

Configuration Manual

MSc Research Project
Cloud Computing

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MSc Project Submission Sheet
School of Computing



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Programme: MSc Cloud Computing **Year:** 2024-25
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Lecturer: Sai Emani
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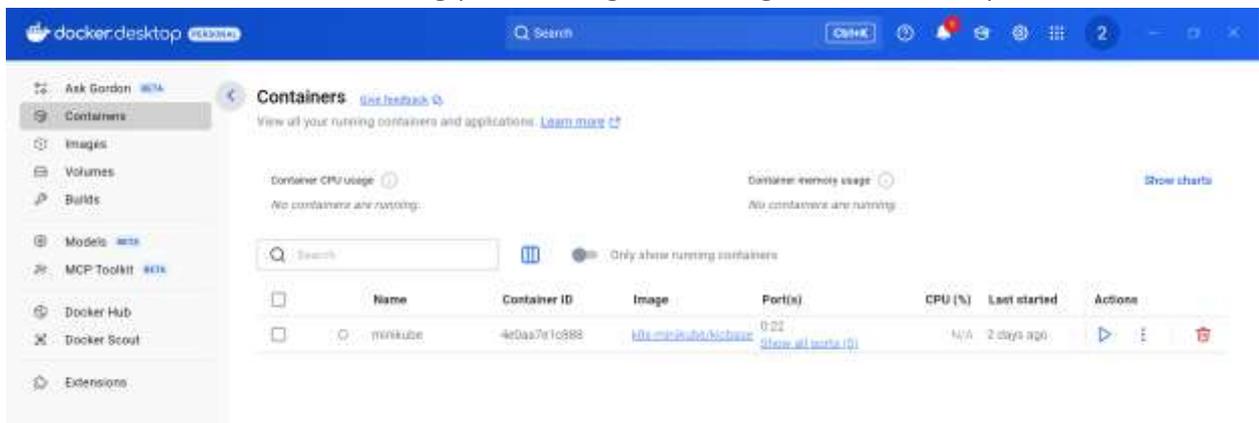
Configuration Manual

Prajwal Kagganti
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Section 1:- Setting up the Environment

1.1.1 Step 1: Install Docker Desktop

1. Download Docker Desktop from: <https://www.docker.com/products/docker-desktop>.
2. Run the installer and proceed through the setup wizard.
3. Ensure “Enable WSL 2 feature” is selected during installation.
4. Restart the machine if prompted.
5. Launch Docker Desktop.
6. Ensure Docker is running (check “Engine running” on dashboard).



1.1.2 Step 2: Create Dockerfile for Flask App

1. Open PowerShell and navigate to your working directory:

```
cd D:\\Kube
```

2. Create a file named Dockerfile with the following content:

```
FROM python:3.13-slim
WORKDIR /app
COPY . /app
RUN pip install --no-cache-dir flask
EXPOSE 5000
CMD ["python", "app.py"]
```

1.1.3 Step 3: Create app.py for Flask App

1. In D:\Kube, create a file app.py:

```
from flask import Flask
app = Flask(__name__)

@app.route('/health')
```

```

def health():
    return {"status": "healthy"}, 200

@app.route('/api/data')
def data():
    return {"message": "Sample data"}, 200

if __name__ == "__main__":
    app.run(host="0.0.0.0", port=5000)

```

1.1.4 Step 4: Build and Run Flask Container

1. Open PowerShell and navigate to D:\Kube.

```
cd D:\\Kube
```

2. Build Docker image:

```
docker build -t flask-local .
```

3. Run the container:

```
docker run -p 5000:5000 flask-local
```

4. Verify in browser: <http://localhost:5000/health>

1.1.5 Step 5: Install Minikube

1. Visit: <https://minikube.sigs.k8s.io/docs/start/>

2. Install using Chocolatey:

```
choco install minikube
```

3. Verify:

```
minikube version
```

```

PS D:\Kube> minikube version
minikube version: v1.36.0
commit: f8f52f5de11fc6ad8244afac475e1d0f96841df1-dirty

```

1.1.6 Step 6: Start Minikube

```
minikube start --driver=docker --cpus=2 --memory=4096mb
```

```
minikube status
```

```

PS D:\Kube> minikube start
* minikube v1.36.0 on Microsoft Windows 11 Home Single Language 10.0.26100.4652 Build 26100.4652
* Using the docker driver based on existing profile
* Starting "minikube" primary control-plane node in "minikube" cluster
* Pulling base image v0.0.47 ...
* Restarting existing docker container for "minikube" ...
* Failing to connect to https://registry.k8s.io/ from inside the minikube container
* To pull new external images, you may need to configure a proxy: https://minikube.sigs.k8s.io/docs/reference/networking/proxy/
* Preparing Kubernetes v1.33.1 on Docker 28.1.1 ...
* Verifying Kubernetes components...
  - Using image gcr.io/k8s-minikube/storage-provisioner:v5
* Enabled addons: storage-provisioner, default-storageclass

D:\Kube\kubectl.exe is version 1.31.0, which may have incompatibilities with Kubernetes 1.33.1.
- Want kubectl v1.33.1? Try 'minikube kubectl -- get pods -A'
* Done! kubectl is now configured to use "minikube" cluster and "default" namespace by default

```

```
PS D:\Kube> minikube status
minikube
type: Control Plane
host: Running
kubelet: Running
apiserver: Running
kubeconfig: Configured
```

Minikube start command and status check command

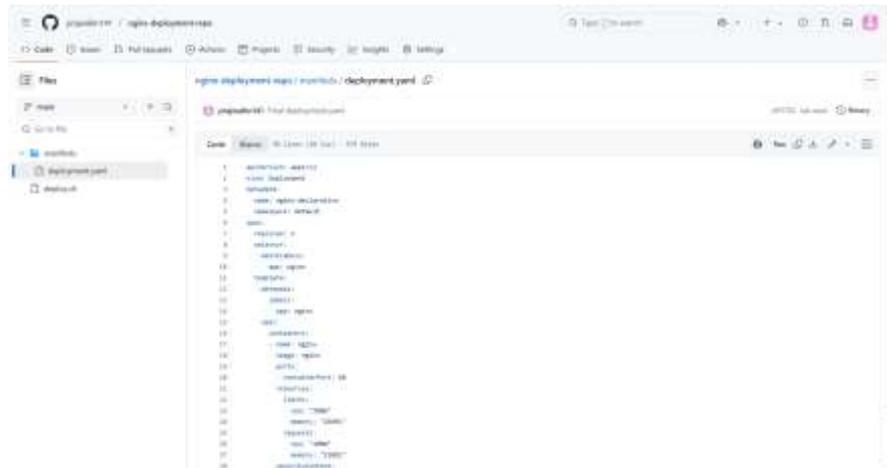
Section 2:- Creating Deployments

1.1.7 Step 7: Create deployment.yaml for Declarative Approach

1. In D:\\Kube, create deployment.yaml:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-declarative
  namespace: default
spec:
  replicas: 2
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      containers:
      - name: nginx
        image: nginx
        ports:
        - containerPort: 80
      resources:
        limits:
          cpu: "200m"
          memory: "256Mi"
        requests:
          cpu: "100m"
          memory: "128Mi"
      securityContext:
        runAsNonRoot: true
        privileged: false
```

Same file is pushed to git with the folder location as /manifests/



1.1.8 Step 8: Apply Declarative Deployment

```
kubectl apply -f D:\Kube\deployment.yaml
kubectl get deployment nginx-declarative -n default
```

[Leave blank space for Screenshot 12: kubectl Apply Output]

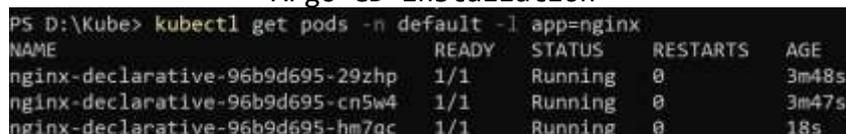
[Leave blank space for Screenshot 13: kubectl Get Deployment Output]

1.1.9 Step 9: Install Argo CD for Declarative GitOps

```
helm repo add argo https://argoproj.github.io/argo-helm
helm repo update
helm install argo argo/argo-cd --namespace argo-cd --create-namespace
kubectl get pods -n argo-cd
```



Argo CD installation



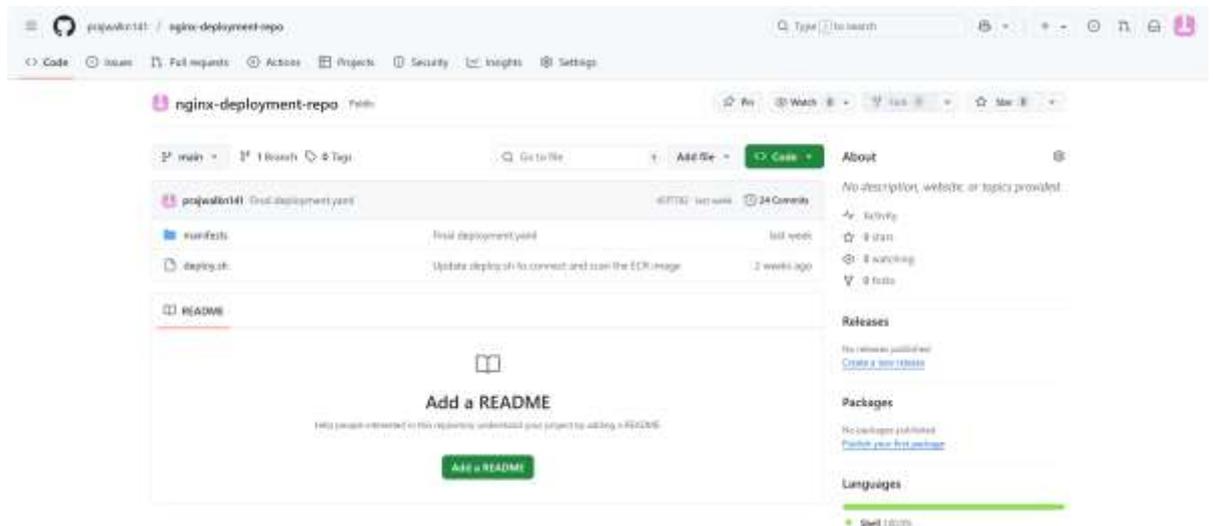
The pods status check for declarative

1.1.10 Step 10: Set Up Git Repo for GitOps

1. Create a GitHub repo: nginx-deployment-repo.

2. Initialize and push manifest:

```
git init
git add manifests/deployment.yaml
git commit -m "Add declarative deployment YAML"
git remote add origin https://github.com/prajwalkn141/nginx-deployment-repo.git
git push -u origin main
```



1.1.11 Step 11: Install Jenkins for Imperative Approach

```
helm repo add jenkinsci https://charts.jenkins.io
helm repo update
helm install my-jenkins jenkinsci/jenkins --namespace default --set
controller.admin.username="admin" --set controller.admin.password="Prajwal2025!" --set
persistence.enabled=false --set agent.enabled=true
kubectl get pods -n default
```

1.1.12 Step 12: Create deploy.sh for Imperative Deployment

Create deploy.sh:

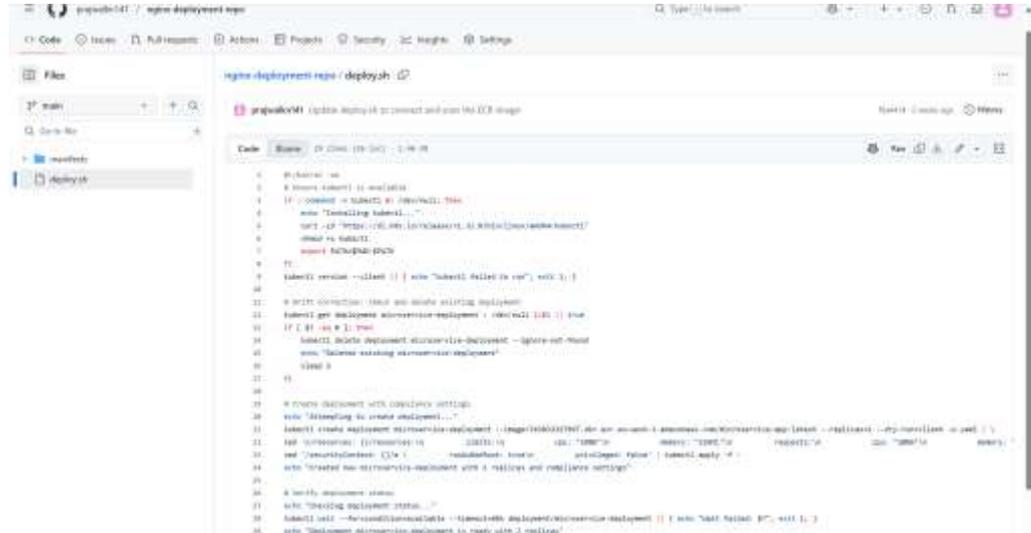
```
#!/bin/sh -xe
if ! command -v kubectl &> /dev/null; then
    echo "Installing kubectl..."
    curl -LO "https://dl.k8s.io/release/v1.31.0/bin/linux/amd64/kubectl"
    chmod +x kubectl
    export PATH=$PWD:$PATH
fi
kubectl version --client || { echo "kubectl failed"; exit 1; }
kubectl get deployment nginx-imperative > /dev/null 2>&1 || true
if [ $? -eq 0 ]; then
    kubectl delete deployment nginx-imperative --ignore-not-found
    echo "Deleted..."
    sleep 5
fi
echo "Attempting to create..."
kubectl create deployment nginx-imperative --image=nginx:1.25-alpine --replicas=2 || {
    echo "Create failed"; exit 1; }
```

```

echo "Created..."
echo "Checking..."
kubectl wait --for=condition=available --timeout=60s deployment/nginx-imperative || {
echo "Wait failed"; exit 1; }
echo "Deployment... is ready"

```

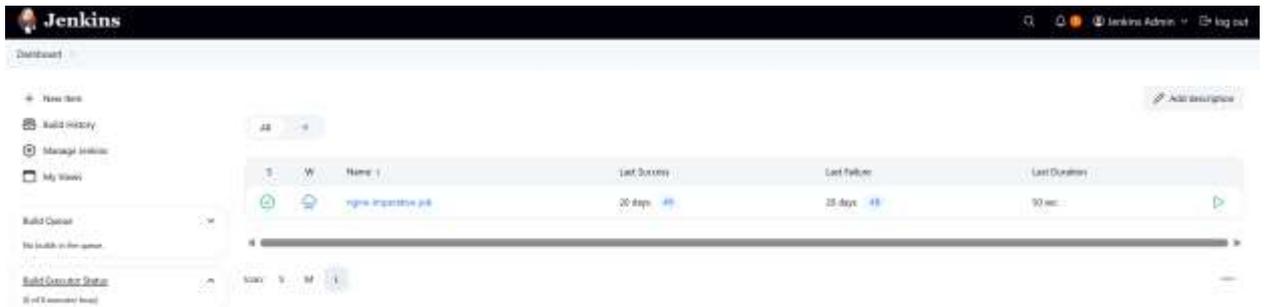
The deploy.sh file in Github



1.1.13 Step 13: Create Jenkins Job for Imperative Deployment

`kubectl port-forward svc/my-jenkins 8080:8080 -n default`

- Create job `nginx-imperative-job`
- Add Git repo, select “Execute shell” step with `Trivy + deploy.sh`



enkins job created (Freestyle job)

```

1 #!/bin/sh -xe
2 # Insure kubectl is available
3 if ! command -v kubectl && /dev/null; then
4   echo "Installing kubectl..."
5   curl -LO "https://dl.k8s.io/release/v1.31.0/bin/linux/amd64/kubectl"
6   chmod +x kubectl
7   export PATH=$PWD:$PATH
8 fi
9 kubectl version --client || { echo "kubectl failed to run"; exit 1; }
10
11 # Drift Correction: Check and delete existing deployment
12 kubectl get deployment microservice-deployment > /dev/null 2>&1 || true
13 if [ $? -eq 0 ]; then
14   kubectl delete deployment microservice-deployment --ignore-not-found
15   echo "Deleted existing microservice-deployment"
16   sleep 5
17 fi
18
19 # Create deployment with compliance settings
20 echo "Attempting to create deployment..."
21 kubectl create deployment microservice-deployment --image=74383337997.dkr.ecr.eu-west-1.amazonaws.com/microservice-app:latest --replicas=2 --dry-run=client -o yaml | \
22 sed 's/resources: {}/resources:\n  limits:\n    cpu: "200m"\n    memory: "256Mi"\n  requests:\n    cpu: "100m"\n    memory:' \
23 sed '/securityContext: {}/s \n  runAsNonRoot: true\n  privileged: false' | kubectl apply -f -
24 echo "Created new microservice-deployment with 2 replicas and compliance settings"
25
26 # Verify deployment status
27 echo "Checking deployment status..."
28 kubectl wait --for=condition=available --timeout=60s deployment/microservice-deployment || { echo "Wait failed: $?"; exit 1; }
29 echo "Deployment microservice-deployment is ready with 2 replicas"

```

e

execute shell section of the Jenkins job



The Build successful in the Jenkins

1.1.14 Step 14: Install Kubescape

`curl -s https://raw.githubusercontent.com/kubescape/kubescape/master/install.sh | /bin/bash`
 kubescape version

```

PS D:\Kube> kubescape version
Your current version is: v3.0.37

```

Section 3:- Testing the env and metrics

1.1.15 Step 15: Scan Declarative Deployment with Kubescape

`kubescape scan framework clusterscan D:\Kube\deployment.yaml --format json --output nginx-results.json`

```

$ kubectl kubescape scan --cluster kubeconfig:default --podid josh --output nginx-compliance.json
  Initialized scanner
  Loaded policies
  Loaded exceptions
  Loaded resource configurations
  Accessed Kubernetes objects
  Reported severity: (starburst-ai-llm) anal conflict error: Functions must not contain multiple outputs for some kinds
  Reported: 0 min. jobs
  Done scanning. Cluster: kubeconfig
  Done aggregating results

Security posture overview for cluster: 'kubeconfig'

In this overview, Kubescape shows you a summary of your cluster security posture, including the number of users who can perform administrative actions. For each result greater than 0, you should evaluate its work, and then define an exception to allow it. This baseline can be used to detect drift in future.

Control plane
+-----+-----+
| Control name | Desc |
+-----+-----+
| API server address port is enabled | https://kubescape-120200000-0000 |
| Anonymous access enabled | https://kubescape-120200000-0000 |
| Audit logs enabled | https://kubescape-120200000-0000 |
| RBAC enabled | https://kubescape-120200000-0000 |
| Secret/Token encryption enabled | https://kubescape-120200000-0000 |
+-----+-----+

Failed to get cloud provider, cluster: kubeconfig

Access control
+-----+-----+-----+
| Control name | Resources | View details |
+-----+-----+-----+
| Administrative Roles | 0 | 3 | kubescape scan control C-0015 -> |
| List Kubernetes secrets | 0 | 3 | kubescape scan control C-0015 -> |
| Restrict access to create pods | 1 | 3 | kubescape scan control C-0188 -> |
| Restrict allowed use of Roles and ClusterRoles | 0 | 3 | kubescape scan control C-0187 -> |
| Portforwarding privileges | 0 | 3 | kubescape scan control C-0001 -> |
| Prevent containers from allowing command execution | 1 | 3 | kubescape scan control C-0002 -> |
| Roles with cluster capabilities | 1 | 3 | kubescape scan control C-0007 -> |
| Validate admission controller (mutating) | 0 | 3 | kubescape scan control C-0019 -> |
+-----+-----+-----+

```

Kubescape scan results

nginx-results

02-08-2025 15:19

JSON File

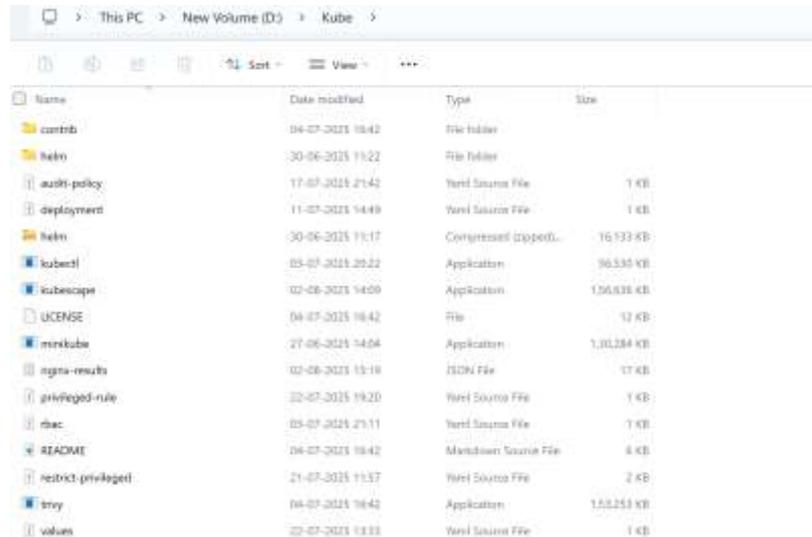
17 KB

1.1.16 Step 16: Install Trivy

```

curl -sL https://raw.githubusercontent.com/aquasecurity/trivy/main/contrib/install.sh
| sh -x --no-interactive
trivy --version

```



1.1.17 Step 17: Scan Imperative Image with Trivy

```

trivy image --exit-code 1 --severity CRITICAL,HIGH,MEDIUM --format table --output
scan_imperative.txt nginx:1.25-alpine

```



```
Administrator@Windows PowerShell: ~
PS C:\Users\Administrator> kubectl apply -f ./
kubectl-binding-abc.authorization.k8s.io/jenkins-deploy-binding created
PS C:\Users\Administrator> kubectl get rolebindings -- default
NAME                ROLE
jenkins-deploy-binding  Role/jenkins-deploy-role
jenkins-sshable-agent  Role/jenkins-sshable-agent
jenkins-sshable-configmap  Role/jenkins-sshable-configmap
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
PS C:\Users\Administrator> kubectl scale deployment nginx-declarative --replicas=1 --default
error: no objects passed to scale deployment.apps "nginx-declarative" not found
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
PS C:\Users\Administrator> kubectl get serviceaccounts -- default
NAME                SECRETS
default             0
jenkins              0
PS C:\Users\Administrator> kubectl get rolebindings -- default
NAME                ROLE
jenkins-deploy-binding  Role/jenkins-deploy-role
jenkins-sshable-agent  Role/jenkins-sshable-agent
jenkins-sshable-configmap  Role/jenkins-sshable-configmap
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
PS C:\Users\Administrator> kubectl scale deployment nginx-declarative --replicas=1 --default
error: no objects passed to scale deployment.apps "nginx-declarative" not found
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
PS C:\Users\Administrator> kubectl get deployments
No resources found in default namespace.
NAME                READY  UP-TO-DATE  AVAILABLE  AGE
nginx-declarative   1/1    1            1          21s
PS C:\Users\Administrator> kubectl scale deployment nginx-declarative --replicas=1
deployment.apps/nginx-declarative scaled
PS C:\Users\Administrator> kubectl get deployments
NAME                READY  UP-TO-DATE  AVAILABLE  AGE
nginx-declarative   1/1    1            1          42s
PS C:\Users\Administrator>
```

Imperative approach drift correction(Manual)



Drift detection in Argo CD(automatic sync with no manual intervention)

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