Deploying a Flask Application on Kubernetes with Auto-Scaling & Load Testing

Overview

This guide walks through deploying a **Flask application** on **Kubernetes**,
handling **authentication issues**, enabling **auto-scaling (HPA)**, and performing **load testing**.

Prerequisites

Ensure you have the following installed:

- **Docker** (for building images)
- **Kubernetes cluster** (with master-vm, worker1-vm, worker2-vm)
- **Metrics Server** (for auto-scaling)

1.Building & Containerizing the Flask Application

Flask Application (app.py)

```
from flask import Flask, jsonify


app = Flask(__name__)


@app.route('/')
def home():
    return jsonify(message="Hello, World! This is a Flask app running in Docker.")


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

Issue: Flask bound to 127.0.0.1 won't be accessible. **Fix:** Use app.run(host="0.0.0.0", port=5000).

Dockerfile

```
FROM python:3.11
WORKDIR /app
COPY . /app
RUN pip install flask
EXPOSE 5000
CMD ["python", "app.py"]
```

Build & Push Image

```
docker build -t kpkm25/flask-kube .
docker push kpkm25/flask-kube
```

2.Deploying Flask App on Kubernetes

Deployment & Service YAML (deployment-service.yaml)

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: flask-app
spec:
  replicas: 3
  selector:
    matchLabels:
      app: flask-app
  template:
    metadata:
      labels:
        app: flask-app
    spec:
      containers:
        - name: flask-container
          image: kpkm25/flask-kube:latest
          ports:
            - containerPort: 5000
          resources:
            requests:
              cpu: "100m"
            limits:
              cpu: "250m"
      imagePullSecrets:
```

```
      - name: docker-secret
---
apiVersion: v1
kind: Service
metadata:
  name: flask-service
spec:
  selector:
    app: flask-app
  ports:
    - protocol: TCP
      port: 80
      targetPort: 5000
  type: NodePort
```

Issue: ErrImagePull due to unauthenticated Docker pulls. **Fix:** Authenticate Kubernetes with Docker Hub.

Apply Deployment

kubectl apply -f deployment-service.yaml

```
master@master-vm:~$ kubectl apply -f deployment-service.yaml
deployment.apps/flask-app created
service/flask-service created
```

3.Fixing Docker Hub Rate Limits (Authentication Issue)

Issue:

Failed to pull image "curlimages/curl": toomanyrequests: You have reached your unauthenticated pull rate limit.

Fix: Authenticate Kubernetes with Docker Hub.

Solution: Create Docker Secret

```
kubectl create secret docker-registry docker-secret \
  --docker-server=https://index.docker.io/v1/ \
  --docker-username=kpkm25 \
  --docker-password=YOUR_DOCKER_HUB_PASSWORD \
```

--docker-email=YOUR_EMAIL

```
master@master-vm:~$ kubectl create secret docker-registry docker-secret   --docker-server=https://index.docker.io/v1/   --docker-use
rname=kirthiksubbiah   --docker-password=Kirthik:2003   --docker-email=kirthiksubbiah@gmail.com
secret/docker-secret created
master@master-vm:~$ kubectl patch serviceaccount default -p '{"imagePullSecrets": [{"name": "docker-secret"}]}'
serviceaccount/default patched
master@master-vm:~$ kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/latest/download/components.yaml
serviceaccount/metrics-server created
clusterrole.rbac.authorization.k8s.io/system:aggregated-metrics-reader created
clusterrole.rbac.authorization.k8s.io/system:metrics-server created
rolebinding.rbac.authorization.k8s.io/metrics-server-auth-reader created
clusterrolebinding.rbac.authorization.k8s.io/metrics-server:system:auth-delegator created
clusterrolebinding.rbac.authorization.k8s.io/system:metrics-server created
service/metrics-server created
deployment.apps/metrics-server created
apiservice.apiregistration.k8s.io/v1beta1.metrics.k8s.io created
master@master-vm:~$ kubectl get pods
NAME                          READY   STATUS    RESTARTS   AGE
flask-app-6b46b4b489-7q4bm    1/1     Running   0          4m39s
flask-app-6b46b4b489-gvcjp    1/1     Running   0          4m38s
flask-app-6b46b4b489-m47lm    1/1     Running   0          4m38s
master@master-vm:~$ kubectl autoscale deployment flask-app --cpu-percent=50 --min=3 --max=10
```

Patch Default Service Account

kubectl patch serviceaccount default -p '{"imagePullSecrets": [{"name": "docker-secret"}]}'

Fix applied! Now Kubernetes will authenticate with Docker Hub and avoid rate limits.

4.Installing & Troubleshooting Metrics Server

kubectl apply -f https://github.com/kubernetes-sigs/metrics-server/releases/latest/download/components.yaml

Issue: x509: certificate signed by unknown authority

Fix: Check the logs:
kubectl logs -n kube-system deployment/metrics-server

Edit metrics-server deployment and add:

kubectl edit deployment -n kube-system metrics-server

In containers description and add:

- --kubelet-insecure-tls

kubectl rollout restart deployment -n kube-system metrics-server

5.Enabling HPA (Horizontal Pod Autoscaler)

kubectl autoscale deployment flask-app --cpu-percent=50 --min=3 --max=10

kubectl get hpa

```
master@master-vm:~$ kubectl autoscale deployment flask-app --cpu-percent=50 --min=3 --max=10
horizontalpodautoscaler.autoscaling/flask-app autoscaled
master@master-vm:~$ kubectl get hpa
NAME        REFERENCE              TARGETS              MINPODS   MAXPODS   REPLICAS   AGE
flask-app   Deployment/flask-app   cpu: <unknown>/50%   3         10        0          0s
```

6.Load Testing & Debugging NodePort Issues

Testing Service Internally

```
kubectl run -it --rm busybox --image=busybox -- /bin/sh
```

```
wget -q -O- http://10.97.210.48:80
```

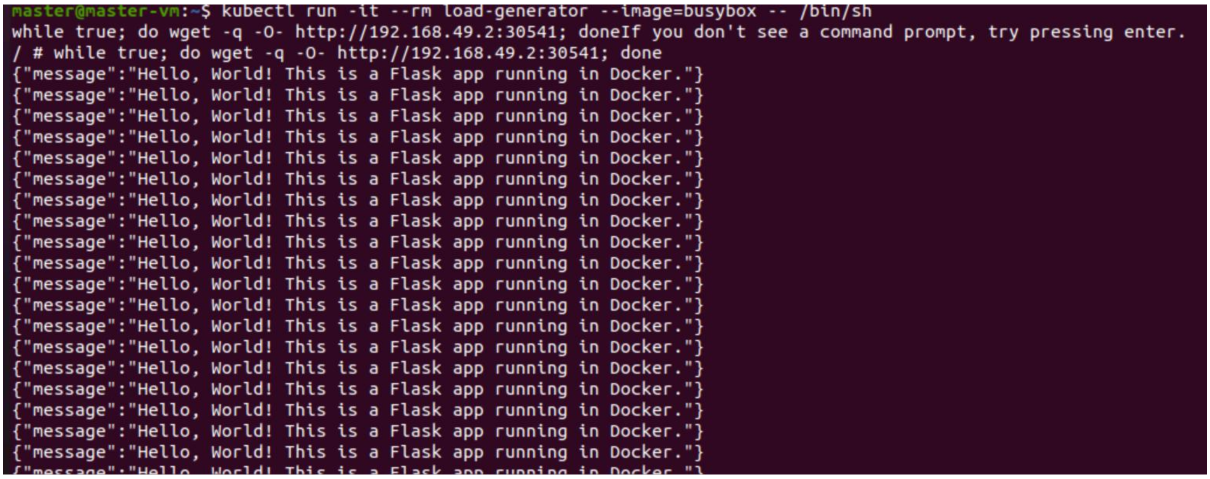
Finding NodePort & Testing External Access

```
kubectl get svc flask-service
```

7.Simulating Load for HPA

```
kubectl run -it --rm load-generator --image=busybox -- /bin/sh
```

```
while true; do wget -q -O- http://192.168.147.129:30455; done
```



```
master@master-vm:~$ kubectl run -it --rm load-generator --image=busybox -- /bin/sh
while true; do wget -q -O- http://192.168.49.2:30541; doneIf you don't see a command prompt, try pressing enter.
/ # while true; do wget -q -O- http://192.168.49.2:30541; done
{"message":"Hello, World! This is a Flask app running in Docker."}
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```
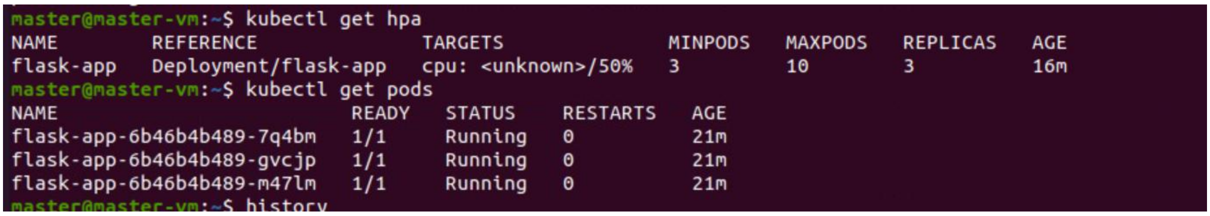
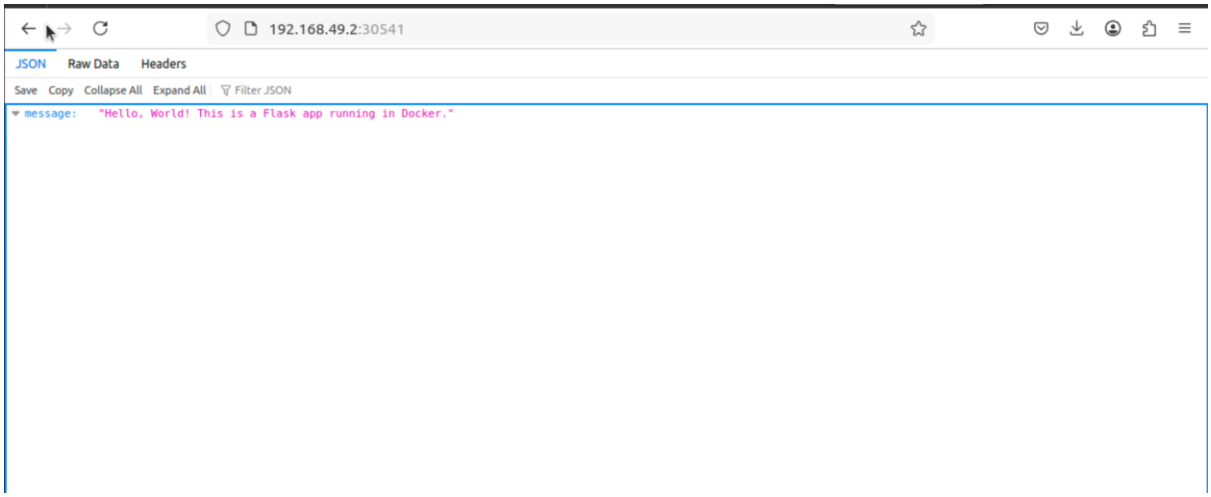

Check Scaling

```
kubectl get hpa
```

```
kubectl get pods
```



```
master@master-vm:~$ kubectl get hpa
NAME        REFERENCE              TARGETS              MINPODS    MAXPODS    REPLICAS    AGE
flask-app   Deployment/flask-app   cpu: <unknown>/50%   3          10         3           16m
master@master-vm:~$ kubectl get pods
NAME                         READY   STATUS    RESTARTS   AGE
flask-app-6b46b4b489-7q4bm   1/1     Running   0          21m
flask-app-6b46b4b489-gvcjp   1/1     Running   0          21m
flask-app-6b46b4b489-m47lm   1/1     Running   0          21m
master@master-vm:~$ history
```


192.168.49.2:30541
JSON
Raw Data
Headers
Save
Copy
Collapse All
Expand All
Filter JSON
message: "Hello, World! This is a Flask app running in Docker."