Project 01

In this project, you will develop a simple Node.js application, deploy it on a local Kubernetes cluster using Minikube, and configure various Kubernetes features. The project includes Git version control practices, creating and managing branches, and performing rebases. Additionally, you will work with ConfigMaps, Secrets, environment variables, and set up vertical and horizontal pod autoscaling.

Project 01

Project Steps

1. Setup Minikube and Git Repository

Start Minikube:

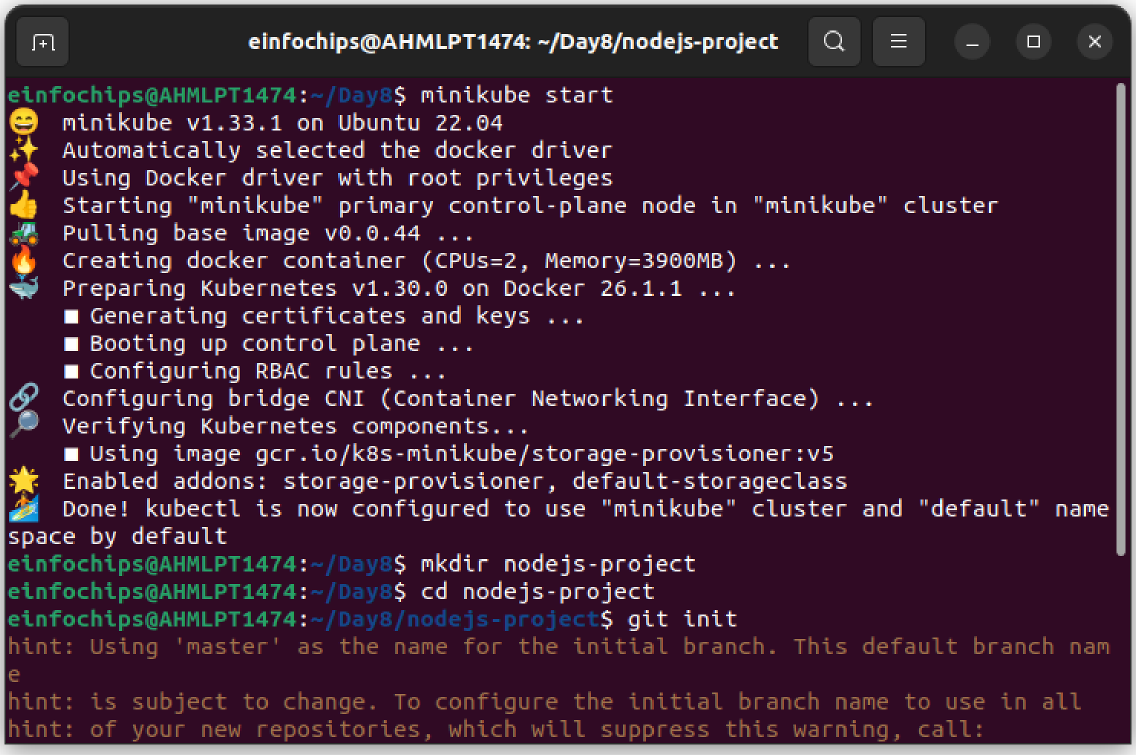
```
minikube start
```

1.2 Set Up Git Repository
Create a new directory for your project:

```
mkdir nodejs-k8s-project
cd nodejs-k8s-project
```

Initialize Git repository:

```
git init
```



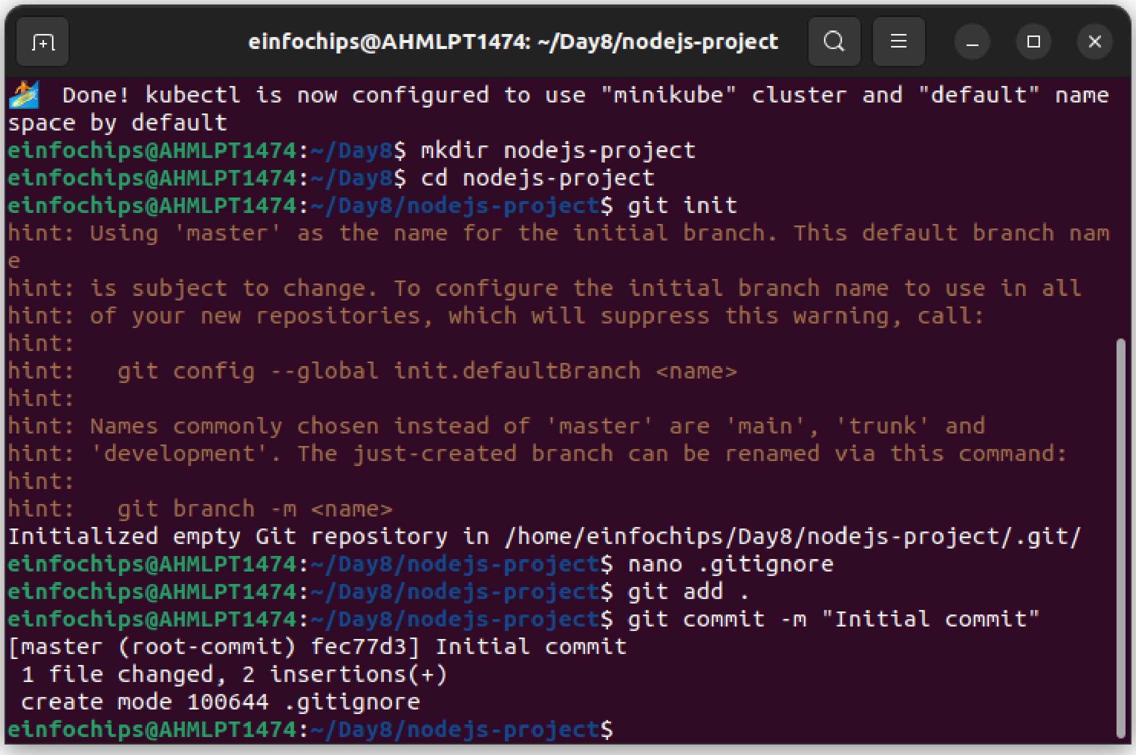
```
einfochips@AHMLPT1474:~/Day8$ minikube start
😄  minikube v1.33.1 on Ubuntu 22.04
✨  Automatically selected the docker driver
📌  Using Docker driver with root privileges
👍  Starting "minikube" primary control-plane node in "minikube" cluster
🚜  Pulling base image v0.0.44 ...
🔥  Creating docker container (CPUs=2, Memory=3900MB) ...
🐳  Preparing Kubernetes v1.30.0 on Docker 26.1.1 ...
    ■ Generating certificates and keys ...
    ■ Booting up control plane ...
    ■ Configuring RBAC rules ...
🔗  Configuring bridge CNI (Container Networking Interface) ...
🔎  Verifying Kubernetes components...
    ■ Using image gcr.io/k8s-minikube/storage-provisioner:v5
🌟  Enabled addons: storage-provisioner, default-storageclass
🏄  Done! kubectl is now configured to use "minikube" cluster and "default" name
space by default
einfochips@AHMLPT1474:~/Day8$ mkdir nodejs-project
einfochips@AHMLPT1474:~/Day8$ cd nodejs-project
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git init
hint: Using 'master' as the name for the initial branch. This default branch nam
e
hint: is subject to change. To configure the initial branch name to use in all
hint: of your new repositories, which will suppress this warning, call:
```

Create a .gitignore file:

```
node_modules/
.env
```

Add and commit initial changes:

```
git add .
git commit -m "Initial commit"
```



```
🏄  Done! kubectl is now configured to use "minikube" cluster and "default" name
space by default
einfochips@AHMLPT1474:~/Day8$ mkdir nodejs-project
einfochips@AHMLPT1474:~/Day8$ cd nodejs-project
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git init
hint: Using 'master' as the name for the initial branch. This default branch nam
e
hint: is subject to change. To configure the initial branch name to use in all
hint: of your new repositories, which will suppress this warning, call:
hint:
hint:   git config --global init.defaultBranch <name>
hint:
hint: Names commonly chosen instead of 'master' are 'main', 'trunk' and
hint: 'development'. The just-created branch can be renamed via this command:
hint:
hint:   git branch -m <name>
Initialized empty Git repository in /home/einfochips/Day8/nodejs-project/.git/
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano .gitignore
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git add .
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git commit -m "Initial commit"
[master (root-commit) fec77d3] Initial commit
 1 file changed, 2 insertions(+)
 create mode 100644 .gitignore
einfochips@AHMLPT1474:~/Day8/nodejs-project$
```

2. Develop a Node.js Application

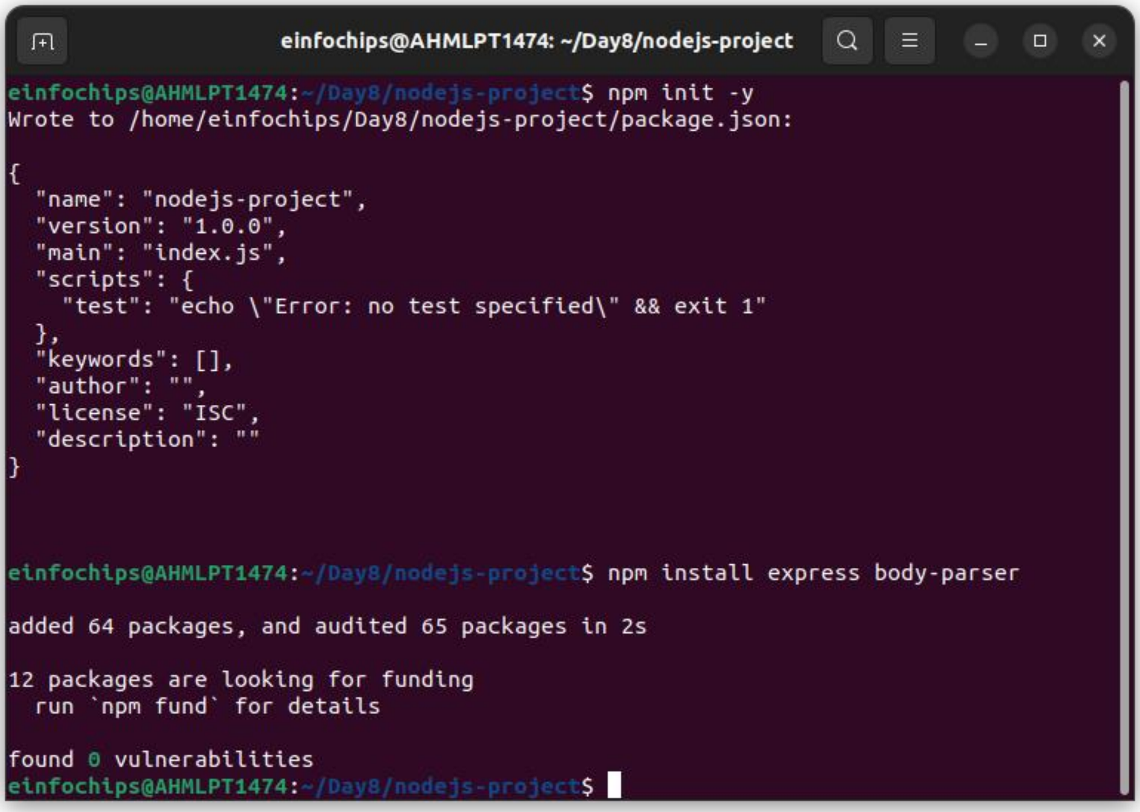
2.1 Create the Node.js App

Initialize the Node.js project:

```
npm init -y
```

Install necessary packages:

```
npm install express body-parser
```



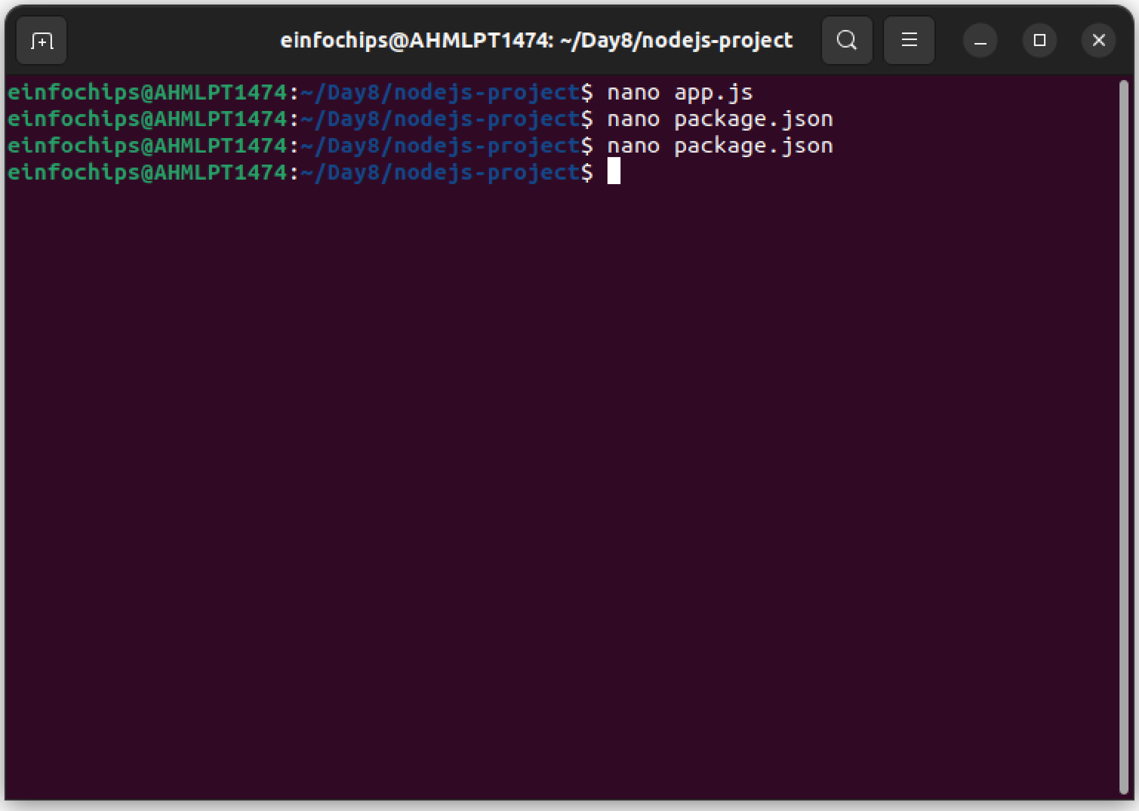
```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ npm init -y
Wrote to /home/einfochips/Day8/nodejs-project/package.json:

{
  "name": "nodejs-project",
  "version": "1.0.0",
  "main": "index.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "keywords": [],
  "author": "",
  "license": "ISC",
  "description": ""
}



einfochips@AHMLPT1474:~/Day8/nodejs-project$ npm install express body-parser

added 64 packages, and audited 65 packages in 2s

12 packages are looking for funding
  run `npm fund` for details

found 0 vulnerabilities
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

Create app.js:

```
const express = require('express');
const bodyParser = require('body-parser');
const app = express();
const PORT = process.env.PORT || 3000;

app.use(bodyParser.json());

app.get('/', (req, res) => {
  res.send('Hello, World!');
});

app.listen(PORT, () => {
  console.log(`Server is running on port ${PORT}`);
});
```

Update package.json to include a start script:

```
"scripts": {
  "start": "node app.js"
}
```



```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano app.js
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano package.json
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano package.json
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

2.2 Commit the Node.js Application
Add and commit changes:

```
git add .
git commit -m "Add Node.js application code"
```

3. Create Dockerfile and Docker Compose

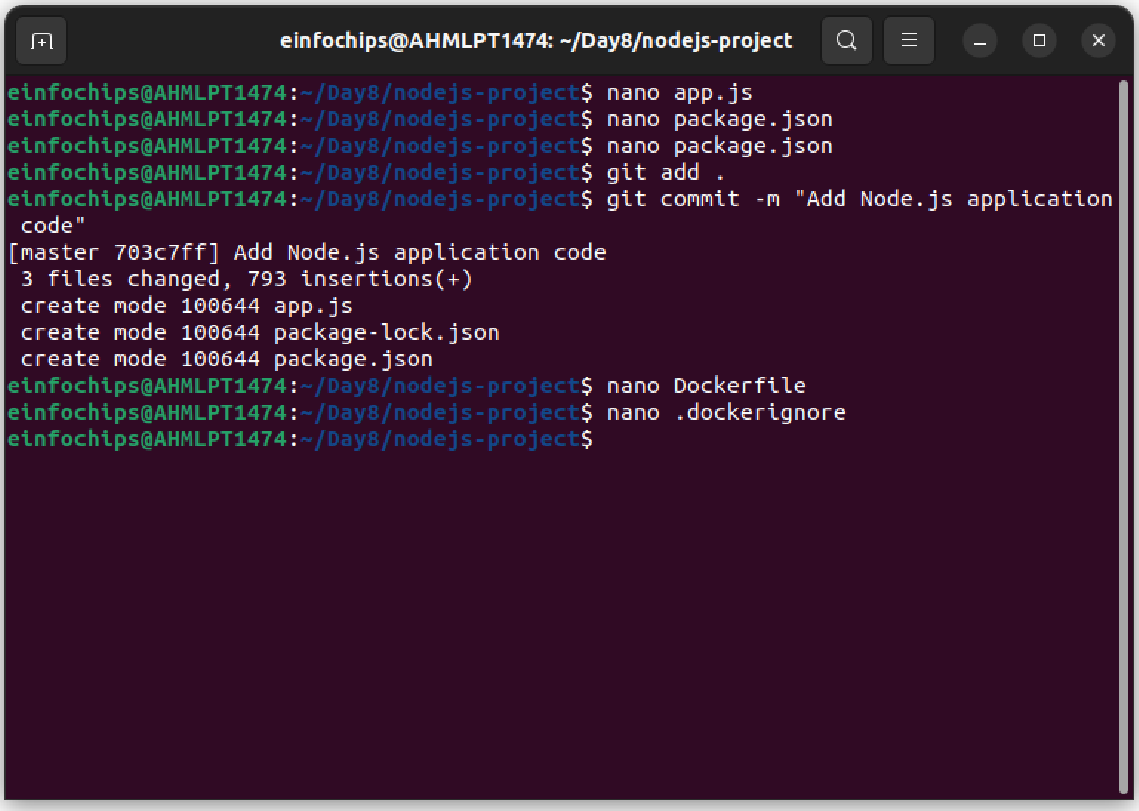
3.1 Create a Dockerfile
Add Dockerfile:

```
# Use official Node.js image
FROM node:18

# Set the working directory
WORKDIR /usr/src/app

# Copy package.json and package-lock.json
COPY package*.json ./

# Install dependencies
```

```
RUN npm install

# Copy the rest of the application code
COPY . .

# Expose the port on which the app runs
EXPOSE 3000

# Command to run the application
CMD [ "npm", "start" ]
```

Create a .dockerignore file:

```
node_modules
.npm
```



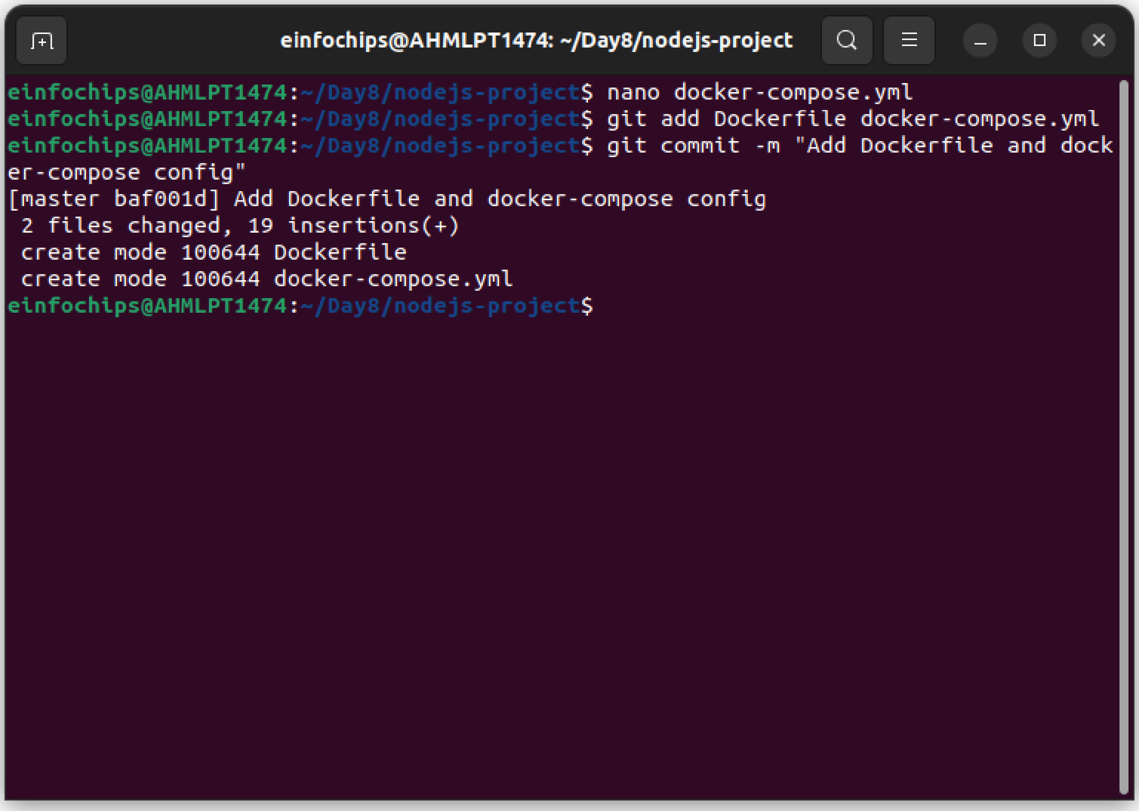
```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano app.js
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano package.json
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano package.json
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git add .
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git commit -m "Add Node.js application
 code"
[master 703c7ff] Add Node.js application code
 3 files changed, 793 insertions(+)
 create mode 100644 app.js
 create mode 100644 package-lock.json
 create mode 100644 package.json
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano Dockerfile
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano .dockerignore
einfochips@AHMLPT1474:~/Day8/nodejs-project$
```

3.2 Create docker-compose.yml (optional for local testing)
Add docker-compose.yml:

```
version: '3'
services:
  app:
    build: .
    ports:
      - "3000:3000"
```

Add and commit changes:

```
git add Dockerfile docker-compose.yml
git commit -m "Add Dockerfile and Docker Compose configuration"
```



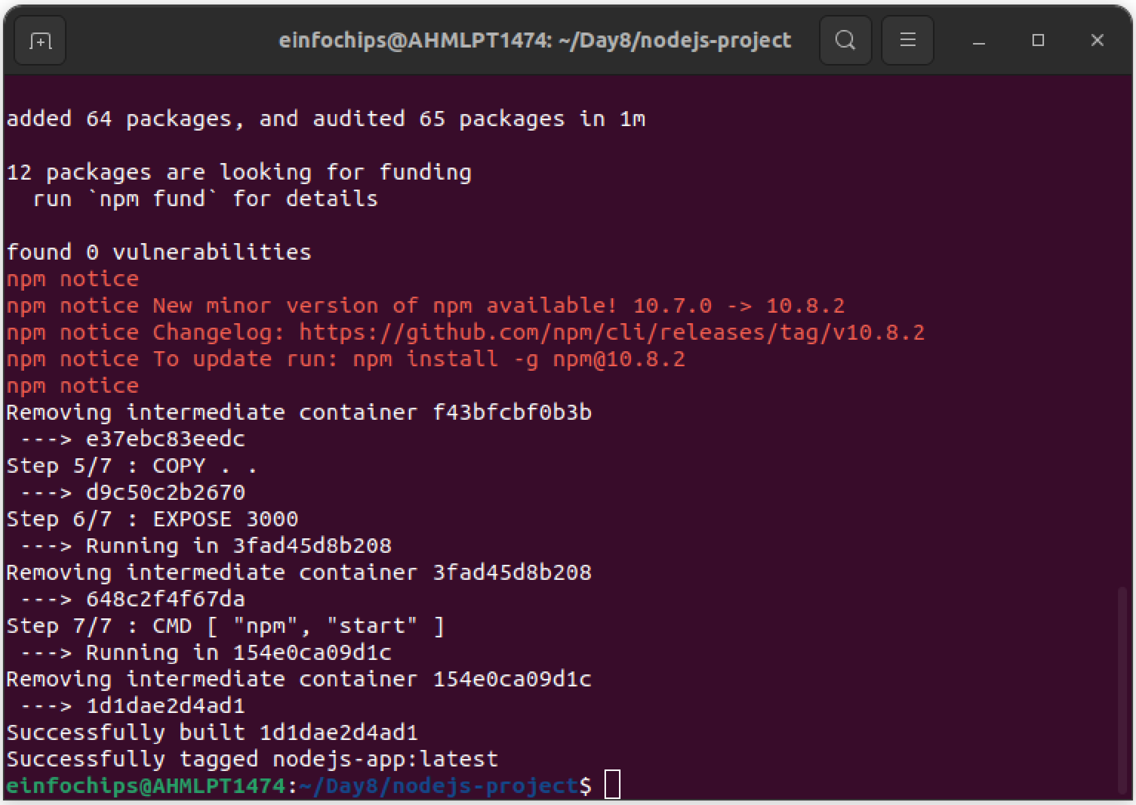
```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano docker-compose.yml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git add Dockerfile docker-compose.yml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git commit -m "Add Dockerfile and dock
er-compose config"
[master baf001d] Add Dockerfile and docker-compose config
 2 files changed, 19 insertions(+)
 create mode 100644 Dockerfile
 create mode 100644 docker-compose.yml
einfochips@AHMLPT1474:~/Day8/nodejs-project$
```

4. Build and Push Docker Image

4.1 Build Docker Image

Build the Docker image:

```
docker build -t nodejs-app:latest .
```

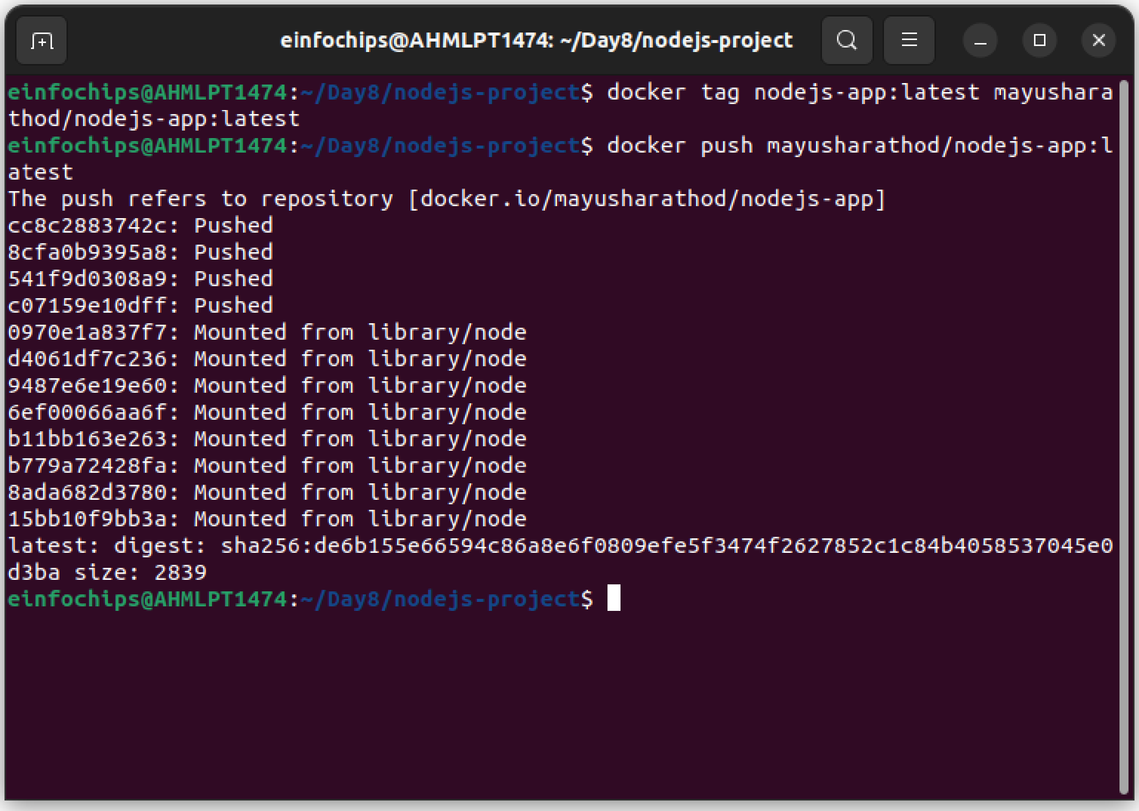


```
added 64 packages, and audited 65 packages in 1m

12 packages are looking for funding
  run `npm fund` for details

found 0 vulnerabilities
npm notice
npm notice New minor version of npm available! 10.7.0 -> 10.8.2
npm notice Changelog: https://github.com/npm/cli/releases/tag/v10.8.2
npm notice To update run: npm install -g npm@10.8.2
npm notice
Removing intermediate container f43bfcbf0b3b
 ---> e37ebc83eedc
Step 5/7 : COPY . .
 ---> d9c50c2b2670
Step 6/7 : EXPOSE 3000
 ---> Running in 3fad45d8b208
Removing intermediate container 3fad45d8b208
 ---> 648c2f4f67da
Step 7/7 : CMD [ "npm", "start" ]
 ---> Running in 154e0ca09d1c
Removing intermediate container 154e0ca09d1c
 ---> 1d1dae2d4ad1
Successfully built 1d1dae2d4ad1
Successfully tagged nodejs-app:latest
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

4.2 Push Docker Image to Docker Hub

Tag and push the image:

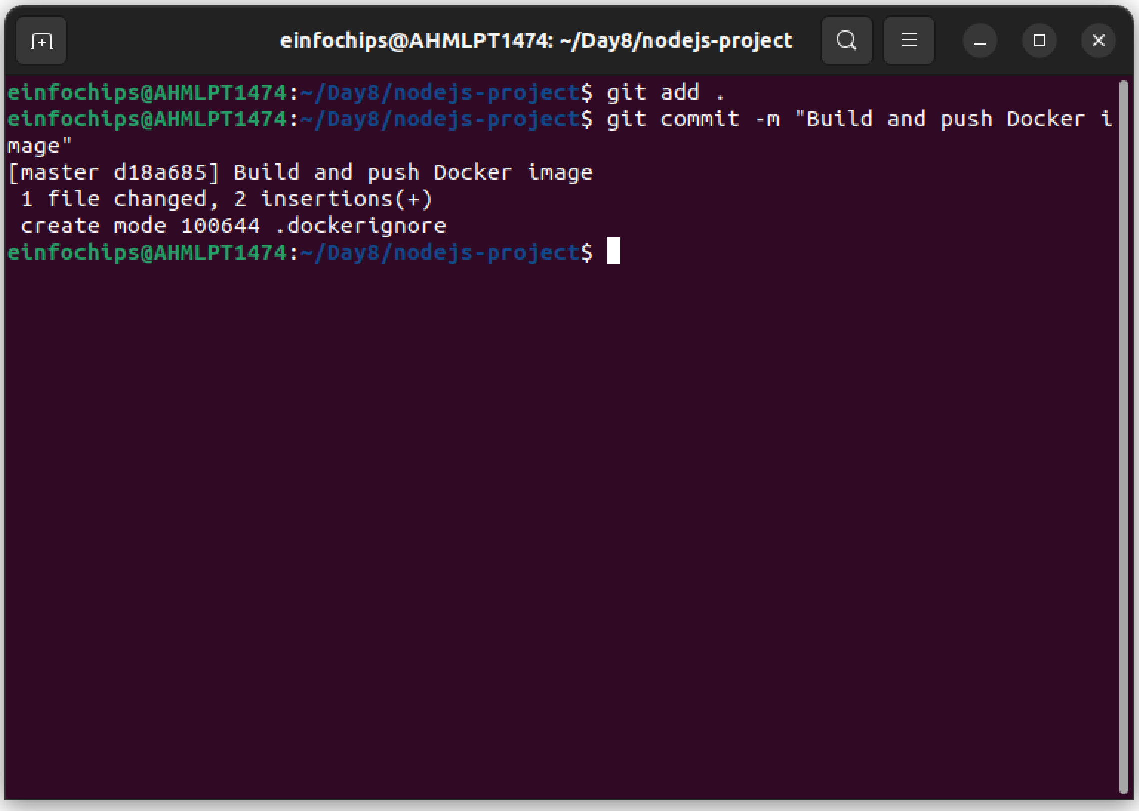
```
docker tag nodejs-app:latest your-dockerhub-username/nodejs-app:latest
docker push your-dockerhub-username/nodejs-app:latest
```



```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ docker tag nodejs-app:latest mayushara
thod/nodejs-app:latest
einfochips@AHMLPT1474:~/Day8/nodejs-project$ docker push mayusharathod/nodejs-app:l
atest
The push refers to repository [docker.io/mayusharathod/nodejs-app]
cc8c2883742c: Pushed
8cfa0b9395a8: Pushed
541f9d0308a9: Pushed
c07159e10dff: Pushed
0970e1a837f7: Mounted from library/node
d4061df7c236: Mounted from library/node
9487e6e19e60: Mounted from library/node
6ef00066aa6f: Mounted from library/node
b11bb163e263: Mounted from library/node
b779a72428fa: Mounted from library/node
8ada682d3780: Mounted from library/node
15bb10f9bb3a: Mounted from library/node
latest: digest: sha256:de6b155e66594c86a8e6f0809efe5f3474f2627852c1c84b4058537045e0
d3ba size: 2839
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

Add and commit changes:

```
git add .
git commit -m "Build and push Docker image"
```



```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git add .
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git commit -m "Build and push Docker i
mage"
[master d18a685] Build and push Docker image
 1 file changed, 2 insertions(+)
 create mode 100644 .dockerignore
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

5. Create Kubernetes Configurations

5.1 Create Kubernetes Deployment

Create kubernetes/deployment.yaml:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nodejs-app-deployment
spec:
  replicas: 2
  selector:
    matchLabels:
      app: nodejs-app
  template:
    metadata:
      labels:
        app: nodejs-app
    spec:
      containers:
      - name: nodejs-app
        image: your-dockerhub-username/nodejs-app:latest
        ports:
```

```
    - containerPort: 3000
    env:
    - name: PORT
      valueFrom:
        configMapKeyRef:
          name: app-config
          key: PORT
    - name: NODE_ENV
      valueFrom:
        secretKeyRef:
          name: app-secrets
          key: NODE_ENV
```

5.2 Create ConfigMap and Secret

Create kubernetes/configmap.yaml:

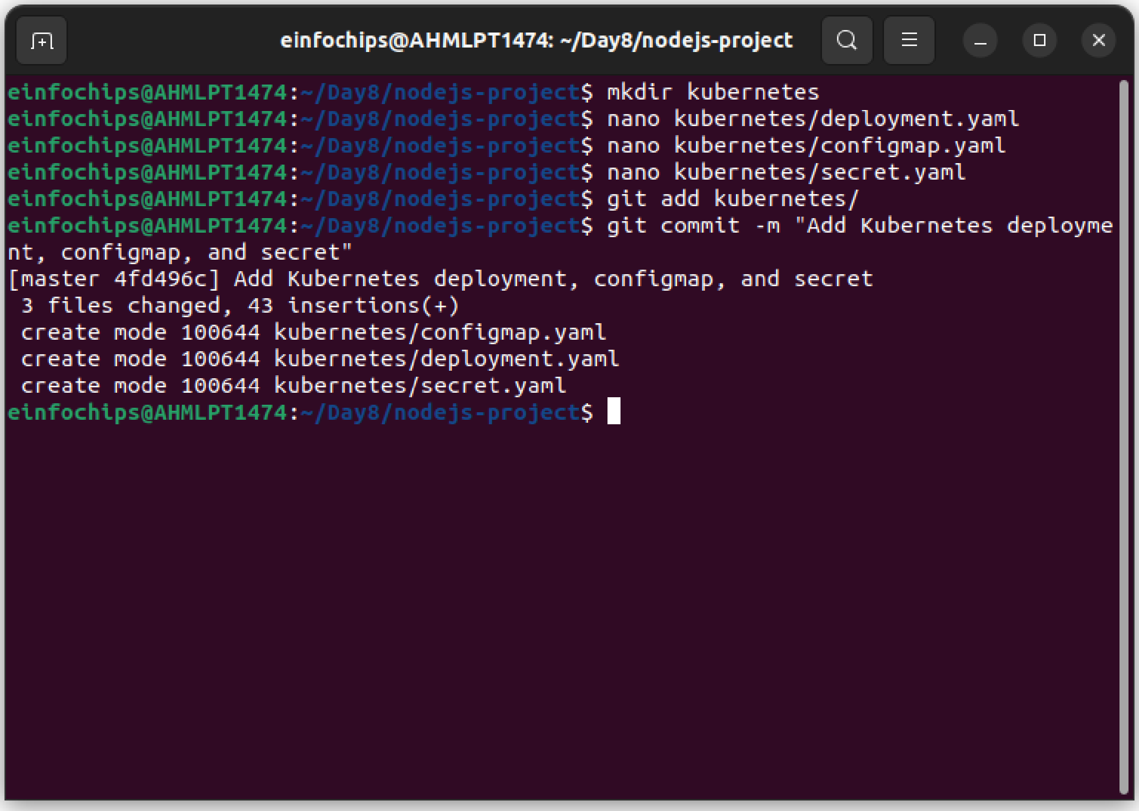
```
apiVersion: v1
kind: ConfigMap
metadata:
  name: app-config
data:
  PORT: "3000"
```

Create kubernetes/secret.yaml:

```
apiVersion: v1
kind: Secret
metadata:
  name: app-secretsgit
type: Opaque
data:
  NODE_ENV: cHJvZHVjdGlvbmFs # Base64 encoded value for "production"
```

Add and commit Kubernetes configurations:

```
git add kubernetes/
git commit -m "Add Kubernetes deployment, configmap, and secret"
```



```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ mkdir kubernetes
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/deployment.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/configmap.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/secret.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git add kubernetes/
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git commit -m "Add Kubernetes deployme
nt, configmap, and secret"
[master 4fd496c] Add Kubernetes deployment, configmap, and secret
 3 files changed, 43 insertions(+)
 create mode 100644 kubernetes/configmap.yaml
 create mode 100644 kubernetes/deployment.yaml
 create mode 100644 kubernetes/secret.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

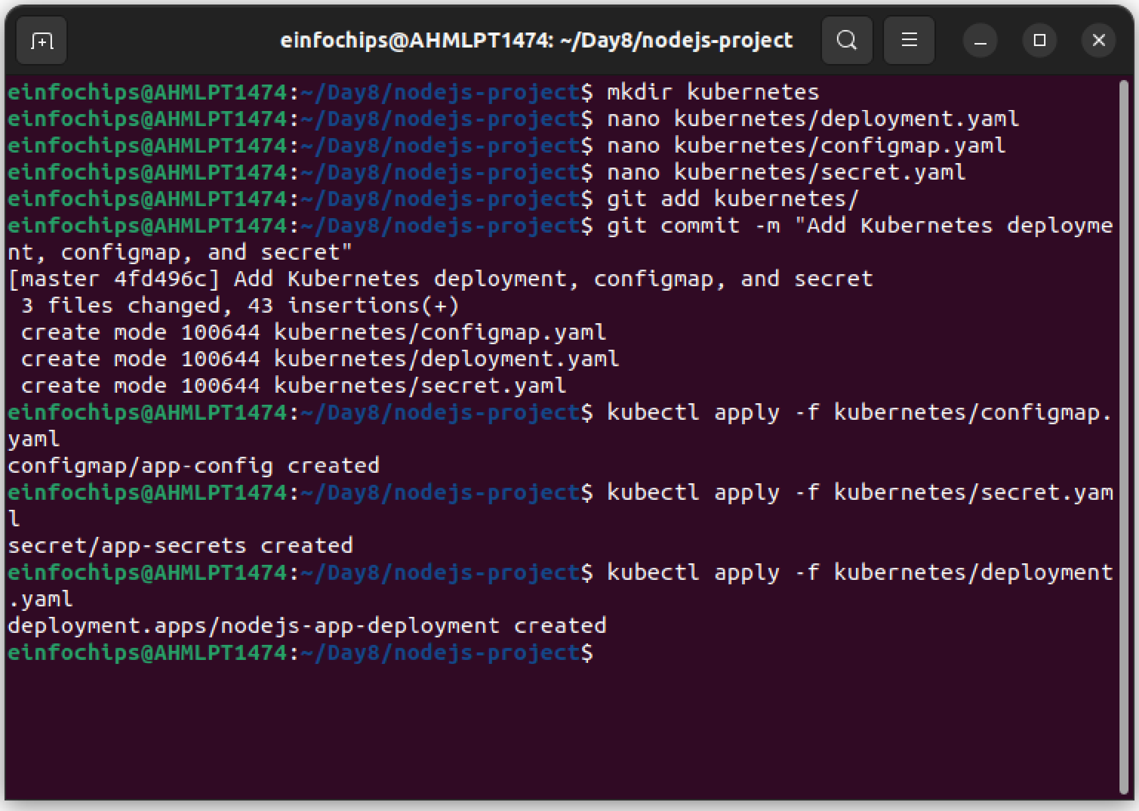
5.3 Apply Kubernetes Configurations

Apply the ConfigMap and Secret:

```
kubectl apply -f kubernetes/configmap.yaml
kubectl apply -f kubernetes/secret.yaml
```

Apply the Deployment:

```
kubectl apply -f kubernetes/deployment.yaml
```



```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ mkdir kubernetes
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/deployment.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/configmap.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/secret.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git add kubernetes/
einfochips@AHMLPT1474:~/Day8/nodejs-project$ git commit -m "Add Kubernetes deployme
nt, configmap, and secret"
[master 4fd496c] Add Kubernetes deployment, configmap, and secret
 3 files changed, 43 insertions(+)
 create mode 100644 kubernetes/configmap.yaml
 create mode 100644 kubernetes/deployment.yaml
 create mode 100644 kubernetes/secret.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/configmap.
yaml
configmap/app-config created
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/secret.yam
l
secret/app-secrets created
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/deployment
.yaml
deployment.apps/nodejs-app-deployment created
einfochips@AHMLPT1474:~/Day8/nodejs-project$
```

6. Implement Autoscaling

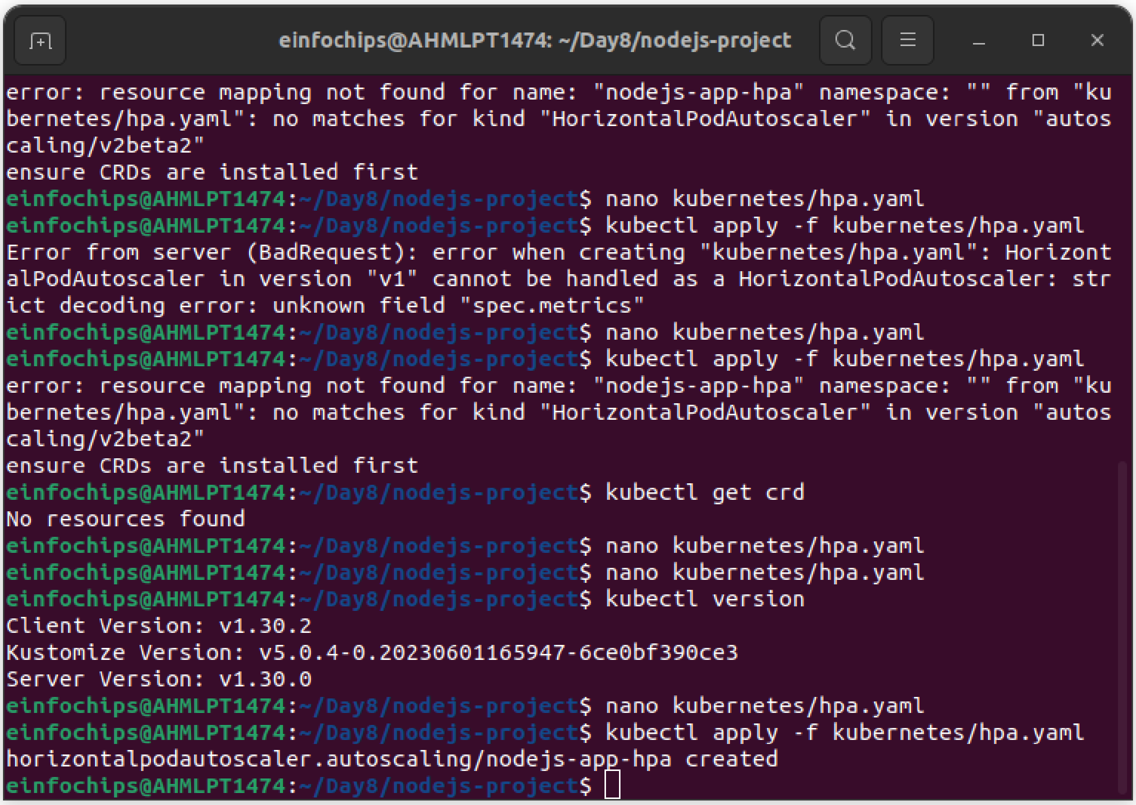
6.1 Create Horizontal Pod Autoscaler

Create kubernetes/hpa.yaml:

```
apiVersion: autoscaling/v2beta2
kind: HorizontalPodAutoscaler
metadata:
  name: nodejs-app-hpa
spec:
  scaleTargetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: nodejs-app-deployment
  minReplicas: 2
  maxReplicas: 5
  metrics:
  - type: Resource
    resource:
      name: cpu
      target:
        type: Utilization
        averageUtilization: 50
```

Apply the HPA:

```
kubectl apply -f kubernetes/hpa.yaml
```



```
error: resource mapping not found for name: "nodejs-app-hpa" namespace: "" from "ku
bernetes/hpa.yaml": no matches for kind "HorizontalPodAutoscaler" in version "autos
caling/v2beta2"
ensure CRDs are installed first
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/hpa.yaml
Error from server (BadRequest): error when creating "kubernetes/hpa.yaml": Horizont
alPodAutoscaler in version "v1" cannot be handled as a HorizontalPodAutoscaler: str
ict decoding error: unknown field "spec.metrics"
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/hpa.yaml
error: resource mapping not found for name: "nodejs-app-hpa" namespace: "" from "ku
bernetes/hpa.yaml": no matches for kind "HorizontalPodAutoscaler" in version "autos
caling/v2beta2"
ensure CRDs are installed first
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl get crd
No resources found
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl version
Client Version: v1.30.2
Kustomize Version: v5.0.4-0.20230601165947-6ce0bf390ce3
Server Version: v1.30.0
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/hpa.yaml
horizontalpodautoscaler.autoscaling/nodejs-app-hpa created
einfochips@AHMLPT1474:~/Day8/nodejs-project$
```

6.2 Create Vertical Pod Autoscaler

Create kubernetes/vpa.yaml:

```
apiVersion: autoscaling.k8s.io/v1beta2
kind: VerticalPodAutoscaler
metadata:
  name: nodejs-app-vpa
spec:
  targetRef:
    apiVersion: apps/v1
    kind: Deployment
    name: nodejs-app-deployment
  updatePolicy:
    updateMode: "Auto"
```

Apply the VPA:

kubectl apply -f kubernetes/vpa.yaml

7. Test the Deployment

7.1 Check the Status of Pods, Services, and HPA

Verify the Pods:

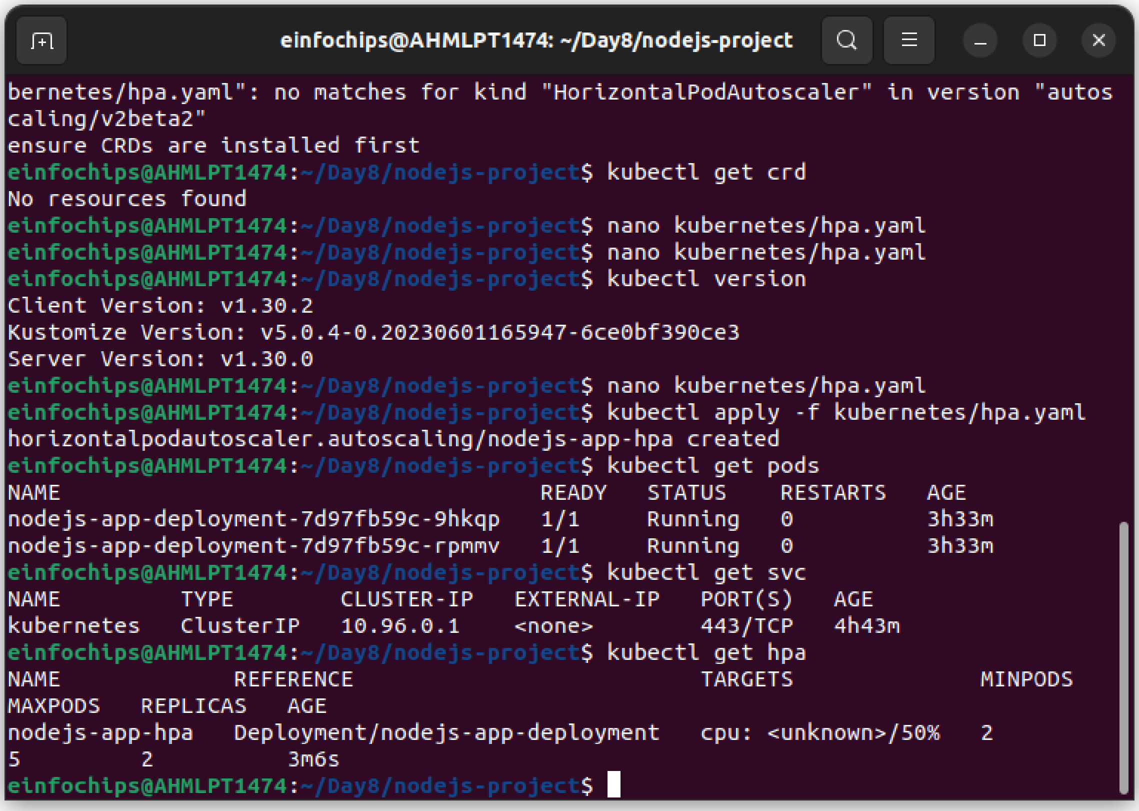
kubectl get pods

Verify the Services:

kubectl get svc

Verify the HPA:

kubectl get hpa



```
bernetes/hpa.yaml": no matches for kind "HorizontalPodAutoscaler" in version "autos
caling/v2beta2"
ensure CRDs are installed first
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl get crd
No resources found
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl version
Client Version: v1.30.2
Kustomize Version: v5.0.4-0.20230601165947-6ce0bf390ce3
Server Version: v1.30.0
einfochips@AHMLPT1474:~/Day8/nodejs-project$ nano kubernetes/hpa.yaml
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl apply -f kubernetes/hpa.yaml
horizontalpodautoscaler.autoscaling/nodejs-app-hpa created
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl get pods
NAME                                       READY   STATUS    RESTARTS   AGE
nodejs-app-deployment-7d97fb59c-9hkqp     1/1     Running   0          3h33m
nodejs-app-deployment-7d97fb59c-rpmmv     1/1     Running   0          3h33m
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl get svc
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.96.0.1    <none>        443/TCP   4h43m
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl get hpa
NAME             REFERENCE                          TARGETS              MINPODS
MAXPODS   REPLICAS   AGE
nodejs-app-hpa   Deployment/nodejs-app-deployment   cpu: <unknown>/50%   2
5         2          3m6s
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```

7.2 Access the Application

Expose the Service:

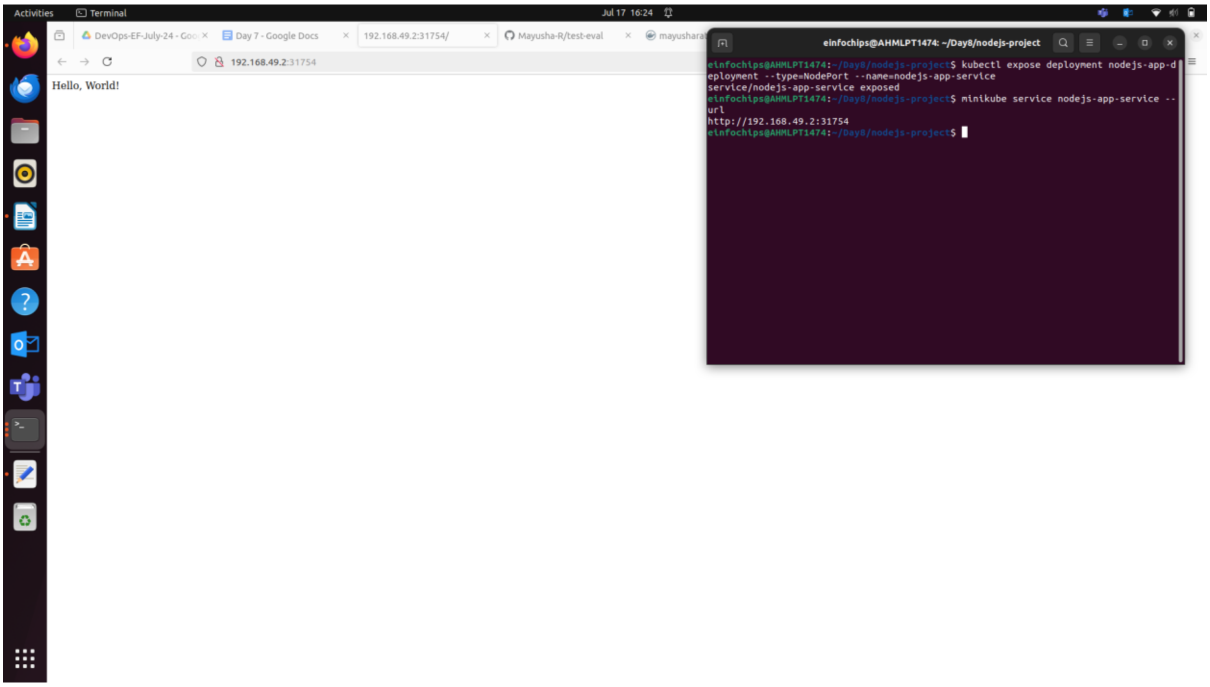
kubectl expose deployment nodejs-app-deployment --type=NodePort --name=nodejs-app-service

-

Get the Minikube IP and Service Port:

minikube service nodejs-app-service --url

- **Access the Application** in your browser using the URL obtained from the previous command.



Hello, World!

einfochips@AHMLPT1474: ~/Day8/nodejs-project

```
einfochips@AHMLPT1474:~/Day8/nodejs-project$ kubectl expose deployment nodejs-app-d
eployment --type=NodePort --name=nodejs-app-service
service/nodejs-app-service exposed
einfochips@AHMLPT1474:~/Day8/nodejs-project$ minikube service nodejs-app-service --
url
http://192.168.49.2:31754
einfochips@AHMLPT1474:~/Day8/nodejs-project$ 
```