

Для выполнения лабораторной работы Вам потребуется следующее:

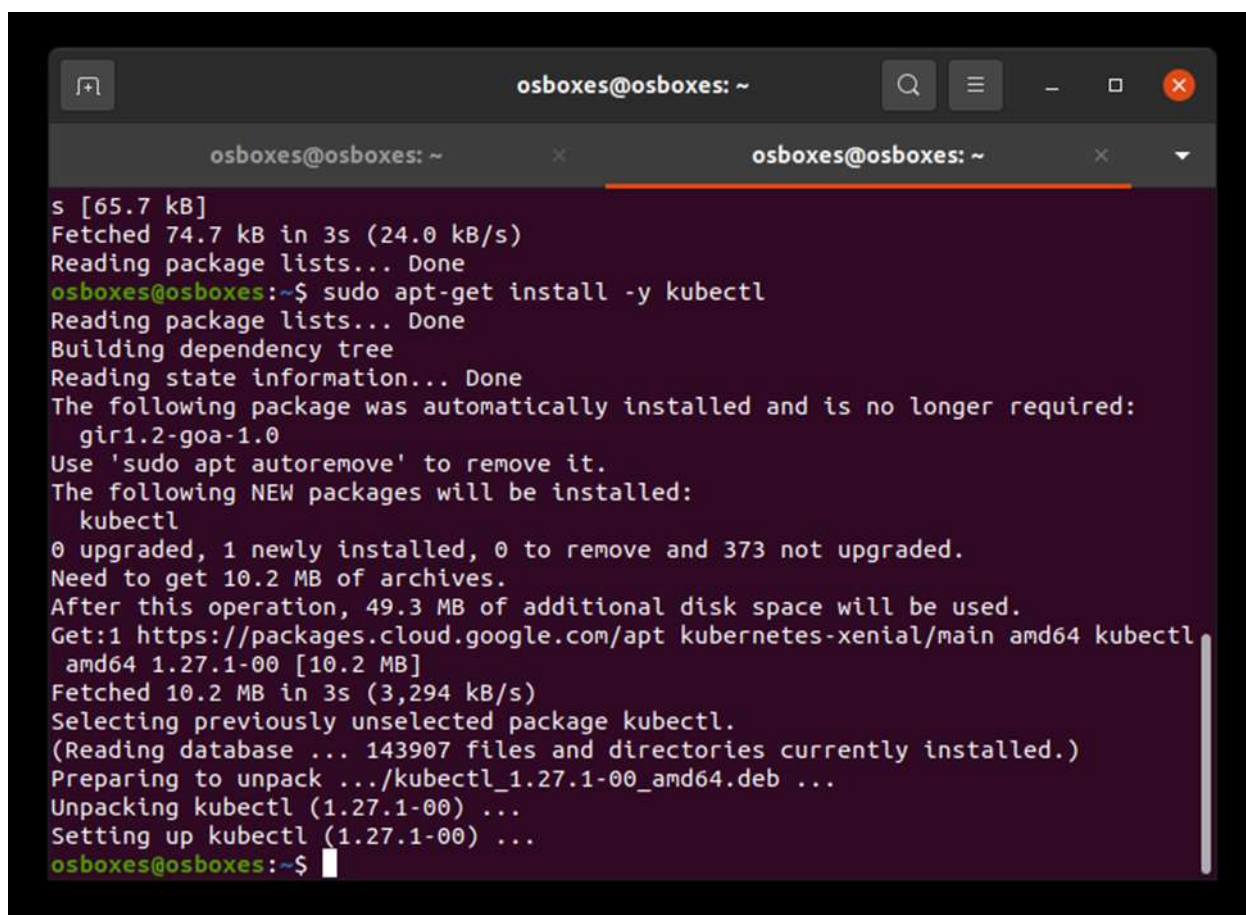
1. Установленный Docker, Docker Compose.
2. Учетная запись на сайте <https://hub.docker.com>.

Инструмент командной строки Kubernetes kubectl

Необходимо установить инструмент командной строки Kubernetes kubectl <https://kubernetes.io/ru/docs/tasks/tools/install-kubectl/>

Установка с помощью встроенного пакетного менеджера

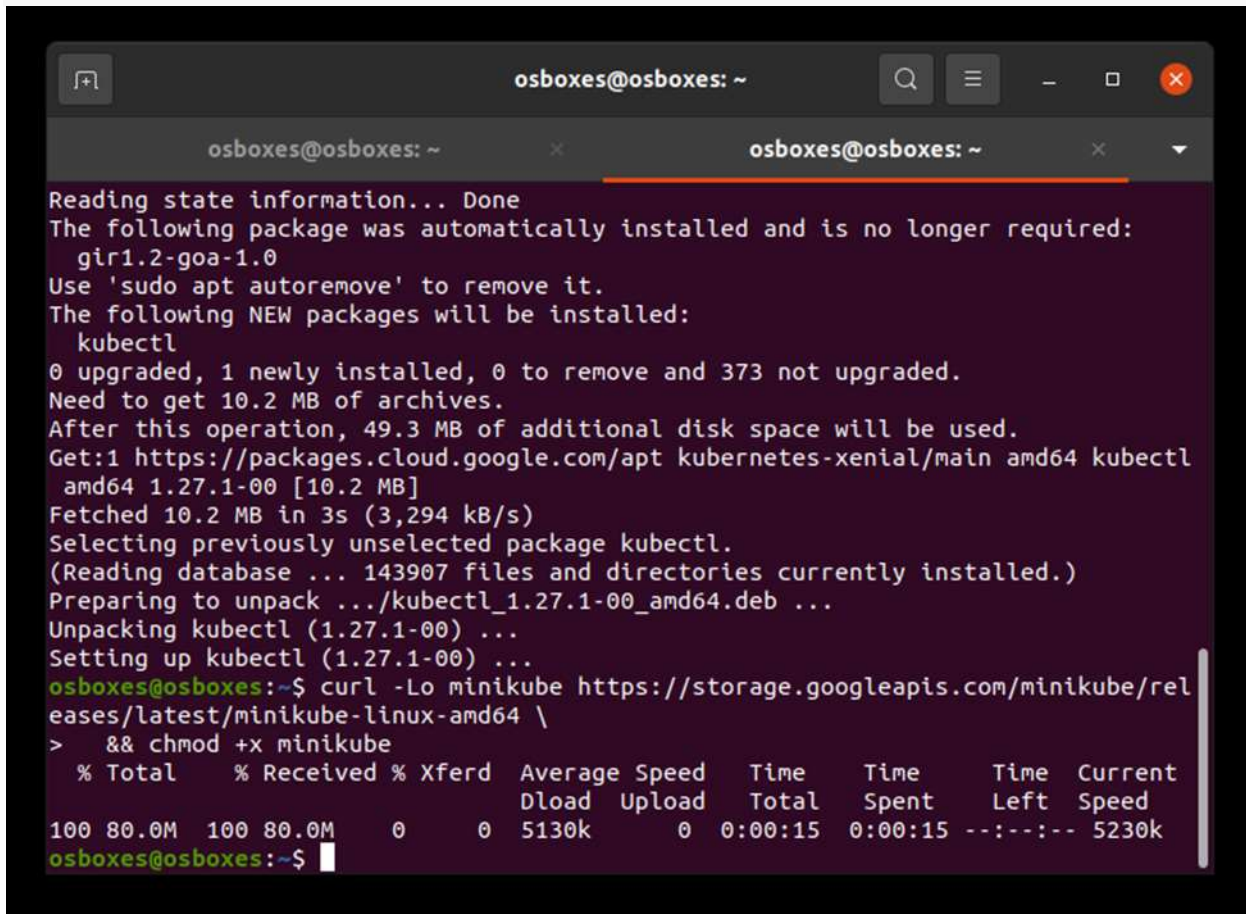
```
sudo apt-get update && sudo apt-get install -y apt-transport-https  
curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -  
echo "deb https://apt.kubernetes.io/ kubernetes-xenial main" | sudo tee -a  
/etc/apt/sources.list.d/kubernetes.list  
sudo apt-get update  
sudo apt-get install -y kubectl
```



```
osboxes@osboxes: ~  
osboxes@osboxes: ~  
s [65.7 kB]  
Fetched 74.7 kB in 3s (24.0 kB/s)  
Reading package lists... Done  
osboxes@osboxes:~$ sudo apt-get install -y kubectl  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following package was automatically installed and is no longer required:  
  gir1.2-goa-1.0  
Use 'sudo apt autoremove' to remove it.  
The following NEW packages will be installed:  
  kubectl  
0 upgraded, 1 newly installed, 0 to remove and 373 not upgraded.  
Need to get 10.2 MB of archives.  
After this operation, 49.3 MB of additional disk space will be used.  
Get:1 https://packages.cloud.google.com/apt kubernetes-xenial/main amd64 kubectl  
  amd64 1.27.1-00 [10.2 MB]  
Fetched 10.2 MB in 3s (3,294 kB/s)  
Selecting previously unselected package kubectl.  
(Reading database ... 143907 files and directories currently installed.)  
Preparing to unpack .../kubectl_1.27.1-00_amd64.deb ...  
Unpacking kubectl (1.27.1-00) ...  
Setting up kubectl (1.27.1-00) ...  
osboxes@osboxes:~$
```

Установка Minikube

```
curl -Lo minikube https://storage.googleapis.com/minikube/releases/latest/minikube-linux-  
amd64 \\  
&& chmod +x minikube
```



The screenshot shows a terminal window with the following output:

```
osboxes@osboxes: ~  
osboxes@osboxes: ~  
Reading state information... Done  
The following package was automatically installed and is no longer required:  
  gir1.2-goa-1.0  
Use 'sudo apt autoremove' to remove it.  
The following NEW packages will be installed:  
  kubectl  
0 upgraded, 1 newly installed, 0 to remove and 373 not upgraded.  
Need to get 10.2 MB of archives.  
After this operation, 49.3 MB of additional disk space will be used.  
Get:1 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubectl  
amd64 1.27.1-00 [10.2 MB]  
Fetched 10.2 MB in 3s (3,294 kB/s)  
Selecting previously unselected package kubectl.  
(Reading database ... 143907 files and directories currently installed.)  
Preparing to unpack .../kubectl_1.27.1-00_amd64.deb ...  
Unpacking kubectl (1.27.1-00) ...  
Setting up kubectl (1.27.1-00) ...  
osboxes@osboxes:~$ curl -Lo minikube https://storage.googleapis.com/minikube/rel  
eases/latest/minikube-linux-amd64 \  
> && chmod +x minikube  
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current  
Dload  Upload   Total             Spent    Left     Speed  
100 80.0M  100 80.0M    0     0  5130k      0  0:00:15  0:00:15 --:--:-- 5230k  
osboxes@osboxes:~$
```

Чтобы исполняемый файл Minikube был доступен из любой директории выполните следующие команды:

```
sudo mkdir -p /usr/local/bin/  
sudo install minikube /usr/local/bin/
```

```
osboxes@osboxes: ~  
gir1.2-goa-1.0  
Use 'sudo apt autoremove' to remove it.  
The following NEW packages will be installed:  
  kubectl  
0 upgraded, 1 newly installed, 0 to remove and 373 not upgraded.  
Need to get 10.2 MB of archives.  
After this operation, 49.3 MB of additional disk space will be used.  
Get:1 https://packages.cloud.google.com/apt/kubernetes-xenial/main amd64 kubectl  
amd64 1.27.1-00 [10.2 MB]  
Fetched 10.2 MB in 3s (3,294 kB/s)  
Selecting previously unselected package kubectl.  
(Reading database ... 143907 files and directories currently installed.)  
Preparing to unpack .../kubectl_1.27.1-00_amd64.deb ...  
Unpacking kubectl (1.27.1-00) ...  
Setting up kubectl (1.27.1-00) ...  
osboxes@osboxes:~$ curl -Lo minikube https://storage.googleapis.com/minikube/releases/latest/minikube-linux-amd64 \>  
&& chmod +x minikube  
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current  
             Dload  Upload   Total   Spent    Left   Speed  
100 80.0M  100 80.0M    0     0  5130k      0  0:00:15  0:00:15 --:--:-- 5230k  
osboxes@osboxes:~$ sudo mkdir -p /usr/local/bin/  
osboxes@osboxes:~$ sudo install minikube /usr/local/bin/  
osboxes@osboxes:~$
```

Запустите локальный кластер Kubernetes:

```
minikube start --driver=docker
```

и проверьте состояния кластера:

```
minikube status
```

```
osboxes@osboxes: ~  
> kubectl.sha256: 64 B / 64 B [-----] 100.00% ? p/s 0s  
> kubelet.sha256: 64 B / 64 B [-----] 100.00% ? p/s 0s  
> kubeadm.sha256: 64 B / 64 B [-----] 100.00% ? p/s 0s  
> kubectl: 45.81 MiB / 45.81 MiB [-----] 100.00% 2.43 MiB p/s 19s  
> kubeadm: 44.61 MiB / 44.61 MiB [-----] 100.00% 1.13 MiB p/s 40s  
> kubelet: 115.65 MiB / 115.65 MiB [-----] 100.00% 2.68 MiB p/s 43s  
■ Generating certificates and keys ...  
■ Booting up control plane ...  
■ Configuring RBAC rules ...  
🔗 Configuring bridge CNI (Container Networking Interface) ...  
■ Using image gcr.io/k8s-minikube/storage-provisioner:v5  
🌐 Verifying Kubernetes components...  
🌟 Enabled addons: storage-provisioner, default-storageclass  
🎉 Done! kubectl is now configured to use "minikube" cluster and "default" name  
space by default  
osboxes@osboxes:~$ minikube status  
minikube  
type: Control Plane  
host: Running  
kubelet: Running  
apiserver: Running  
kubeconfig: Configured  
osboxes@osboxes:~$
```

Создадим небольшое веб приложение app.py

```
from flask import Flask

app = Flask(__name__)

@app.route('/')
def hello_world():
    return 'Hello, World! Simple web app'

if __name__ == '__main__':
    app.run(debug=True, host='0.0.0.0', port='4000')
```

Dockerfile

```
# Use an official Python runtime as a parent image
FROM python:3.9-slim-buster

# Set the working directory to /app
WORKDIR /app

# Copy the current directory contents into the container at /app
COPY . /app

# Install any needed packages specified in requirements.txt
RUN pip install --no-cache-dir -r requirements.txt

# Make port 4000 available to the world outside this container
EXPOSE 4000

# Define environment variables
ENV FLASK_APP=app.py
ENV FLASK_ENV=development
ENV FLASK_DEBUG=1

# Run app.py when the container launches
CMD ["flask", "run", "--host=0.0.0.0", "--port=4000"]
```

файл requirements.txt

```
Flask==2.1.0
```


Перейдем в текущий каталог с созданными файлами

```
osboxes@osboxes: ~/Example
■ Using image docker.io/kubernetesui/dashboard:v2.7.0
■ Using image docker.io/kubernetesui/metrics-scraper:v1.0.8
💡 Some dashboard features require the metrics-server addon. To enable all features please run:

    minikube addons enable metrics-server

🌟 Enabled addons: storage-provisioner, default-storageclass, dashboard
🚀 Done! kubectl is now configured to use "minikube" cluster and "default" namespace by default
osboxes@osboxes:~$ minikube status
minikube
type: Control Plane
host: Running
kubelet: Running
apiserver: Running
kubeconfig: Configured

osboxes@osboxes:~$ cd ..
osboxes@osboxes:/home$ cd osboxes/Example
osboxes@osboxes:~/Example$ dir
app.py  Dockerfile  requirements.txt
osboxes@osboxes:~/Example$
```

Соберем образ

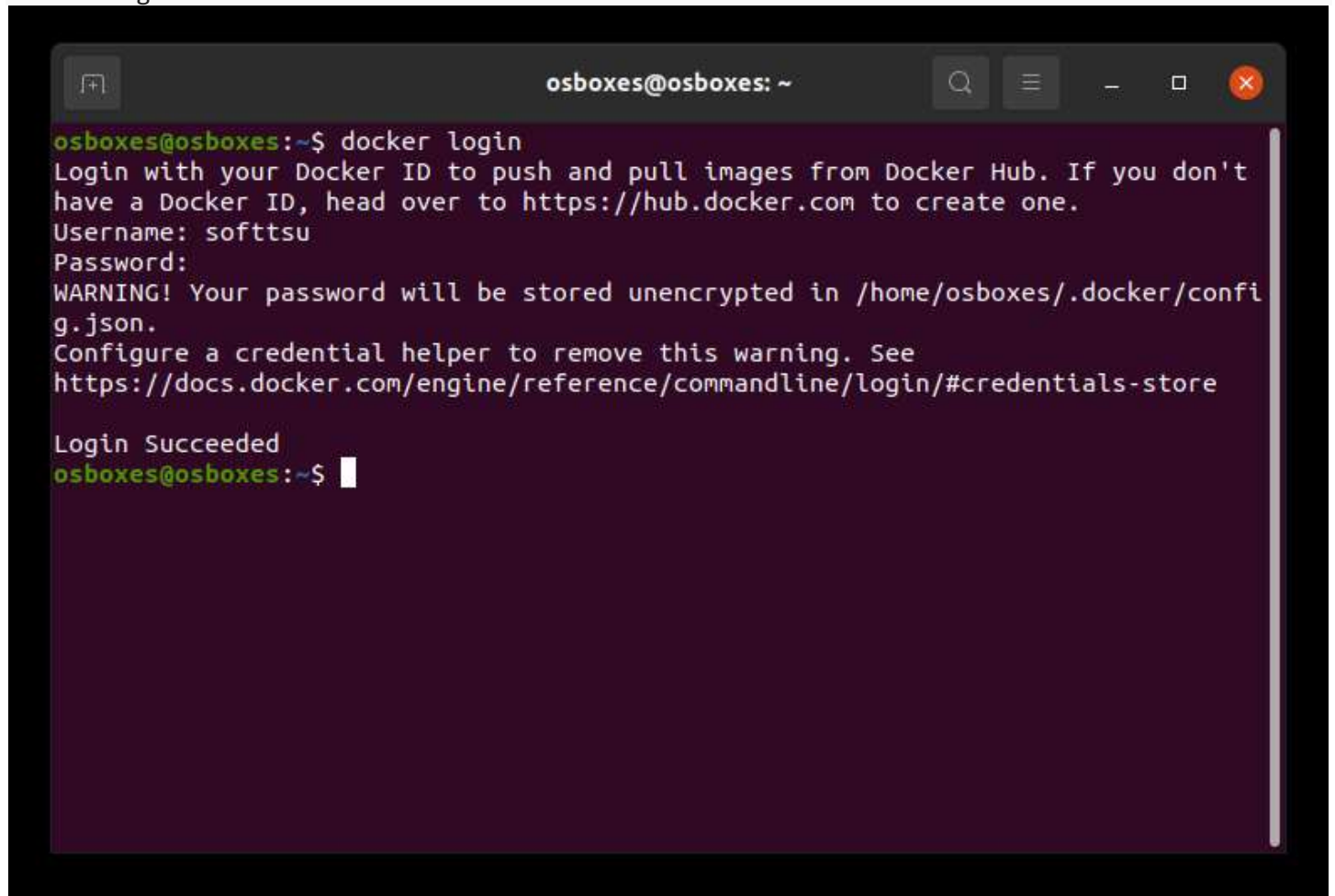
```
docker build -t my-web .
```

```
osboxes@osboxes: ~/Example

osboxes@osboxes:~$ cd ..
osboxes@osboxes:/home$ cd osboxes/Example
osboxes@osboxes:~/Example$ dir
app.py  Dockerfile  requirements.txt
osboxes@osboxes:~/Example$ docker build -t my-web .
[+] Building 2.1s (10/10) FINISHED
=> [internal] load .dockerignore 0.1s
=> => transferring context: 2B 0.0s
=> [internal] load build definition from Dockerfile 0.1s
=> => transferring dockerfile: 627B 0.0s
=> [internal] load metadata for docker.io/library/python:3.9-slim-buster 1.8s
=> [auth] library/python:pull token for registry-1.docker.io 0.0s
=> [1/4] FROM docker.io/library/python:3.9-slim-buster@sha256:1c5091a9ba 0.0s
=> [internal] load build context 0.0s
=> => transferring context: 93B 0.0s
=> CACHED [2/4] WORKDIR /app 0.0s
=> CACHED [3/4] COPY . /app 0.0s
=> CACHED [4/4] RUN pip install --no-cache-dir -r requirements.txt 0.0s
=> exporting to image 0.0s
=> => exporting layers 0.0s
=> => writing image sha256:04db984ef774d3109dd219727974baab1b1905aba3ca0 0.0s
=> => naming to docker.io/library/my-web 0.0s
osboxes@osboxes:~/Example$
```

Авторизуемся в docker

Docker login

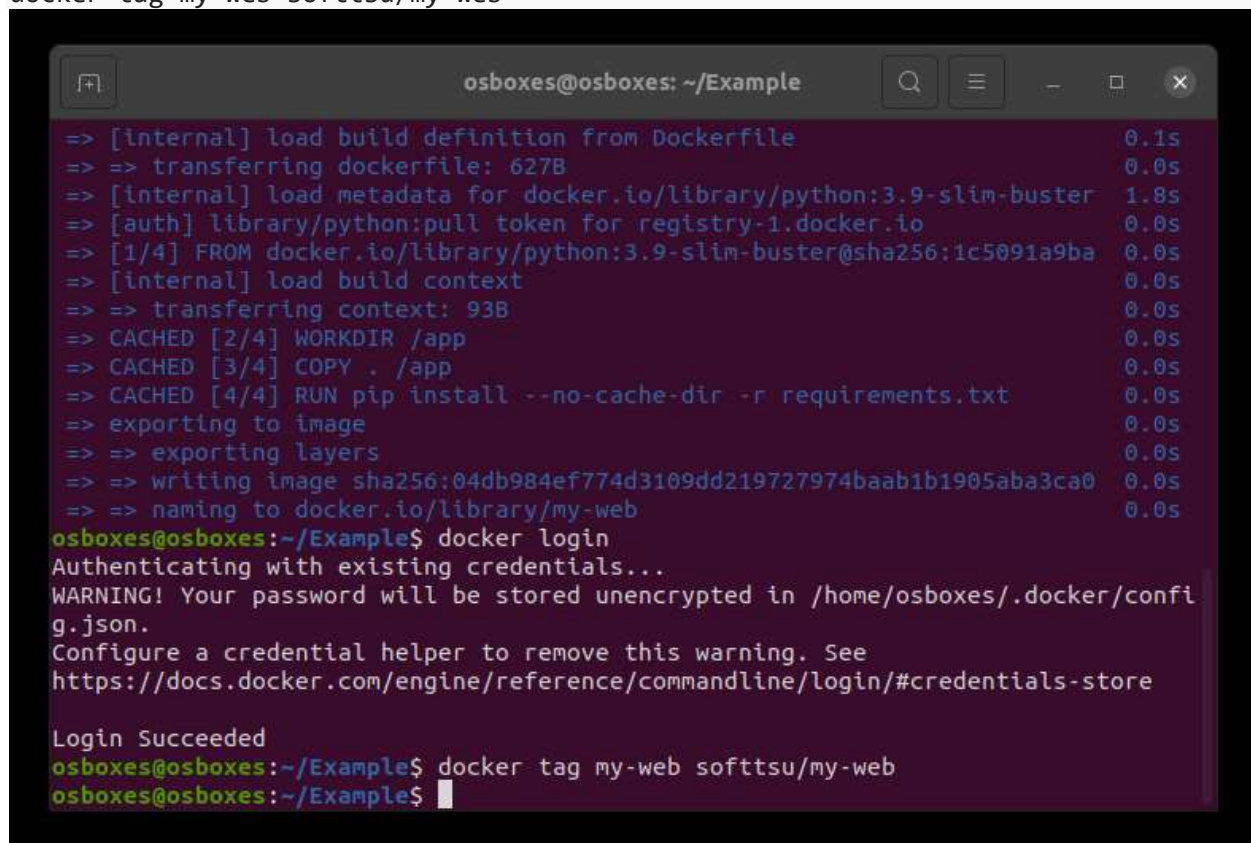
A terminal window titled 'osboxes@osboxes: ~' with standard window controls. The terminal shows the execution of 'docker login'. It prompts for a Docker ID, then a username ('softtsu'), and a password. A warning message states that the password will be stored unencrypted in a configuration file. It then provides a link to configure a credential helper. Finally, it reports 'Login Succeeded' and returns to the shell prompt.

```
osboxes@osboxes:~$ docker login
Login with your Docker ID to push and pull images from Docker Hub. If you don't
have a Docker ID, head over to https://hub.docker.com to create one.
Username: softtsu
Password:
WARNING! Your password will be stored unencrypted in /home/osboxes/.docker/conn
fig.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
osboxes@osboxes:~$
```

Создадим тег образа

docker tag my-web softtsu/my-web

A terminal window titled 'osboxes@osboxes: ~/Example' with standard window controls. The terminal shows the execution of a Docker build command. It displays progress for loading the build definition, transferring the Dockerfile, loading metadata, authenticating with the registry, and exporting the image. After the build is complete, it shows the 'docker login' command being executed, which authenticates with existing credentials. Finally, it shows the 'docker tag' command being used to tag the local image as 'softtsu/my-web'.

```
osboxes@osboxes:~/Example$ docker build -t my-web .
=> [internal] load build definition from Dockerfile                                0.1s
=> => transferring dockerfile: 627B                                              0.0s
=> [internal] load metadata for docker.io/library/python:3.9-slim-buster         1.8s
=> [auth] library/python:pull token for registry-1.docker.io                    0.0s
=> [1/4] FROM docker.io/library/python:3.9-slim-buster@sha256:1c5091a9ba        0.0s
=> [internal] load build context                                                 0.0s
=> => transferring context: 93B                                                  0.0s
=> CACHED [2/4] WORKDIR /app                                                      0.0s
=> CACHED [3/4] COPY . /app                                                       0.0s
=> CACHED [4/4] RUN pip install --no-cache-dir -r requirements.txt               0.0s
=> exporting to image                                                            0.0s
=> => exporting layers                                                            0.0s
=> => writing image sha256:04db984ef774d3109dd219727974baab1b1905aba3ca0       0.0s
=> => naming to docker.io/library/my-web                                         0.0s
osboxes@osboxes:~/Example$ docker login
Authenticating with existing credentials...
WARNING! Your password will be stored unencrypted in /home/osboxes/.docker/conn
fig.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
osboxes@osboxes:~/Example$ docker tag my-web softtsu/my-web
osboxes@osboxes:~/Example$
```

И разместим его в репозитории используя следующий формат

`docker push user_name/repository_name`,

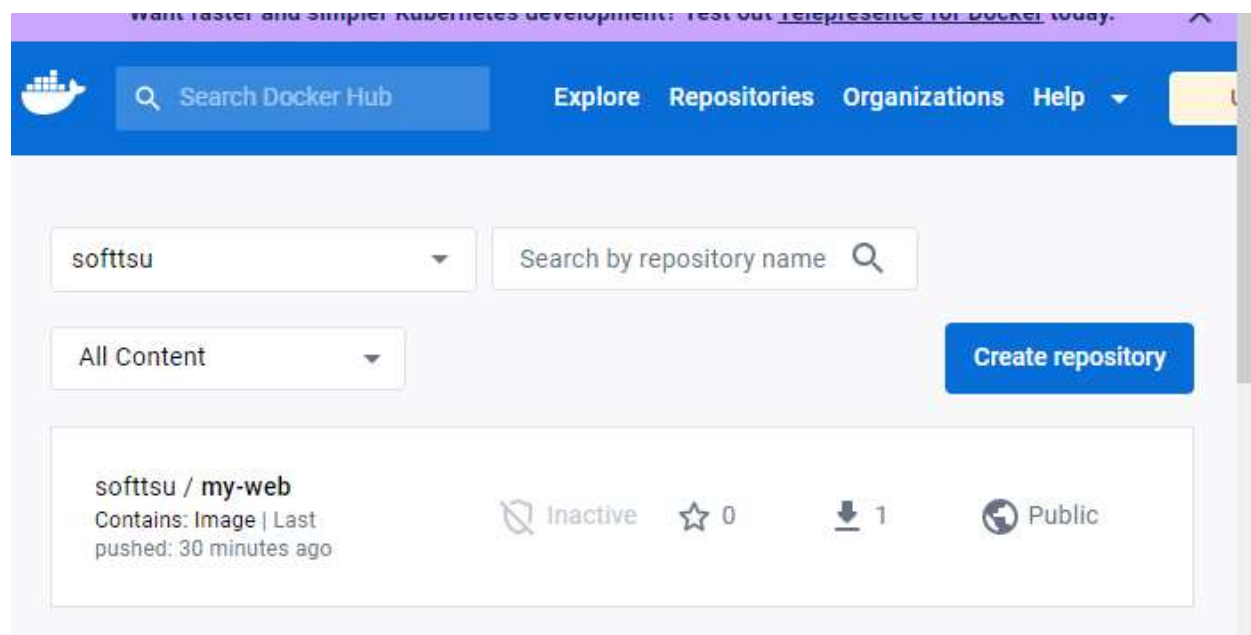
где `user_name` имя пользователя на сайте <https://hub.docker.com>

`repository_name` имя репозитория

```
docker push softtsu/my-web
```

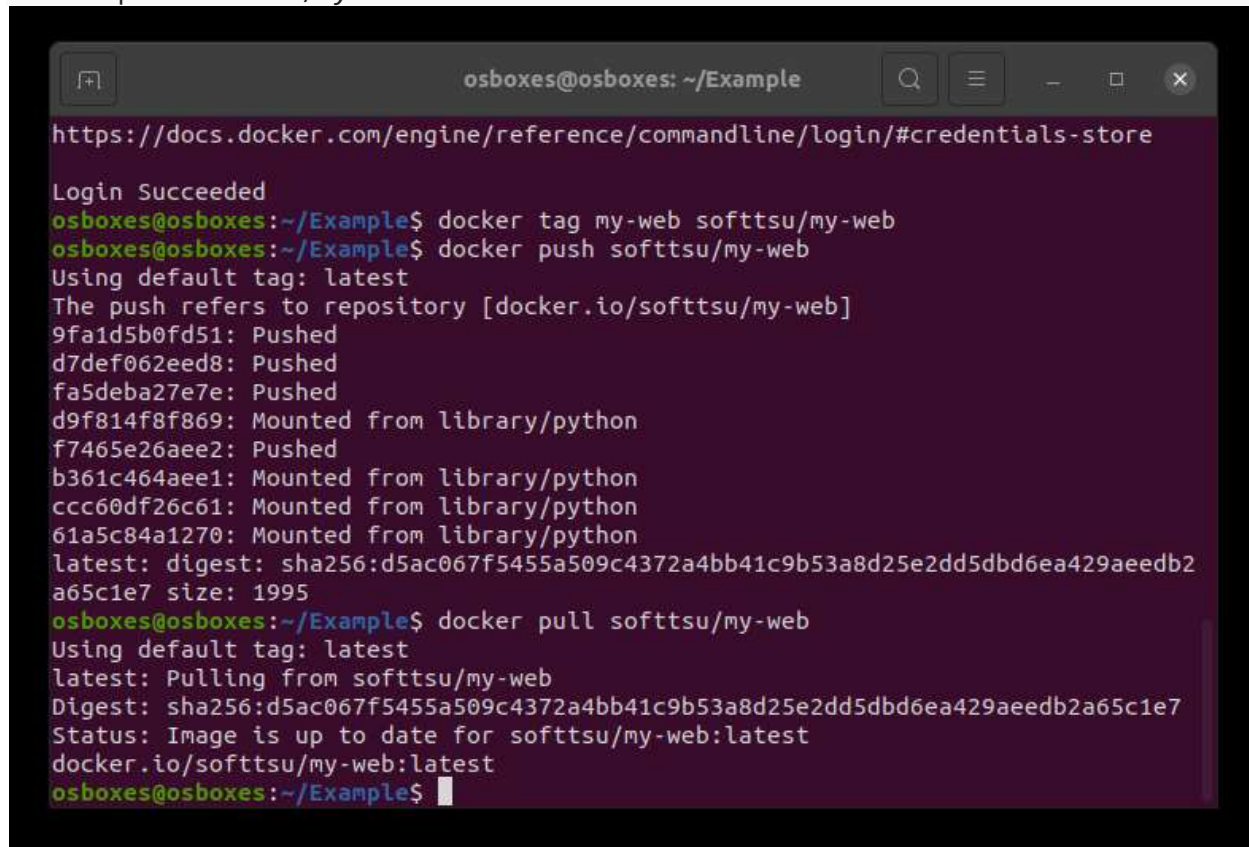
```
osboxes@osboxes: ~/Example
=> => naming to docker.io/library/my-web 0.0s
osboxes@osboxes:~/Example$ docker login
Authenticating with existing credentials...
WARNING! Your password will be stored unencrypted in /home/osboxes/.docker/config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store

Login Succeeded
osboxes@osboxes:~/Example$ docker tag my-web softtsu/my-web
osboxes@osboxes:~/Example$ docker push softtsu/my-web
Using default tag: latest
The push refers to repository [docker.io/softtsu/my-web]
9fa1d5b0fd51: Pushed
d7def062eed8: Pushed
fa5deba27e7e: Pushed
d9f814f8f869: Mounted from library/python
f7465e26aee2: Pushed
b361c464aee1: Mounted from library/python
ccc60df26c61: Mounted from library/python
61a5c84a1270: Mounted from library/python
latest: digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aee2b2a65c1e7 size: 1995
osboxes@osboxes:~/Example$
```



Загрузим образ из Docker Hub с помощью команды pull

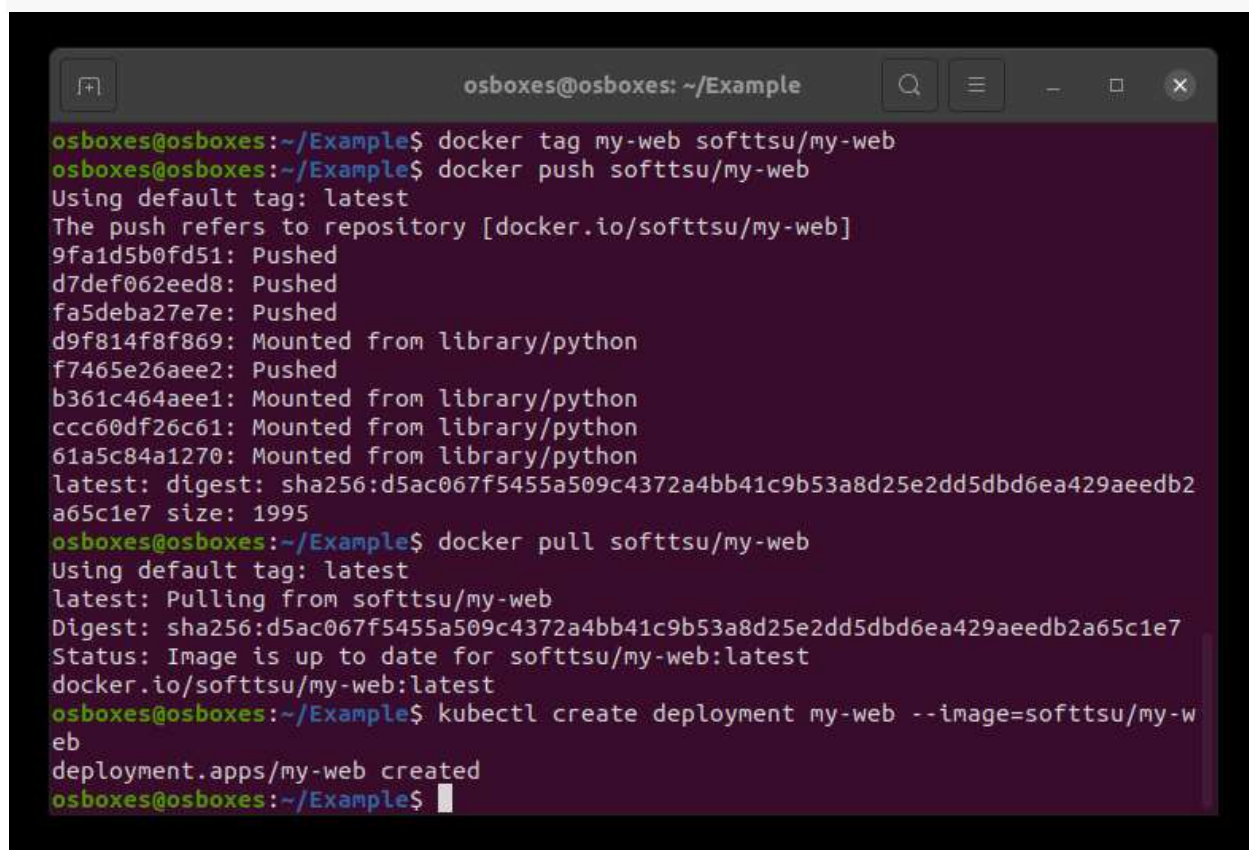
```
docker pull softtsu/my-web
```



```
osboxes@osboxes: ~/Example
https://docs.docker.com/engine/reference/commandline/login/#credentials-store
Login Succeeded
osboxes@osboxes:~/Example$ docker tag my-web softtsu/my-web
osboxes@osboxes:~/Example$ docker push softtsu/my-web
Using default tag: latest
The push refers to repository [docker.io/softtsu/my-web]
9fa1d5b0fd51: Pushed
d7def062eed8: Pushed
fa5deba27e7e: Pushed
d9f814f8f869: Mounted from library/python
f7465e26aee2: Pushed
b361c464aee1: Mounted from library/python
ccc60df26c61: Mounted from library/python
61a5c84a1270: Mounted from library/python
latest: digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7 size: 1995
osboxes@osboxes:~/Example$ docker pull softtsu/my-web
Using default tag: latest
latest: Pulling from softtsu/my-web
Digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7
Status: Image is up to date for softtsu/my-web:latest
docker.io/softtsu/my-web:latest
osboxes@osboxes:~/Example$
```

Создадим развёртывание (Deployment) в Kubernetes

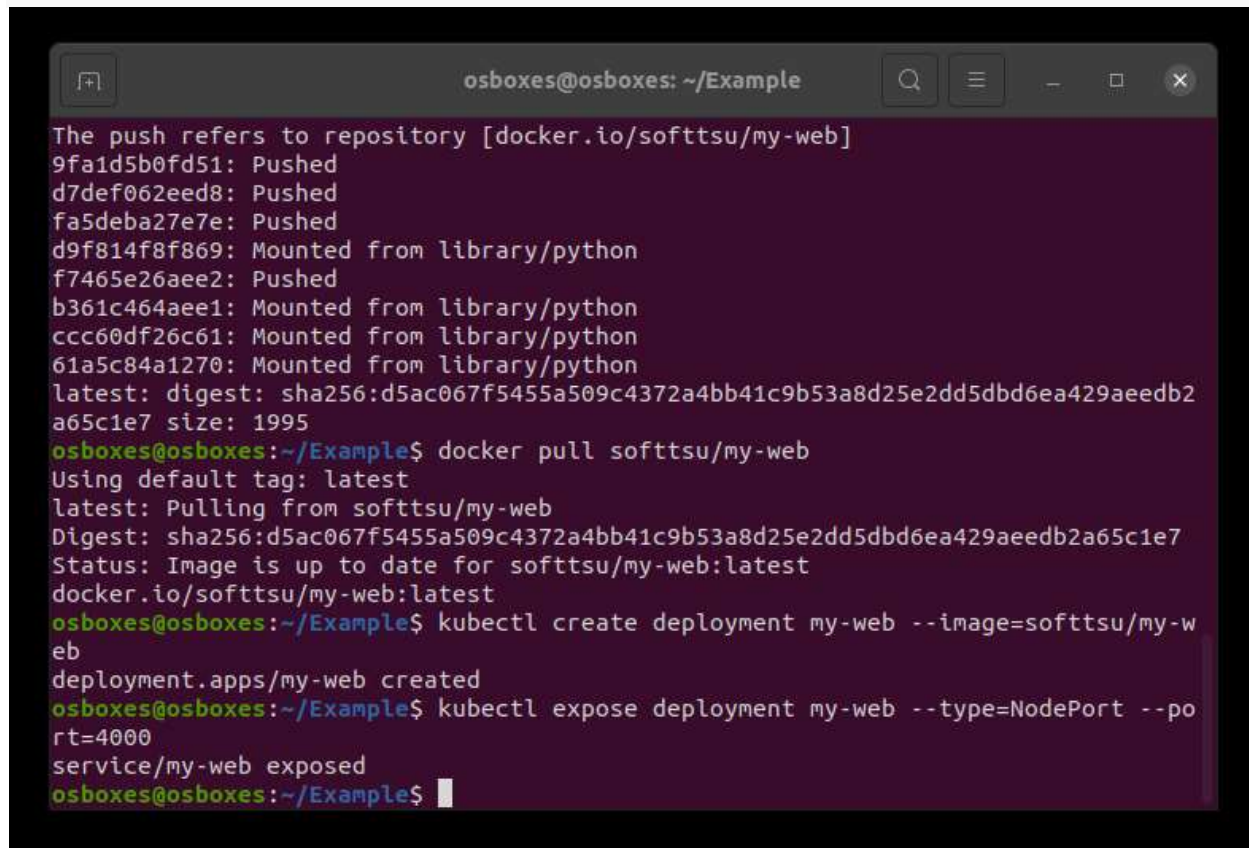
```
kubectl create deployment my-web --image=softtsu/my-web
```



```
osboxes@osboxes:~/Example$ docker tag my-web softtsu/my-web
osboxes@osboxes:~/Example$ docker push softtsu/my-web
Using default tag: latest
The push refers to repository [docker.io/softtsu/my-web]
9fa1d5b0fd51: Pushed
d7def062eed8: Pushed
fa5deba27e7e: Pushed
d9f814f8f869: Mounted from library/python
f7465e26aee2: Pushed
b361c464aee1: Mounted from library/python
ccc60df26c61: Mounted from library/python
61a5c84a1270: Mounted from library/python
latest: digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7 size: 1995
osboxes@osboxes:~/Example$ docker pull softtsu/my-web
Using default tag: latest
latest: Pulling from softtsu/my-web
Digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7
Status: Image is up to date for softtsu/my-web:latest
docker.io/softtsu/my-web:latest
osboxes@osboxes:~/Example$ kubectl create deployment my-web --image=softtsu/my-web
deployment.apps/my-web created
osboxes@osboxes:~/Example$
```

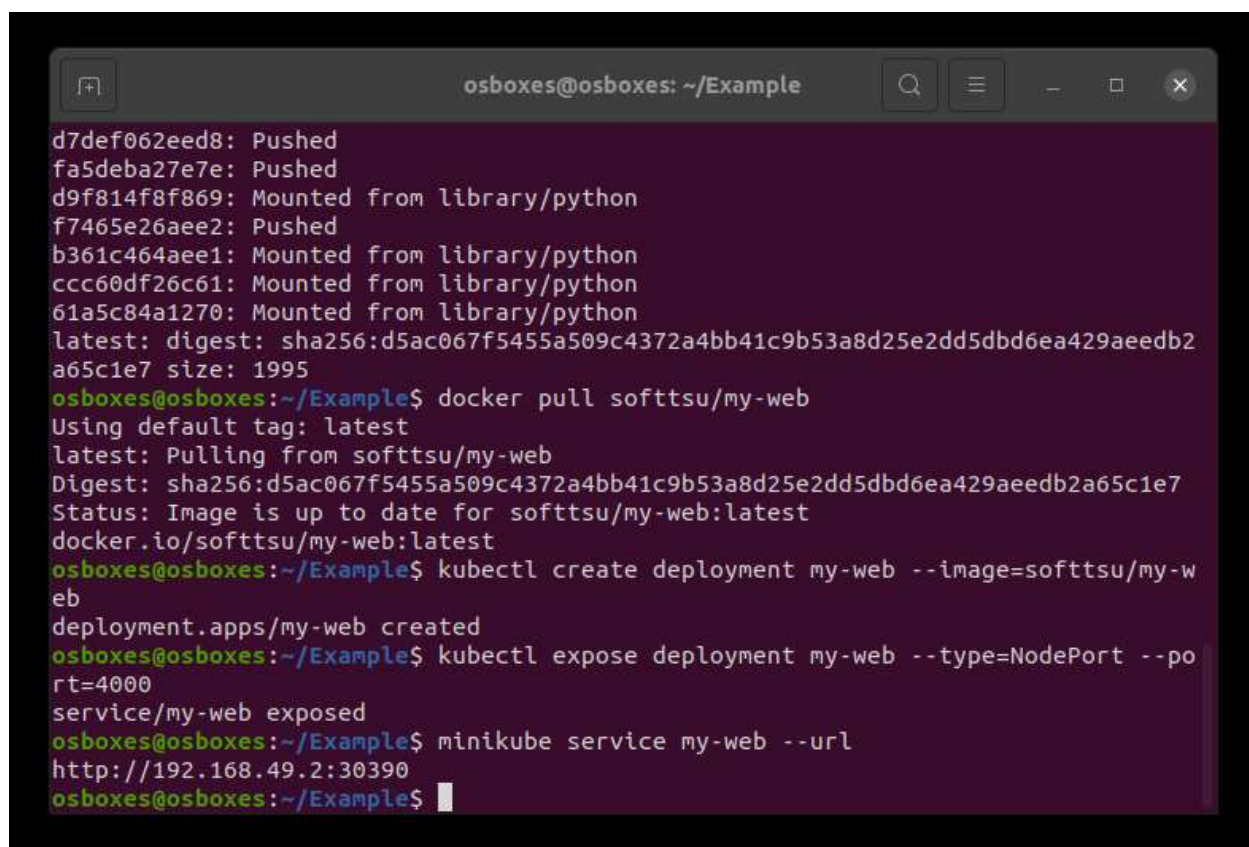

Чтобы получить доступ к объекту Deployment извне, создадим объект сервиса (Service):

```
kubectl expose deployment my-web --type=NodePort --port=4000
```



```
osboxes@osboxes: ~/Example
The push refers to repository [docker.io/softtsu/my-web]
9fa1d5b0fd51: Pushed
d7def062eed8: Pushed
fa5deba27e7e: Pushed
d9f814f8f869: Mounted from library/python
f7465e26aee2: Pushed
b361c464aee1: Mounted from library/python
ccc60df26c61: Mounted from library/python
61a5c84a1270: Mounted from library/python
latest: digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7 size: 1995
osboxes@osboxes:~/Example$ docker pull softtsu/my-web
Using default tag: latest
latest: Pulling from softtsu/my-web
Digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7
Status: Image is up to date for softtsu/my-web:latest
docker.io/softtsu/my-web:latest
osboxes@osboxes:~/Example$ kubectl create deployment my-web --image=softtsu/my-web
deployment.apps/my-web created
osboxes@osboxes:~/Example$ kubectl expose deployment my-web --type=NodePort --port=4000
service/my-web exposed
osboxes@osboxes:~/Example$
```

Узнайте URL-адрес открытого (exposed) сервиса, чтобы просмотреть подробные сведения о сервисе:

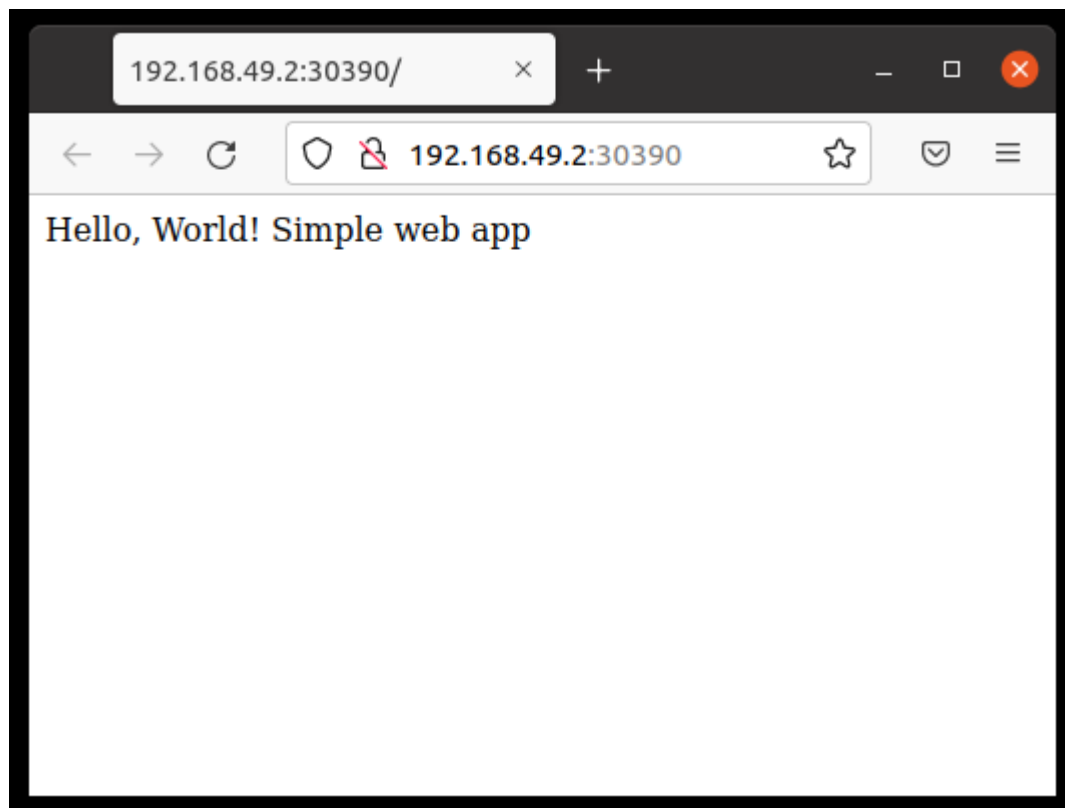


```
osboxes@osboxes: ~/Example
d7def062eed8: Pushed
fa5deba27e7e: Pushed
d9f814f8f869: Mounted from library/python
f7465e26aee2: Pushed
b361c464aee1: Mounted from library/python
ccc60df26c61: Mounted from library/python
61a5c84a1270: Mounted from library/python
latest: digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7 size: 1995
osboxes@osboxes:~/Example$ docker pull softtsu/my-web
Using default tag: latest
latest: Pulling from softtsu/my-web
Digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeeb2a65c1e7
Status: Image is up to date for softtsu/my-web:latest
docker.io/softtsu/my-web:latest
osboxes@osboxes:~/Example$ kubectl create deployment my-web --image=softtsu/my-web
deployment.apps/my-web created
osboxes@osboxes:~/Example$ kubectl expose deployment my-web --type=NodePort --port=4000
service/my-web exposed
osboxes@osboxes:~/Example$ minikube service my-web --url
http://192.168.49.2:30390
osboxes@osboxes:~/Example$
```

Результат работы веб приложения

curl <http://192.168.49.2:30390>

```
osboxes@osboxes: ~/Example
fa5deba27e7e: Pushed
d9f814f8f869: Mounted from library/python
f7465e26aee2: Pushed
b361c464aee1: Mounted from library/python
ccc60df26c61: Mounted from library/python
61a5c84a1270: Mounted from library/python
latest: digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeedb2a65c1e7 size: 1995
osboxes@osboxes:~/Example$ docker pull softtsu/my-web
Using default tag: latest
latest: Pulling from softtsu/my-web
Digest: sha256:d5ac067f5455a509c4372a4bb41c9b53a8d25e2dd5dbd6ea429aeedb2a65c1e7
Status: Image is up to date for softtsu/my-web:latest
docker.io/softtsu/my-web:latest
osboxes@osboxes:~/Example$ kubectl create deployment my-web --image=softtsu/my-web
deployment.apps/my-web created
osboxes@osboxes:~/Example$ kubectl expose deployment my-web --type=NodePort --port=4000
service/my-web exposed
osboxes@osboxes:~/Example$ minikube service my-web --url
http://192.168.49.2:30390
osboxes@osboxes:~/Example$ curl http://192.168.49.2:30390
Hello, World! Simple web apposboxes@osboxes:~/Example$
```



Просмотреть графический интерфейс kubernetes можно с помощью команды

```
minikube dashboard
```

