ECE 6363 Lab 5

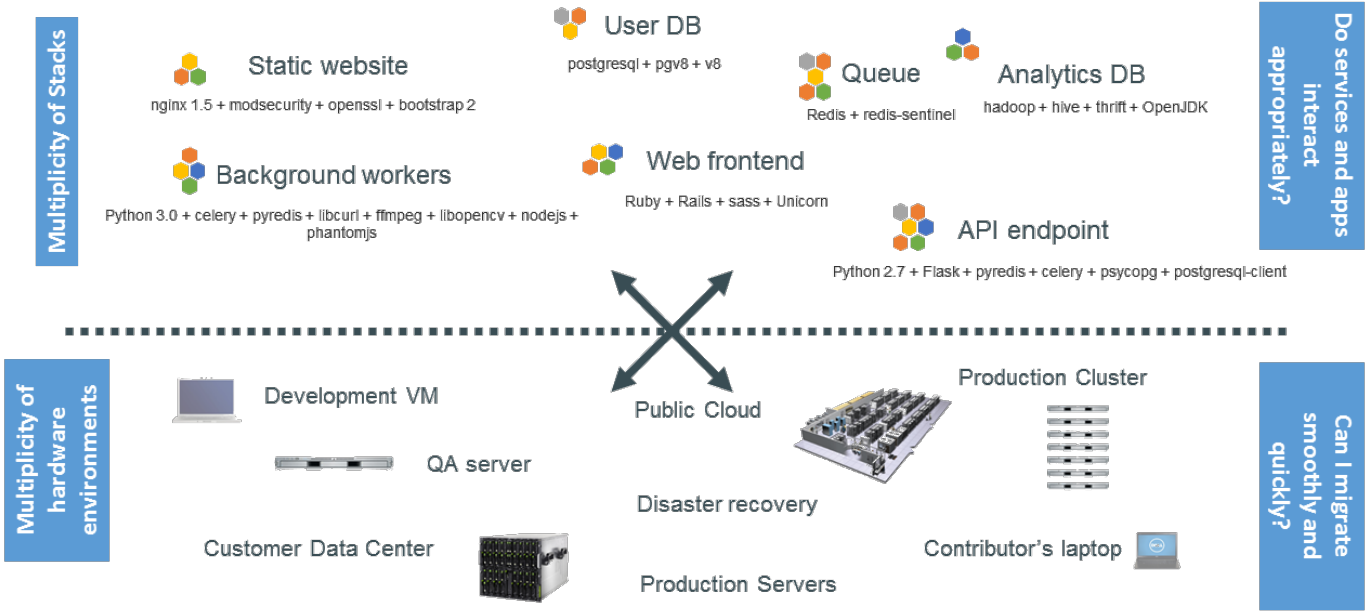
Hosting a web service using Kubernetes orchestration

Objectives

- Understand the concept of container and the reason for cloud orchestration
- Get familiar with the Kubernetes and how to use the Kubernetes orchestration tool.
- Experience with hosting a popular cloud service using Kubernetes
- Use Kubernetes to deploy your WordPress server with a trivial loadbalancer
- Understand that you can manage Kubernetes services on Google Cloud Platform (Google Kubernetes Engine)

Why do we need containers?

The deployment problem



Multiplicity of Stacks

Static website

nginx 1.5 + modsecurity + openssl + bootstrap 2

User DB

postgresql + pgv8 + v8

Queue

Redis + redis-sentinel

Analytics DB

hadoop + hive + thrift + OpenJDK

Background workers

Python 3.0 + celery + pyredis + libcurl + ffmpeg + libopencv + nodejs + phantomjs

Web frontend

Ruby + Rails + sass + Unicorn

API endpoint

Python 2.7 + Flask + pyredis + celery + psycopg + postgresql-client

Do services and apps interact appropriately?

Multiplicity of hardware environments

Development VM

QA server

Customer Data Center

Public Cloud

Disaster recovery

Production Servers

Production Cluster

Contributor's laptop

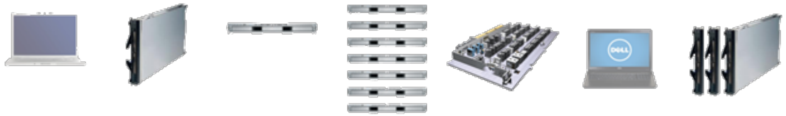
Can I migrate smoothly and quickly?

from Docker slideshare

Why do we need containers?

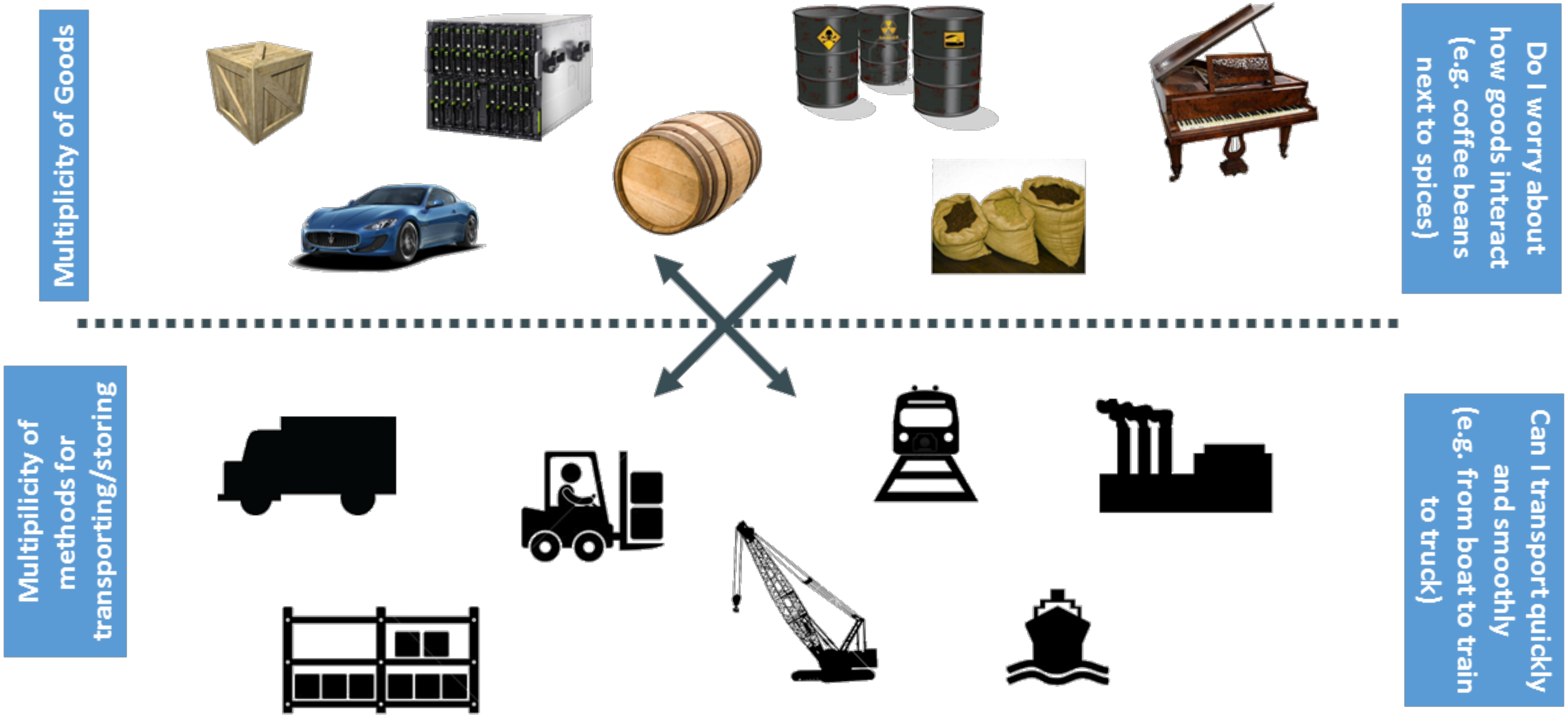
The deployment problem

	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor's laptop	Customer Servers
Static website	?	?	?	?	?	?	?
Web frontend	?	?	?	?	?	?	?
Background workers	?	?	?	?	?	?	?
User DB	?	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?	?
Queue	?	?	?	?	?	?	?



from Docker slideshare

An inspiration: Cargo transport



Multiplicity of Goods

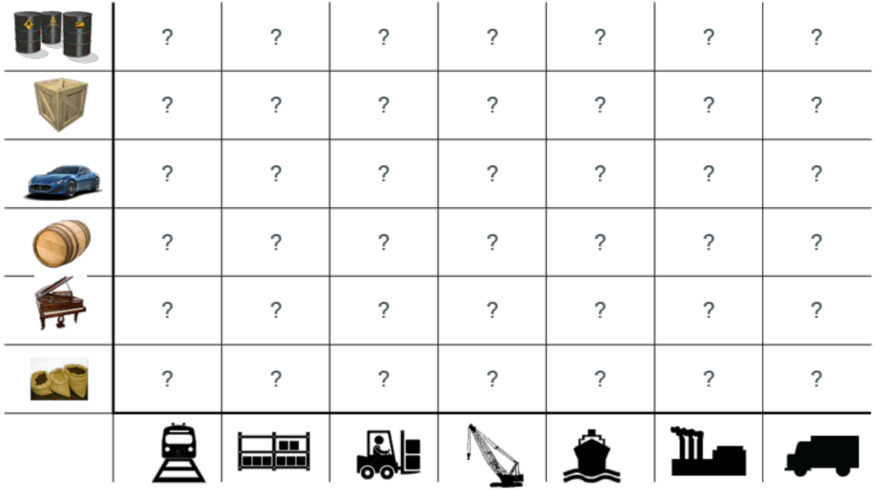
Do I worry about how goods interact (e.g. coffee beans next to spices)

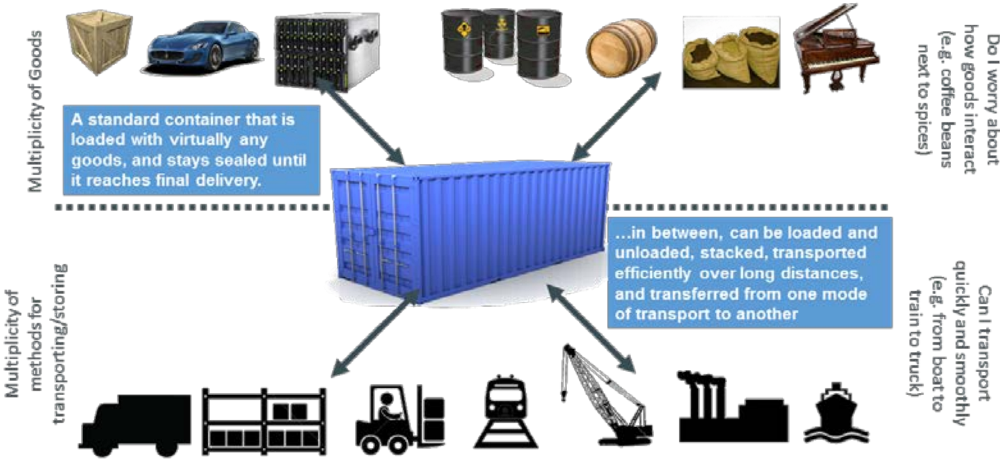
Multipilicity of methods for transporting/storing

Can I transport quickly and smoothly (e.g. from boat to train to truck)

from Docker slideshare

Intermodal shipping containers




Multiplicity of Goods
Do I worry about how goods interact (e.g. coffee beans next to spices)
Multiplicity of methods for transporting/storing
Can I transport quickly and smoothly (e.g. from boat to train to truck)

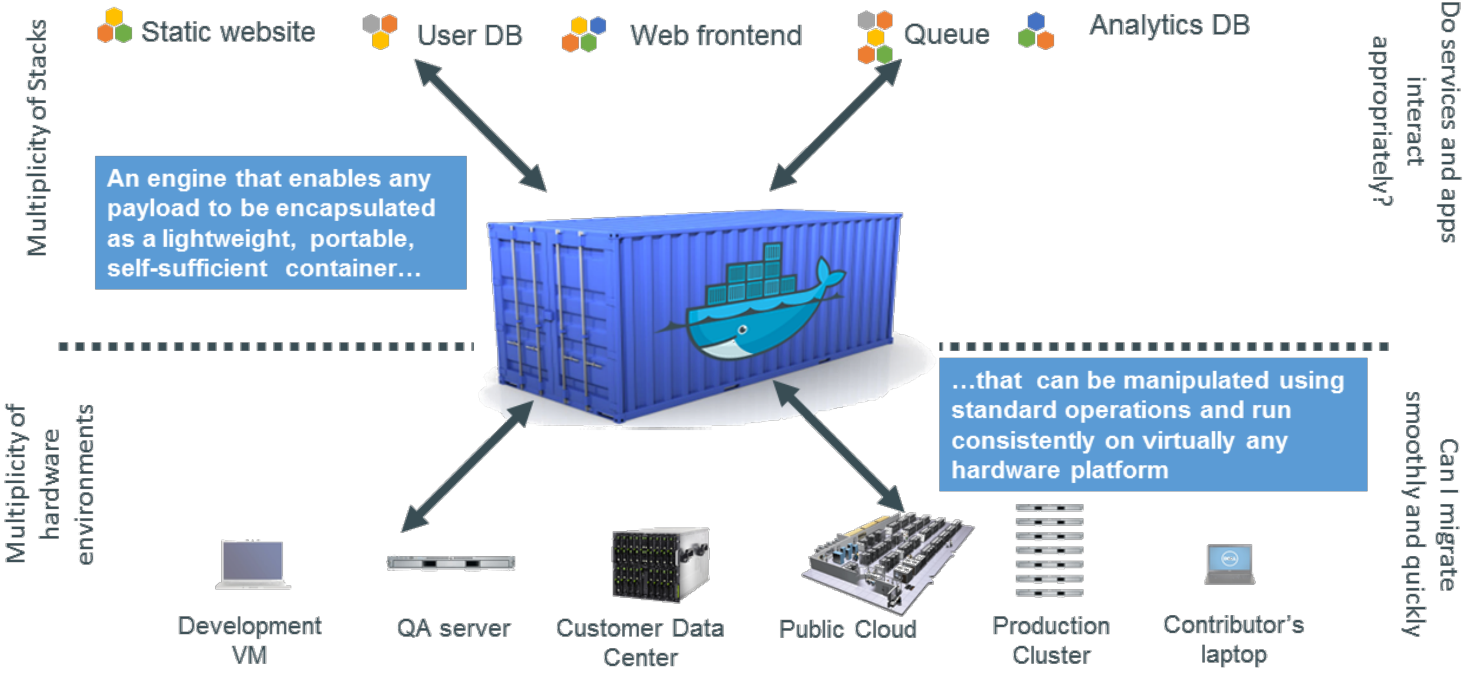
A standard container that is loaded with virtually any goods, and stays sealed until it reaches final delivery.

...in between, can be loaded and unloaded, stacked, transported efficiently over long distances, and transferred from one mode of transport to another

from Docker slideshare

Why do we need containers?

A shipping container system for applications



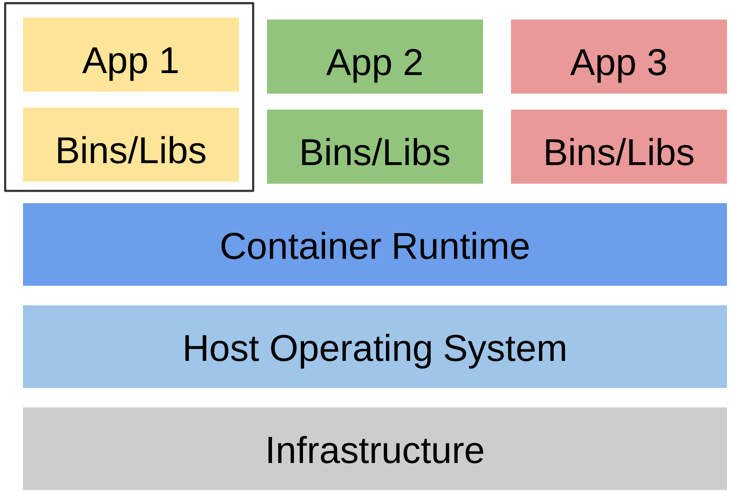
An engine that enables any payload to be encapsulated as a lightweight, portable, self-sufficient container…

…that can be manipulated using standard operations and run consistently on virtually any hardware platform

from Docker slideshare

What is a Container?

Acontainer is a standard unit of software that packages up code and all its dependencies so the application runs quickly and reliably from one computing environment to another.



App 1

Bins/Libs

App 2

Bins/Libs

App 3

Bins/Libs

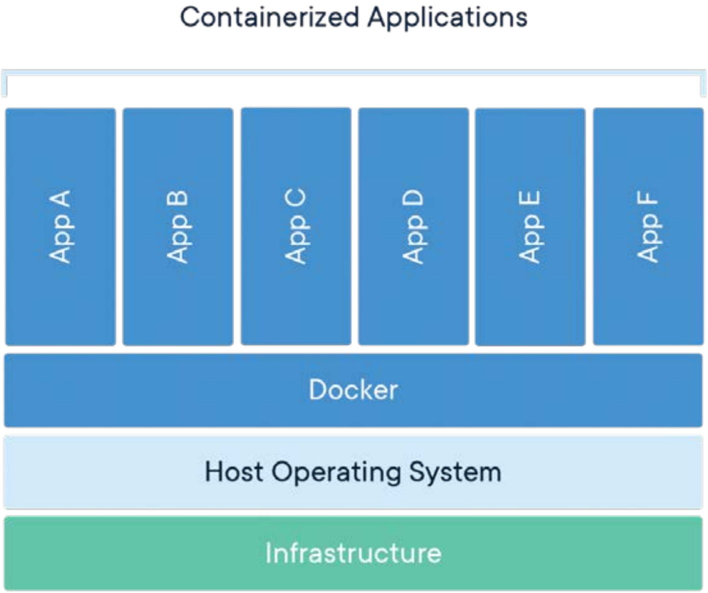
Container Runtime

Host Operating System

Infrastructure

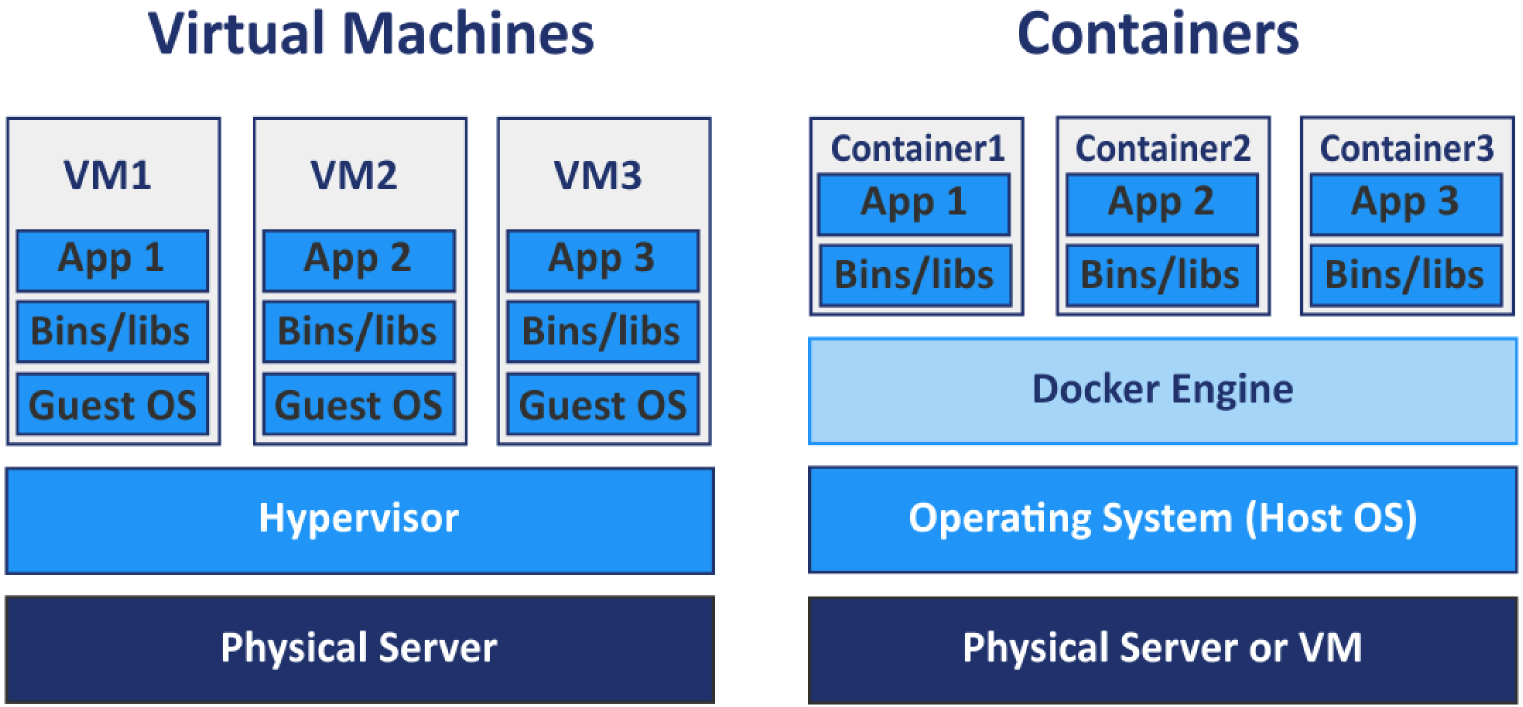
Docker

Apopular, open-source container format



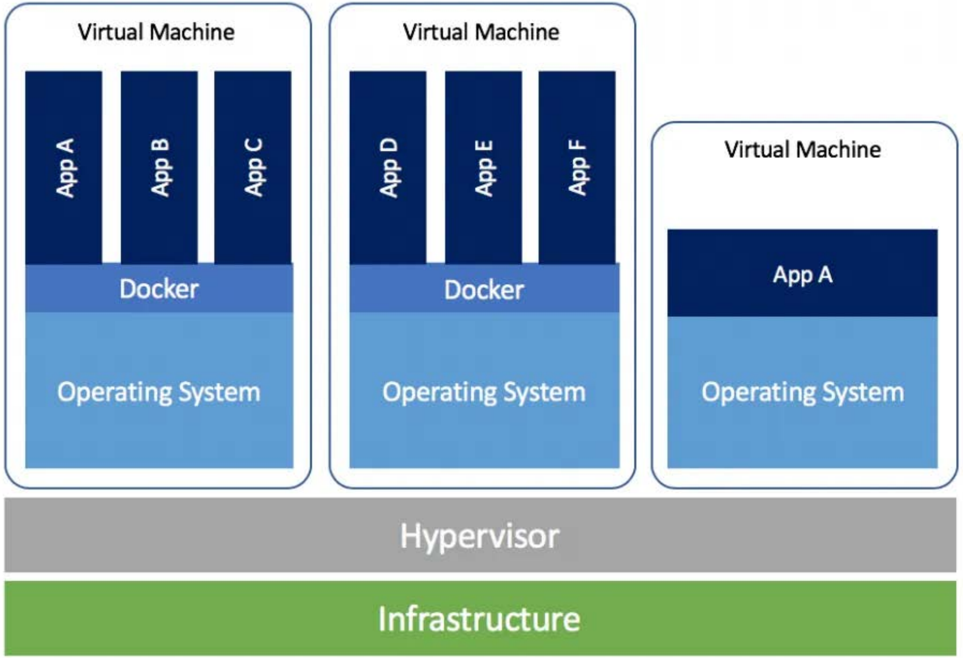
https://www.docker.com/resources/what-container

Virtual machines vs Containers



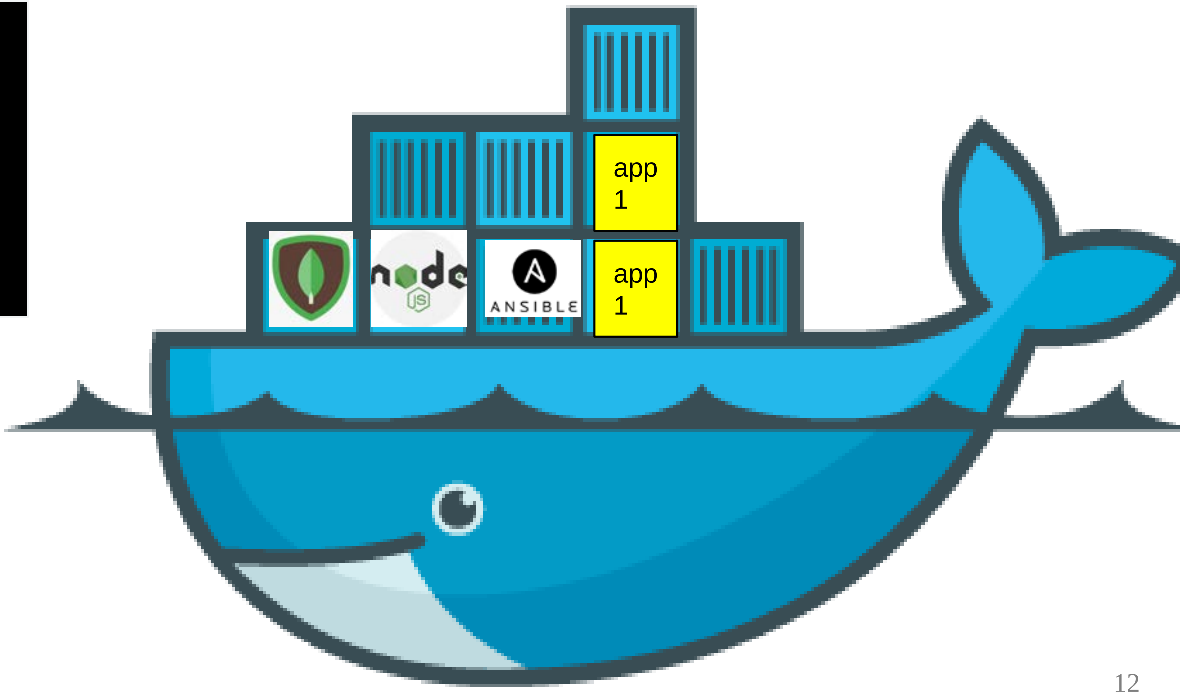
Can VMs and Docker coexist?

Yes



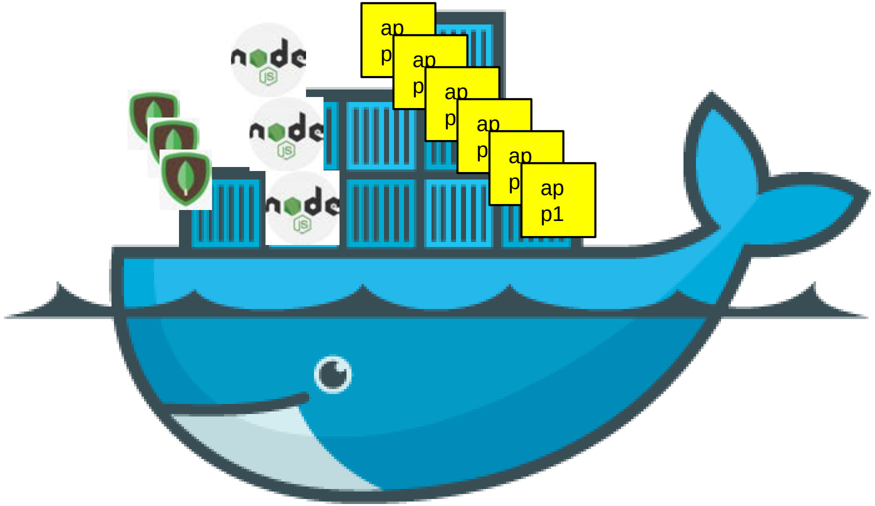
How is it done?

```
docker run my-mongodb
docker run my-nodejs
docker run my-ansible
docker run my-app1
docker run my-app1
docker run my-app2
```



Why container orchestrate?

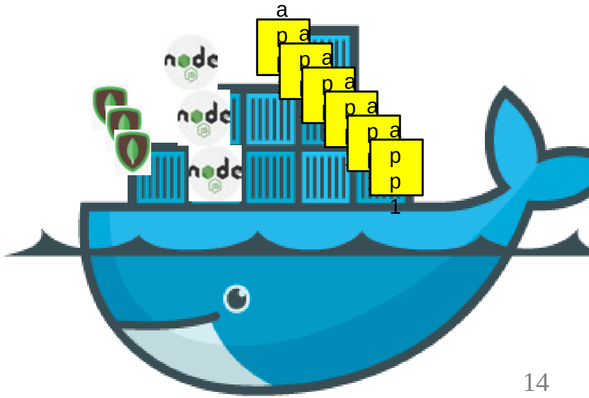
What happens if our applications start to get more load?



What is container orchestration used for?

Container orchestration automates the deployment, management, scaling, and networking of containers.

- Provisioning and deployment
- Configuration and scheduling
- Resource allocation
- Scaling or removing containers across your infrastructure
- Load balancing and traffic routing
- Health monitoring



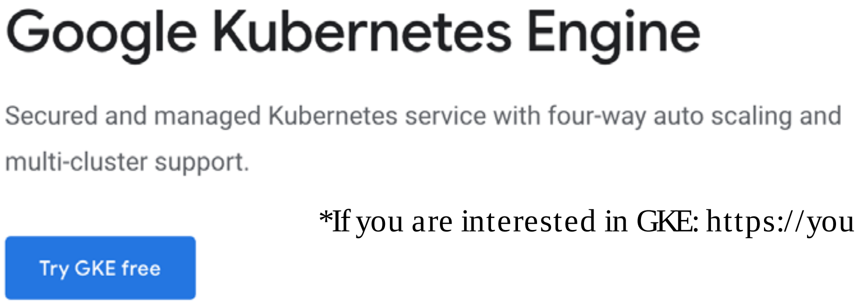
Kubernetes

Kubernetes is a portable, extensible, open-source platform for managing containerized workloads and services, that facilitates both declarative configuration and automation.

Documentation: https://kubernetes.io/docs/home/

Yes, you can use Kubernetes with cloud providers

Google Cloud Platform:


Google Kubernetes Engine

Secured and managed Kubernetes service with four-way auto scaling and multi-cluster support.

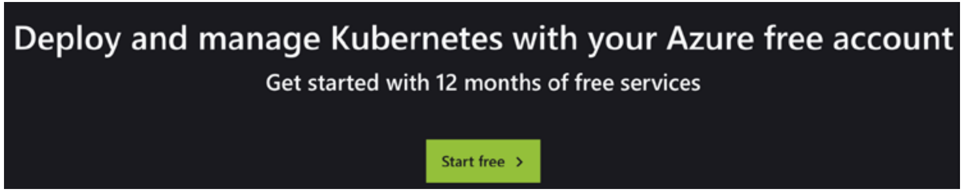
*If you are interested in GKE: https://youtu.be/yBOjWr24C6o

Amazon EKS:

Amazon Elastic Kubernetes Service

The most trusted way to run Kubernetes

Microsoft Azure:


Deploy and manage Kubernetes with your Azure free account

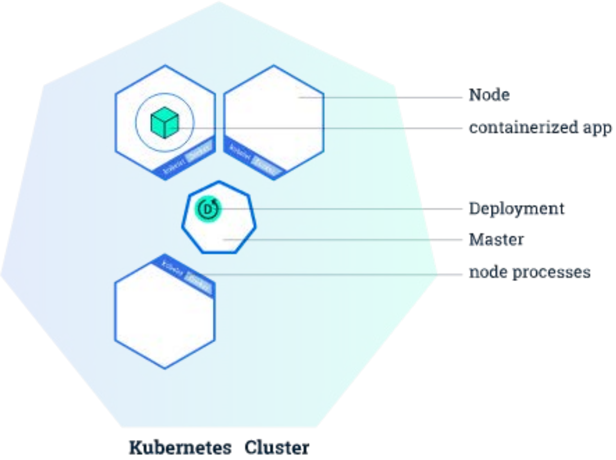
Get started with 12 months of free services

Application Deployment with Kubernetes

You can deploy your containerized applications with Kubernetes in a portable, scalable and extensible way

```
docker run my-app1
```

```
kubectl run --replicas=100 my-app1
```



Minikube

A tool that runs a single-node Kubernetes cluster in a virtual machine on your personal computer.

It is easy to set up, it is let you focus on learning and developing Kubernetes

https://minikube.sigs.k8s.io/docs/start/

Deliverables

Goal

Host WordPress server on your Kubernetes cluster.

Tasks description

You will setup a Kubernetes cluster in a single-node mode on your laptop.

You will use kubectl commands and minikube to run your Kubernetes cluster in a virtual machine locally.

You will use Helm, a tool that streamlines installing and managing Kubernetes applications, to help you automate the deployment of wordpress.

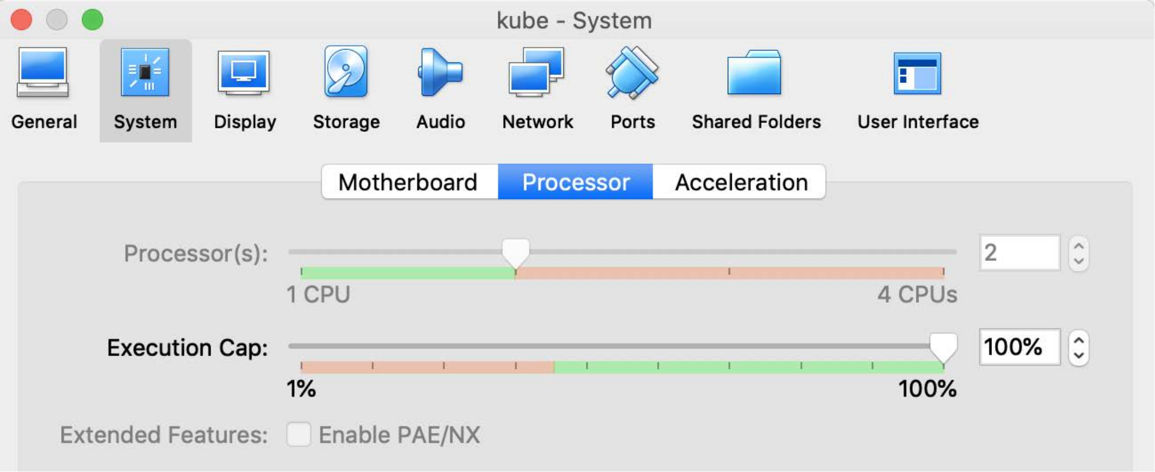
You will monitor the health status of your cluster

Recommended system configuration

Ubuntu VM(16.04 or later) in Virtualbox

>= 2 CPUs

>= 2Gram



Processor(s): 2

Execution Cap: 100%

Extended Features: □ Enable PAE/NX

Tools you need in the lab

Install Docker

Install kubectl

Install minikube

Install helm

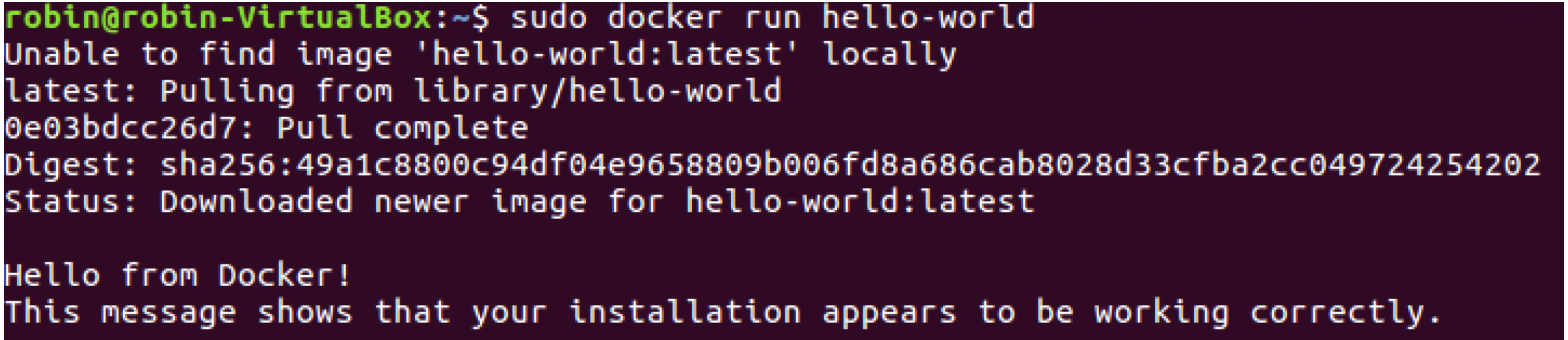
Install Docker Engine

Install Docker Engine on Ubuntu:

Follow instructions in the document:

https://docs.docker.com/engine/install/ubuntu/

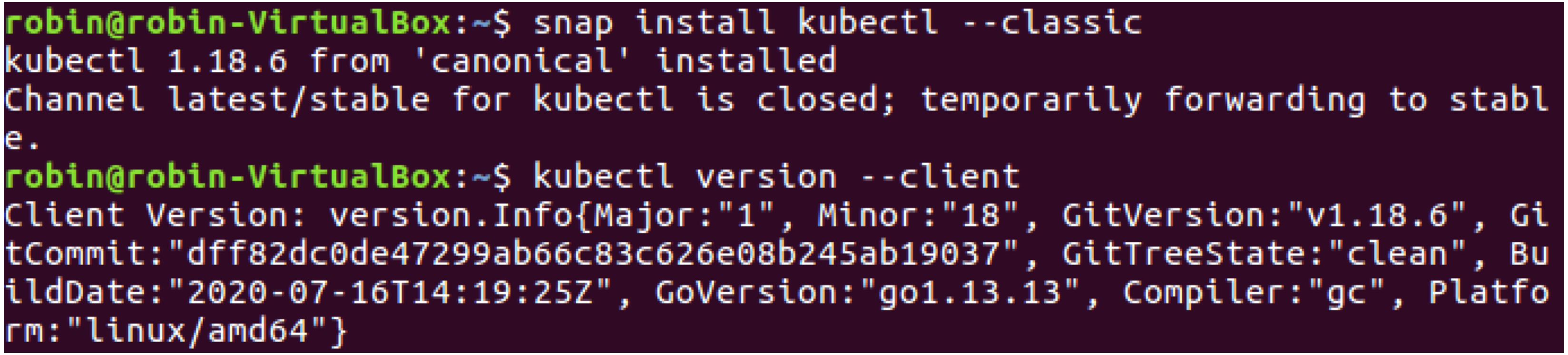
Verify that Docker is installed correctly: `sudo docker run hello-world`



```
robin@robin-VirtualBox:~$ sudo docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
0e03bdcc26d7: Pull complete
Digest: sha256:49a1c8800c94df04e9658809b006fd8a686cab8028d33cfba2cc049724254202
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.
```

Install Kubectl

https://kubernetes.io/docs/tasks/tools/install-kubectl/



```
robin@robin-VirtualBox:~$ snap install kubectl --classic
kubectl 1.18.6 from 'canonical' installed
Channel latest/stable for kubectl is closed; temporarily forwarding to stabl
e.
robin@robin-VirtualBox:~$ kubectl version --client
Client Version: version.Info{Major:"1", Minor:"18", GitVersion:"v1.18.6", Gi
tCommit:"dff82dc0de47299ab66c83c626e08b245ab19037", GitTreeState:"clean", Bu
ildDate:"2020-07-16T14:19:25Z", GoVersion:"go1.13.13", Compiler:"gc", Platfo
rm:"linux/amd64"}
```

Install and run minikube

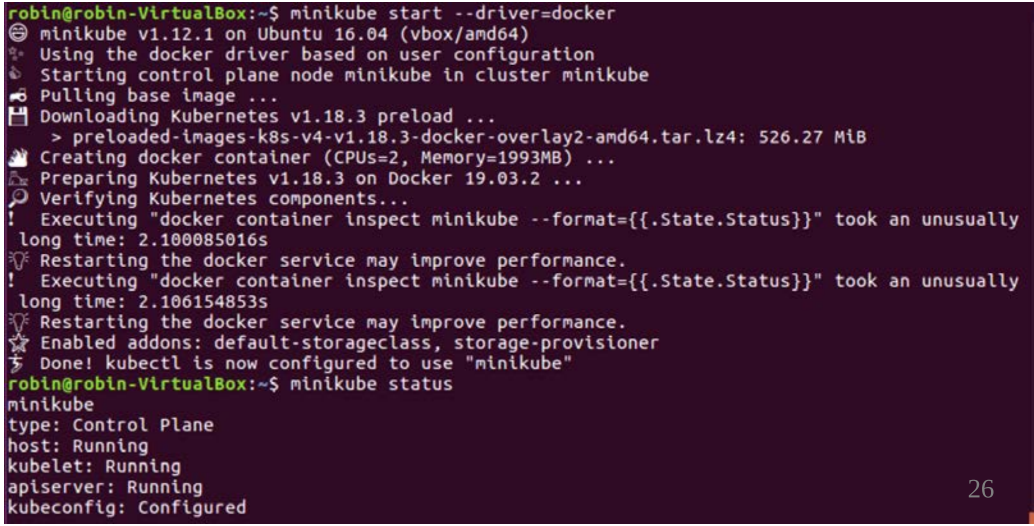
you will need curl: `sudo apt install curl`

Follow installation instruction on https://kubernetes.io/docs/tasks/tools/install-minikube/

Confirm installation

```
minikube start --driver=docker
```

```
minikube status
```



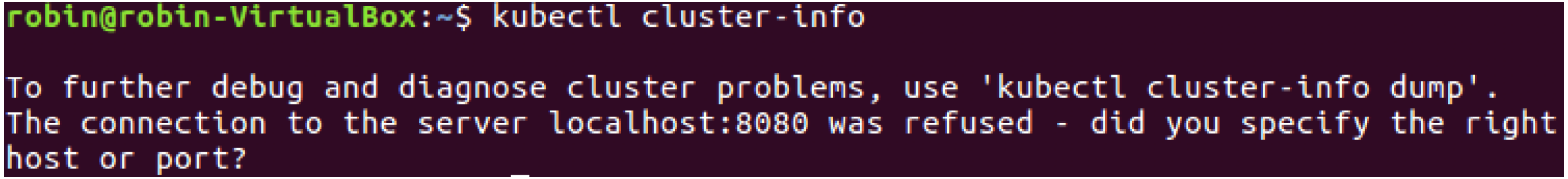
```
robin@robin-VirtualBox:~$ minikube start --driver=docker
😄  minikube v1.12.1 on Ubuntu 16.04 (vbox/amd64)
✨  Using the docker driver based on user configuration
👍  Starting control plane node minikube in cluster minikube
🚜  Pulling base image ...
💾  Downloading Kubernetes v1.18.3 preload ...
    > preloaded-images-k8s-v4-v1.18.3-docker-overlay2-amd64.tar.lz4: 526.27 MiB
🔥  Creating docker container (CPUs=2, Memory=1993MB) ...
🐳  Preparing Kubernetes v1.18.3 on Docker 19.03.2 ...
🔎  Verifying Kubernetes components...
❗  Executing "docker container inspect minikube --format={{.State.Status}}" took an unusually
 long time: 2.100085016s
💡  Restarting the docker service may improve performance.
❗  Executing "docker container inspect minikube --format={{.State.Status}}" took an unusually
 long time: 2.106154853s
💡  Restarting the docker service may improve performance.
🌟  Enabled addons: default-storageclass, storage-provisioner
🏄  Done! kubectl is now configured to use "minikube"
robin@robin-VirtualBox:~$ minikube status
minikube
type: Control Plane
host: Running
kubelet: Running
apiserver: Running
kubeconfig: Configured
```

Verify your kubectl configuration

At terminal:

```
kubectl cluster-info
```

*If you do Not setup minikube correctly, you will likely see this message



```
robin@robin-VirtualBox:~$ kubectl cluster-info

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
The connection to the server localhost:8080 was refused - did you specify the right
host or port?
```

WordPress

WordPress is one of the most versatile open source content management systems on the market. Apublishing platform for building blogs and websites. It currently powers more than 25% of the web.*

https://wordpress.org/

Meet WordPress

WordPress is open source software you can use to create a beautiful website, blog, or app.

Beautiful designs, powerful features, and the freedom to build anything you want. WordPress is both free and priceless at the same time.

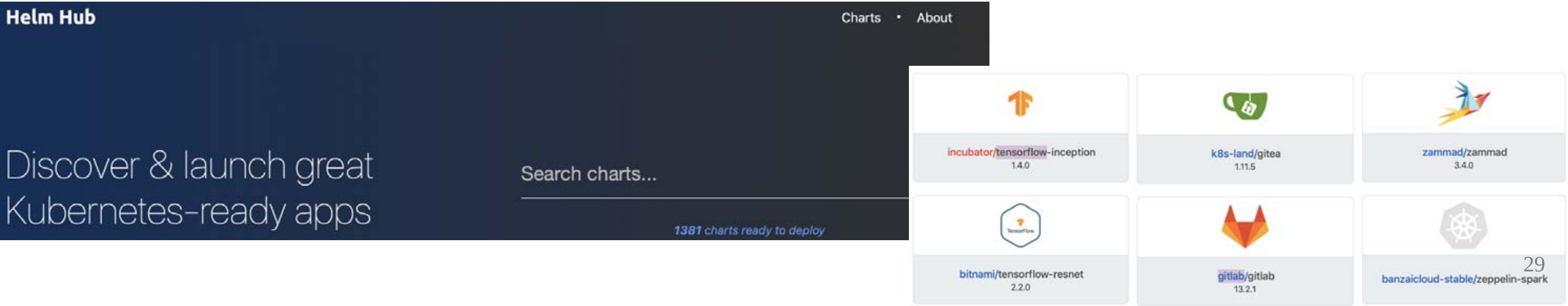
*Fun fact: NYU offers current faculty, students, and staff a custom version of WordPress for free. https://nyu.service-now.com/servicelink/kb_search.do?id=KB0015657

Host a wordpress server - about helm

Since Wordpress requires a database, it is easiest to deploy the cluster using a tool call Helm. https://github.com/helm/helm

Helm is a package manager specifically designed for Kubernetes.

First install helm: `snap install helm --classic`



Helm Hub

Charts • About

Discover & launch great Kubernetes-ready apps

Search charts...

1381 charts ready to deploy

incubator/tensorflow-inception
1.4.0

k8s-land/gitea
1.11.5

zammad/zammad
3.4.0

bitnami/tensorflow-resnet
2.2.0

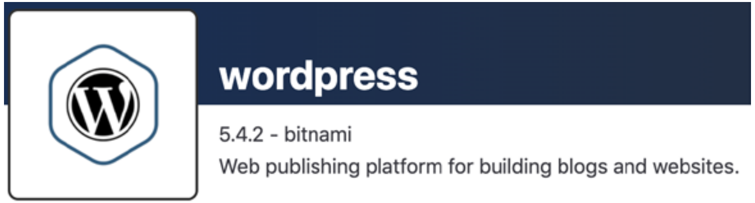
gitlab/gitlab
13.2.1

banzaicloud-stable/zeppelin-spark

Host a wordpress server - using helm

Read the instruction of helm for WordPress:

https://hub.helm.sh/charts/bitnami/wordpress



wordpress

5.4.2 - bitnami

Web publishing platform for building blogs and websites.

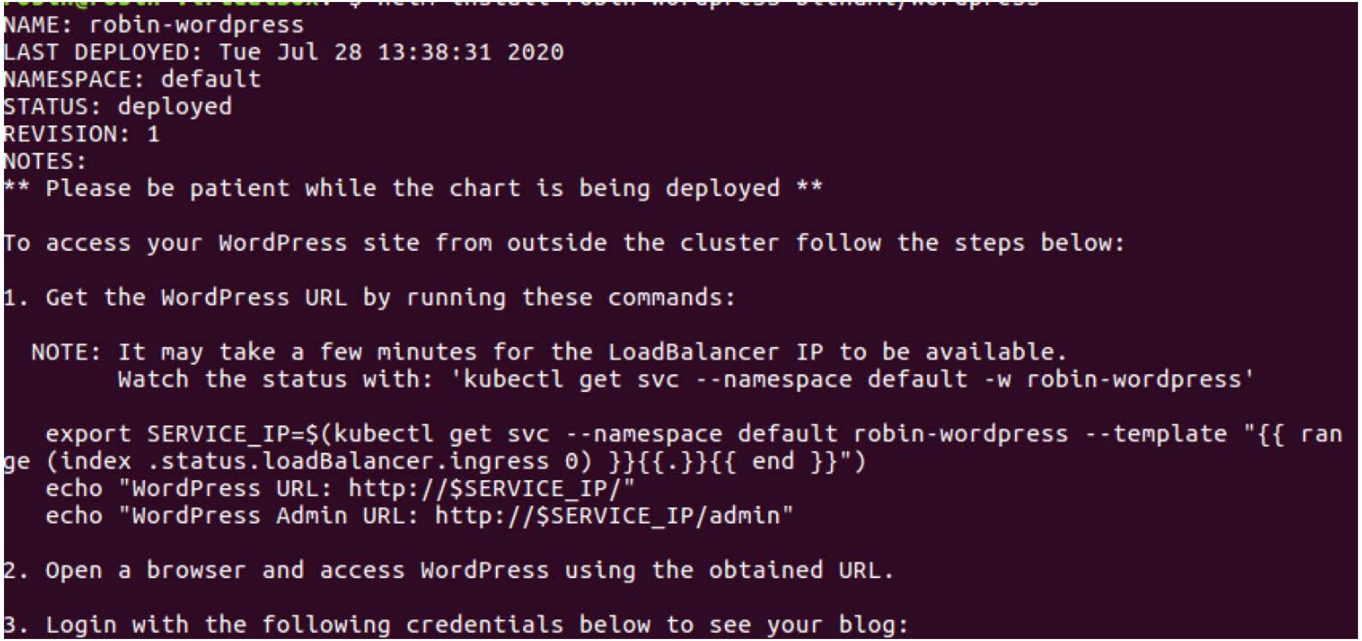
Add the bitnami repo and update it:

```
helm repo add bitnami https://charts.bitnami.com/bitnami
helm repo update
```

Deploy wordpress on your Kubernetes cluster in the default configuration

Host a wordpress server

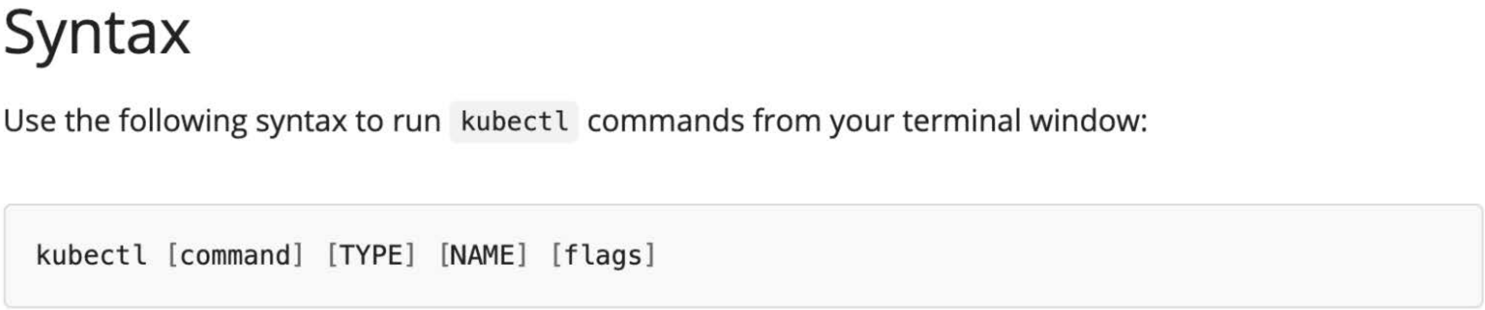
When you deploy your wordpress server with helm, you will find instructional messages from your terminal. Use it to find your url and login information.



```
robin@robin-VirtualBox:~$ helm install robin-wordpress bitnami/wordpress
NAME: robin-wordpress
LAST DEPLOYED: Tue Jul 28 13:38:31 2020
NAMESPACE: default
STATUS: deployed
REVISION: 1
NOTES:
** Please be patient while the chart is being deployed **

To access your WordPress site from outside the cluster follow the steps below:

1. Get the WordPress URL by running these commands:

  NOTE: It may take a few minutes for the LoadBalancer IP to be available.
        Watch the status with: 'kubectl get svc --namespace default -w robin-wordpress'

   export SERVICE_IP=$(kubectl get svc --namespace default robin-wordpress --template "{{ ran
ge (index .status.loadBalancer.ingress 0) }}{{.}}{{ end }}")
   echo "WordPress URL: http://$SERVICE_IP/"
   echo "WordPress Admin URL: http://$SERVICE_IP/admin"

2. Open a browser and access WordPress using the obtained URL.

3. Login with the following credentials below to see your blog:
```

Kubectl command

kubectl command line tool lets you control Kubernetes clusters



Syntax

Use the following syntax to run `kubectl` commands from your terminal window:

```
kubectl [command] [TYPE] [NAME] [flags]
```

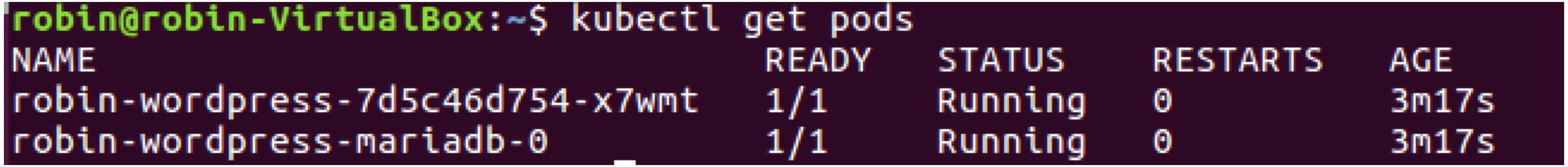
Kubectl commands

Use kubectl to view and find your resources for wordpress deployment

`kubectl get services`

`kubectl get pods`

……



```
robin@robin-VirtualBox:~$ kubectl get pods
NAME                                 READY   STATUS    RESTARTS   AGE
robin-wordpress-7d5c46d754-x7wmt     1/1     Running   0          3m17s
robin-wordpress-mariadb-0            1/1     Running   0          3m17s
```

Can you find your running services? Does it crash? Does it restart automatically?

Hints for wordpress deployment

How to access your application?

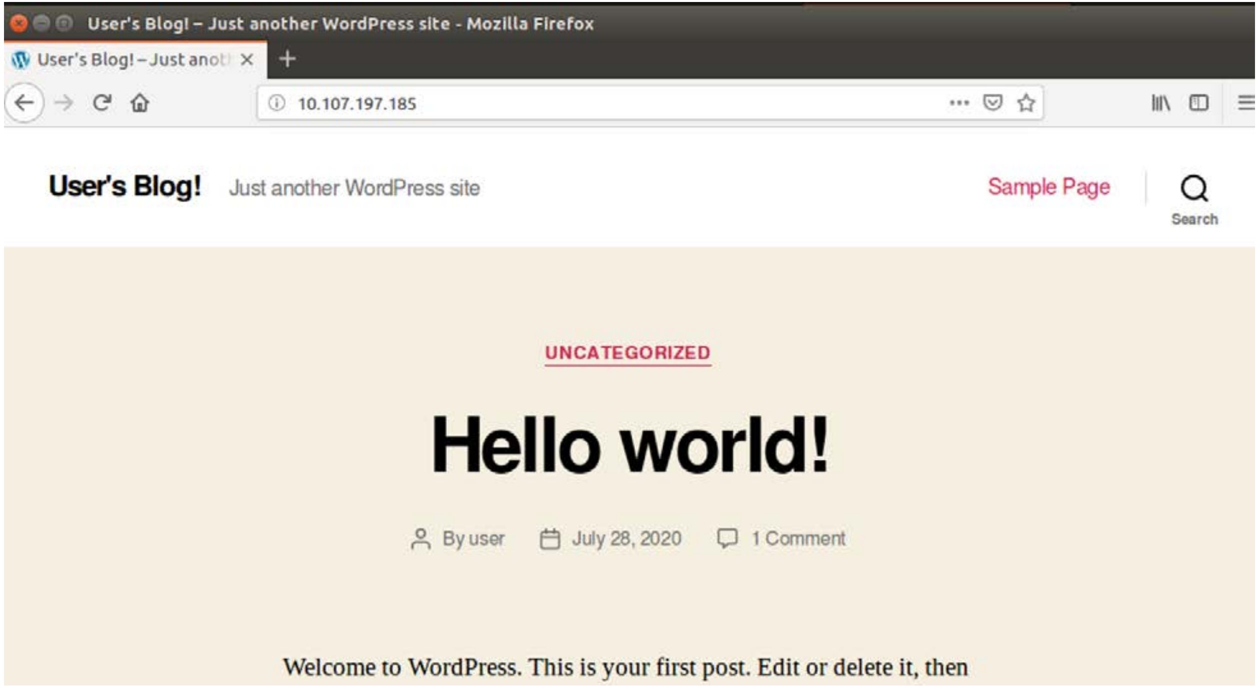
You will need Kubernetes to service your wordpress server with LoadBalancer.

A LoadBalancer service is the standard way to expose a service to the internet.

https://minikube.sigs.k8s.io/docs/handbook/accessing/#using-minikube-tunnel

Wordpress

Verify your service on your browser by **your wordpress URL**

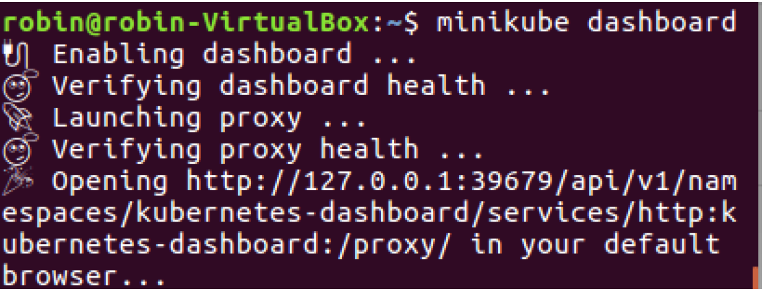


Welcome to WordPress. This is your first post. Edit or delete it, then

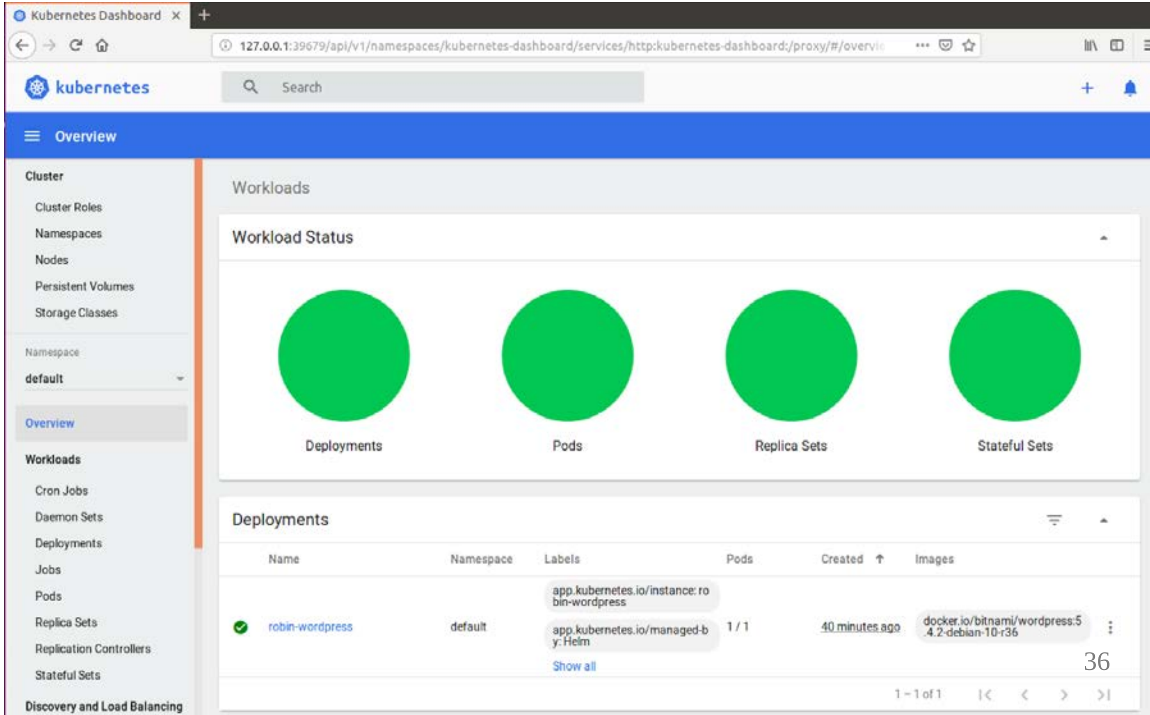
Monitor your cluster

Kubernetes Dashboard is a web-based UI that allows you to monitor clusters. Play with the dashboard and troubleshoot your applications!

```
minikube dashboard
```



```
robin@robin-VirtualBox:~$ minikube dashboard
🔌  Enabling dashboard ...
🤔  Verifying dashboard health ...
🚀  Launching proxy ...
🤔  Verifying proxy health ...
🎉  Opening http://127.0.0.1:39679/api/v1/namespaces/kubernetes-dashboard/services/http:kubernetes-dashboard:/proxy/ in your default browser...
```



	Name	Namespace	Labels	Pods	Created ↑	Images
✓	robin-wordpress	default	app.kubernetes.io/instance: robin-wordpress app.kubernetes.io/managed-by: Helm Show all	1 / 1	40 minutes ago	docker.io/bitnami/wordpress:5.4.2-debian-10-r36

1 – 1 of 1

References

https://kubernetes.io/docs/concepts/overview/what-is-kubernetes/

https://kubernetes.io/docs/tasks/tools/install-kubectl/

https://kubernetes.io/docs/tasks/tools/install-minikube/

https://github.com/helm/helm