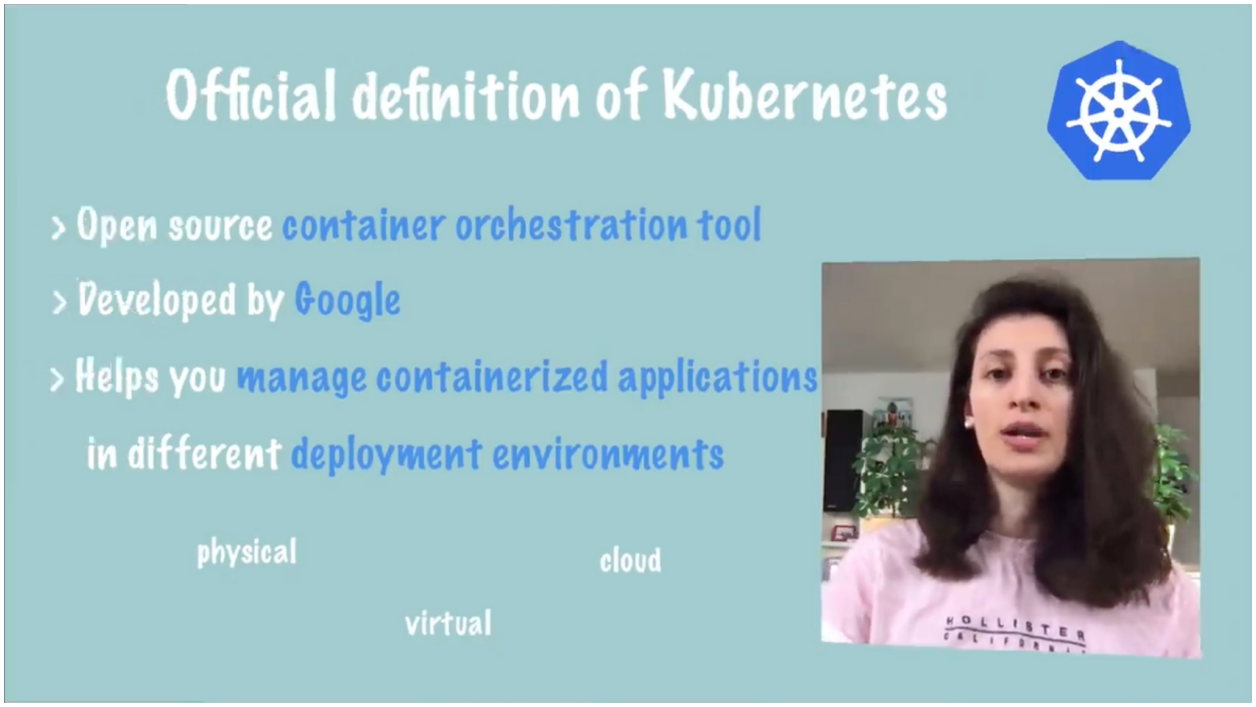
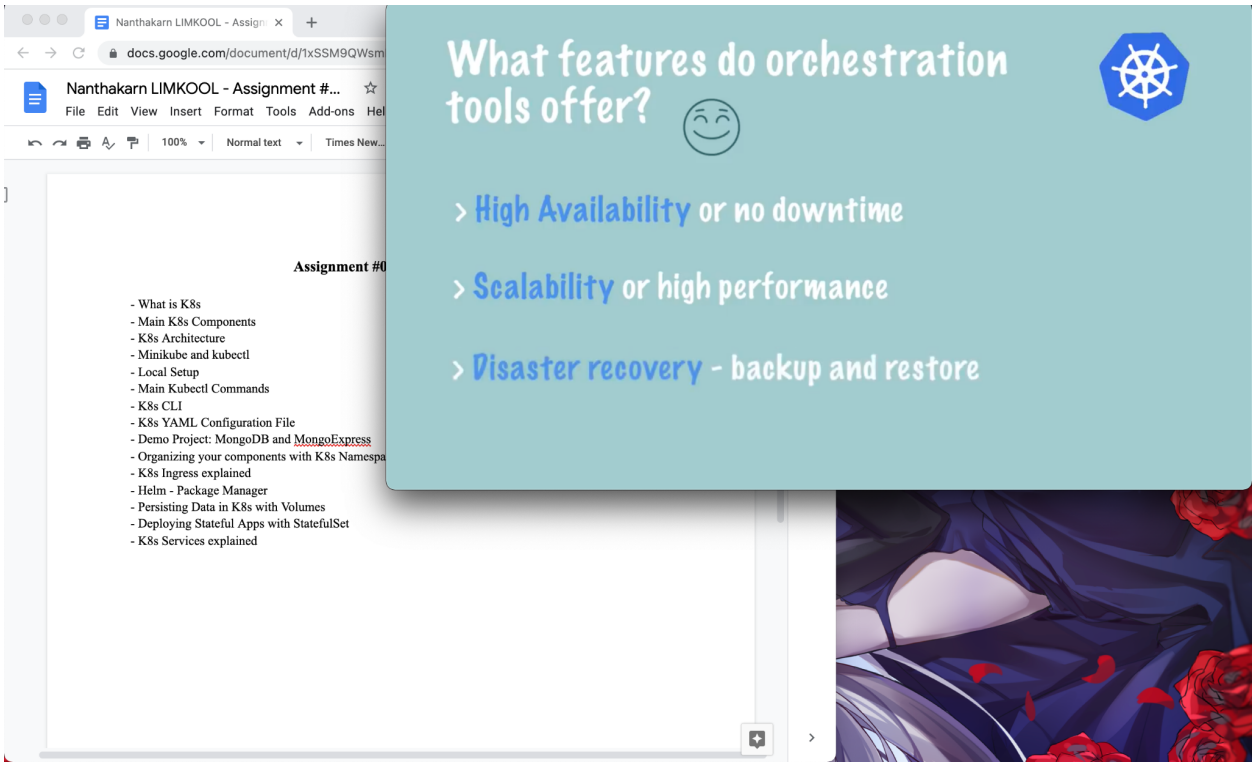
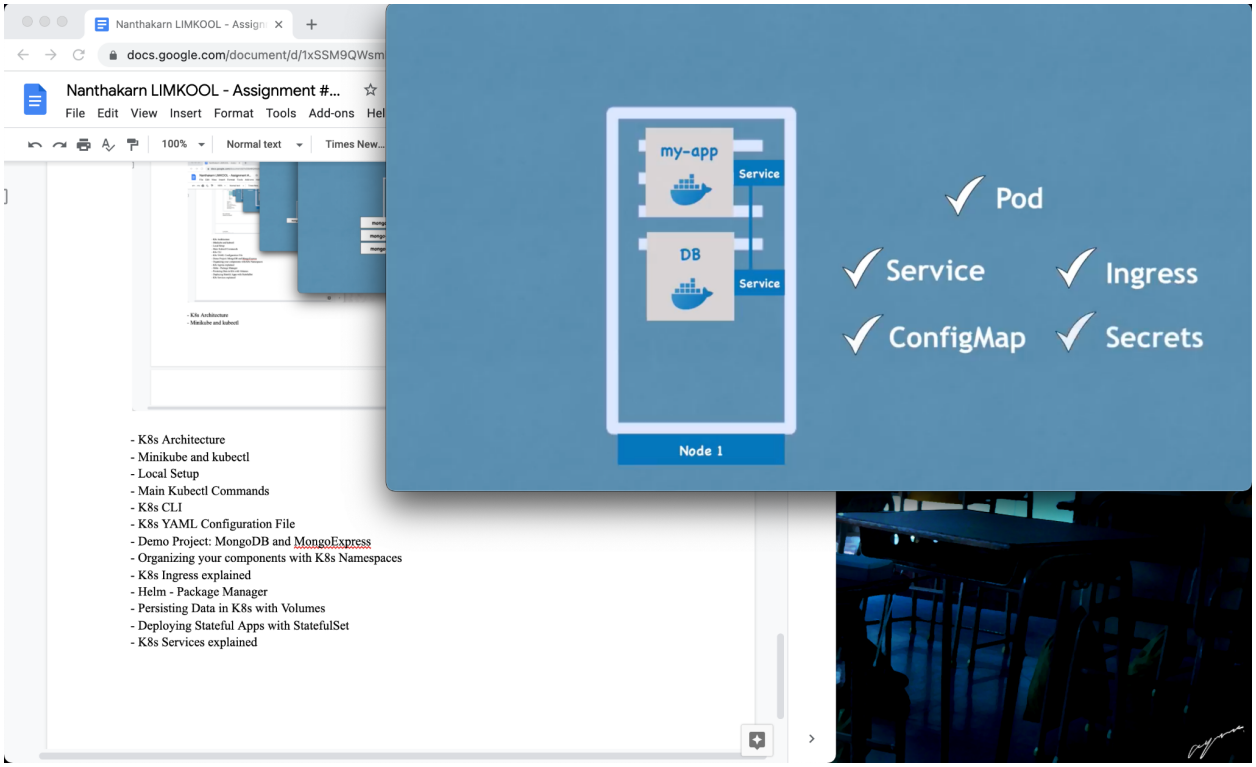
Assignment #08: Kubernetes Lab

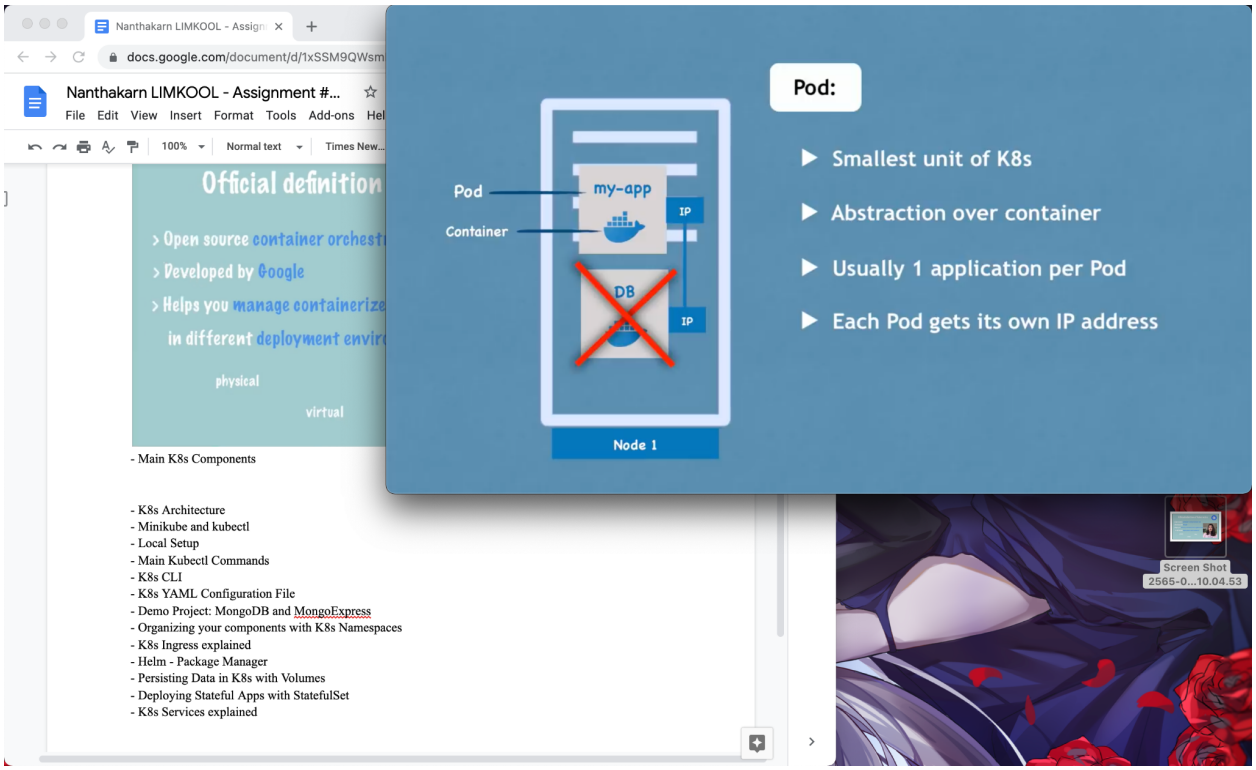
- What is K8s

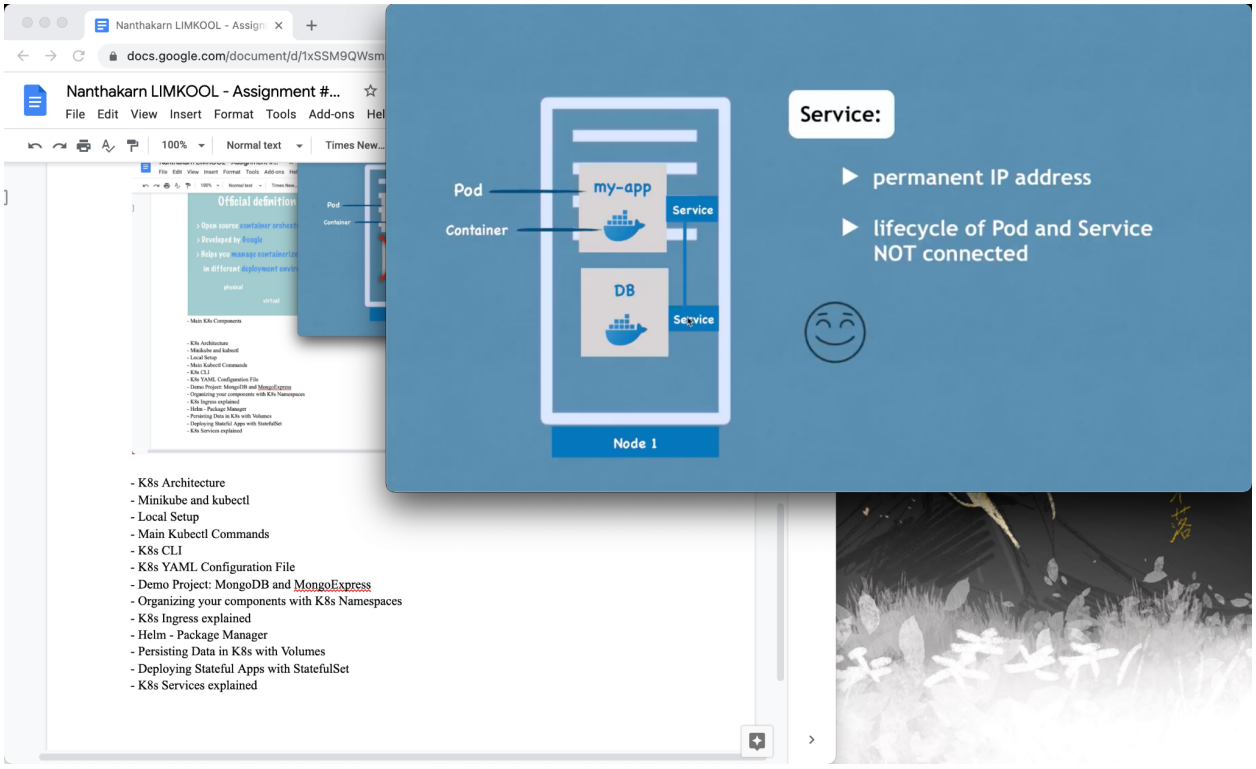




- Main K8s Components






Nanthakarn LIMKOOL - Assign
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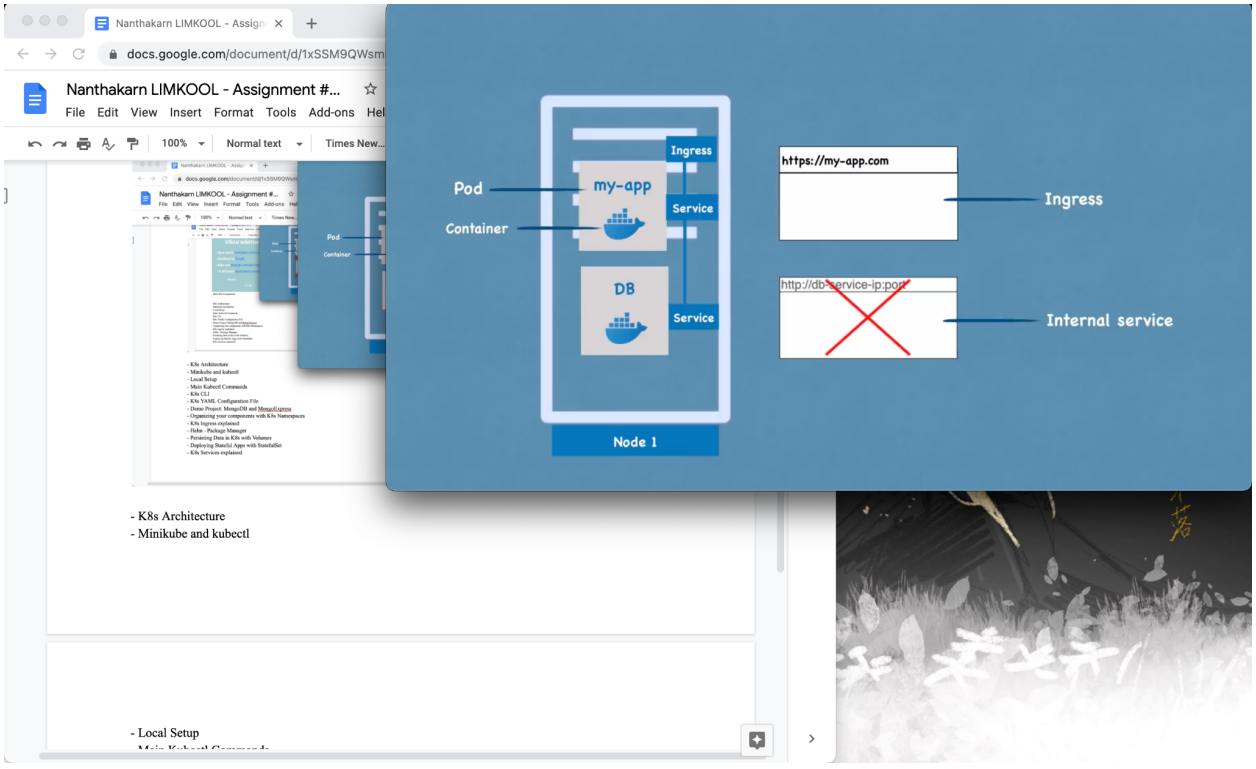
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
Normal text
Times New...
Pod
Container
my-app
Service
DB
Service
Node 1
Service:
permanent IP address
lifecycle of Pod and Service NOT connected
- K8s Architecture
- Minikube and kubectl
- Local Setup
- Main Kubectl Commands
- K8s CLI
- K8s YAML Configuration File
- Demo Project: MongoDB and MongoExpress
- Organizing your components with K8s Namespaces
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained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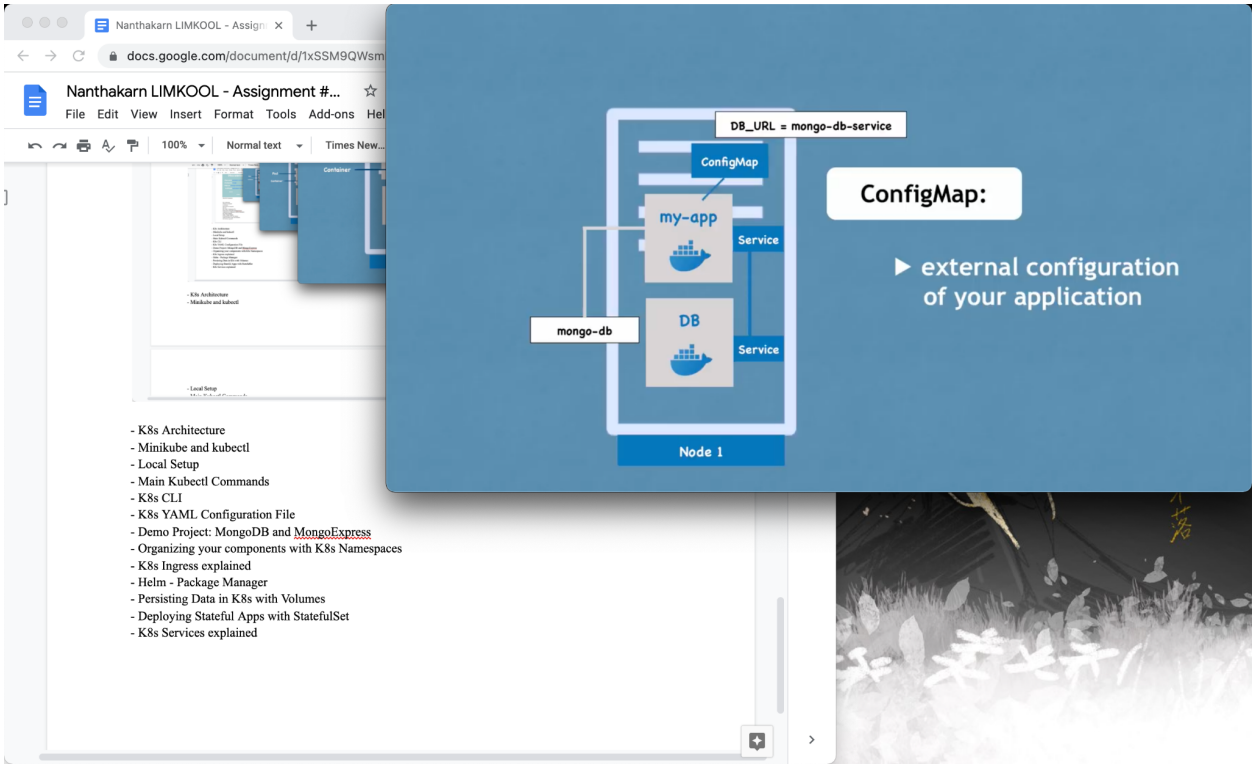
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
Normal text
Times New...
Pod
Container
my-app
Ingress
Service
DB
Service
Node 1
https://my-app.com
Ingress
http://db-service-ip:port
Internal service
- K8s Architecture
- Minikube and kubectl
- Local Setup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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100% Normal text Times New...
DB_URL = mongo-db-service
ConfigMap
my-app
Service
mongo-db
DB
Service
Node 1
ConfigMap:
external configuration of your application
- K8s Architecture
- Minikube and kubectl
- Local Setup
- Main Kubectl Commands
- K8s CLI
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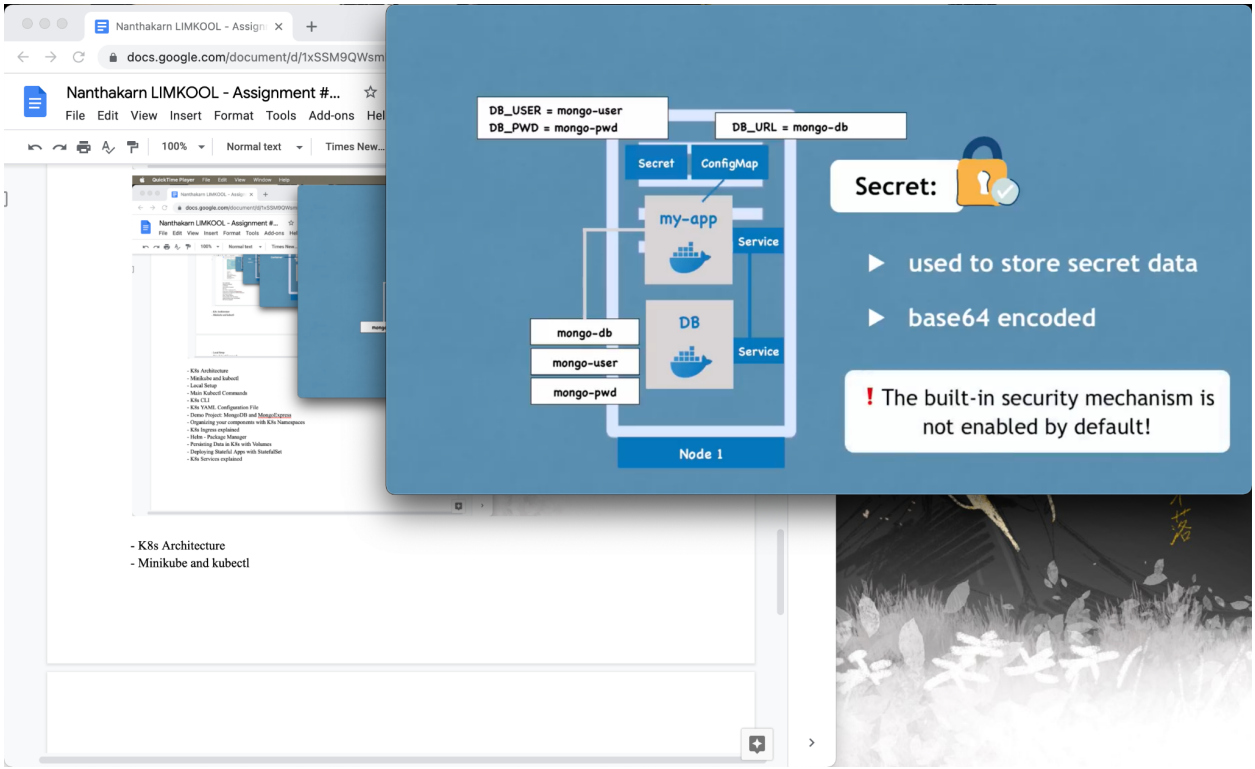
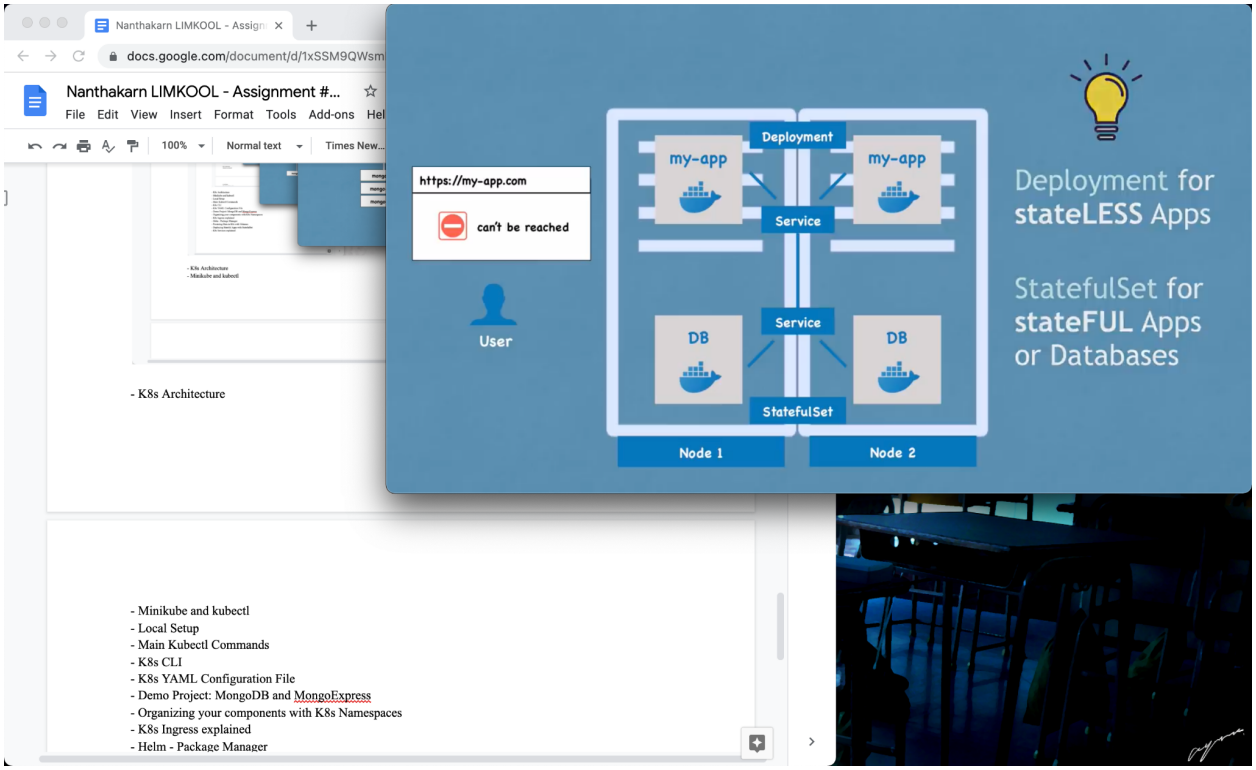
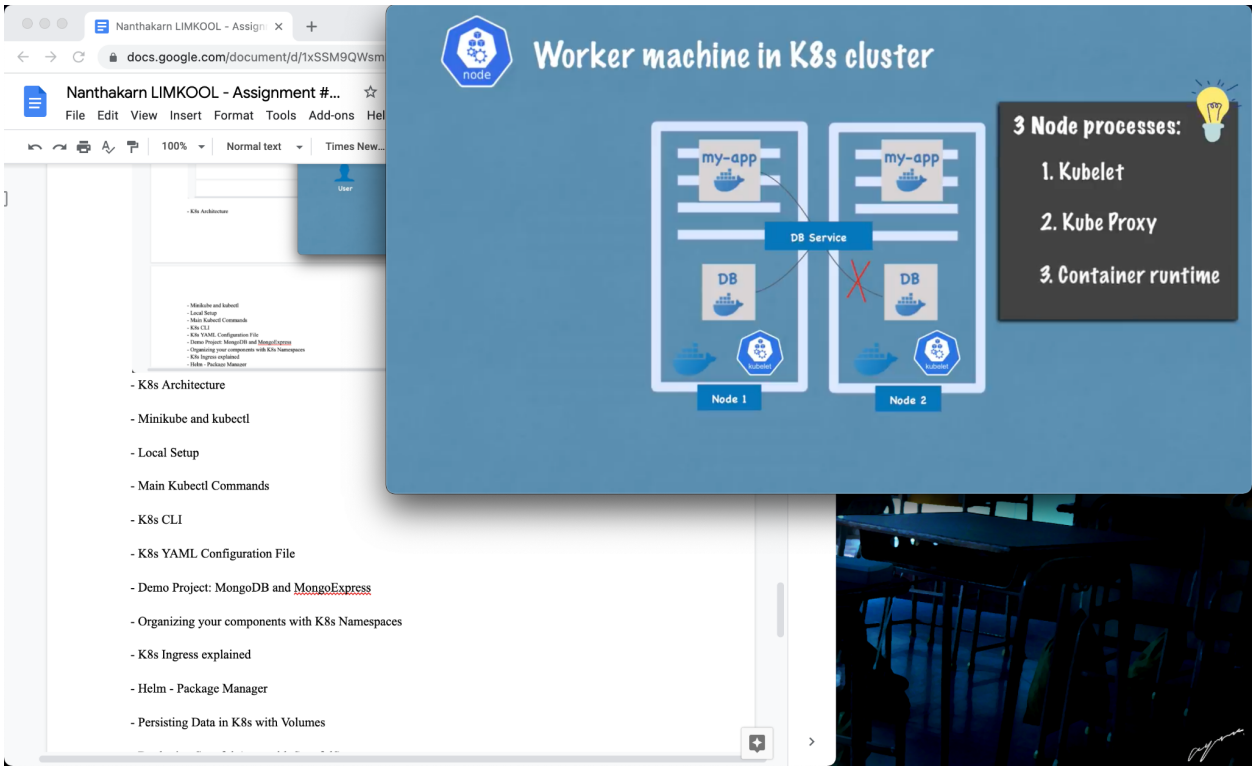
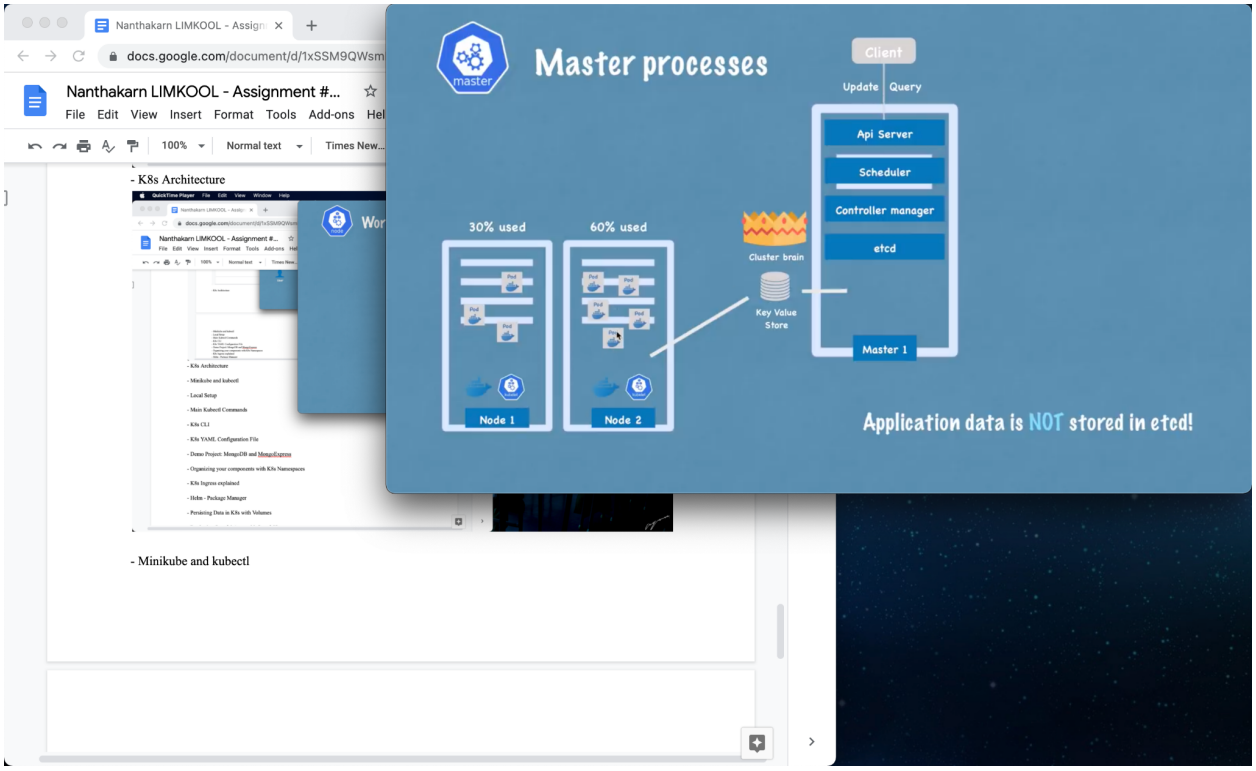
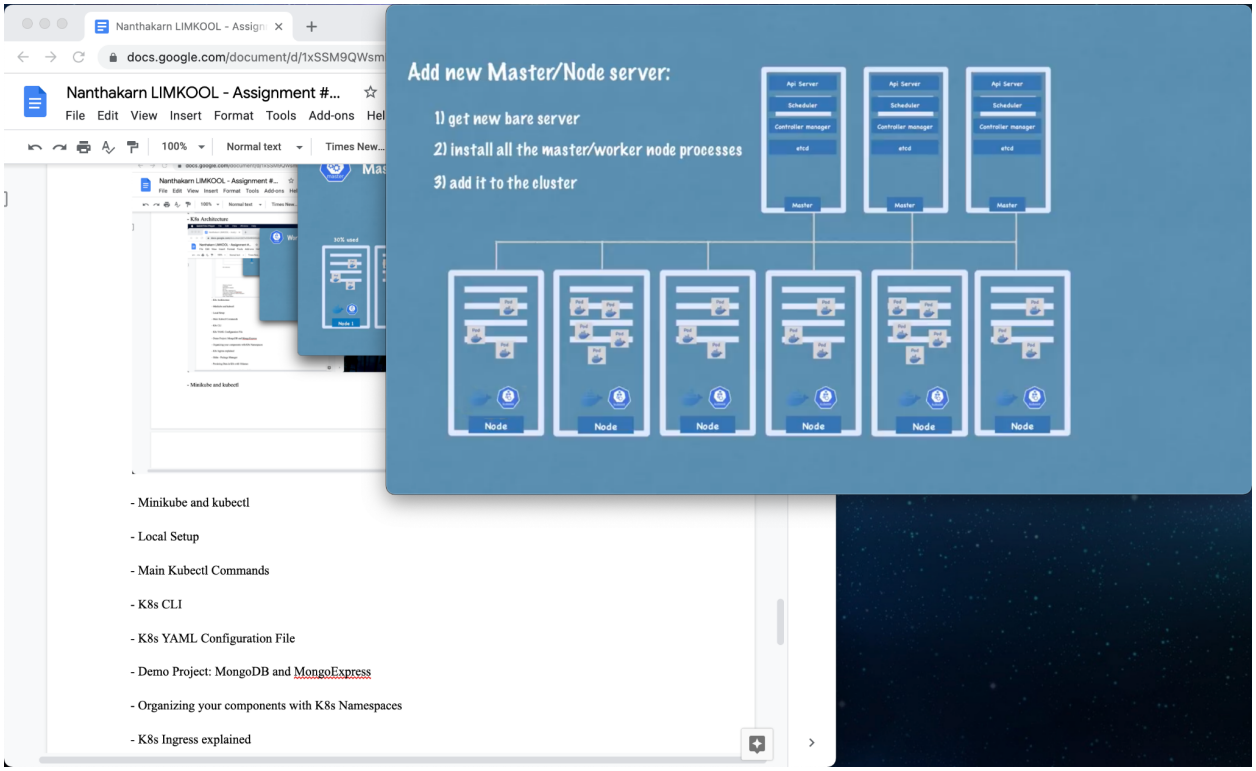

Nanthakarn LIMKOOL - Assign
docs.google.com/document/d/1xSSM9QWsm
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100% Normal text Times New...
DB_USER = mongo-user
DB_PWD = mongo-pwd
DB_URL = mongo-db
Secret
ConfigMap
my-app
Service
mongo-db
mongo-user
mongo-pwd
DB
Service
Node 1
Secret:
used to store secret data
base64 encoded
! The built-in security mechanism is not enabled by default!
- K8s Architecture
- Minikube and kubectl



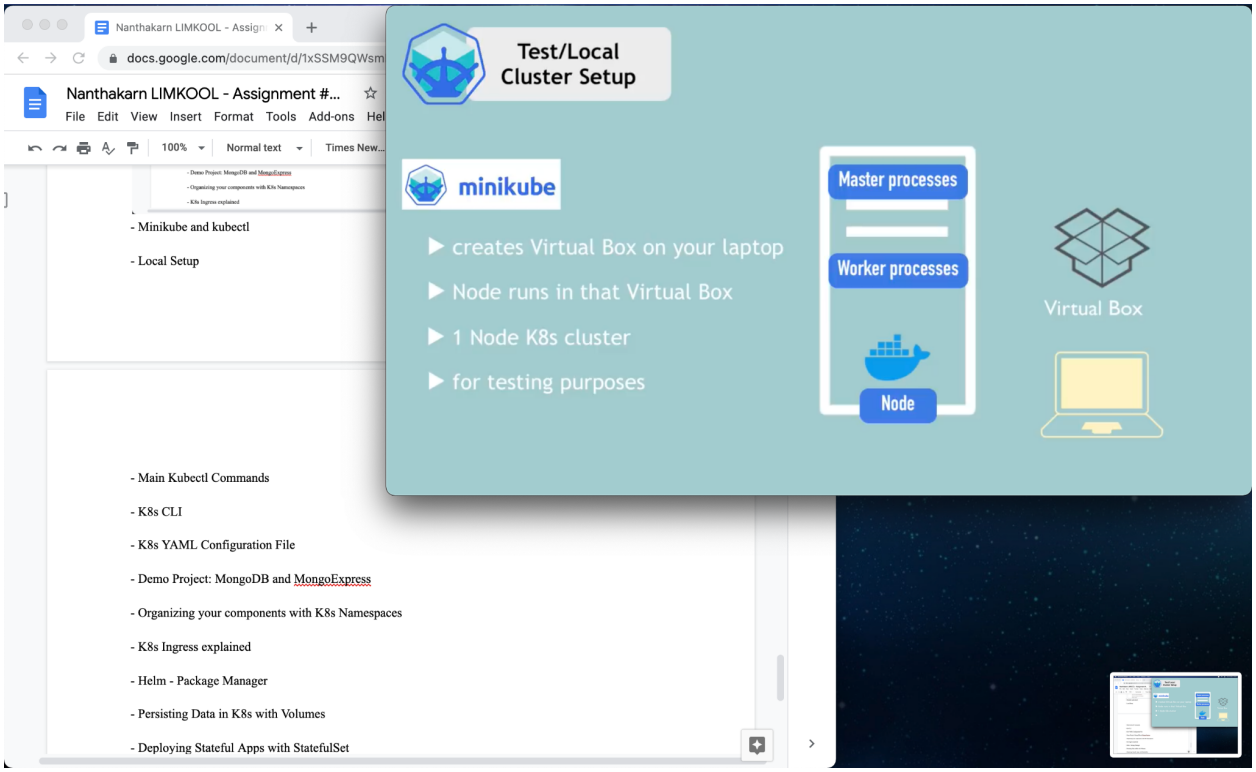
- K8s Architecture







- Minikube and kubectl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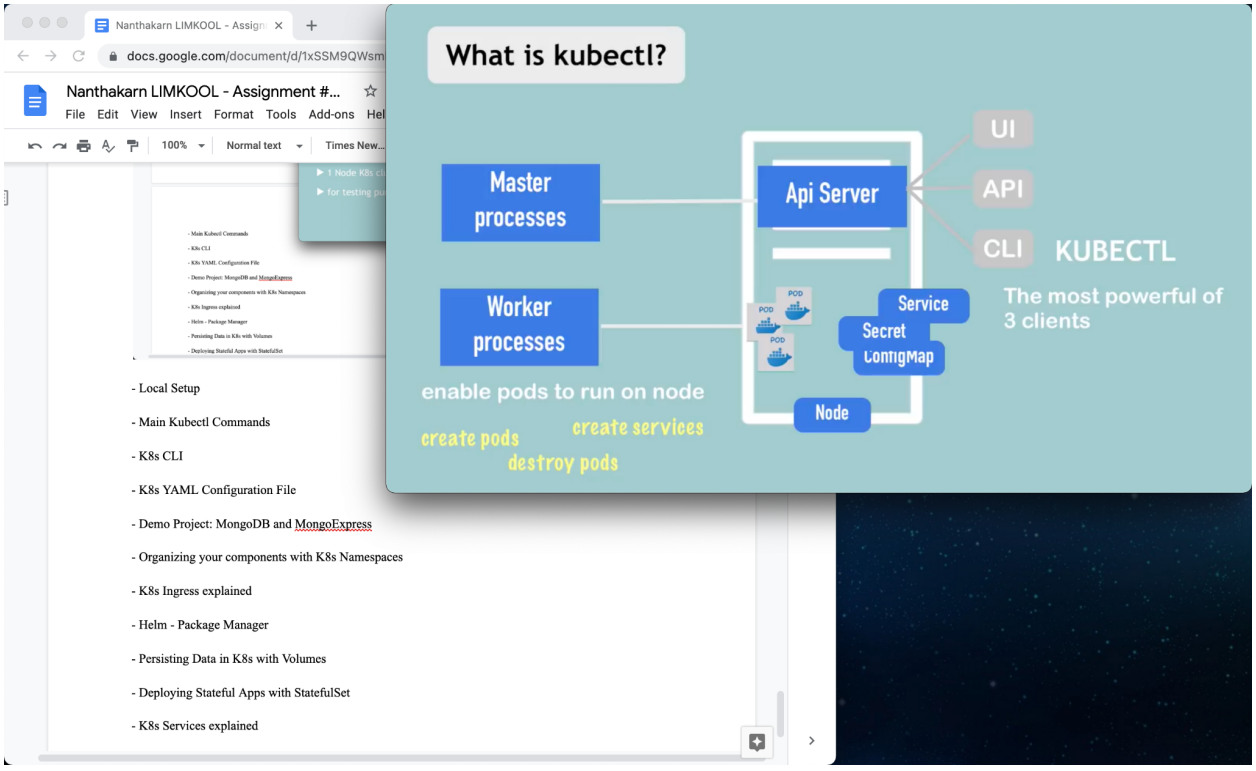
File Edit View Insert Format Tools Add-ons Hel
docs.google.com/document/d/1xSSM9QWsm
- Minikube and kubectl
- Local Setup
- Main Kubectl Commands
- K8s CLI
- K8s YAML Configuration File
- Demo Project: MongoDB and MongoExpress
- Organizing your components with K8s Namespaces
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
Test/Local Cluster Setup
minikube
creates Virtual Box on your laptop
Node runs in that Virtual Box
1 Node K8s cluster
for testing purposes
Master processes
Worker processes
Node
Virtual Box


Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
docs.google.com/document/d/1xSSM9QWsm
- Local Setup
- Main Kubectl Commands
- K8s CLI
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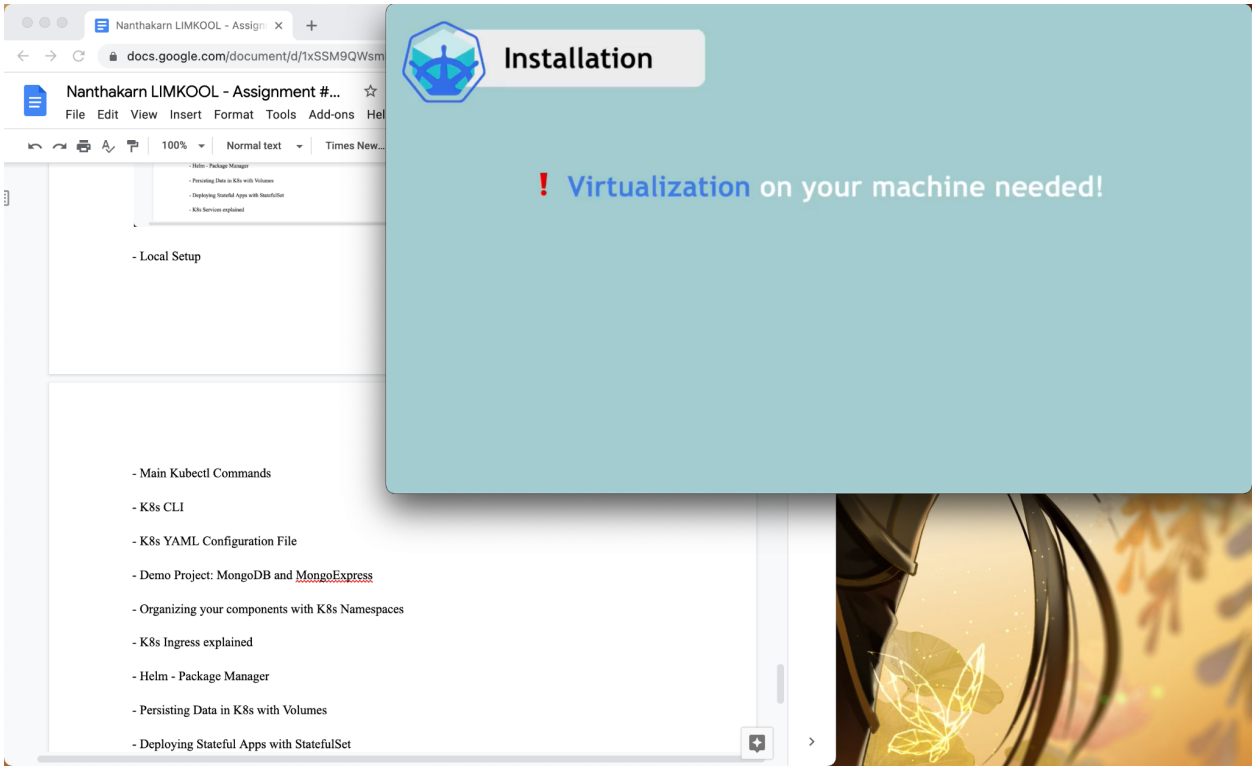
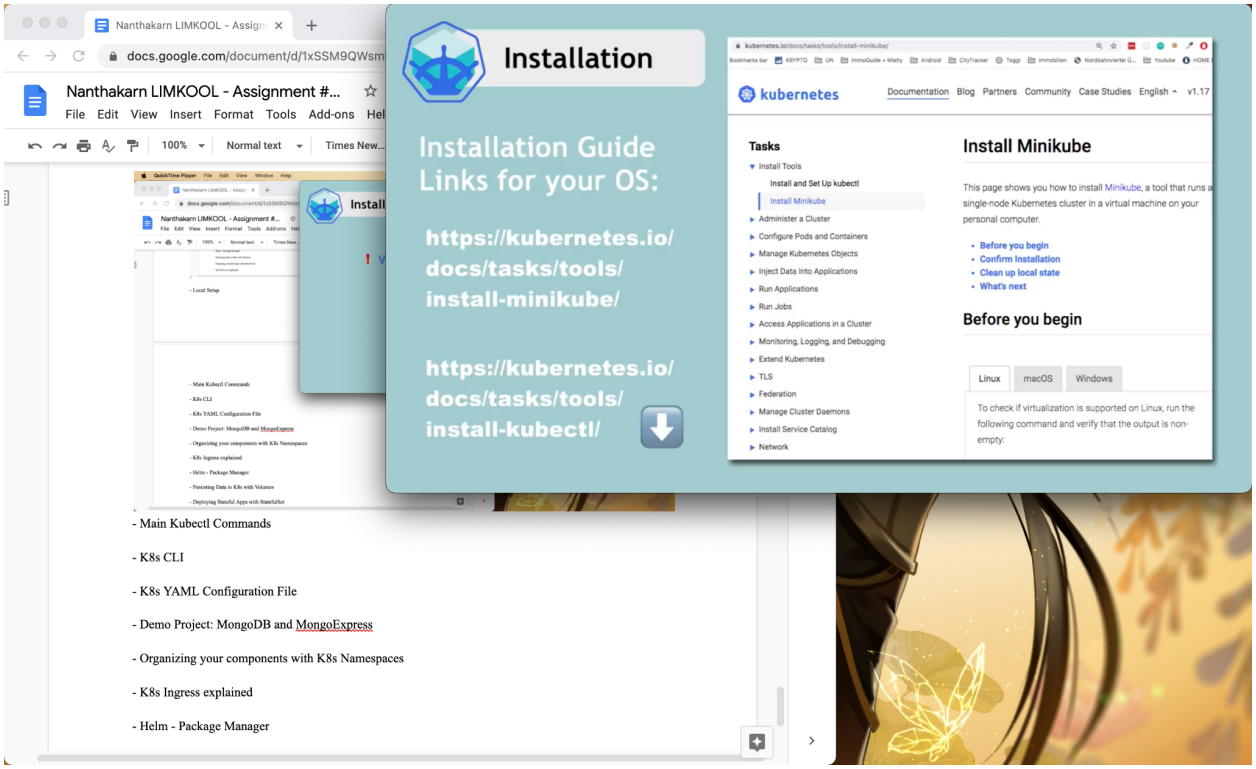
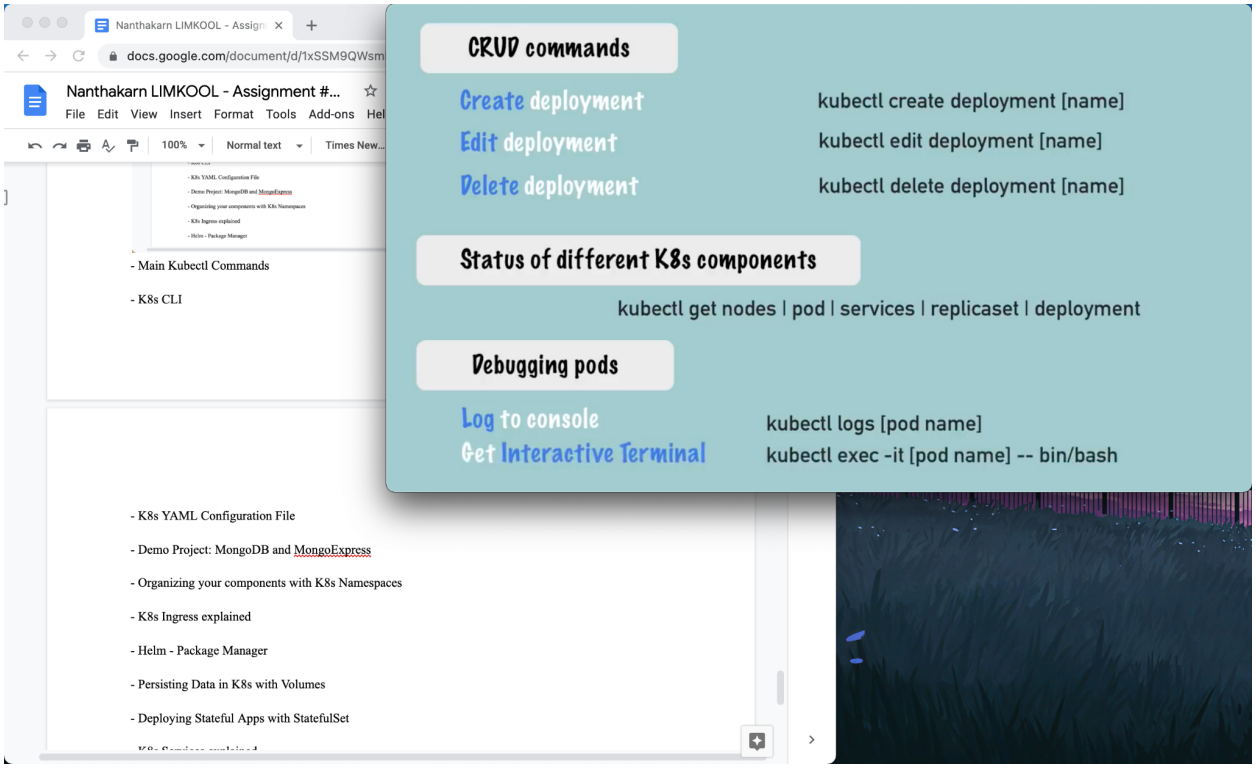
- K8s Services explained
What is kubectl?
Master processes
Worker processes
enable pods to run on node
create pods
destroy pods
create services
Api Server
Node
POD
Service
Secret
ConfigMap
UI
API
CLI
KUBECTL
The most powerful of 3 clients

- Local Setup

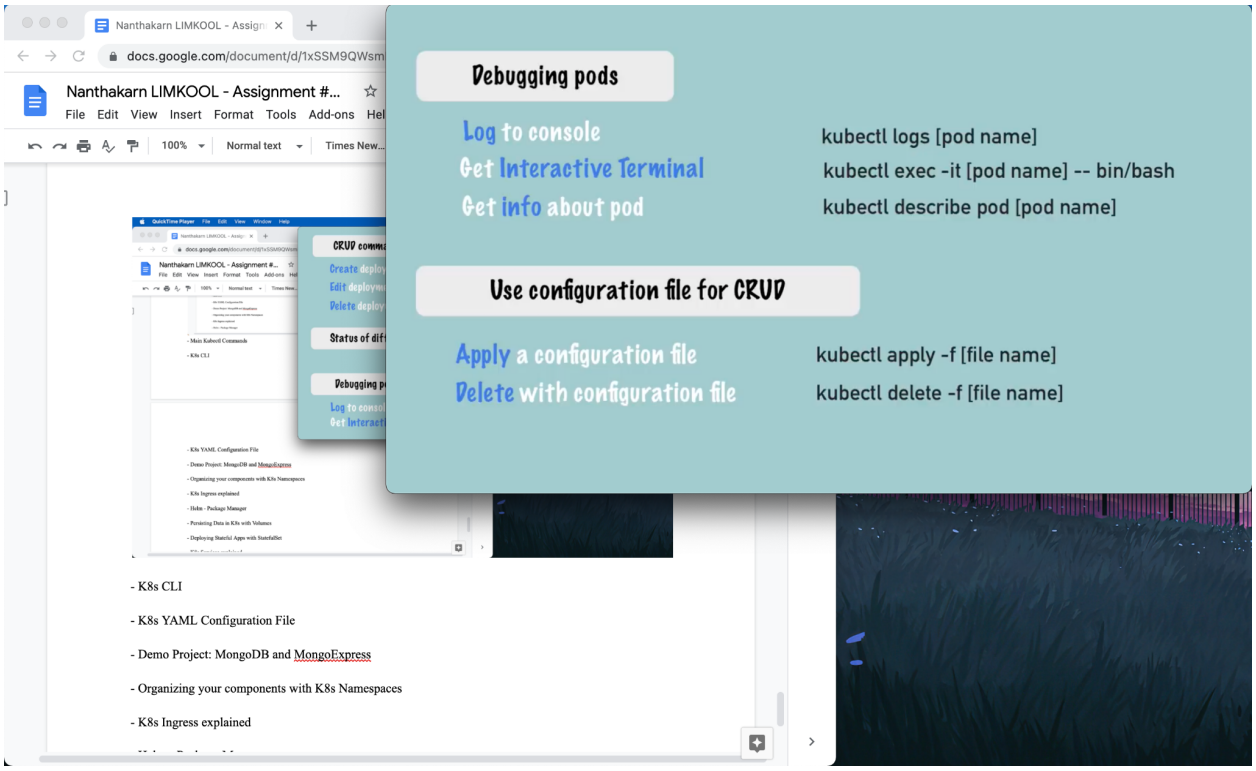




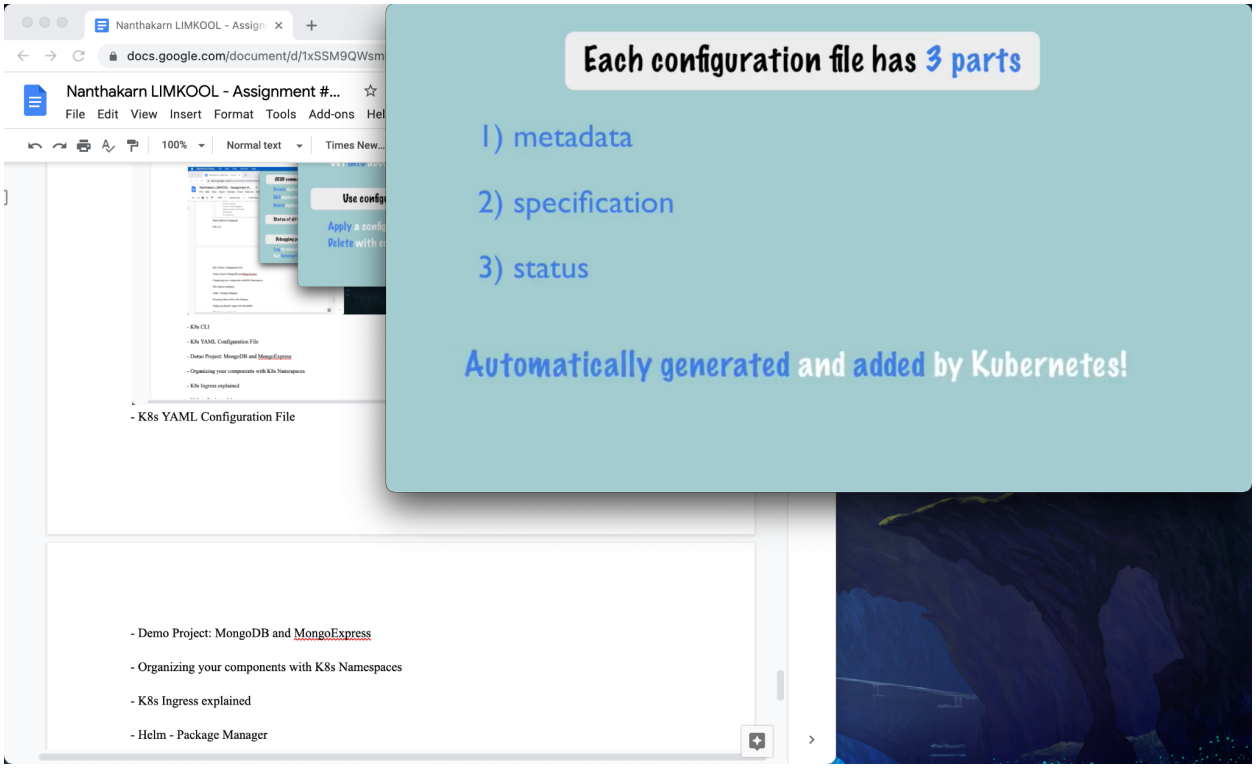
- Main Kubectl Commands



- K8s CLI



- K8s YAML Configuration File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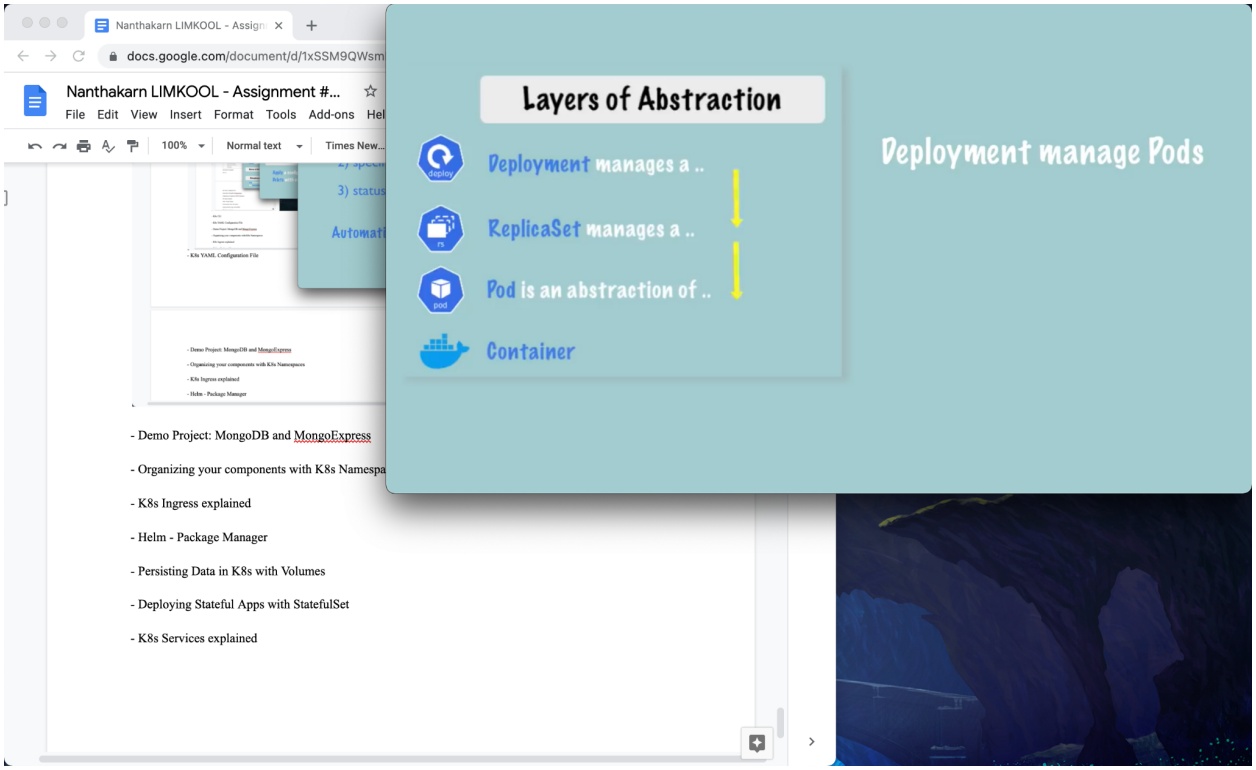
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
Normal text
Times New...
- K8s YAML Configuration File
Each configuration file has 3 parts
1) metadata
2) specification
3) status
Automatically generated and added by Kubernetes!
- Demo Project: MongoDB and MongoExpress
- Organizing your components with K8s Namespaces
- K8s Ingress explained
- Helm - Package Manager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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
Normal text
Times New...
Layers of Abstraction
Deployment manages a ..
ReplicaSet manages a ..
Pod is an abstraction of ..
Container
Deployment manage Pods
- Demo Project: MongoDB and MongoExpress
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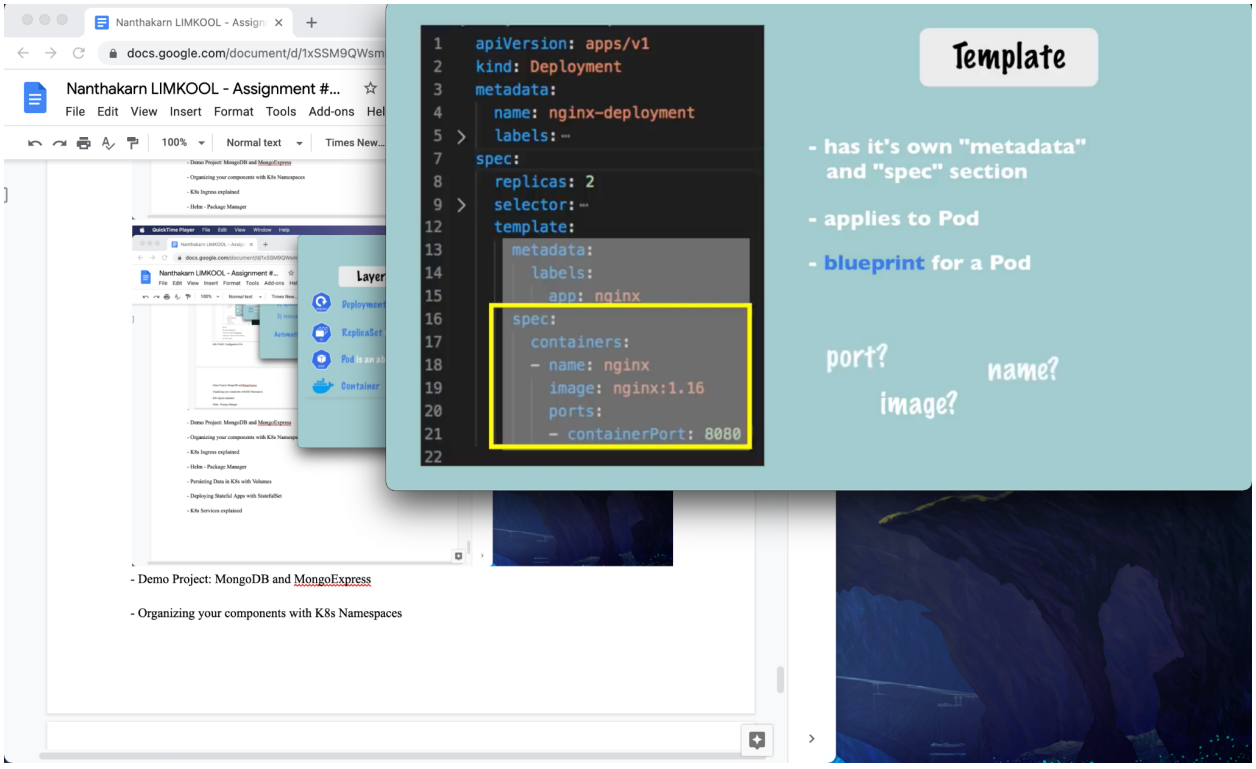
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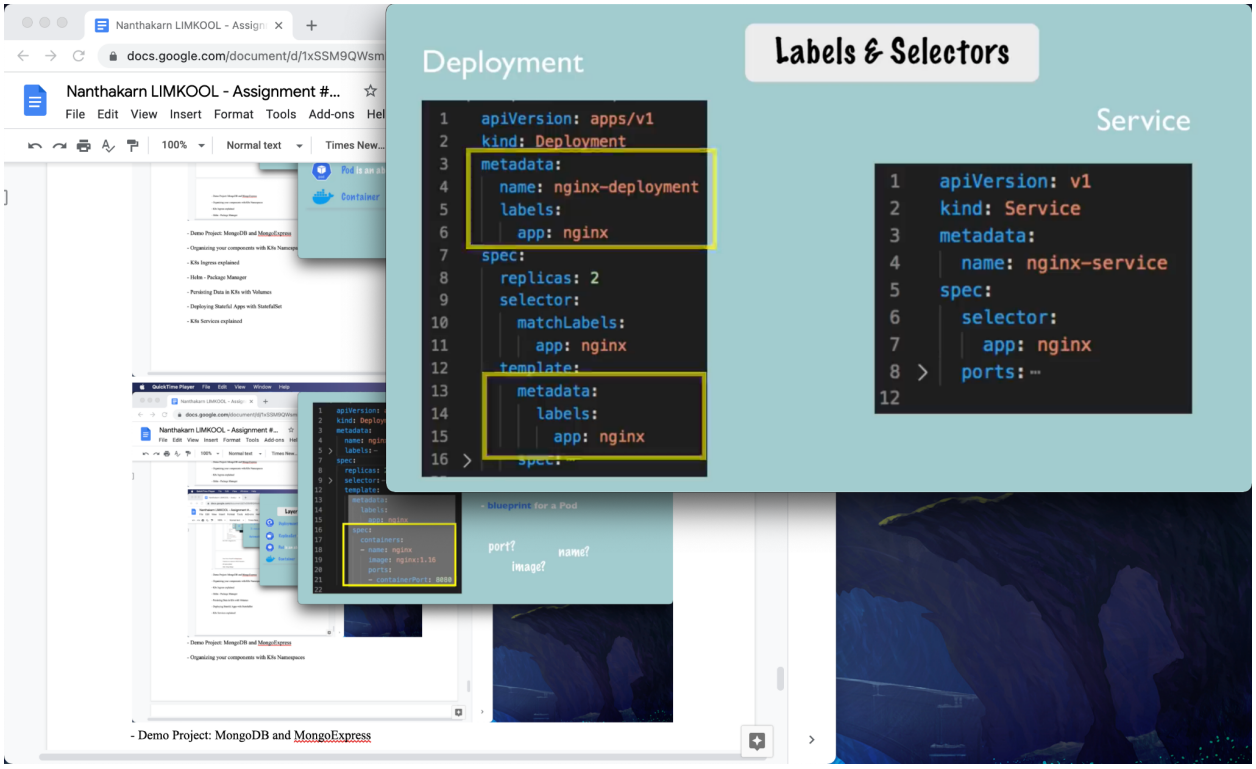
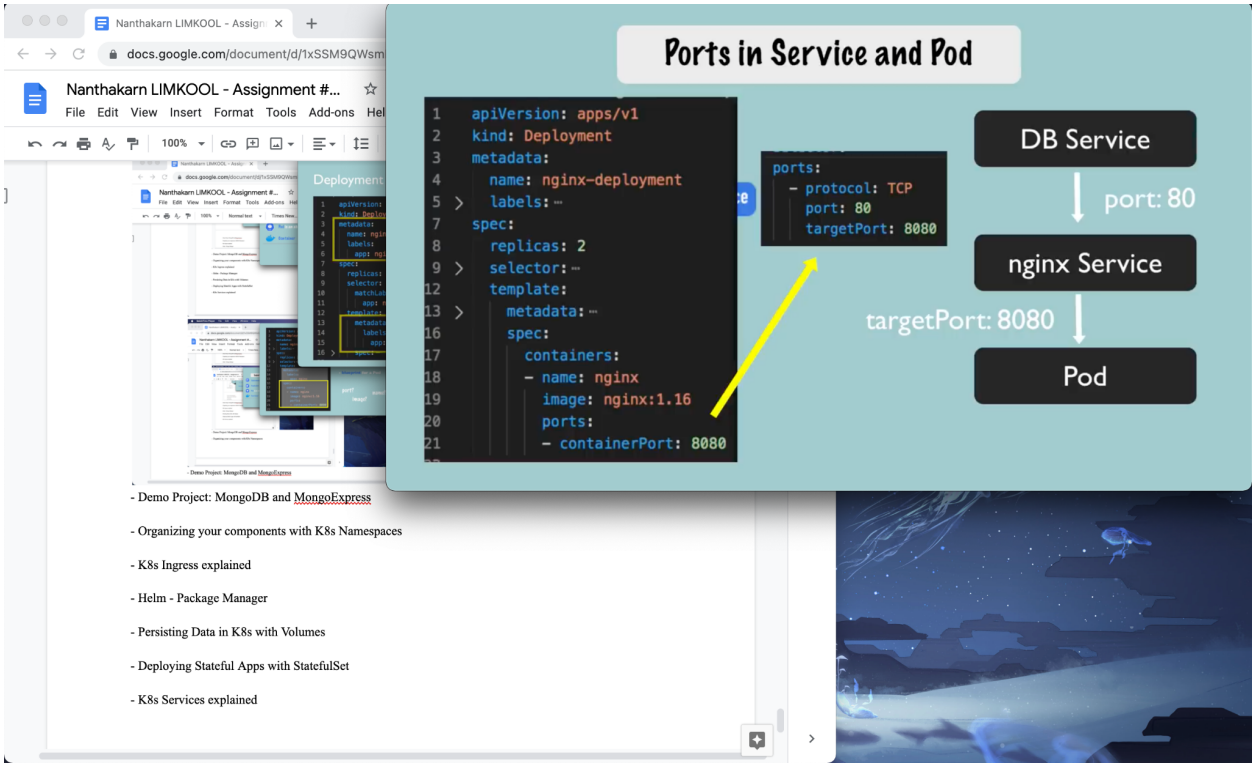
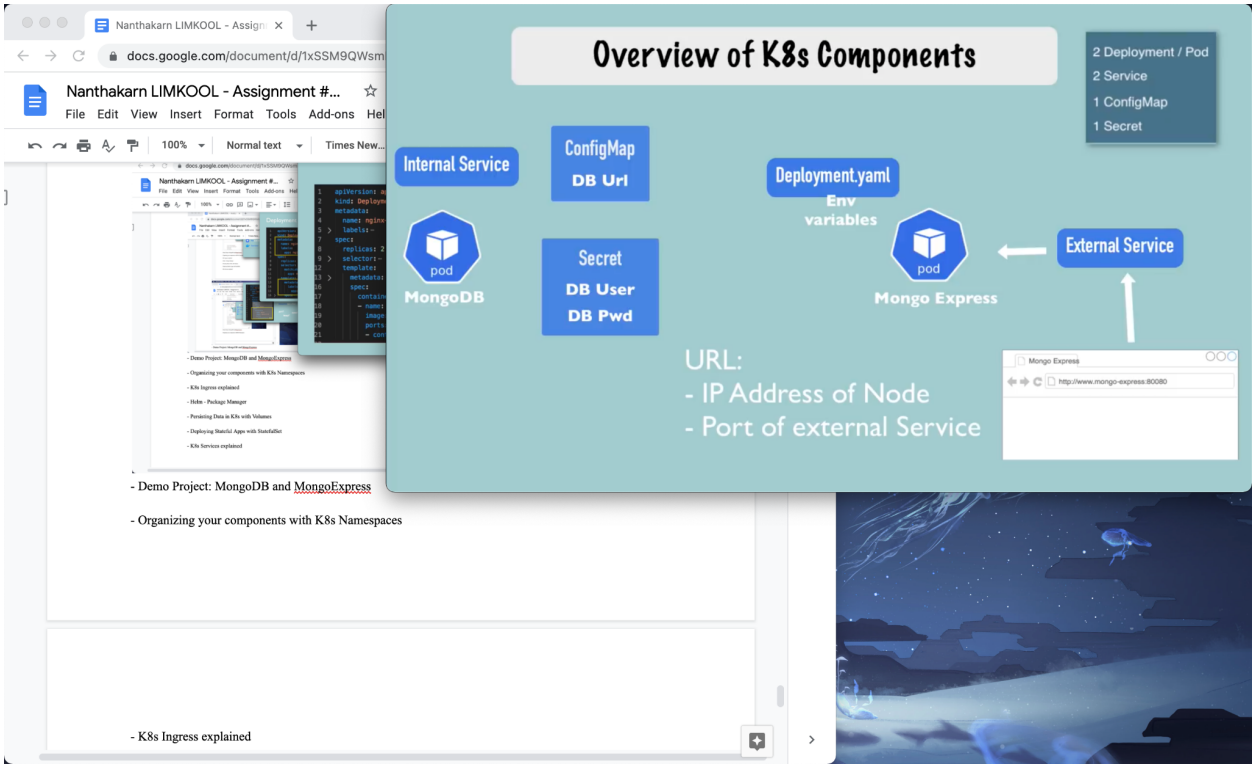
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
Normal text
Times New...
apiVersion: apps/v1
kind: Deployment
metadata:
name: nginx-deployment
labels:
spec:
replicas: 2
selector:
template:
metadata:
labels:
app: nginx
spec:
containers:
- name: nginx
image: nginx:1.16
ports:
- containerPort: 8080
Template
- has it's own "metadata" and "spec" section
- applies to Pod
- blueprint for a Pod
port?
name?
image?
- Demo Project: MongoDB and MongoExpress
- Organizing your components with K8s Namespaces





- Demo Project: MongoDB and MongoExpress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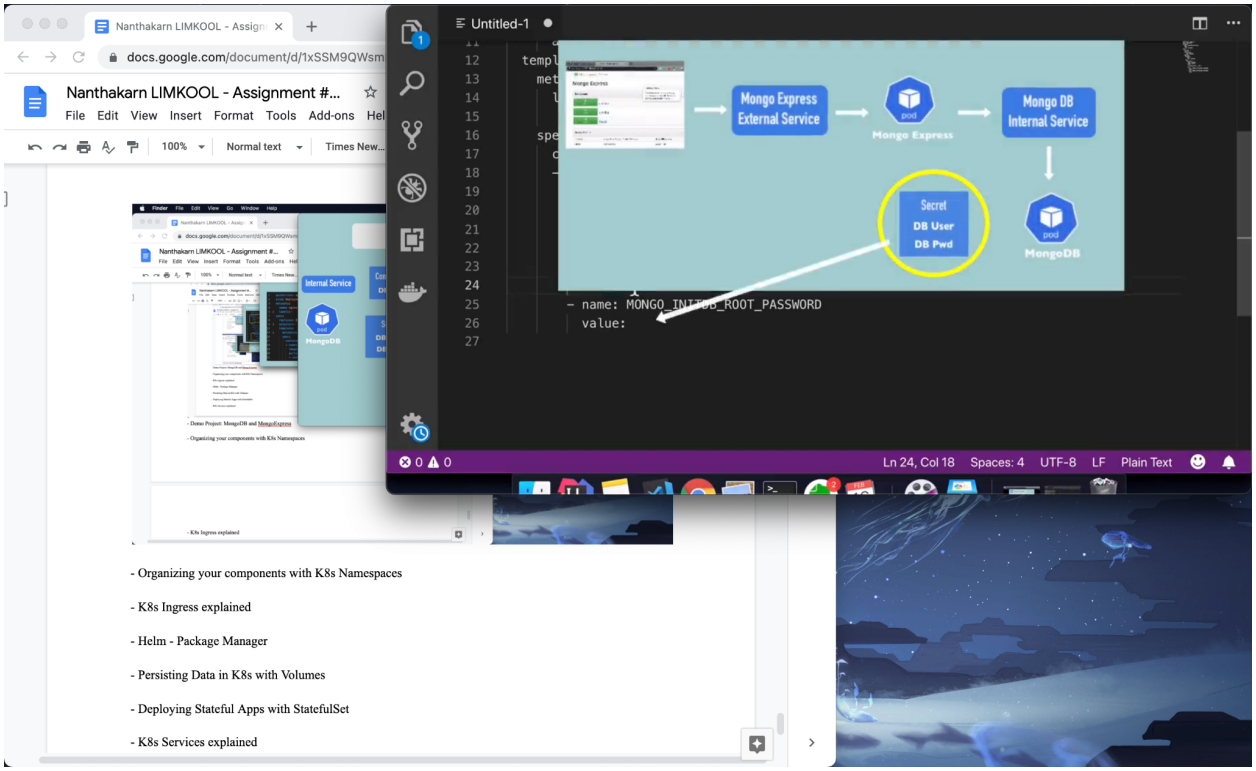
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100% Normal text Times New...
Overview of K8s Components
2 Deployment / Pod
2 Service
1 ConfigMap
1 Secret
Internal Service
ConfigMap
DB Url
Deployment.yaml
Env
variables
pod
MongoDB
Secret
DB User
DB Pwd
pod
Mongo Express
External Service
URL:
- IP Address of Node
- Port of external Service
Mongo Express
http://www.mongo-express:80080
- Demo Project: MongoDB and MongoExpress
- Organizing your components with K8s Namespaces
- K8s Ingress explained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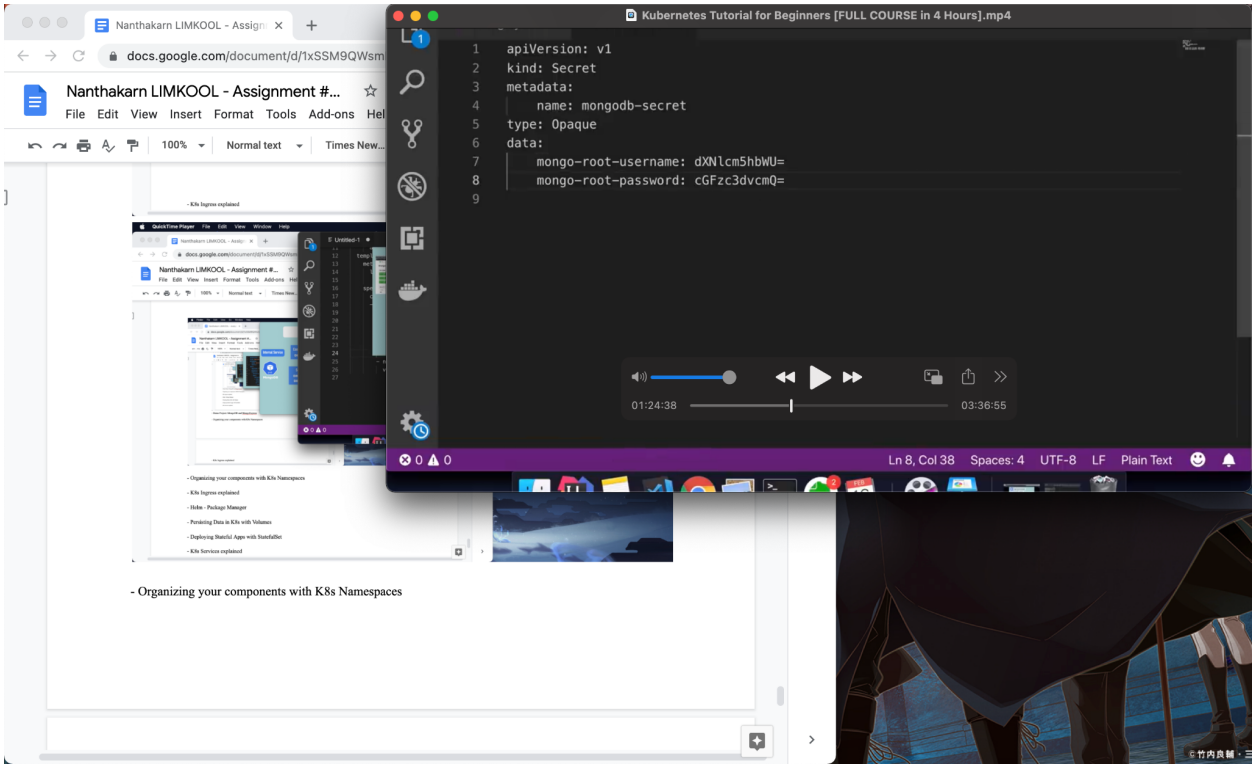
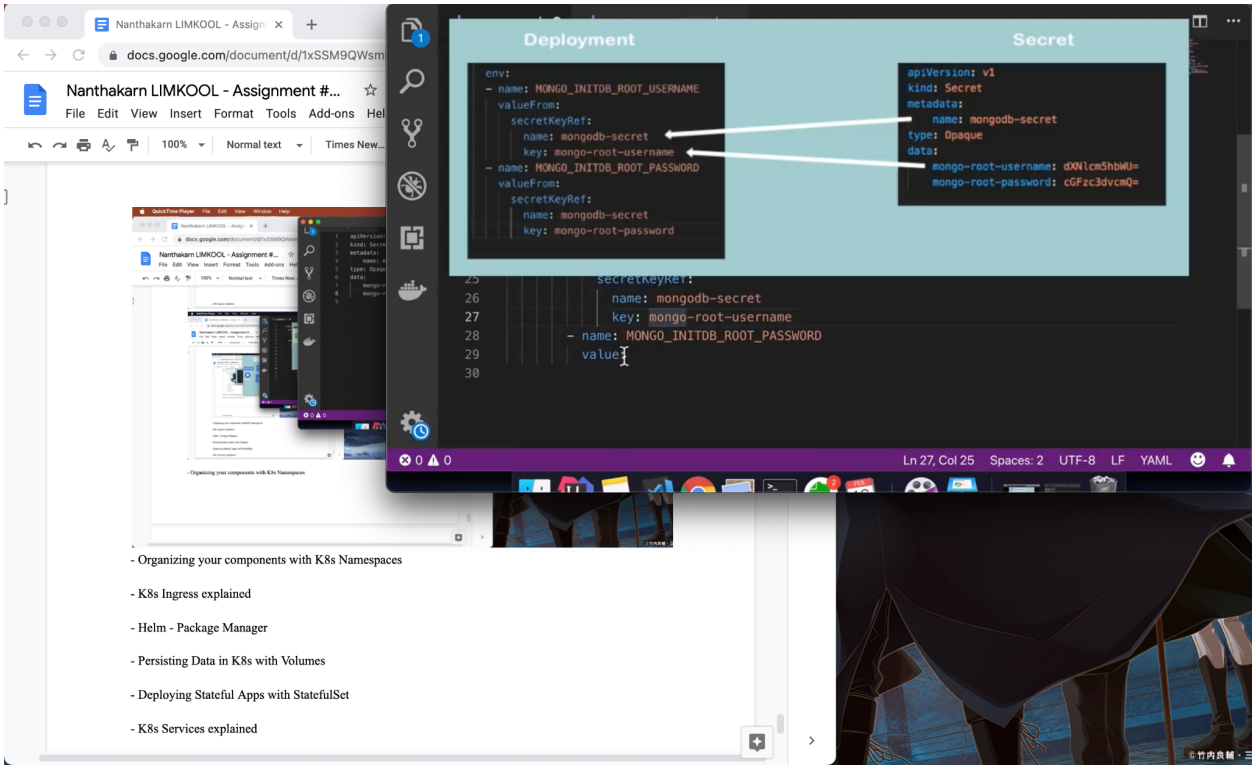
docs.google.com/document/d/1xSSM9QWsm
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100% Normal text Times New...
Untitled-1
Mongo Express
External Service
pod
Mongo Express
Mongo DB
Internal Service
Secret
DB User
DB Pwd
pod
MongoDB
- name: MONGO_INITDB_ROOT_PASSWORD
value:
Ln 24, Col 18 Spaces: 4 UTF-8 LF Plain Text
- Organizing your components with K8s Namespaces
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained


Nanthakarn LIMKOOL - Assignment #...
docs.google.com/document/d/1xSSM9QWsm
File Edit View Insert Format Tools Add-ons Hel
100% Normal text Times New...
Kubernetes Tutorial for Beginners [FULL COURSE in 4 Hours].mp4
apiVersion: v1
kind: Secret
metadata:
name: mongodb-secret
type: Opaque
data:
mongo-root-username: dXNlcm5hbWU=
mongo-root-password: cGFzc3dvcmQ=
01:24:38
03:36:55
Ln 8, Col 38 Spaces: 4 UTF-8 LF Plain Text
- Organizing your components with K8s Namespaces


Nanthakarn LIMKOOL - Assignment #...
docs.google.com/document/d/1xSSM9QWsm
File Edit View Insert Format Tools Add-ons Hel
100% Normal text Times New...
Deployment
env:
- name: MONGO_INITDB_ROOT_USERNAME
valueFrom:
secretKeyRef:
name: mongodb-secret
key: mongo-root-username
- name: MONGO_INITDB_ROOT_PASSWORD
valueFrom:
secretKeyRef:
name: mongodb-secret
key: mongo-root-password
Secret
apiVersion: v1
kind: Secret
metadata:
name: mongodb-secret
type: Opaque
data:
mongo-root-username: dXNlcm5hbWU=
mongo-root-password: cGFzc3dvcmQ=
Ln 27, Col 25 Spaces: 2 UTF-8 LF YAML
- Organizing your components with K8s Namespaces
- K8s Ingress explained
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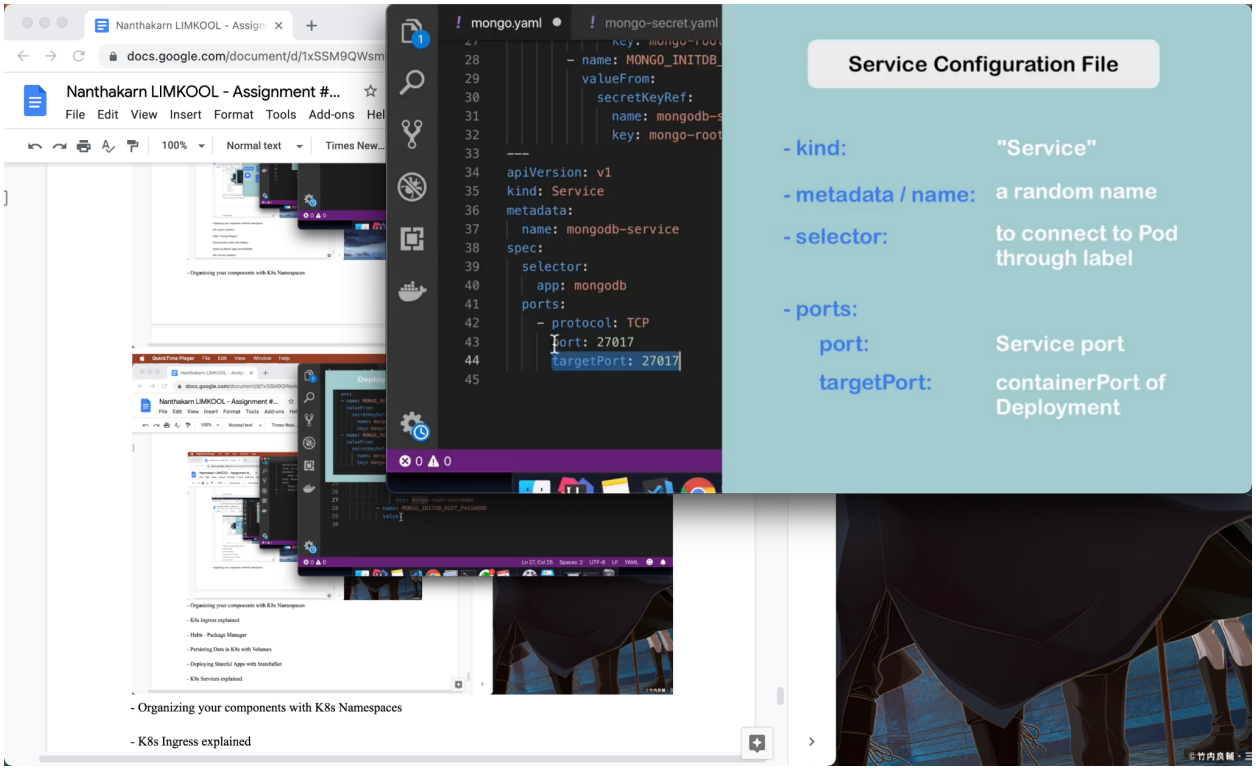
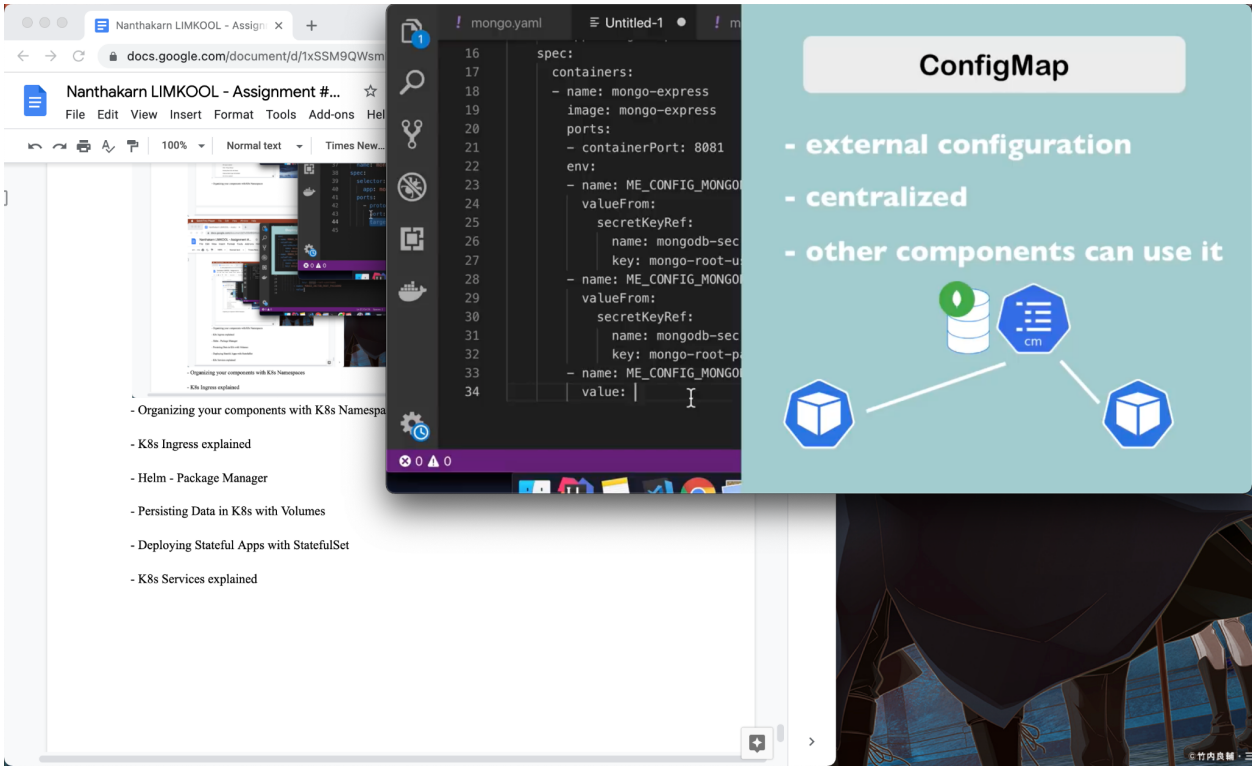

Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons
mongo.yaml
mongo-secret.yaml
apiVersion: v1
kind: Service
metadata:
name: mongodb-service
spec:
selector:
app: mongodb
ports:
- protocol: TCP
port: 27017
targetPort: 27017
Service Configuration File
- kind: "Service"
- metadata / name: a random name
- selector: to connect to Pod through label
- ports:
port: Service port
targetPort: containerPort of Deployment
- Organizing your components with K8s Namespaces
- K8s Ingress explained


Nanthakarn LIMKOOL - Assignment #...
docs.google.com/document/d/1xSSM9QWsm
File Edit View Insert Format Tools Add-ons Hel
mongo.yaml
Untitled-1
spec:
containers:
- name: mongo-express
image: mongo-express
ports:
- containerPort: 8081
env:
- name: ME_CONFIG_MONGO
valueFrom:
secretKeyRef:
name: mongodb-sec
key: mongo-root-u
- name: ME_CONFIG_MONGO
valueFrom:
secretKeyRef:
name: mongodb-sec
key: mongo-root-p
- name: ME_CONFIG_MONGO
value:
ConfigMap
- external configuration
- centralized
- other components can use it
cm
- Organizing your components with K8s Namespa
- K8s Ingress explained
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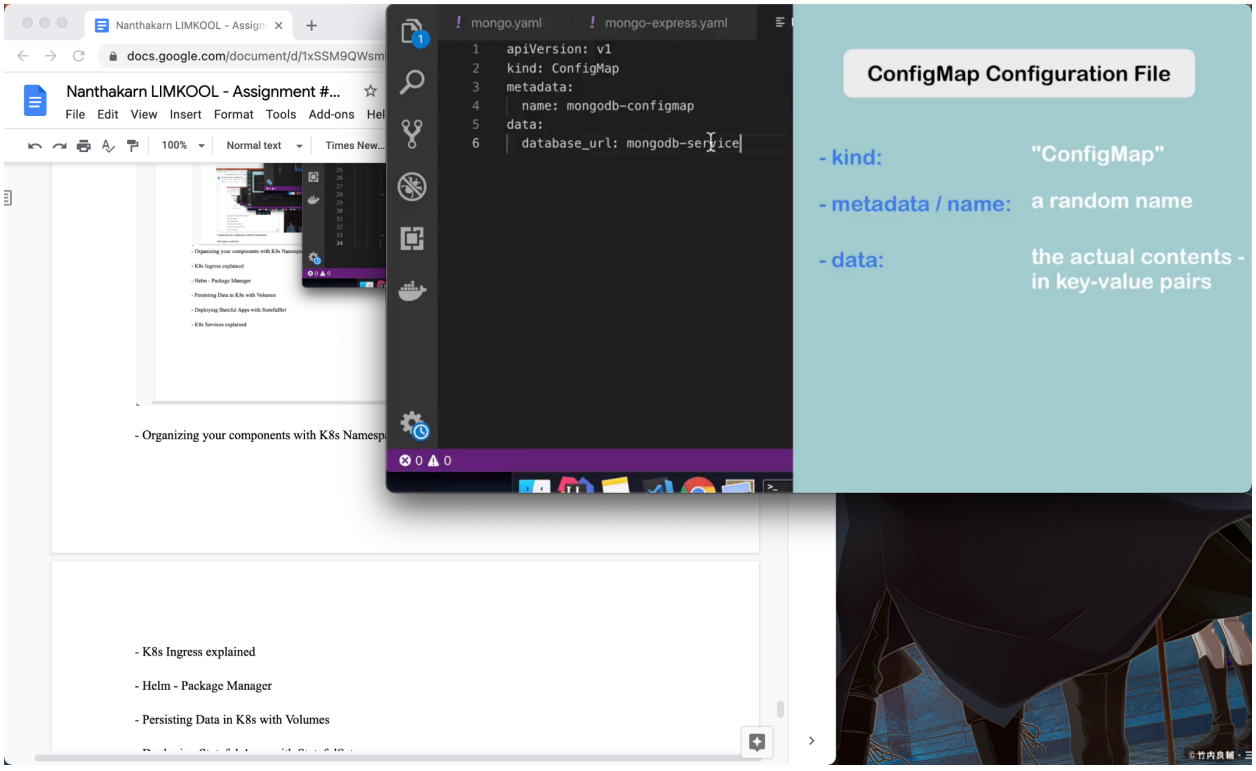
Nanthakarn LIMKOOL - Assignment #...
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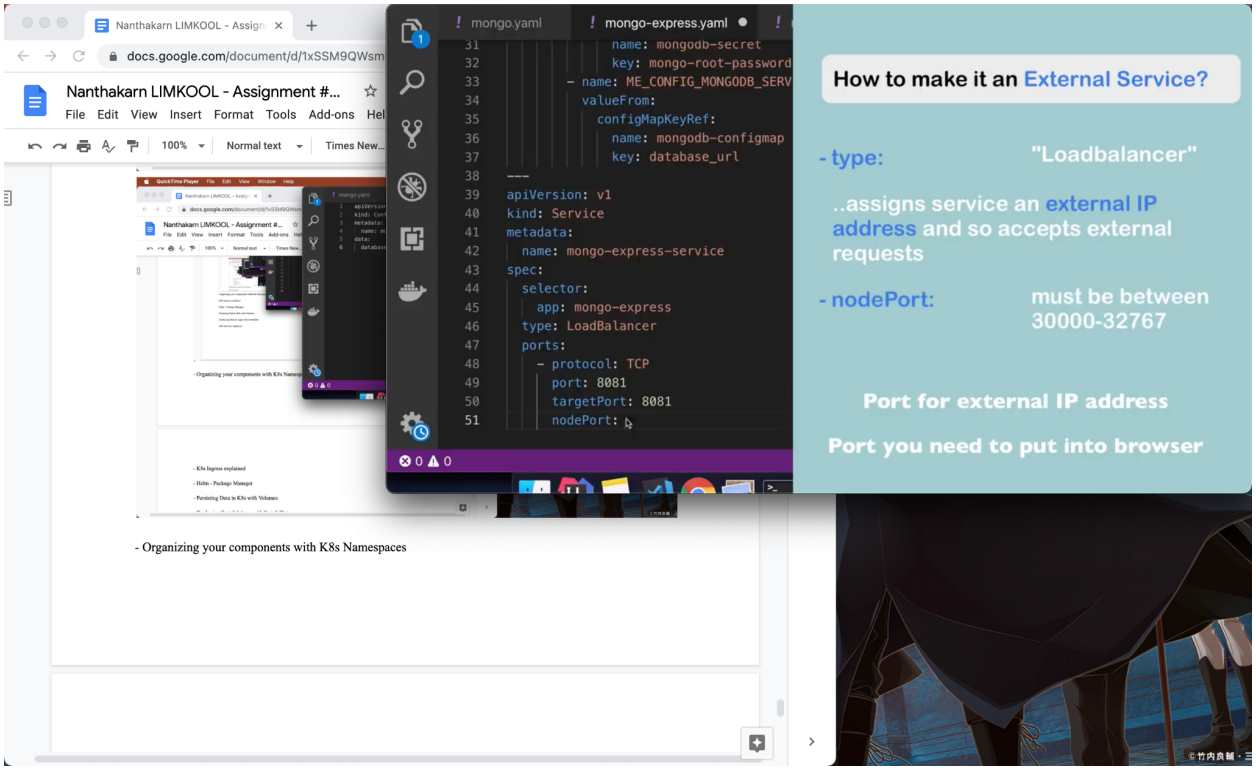
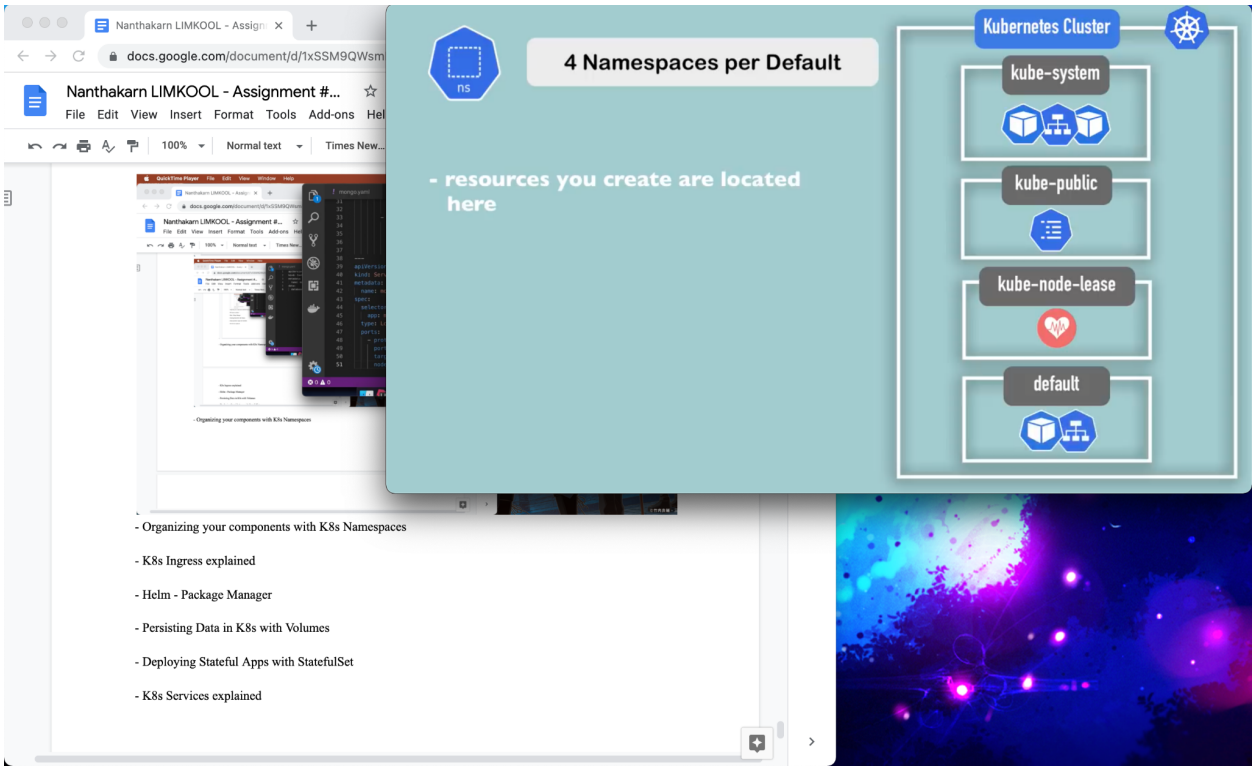
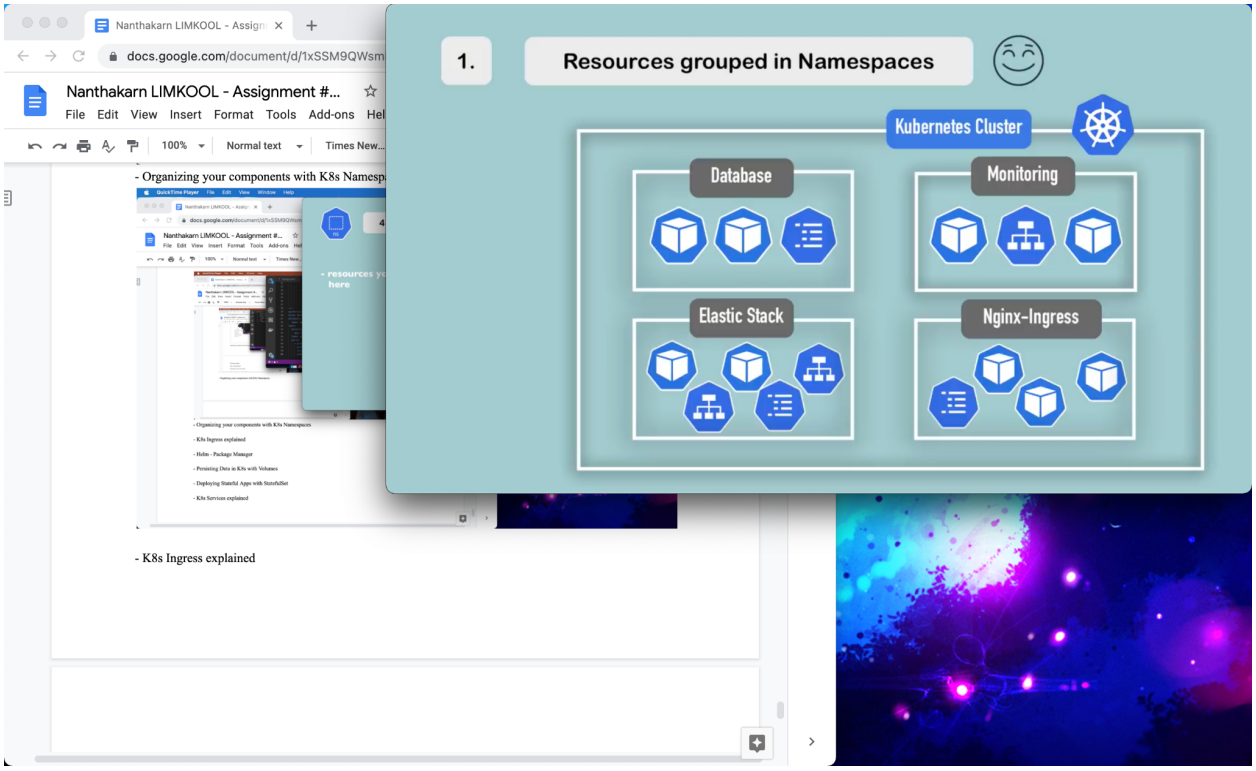
File Edit View Insert Format Tools Add-ons Hel
mongo.yaml
mongo-express.yaml
apiVersion: v1
kind: ConfigMap
metadata:
name: mongodb-configmap
data:
database_url: mongodb-service
ConfigMap Configuration File
- kind: "ConfigMap"
- metadata / name: a random name
- data: the actual contents - in key-value pairs
- Organizing your components with K8s Namesp
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes



- Organizing your components with K8s Namespaces

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File Edit View Insert Format Tools Add-ons Hel
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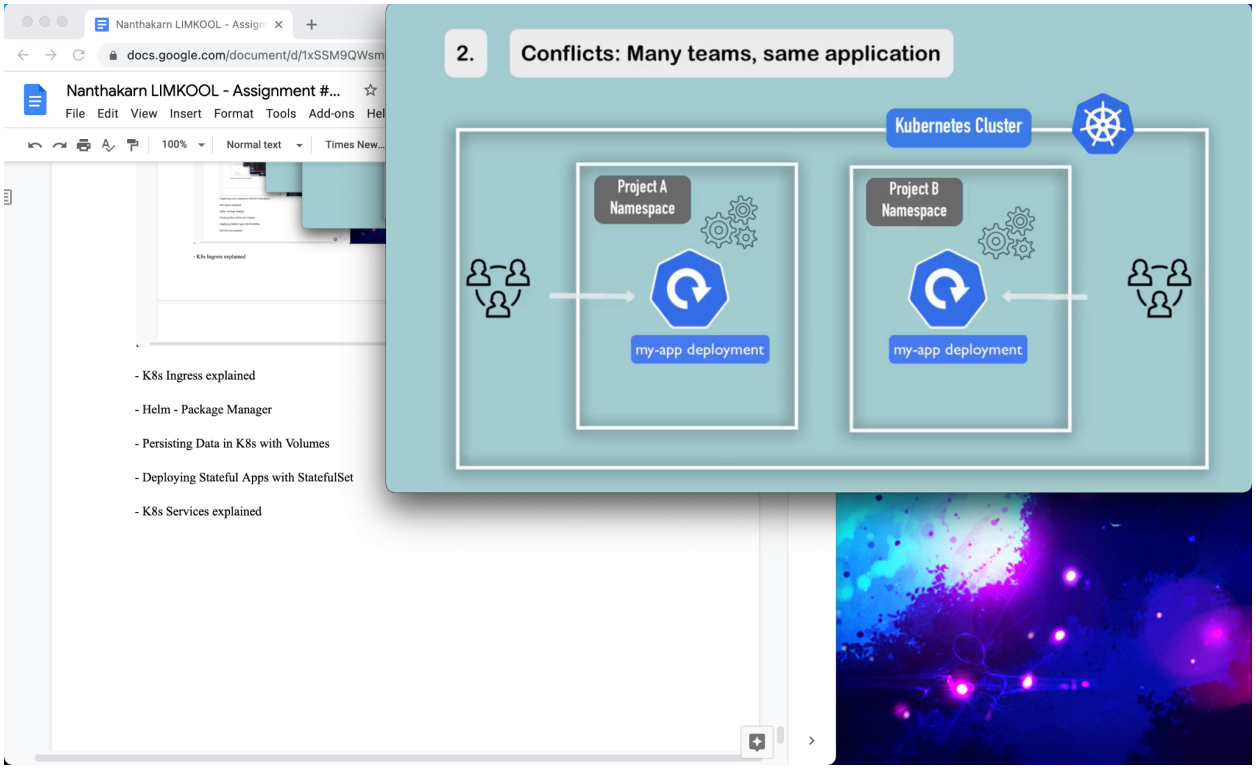
- Organizing your components with K8s Namesp
- K8s Ingress explained
1.
Resources grouped in Namespaces
Kubernetes Cluster
Database
Monitoring
Elastic Stack
Nginx-Ingress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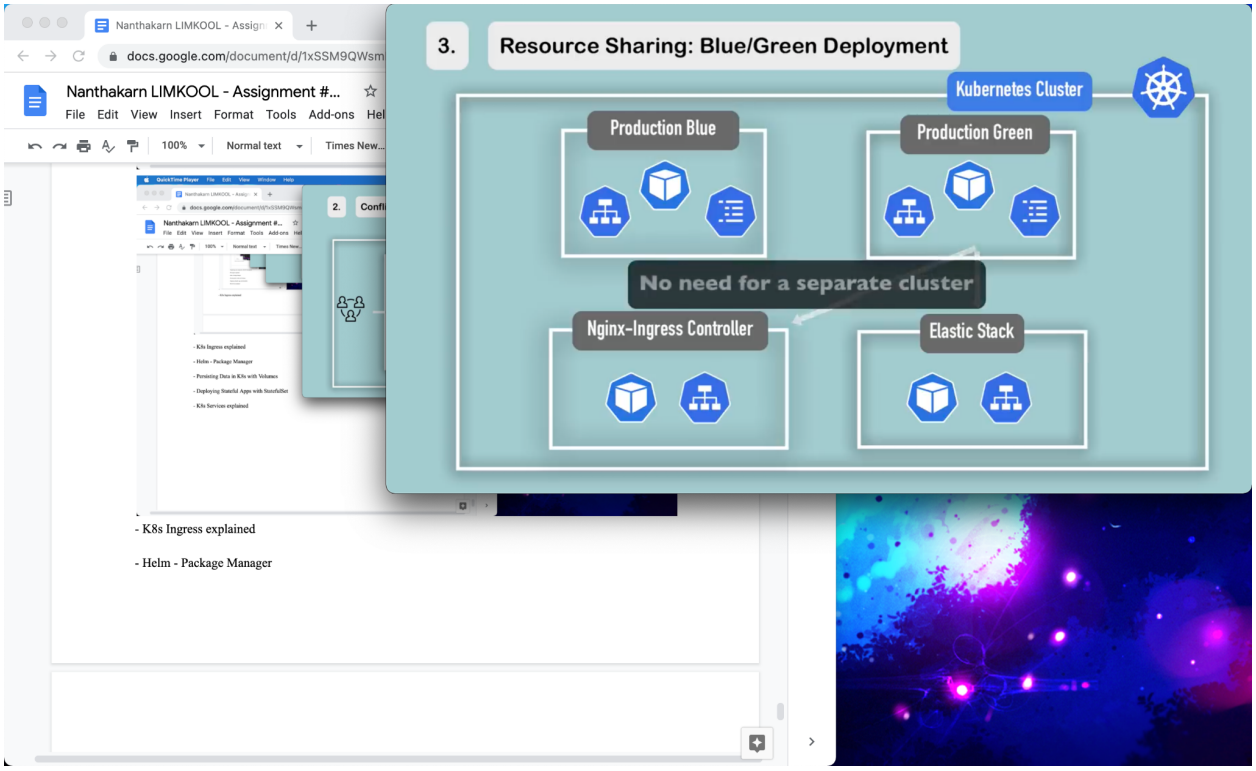
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained
2.
Conflicts: Many teams, same application
Kubernetes Cluster
Project A Namespace
Project B Namespace
my-app deployment
my-app deployment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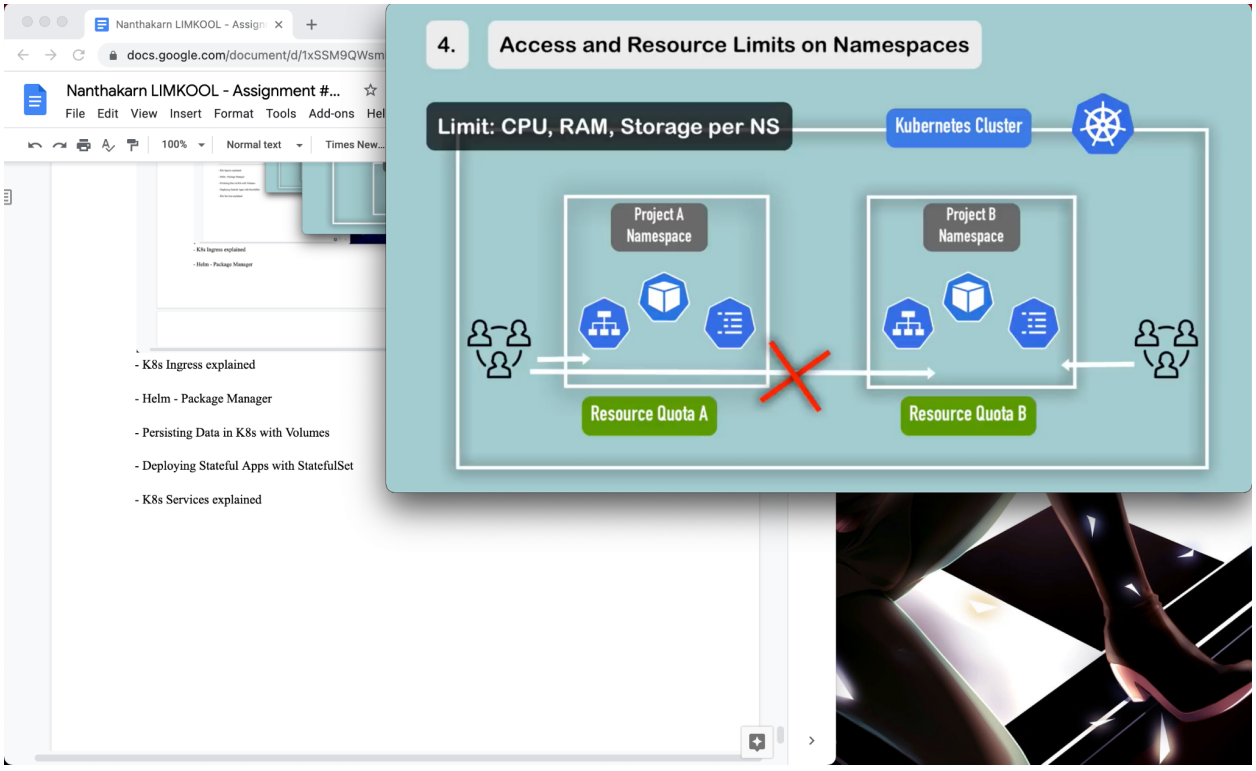
3.
Resource Sharing: Blue/Green Deployment
Kubernetes Cluster
Production Blue
Production Green
No need for a separate cluster
Nginx-Ingress Controller
Elastic Stack
- K8s Ingress explained
- Helm - Package Manager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File Edit View Insert Format Tools Add-ons Hel
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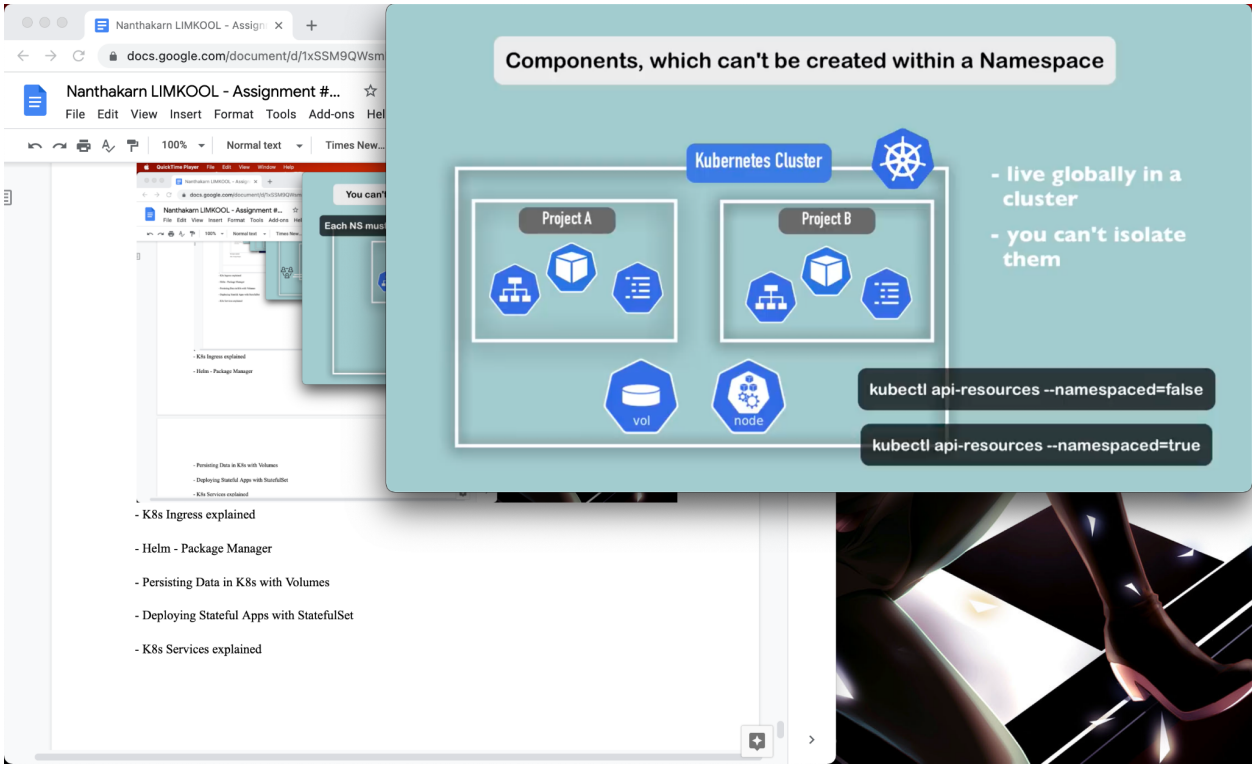
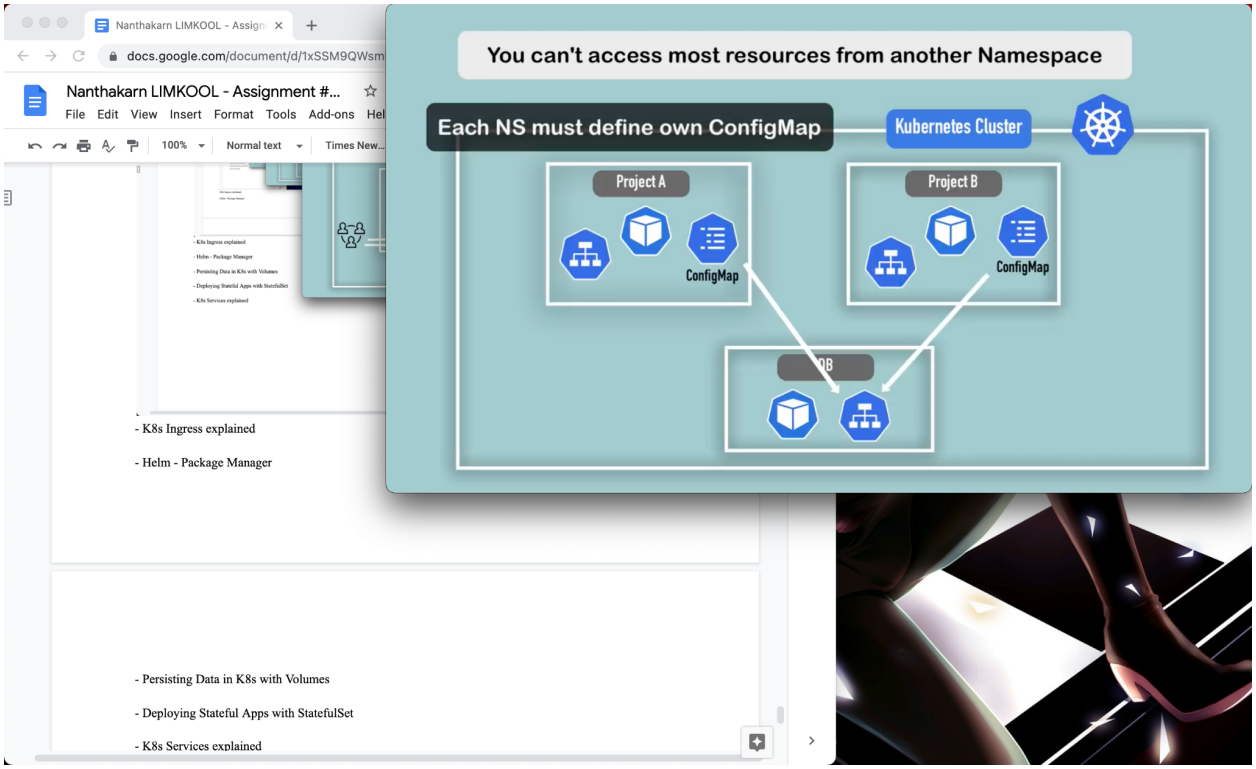
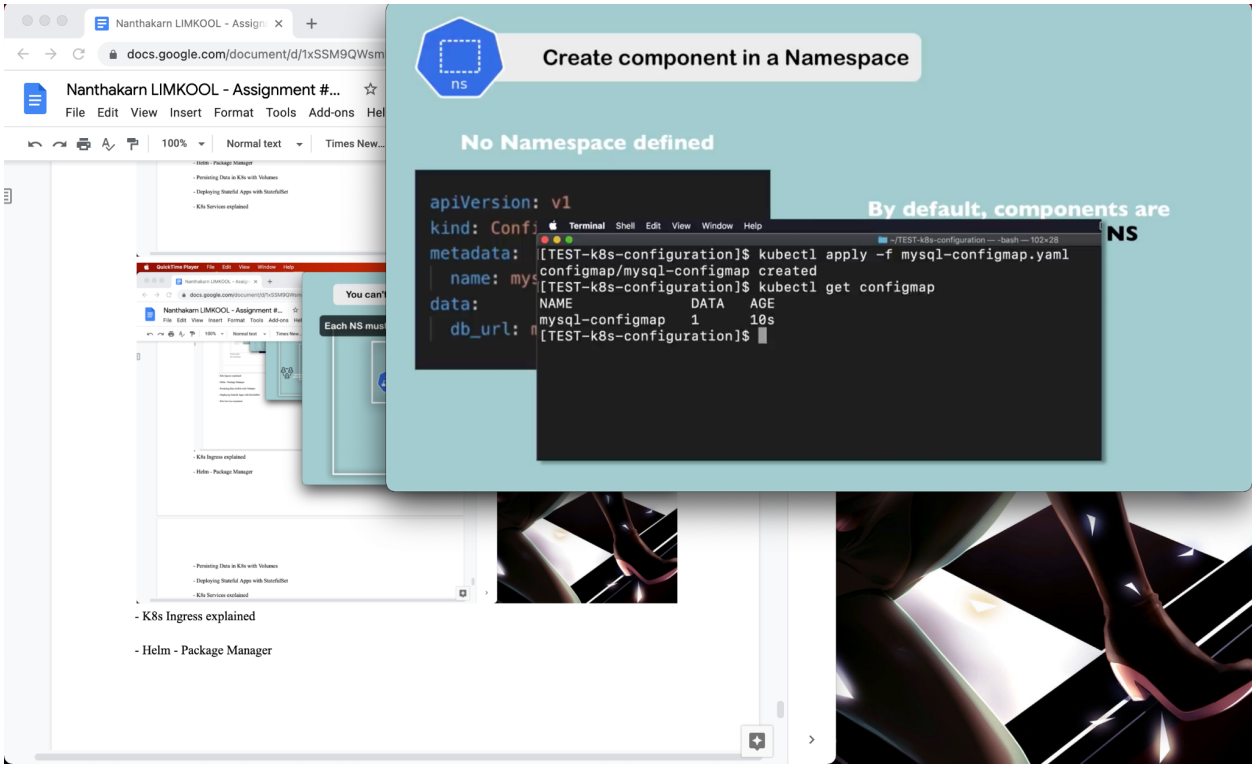
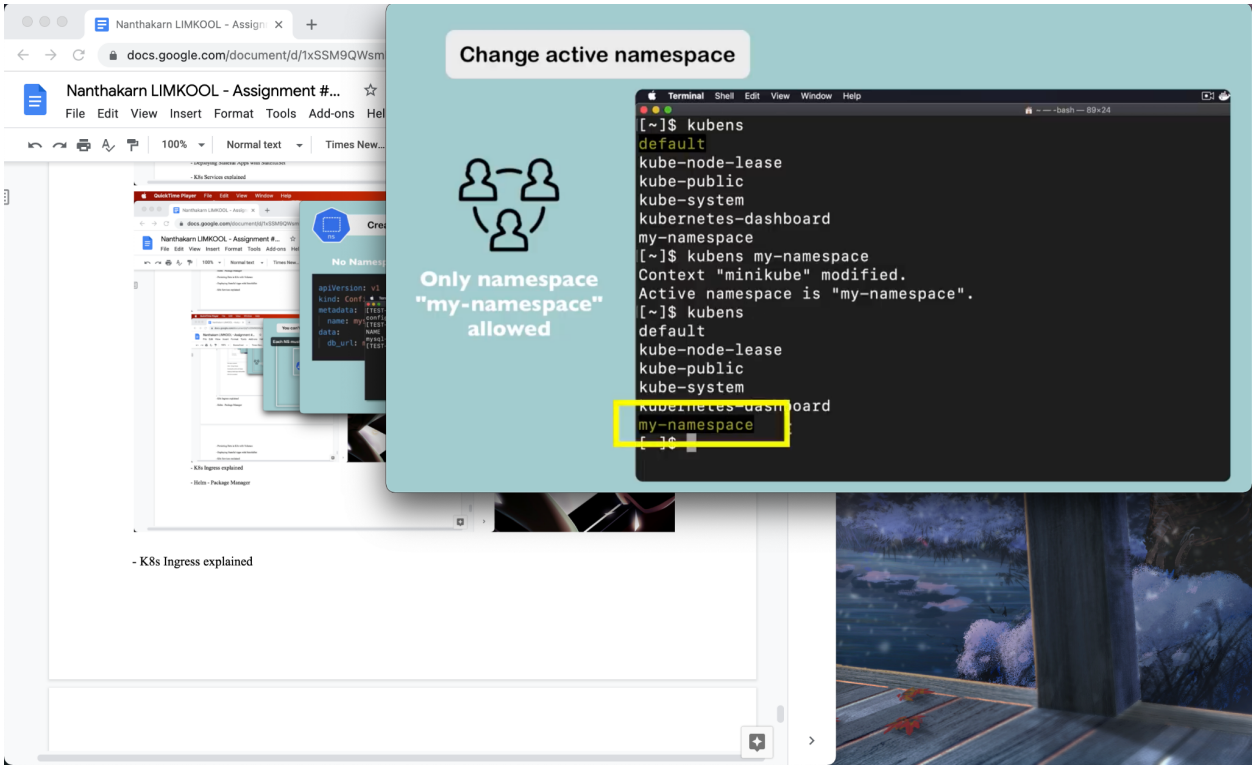
4.
Access and Resource Limits on Namespaces
Limit: CPU, RAM, Storage per NS
Kubernetes Cluster
Project A Namespace
Project B Namespace
Resource Quota A
Resource Quota B
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained

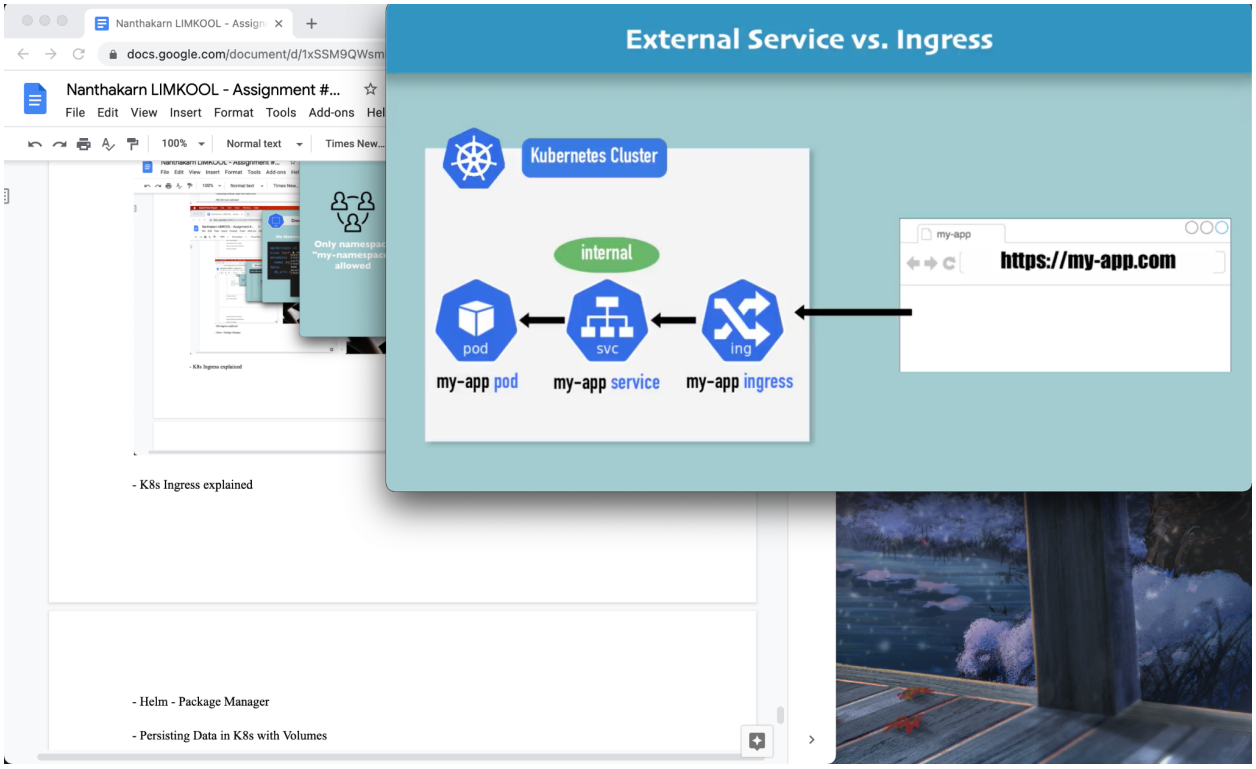

Components, which can't be created within a Namespace
Kubernetes Cluster
Project A
Project B
vol
node
- live globally in a cluster
- you can't isolate them
kubectl api-resources --namespaced=false
kubectl api-resources --namespaced=true
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained


You can't access most resources from another Namespace
Each NS must define own ConfigMap
Kubernetes Cluster
Project A
Project B
ConfigMap
ConfigMap
DB
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained





- K8s Ingress explained


Nanthakarn LIMKOOL - Assign
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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
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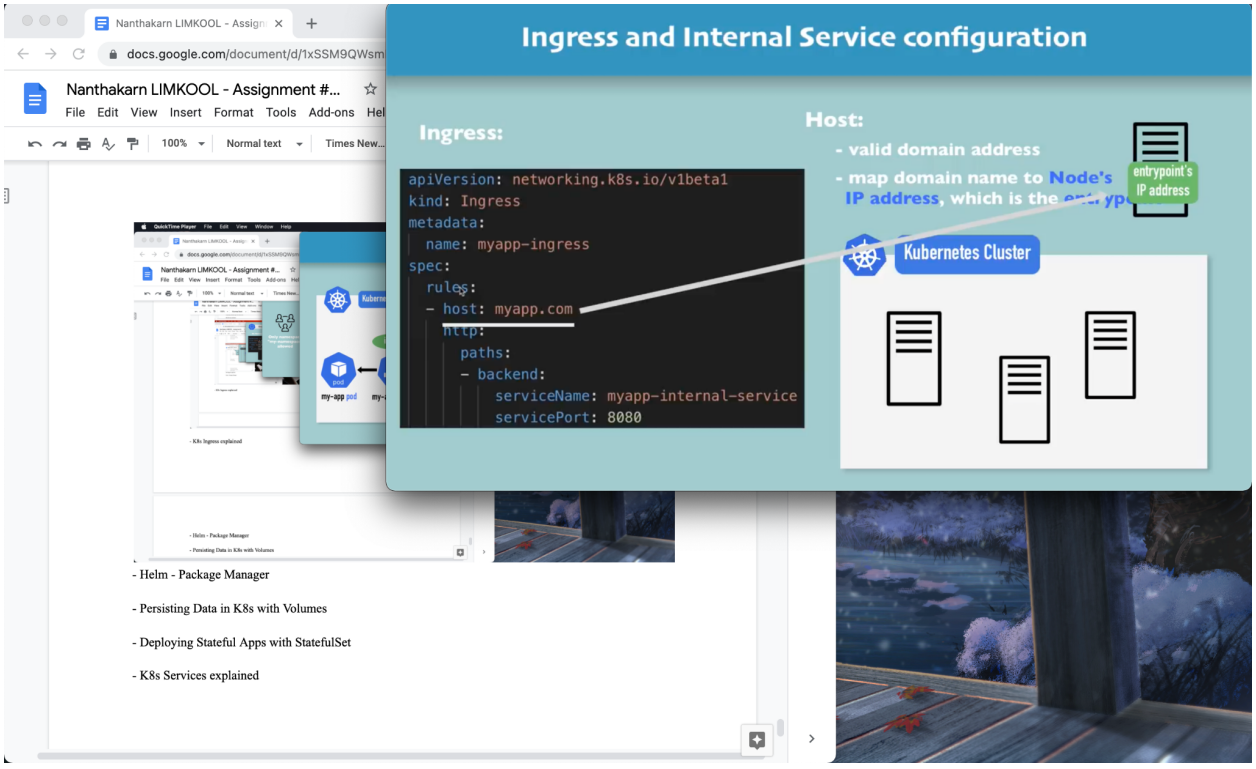
External Service vs. Ingress
Kubernetes Cluster
internal
pod
svc
ing
my-app pod
my-app service
my-app ingress
my-app
https://my-app.com
- K8s Ingress explained
- Helm - Package Manager
- Persisting Data in K8s with Volumes


Nanthakarn LIMKOOL - Assign
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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
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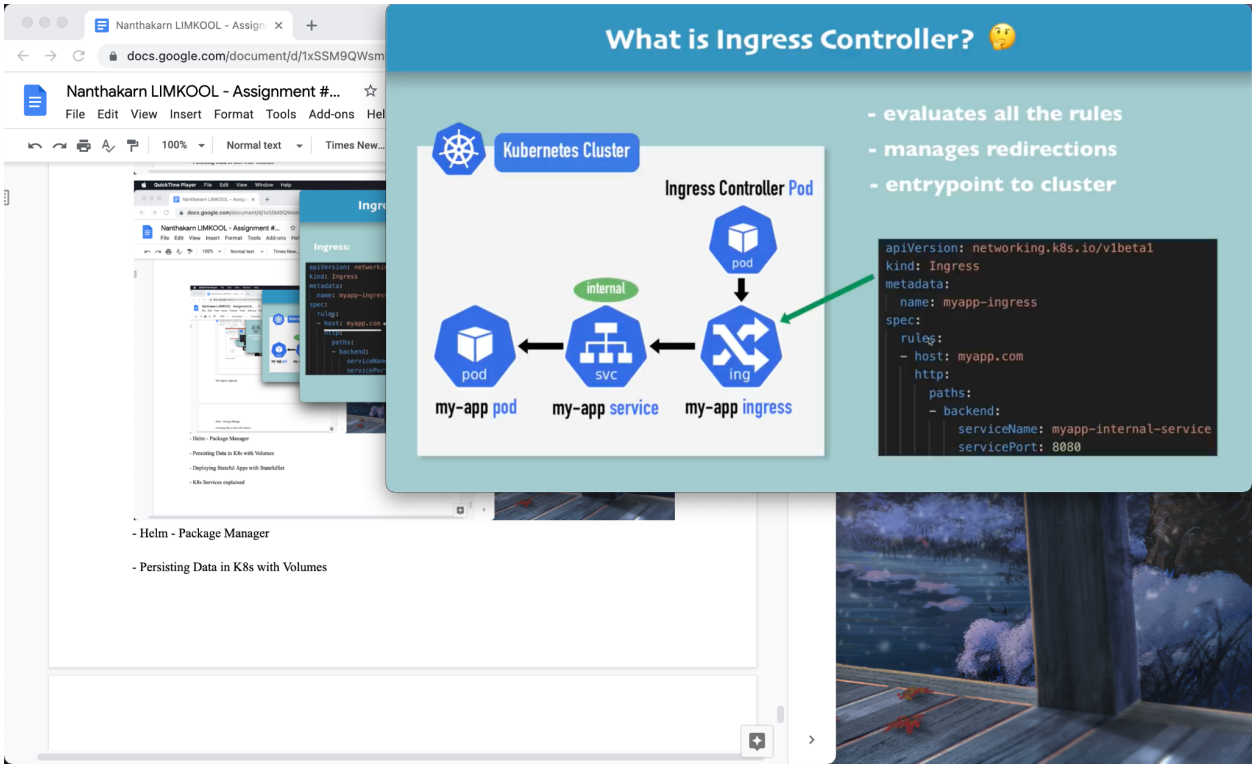
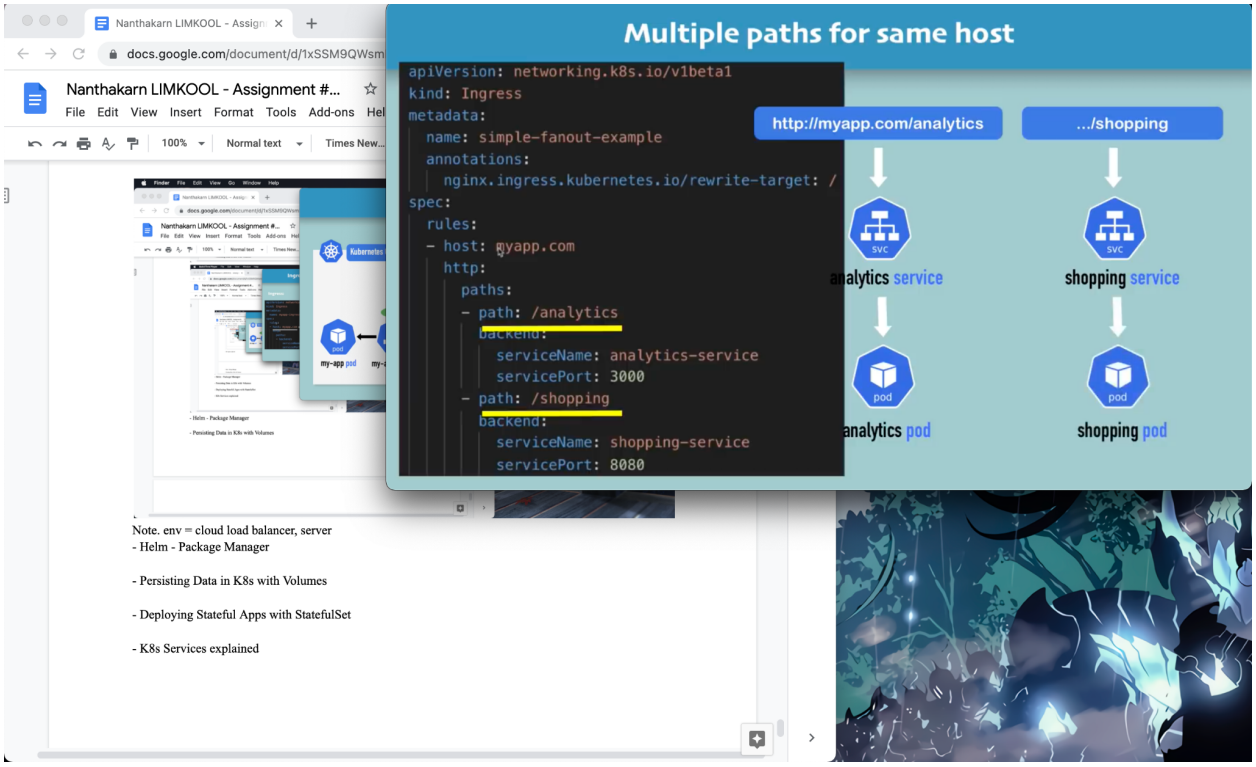
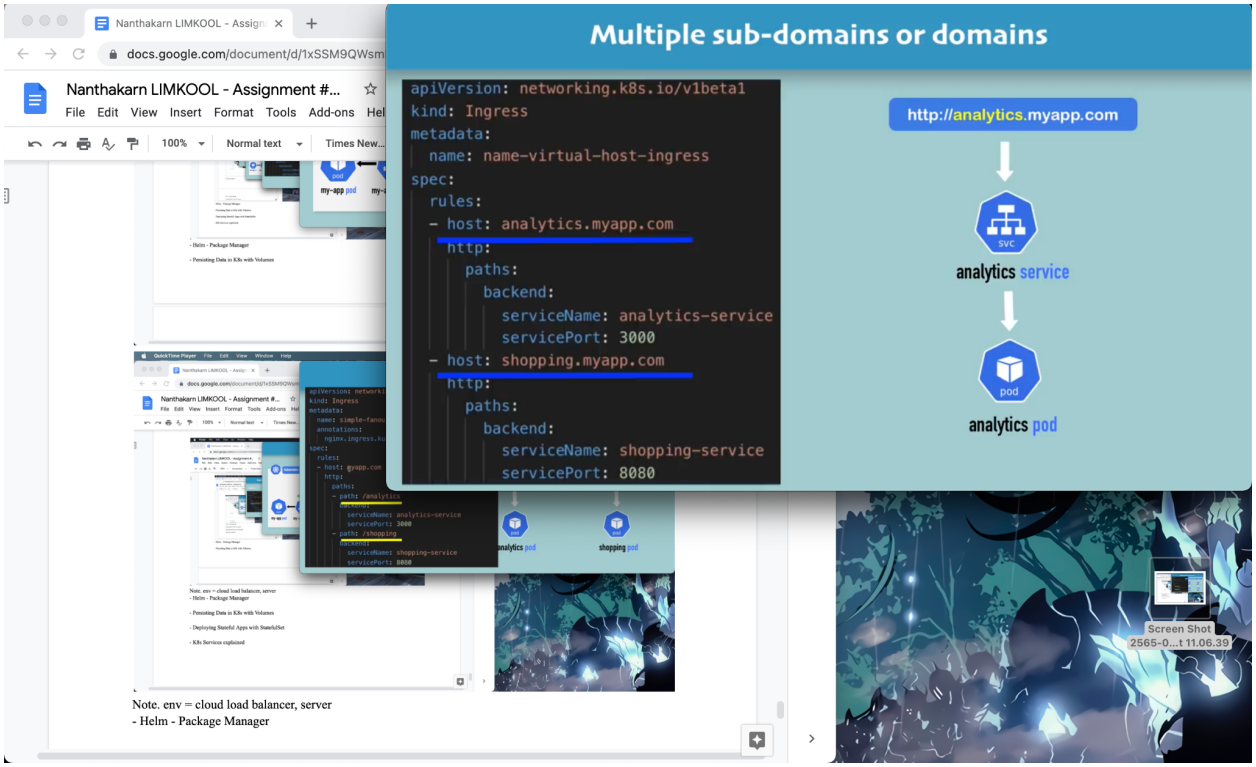
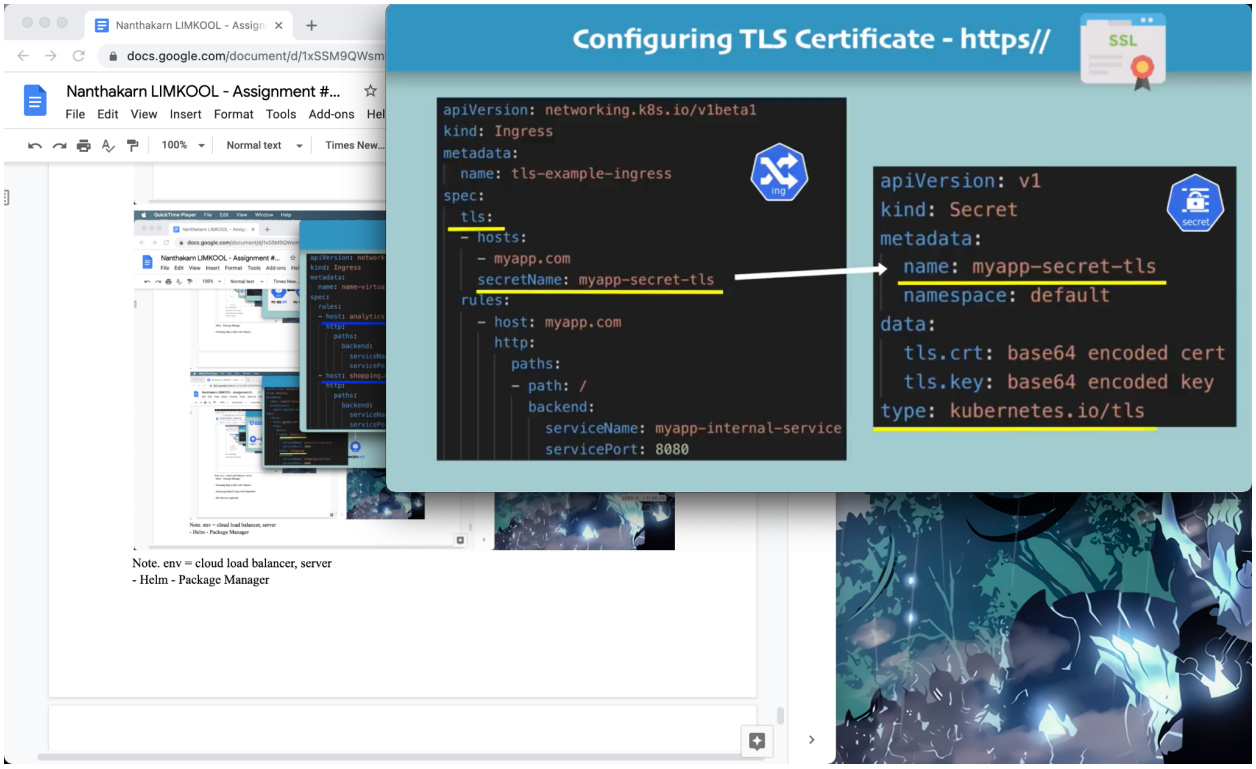
Times New...
Ingress and Internal Service configuration
Ingress:
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
name: myapp-ingress
spec:
rules:
- host: myapp.com
http:
paths:
- backend:
serviceName: myapp-internal-service
servicePort: 8080
Host:
- valid domain address
- map domain name to Node's IP address, which is the
entrypoint's IP address
Kubernetes Cluster
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained



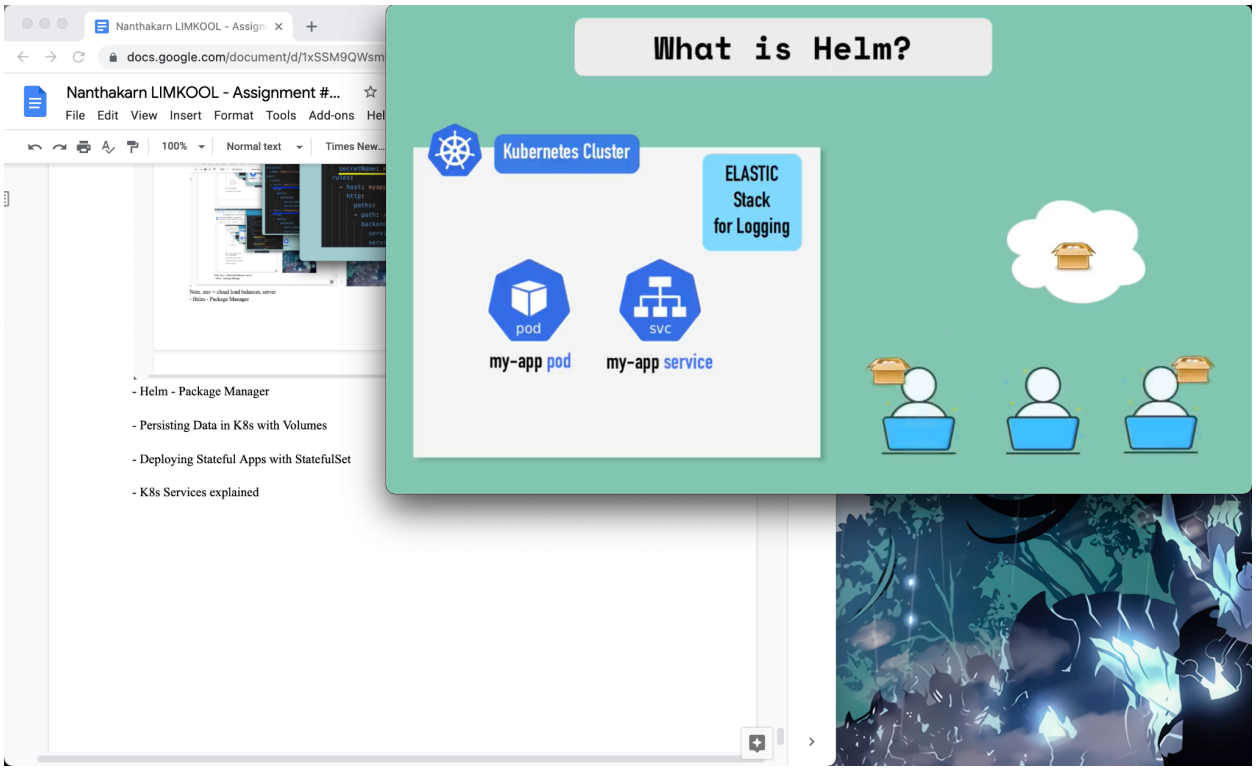
Note. env = cloud load balancer, server

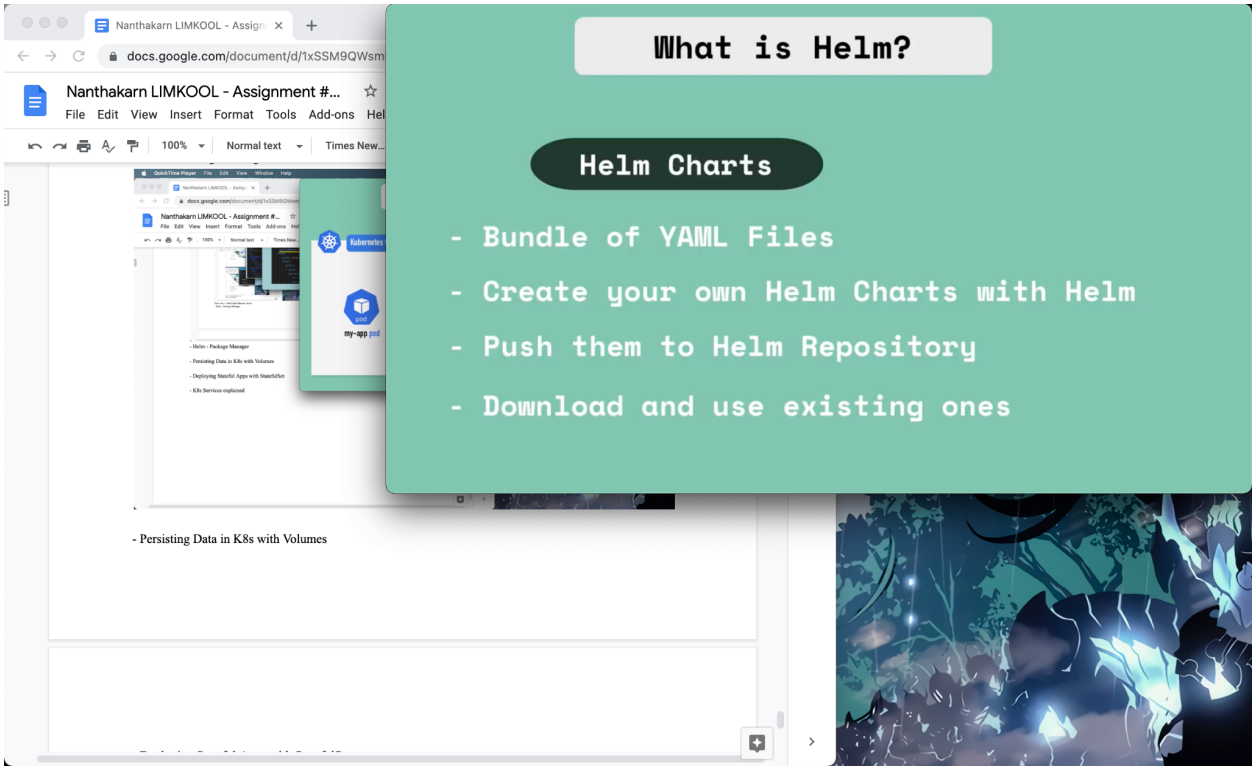

Multiple paths for same host
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
name: simple-fanout-example
annotations:
nginx.ingress.kubernetes.io/rewrite-target: /
spec:
rules:
- host: myapp.com
http:
paths:
- path: /analytics
backend:
serviceName: analytics-service
servicePort: 3000
- path: /shopping
backend:
serviceName: shopping-service
servicePort: 8080
http://myapp.com/analytics
.../shopping
svc
analytics service
shopping service
pod
analytics pod
shopping pod
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons
Note. env = cloud load balancer, server
- Helm - Package Manager
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained

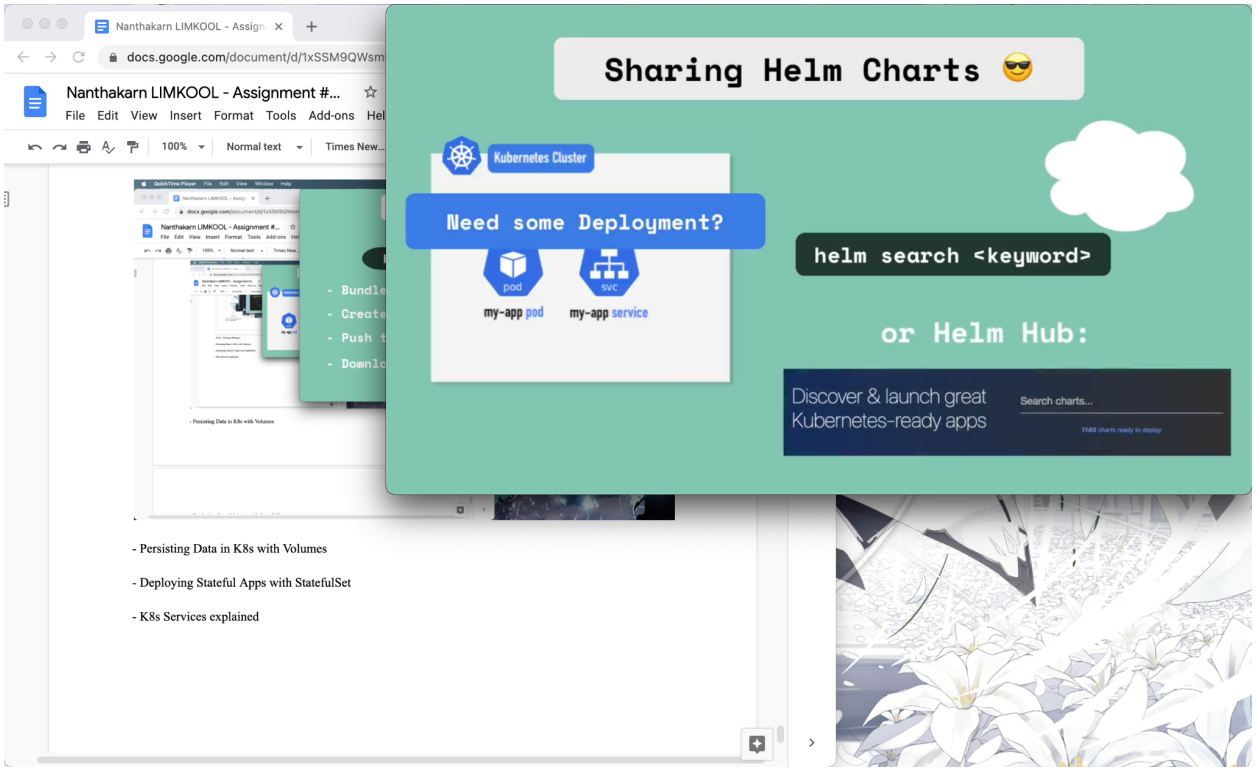

Multiple sub-domains or domains
apiVersion: networking.k8s.io/v1beta1
kind: Ingress
metadata:
name: name-virtual-host-ingress
spec:
rules:
- host: analytics.myapp.com
http:
paths:
backend:
serviceName: analytics-service
servicePort: 3000
- host: shopping.myapp.com
http:
paths:
backend:
serviceName: shopping-service
servicePort: 8080
http://analytics.myapp.com
svc
analytics service
pod
analytics pod
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons
Note. env = cloud load balancer, server
- Helm - Package Manager
Screen Shot
2565-0...t 11.06.39

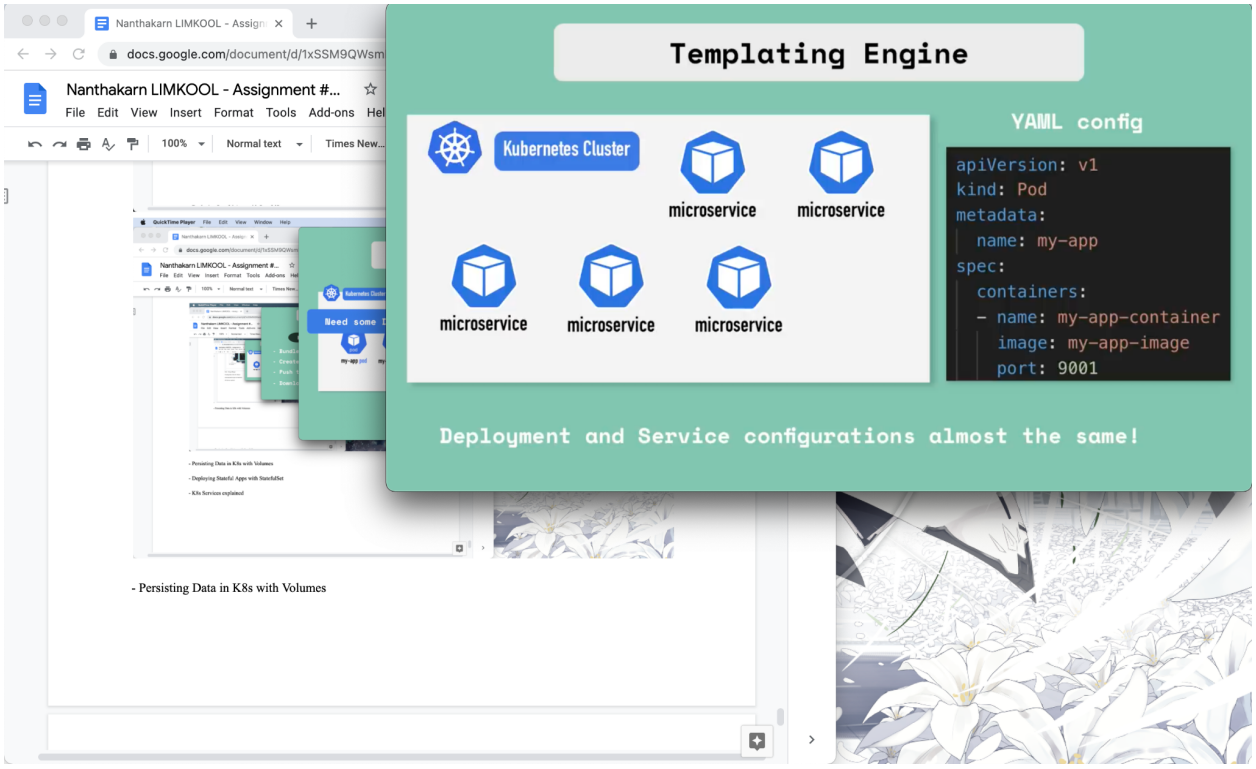


- Helm - Package Manager

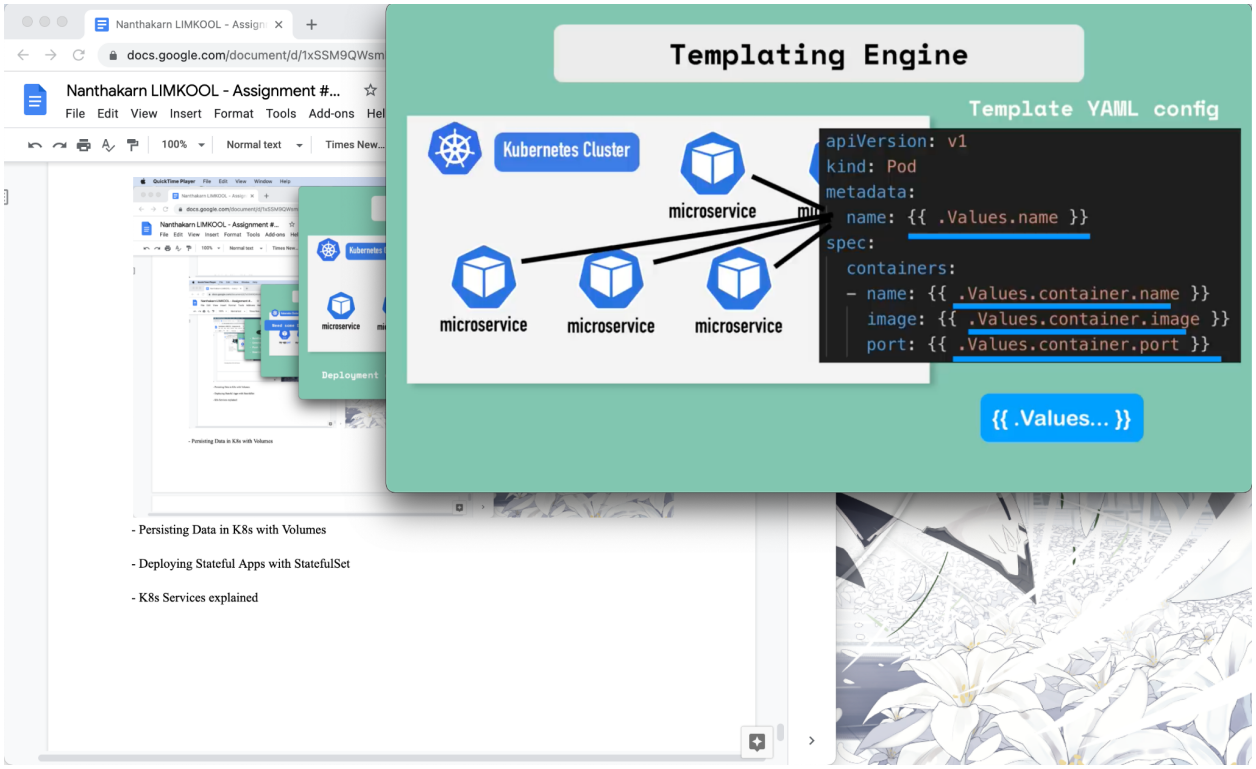



What is Helm?
Helm Charts
- Bundle of YAML Files
- Create your own Helm Charts with Helm
- Push them to Helm Repository
- Download and use existing ones
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons
- Persisting Data in K8s with Volumes


Sharing Helm Charts 😎
Kubernetes Cluster
Need some Deployment?
pod
svc
my-app pod
my-app service
helm search <keyword>
or Helm Hub:
Discover & launch great Kubernetes-ready apps
Search charts...
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet
- K8s Services explained



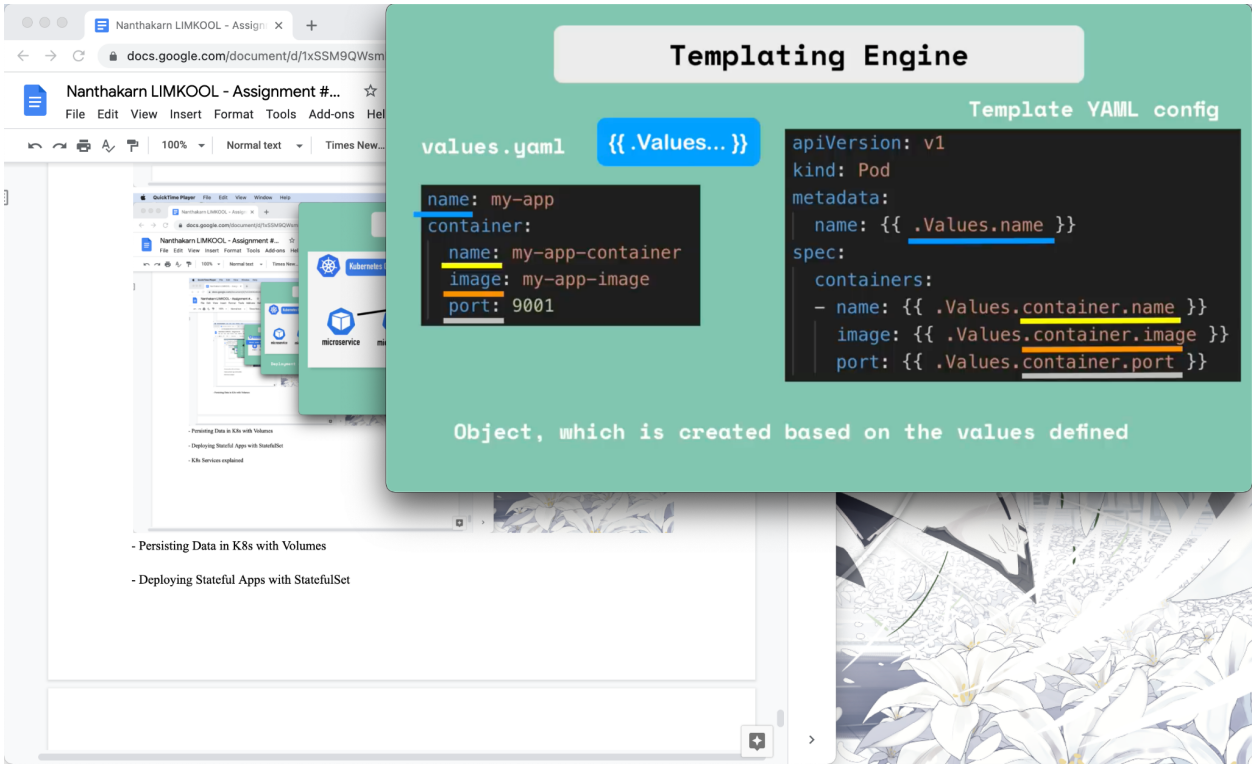
- Persisting Data in K8s with Volumes



- Persisting Data in K8s with Volumes

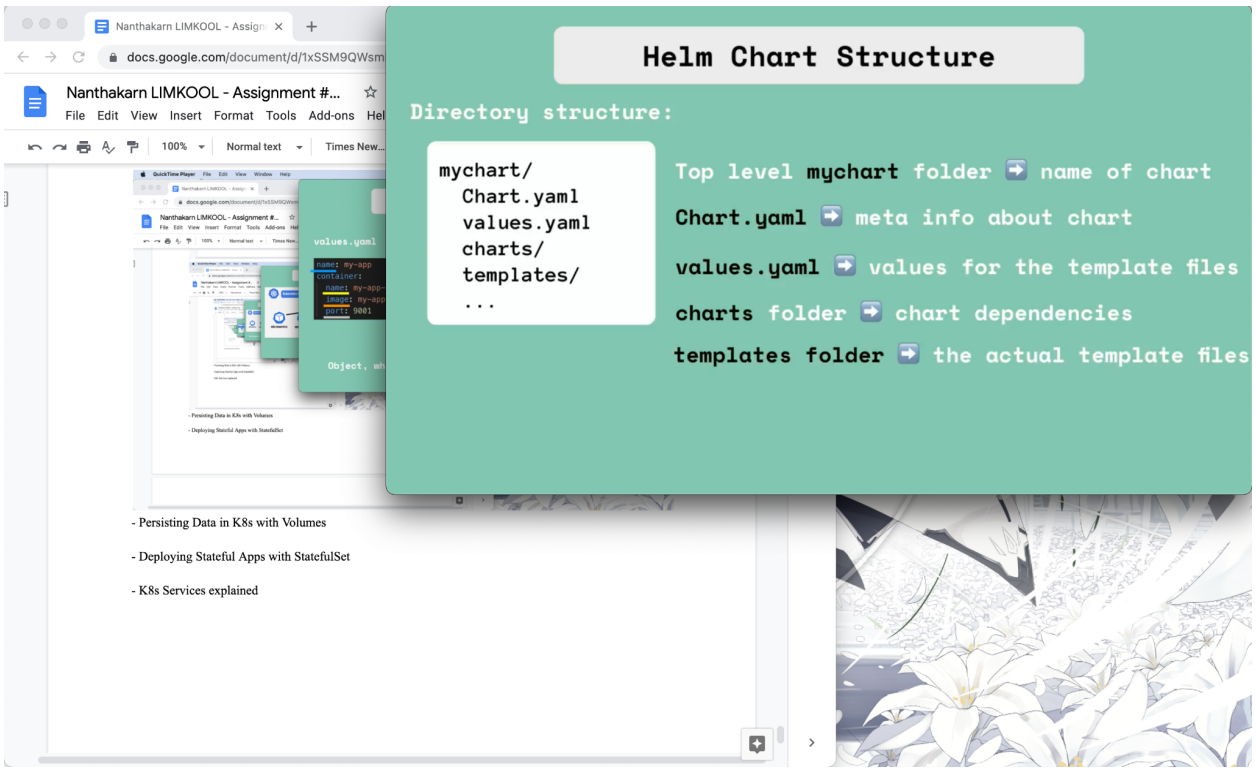
- Deploying Stateful Apps with StatefulSet

- K8s Services explained



- Persisting Data in K8s with Volumes

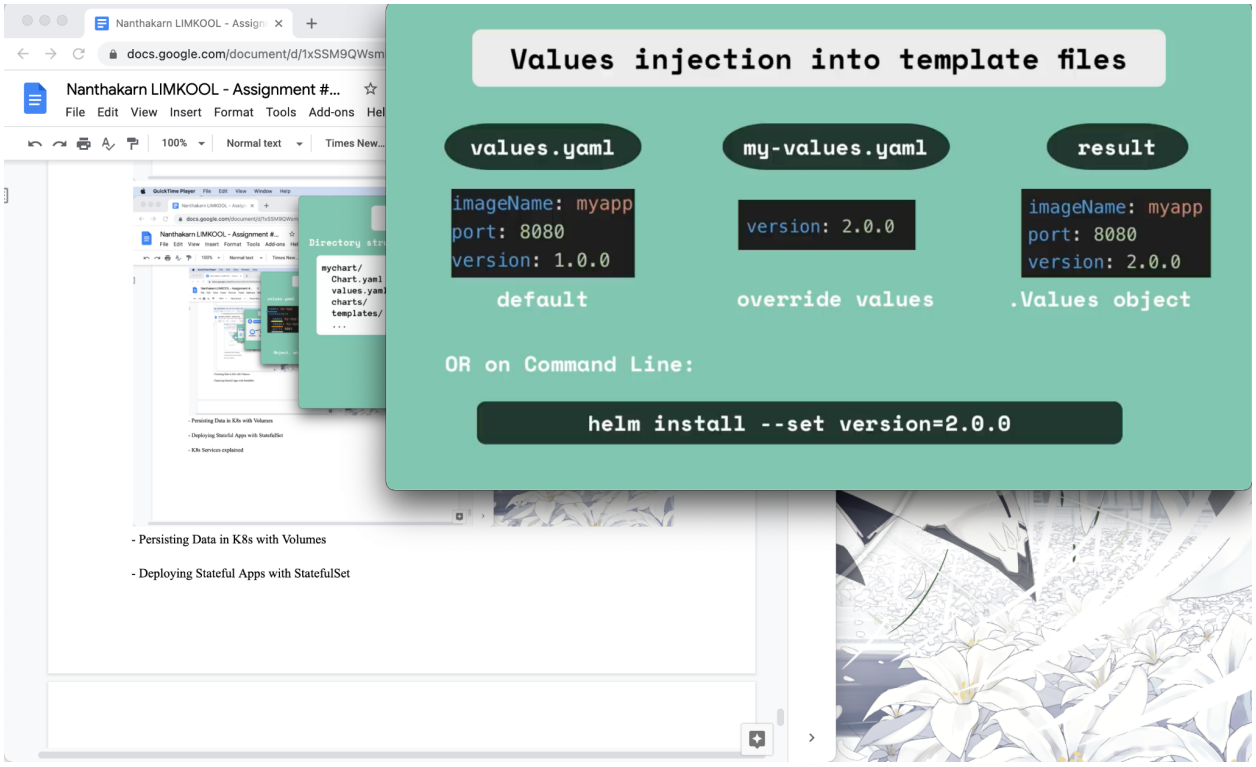
- Deploying Stateful Apps with StatefulSet



- Persisting Data in K8s with Volumes

- Deploying Stateful Apps with StatefulSet

- K8s Services explained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Nanthakarn LIMKOOL - Assignment #...
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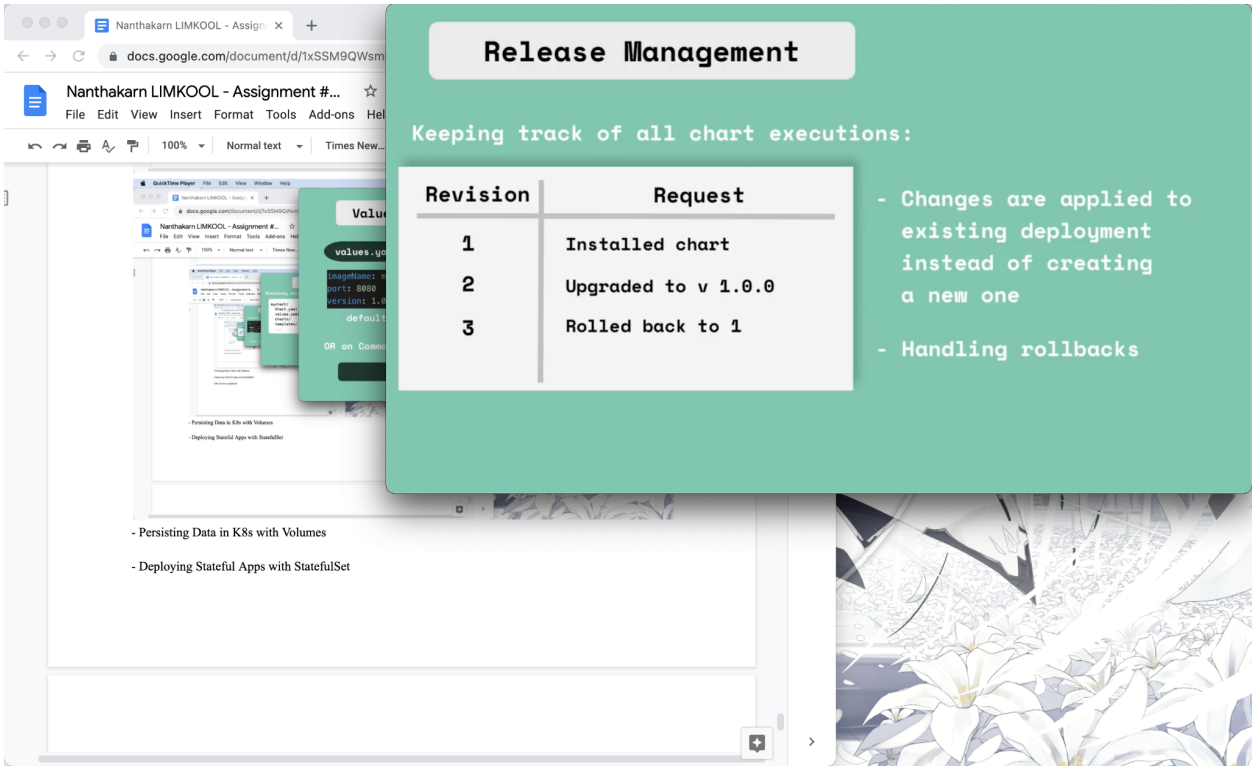
Values injection into template files
values.yaml
imageName: myapp
port: 8080
version: 1.0.0
default
my-values.yaml
version: 2.0.0
override values
result
imageName: myapp
port: 8080
version: 2.0.0
.Values object
OR on Command Line:
helm install --set version=2.0.0
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
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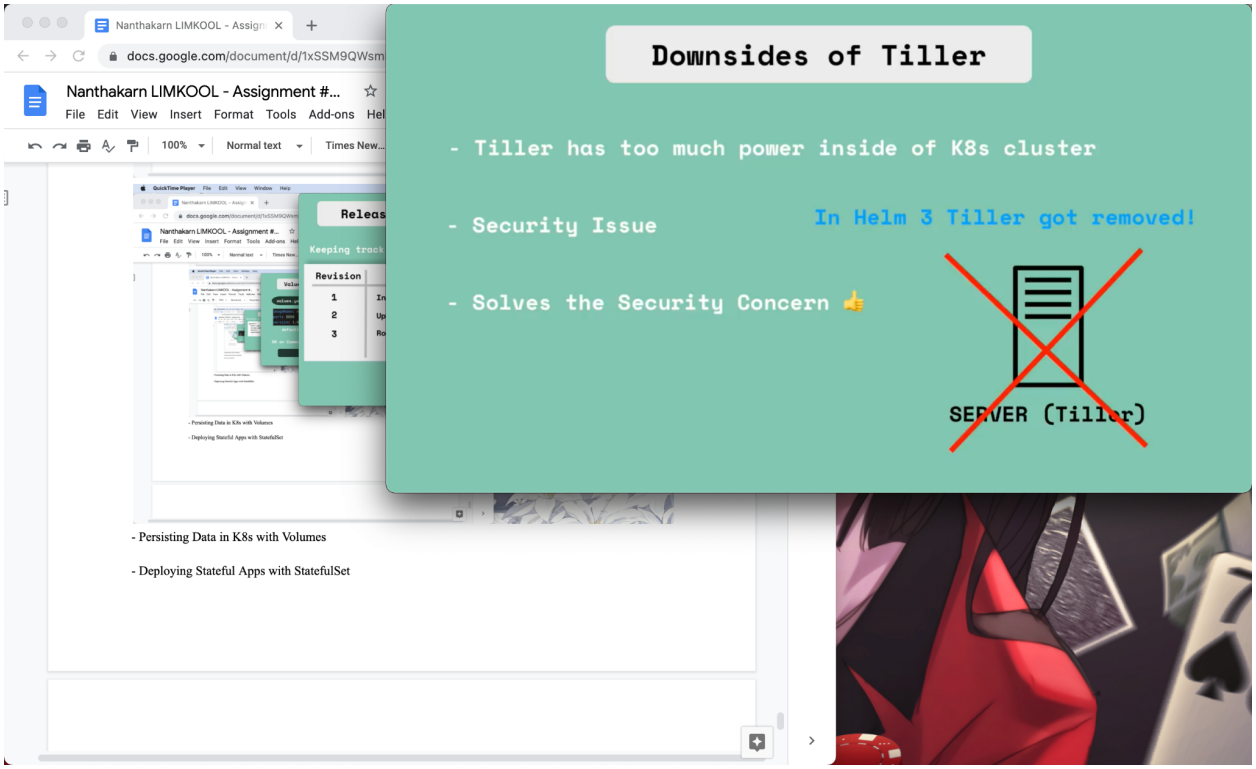
Release Management
Keeping track of all chart executions:
Revision
Request
1
Installed chart
2
Upgraded to v 1.0.0
3
Rolled back to 1
- Changes are applied to existing deployment instead of creating a new one
- Handling rollbacks
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet


Nanthakarn LIMKOOL - Assign
docs.google.com/document/d/1xSSM9QWsm
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
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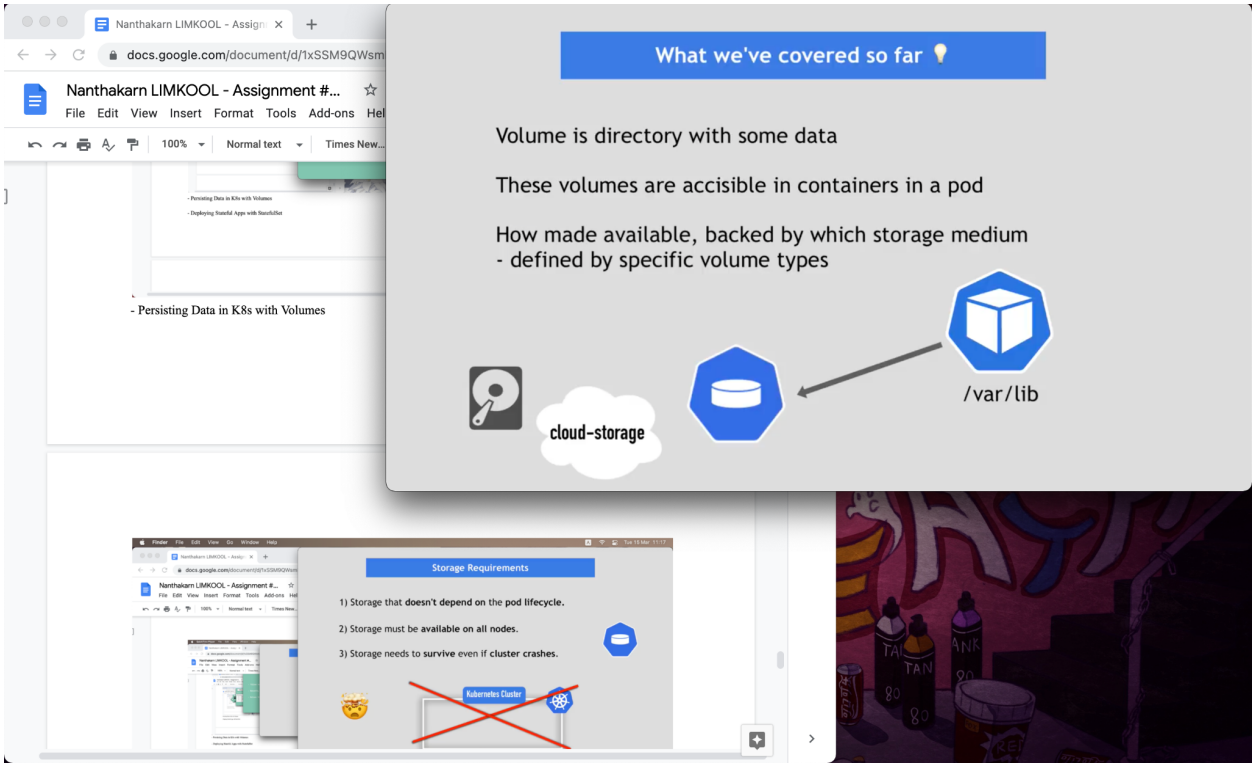
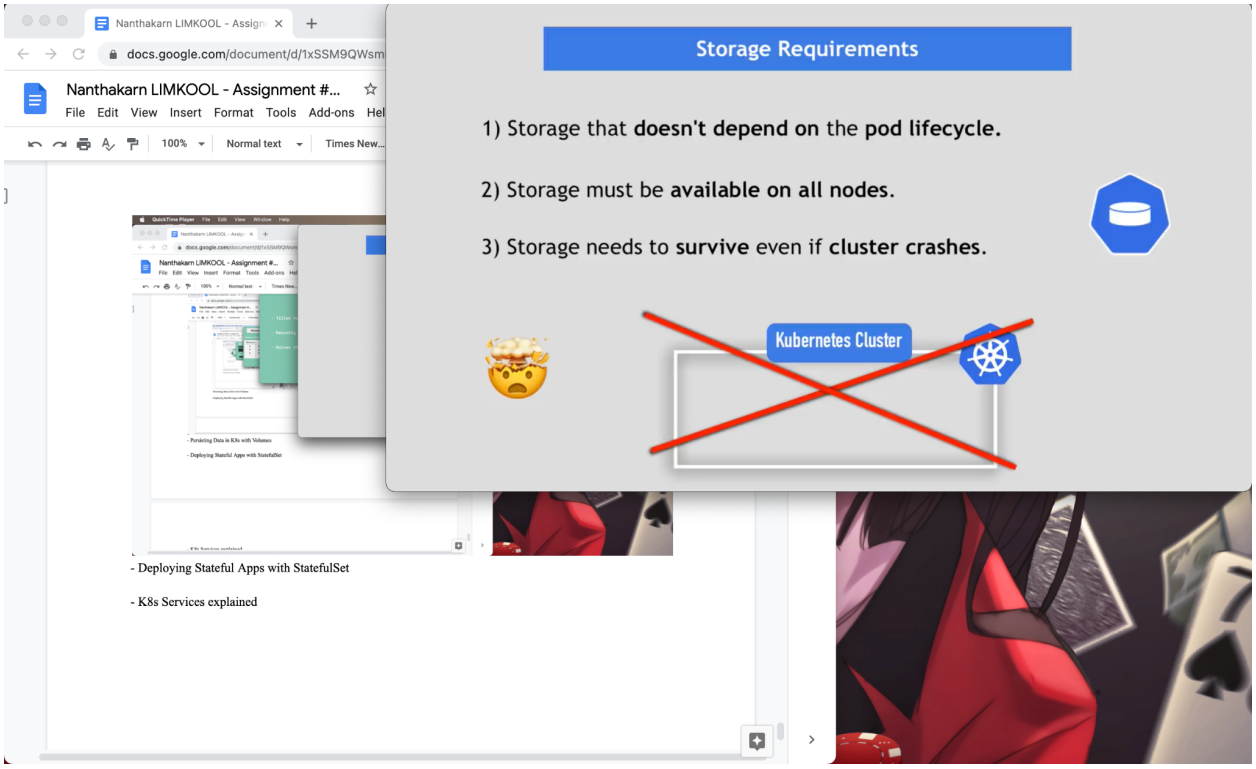
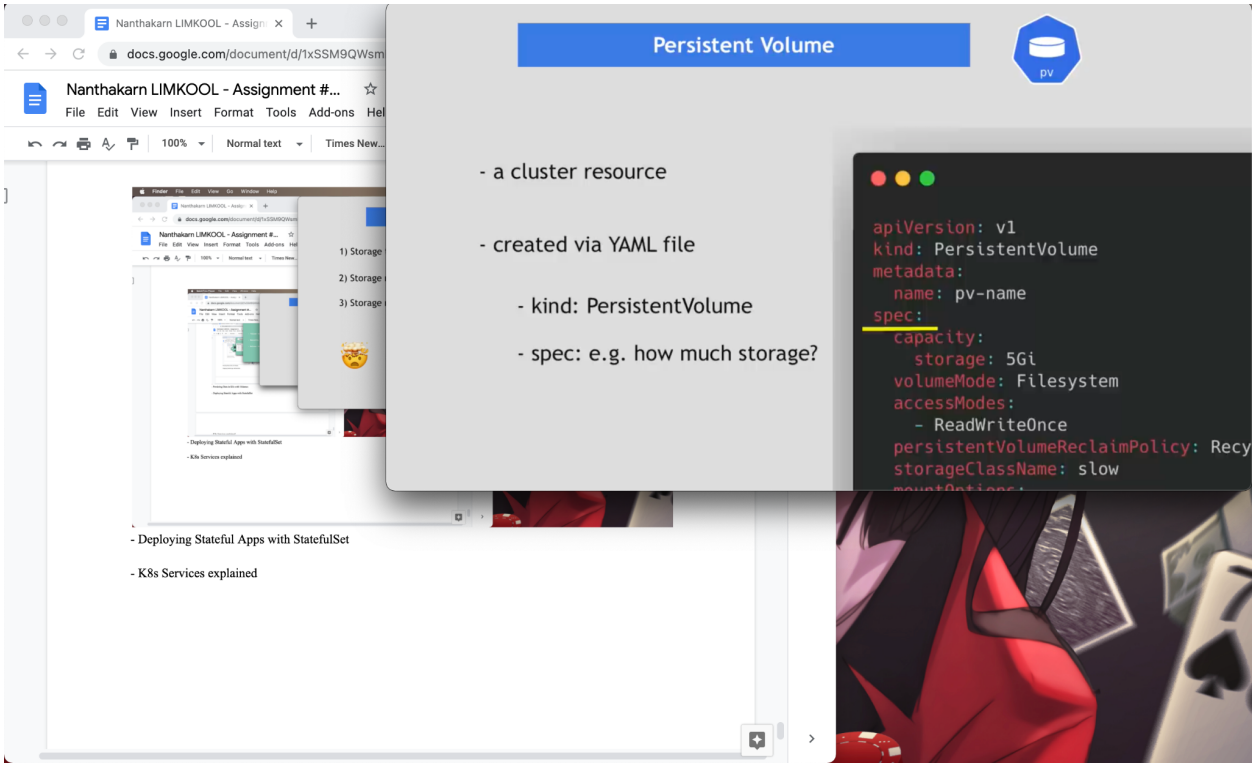
Times New...
Downsides of Tiller
- Tiller has too much power inside of K8s cluster
- Security Issue
- Solves the Security Concern 👍
In Helm 3 Tiller got removed!
SERVER (Tiller)
- Persisting Data in K8s with Volumes
- Deploying Stateful Apps with StatefulSet

- Persisting Data in K8s with Volumes




Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons
Storage Requirements
1) Storage that doesn't depend on the pod lifecycle.
2) Storage must be available on all nodes.
3) Storage needs to survive even if cluster crashes.
Kubernetes Cluster
- Deploying Stateful Apps with StatefulSet
- K8s Services explained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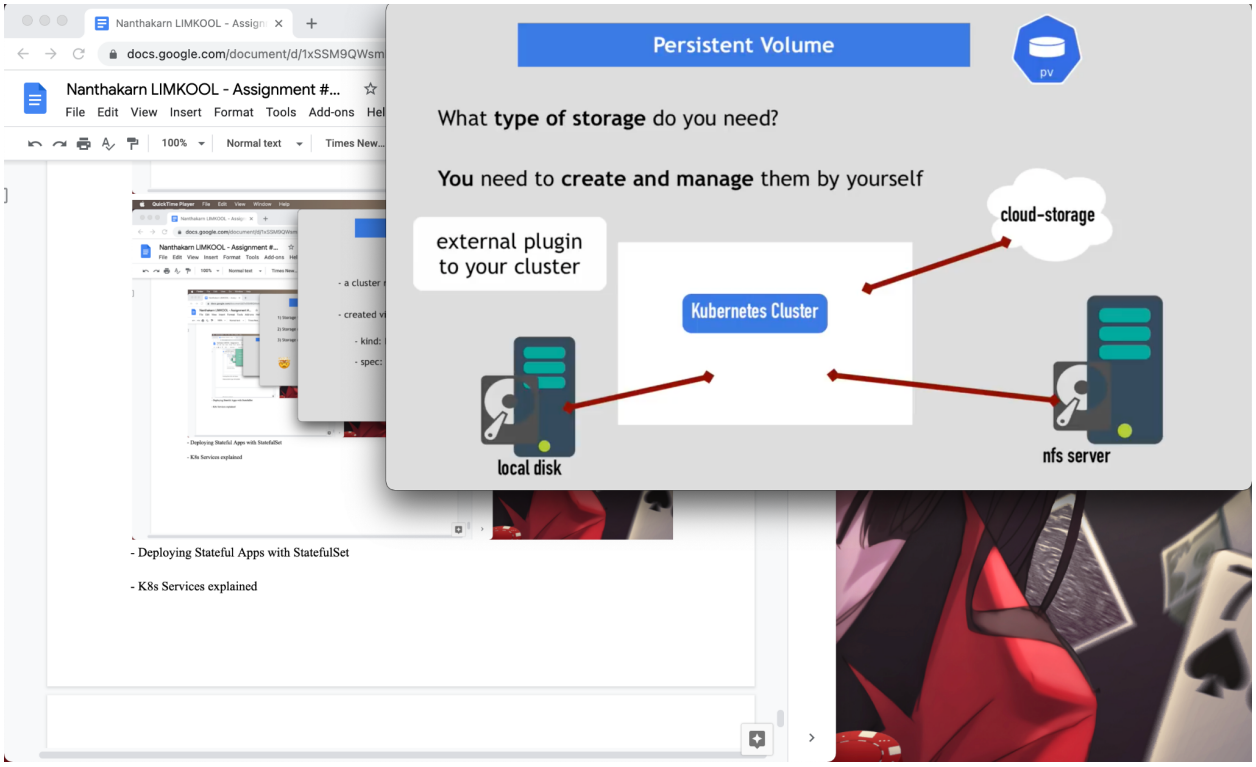
File Edit View Insert Format Tools Add-ons
Persistent Volume
pv
- a cluster resource
- created via YAML file
- kind: PersistentVolume
- spec: e.g. how much storage?
apiVersion: v1
kind: PersistentVolume
metadata:
name: pv-name
spec:
capacity:
storage: 5Gi
volumeMode: Filesystem
accessModes:
- ReadWriteOnce
persistentVolumeReclaimPolicy: Recy
storageClassName: slow
- Deploying Stateful Apps with StatefulSet
- K8s Services explained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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
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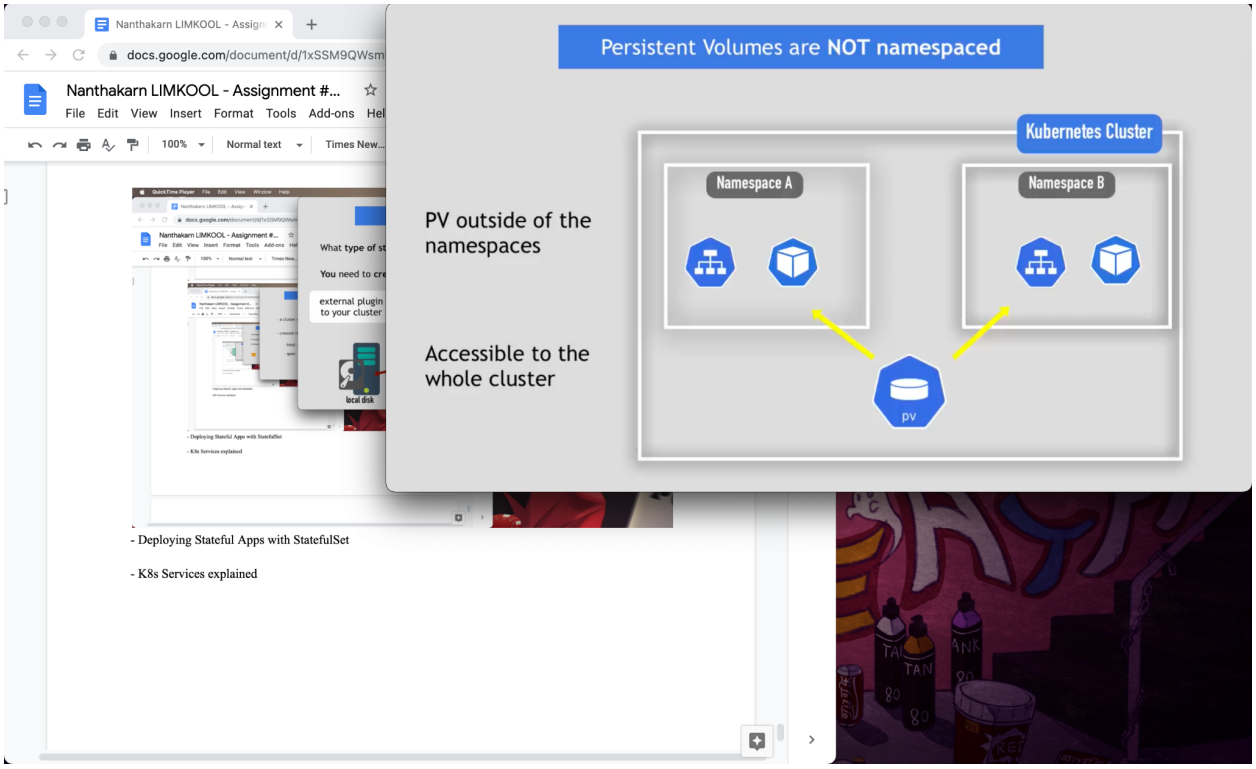
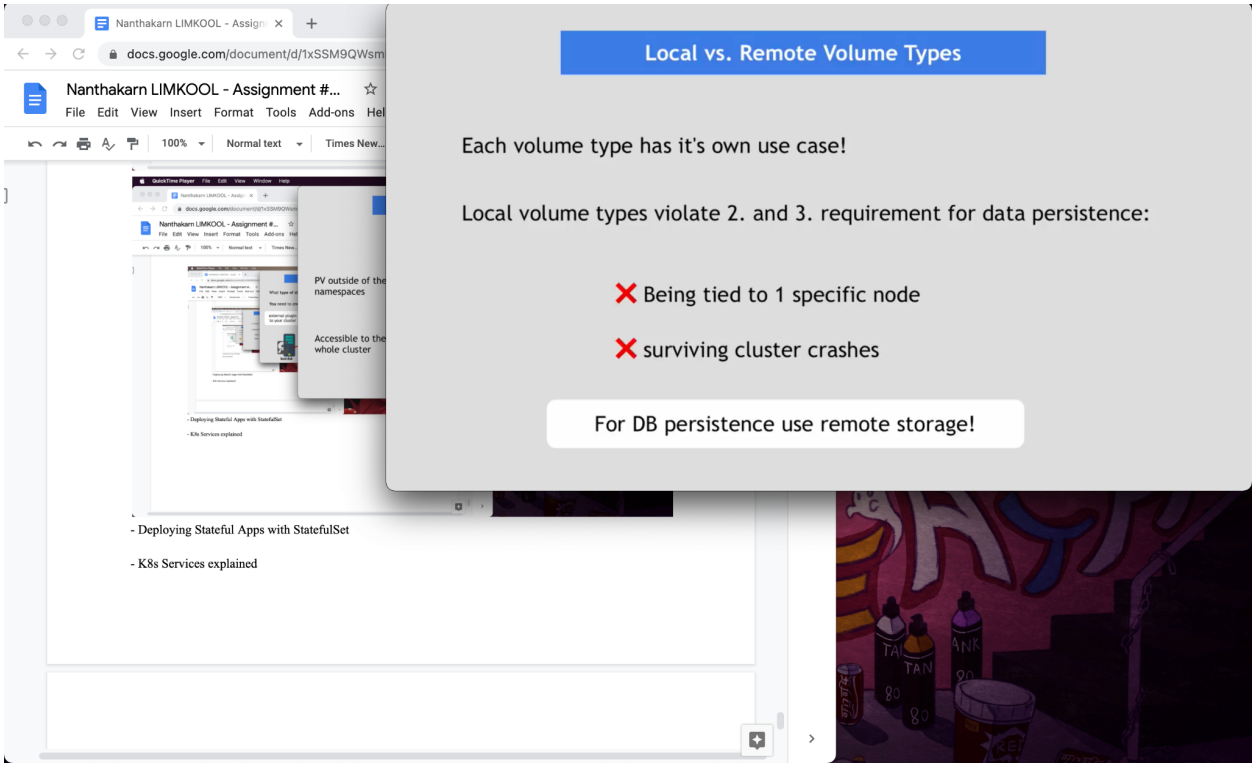
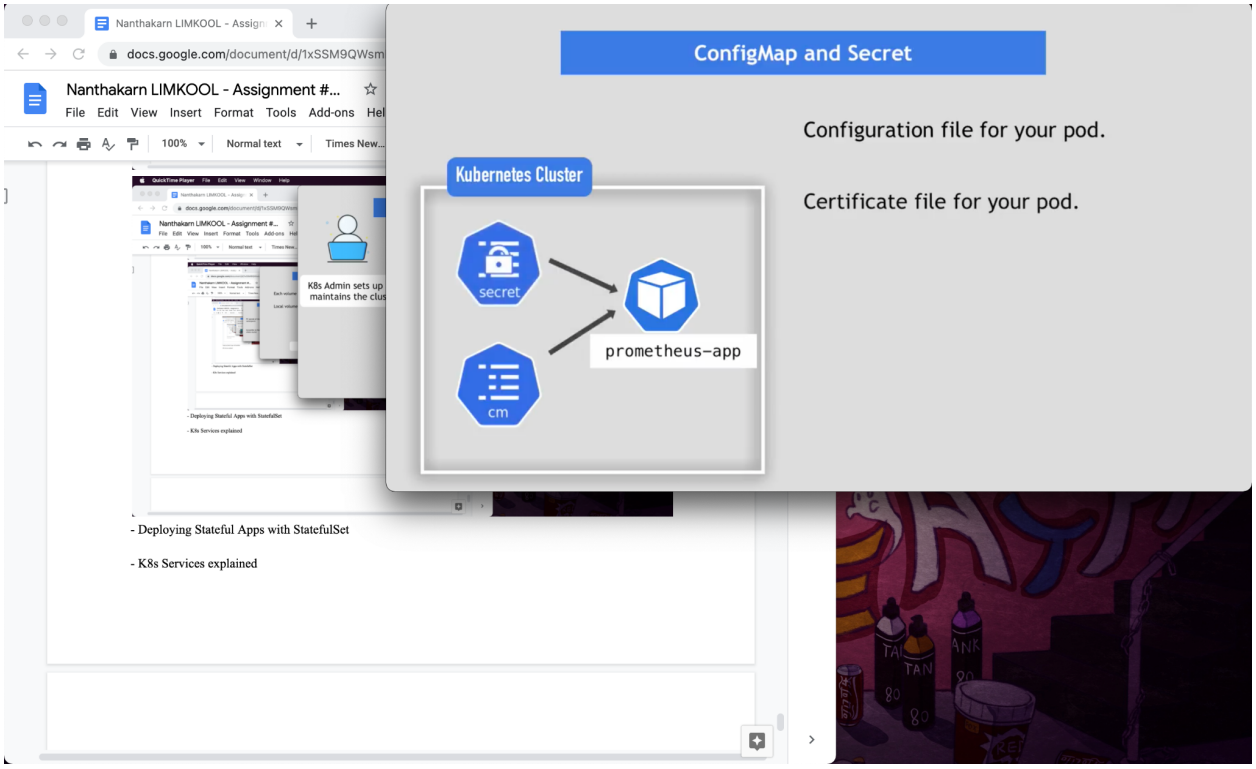
Persistent Volume
pv
What type of storage do you need?
You need to create and manage them by yourself
external plugin to your cluster
cloud-storage
Kubernetes Cluster
local disk
nfs server
- Deploying Stateful Apps with StatefulSet
- K8s Services explained


Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
docs.google.com/document/d/1xSSM9QWsm
Persistent Volumes are NOT namespaced
PV outside of the namespaces
Accessible to the whole cluster
Kubernetes Cluster
Namespace A
Namespace B
pv
- Deploying Stateful Apps with StatefulSet
- K8s Services explained


Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
docs.google.com/document/d/1xSSM9QWsm
Local vs. Remote Volume Types
Each volume type has it's own use case!
Local volume types violate 2. and 3. requirement for data persistence:
❌ Being tied to 1 specific node
❌ surviving cluster crashes
For DB persistence use remote storage!
- Deploying Stateful Apps with StatefulSet
- K8s Services explained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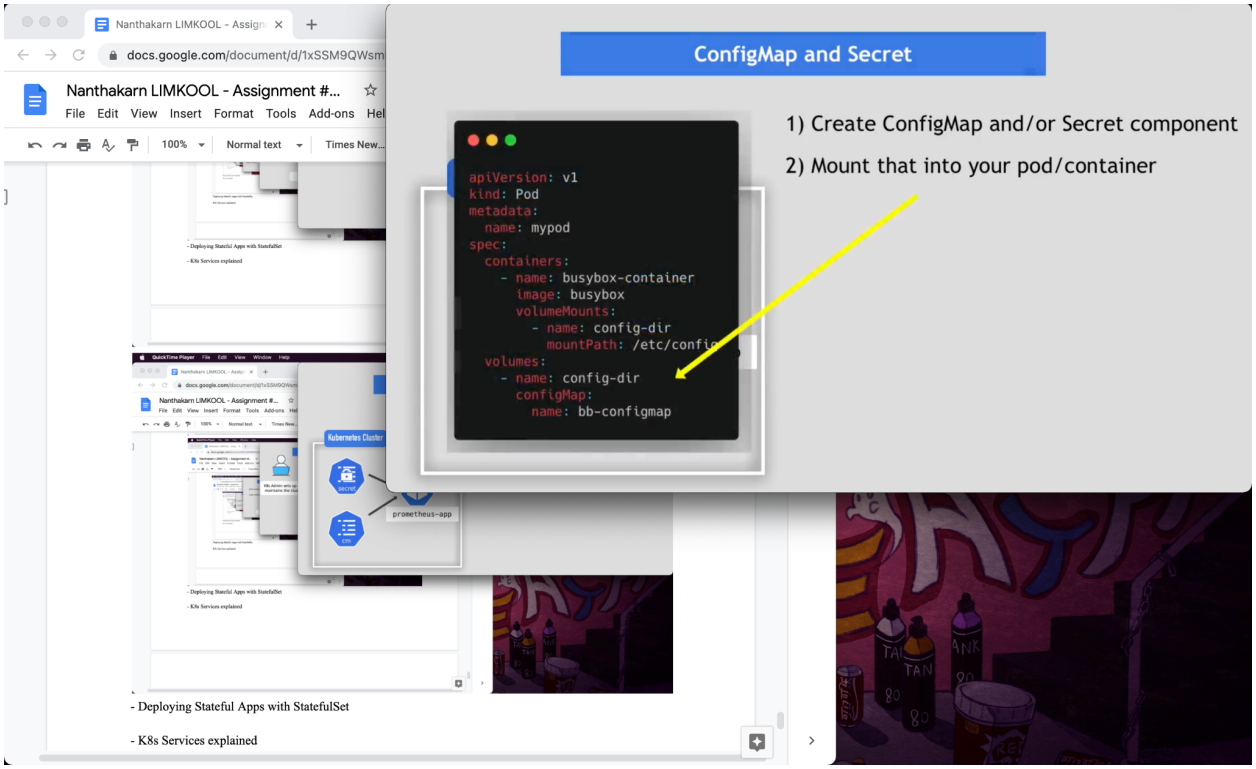
File Edit View Insert Format Tools Add-ons
ConfigMap and Secret
Configuration file for your pod.
Certificate file for your pod.
Kubernetes Cluster
secret
cm
prometheus-app
- Deploying Stateful Apps with StatefulSet
- K8s Services explained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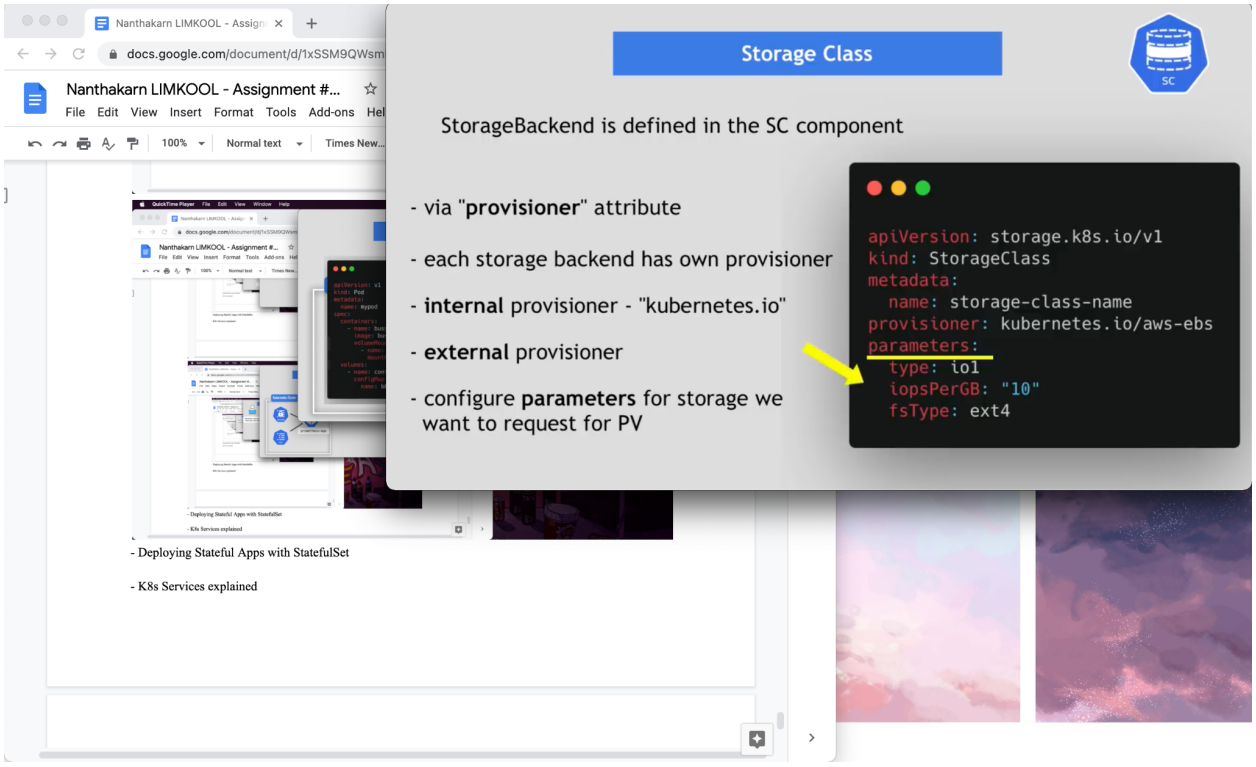
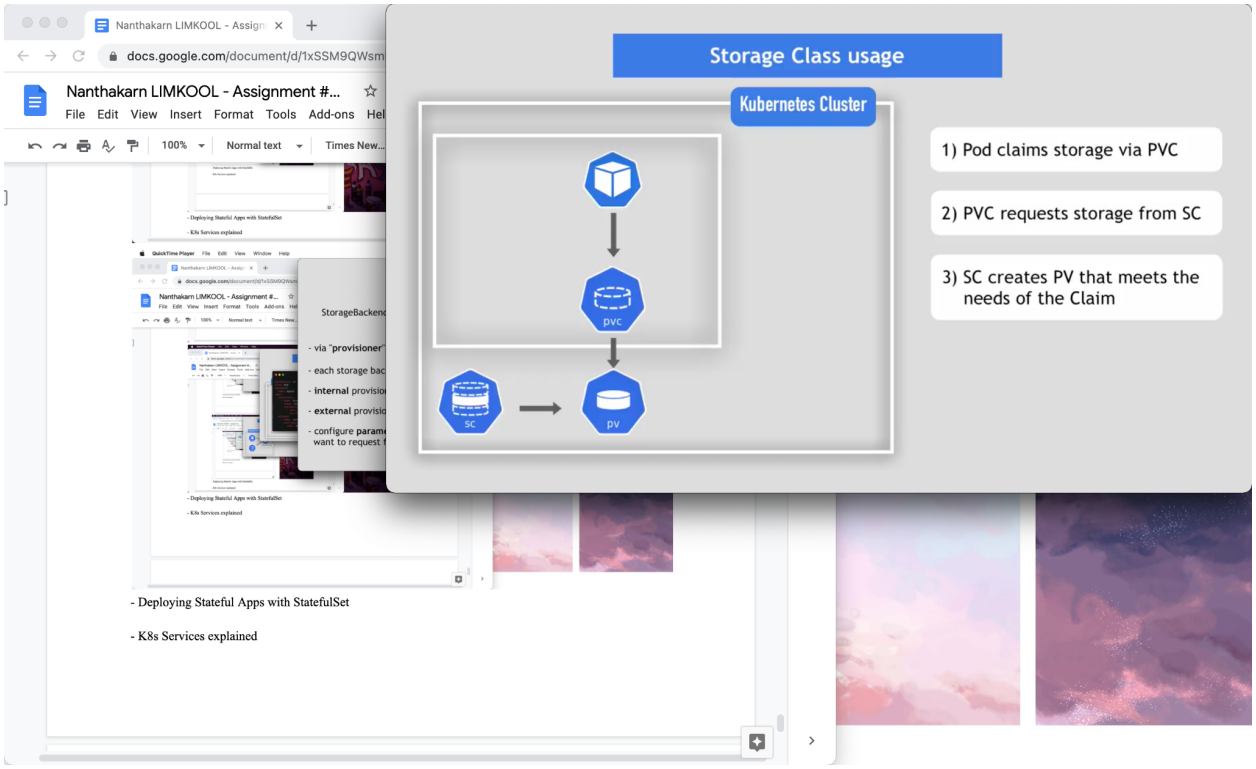
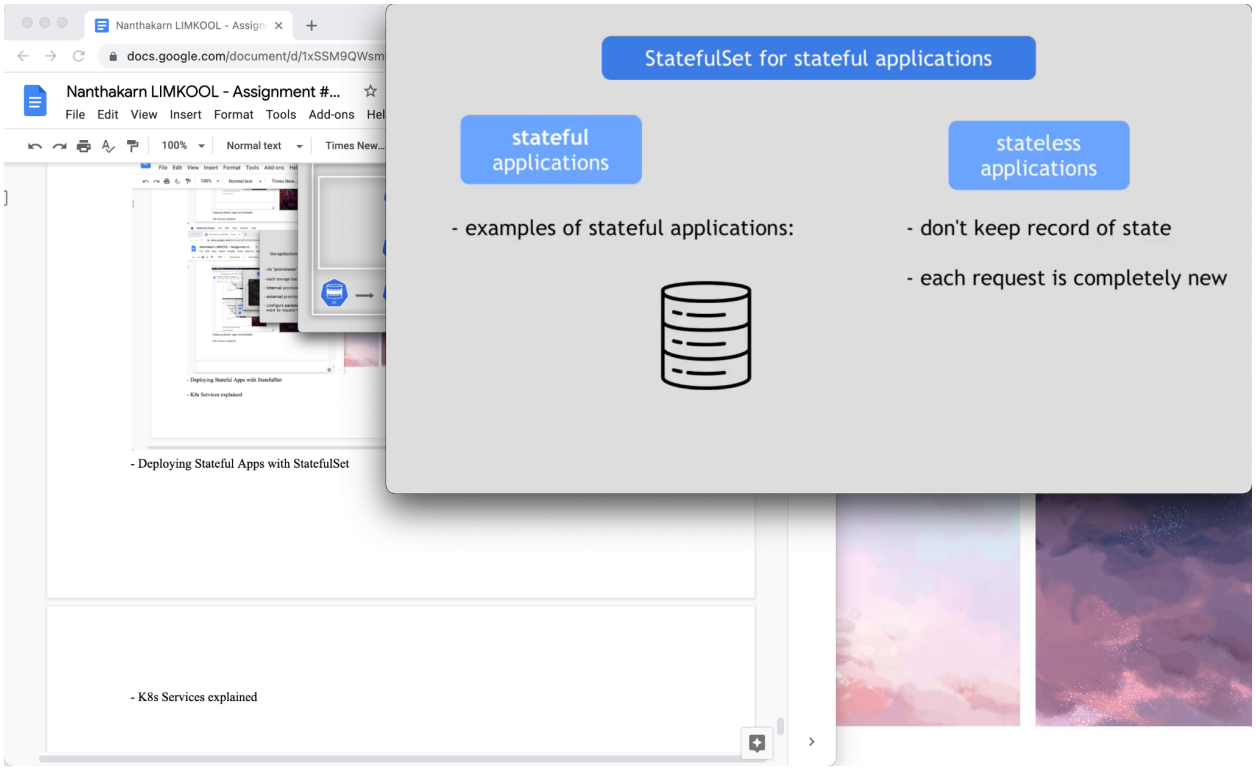
File Edit View Insert Format Tools Add-ons
ConfigMap and Secret
1) Create ConfigMap and/or Secret component
2) Mount that into your pod/container
apiVersion: v1
kind: Pod
metadata:
name: mypod
spec:
containers:
- name: busybox-container
image: busybox
volumeMounts:
- name: config-dir
mountPath: /etc/confi
volumes:
- name: config-dir
configMap:
name: bb-configmap
- Deploying Stateful Apps with StatefulSet
- K8s Services explained





- Deploying Stateful Apps with StatefulSet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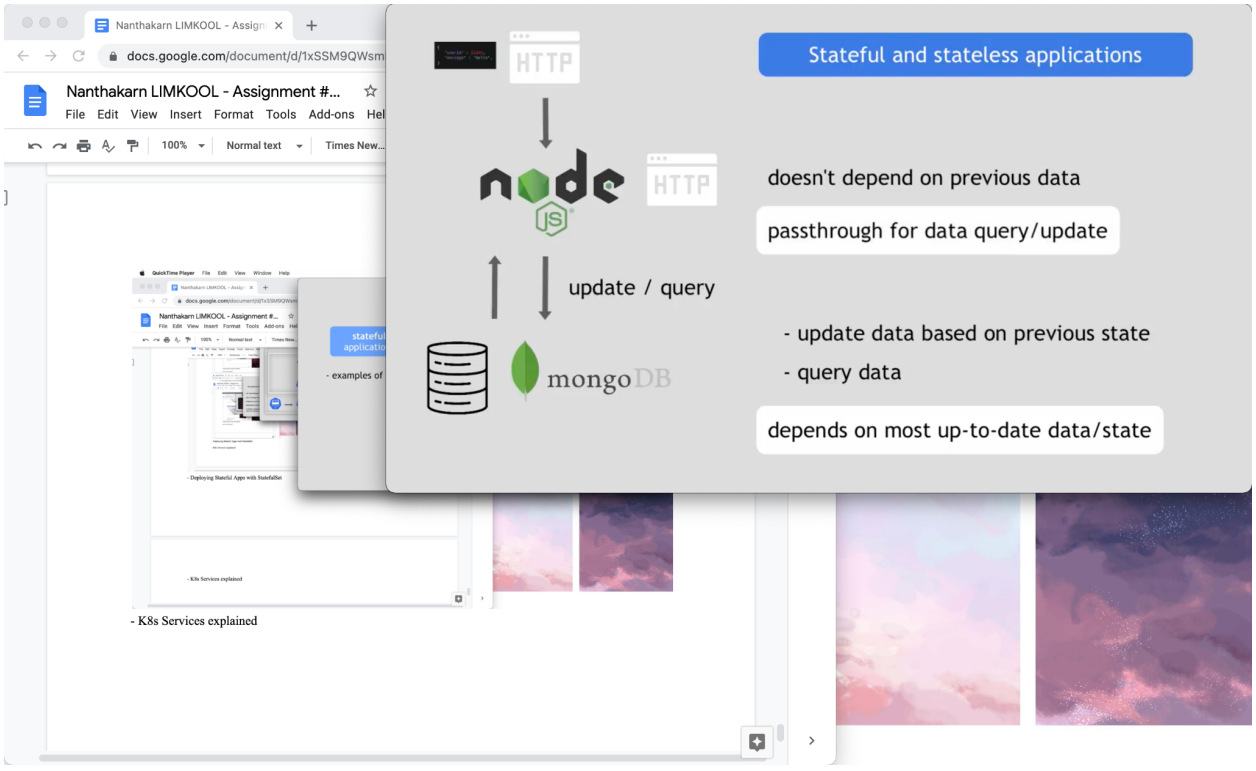
Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
100%
Normal text
Times New...
- Deploying Stateful Apps with StatefulSet
- K8s Services explained
StatefulSet for stateful applications
stateful applications
stateless applications
- examples of stateful applications:
- don't keep record of state
- each request is completely new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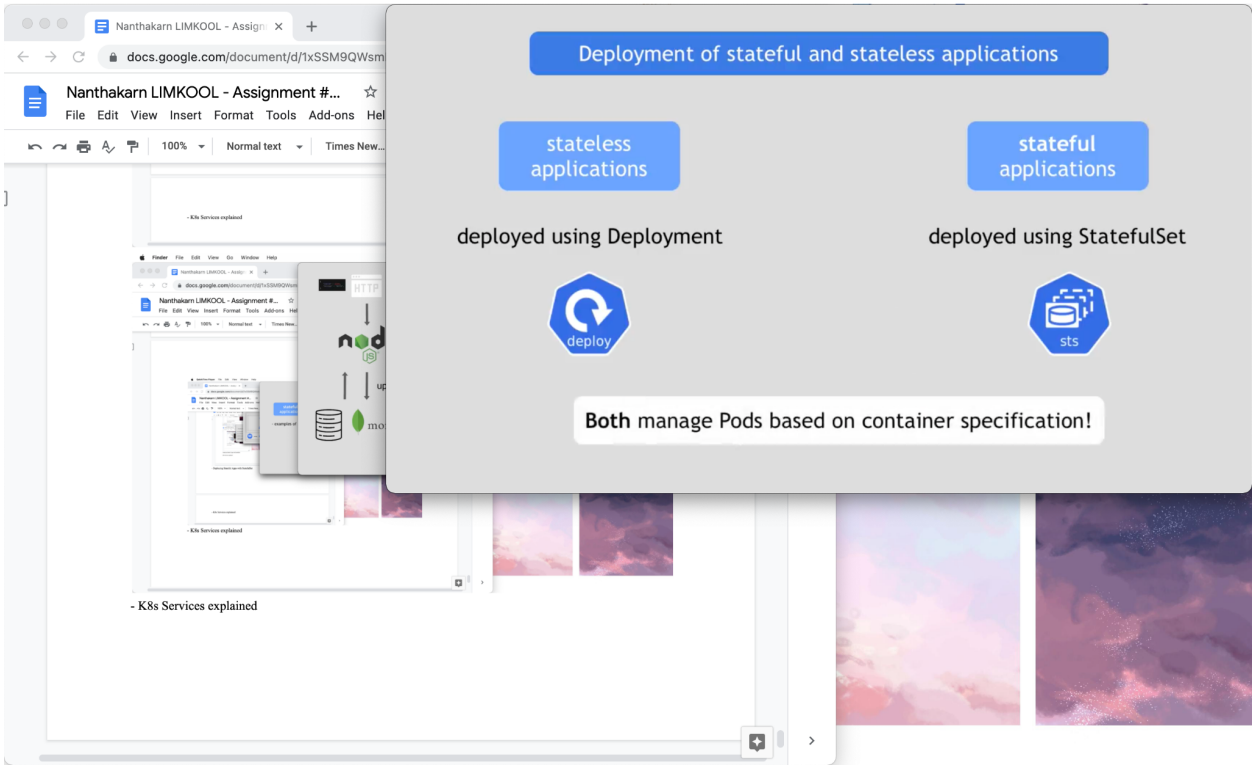
Times New...
- Deploying Stateful Apps with StatefulSet
- K8s Services explained
HTTP
node
HTTP
update / query
mongoDB
Stateful and stateless applications
doesn't depend on previous data
passthrough for data query/update
- update data based on previous state
- query data
depends on most up-to-date data/state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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
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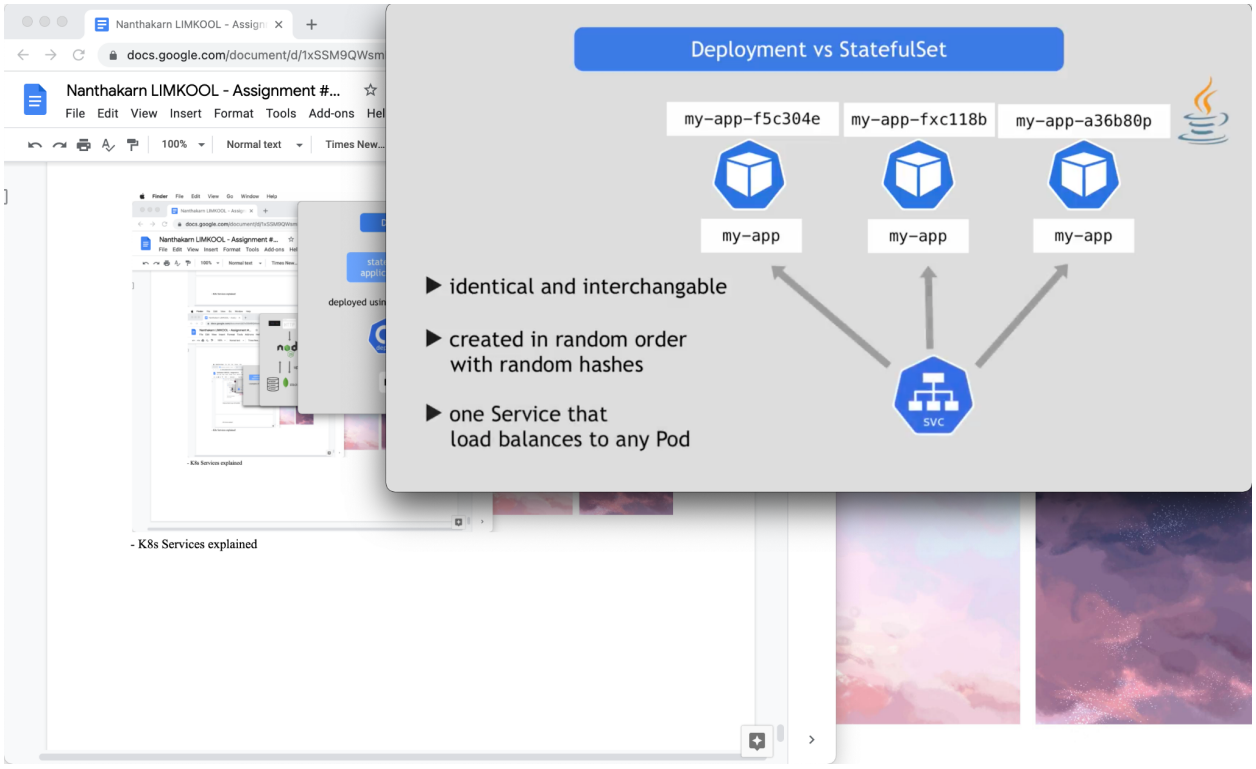
- K8s Services explained
Deployment of stateful and stateless applications
stateless applications
stateful applications
deployed using Deployment
deployed using StatefulSet
deploy
sts
Both manage Pods based on container specification!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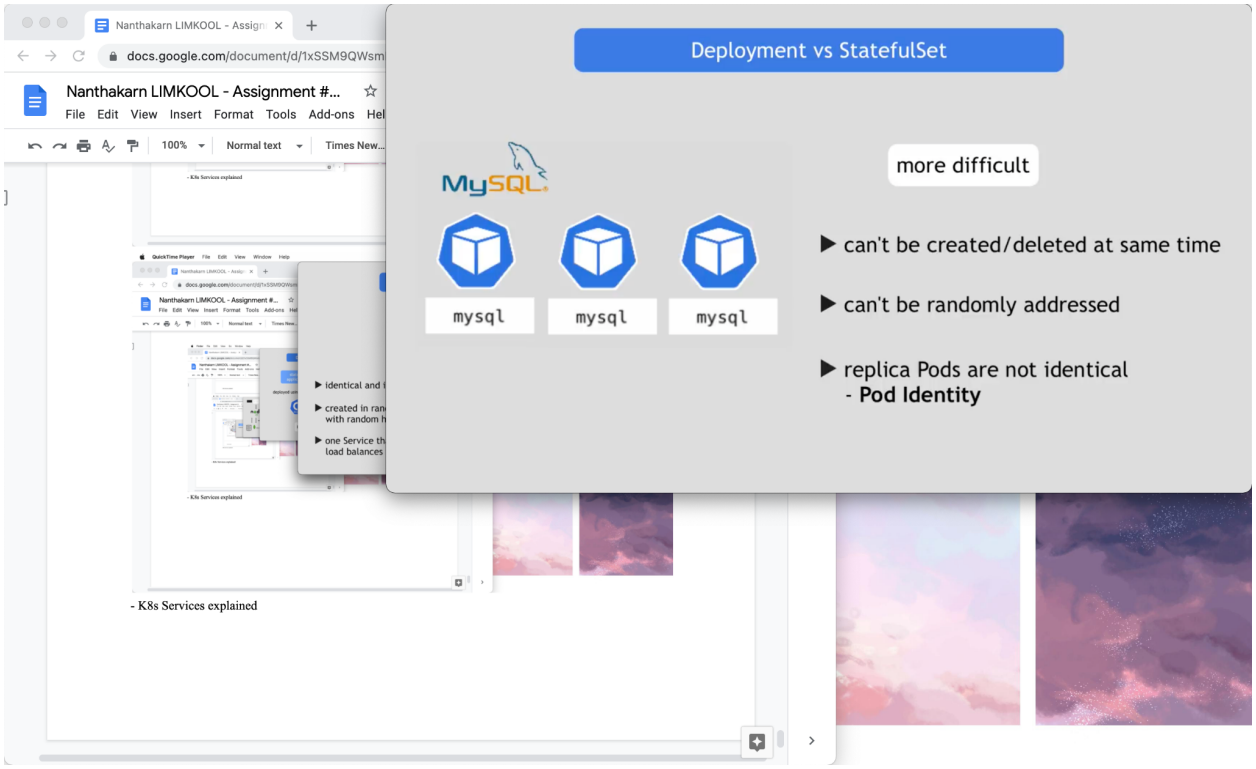
- K8s Services explained
Deployment vs StatefulSet
my-app-f5c304e
my-app-fxc118b
my-app-a36b80p
my-app
my-app
my-app
SVC
▶ identical and interchangable
▶ created in random order with random hashes
▶ one Service that load balances to any Pod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Nanthakarn LIMKOOL - Assignment #...
File Edit View Insert Format Tools Add-ons Hel
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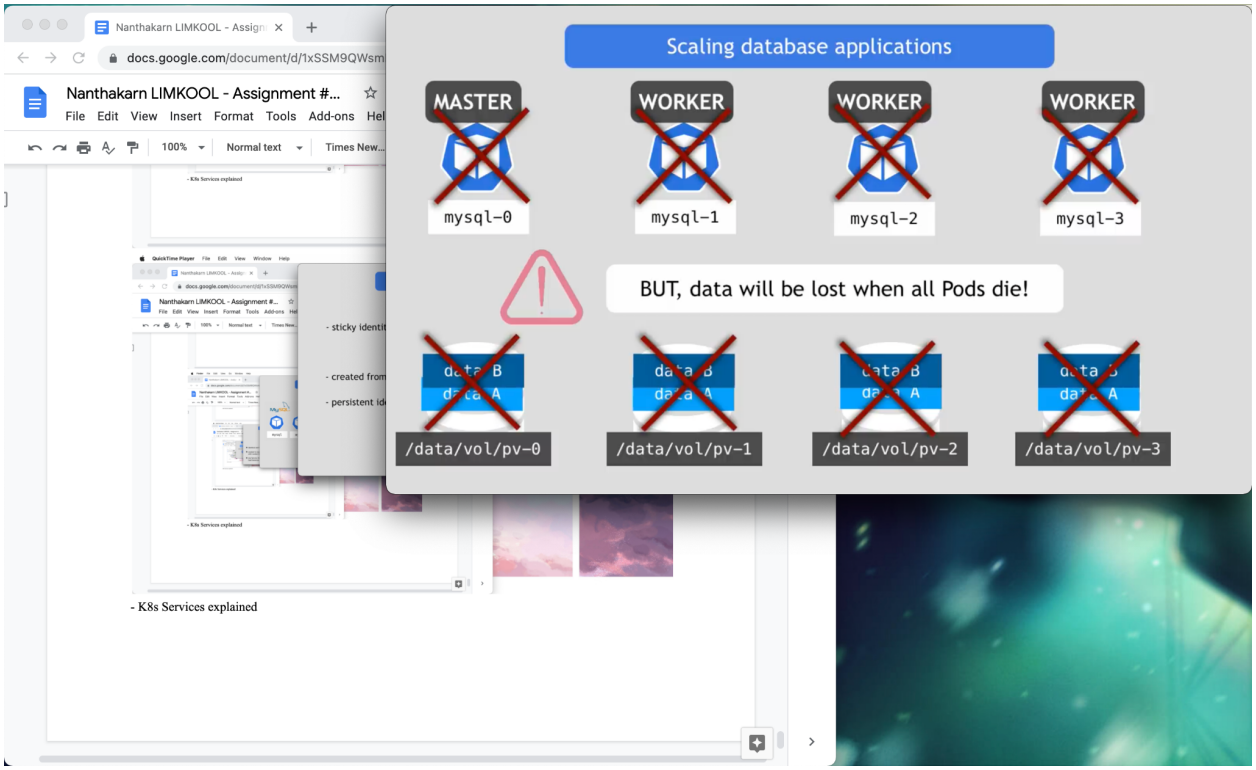
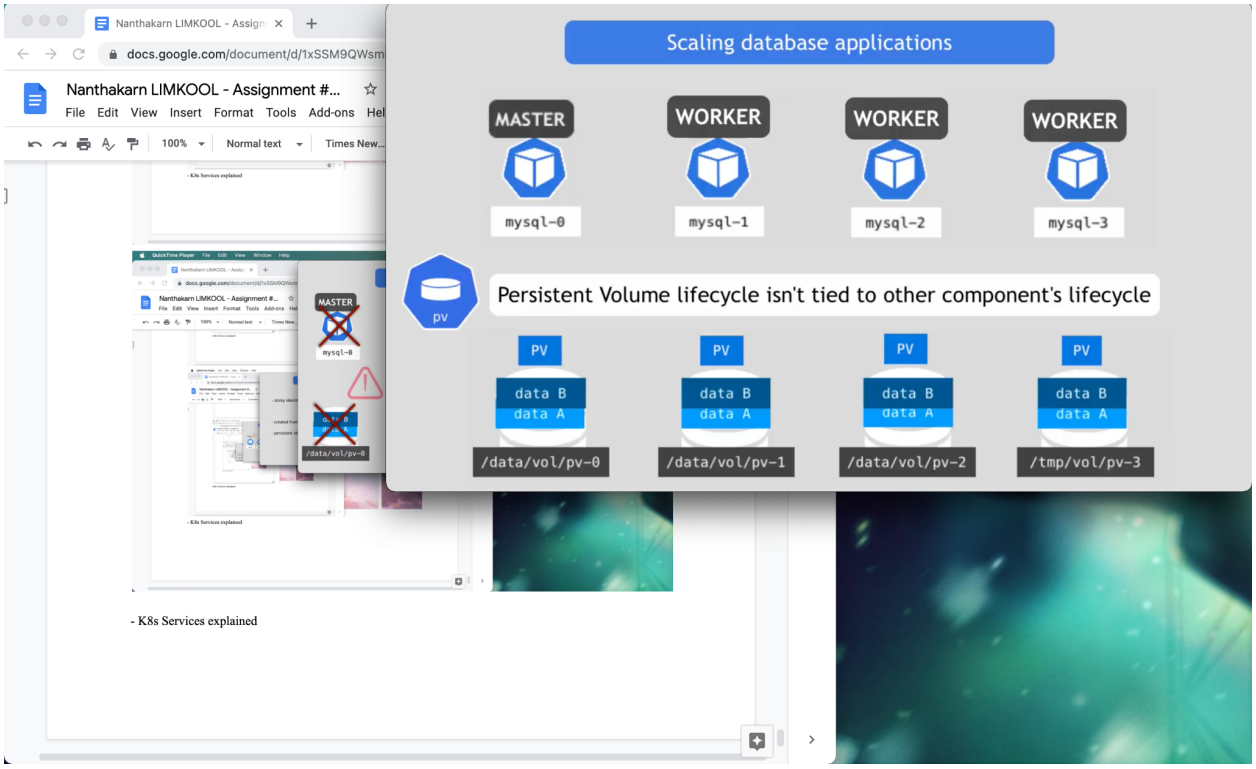
- K8s Services explained
Deployment vs StatefulSet
MySQL
mysql
mysql
mysql
more difficult
▶ can't be created/deleted at same time
▶ can't be randomly addressed
▶ replica Pods are not identical
- Pod Identity



After config pod state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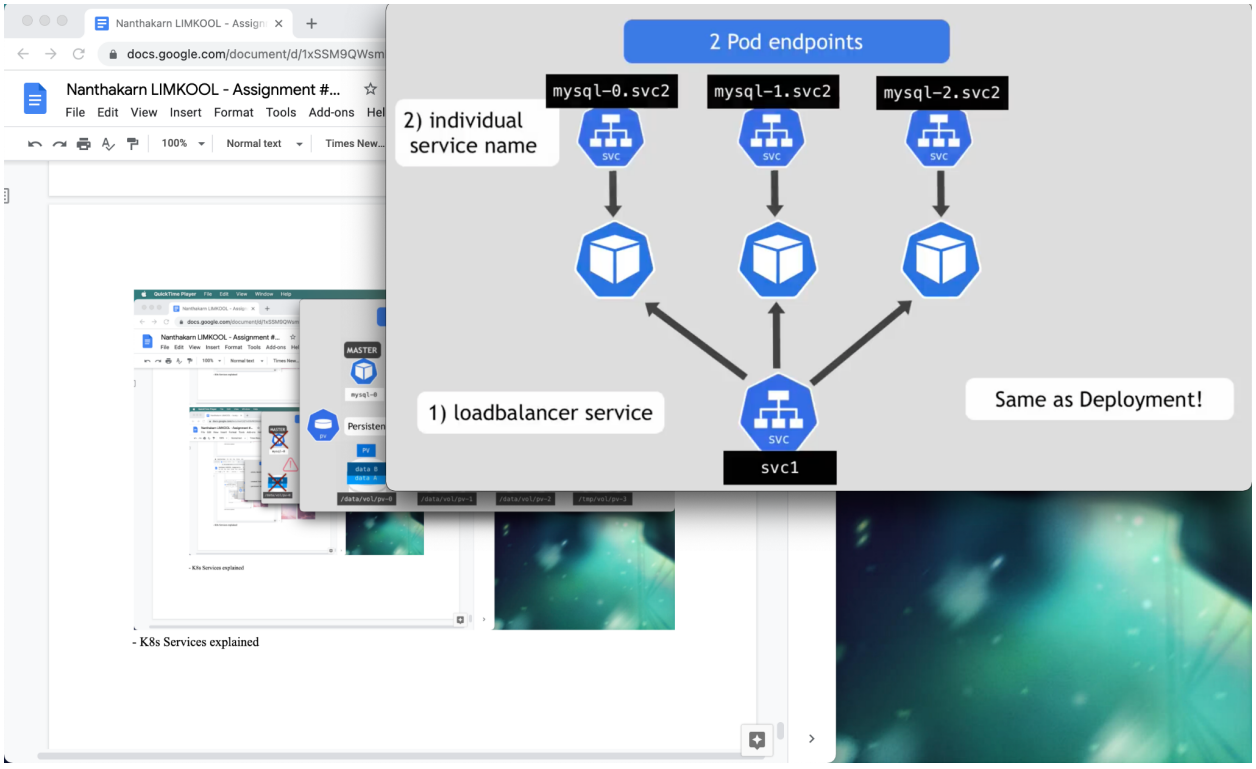
Scaling database applications
MASTER
WORKER
WORKER
WORKER
mysql-0
mysql-1
mysql-2
mysql-3
pv
Persistent Volume lifecycle isn't tied to other component's lifecycle
PV
data B
data A
/data/vol/pv-0
/data/vol/pv-1
/data/vol/pv-2
/tmp/vol/pv-3
- K8s Services explained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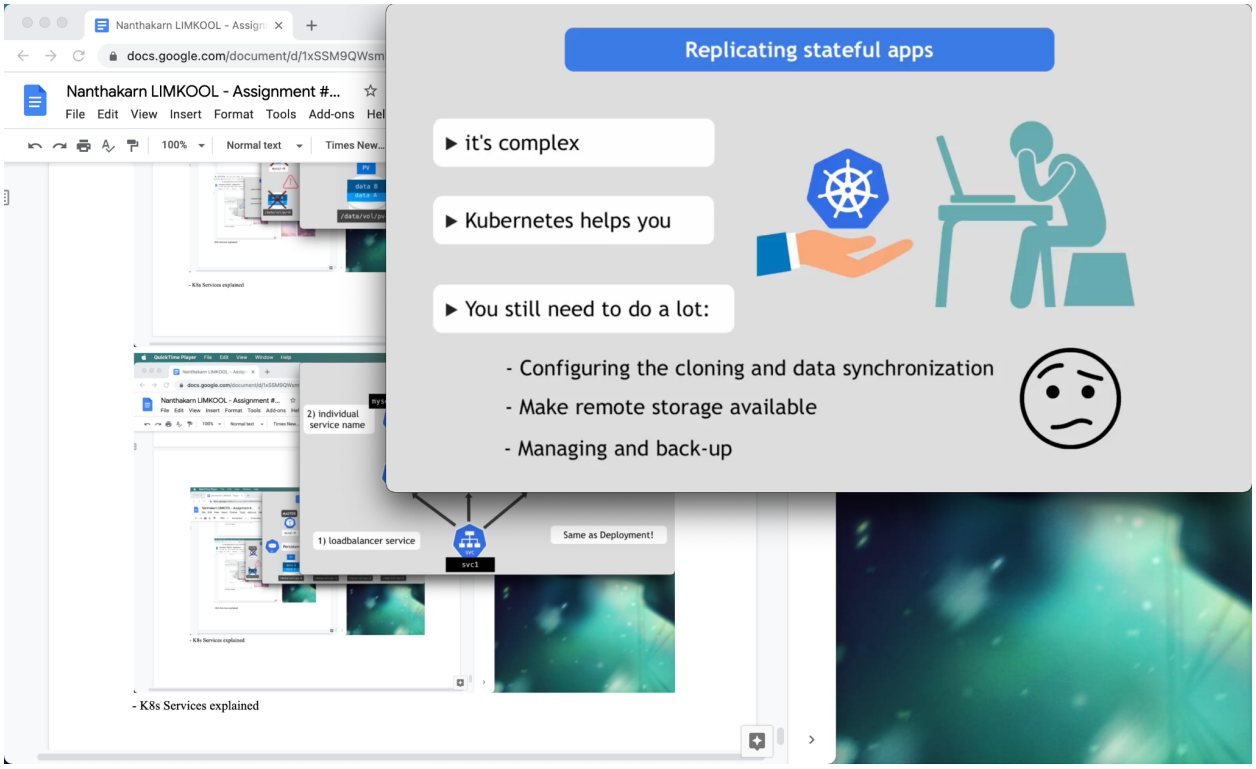
2 Pod endpoints
mysql-0.svc2
mysql-1.svc2
mysql-2.svc2
2) individual service name
SVC
1) loadbalancer service
Same as Deployment!
svc1
- K8s Services explained



- K8s Services explained