

# Configuration Manual

MSc Research Project Cloud Computing

Anjalee Student ID: x19107803

School of Computing National College of Ireland

Supervisor: Manuel Tova-Izquierdo

#### National College of Ireland Project Submission Sheet School of Computing



Student Name:	Anjalee
Student ID:	x19107803
Programme:	Cloud Computing
Year:	2020
Module:	MSc Research Project
Supervisor:	Manuel Tova-Izquierdo
Submission Due Date:	17/08/2020
Project Title:	Configuration Manual
Word Count:	XXX
Page Count:	9

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.

<u>ALL</u> internet material must be referenced in the bibliography section. Students are required to use the Referencing Standard specified in the report template. To use other author's written or electronic work is illegal (plagiarism) and may result in disciplinary action.

I agree to an electronic copy of my thesis being made publicly available on TRAP the National College of Ireland's Institutional Repository for consultation.

Signature:	Anjalee
Date:	16th August 2020

#### PLEASE READ THE FOLLOWING INSTRUCTIONS AND CHECKLIST:

Attach a completed copy of this sheet to each project (including multiple copies).	
Attach a Moodle submission receipt of the online project submission, to	
each project (including multiple copies).	
You must ensure that you retain a HARD COPY of the project, both for	
your own reference and in case a project is lost or mislaid. It is not sufficient to keep	
a copy on computer.	

Assignments that are submitted to the Programme Coordinator office must be placed into the assignment box located outside the office.

Office Use Only				
Signature:				
Date:				
Penalty Applied (if applicable):				

## Configuration Manual

### Anjalee x19107803

### 1 Create Cluster on Digital Ocean

The steps for creating a Kubernetes cluster on DigitalOcean using Control Panel are:

Step 1: From the **Create** menu, select **Clusters** option. The page will be shown as:

Select the Kubernetes versi	an. The newest available v	ersion is selected by default.			
118.6-do.0 (latest)	🕖 Tip: We generally	y recommend the latest version	unless your team		
	has a specific nee	ed. See the DigitalOcean Kubo	rnetes release notes.		
Choose a datace	enter region				
Your Kubernetes cluster will	be located in a single data	acenter.			
				5.1.4	_
New York	Ametodam	San Francisco	Singaporto		Frankfurt
NOW TOPK	Ansterdam	San Francisco	Singapore	London	Frankturt
1 2 3	1 2 3	1 2 3	1	1	1
Toronto	Bangalore				
1	1				
VPC Network					
autour-stor DEPROFI					
			Head	s up	
All resources created in this	datacenter will be membe	rs of the same VPC network. T	hey can Principal	s up noturaliza ir nov sutomatir	
All resources created in this communicate securely over	datacenter will be membe their Private IP addresses.	ers of the same VPC network. T What does this mean?	hey can Private cnable	s <b>up</b> networking is now automatic d. You can create new netwo	ally rks or just
All resources created in this communicate securely over	datacenter will be membe their Private IP addresses.	ers of the same VPC network. T What does this mean?	hsy can Private crable use the	S Up networking is now automatic d. You can create new netwo default.	ally iks or just
All resources created in this communicate securely over	datacenter will be membe their Private IP addresses.	rs of the same VPC network. T What does this mean?	hey can Private anable use the OK	s up networking is now automatic d. You can create new networ default. .earn more (?	ally As orjust
All resources created in this communicate securely over	datacenter will be membe their Private IP addresses.	ers of the same VPC network. T What does this mean?	hoy can Private errebie use the OK	s up notworking is now automatic d. You can create now notwo dafault .aam more C	ally des or just
All resources created in this communicate socurely over Choose cluster of Increasing the number of no	datacenter will be membe their Private IP addresses.	rs of the same VPC network. T What does this mean? more instances of the schedul	hey can Private areation as the OK Ed services. Adding more no	S Up notworking is now automatic d. You can create now notwor datauk arm more C de pools allows	aðy Acs or just
All resources created in this communicate socurely over Choose cluster of Increasing the number of ne you to schedule pode to diff	datacenter will be membe their Private IP addresses. capacity 7 des in a pool lets you run errent node pools so each ;	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st	hey can Heed Private or the OK E ed services. Adding more no orage it requires. You can ad	s up networking is now automatic d. You can create now networ default earn more <i>C</i> de pools allows d and remove	ally des or just
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pods to diff	datacenter will be mombe datacenter will be mombe school Private IP addresses. Capacity 2 des in a pool lets you run erent node pools so each y time.	irs of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st	hey can Friend use the OK I ad services: Adding more no orage it requires. You can ad	s up notworking is now automatic it. Now can croate new notwor default. .aum more (? de pools allows d and remove	ally des orjunt
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pods to diffi nodes and node poels at an A Important: You are near	datacenter will be mombe datacenter will be mombe reprivate IP addresses.	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase	hey can Field was the OK N ad services. Adding more no orage it requires. You can ad	s up notworking is now automatic d low can create new notwor default. .aum more (? de pools allows d and remove	ally As or just
All resources croated in this communicate securely over Choose cluster of increasing the number of ne you to schedule pods to diffi nodes and node pools at an All Important: You are near NODE POOL NAME	datacenter will be mombe datacenter will be mombe reprint Private IP addresses. appacity 2 des in a pool lets you run errent node pools so each y time. the 10 Droplet limit on you MACHINE TYT	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ur account. Request Increase PE (DROPLET)	hey can Head Note the Constant of services. Adding more no orage it requires. You can ad	s up notworking is now automatic d low can create new notwor default. .am more () de pools allows d and remove	aday des or just
All resources created in this communicate securely over Choose cluster of increasing the number of ne you to schedule pods to diffi nodes and node poels at an Important: You are near NODE POOL NAME Entry pold man.	datacenter will be mombe datacenter will be mombe capacity 2 des in a pool lets you run erent node pools so each y time. the 10 Droplet limit on yos MACHINE TYT Standard	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ur account. Request Increase PE (DROPLET) nodes	hey can Head Pieta and services. Adding more no orage it requires. You can ad NODE PLAN \$20/Month per nod	s up notworking is now automatic distant. .am more C de pools allows d and remove	Aday Ans or just
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pods to diff nodes and node pools at an index and node pools at an index node Pool NAME Drive pool NAME Drive pool name pool-tignGeqb5	datacenter will be mombe their Private IP addresses. Capacity 2 des in a pool lets you run orent node pools so each y time. the 10 Droplet limit on you MACHINE TYT Standard Variable rati	Ins of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes is of memory per shared CPU	hey can Head Pieta and a solution of the solu	s up notworking is now automatic distant. .aum more (2 de pools allows d and remove e(\$0.030/hr) 11/bib) (23/070/s	Ada or just
All resources created in this communicate securely over Choose cluster of Increasing the number of ne nodes and node pools at an index and node pools at an index and node pools at an index node pool set an index node pool set an index node pool set an index node pool set an index node pool name top pool name pool signification	datacenter will be mombe their Private IP addresses. Capacity 2 des in a pool lets you run i erent node pools so each y yime. the 10 Droplet limit on you MACHINE TYI Standard Variable rati	Its of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes to of memory per shared CPU	hey can Head Pieta de ond sorvices: Adding more no orage it requires. You can ad NODE PLAN \$200Month per nod 25 GB INM mable (4 can	s up notworking is now automatic distant. 	Ada or just
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pools at an an Important: You are near NOE POOL NAME Enter post name pool-tignSeqb5 Add Additional Noda Pool	datacenter will be mombe their Private IP addresses. Capacity 💽 des in a pool lets you run n errent node pools so each y time. the 10 Droplet limit on you MACHINE TYT Standard Vanisher not	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes to it manory per stared CPU	hey can Head Picture and services. Adding more no orage it requires. You can ad NODE PLAN SOMMONT per nod SOMMONT per nod SOMMONT per nod	s Lp Indexofing is now automatin default ann more (? de pools allows d and remove a (\$0.030/hr)	naky Act or just
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pools at an Once Pool. NAME Interpretant: You are near NOCE POOL NAME Enter pool says pool-tignfocqb6	datacenter will be membe their Private IP addresses. Capacity 7 des in a pool lets you run n erent node pools so each, y time. MACHINE TYI Standard Variable rati	res of the same VPC network. 1 What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes to of memory par shared CPU	hey can Head Picets ad services. Adding more no orage it requires. You can ad NODE PLAN \$20/Month per nod 2.5 GB IMM seate (4 G	s Lp notworking is now automatic 4 Sources results new notwork default: de pools allows d and remove e (\$0.030(hr) 1 Intel / 2 VCPUs	numeer nodes
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pools at an oute schedule pools at an Mole Pool NAME Enter pool ranse pool-tignGeqbG Add Additional Node Pool	datacenter will be membe their Private IP addresses.	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ur account. Request Increase PE (DROPLET) nodes to of memory par shared CPU	hey can Head Note PLAN NODE PLAN SC ID INM wable (4 Co	s Lp notworking is now satematic 4 low can contain new notwork default. aren more () de pools allows d and remove a (\$0.030/hr) 1 lista) / 2 vCPUs	numeer nodes
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pods to diff ondes and node poels at an Important: You are near NODE POOL NAME Enter pool signGegb5 Add Additional Node Pool	datacenter will be membe their Private IP addresses. Capacity 2 des in a pool lets you run i erent node pools so each y time. 	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ur account. Request Increase PE (DROPLET) nodes to of memory per shared CPU	hey can Head Piceta works or the ord for ord ford for ord for ord for ord for ord for ord for ord for ord ford for ord ford for ord ford ford for ord ford for ord ford ford ford ford fo	s up notworking is now submatic A low can contain now notwork default. 	xaky de or just NUMBER NODES 3 ∧ √
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule pools to all you to schedule pools to all mode node pools at an Important: You are near NODE POOL NAME Enter pool significação Add Additional Node Pool Add Additional Node Pool	datacenter will be mombe their Private IP addresses. Capacity 2 des in a pool lets you run i erent node pools so each y time. ************************************	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes to of memory per shared CPU	hey can Head Picture ad services. Adding more no orage it requires. You can ad NODE PLAN 7 \$20/Month per nod 25 CB DAM matter (# Cl	s Lp notworking is now submatic A low can contain now notwork default. de pools allows d and remove a (\$0.030/hr) II halp/2 vCPUs	NUMBER NODES
All resources created in this communicate securely over Choose cluster of increasing the number of ne you to schedule pods to diff needs and node pools at an Important: You are near NODE POOL NAME Enter pool name pool tignfocqb6 Add Additional Node Pool Add Tags	datacontor will be mombe datacontor will be mombe addresses.	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes is at memory par shared CPU	hey can Head Picture ad services. Adding more no orage it requires. You can ad NODE PLAN 7 \$20/Month per rod 25 GB DMM subtle (F Cl	s Lp notworking is now submatic il force an control now notwork default. ann mene () de pools allows d and remove e (\$0.030/hr) B hubp/2 vcPUs	NUMBER NODES
All resources created in this communicate securely over Choose cluster of Increasing the number of ne you to schedule poels to diff modes and node poels at an More Pool NAME Enter pool name pool tignfocgb6 Add Additional Node Pool Add Tags Add optional tags to your ch	datacontor will be mombe datacontor will be mombe entry Private IP addresses. appacity 2 des in a pool lets you run i errent node pools so each j y time. ***********************************	In the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes is of memory par shared CPU	hey can Head Picture ad services. Adding more no orage it requires. You can ad NODE PLAN 7 \$20/Month per nod 25 GB RM4 matter (r Cl	s Lp notworking is now submatic A low can contain now notwork default. de pools allows d and remove a (\$0.020/hr) B hub)/2 vCR/h	NUMBER NODES
All resources created in this communicate securely over Choose cluster of increasing the number of ne you to schedule pods to diff onde pools at an Important: You are near NODE POOL NAME Enter pool signScepts Add Additional Node Pool Add Additional Node Pool Add Tags Add optional tags to your cl Type tags here	datacontor will be mombe datacontor will be mombe capacity 2 des in a pool lets you run i erent node pools so each y time. ••••••••••••••••••••••••••••••••••••	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes to of memory per shared CPU	hey can Head Picture ad services. Adding more no orage it requires. You can ad NODE PLAN 7 \$20/Month per rod 25 GB DAM matter (r Cl	s Lp notworking is now submatic il Alva can contain now notwork default. de pools allows d and remove a (\$0.030/hr) B help/2 vCPUs	NUMBER NODES
All resources created in this communicate securely over Choose cluster of increasing the number of ne you to schedule pools to all onedes and node pools at an Important: You are near NODE POOL NAME Enter pool signScelbS Add Additional Node Pool Add Additional Node Pool Add Tags Add optional tags to your cl Type tags hore	datacontor will be mombe datacontor will be mombe capacity 2 des in a pool lets you run i errent node pools so each y time. MACHINE TY which is Doroplet limit on you MACHINE TY Standard Variable rall month \$0.028hour ustor.	res of the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes to of memory per shared CPU	hey can Head Picture ad services. Adding more no orage it requires. You can ad NODE PLAN 7 \$20/Month per rod 25 GB DAM matter (# Cl	s Lp notworking is now submatic il Alva can conta now notwork default. de pools allows d and remove a (\$0.030/hr) B help/2 vCPUs	NUMBER NODES
All resources created in this communicate socurely over Choose cluster of Increasing the number of ne you to schedde pools to diff nodes and node pools at an Important: You are near NODE POOL NAME Enter pool tignfocebb Add Additional Noda Pool Add Additional Noda Pool Add Additional Noda Pool Add Tags Add optional tags to your cl Type tags here Choose a name	dataconter will be mombe dataconter will be mombe addresses. apacity 2 des in a pool lets you run i errent node pools so each j time. MACHINE TY Standard Variable rational MACHINE TY Standard Variable rational Standard Variable rational MACHINE TY	In the same VPC network. T What does this mean? more instances of the schedul pod has the RAM, CPU, and st ar account. Request Increase PE (DROPLET) nodes is at memory par shared CPU	hey can Head Picture ad services. Adding more no orage it requires. You can ad NODE PLAN 7 \$20/Month per nod 25 GB DAM matter (r Cr	s Lp notworking is now natomatik 4 low can contain now notwork default. default. de pools allows d and remove e (\$0.020/hr) B hubj/2 wCR/s	NUMBER NODES

1

<sup>&</sup>lt;sup>1</sup>Creating Clustershttps://www.digitalocean.com/docs/kubernetes/how-to/create-clusters/

- Step 2: Then, select the latest Kubernetes version and nearset datacenter region.
- Step 3: Select the VPC network related to the cluster. According to the requirement, the cluster capacity is selected. The K8s, cluster ID and resource type tags are by default to the worker nodes.
- Step 4: Finally select the **Create Cluster** button. The control panel will show the cluster as :

$\dot{H} \rightarrow C$ $\hat{H}$ cloud.digita	alocean.com/projects/df0d7664-1599-4b8f-a2ad-075a59d60c42/resources?i=510a3b&preserveScrollPosition=true	e Q ☆ 🏞
🗄 Apps 🍦 Case Studies 🛛 🔿	Home - Norma Sm 🔹 rian.ie - Results 🐧 Being Critical - Aca 🖸 shopizer-ecommerc 🟮 hops/DominantRes	M Setting up a Kuber 🐵 Container runtimes.
<b>२</b>	arch by resource name or public IP (Ctrl+B)	Create V (2) \$88.27 Credit Remaining
ROJECTS ^		
Kubernetes     New Project	Class project / Educational purposes	→ Move Resources
IANAGE ^	Resources Activity Settings	
Droplets		
Cubernetes	DROPLETS (1)	
/olumes	• (a) ubuntu-s-1vcpu-1gb-Ion1-01 165.22.120.222	(3) ···
Databases		
spaces		
mages	Create something new Learn	ing materials
letworking	Create a Managed Database Start using Spaces Ghost	
Aonitoring	Worry-free database management     Very-free database management     Very-free database management     Appli	To Set Up the DigitalOcean Ghost One-Click cation for Ubuntu 16.04
DISCOVER ^	Distribute traffic between multiple Droplets Grafa	na
Marketplace	How	To Install and Configure Grafana to Plot Beautiful so from Zabbix on ContOS Z

### 2 Kubectl and Doctl set up in Ubuntu

 $^{2}$  The command for installing doctl for Digital Ocean in ubuntu machine are:

#### #sudo snap install doctl

Then, download the doct and copy the URL to get the file in home directory using curl.

# cd curl -OL https://github.com/digitalocean/doctl/releases/download/v1.46.0/doctl-1.46.0-linux-amd64.tar.gz

For Extracting use : tar xf /doctl-1.46.0-linux-amd64.tar.gz Then, check if the docker is configured or not.

Authenticate the connection with the command :

#### # doctl auth init

Then, the generated token is used to authenticate and connect to the DO account. To verify if doct is working use the below command:

#### # doctl compute droplet list

<pre>ilave@kslave:~/.kube</pre>	\$ docker version
:lient:	
Version:	19.03.8
API version:	1.40
Go version:	go1.13.8
Git commit:	afacb8b7f0
Built:	Tue Jun 23 22:26:12 2020
OS/Arch:	linux/amd64
Experimental:	false
Got permission denie	d while trying to connect to the Docker daemon socket at unix:///var/run/docker.sock: Get http://%2Fvar%2Frun%2Fdocker.sock/v1
.40/version: dial ur	ix /var/run/docker.sock: connect: permission denied
<pre>slave@kslave:~/.kube</pre>	\$ sudo docker version
[sudo] password for	slave:
lient:	
Version:	19.03.8
API version:	1.40
Go version:	go1.13.8
Git commit:	afacb8b7f0
Built:	Tue Jun 23 22:26:12 2020
OS/Arch:	linux/amd64
Experimental:	false
Server:	
Engine:	
Version:	19.03.8
API version:	1.40 (minimum version 1.12)
Go version:	go1.13.8
Git commit:	afacb8b7f0
Built:	Thu Jun 18 08:26:54 2020
OS/Arch:	linux/amd64
Experimental:	false
containerd:	
Version:	1.3.3-0ubuntu2
GitCommit:	
runc:	
Version:	spec: 1.0.1-dev
GitCommit:	
docker-init:	
Version:	0.18.0
GitCommit:	
slave@kslave:~/.kube\$ d	octi compute droplet list
1D Name Statur	Public IPv4 Private IPv4 Public IPv6 Menory VCPUs Disk Region Image VPC UUID
200647184 pool-71ats	1993 Volumes M52-3jfrkx 157.245.46.166 10.106.0.3 4096 2 80 lon1 Debian do-kube-1.18.3-do.0 dbd96b0a-72c1-46b8-855a-
b3d28169dc17 active	k8s:9664e8f4-33f6-49ad-a2ab-a6d57d3d5185,k8s:worker private_networking
200647185 pool-71ats	yh52-3]rhy 157.245.47.188 10.106.0.4 4096 2 80 lon1 Debian do-kube-1.18.3-do.0 dbd96b0a-72c1-46b8-855a-
b30281090CI7 active	K85:90048814-3310-4980-8280-800570303185,K85;K01K81 pi tvate_networktng

For Kubernetes setup, following commands were used:

#### #sudo snap connect doctl:kube-config \_\_mkdir -p \$HOME.kube\_\_ sudo #chown \$(id -u):\$(id -g) \$HOME/.kube

Then directory is created for storing configuration. **#mkdir -p \$HOME/.kube\_\_sudo chown \$(id -u):\$(id -g) \$HOME/.kube** With doctl, Kubernetes configuration can be saved. **#doctl kubernetes cluster kubeconfig save k8s-1-18-3-do-0-lon1-1595187552910** 3

lave@kslave:~/.kube\$ doctl kubernetes cluster kubeconfig save k8s-1-18-3-do-0-lon1-1595187552910
otice: Adding cluster credentials to kubeconfig file found in "/home/slave/.kube/config"
otice: Setting current-context to do-lon1-k8s-1-18-3-do-0-lon1-1595187552910

### 3 Install Docker in Ubuntu and Containerize the app

Step 1: Create folder "app1" and "app2" that will contain the web app TestApp1 and TestApp2 respectively. To containerize the app, "Dockerfile" is created as shown in the below figure. Also, "Makefile" is created to automate the commands.

<sup>&</sup>lt;sup>2</sup>https://kubectl.docs.kubernetes.io/

<sup>&</sup>lt;sup>3</sup>Doctl Set uphttps://github.com/digitalocean/doctl



Step 2: To containerize the app, following commands should be used.

This command will build the image. # sudo make build



Once the build is done properly, run the command from the Makefile created. # sudo make run



Push the image to docker hub repo, the repo created on DockerHub as anjalee19/app1. Now, the image can be pulled and run using Kubernetes. Similar process should be done to push app2 image to DockerHub.

#### # sudo make push

0002011/00/21002100/2002002/002200000000
<pre>slave@kslave:~/Documents/K8sTest/TestApp1\$ sudo make push</pre>
[sudo] password for slave:
docker push "anialee19/app1":"v2"
The push refers to repository [docker io/anjalee19/app1]
hefifoafilea: Lavas alsoadu avists
Jal Sale Ale Ale Ale Ale Ale Ale Ale Ale Ale A
SUSSASEAUDII. Layer already exists
30899/dce326: Layer already exists
4f779570099c: Layer already exists
See61aca3Sec: Layer already exists
423451ed44f2: Layer already exists
b2aaf85d6633: Layer already exists
88601a85ce11: Layer already exists
42f9c2f9c08e: Laver already exists
99e8bd3efaaf: Laver already exists
bee1e39d7c3a: Laver already exists
1f59adb2e206: Laver already exists
Craffs4855c0: Laver already exists
abbase13021. Laver already exists
V2: drgest: snazso://bezb0/b94Cb380004012cestedb902/0811025abb3att2/b310t4a2ceetd/0 stze: 3200

4

### 4 Creation of Pods

Step 1: The doctl set up is done and cluster is running with 2 nodes, but there is no container running in it. The containerized "app1" and "app2" should be executed to create pods. Kubernetes resource configs are used to create pods.

Step 2: The secret.yaml is created, which has the docker hub credential.



Step 3: Login with docker hub credential. # sudo docker login

- Step 4: The /.docker/config.json will be created in the home directory. The auth key used in the secret.yaml is generated by following command:
  # sudo cat /.docker/config.json base64 -w0
  The name "dockerpullsecret" will be used for deployment as shown in the figure.
- Step 5: The deployment and the service will be applied for app1 and app2 by executing file app1.yaml and app2.yaml respectively. Use below commands to apply app1.yaml app2.yaml:

# kubectl apply -f app1.yaml
# kubectl apply -f app2.yaml



<sup>&</sup>lt;sup>4</sup>https://cloud.google.com/kubernetes-engine/docs/concepts/pod/



Step 6: Then with **#kubectl get all** command will show all the pods and services in the Kubernetes.

slave@kslave:~/Docum	ents/K8sT	est/I	K8s\$ kubect	tl get	all			
NAME	R	EADY	STATUS	REST	TARTS	AGE		
pod/app1-bd4d77f77-c	rg8z 1	/1	Running	0		42s		
pod/app1-bd4d77f77-p	27lj 1	/1	Running	0		42s		
pod/app2-5bb54d57fd-;	xortx 1	/1	Running	0		7m33s		
pod/app2-5bb54d57fd-	zcpkj 1	/1	Running	0		7m33s		
NAME	ТҮРЕ		CLUSTER-IP		EXTER	NAL-IP	PORT(S)	AGE
service/app1	ClusterI	P :	10.245.230	. 192	<none< td=""><td>&gt;</td><td>80/TCP</td><td>2d16h</td></none<>	>	80/TCP	2d16h
service/app2	ClusterI	P :	10.245.147	.108	<none< td=""><td>&gt;</td><td>80/TCP</td><td>20h</td></none<>	>	80/TCP	20h
service/kubernetes	ClusterI	P :	10.245.0.1		<none:< td=""><td>&gt;</td><td>443/TCP</td><td>13d</td></none:<>	>	443/TCP	13d
NAME	READY	UP	-TO-DATE	AVAILA	ABLE	AGE		
deplovment.apps/app1	2/2	2		2		43s		
deployment.apps/app2	2/2	2		2		7m33s		
NAME			DESIRED	CURREN	IT R	EADY	AGE	
replicaset.apps/app1	-bd4d77f7	7	2	2	2		43s	
replicaset.apps/app2	- 5bb54d57	fd	2	2	2		7m33s	

As shown in the figure, the Cluster IPs 10.245.230.192 and 10.245.147.108 are used for the service. The app1 and app2 are available internally at 10.245.230.192 and 10.245.147.108 respectively at port 80. The container ports are 3000 and 3001.  $_5$ 

### 5 Setting Up Nginx Ingress controller

- Step 1: First step is to create resources needed by this controller, the maintenance is done by Nginx. The command to create such resources are: #kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingressnginx/nginx-0.30.0/deploy/static/mandatory.yaml
- Step 2: Ingress Controller Service is created that will balance load. The cloud-generic.yaml file contains the definition of service. The externalTrafficPolicy: Cluster, the command to apply this config file is: kubectl apply -f cloud-generic.yaml
- Step 3: Verify the Controller pods are started with the command: **kubectl get pods** –**all-namespaces** -**l app.kubernetes.io/name=ingressnginx**

slavegkslave:-/Documents/K8sTest/K8s\$ kubectl get pods --all-namespaces -l app.kubernetes.ic/name=ingress-ngin: NAMESPACE NAME NAME ingress-nginx nginx-ingress-controller-5bb8fb4bb6-7wk9p 1/1 Running 0 44h

The command **kubectl get svc** –**namespace=ingress-nginx** will give the ports 80 and 443.

<sup>&</sup>lt;sup>5</sup>https://stackoverflow.com/a/54322869

<pre>slave@kslave:~/Documents/K8sTest/K8s\$ kubectl get svcnamespace=ingress-nginx</pre>							
NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE		
ingress-nginx	LoadBalancer	10.245.29.16	188.166.137.37	80:32342/TCP,443:32595/TCP	44h		

Step 4: Then generate Ingress for app1 and app2 resource. Apply app1app2\_ingress.yaml file to Kubernetes.

kubectl apply -f app1app2\_ingress.yaml

slave@kslave:~/Docum	ents/K8sTest/K8s\$ kubectl describe ingress
Name: ap	p1app2-ingress
Namespace: de	fault
Address: 18	8.166.137.37
Default backend: de	fault-http-backend:80 ( <error: "default-http-backend"="" endpoints="" found="" not="">)</error:>
TLS:	
tls-secret termina	tes app1.clenet.tech,www.app1.clenet.tech,app2.clenet.tech,www.app2.clenet.tech
Rules:	
Host	Path Backends
app1.clenet.tech	
	app1:80 (10.244.0.109:3000,10.244.0.135:3000)
www.app1.clenet.te	ch
	/ app1:80 (10.244.0.109:3000,10.244.0.135:3000)
	/app1_default
app2.clenet.tech	
	app2:80 (10.244.0.246:3001,10.244.0.4:3001)
www.app2.clenet.te	ch i i i i i i i i i i i i i i i i i i i
	/ app2:80 (10.244.0.246:3001,10.244.0.4:3001)
	/app2_default app2:80 (10.244.0.246:3001,10.244.0.4:3001)
Annotations:	cert-manager.io/cluster-issuer: letsencrypt-production
	kubernetes.io/ingress.class: nginx
	nginx.ingress.kubernetes.io/rewrite-target: /

### 6 Install and Configure Cert-Manager

- Step 1: Before installing Cert-Manager, first create Namespace to run it. The command used is: kubectl create namespace cert-manager
- Step 2: Then, install Custom Resource Definitions related to cert-manager with the command:

 $kubectl\ apply\ -validate = false\ -f\ https://github.com/jetstack/cert-manager/releases/manager.yaml$ 

Verify the installed cert-manager with the command:

kubectl get pods --namespace cert-manager

<pre>slave@kslave:~/Documents/K8sTest/K8s\$ ku</pre>	ibectl get	podsnam	espace cert	-manager
NAME	READY	STATUS	RESTARTS	AGE
cert-manager-85db5c4c87-mlkdv	1/1	Running	0	28s
cert-manager-cainjector-7959549c78-mvw7z	: 1/1	Running	0	28s
cert-manager-webhook-5c8696f555-rk4xj	1/1	Running	Θ	28s

### 7 Implement Custom Scheduler- FFMRA

Step 1: The **scheduler.yaml** is created in the directory K8sTest defining the name of the custom scheduler and the pods in the container to be deployed. The **ffmra.go** is created where the custom scheduler logic is written.

slave@kslave:~/Documents/K8sTest/K8s\$ kubectl get ingress						
NAME	CLASS	HOSTS	ADDRESS	PORTS	AGE	
app1app2-ingress	<none></none>	app1.clenet.tech,www.app1.clenet.tech,app2.clenet.tech + 1 more	188.166.137.37	80, 443	45h	
<pre>slave@kslave:~/Documents/K8sTest/K8s\$ kubectl describe ingressName:app1app2-ingress</pre>						

- Step 2: With Dockerfile, scheduler's container image is build.
- Step 3: Create a deployment with the custom scheduler code using the command: **kubectl apply -f scheduler.yaml**
- Step 4: Verify if the scheduler is working on the pods. **kubectl get pods** The output will be as:

<pre>stave@kstave:~/Documents/K8sTest/K8s\$ kubectt get pods</pre>							
NAME	READY	STATUS	RESTARTS	AGE			
app1-78bd6c6c9b-scxtv	1/1	Running	0	4d23h			
app1-78bd6c6c9b-zk9qf	1/1	Running	0	4d23h			
app2-565bd4b94f-n7279	1/1	Running	0	4d23h			
app2-565bd4b94f-wj8xx	1/1	Running	0	4d23h			
ffmra-scheduler-59447648cf-tdzgz	2/2	Running	0	23h			

Step 5: The scheduler is running and using **kubectl describe pod ffmra-scheduler** to verify the status of the running scheduler.

stave@kstave:•	<pre>v/bocuments/ksslest/ksss kubectl describe pod ttmra-scheduler</pre>
Name:	ffmra-scheduler-59447648cf-tdzgz
Namespace:	default
Priority:	0
Node:	pool-71atsyh52-3jrhx/10.106.0.3
Start Time:	Thu, 13 Aug 2020 01:51:58 +0100
Labels:	app=ffmra-scheduler
	pod-template-hash=59447648cf
Annotations:	<none></none>
Status:	Running
IP:	10.244.0.146
IPs:	
IP:	10.244.0.146
Controlled By:	: ReplicaSet/ffmra-scheduler-59447648cf

Step 6: The status can be checked on Kubernetes dashboard.<sup>6</sup>

### 8 Kubernetes Monitoring Stack Set up Digital Ocean

78

- Step 1: The Digital Ocean monitoring stack is the integration of Grafana and Prometheus. These helps in monitoring the cluster, applications with graphs, charts, etc. Install Monitoring stack from the DO control panel and then follow the next steps.
  - <sup>6</sup>https://kubernetes.io/docs/tasks/extend-kubernetes/configure-multiple-schedulers/

 $^{8}$  https://www.digitalocean.com/community/tutorials/how-to-set-up-a-kubernetes-monitoring-stack-wit

<sup>&</sup>lt;sup>7</sup>https://kubernetes.github.io/ingress-nginx/user-guide/monitoring/

Step 2: Download the config file and save it to the local machine's Downloads folder. Then, copy the file to kubectl directory. The commands used are:

# cp /.kube/config /.kube/config.bkup

# cp  $\ /Downloads/k8s-1-18-3-do-0-lon1-1595187552910-kubeconfig.yaml <math display="inline">/.kube/config$ 

Step 3: To verify run # kubectl get pods -A, the result will be as:

prometheus-operator	alertmanager-prometheus-operator-alertmanager-0	2/2	Running	0	
prometheus-operator	prometheus-operator-grafana-6dbf66d75b-pt2ws	2/2	Running	0	
prometheus-operator	prometheus-operator-kube-state-metrics-69fcc8d48c-dz8l9	1/1	Running	0	
prometheus-operator	prometheus-operator-operator-6895d99c87-w9296	2/2	Running	0	
prometheus-operator	prometheus-operator-prometheus-node-exporter-lwwf6	1/1	Running	0	
prometheus-operator	prometheus-operator-prometheus-node-exporter-w9p72	1/1	Running	0	
prometheus-operator	prometheus-prometheus-operator-prometheus-0	3/3	Running	1	
and the second sec					

 Step 4: Set up Grafana as IP is not accessible publicly, so port-forwarding can be used.
 # kubectl -n prometheus-operator get pods — grep prometheus-operatorgrafana
 #kubectl port forward prometheus operator grafana 6dbf66d75b pt2ws

 $\# kubectl\ port-forward\ prometheus-operator-grafana-6dbf66d75b-pt2ws -n\ prometheus-operator\ 8080:3000$ 

Step 5: Then, login to Grafana dashboard at 127.0.0.1:8080 with username as "admin" and password as "prom-operator". The dashboard will look as:

