

# Containers

Monday, December 1, 2025 11:01 AM

30% theoretical

70% exercise

Wherever possible take notes

What do you know about containers technology?

Once I build my app it need to be deployed in the cloud. On prem or may be another cloud.

Migration become always a challenge. Dependency. Os get different. Trouble shooting this kind of issue takes times.

This is kind of wastage in your development lifecycle.

Recent failure in the cloud.

Amazon failed azure failed.

Client will never understand

Once you build your application it should run every where as it is.

We want to run all your app on top of a single server.

There component are build using multiple language. Ai python frontend is in react node js I want to run this on top of a single server.

We don't want this

As micro service all the service will consume less resources. I can run all this app on top of one single server

Why you want to do faster deployment?

# Migration

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How easily can we migrate our application.

1. Light weight
2. It should only have all the dependency.

What is the size of an linux os. 4GB

How to curtail down the os size.

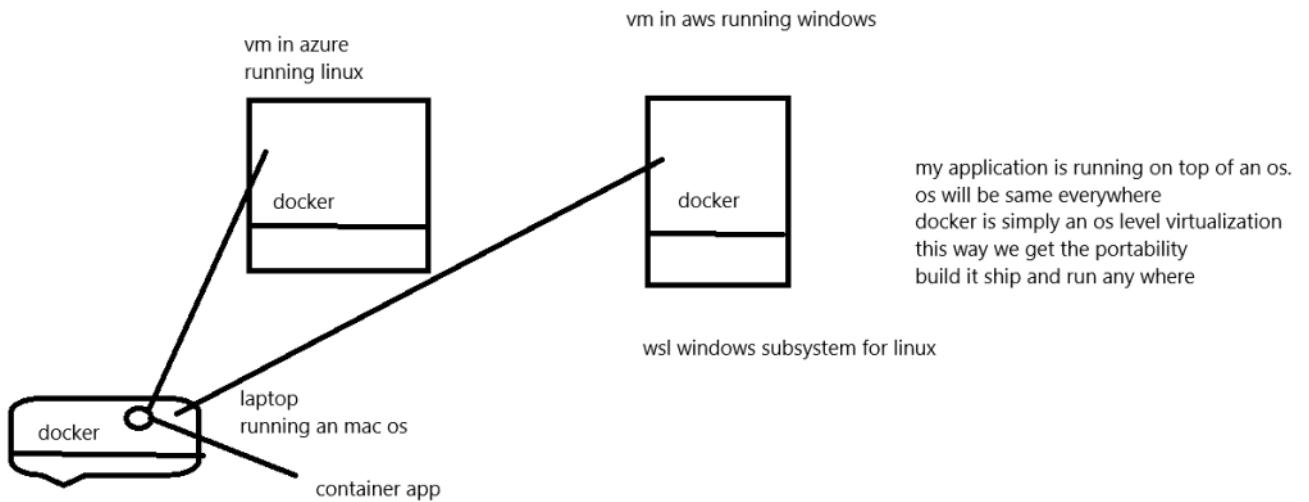
They have os light weight

Container always have an os but light weight.

But when we reduce our os size. Security will be always a concern

How to secure your k8s cluster.

If containers run on top of os. How the portability will work



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# Best practice

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Software Development Life Cycle.

The best practice to deploy your application is to have all the dependency library everything should be packed together

Build it ship it run anywhere.

Ikea

Box

Instruction

All the screw and tight those screw

1. Containers give you portability
2. Build it ship it run anywhere
3. Container are light weight they have os but with limited capability to run your application.

Image: it is always in rest state

1. Ship the application in a tar format
- Container : they are always in runnable state means we can interact with the container. They are also called as vm

Engine: when I run a container what we need cpu ram storage networking. How this cpu ram storage networking will be allocated to every single container is being take care by engine.

This engine shared your os level resources.

Registry: store

Runnable thing you stored in artifactory: jfrog nexus

File storage: read write

Object storage : it is read only storage

# Distributed state

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Inside my container we run web based application. Stateless. Which do not store client data. Between the session,

But there are statefull app.

Database

Application system storing the logs

Payment gw

Data need to be stored.

Container to store the data in shared or external storage

By default container are ephemeral in nature.

You stop your container start it data will be there

If you delete your container the data will be lost

In statefull app you need to storage.

Cloud business

When your vm is running they charge

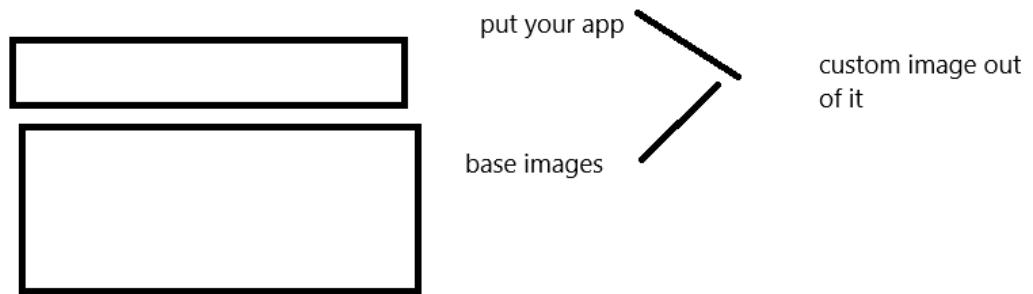
storage

# Demo

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1. Inside the vm we are going to install docker
2. Create some container try to access the same outside the network.

```
[root@ip-172-31-93-196 ~]$ docker container run --publish 80:80 --detach nginx
Docker container run will always create a new container for you. So we need to provide images for the
new container
Unable to find image 'nginx:latest' locally #it will give me that unable which means that this image is not
available locally
latest: Pulling from library/nginx : it will go to hub.docker.com and download the image
de57a609c9d5: Pull complete
53d743880af4: Pull complete
b5feb73171bf: Pull complete
77fa2eb06317: Pull complete
108ab8292820: Pull complete
192e2451f875: Pull complete
0e4bc2bd6656: Pull complete
137b08466659: Download complete
43536266b8d9: Download complete
Digest: sha256:553f64aecdc31b5bf944521731cd70e35da4faed96b2b7548a3d8e2598c52a42
Status: Downloaded newer image for nginx:latest
3ffca514ff7e9783e1d177951010d1524c58536558b9d784ce0f1348074c0eac #finally create a new
container for you
###
You build an python application or a go lang app.
You always want to make it runnable.
```



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Once your application build use an appropriate container image and create a custom image out of it.  
Docker will make you focus only on application

# Container vs process

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There are multiple containers are running how the isolation between this container work.

I start ppt I start crome

Process id

#lets verify that container are really running as process id

# Cg group and namespace

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Stop means gracefully shut down the container

Kill

Controll the resource allocation to your container

# How to login inside a container

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How to look into the logs and login inside a docker container.

We will create a docker db container.

Check the password

And using the password we will login inside the container.

# Volumes

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Why you need volumes in container?

You need persistent volume

I am running an mysql 8.1 version later on I want to upgrade to 8.2 version

I need to delete mysql 8.1 version download the latest image run my container with the latest image

Container are running as process id can process store our data.

When you want to create an persistent volume you need to put -v

mysql-db(this is the label of the volume:/var/lib/mysql #this is the volume path we have define inside my contianer

# Recap

Tuesday, December 2, 2025 10:11 AM

We learn about container and difference between container and virtual machine.  
Container is an os level virtualization some time we called as tier 2 virtualization  
Tier infrastructure level virtualization vm ware esxi host

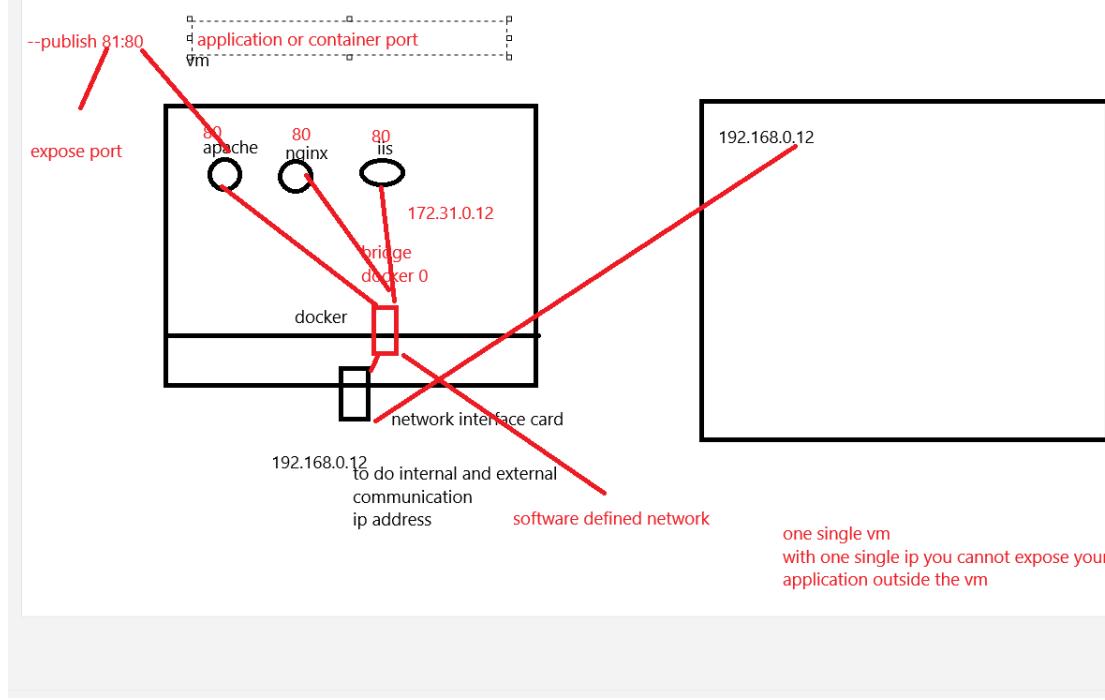
Containers gives you portability? It run on top of os.

Container give you isolation. Cg group and name space use process id.  
--detach process will make that process run as deamon.

## Networking in docker

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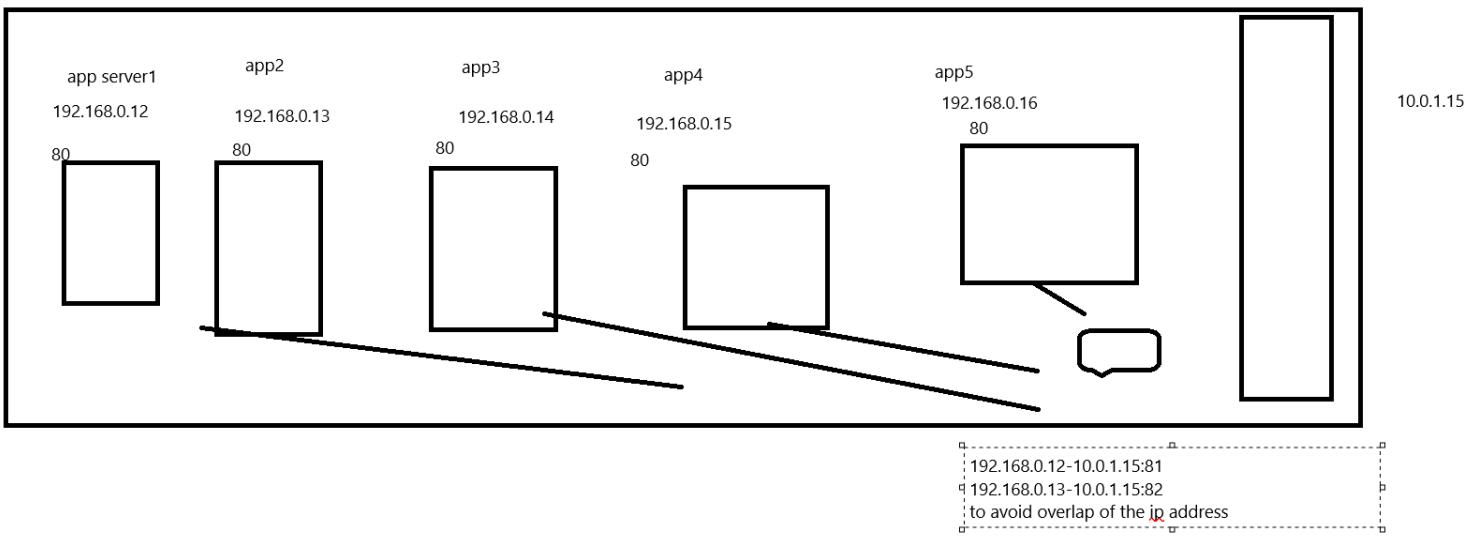
Port triggering  
Port forwarding



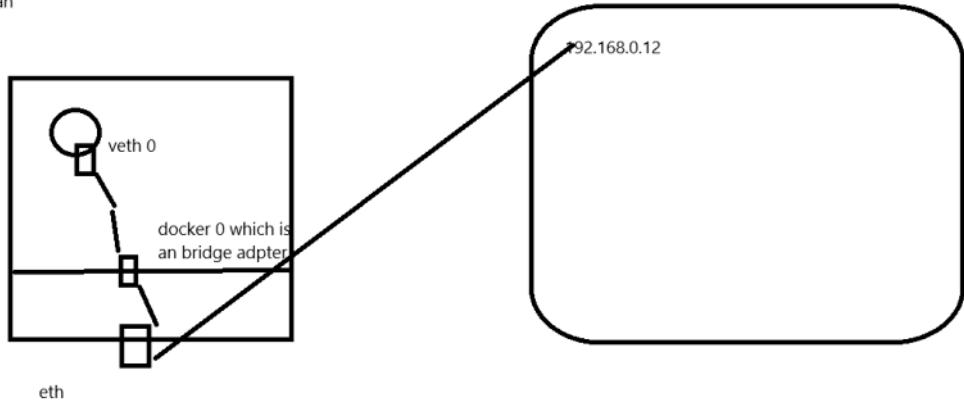
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port triggering

firewall



vlan



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# Container networking

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Container port

--publish 81:80 -container port

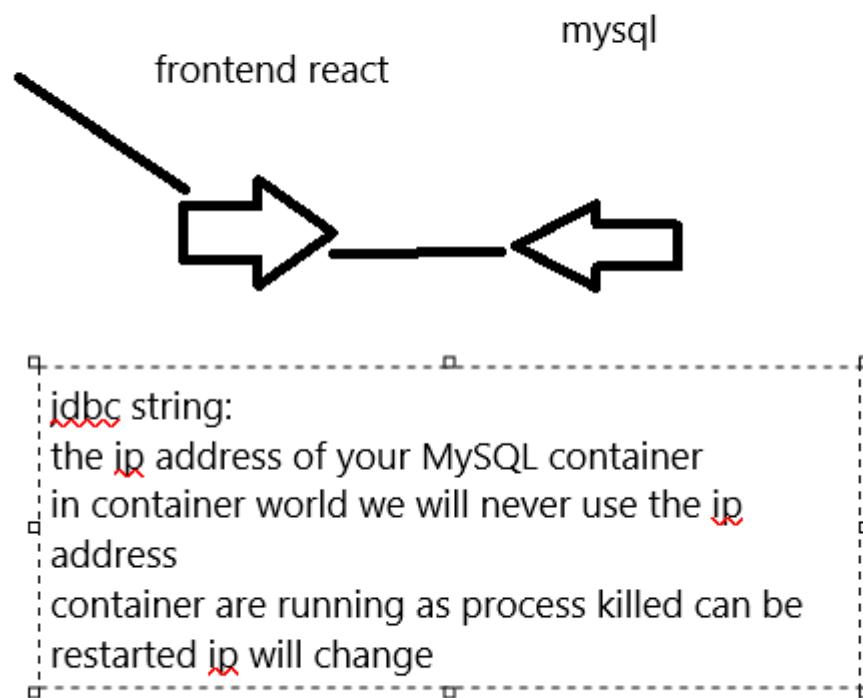
Container port is the port your application.

Application.properties : 8081

-p 81:8081

Flask 5000

-p 81:5000



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When you install container by default a dns server get installed so you need to always map your container with the name

# Images

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Till know whatever images we have use they are also called as base image.

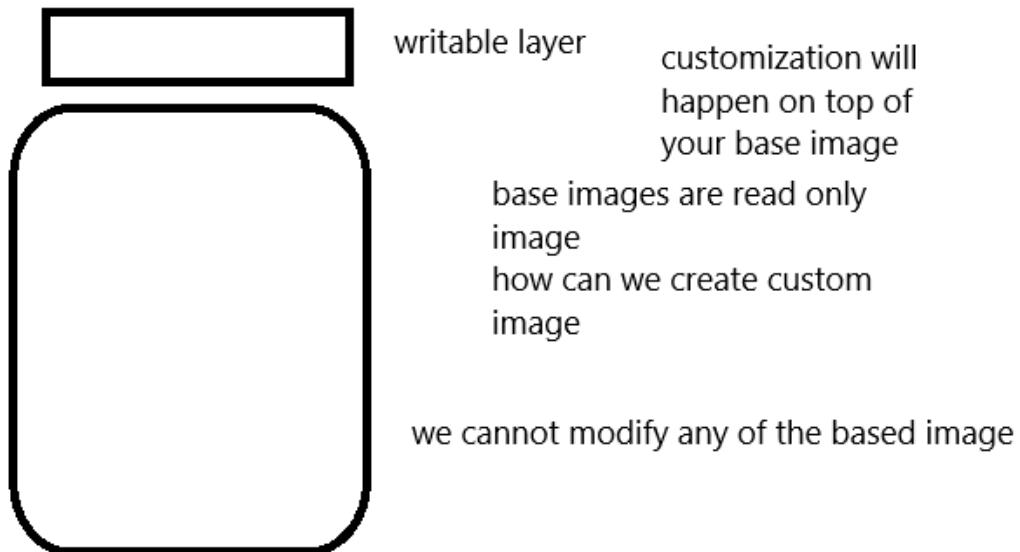
Python

Go lang

Nodejs application

Every this is already ready you just need to package your application on top of this base images.

Base images are readable images



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# Demo

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1. We will install openjdk
2. We will install maven
3. Clone an spring app
4. Inside the spring application folder we will create a docker file
5. Finally we will build the image and push it to a remote repo

## Demo 2

We will see how to create a multi build image

Compilation and creation on the image will happen using single dockerfile

This is an spring boot application.

What will be the base image your are going to use

All the instruction in docker file are given in capital letter

# Multi build image

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Stage 1: we compile the application using mvn clean package

Stage 2: we created the docker file and provide the instruction to build the image

I can compile the app inside the container

Once the jar file created I can run the jar file from the container.

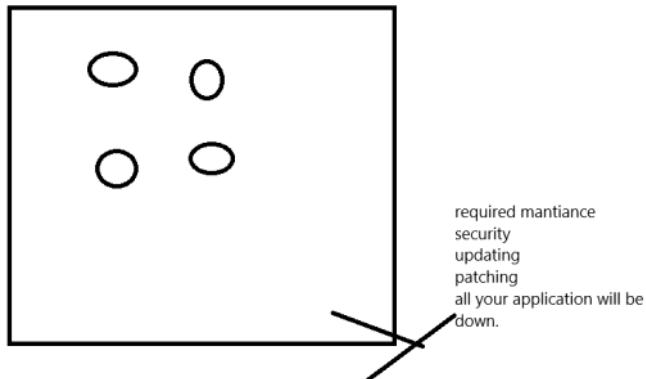
This way the benefit we are getting in the base machine we do not need to install openjdk or maven

Go lang or python

Everything will be completed with the docker file only

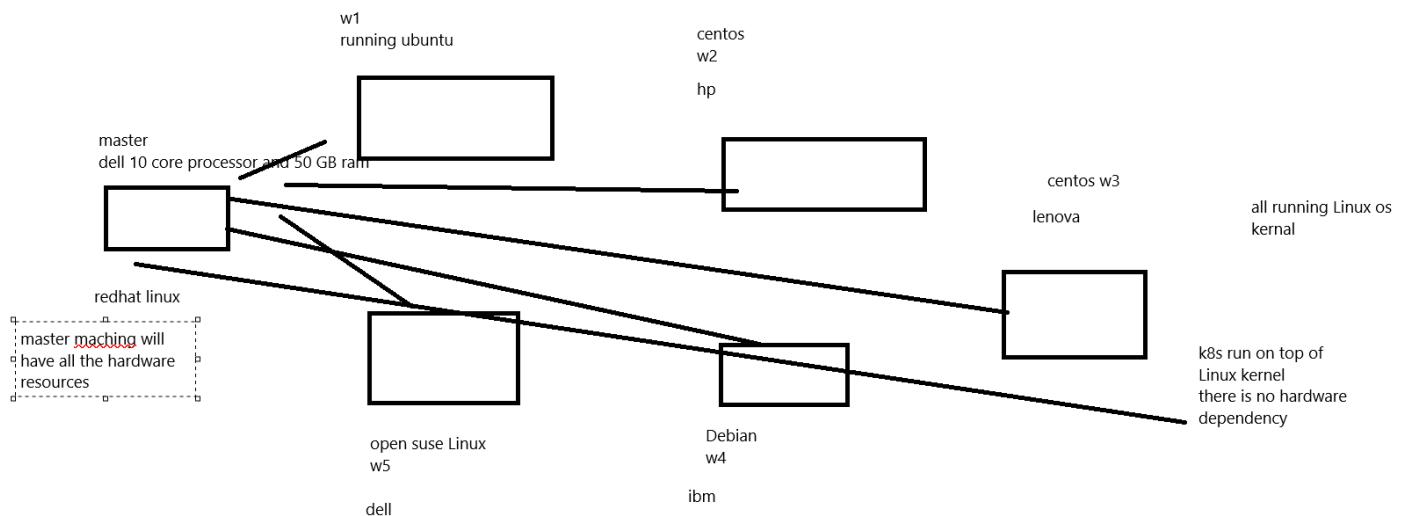
## Kubernetes

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We need an HA or resilient architecture.  
How to achieve zero downtime in container based application  
K8s comes into picture.  
What is clustering?  
If I can run my application on top of multiple nodes  
If one of the nodes goes down then also our app is always running.  
Application supported by multiple servers.

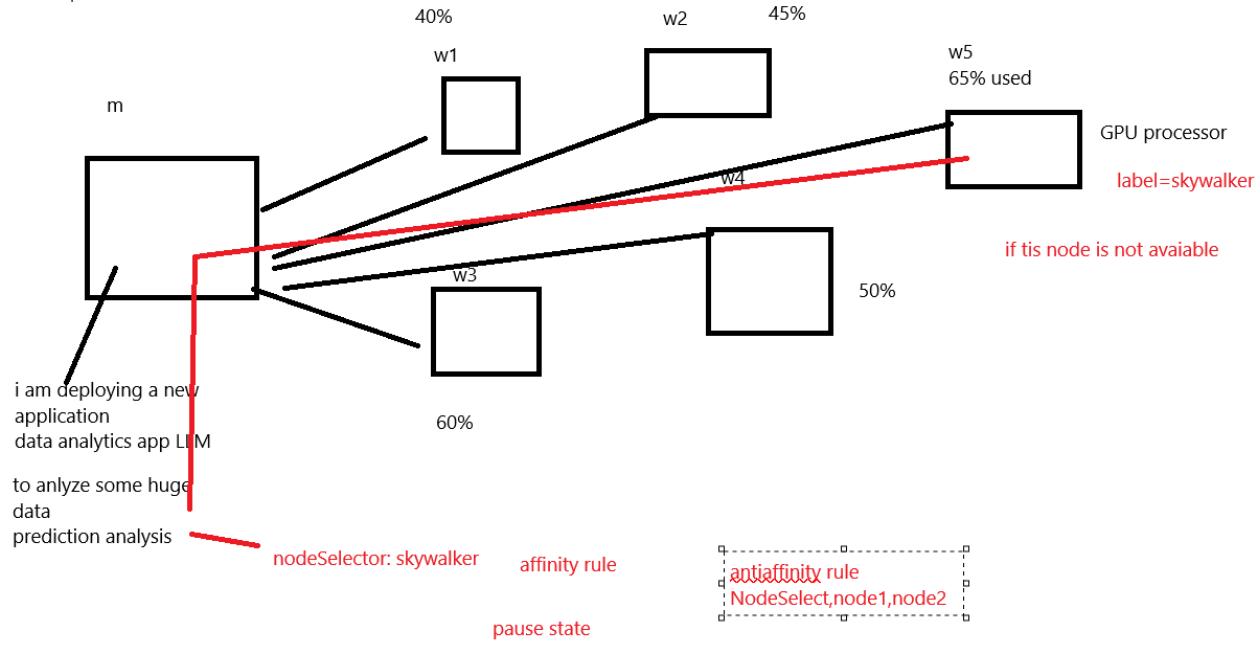


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## Container Run Time

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Container run time means docker  
January 2020 what happen pandemic has come.  
All the open source got bankrupt even docker also bankrupt  
Docker become a paid product k8s is opensource k8s cannot use docker engine.  
There are other container engines. 1.22 version they stop supporting docker.  
Containerd  
Crio  
Podman  
Runc  
Ctr  
Virtlet  
K8s do not support docker  
We need to use some other container engine  
Used to build images  
How to interact with your k8s cluster  
To interact with windows we use RDP  
To interact with linux ssh  
It always does API based communication.  
They have released k8s 1.35 version  
1.34 version they need to upgrade  
They need to take the backup of etcd  
Then only they will upgrade the cluster  
And restore the backup of etcd



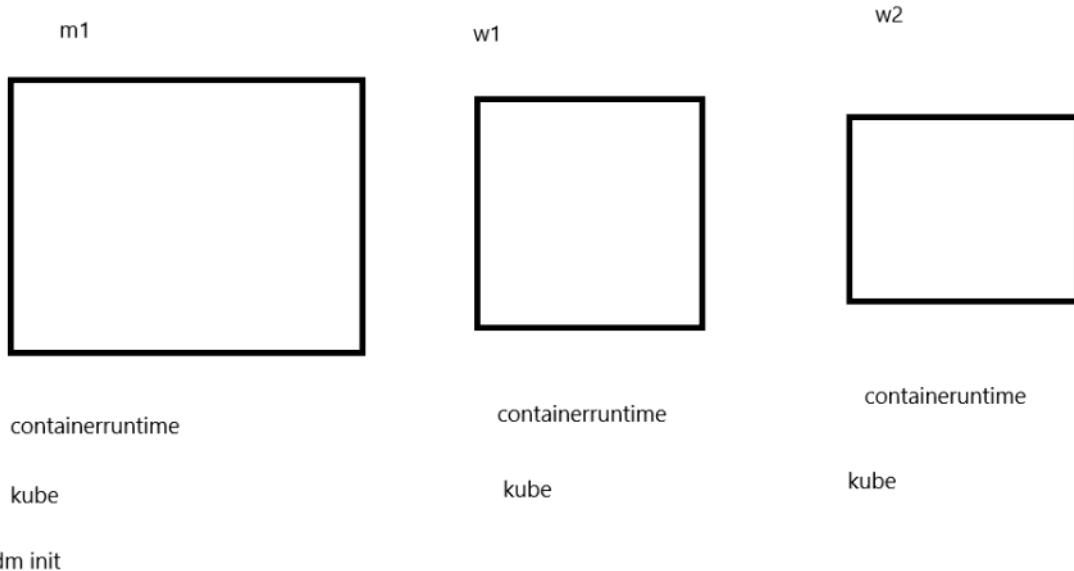
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## Kubernetes master and worker node installation

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Quite simple

If you have 8 Gb of RAM you can make it 16 Gb by combining HDD  
SWAP memory



kubeadm init

kubeadm init will make your master node as control plane

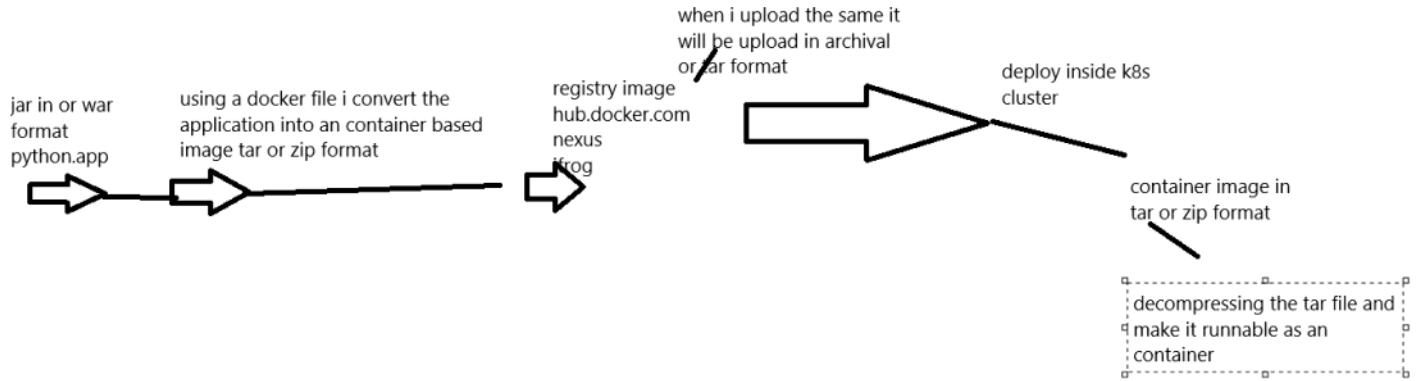
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I have created a shell script which will install all these packages

## Pod

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Inside your k8s cluster app the communication happen using api get put request http request  
Inside your k8s we are going to run an container  
Container are in image format which is like a tar format  
Pod is an api which will convert this image into an runnable object runnable container inside your k8s cluster  
It is a wrapper which help you to run your container workload



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# Yaml

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Inside your k8s cluster all the manifest you are writing it is in yaml format json

How to do indentation in yaml

Two spaces

1. In my hand I have a container image stored in a repo
2. I want to run this container image inside my k8s cluster
3. When we create a pod in your k8s cluster it is kind of vm we have created

To make it accessible outside your k8s cluster we need to create something called as service

Service clusterip nodeport load balancer

# Recap

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K8s architecture

K8s do not support any docker command line

Circtl ps crictl ls crictl image

All the component in k8s are running as contianer

# Pod in k8s

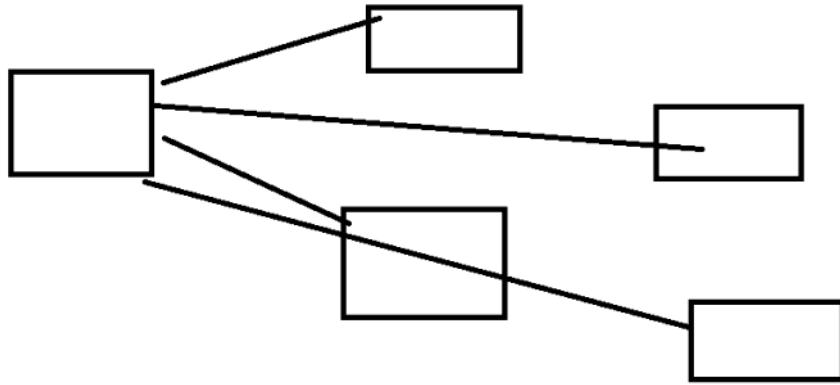
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It is an wrapper or it is an api which help me to run my container workload

Pod is used to deploy your container workload in k8s

## Namespace

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inside your cluster  
you want to create environment  
dev test staging prod  
quota management in this  
environment  
when a user logged in he will have  
access to dev environment  
RBAC  
network policy

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Logical separation of your k8s cluster.  
You have build an application for accounting purpose .  
I am an individual person.  
Training business. 80 per year  
1 core money you are earning by sitting in your home.  
Who are the people envy us.  
10% I have to pay tax tds  
18% gst  
In a month I do almost 3 billing  
5 bills  
Zoho account package., 1200 per month

# Namespace demo

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1. We will create a namespace
2. Allocate quota in the namespace cpu ram how many pod you want to run

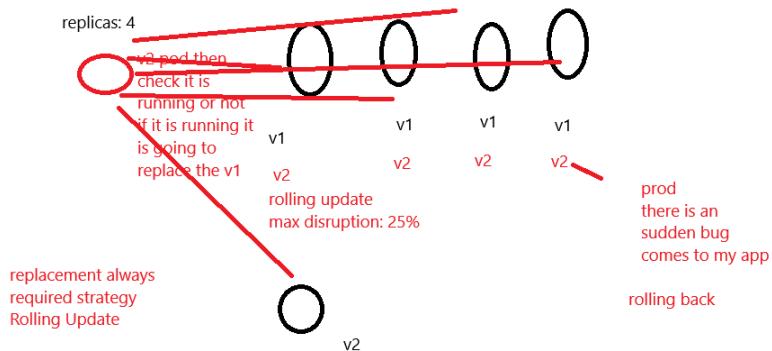
There are some pre defined namespaces

```
[root@ip-172-31-93-226 ~]$ kubectl get ns
NAME      STATUS  AGE
default   Active  18h #if you create a pod without the namespace it will always go inside default
namespace
kube-node-lease  Active  18h : used for node machine
kube-public    Active  18h: you want to create a pod and it should be available across your namespace
kube-system    Active  18h: all the system related packages run on
```

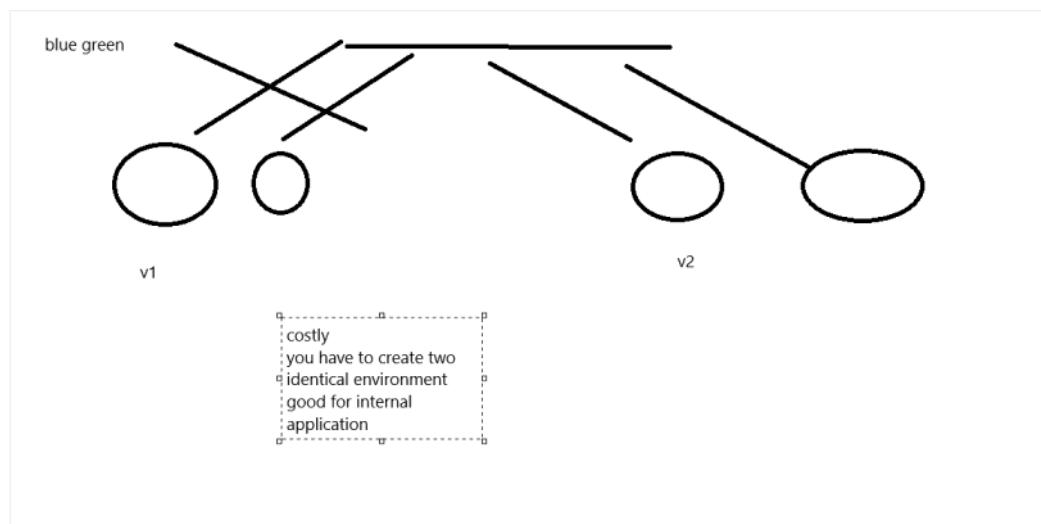
## Deployment

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I want to make my container ha  
To make your pod ha we need something called as Replicaset  
There is an api which can make your pod HA  
But managing two different manifest file is always a challenge  
Deployment: pod+Replicaset  
Replica: 1  
If I delete the pod it will come back  
Replica: 10 same pod will be created ten times.  
Declare the new state of the pod by updating the template

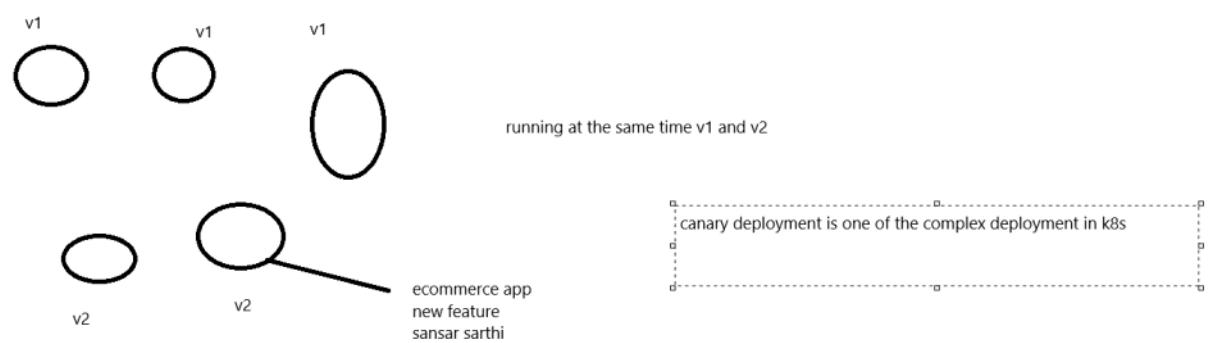


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## canary deployment



## canary deployment



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You need to learn about service mesh

Project as a Project Manager

You should always look into this strategy

Deployment also help you to do autoscaling

Kubernetes do propo scaling

5 if the utilization of the 5 pod goes more than 80% max 10

Add another 5 pod

7

## Service in k8s

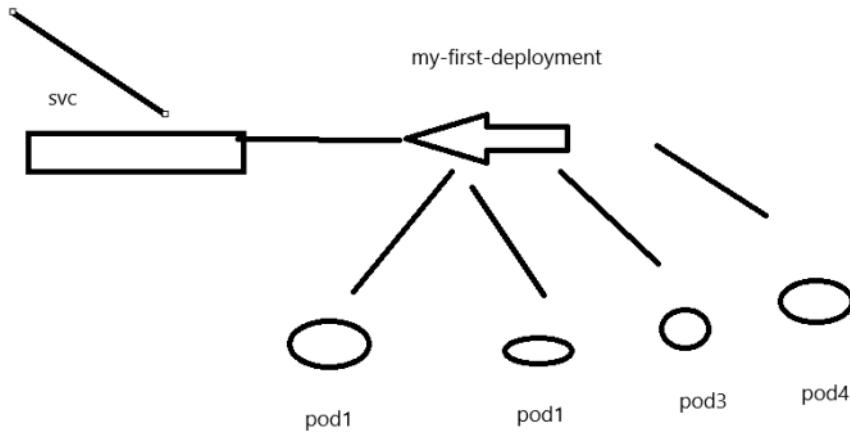
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Till know whatever pod we have created they are like vms  
You want to expose this application outside or inside your k8s cluster  
Kubeproxy

There are three type of services

1. Clusterip : when you want to expose your application inside your cluster internal networking
2. Nodeport: using node machine ip address and a port number we can access my application 30000-32767
3. Load Balancer: but it is available with k8s fully managed aks eks gke

We created a svc for our deployment down the line in the deployment we have 5 pods



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Just to show that same app can be exposed internally and external  
React based app: you will expose externally database with cluster ip  
From

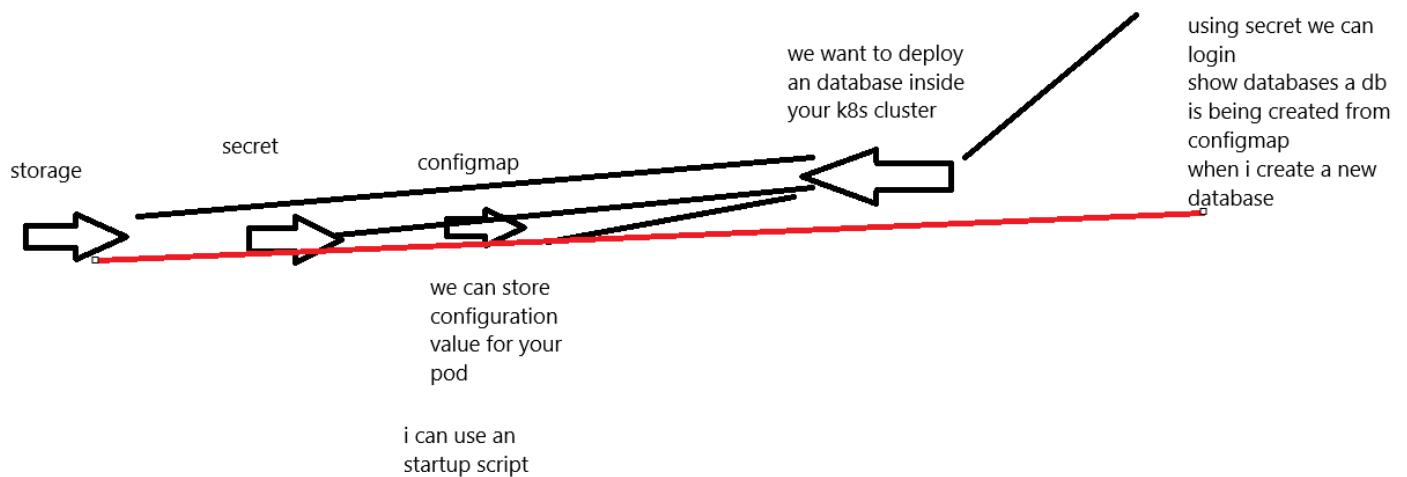
## Rolling update

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From the browser if I can see the ip address of the pod

Using deployment we can do rolling update

Currently



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## Storage

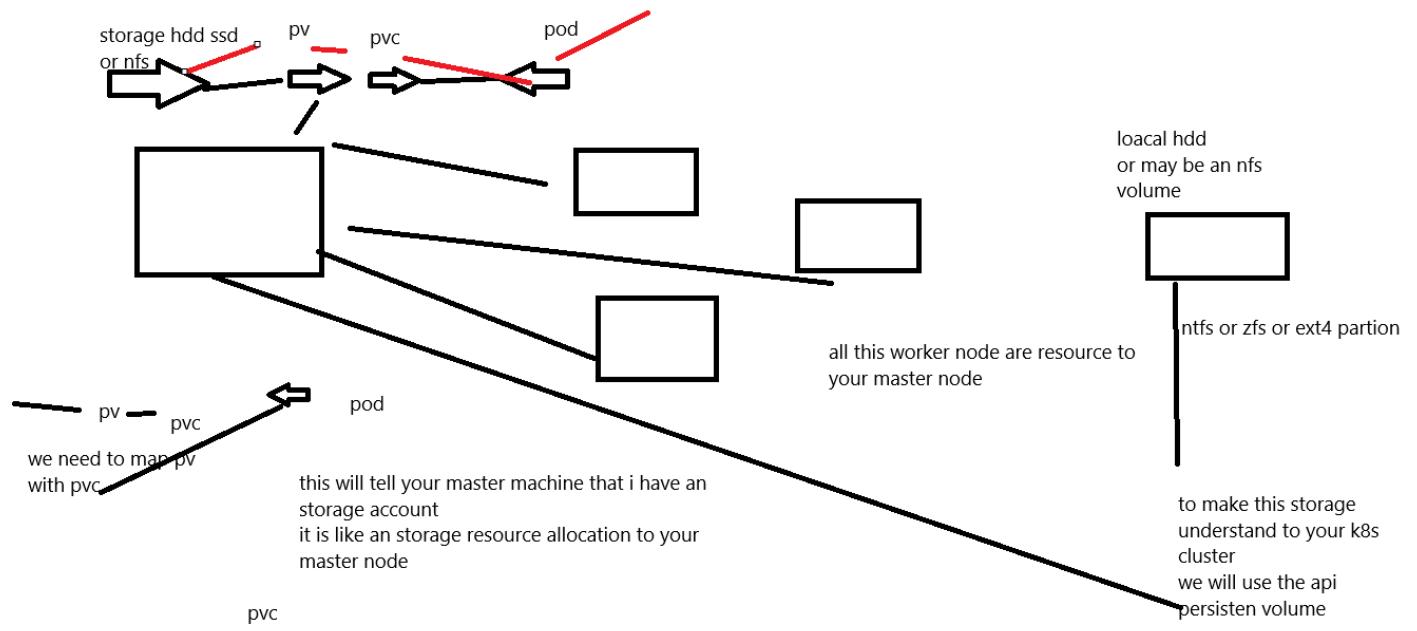
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To create storage in k8s we need to use two different api

Persistent Volume

Persistent Volume Claim

Why we are using two different api



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# Configmap

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Configmap: means we can store some configuration value or we can store startup script or boot strap script

Anything you store inside configmap will not be encrypted

Configmap can store maximum 1 MB of data.

# Mysql deployment

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1. Attaching volume with the pod
2. Attaching secret with the pod
3. Attaching configmap with the pod
4. Nodeselector affinity using the same I can run a pod in a particular node
5. Create database employee
6. This folder will be created in /mnt/data/employee

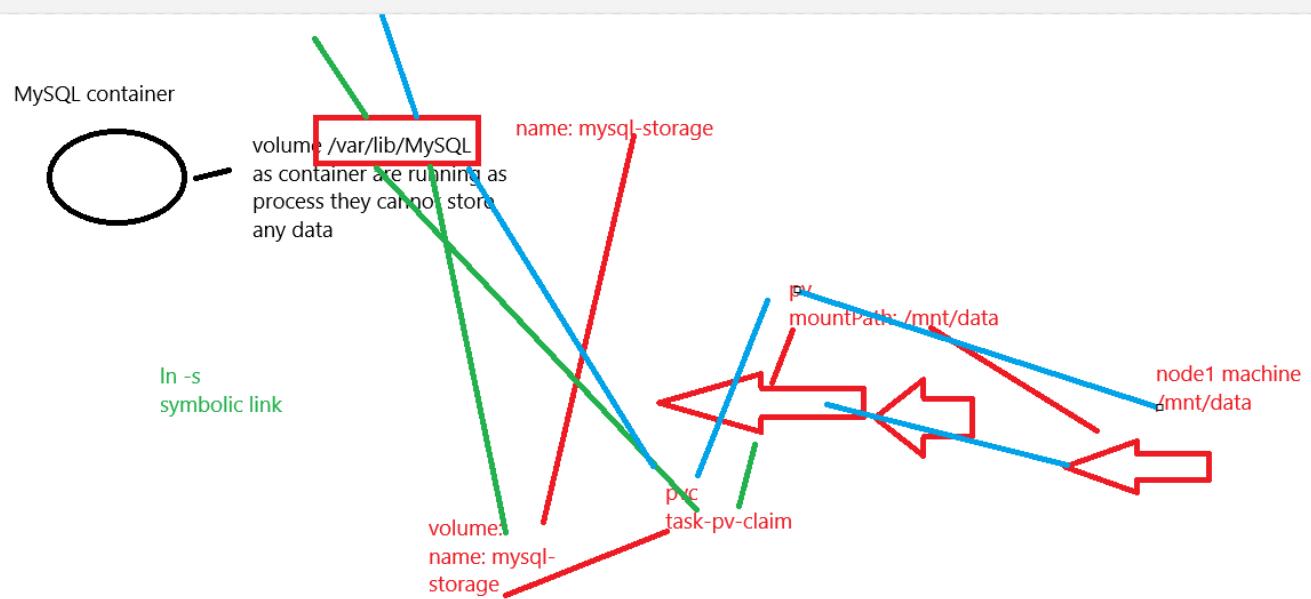
Argocd

## Recap

Thursday, December 4, 2025 10:16 AM

1. We want to deploy an mysql db
2. We need persistent storage
3. We created a directory in one of the node
4. We created persistent volume api. Administratively provision an storage account for your containers.
5. You build an app which collect customer in a log format and you want to run some analysis
6. You will always request an storage where you can store your data.
7. Node is kind of resource
8. Persistent volume is an resource to your k8s cluster.
9. Pvc : to use this pv we need to map it with PVC-then only I can attach my storage with your pod.
10. Config map: it is like an startup script. Whatever data you are storing in configmap it will be stored in unencrypted format. Config map max 1Mb of data can be stored.
11. Finally we have created a secret and stored my secret in base64 encoded format.

We will create an mysql deployment and attach pvc configmap secret  
Affinity rule where the pod is going to run on a particular node only.



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### Thin provisioning

In vmware the storage concept of thin and thick provision

Thick : 5 GB: will be allocated to a vm if the vm is using 2 GB

5Gb but I am using 2Gb

### Reclaim policy

Retain: default policy : if your pod got delete and another pod comes then also the storage will be there

Deleted: if you delete your pod the storage will be deleted

Recycle: you delete your pod the storage will not be delete but data inside the storage will be clean up

# Frontend

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We will expose the mysql database

Deploy an frontend application using spring boot and try to access the app.

# Statefulset

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Deployment is stateless  
One that retain the data.  
You also need stable unique identifier  
Stable persistent storage  
Order gracefully deployment and scaling  
Headless service

1. We will first create an headless service
2. Then we will deploy the storage solution
3. Then we are going to deploy the stateful postgress app

Without an cluster ip how the resultion inside your k8s cluster will happen  
From 1.22 version they have included a DNS service called as core dns  
Headless service is about internal dns resolution using core dns service  
Without the ip the frontend can communicate internally using dns name

Next activity

# CKAD

Thursday, December 4, 2025 2:53 PM

Certified K8s Application Developer 445 dollar

258\$

You will get 1 year to appear for the exam

Two attempts

Handson exercise

You will also get two simulator before you can go for your first exam

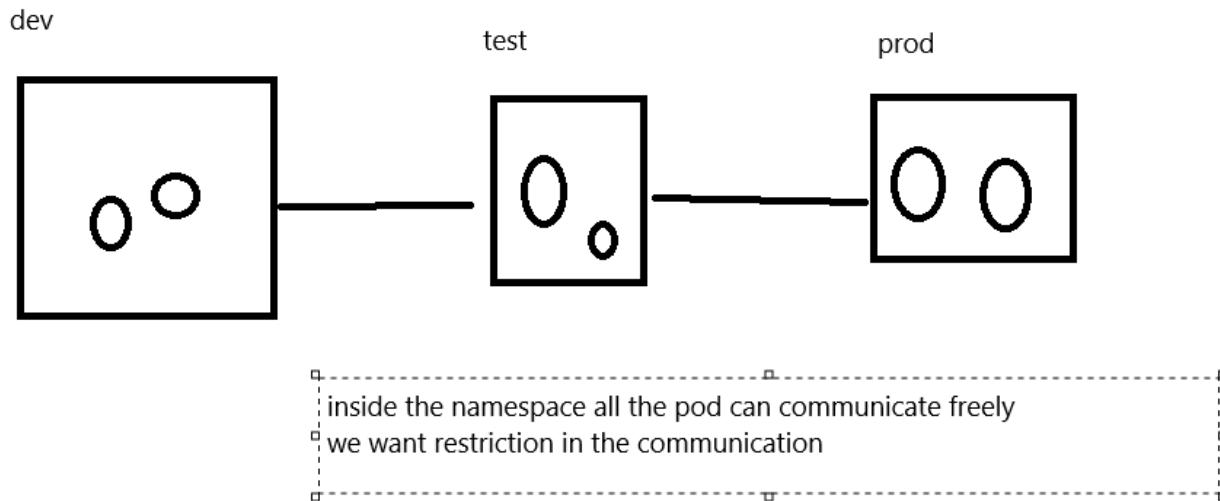
K8s certification is not an cloud specific

You can operate k8s in aws azure gcp tanzo vmware

# Network policy

Thursday, December 4, 2025 3:05 PM

What is the need of network policy.

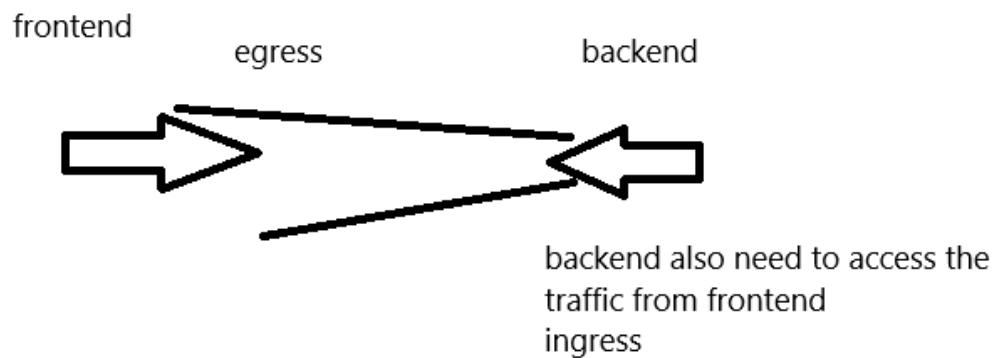


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# NP Demo

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1. We will create a namespace
2. Inside the namespace we will create two pod and see they can communicate with each other
3. We will create an deny policy in the namespace
4. Then test it the communication will be stopped
5. Exception
  - a. With the cidr ip range of your pod
  - b. Exception on namespace
  - c. Pod selector using the label
  - d. Port number also



1. frontend want to initiate traffic to backend : egress or ingress

inside namespace we will have multiple pod  
but how frontend is going to initiate traffic to the backend we  
need to create this exception  
how backend will accept the connection from frontend we need  
to create this exception

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1. We will create egress rule from frontend to backend

# Upgrade

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When you want to upgrade your k8s cluster first upgrade the master or control plane then only you can upgrade the worker node.

We need to drain the node.

It will disable the scheduling. No more pod is going to run inside this node