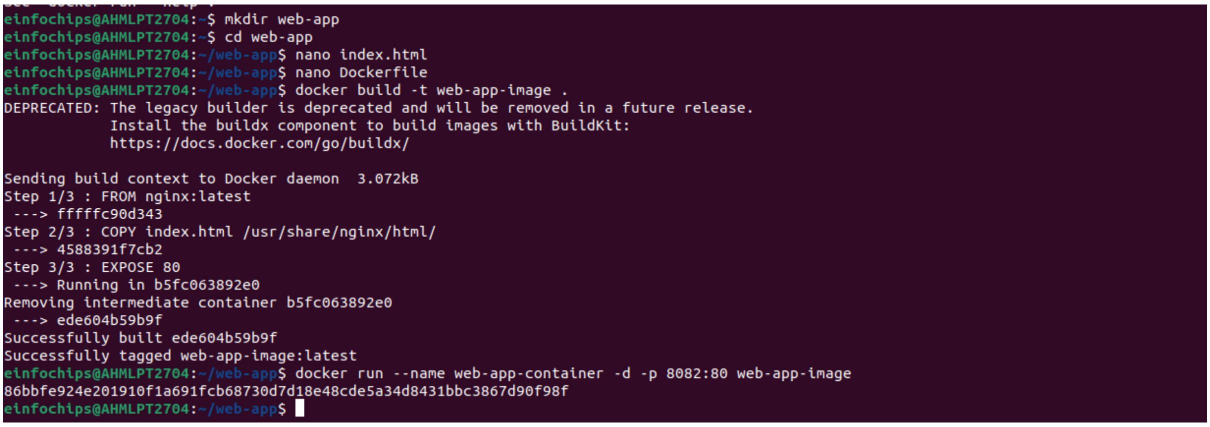
Project Overview

Participants are required to deploy a simple static web application on a Kubernetes cluster using Minikube, set up advanced ingress networking with URL rewriting and sticky sessions, and configure horizontal pod autoscaling to manage traffic efficiently. The project will be divided into stages, with each stage focusing on specific aspects of Kubernetes ingress, URL rewriting, sticky sessions, and autoscaling.

Requirements and Deliverables

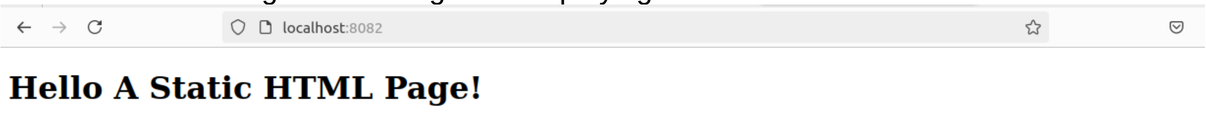
Stage 1: Setting Up the Kubernetes Cluster and Static Web App



```
einfochips@AHMLPT2704:~$ mkdir web-app
einfochips@AHMLPT2704:~$ cd web-app
einfochips@AHMLPT2704:~/web-app$ nano index.html
einfochips@AHMLPT2704:~/web-app$ nano Dockerfile
einfochips@AHMLPT2704:~/web-app$ docker build -t web-app-image .
DEPRECATED: The legacy builder is deprecated and will be removed in a future release.
            Install the buildx component to build images with BuildKit:
            https://docs.docker.com/go/buildx/

Sending build context to Docker daemon  3.072kB
Step 1/3 : FROM nginx:latest
 ---> fffffc90d343
Step 2/3 : COPY index.html /usr/share/nginx/html/
 ---> 4588391f7cb2
Step 3/3 : EXPOSE 80
 ---> Running in b5fc063892e0
Removing intermediate container b5fc063892e0
 ---> ede604b59b9f
Successfully built ede604b59b9f
Successfully tagged web-app-image:latest
einfochips@AHMLPT2704:~/web-app$ docker run --name web-app-container -d -p 8082:80 web-app-image
86bbfe924e201910f1a691fcb68730d7d18e48cde5a34d8431bbc3867d90f98f
einfochips@AHMLPT2704:~/web-app$ 
```

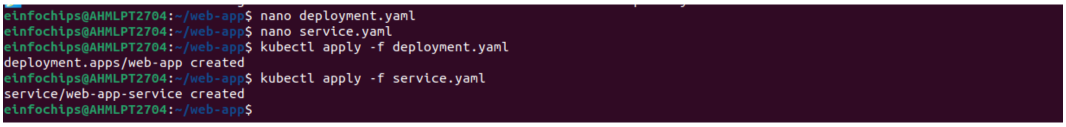
Here I have create a folder named web-app. Inside this, there is index.html file and dockerfile for building docker image and deploying it on docker hub.



Hello A Static HTML Page!

This is sample output of that url.

Kubernetes Deployment:

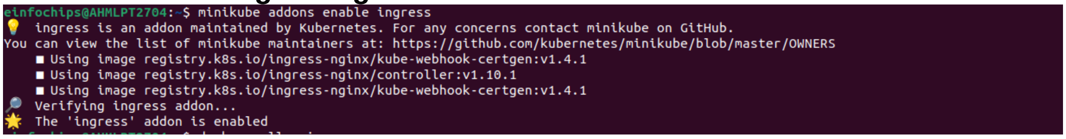


```
einfochips@AHMLPT2704:~/web-app$ nano deployment.yaml
einfochips@AHMLPT2704:~/web-app$ nano service.yaml
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f deployment.yaml
deployment.apps/web-app created
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f service.yaml
service/web-app-service created
einfochips@AHMLPT2704:~/web-app$
```

This is deployment and service file which needs to be applied in kubernetes.

Stage 2: Configuring Ingress Networking

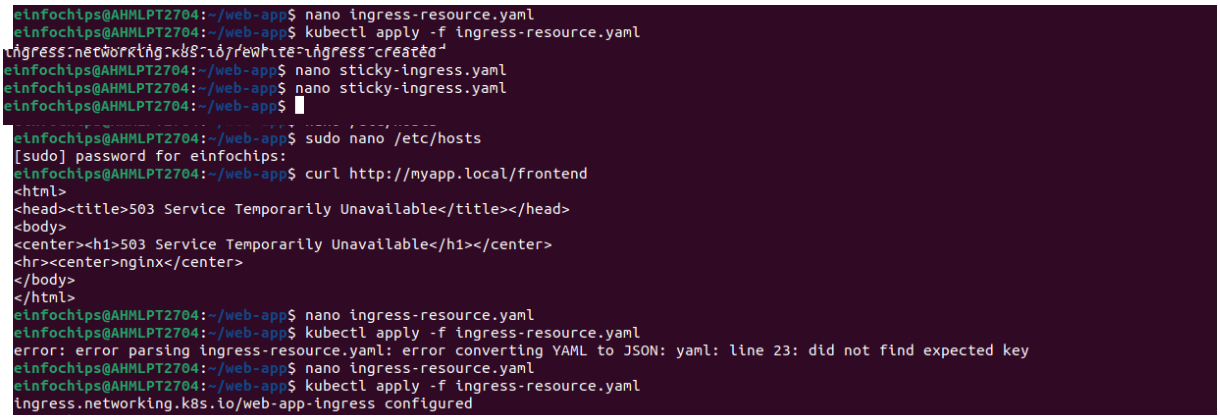
4. **Install and Configure Ingress Controller:**



```
einfochips@AHMLPT2704:~$ minikube addons enable ingress
💡  ingress is an addon maintained by Kubernetes. For any concerns contact minikube on GitHub.
You can view the list of minikube maintainers at: https://github.com/kubernetes/minikube/blob/master/OWNERS
    ▪ Using image registry.k8s.io/ingress-nginx/kube-webhook-certgen:v1.4.1
    ▪ Using image registry.k8s.io/ingress-nginx/controller:v1.10.1
    ▪ Using image registry.k8s.io/ingress-nginx/kube-webhook-certgen:v1.4.1
🔎  Verifying ingress addon...
🌟  The 'ingress' addon is enabled
```

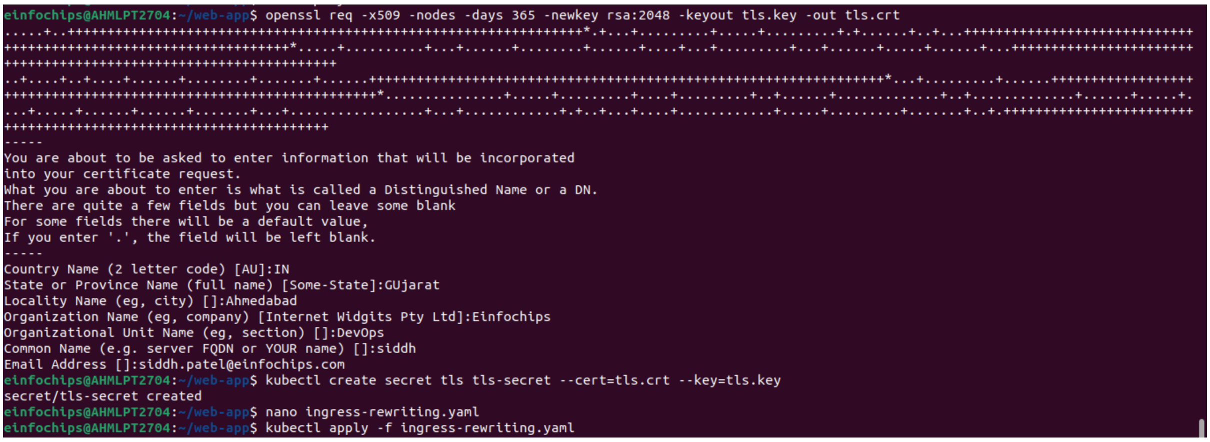
This command enables ingress inside minikube.

5. **Create Ingress Resource:**



```
einfochips@AHMLPT2704:~/web-app$ nano ingress-resource.yaml
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f ingress-resource.yaml
ingress.networking.k8s.io/rewrite-ingress created
einfochips@AHMLPT2704:~/web-app$ nano sticky-ingress.yaml
einfochips@AHMLPT2704:~/web-app$ nano sticky-ingress.yaml
einfochips@AHMLPT2704:~/web-app$ 
einfochips@AHMLPT2704:~/web-app$ sudo nano /etc/hosts
[sudo] password for einfochips:
einfochips@AHMLPT2704:~/web-app$ curl http://myapp.local/frontend
<html>
<head><title>503 Service Temporarily Unavailable</title></head>
<body>
<center><h1>503 Service Temporarily Unavailable</h1></center>
<hr><center>nginx</center>
</body>
</html>
einfochips@AHMLPT2704:~/web-app$ nano ingress-resource.yaml
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f ingress-resource.yaml
error: error parsing ingress-resource.yaml: error converting YAML to JSON: yaml: line 23: did not find expected key
einfochips@AHMLPT2704:~/web-app$ nano ingress-resource.yaml
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f ingress-resource.yaml
ingress.networking.k8s.io/web-app-ingress configured
```

Now to access the resources in ingress, we need to create ingress-resource.yaml file. Then by 'minikube ip' command we can get its IP, which needs to be given to hosts file, for executing our application on browser.



```
einfochips@AHMLPT2704:~/web-app$ openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout tls.key -out tls.crt
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-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:IN
State or Province Name (full name) [Some-State]:GUjarat
Locality Name (eg, city) []:Ahmedabad
Organization Name (eg, company) [Internet Widgits Pty Ltd]:Einfochips
Organizational Unit Name (eg, section) []:DevOps
Common Name (e.g. server FQDN or YOUR name) []:siddh
Email Address []:siddh.patel@einfochips.com
einfochips@AHMLPT2704:~/web-app$ kubectl create secret tls tls-secret --cert=tls.crt --key=tls.key
secret/tls-secret created
einfochips@AHMLPT2704:~/web-app$ nano ingress-rewriting.yaml
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f ingress-rewriting.yaml
```
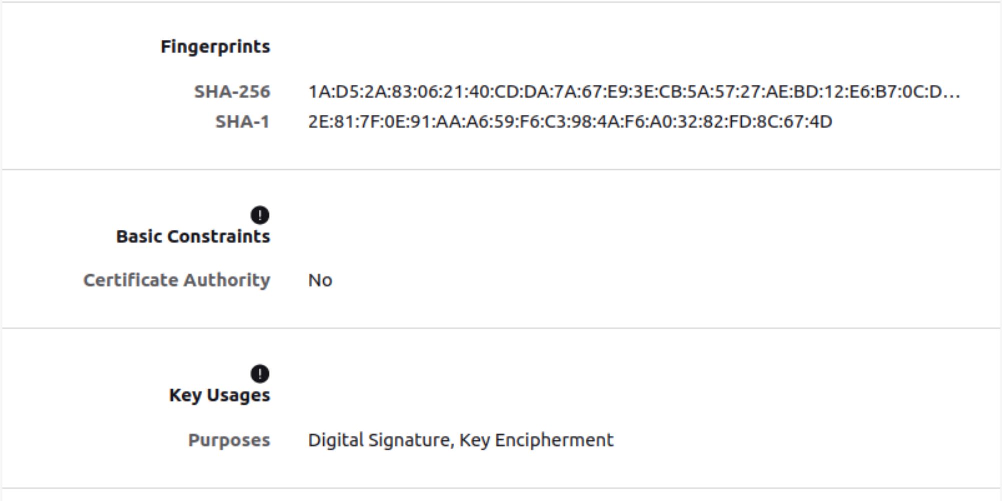

For using TLS certificate, we need to download tls.ke and tls.crt files from url.

Afterwards, by creating a secret this certificate gets bind to the minikube ip.



Fingerprints

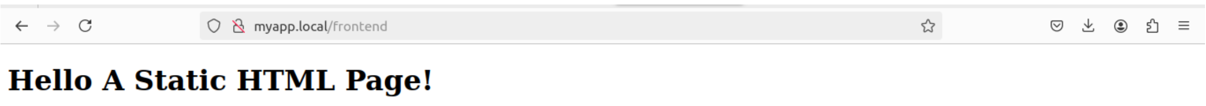
SHA-256	1A:D5:2A:83:06:21:40:CD:DA:7A:67:E9:3E:CB:5A:57:27:AE:BD:12:E6:B7:0C:D…
SHA-1	2E:81:7F:0E:91:AA:A6:59:F6:C3:98:4A:F6:A0:32:82:FD:8C:67:4D

Basic Constraints

Certificate Authority	No

Key Usages

Purposes	Digital Signature, Key Encipherment



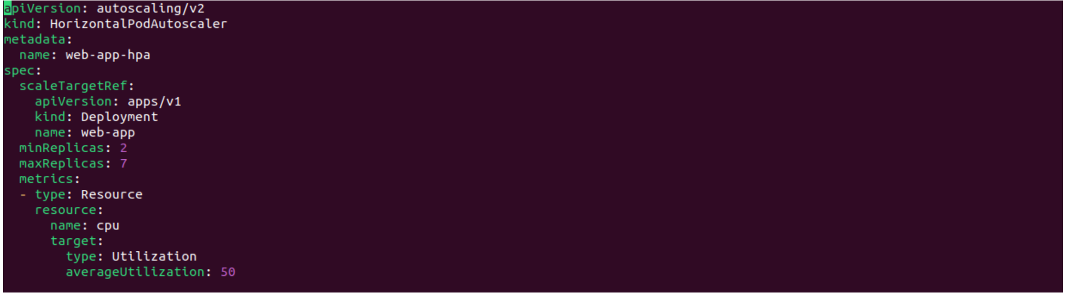
Hello A Static HTML Page!

This is output of frontend page running index.html file which was previously created.

Stage 3: Implementing Horizontal Pod Autoscaling

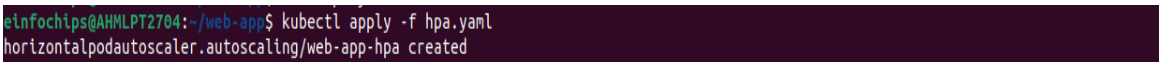
6. Configure Horizontal Pod Autoscaler:

hpa.yaml:



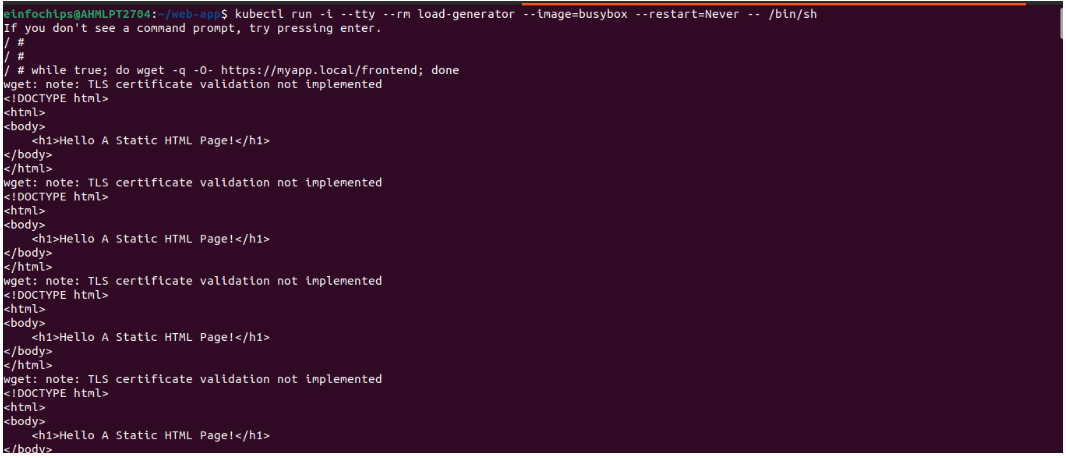
```
apiVersion: autoscaling/v2
kind: HorizontalPodAutoscaler
metadata:
  name: web-app-hpa
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: web-app
  minReplicas: 2
  maxReplicas: 7
  metrics:
  - type: Resource
    resource:
      name: cpu
      target:
        type: Utilization
        averageUtilization: 50
```

For autoscaling, HPA file is created in which minimum and maximum replicas threshold needs to be specified, also with the average cpu utilization.

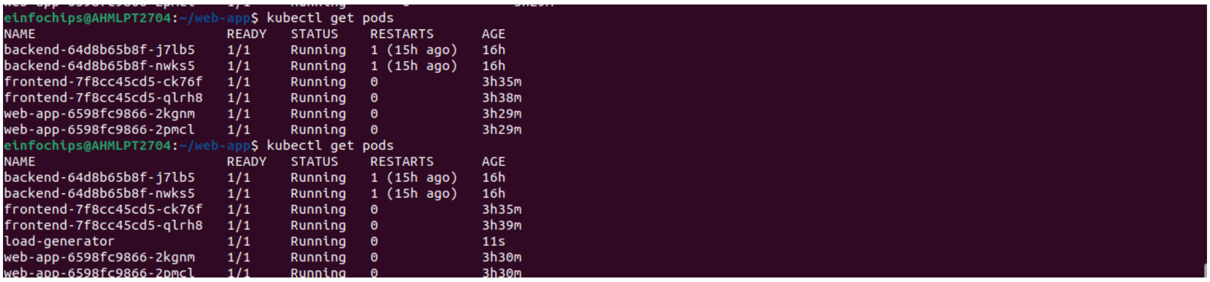


```
einfochips@AHMLPT2704:~/web-app$ kubectl apply -f hpa.yaml
horizontalpodautoscaler.autoscaling/web-app-hpa created
```

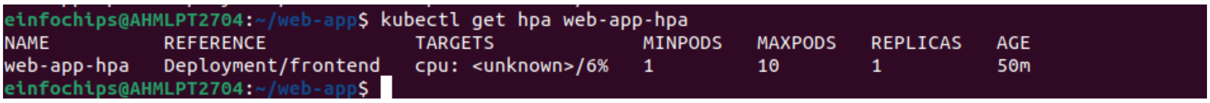
7. Stress Testing:



```
einfochips@AHMLPT2704:~/web-app$ kubectl run -i --tty --rm load-generator --image=busybox --restart=Never -- /bin/sh
If you don't see a command prompt, try pressing enter.
/ #
/ #
/ # while true; do wget -q -O- https://myapp.local/frontend; done
wget: note: TLS certificate validation not implemented
<!DOCTYPE html>
<html>
<body>
    <h1>Hello A Static HTML Page!</h1>
</body>
</html>
wget: note: TLS certificate validation not implemented
<!DOCTYPE html>
<html>
<body>
    <h1>Hello A Static HTML Page!</h1>
</body>
</html>
wget: note: TLS certificate validation not implemented
<!DOCTYPE html>
<html>
<body>
    <h1>Hello A Static HTML Page!</h1>
</body>
</html>
wget: note: TLS certificate validation not implemented
<!DOCTYPE html>
<html>
<body>
    <h1>Hello A Static HTML Page!</h1>
</body>
```



```
einfochips@AHMLPT2704:~/web-app$ kubectl get pods
NAME                        READY   STATUS    RESTARTS      AGE
backend-64d8b65b8f-j7lb5    1/1     Running   1 (15h ago)   16h
backend-64d8b65b8f-nwks5    1/1     Running   1 (15h ago)   16h
frontend-7f8cc45cd5-ck76f   1/1     Running   0             3h35m
frontend-7f8cc45cd5-qlrh8   1/1     Running   0             3h38m
web-app-6598fc9866-2kgnm    1/1     Running   0             3h29m
web-app-6598fc9866-2pmcl    1/1     Running   0             3h29m
einfochips@AHMLPT2704:~/web-app$ kubectl get pods
NAME                        READY   STATUS    RESTARTS      AGE
backend-64d8b65b8f-j7lb5    1/1     Running   1 (15h ago)   16h
backend-64d8b65b8f-nwks5    1/1     Running   1 (15h ago)   16h
frontend-7f8cc45cd5-ck76f   1/1     Running   0             3h35m
frontend-7f8cc45cd5-qlrh8   1/1     Running   0             3h39m
load-generator              1/1     Running   0             11s
web-app-6598fc9866-2kgnm    1/1     Running   0             3h30m
web-app-6598fc9866-2pmcl    1/1     Running   0             3h30m
```



```
einfochips@AHMLPT2704:~/web-app$ kubectl get hpa web-app-hpa
NAME          REFERENCE             TARGETS            MINPODS   MAXPODS   REPLICAS   AGE
web-app-hpa   Deployment/frontend   cpu: <unknown>/6%  1         10        1          50m
einfochips@AHMLPT2704:~/web-app$
```

kubectl run -i --tty --rm load-generator --image=busybox --restart=Never -- /bin/sh

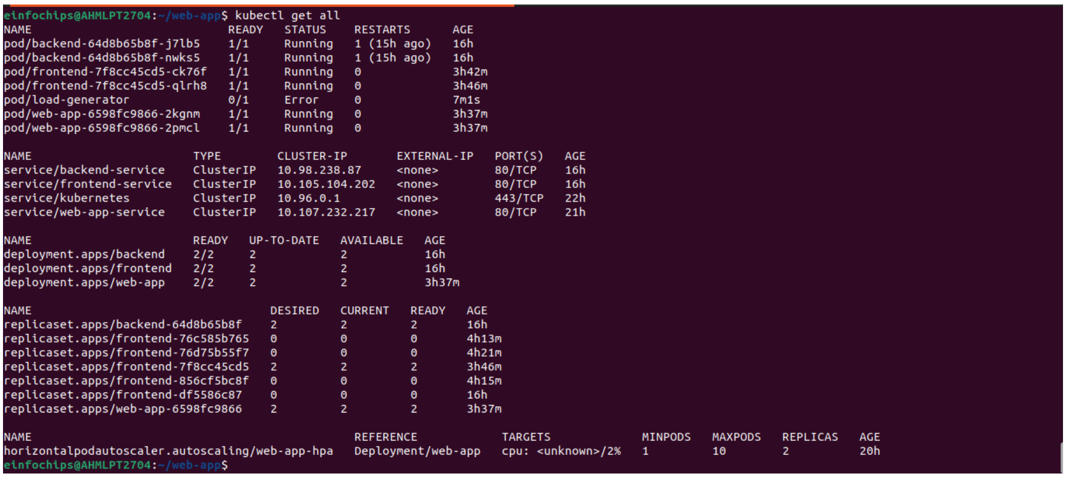
# Inside the pod, run the following command to generate load

while true; do wget -q -O- http://myapp.local/frontend; done

This command is used for creating load on Pods so that whenever needed, extra replicas are created automatically.

Stage 4: Final Validation and Cleanup

8. **Final Validation:**



```
einfochips@AHMLPT2704:~/web-app$ kubectl get all
NAME                            READY   STATUS    RESTARTS      AGE
pod/backend-64d8b65b8f-j7lb5    1/1     Running   1 (15h ago)   16h
pod/backend-64d8b65b8f-nwks5    1/1     Running   1 (15h ago)   16h
pod/frontend-7f8cc45cd5-ck76f   1/1     Running   0             3h42m
pod/frontend-7f8cc45cd5-qlrh8   1/1     Running   0             3h46m
pod/load-generator              0/1     Error     0             7m1s
pod/web-app-6598fc9866-2kgnm    1/1     Running   0             3h37m
pod/web-app-6598fc9866-2pmcl    1/1     Running   0             3h37m

NAME                       TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)   AGE
service/backend-service    ClusterIP   10.98.238.87     <none>        80/TCP    16h
service/frontend-service   ClusterIP   10.105.104.202   <none>        80/TCP    16h
service/kubernetes         ClusterIP   10.96.0.1        <none>        443/TCP   22h
service/web-app-service    ClusterIP   10.107.232.217   <none>        80/TCP    21h

NAME                       READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/backend    2/2     2            2           16h
deployment.apps/frontend   2/2     2            2           16h
deployment.apps/web-app    2/2     2            2           3h37m

NAME                                  DESIRED   CURRENT   READY   AGE
replicaset.apps/backend-64d8b65b8f    2         2         2       16h
replicaset.apps/frontend-76c585b765   0         0         0       4h13m
replicaset.apps/frontend-76d75b55f7   0         0         0       4h21m
replicaset.apps/frontend-7f8cc45cd5   2         2         2       3h46m
replicaset.apps/frontend-856cf5bc8f   0         0         0       4h15m
replicaset.apps/frontend-df5586c87    0         0         0       16h
replicaset.apps/web-app-6598fc9866    2         2         2       3h37m

NAME                                              REFERENCE            TARGETS            MINPODS   MAXPODS   REPLICAS   AGE
horizontalpodautoscaler.autoscaling/web-app-hpa   Deployment/web-app   cpu: <unknown>/2%  1         10        2          20h
einfochips@AHMLPT2704:~/web-app$
```

9. **Cleanup:**
   - ○ kubectl delete ingress web-app-ingress
   - ○ kubectl delete hpa web-app-hpa
   - ○ kubectl delete service web-app-service
   - ○ kubectl delete service web-app-service
   - ○ kubectl delete deployment siddhpatel/web-app