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
Module:	Research Project
Lecturer:	Sai Emani
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Configuration Manual

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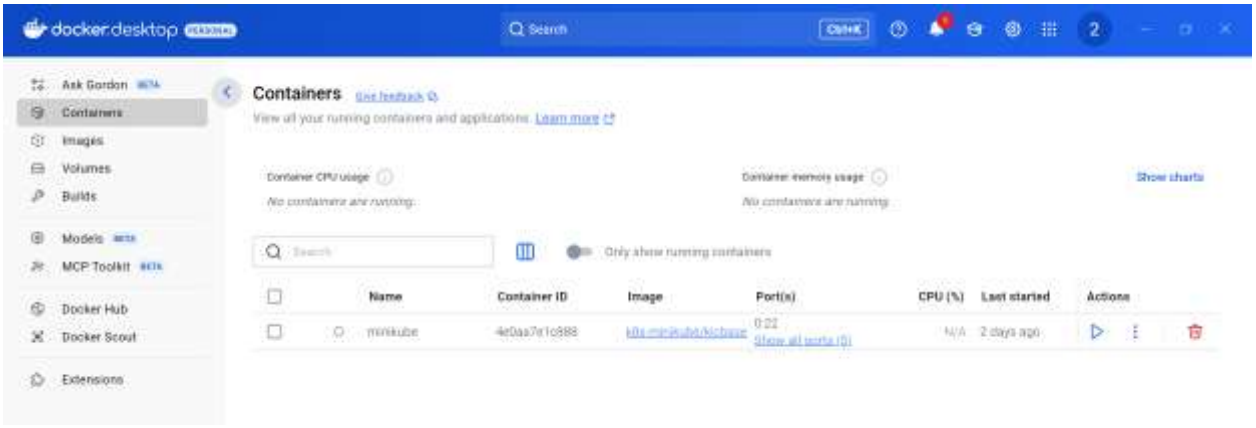
Section 1:- Setting up the Environment

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')
```

```python
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
   ```

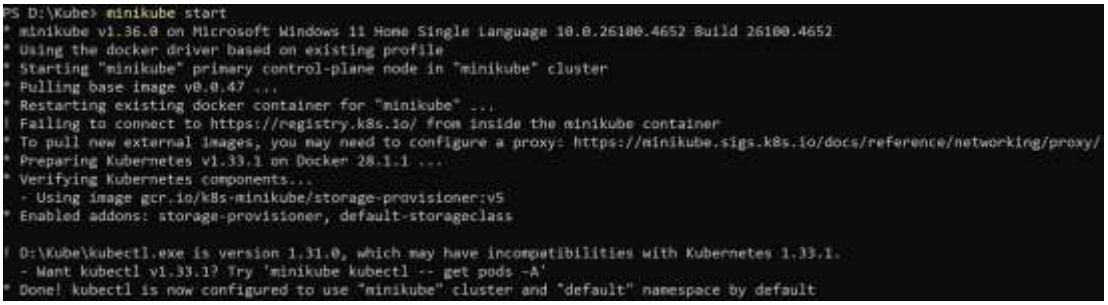
3. Verify:

   ```
   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 status
minikube
type: Control Plane
host: Running
kubelet: Running
apiserver: Running
kubeconfig: Configured
```

Minikube start command and status check command

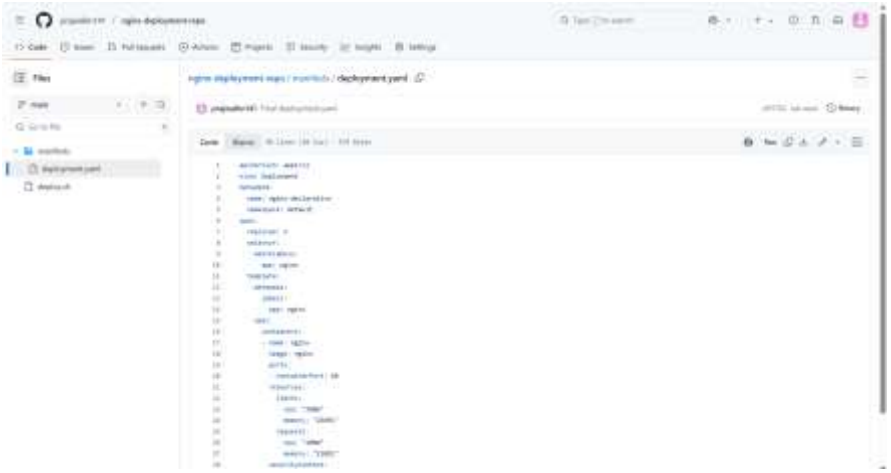
Section 2:- Creating Deployments

1.1.7 Step 7: Create deployment.yaml for Declarative Approach

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

```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

```
PS D:\Kube> kubectl get pods -n default -l app=nginx
NAME                                  READY   STATUS    RESTARTS   AGE
nginx-declarative-96b9d695-29zhp      1/1     Running   0          3m48s
nginx-declarative-96b9d695-cn5w4      1/1     Running   0          3m47s
nginx-declarative-96b9d695-hm7qc      1/1     Running   0          18s
```

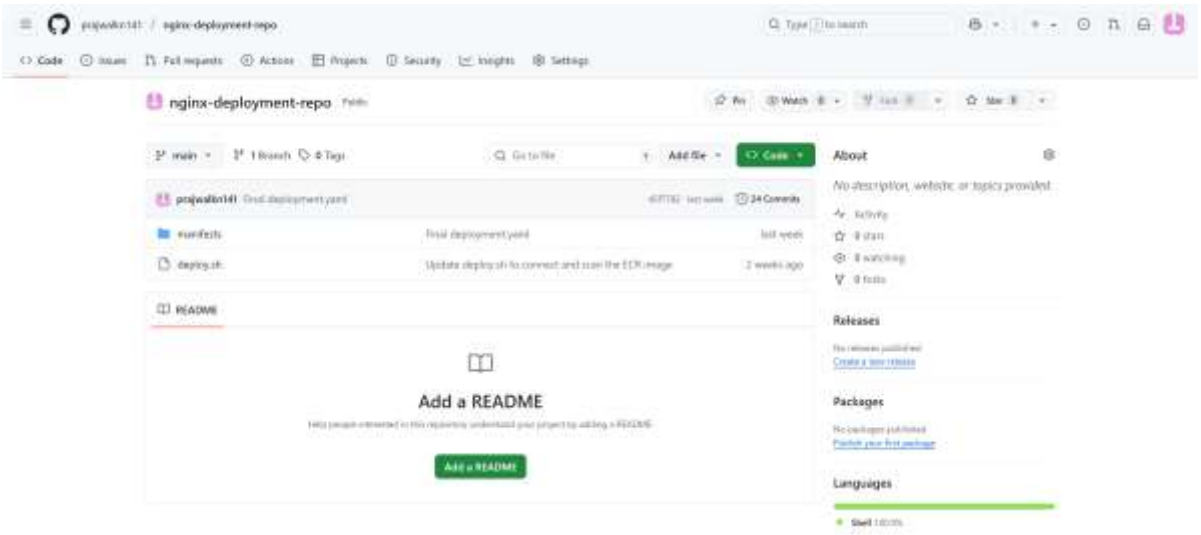
The pods status check for declarative

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
```

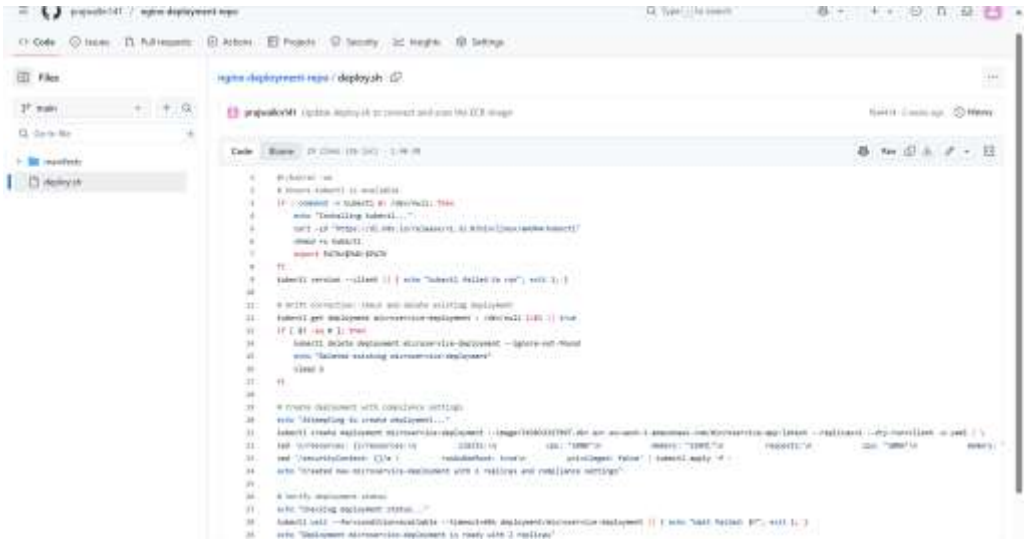
1.1.12 Step 12: Create deploy.sh for Imperative Deployment

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"
```

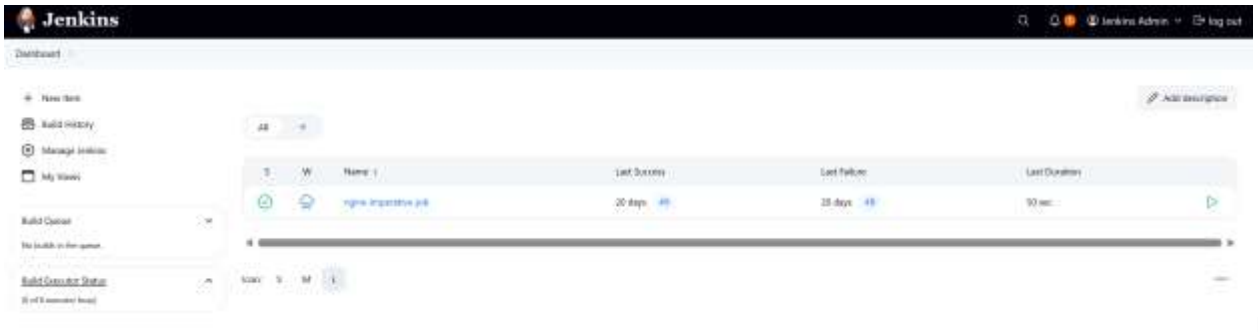
The deploy.sh file in Github



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`



J

enkins job created (Freestyle job)

```
#!/bin/sh -xe
# Ensure kubectl is available
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 to run"; exit 1; }

# Drift Correction: Check and delete existing deployment
kubectl get deployment microservice-deployment > /dev/null 2>&1 || true
if [ $? -eq 0 ]; then
    kubectl delete deployment microservice-deployment --ignore-not-found
    echo "Deleted existing microservice-deployment"
    sleep 5
fi

# Create deployment with compliance settings
echo "Attempting to create deployment..."
kubectl create deployment microservice-deployment --image=743833337997.dkr.ecr.eu-west-1.amazonaws.com/microservice-app:latest --replicas=2 --dry-run=client -o yaml | \
sed 's/resources: {}/resources:\n          limits:\n            cpu: "200m"\n            memory: "256Mi"\n          requests:\n            cpu: "100m"\n            memory:
sed '/securityContext: {}/a \          runAsNonRoot: true\n          privileged: false' | kubectl apply -f -
echo "Created new microservice-deployment with 2 replicas and compliance settings"

# Verify deployment status
echo "Checking deployment status..."
kubectl wait --for=condition=available --timeout=60s deployment/microservice-deployment || { echo "Wait failed: $?"; exit 1; }
echo "Deployment microservice-deployment is ready with 2 replicas"
```

e

xecute shell section of the Jenkins job

The Build successful in the Jenkins

1.1.14 Step 14: Install Kubescape

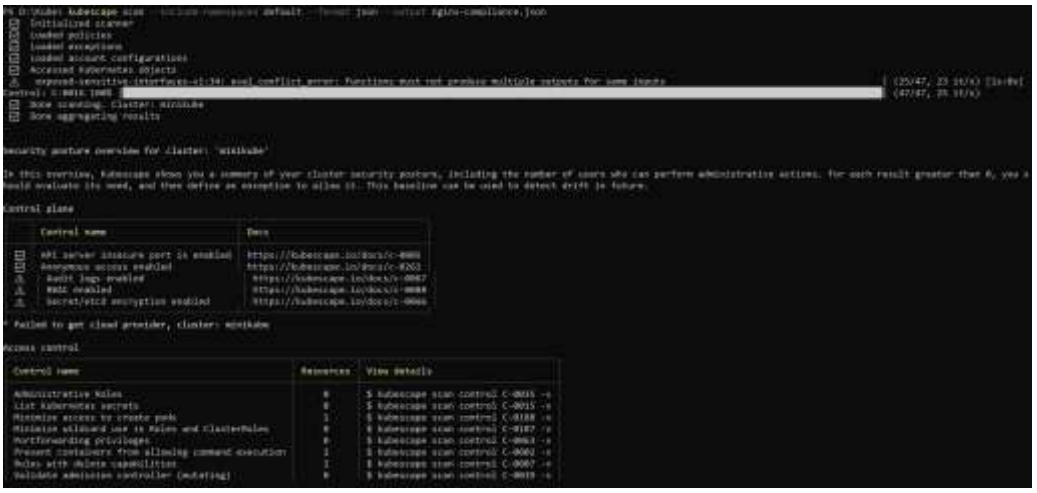
```
curl -s https://raw.githubusercontent.com/kubescape/kubescape/master/install.sh | /bin/bash
kubescape version
```

```
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

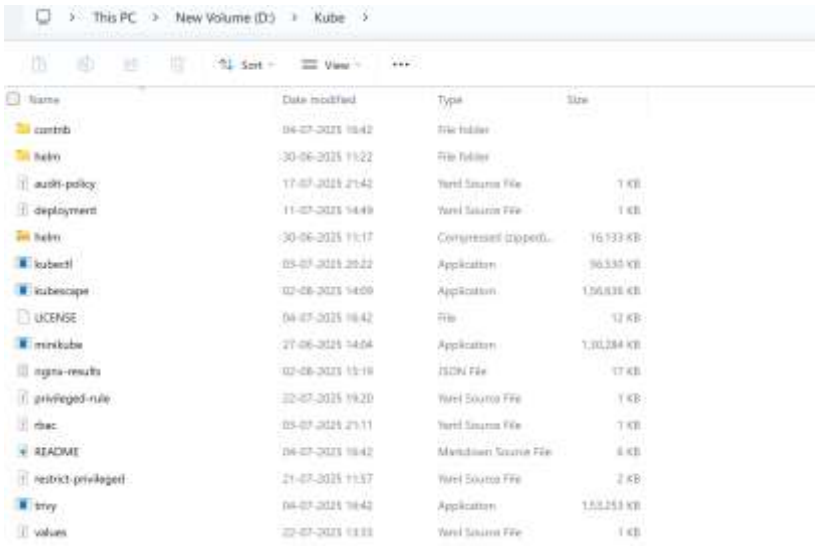
```
kubescape scan framework clusterscan D:\Kube\deployment.yaml --format json --output nginx-results.json
```



Kubescape scan results

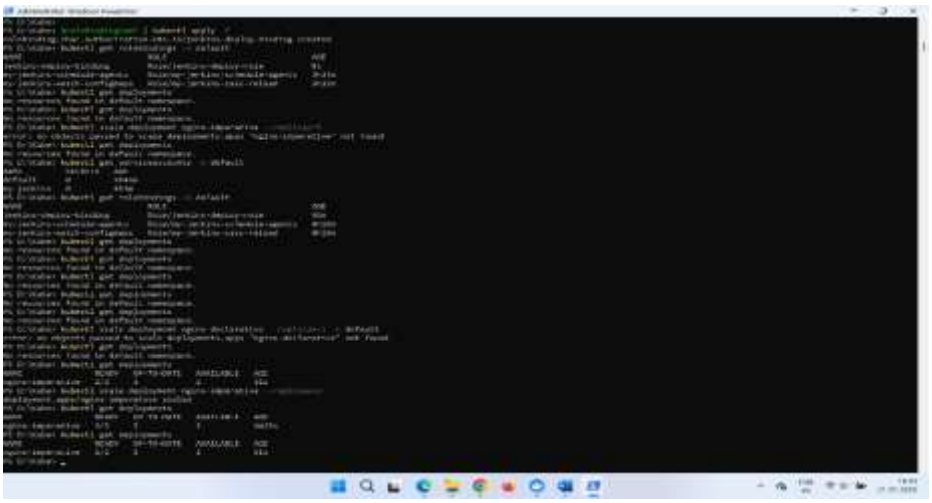
1.1.16 Step 16: Install Trivy

```
curl -sfL 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
```

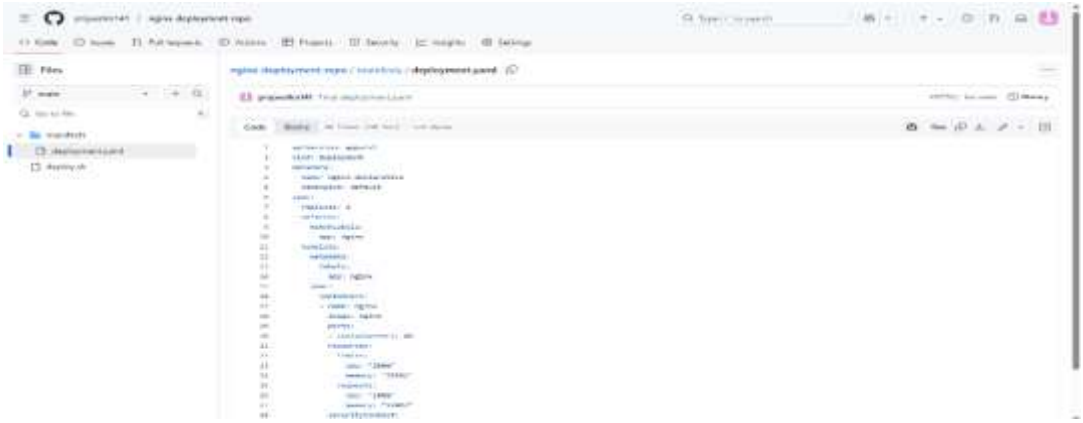


Trivy scan results for the imperative deployment

1.1.18 Step 18: Scan Declarative Image with Trivy

```
trivy image --severity CRITICAL,HIGH nginx:latest
```

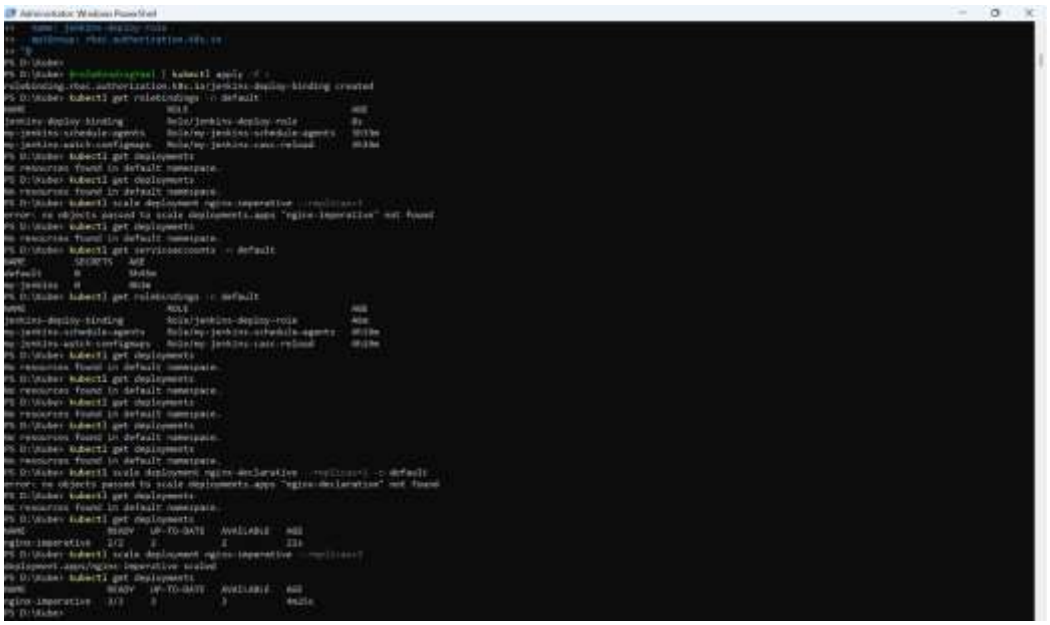
Trivy scan results for the declarative deployment



Deployment.yaml file which is used in declarative deployment

1.1.19 Step 19: Simulate and Test Drift Correction

```
kubectl scale deployment nginx-declarative --replicas=3
kubectl get deployment nginx-declarative
kubectl apply -f D:\Kube\deployment.yaml
```



Imperative approach drift correction(Manual)

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

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