

Департамент образования и науки города Москвы
Государственное автономное образовательное учреждение
высшего образования города Москвы
«Московский городской педагогический университет»
Институт цифрового образования
Департамент информатики управления и технологий

Мареев Георгий Александрович БД-241м

Практическая работа 4-2. Сервис Kubernetes

Направление подготовки/специальность
38.04.05 - Бизнес-информатика
Бизнес-аналитика и большие данные
(очная форма обучения)

Руководитель дисциплины:
Босенко Т.М., доцент департамента
информатики, управления и технологий,
кандидат технических наук

Москва
2024

Введение

Цель: развернуть собственный сервис Kubernetes

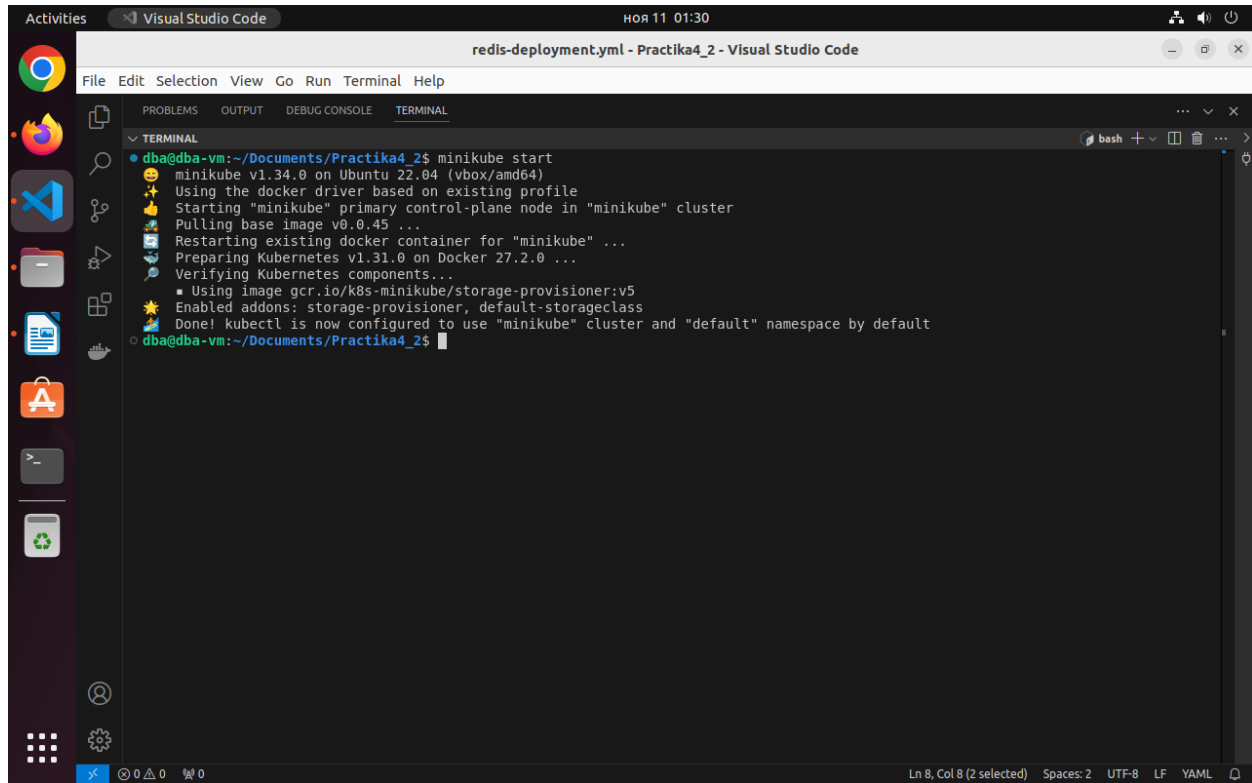
Задачи:

1. Развернуть сервис в связке из минимум 2 контейнеров + 1 init
2. минимум два Deployment, по количеству сервисов
3. кастомный образ для минимум одного Deployment
4. минимум один Deployment должен содержать в себе контейнер и инит-контейнер
5. минимум один Deployment должен содержать volume (любой)
6. обязательно использование ConfigMap и/или Secret
7. обязательно Service хотя бы для одного из сервисов
8. Liveness и/или Readiness пробы минимум в одном из Deployment
9. обязательно использование лейблов

Основная часть

1. Запуск minikube

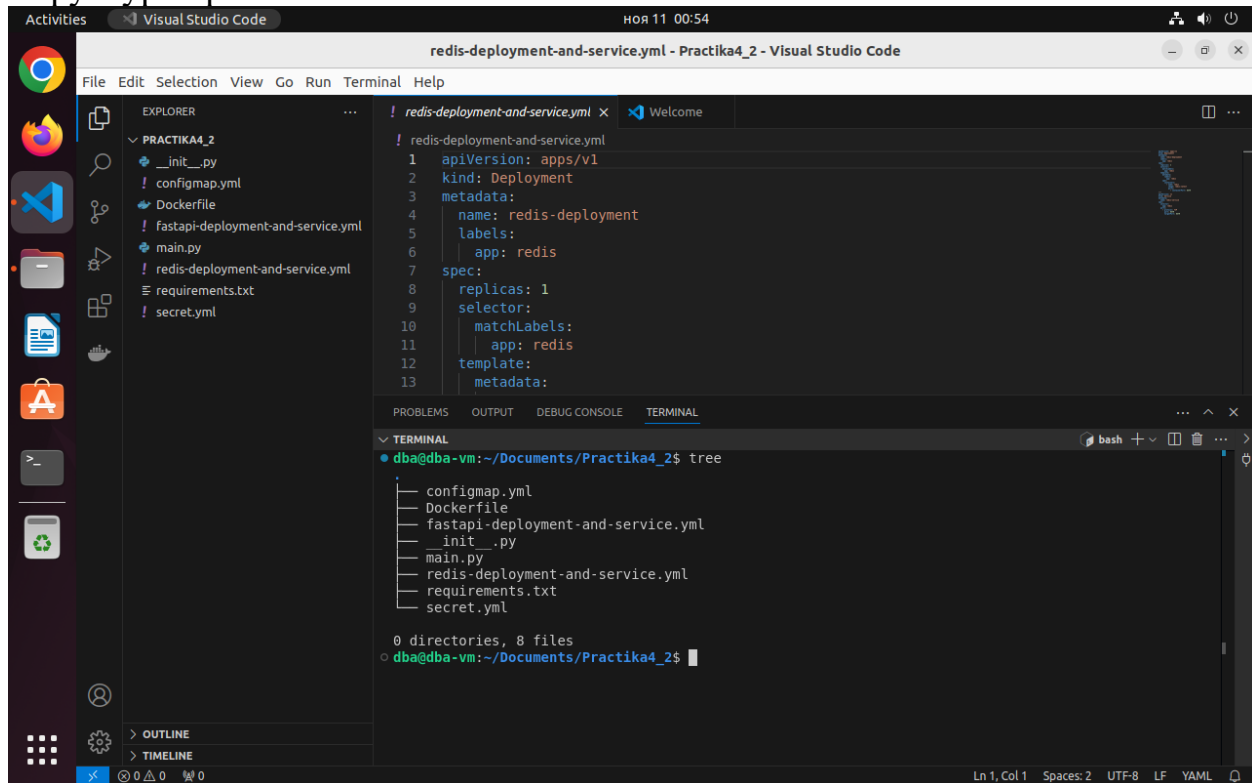
Minikube start



```
dba@dba-vm:~/Documents/Practika4_2$ minikube start
minikube v1.34.0 on Ubuntu 22.04 (vbox/amd64)
Using the docker driver based on existing profile
Starting "minikube" primary control-plane node in "minikube" cluster
Pulling base image v0.0.45 ...
Restarting existing docker container for "minikube" ...
Preparing Kubernetes v1.31.0 on Docker 27.2.0 ...
Verifying Kubernetes components...
  Using image gcr.io/k8s-minikube/storage-provisioner:v5
  Enabled addons: storage-provisioner, default-storageclass
Done! kubectrl is now configured to use "minikube" cluster and "default" namespace by default
dba@dba-vm:~/Documents/Practika4_2$
```

Figure 1minikube start

2. Структура проекта



```
redis-deployment-and-service.yaml - Practika4_2 - Visual Studio Code

! redis-deployment-and-service.yaml
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    name: redis-deployment
5    labels:
6      app: redis
7  spec:
8    replicas: 1
9    selector:
10     matchLabels:
11       app: redis
12   template:
13     metadata:
```

```
dba@dba-vm:~/Documents/Practika4_2$ tree
.
├── configmap.yaml
├── Dockerfile
├── fastapi-deployment-and-service.yaml
├── init_.py
├── main.py
├── redis-deployment-and-service.yaml
├── requirements.txt
└── secret.yaml

0 directories, 8 files
dba@dba-vm:~/Documents/Practika4_2$
```

Figure 2Изначальная структура проекта

3. Разделение манифестов

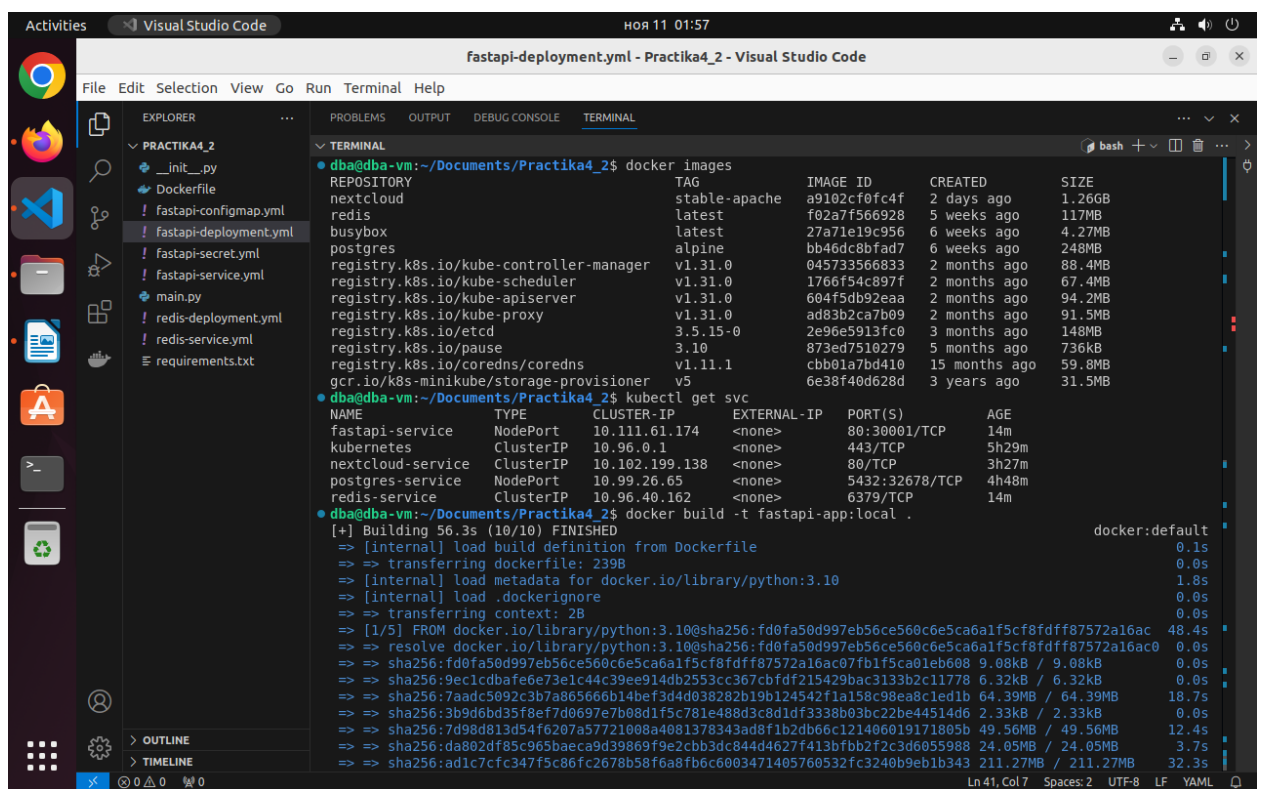
dba@dba-vm:~/Documents/Practika4_2\$ tree

```
.
├── Dockerfile
├── fastapi-configmap.yml
├── fastapi-deployment.yml
├── fastapi-secret.yml
├── fastapi-service.yml
├── __init__.py
├── main.py
├── redis-deployment.yml
├── redis-service.yml
└── requirements.txt
```

0 directories, 10 files

dba@dba-vm:~/Documents/Practika4_2\$

4. Были проблемы из-за того, что не настроил окружение Docker с Minikube, fastapi не работал,



The screenshot shows a Visual Studio Code window with a terminal running several commands. The first command is `docker images`, which lists various images including `nextcloud`, `redis`, `busybox`, `postgres`, and several Kubernetes components. The second command is `kubectl get svc`, which displays a table of services. The third command is `docker build -t fastapi-app:local .`, which shows the progress of building a Docker image from the `Dockerfile`.

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
fastapi-service	NodePort	10.111.61.174	<none>	80:30001/TCP	14m
kubernetes	ClusterIP	10.96.0.1	<none>	443/TCP	5h29m
nextcloud-service	ClusterIP	10.102.199.138	<none>	80/TCP	3h27m
postgres-service	NodePort	10.99.26.65	<none>	5432:32678/TCP	4h48m
redis-service	ClusterIP	10.96.40.162	<none>	6379/TCP	14m

Figure 3 Problems

Решение:

```
dba@dba-vm:~/Documents/Practika4_2$ minikube docker-env
export DOCKER_TLS_VERIFY="1"
export DOCKER_HOST="tcp://192.168.49.2:2376"
export DOCKER_CERT_PATH="/home/dba/.minikube/certs"
```

```
export MINIKUBE_ACTIVE_DOCKERD="minikube"
```

```
# To point your shell to minikube's docker-daemon, run:
```

```
# eval $(minikube -p minikube docker-env)
```

```
dba@dba-vm:~/Documents/Practika4_2$ eval $(minikube docker-env)
```

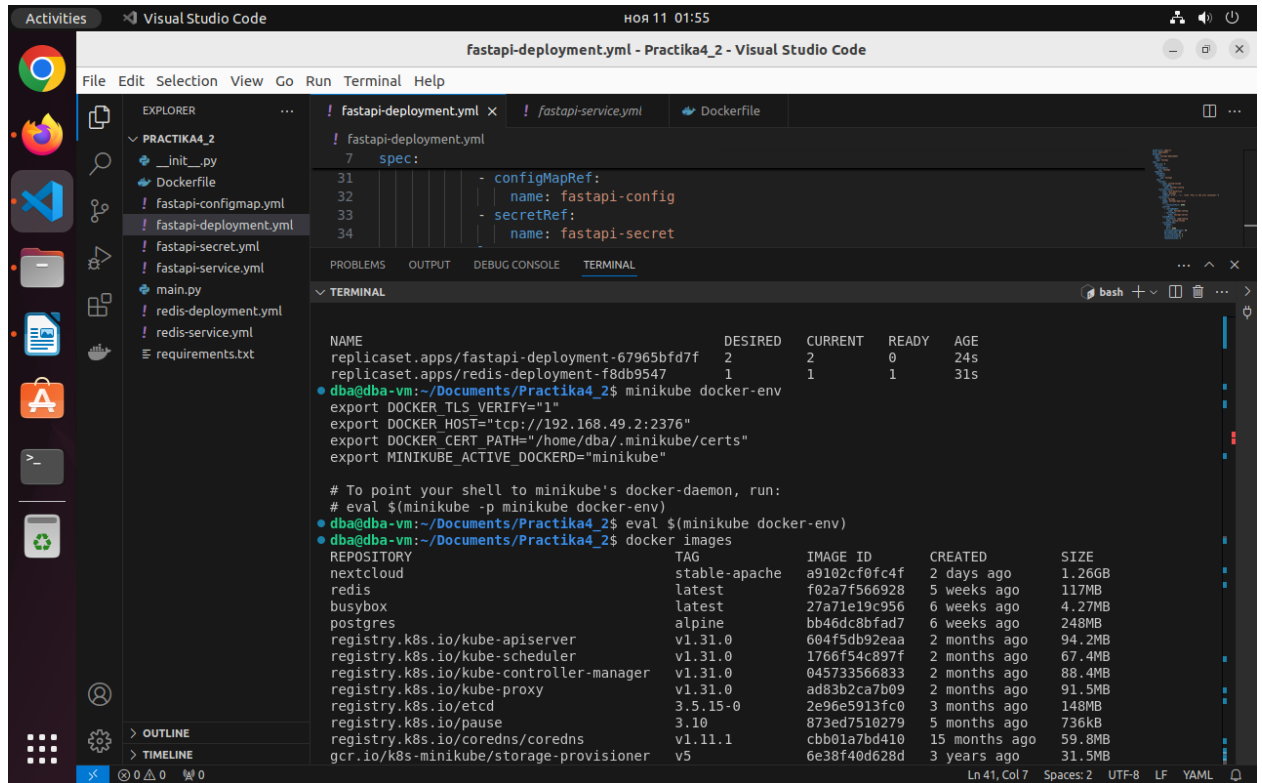


Figure 4 Настройка окружения

5. Docker build(docker build -t fastapi-app:local .)

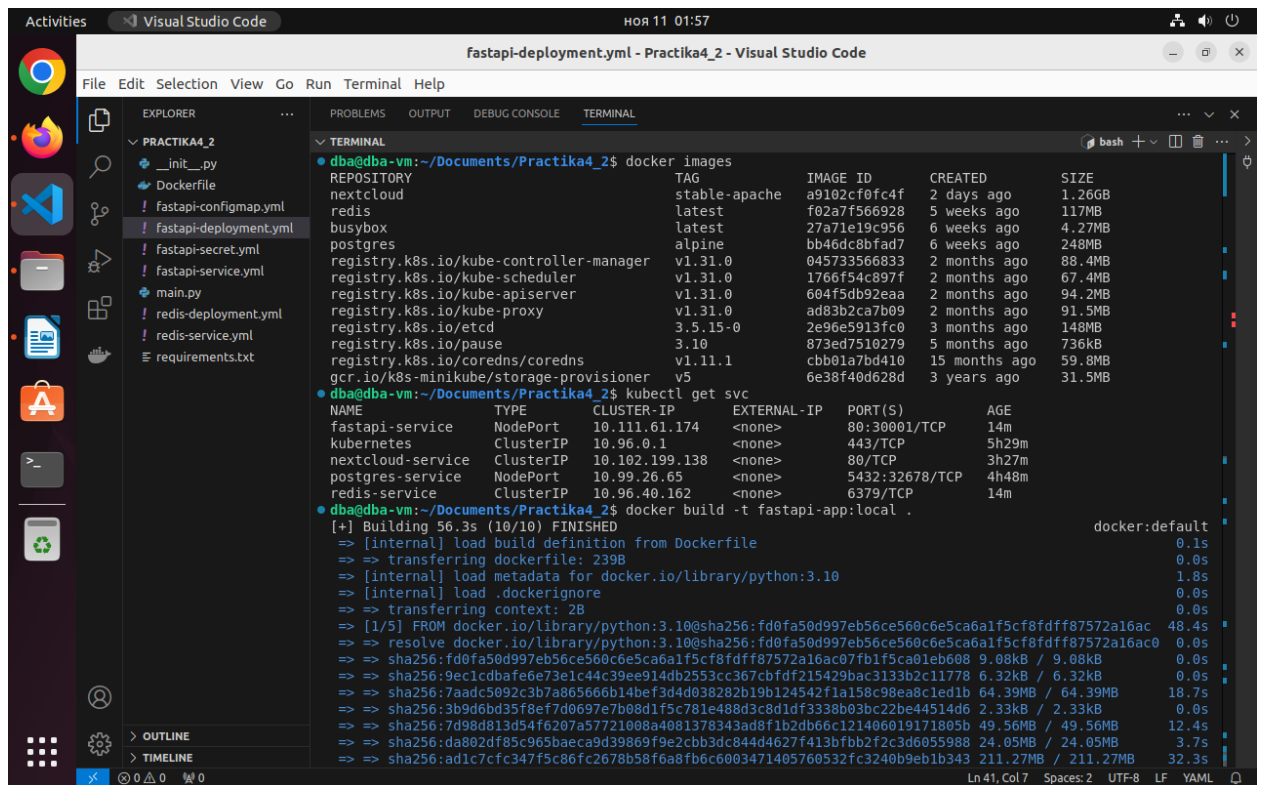


Figure 5 docker build

6. Создание и добавление манифестов
 Сначала Secrets и ConfigMaps:

```
kubectl apply -f fastapi-secret.yml
```

```
kubectl apply -f fastapi-configmap.yml
```


 Deployments:

```
kubectl apply -f redis-deployment.yml
```

```
kubectl apply -f fastapi-deployment.yml
```


 Services:

```
kubectl apply -f redis-service.yml
```

```
kubectl apply -f fastapi-service.yml
```
7. Состояние проекта и образов
 docker images

```
kubectl get pods – все поды работают
```

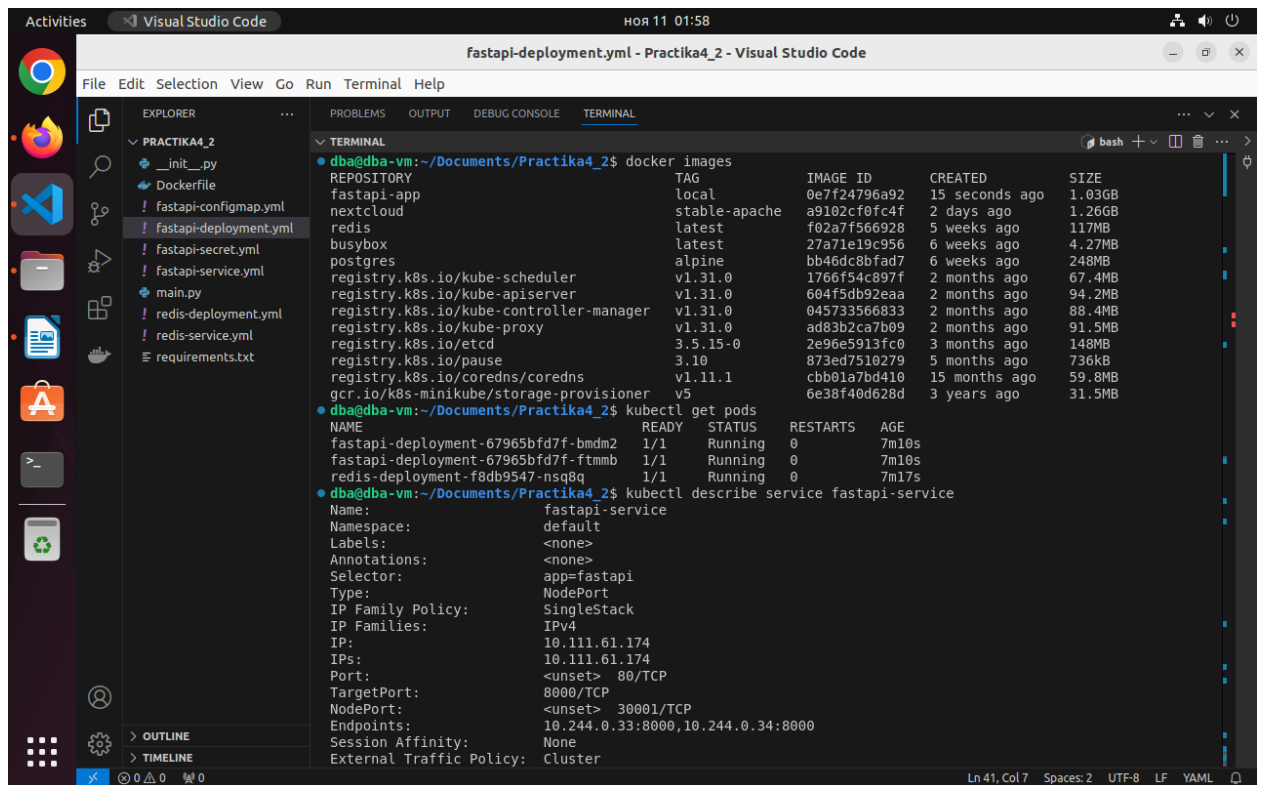


Figure 6 Состояние проекта

kubectl get deployment
 kubectl get configmap
 kubectl get secret
 kubectl get service

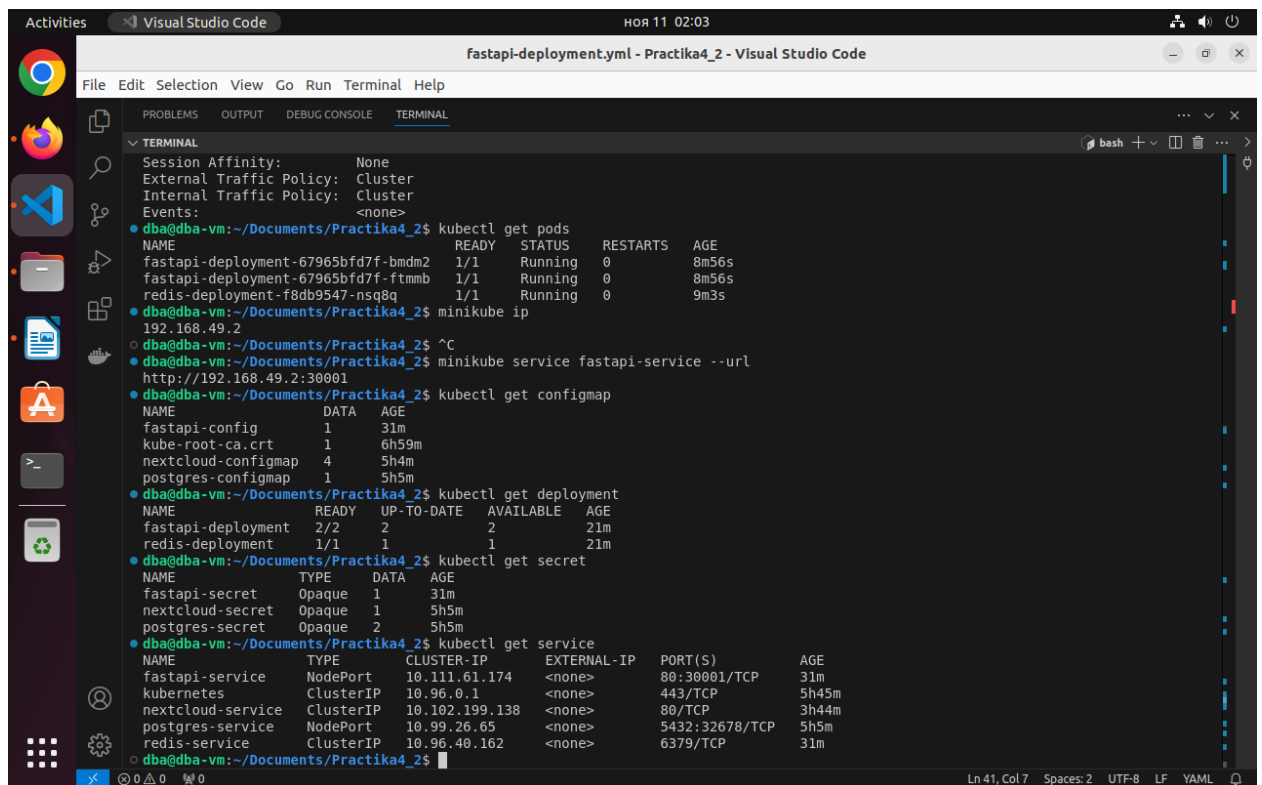
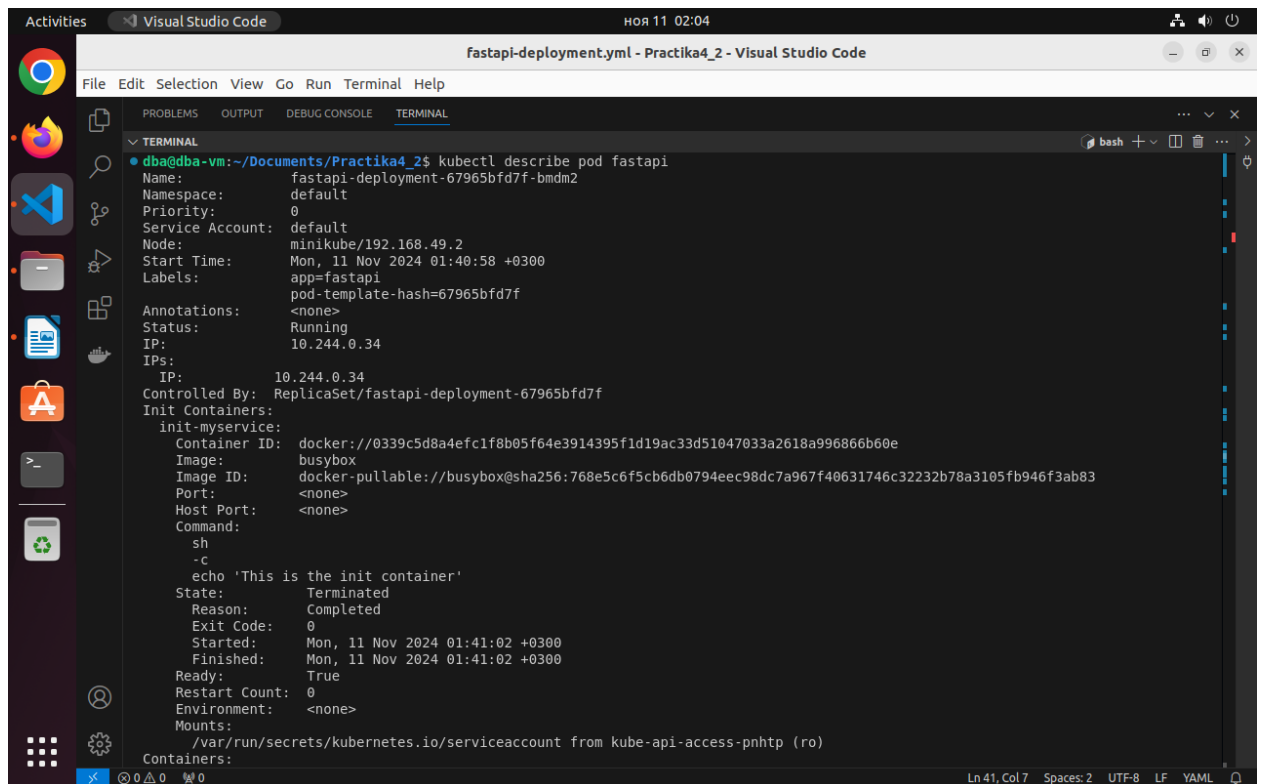


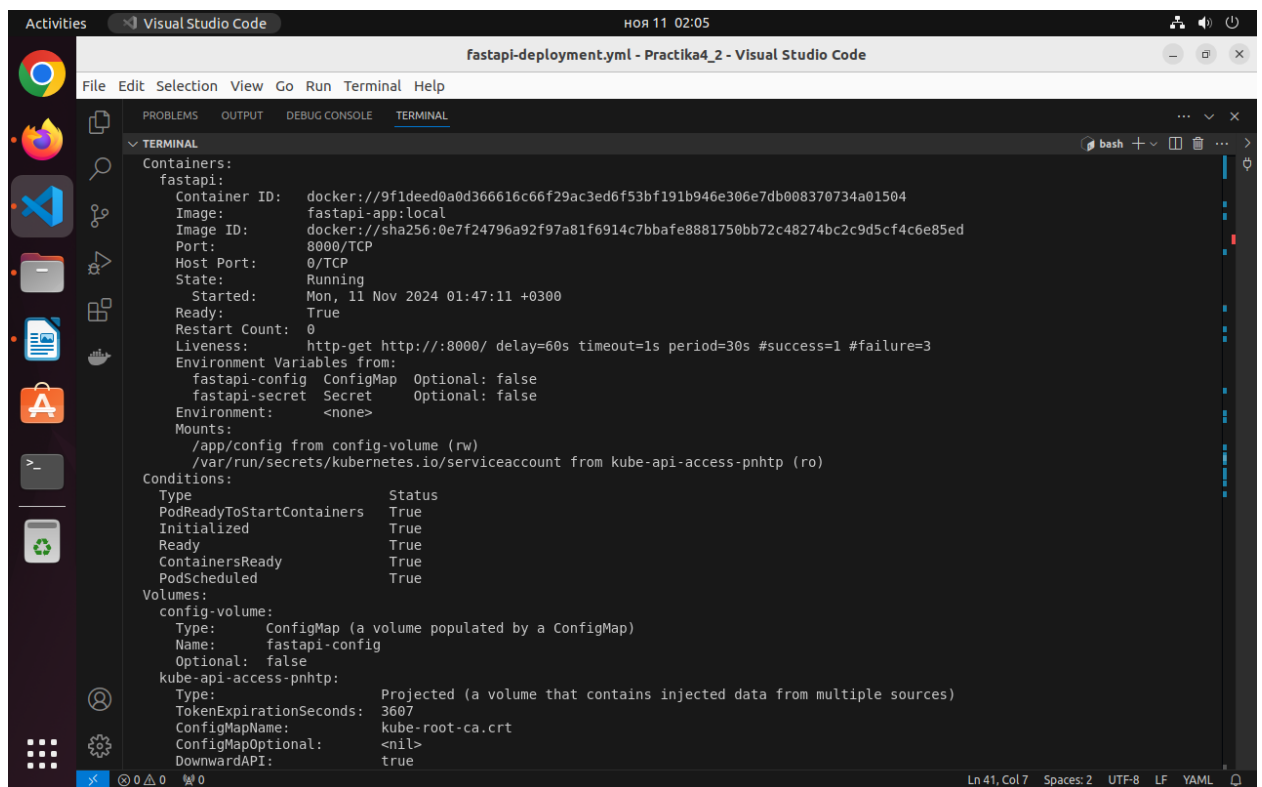
Figure 7 ConfigMap,Deployment u Secret,Service

8. Проверка состояние fastapi kubectl describe service fastapi-service



```
fastapi-deployment.yml - Practika4_2 - Visual Studio Code
File Edit Selection View Go Run Terminal Help
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
dba@dba-vm:~/Documents/Practika4_2$ kubectl describe pod fastapi
Name: fastapi-deployment-67965bfd7f-bmdm2
Namespace: default
Priority: 0
Service Account: default
Node: minikube/192.168.49.2
Start Time: Mon, 11 Nov 2024 01:40:58 +0300
Labels: app=fastapi
pod-template-hash=67965bfd7f
Annotations: <none>
Status: Running
IP: 10.244.0.34
IPs: 10.244.0.34
Controlled By: ReplicaSet/fastapi-deployment-67965bfd7f
Init Containers:
  init-myservice:
    Container ID: docker://0339c5d8a4efc1f8b05f64e3914395f1d19ac33d51047033a2618a996866b0e
    Image: busybox
    Image ID: docker-pullable://busybox@sha256:768e5c6f5cb6db0794e9c98dc7a967f40631746c32232b78a3105fb946f3ab83
    Port: <none>
    Host Port: <none>
    Command:
      sh
      -c
      echo 'This is the init container'
    State: Terminated
      Reason: Completed
      Exit Code: 0
      Started: Mon, 11 Nov 2024 01:41:02 +0300
      Finished: Mon, 11 Nov 2024 01:41:02 +0300
    Ready: True
    Restart Count: 0
    Environment: <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-pnhttp (ro)
Containers:
  fastapi:
    Container ID: docker://9f1deed0a0d366616c66f29ac3ed6f53bf191b946e306e7db008370734a01504
    Image: fastapi-app:local
    Image ID: docker://sha256:0e7f24796a92f97a81f6914c7bbafe8881750bb72c48274bc2c9d5cf4c6e85ed
    Port: 8000/TCP
    Host Port: 0/TCP
    State: Running
      Started: Mon, 11 Nov 2024 01:47:11 +0300
      Ready: True
      Restart Count: 0
    Liveness: http-get http://:8000/ delay=60s timeout=1s period=30s #success=1 #failure=3
    Environment Variables from:
      fastapi-config ConfigMap Optional: false
      fastapi-secret Secret Optional: false
    Environment: <none>
    Mounts:
      /app/config from config-volume (rw)
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-pnhttp (ro)
Conditions:
  Type PodReadyToStartContainers Initialized Ready ContainersReady PodScheduled
  Status True True True True True
Volumes:
  config-volume:
    Type: ConfigMap (a volume populated by a ConfigMap)
    Name: fastapi-config
    Optional: false
  kube-api-access-pnhttp:
    Type: Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds: 3607
    ConfigMapName: kube-root-ca.crt
    ConfigMapOptional: <nil>
    DownwardAPI: true
```

Figure 8 describe service fastapi-service



```
fastapi-deployment.yml - Practika4_2 - Visual Studio Code
File Edit Selection View Go Run Terminal Help
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
dba@dba-vm:~/Documents/Practika4_2$ kubectl describe service fastapi-service
Name: fastapi-service
Namespace: default
Labels: app=fastapi
Selector: app=fastapi
Type: ClusterIP
IP: 10.244.0.1
Port: 8000/TCP
TargetPort: 8000/TCP
NodePort: 30080/TCP
Endpoints: 10.244.0.34:8000
Session Affinity: None
No proxy is required
Conditions:
  Type Status
  PodReadyToStartContainers True
  Initialized True
  Ready True
  ContainersReady True
  PodScheduled True
Volumes:
  config-volume:
    Type: ConfigMap (a volume populated by a ConfigMap)
    Name: fastapi-config
    Optional: false
  kube-api-access-pnhttp:
    Type: Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds: 3607
    ConfigMapName: kube-root-ca.crt
    ConfigMapOptional: <nil>
    DownwardAPI: true
```

Figure 9 describe service fastapi-service


```
ConfigMapOptional: <nil>
DownwardAPI: true
QoS Class: BestEffort
Node-Selectors: <none>
Tolerations:
  node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
  node.kubernetes.io/unreachable:NoExecute op=Exists for 300s

Events:
  Type       Reason      Age      From          Message
  ----       -
Normal      Scheduled   23m      default-scheduler   Successfully assigned default/fastapi-deployment-67965bfd7f-bmdm2 to m
Normal      Pulling     23m      kubelet         Pulling image "busybox"
Normal      Pulled      23m      kubelet         Successfully pulled image "busybox" in 1.275s (2.538s including waitin
g). Image size: 4269694 bytes.
Normal      Created     23m      kubelet         Created container init-myservice
Normal      Started     23m      kubelet         Started container init-myservice
Warning     Failed      22m (x3 over 23m)   kubelet         Error: ErrImagePull
Warning     Failed      21m (x5 over 23m)   kubelet         Error: ImagePullBackOff
Normal      Pulling     21m (x4 over 23m)   kubelet         Pulling image "fastapi-app:local"
Warning     Failed      21m (x4 over 23m)   kubelet         Failed to pull image "fastapi-app:local": Error response from daemon:
pull access denied for fastapi-app, repository does not exist or may require 'docker login': denied: requested access to the resour
ce is denied
Normal      BackOff     18m (x20 over 23m)   kubelet         Back-off pulling image "fastapi-app:local"

Name:          fastapi-deployment-67965bfd7f-ftmmb
Namespace:     default
Priority:       0
Service Account: default
Node:          minikube/192.168.49.2
Start Time:    Mon, 11 Nov 2024 01:40:59 +0300
Labels:        app=fastapi
               pod-template-hash=67965bfd7f
Annotations:   <none>
Status:        Running
IPs:           10.244.0.33
IPs:           10.244.0.33
```

Figure 10 describe service fastapi-service

```
IPs:
  10.244.0.33
Controlled By: ReplicaSet/fastapi-deployment-67965bfd7f
Init Containers:
  init-myservice:
    Container ID:  docker://228179ace57d77325ef427c3de1c2d58c5c14606115d2d5b02599d5be2ea96d1
    Image:         busybox
    Image ID:      docker-pullable://busybox@sha256:768e5c6f5cb6db0794ec98dc7a967f40631746c32232b78a3105fb946f3ab83
    Port:          <none>
    Host Port:     <none>
    Command:
      sh
      -c
      echo 'This is the init container'
    State:         Terminated
      Reason:      Completed
      Exit Code:    0
      Started:     Mon, 11 Nov 2024 01:41:01 +0300
      Finished:    Mon, 11 Nov 2024 01:41:01 +0300
    Ready:         True
    Restart Count: 0
    Environment:   <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from kube-api-access-jhjb6 (ro)
Containers:
  fastapi:
    Container ID:  docker://d70191730fd3d94c7d350608da4cf065d911090543bdd62d29df428948dd3541
    Image:         fastapi-app:local
    Image ID:      docker://sha256:0e7f24796a92f97a81f6914c7bbafe8881750bb72c48274bc2c9d5cf4c6e85ed
    Port:          8000/TCP
    Host Port:     0/TCP
    State:         Running
      Started:     Mon, 11 Nov 2024 01:47:23 +0300
    Ready:         True
    Restart Count: 0
    Liveness:      http-get http://:8000/ delay=60s timeout=1s period=30s #success=1 #failure=3
    Environment Variables from:
```

Figure 11 describe service fastapi-service

```
fastapi-deployment.yml - Practika4_2 - Visual Studio Code

Ready: True
ContainersReady: True
PodScheduled: True

Volumes:
  config-volume:
    Type: ConfigMap (a volume populated by a ConfigMap)
    Name: fastapi-config
    Optional: false
  kube-api-access-jhjb6:
    Type: Projected (a volume that contains injected data from multiple sources)
    TokenExpirationSeconds: 3607
    ConfigMapName: kube-root-ca.crt
    ConfigMapOptional: <nil>
    DownwardAPI: true
QoS Class: BestEffort
Node-Selectors: <none>
Tolerations:
  node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
  node.kubernetes.io/unreachable:NoExecute op=Exists for 300s

Events:
  Type      Reason      Age      From      Message
  ----      -
Normal     Scheduled   23m      default-scheduler   Successfully assigned default/fastapi-deployment-67965bfd7f-ftmmb to m
Normal     Pulling     23m      kubelet    Pulling image "busybox"
Normal     Pulled      23m      kubelet    Successfully pulled image "busybox" in 1.268s (1.268s including waitin
g). Image size: 4269694 bytes.
Normal     Created     23m      kubelet    Created container init-myservice
Normal     Started     23m      kubelet    Started container init-myservice
Warning    Failed      22m (x3 over 23m)   kubelet    Error: ErrImagePull
Warning    Failed      21m (x5 over 23m)   kubelet    Error: ImagePullBackOff
Normal     Pulling     21m (x4 over 23m)   kubelet    Pulling image "fastapi-app:local"
Warning    Failed      21m (x4 over 23m)   kubelet    Failed to pull image "fastapi-app:local": Error response from daemon:
pull access denied for fastapi-app, repository does not exist or may require 'docker login': denied: requested access to the resour
ce is denied
Normal     BackOff     18m (x19 over 23m)   kubelet    Back-off pulling image "fastapi-app:local"
```

Figure 12 describe service fastapi-service

9. Config view

```
fastapi-deployment.yml - Practika4_2 - Visual Studio Code

ce is denied
Normal BackOff 18m (x19 over 23m) kubelet Back-off pulling image "fastapi-app:local"

dba@dba-vm:~/Documents/Practika4_2$ kubectl config view
apiVersion: v1
clusters:
- cluster:
    certificate-authority: /home/dba/.minikube/ca.crt
    extensions:
    - extension:
        last-update: Mon, 11 Nov 2024 01:29:32 MSK
        provider: minikube.sigs.k8s.io
        version: v1.34.0
      name: cluster info
    server: https://192.168.49.2:8443
  name: minikube
contexts:
- context:
    cluster: minikube
    extensions:
    - extension:
        last-update: Mon, 11 Nov 2024 01:29:32 MSK
        provider: minikube.sigs.k8s.io
        version: v1.34.0
      name: context info
    namespace: default
    user: minikube
  name: minikube
current-context: minikube
kind: Config
preferences: {}
users:
- name: minikube
  user:
    client-certificate: /home/dba/.minikube/profiles/minikube/client.crt
    client-key: /home/dba/.minikube/profiles/minikube/client.key
```

Figure 13 Config view

10. Проверка приложения

```
minikube ip  
minikube service fastapi-service --url
```

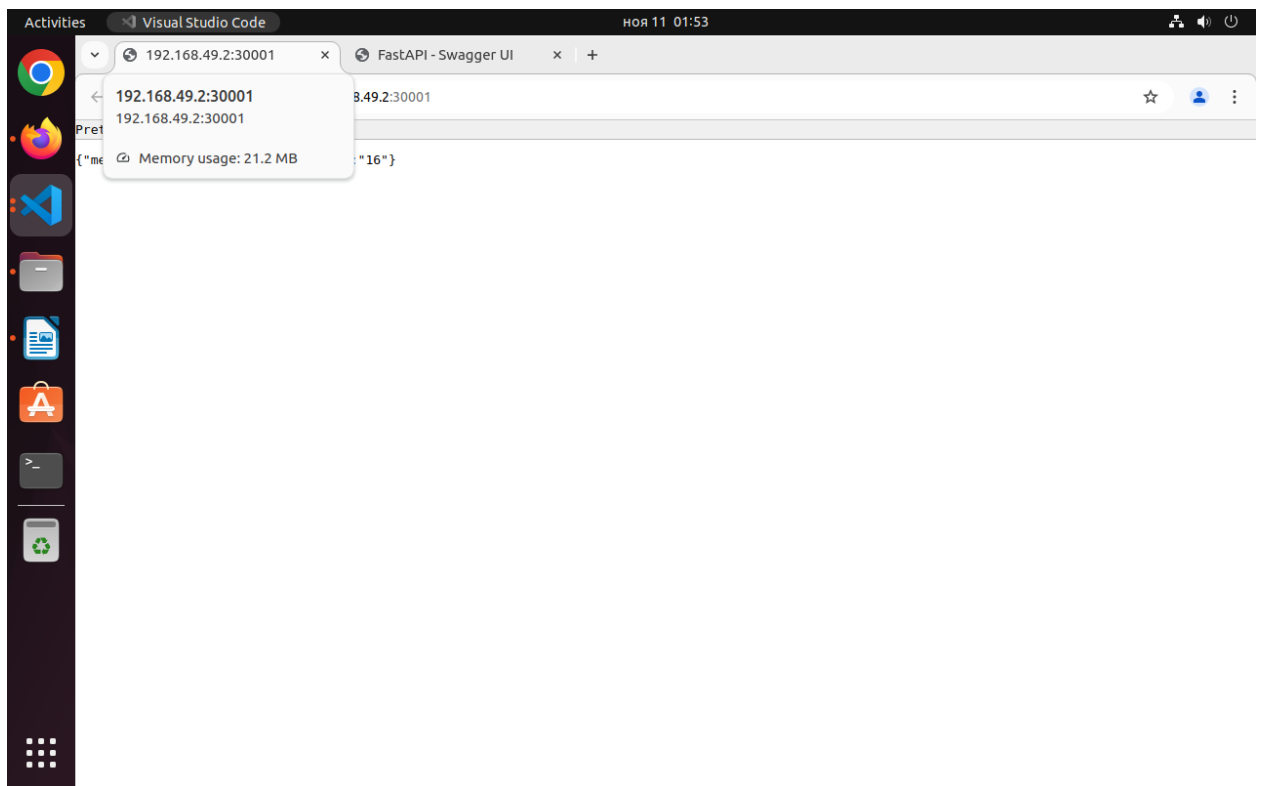


Figure 14 Working

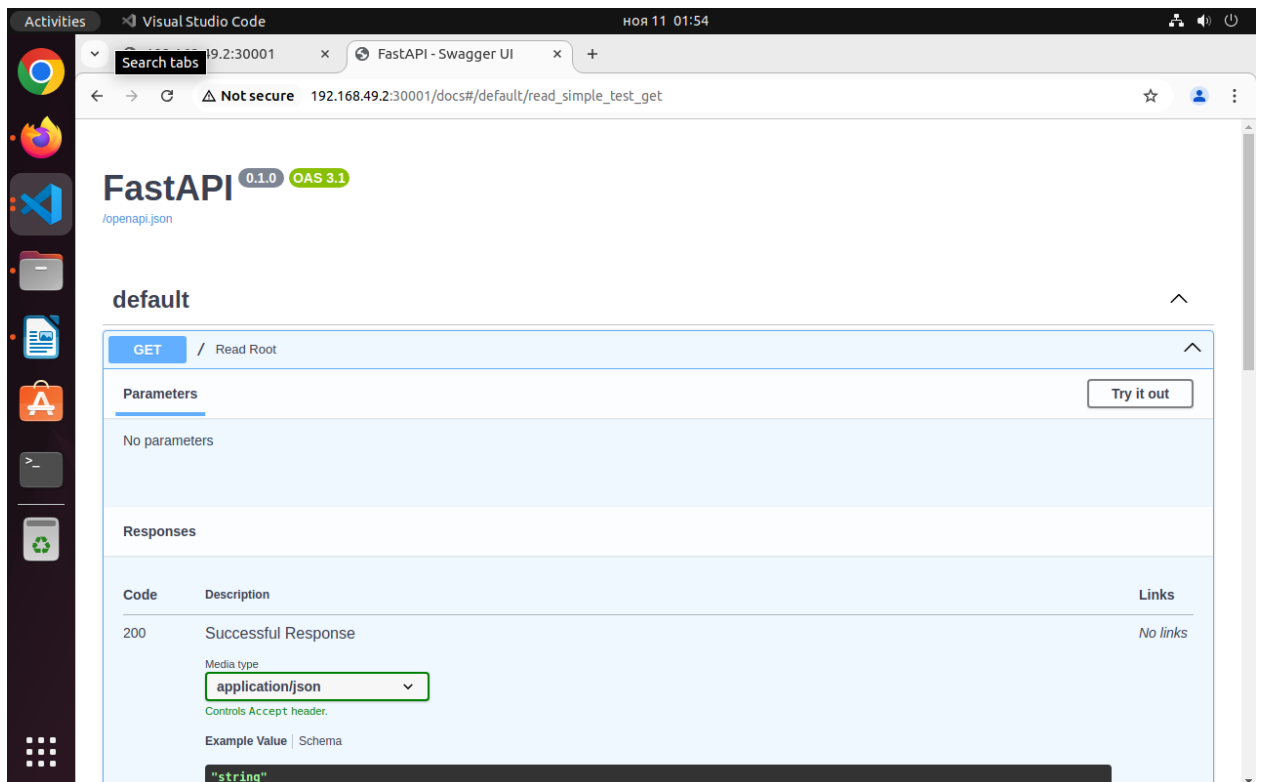


Figure 15 Working

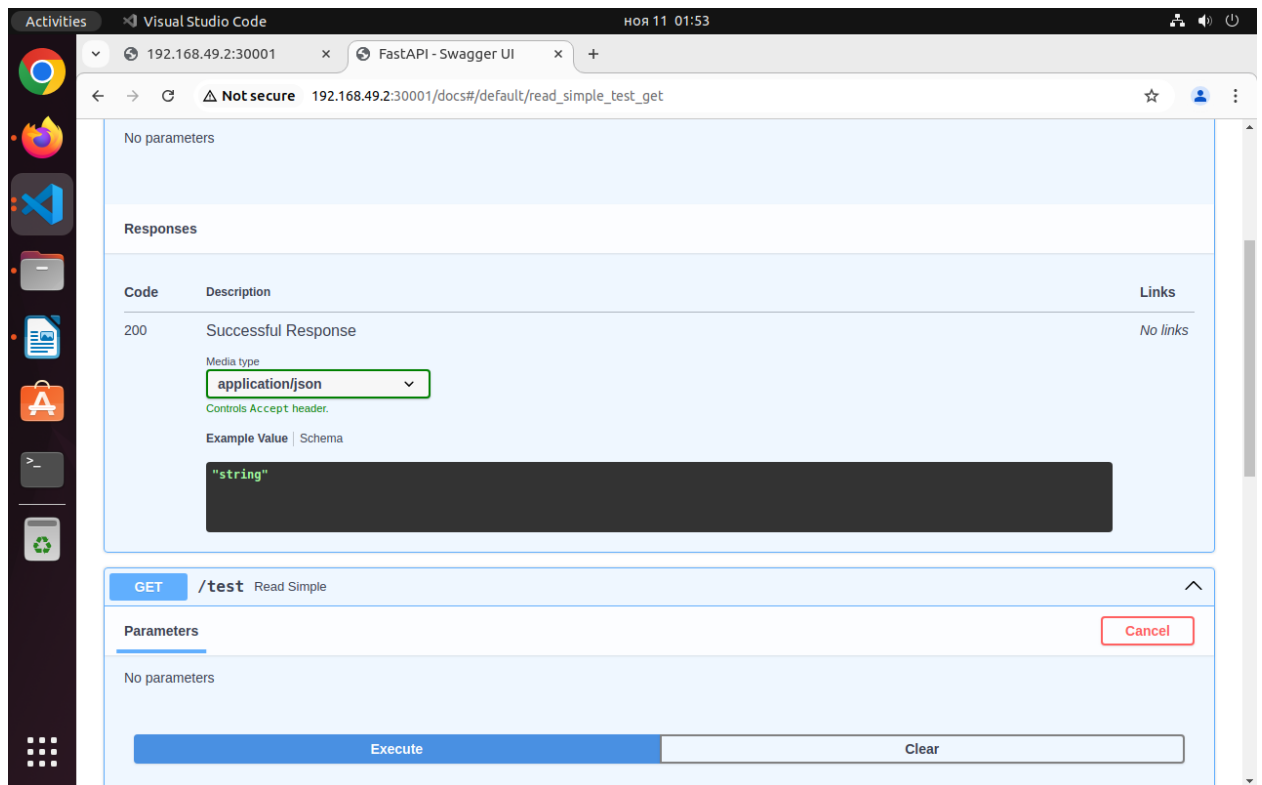


Figure 16 Working

Заключение

В результате выполнения практической работы была выполнена задача по разворачиванию собственного сервиса в Kubernetes, что позволило применить на практике ключевые концепции и возможности данной платформы контейнеризации. Был получен комплексный опыт, который укрепил знания о принципах работы и управлении Kubernetes.