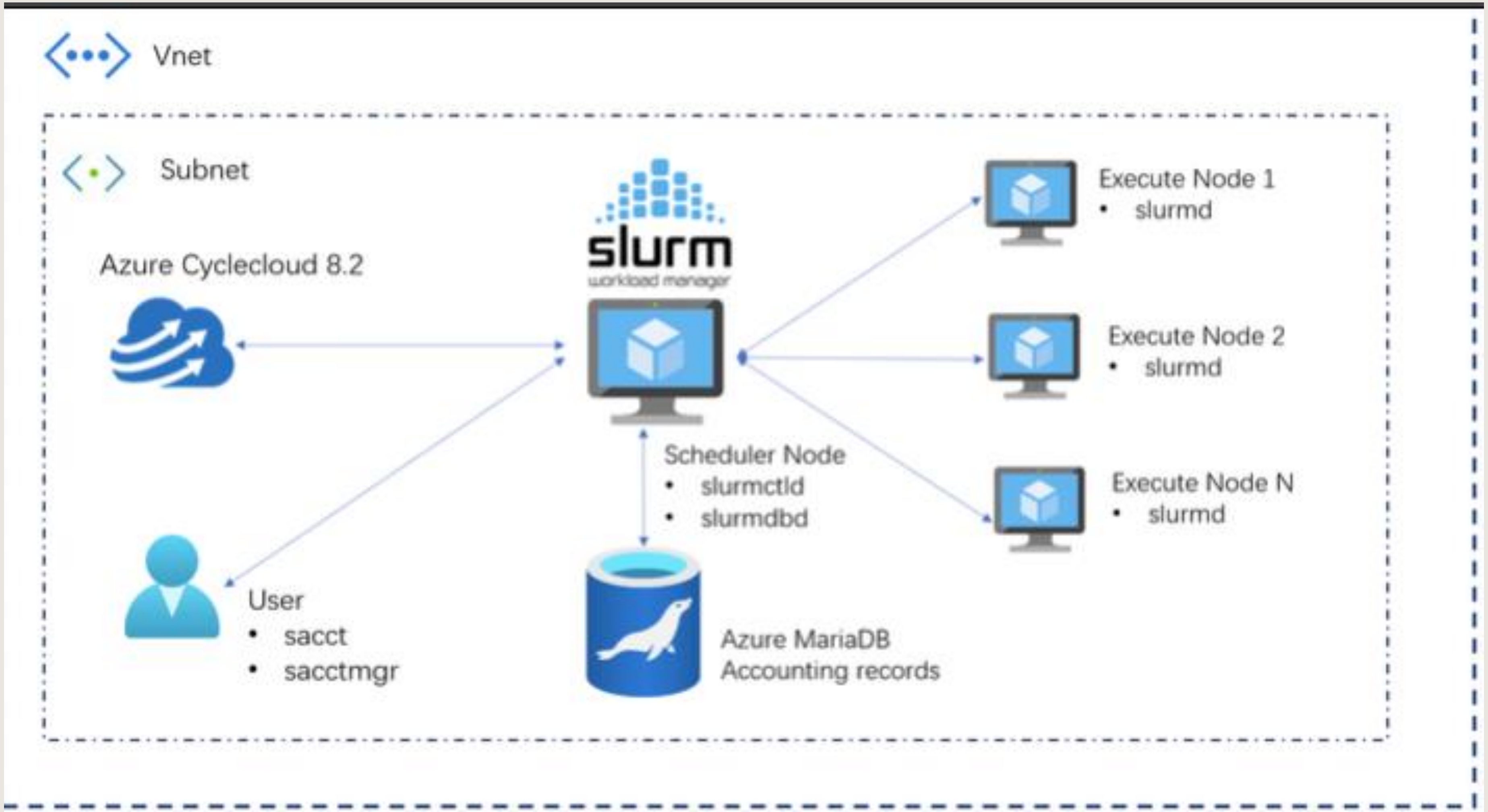
- Dynamic research grid per researcher means no job queues
- Practically unlimited compute pool
- No resource contention
- Ability to switch to new hardware as it becomes available

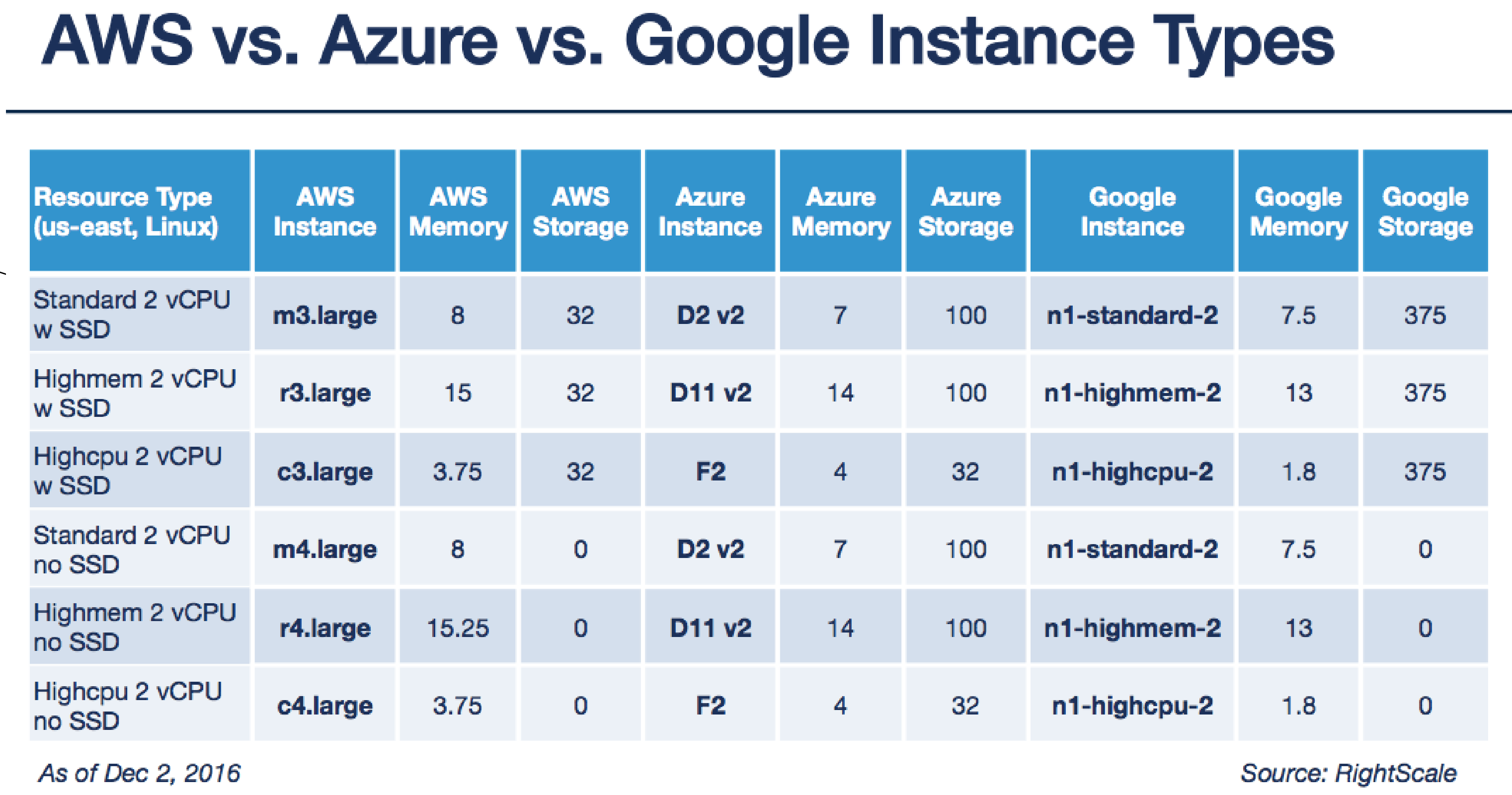
INTRODUCING HPC AND PARALLELCLUSTER(AWS)/CYCLECLOUD(AZURE)

- CloudFormation + Cluster Management == ParallelCluster
- Simple to install, easy to manage
- Everything you need to get a cluster up and running in a minute
  - Master node with schedular
  - Compute nodes that grow and shrink on demand
  - Shared NFS storage
    - /shared
    - /home


AWS Data
Files
Apps
AWS
Send market, trade, and/or counterparty data to AWS
AWS Batch
Configure resources and schedule when to run your grid compute engines
Grid Compute
Grid compute engines run based on your AWS Batch configuration
Storage
Store results for further analysis or long-term

INTRODUCING HPC AND PARALLELCLUSTER(AWS)/CYCLECLOUD(AZURE)





AWS vs. Azure vs. Google Instance Types

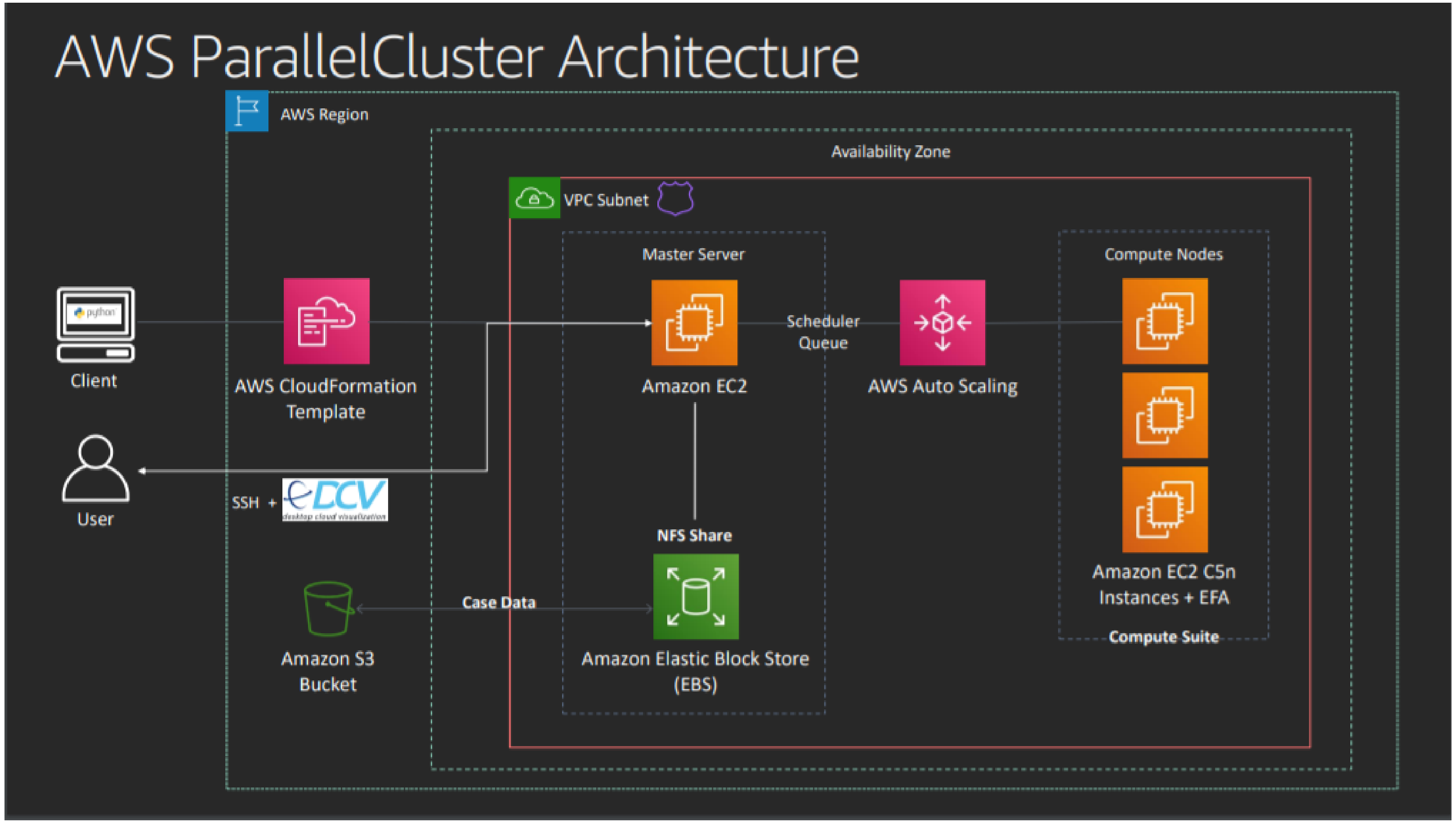
Resource Type (us-east, Linux)	AWS Instance	AWS Memory	AWS Storage	Azure Instance	Azure Memory	Azure Storage	Google Instance	Google Memory	Google Storage
Standard 2 vCPU w SSD	**m3.large**	8	32	**D2 v2**	7	100	**n1-standard-2**	7.5	375
Highmem 2 vCPU w SSD	**r3.large**	15	32	**D11 v2**	14	100	**n1-highmem-2**	13	375
Highcpu 2 vCPU w SSD	**c3.large**	3.75	32	**F2**	4	32	**n1-highcpu-2**	1.8	375
Standard 2 vCPU no SSD	**m4.large**	8	0	**D2 v2**	7	100	**n1-standard-2**	7.5	0
Highmem 2 vCPU no SSD	**r4.large**	15.25	0	**D11 v2**	14	100	**n1-highmem-2**	13	0
Highcpu 2 vCPU no SSD	**c4.large**	3.75	0	**F2**	4	32	**n1-highcpu-2**	1.8	0

As of Dec 2, 2016

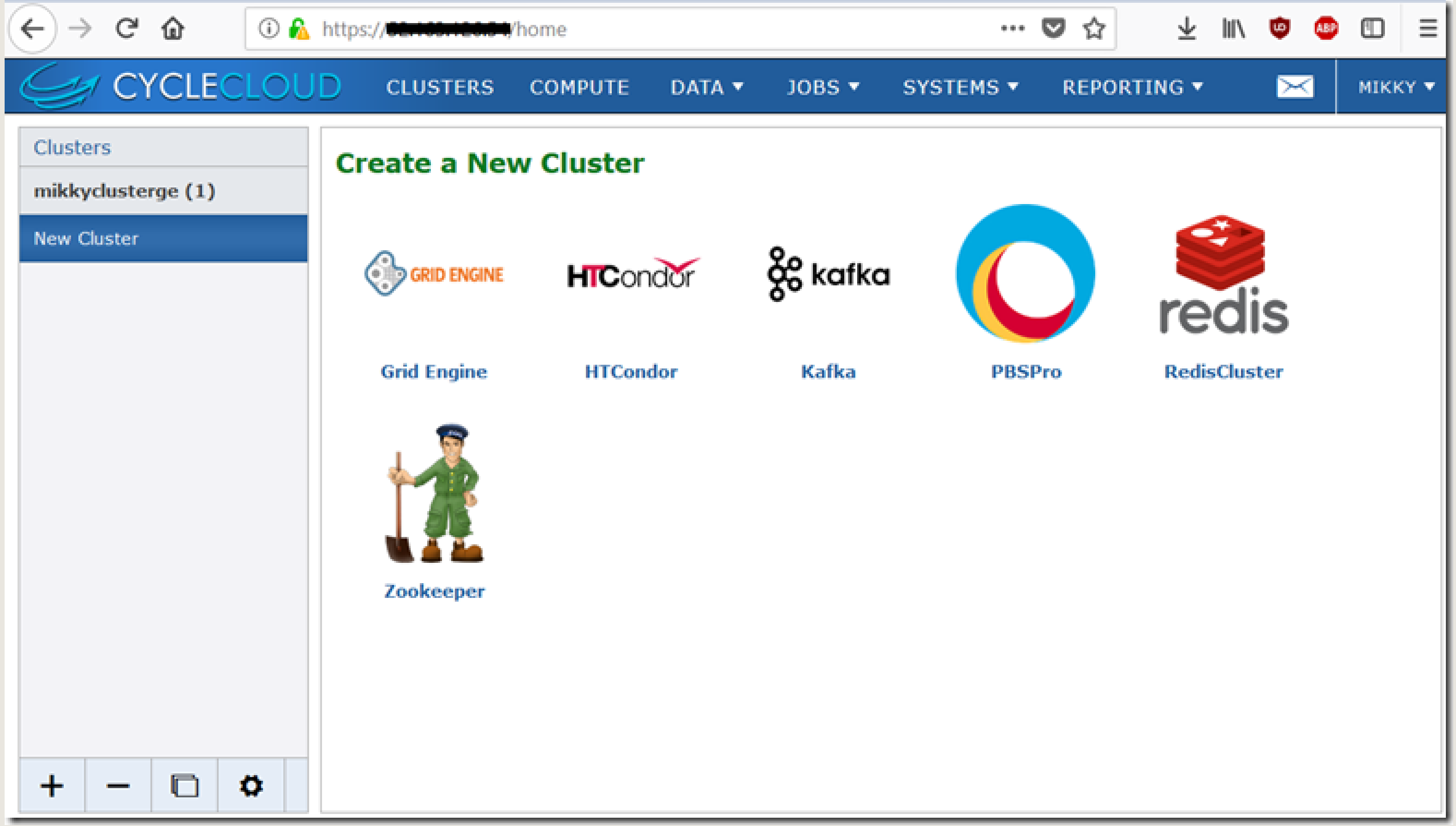
Source: RightScale

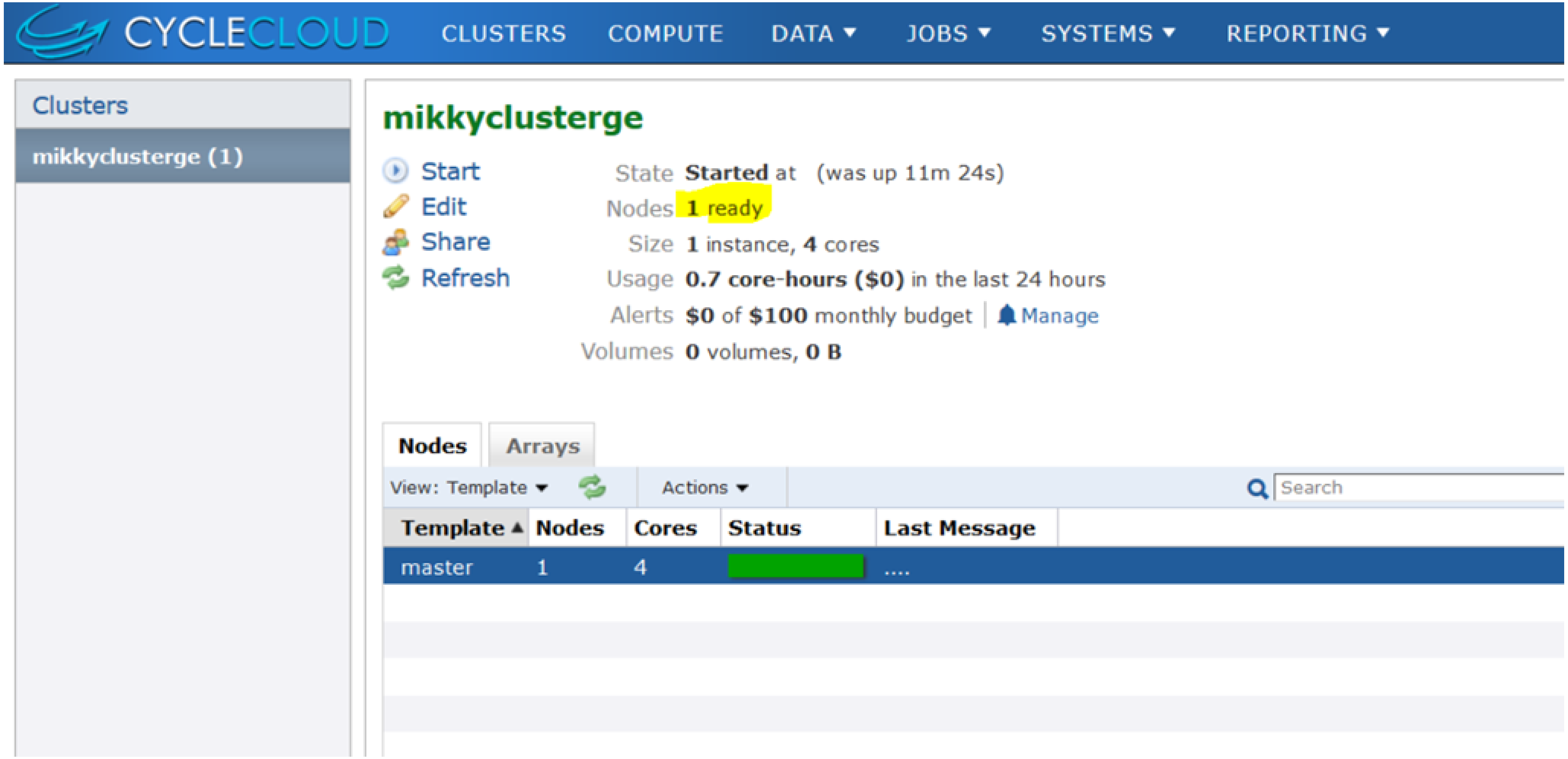
INSTANCE TYPE CHOICE

ParallelCluster/CycleCloud Architecture



HOW TO SETUP CYCLECLOUD





mikkyclusterge

State	**Started** at (was up 11m 24s)
Nodes	**1** ready
Size	**1** instance, **4** cores
Usage	**0.7 core-hours ($0)** in the last 24 hours
Alerts	**$0** of **$100** monthly budget
Volumes	**0** volumes, **0 B**

Template ▲	Nodes	Cores	Status	Last Message
master	1	4	🟩	....

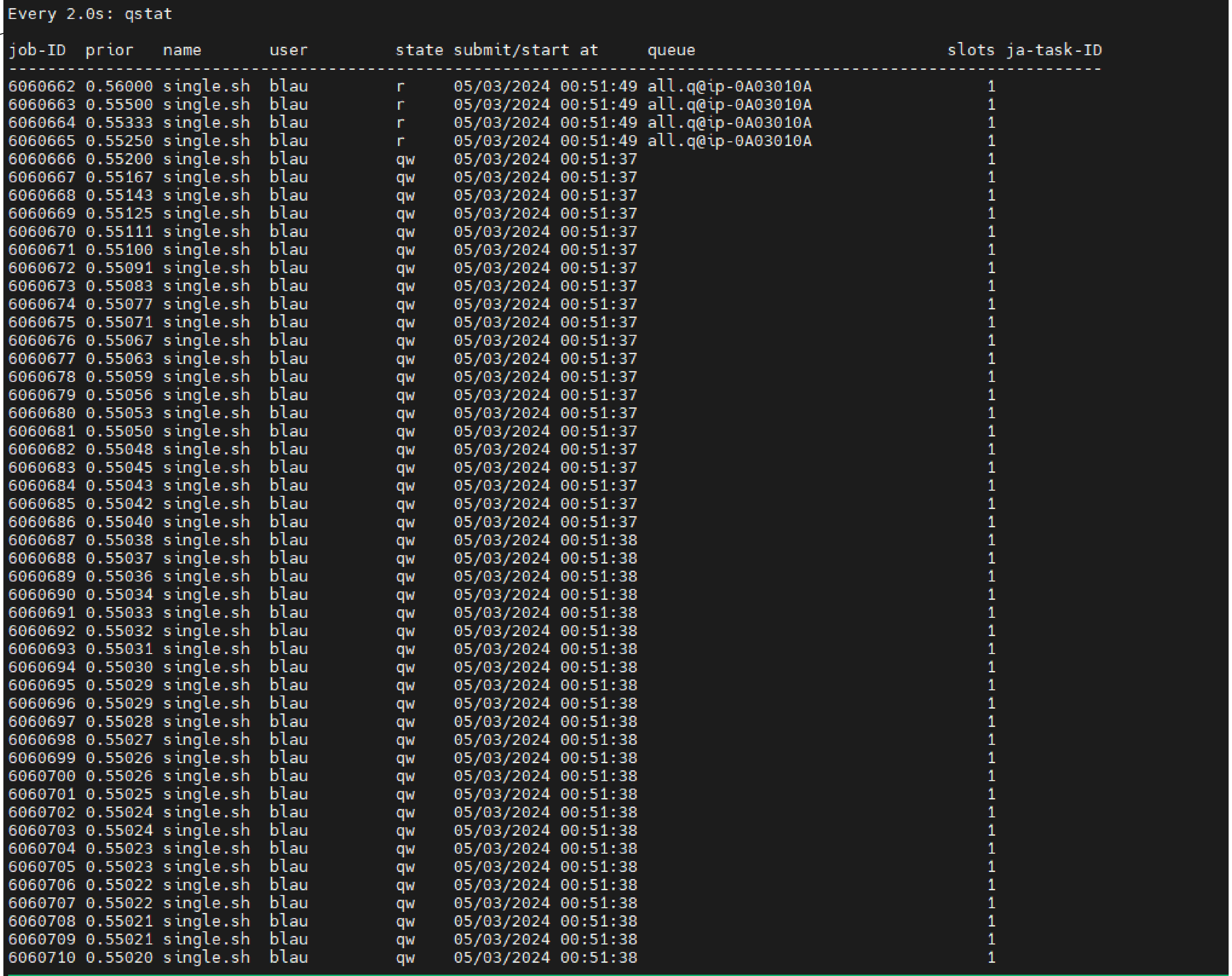
WORKFLOW DEMO

Workflow demo

```
python analysis.py --source “xxx" –learning_rate “0.02" --model “yyy" –config “myconfig.json” –save_result “True"
```

To run the same job in HPC

```
qsub python analysis.py --source “xxx" –learning_rate “0.02" --model “yyy" –config “myconfig.json” –save_result “True"
```



```
Every 2.0s: qstat

job-ID  prior   name       user         state submit/start at     queue                          slots ja-task-ID
-----------------------------------------------------------------------------------------------------------------
6060662 0.56000 single.sh  blau         r     05/03/2024 00:51:49 all.q@ip-0A03010A                  1
6060663 0.55500 single.sh  blau         r     05/03/2024 00:51:49 all.q@ip-0A03010A                  1
6060664 0.55333 single.sh  blau         r     05/03/2024 00:51:49 all.q@ip-0A03010A                  1
6060665 0.55250 single.sh  blau         r     05/03/2024 00:51:49 all.q@ip-0A03010A                  1
6060666 0.55200 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060667 0.55167 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060668 0.55143 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060669 0.55125 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060670 0.55111 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060671 0.55100 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060672 0.55091 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060673 0.55083 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060674 0.55077 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060675 0.55071 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060676 0.55067 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060677 0.55063 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060678 0.55059 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060679 0.55056 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060680 0.55053 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060681 0.55050 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060682 0.55048 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060683 0.55045 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060684 0.55043 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060685 0.55042 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060686 0.55040 single.sh  blau         qw    05/03/2024 00:51:37                                    1
6060687 0.55038 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060688 0.55037 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060689 0.55036 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060690 0.55034 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060691 0.55033 single.sh  blau         qw    05/03/2024 00:51:38                                    1
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6060699 0.55026 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060700 0.55026 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060701 0.55025 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060702 0.55024 single.sh  blau         qw    05/03/2024 00:51:38                                    1
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6060705 0.55023 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060706 0.55022 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060707 0.55022 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060708 0.55021 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060709 0.55021 single.sh  blau         qw    05/03/2024 00:51:38                                    1
6060710 0.55020 single.sh  blau         qw    05/03/2024 00:51:38                                    1
```
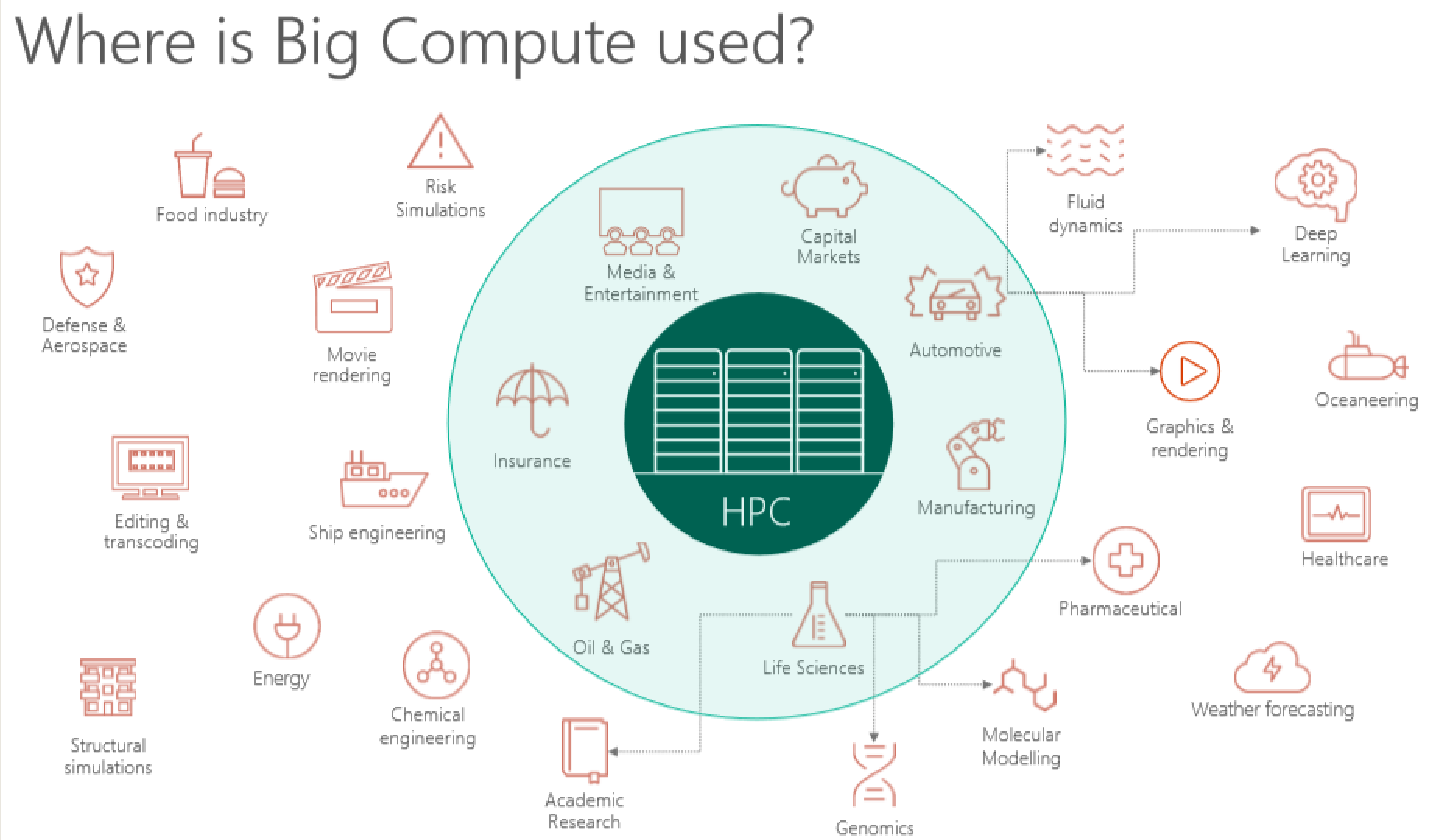

Advantages

- You can choose the smallest available machine to run
- All the computed nodes shared the same EBS drive, so all the results can be saved in same place (I normally choose the cheapest magnetic drive)
- All the log file is saved, you can use simple unix command to check the results (imagine you use GUI and need to click each log file manually)
- All the compute nodes will have same config as the master node, no need to worry all about the virtual environment/docker/setup etc

POTENTIAL APPLICATION



Where is Big Compute used?

THANK YOU