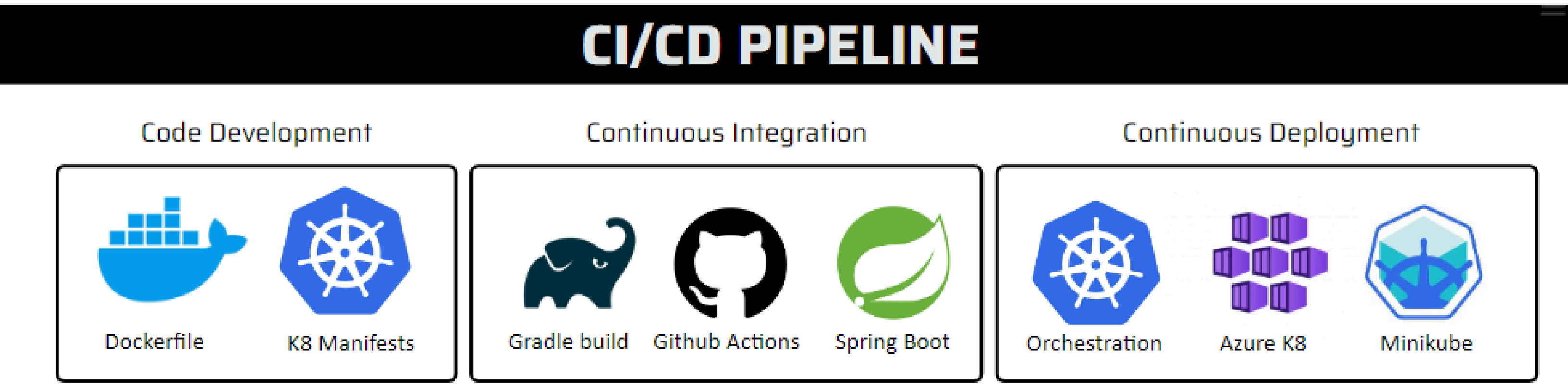
"Ss. Cyril and Methodius" University in Skopje
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

Realtime Chat - Continuous Integration/Continous Delivery

Берат Ахметај - 216130



Фази на проектот:

Materials:

Github Repository

DockerHub Repository

Ф1: јавен git репозиториум

Цел на проектот:

Во оваа секција ќе објасниме како ја користиме апликацијата за систем за чат користејќи WebSocket, Spring Boot, Java како backend, PostgreSQL од Azure како база на податоци и Thymeleaf како фронтенд шаблонски мотор, и како сето ова е поставено во јавен репозиториум на GitHub.

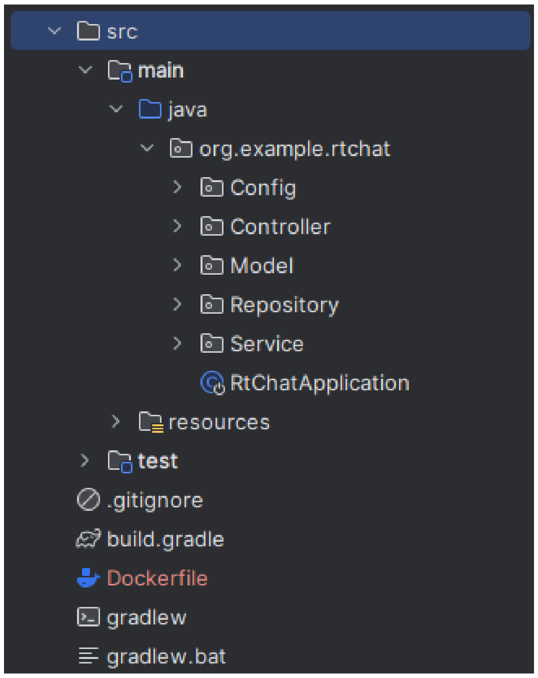
Иницијализација на локалниот Git репозиториум

```
git init
git remote add origin https://github.com/BeratAhmetaj/RT-CHAT-KIII.git
```

Додавање на апликацијата во репозиториумот

```
git commit -m "Initial commit of chat application"
git push -u origin master
```

Структура на апликацијата



```
src
  main
    java
      org.example.rtchat
        Config
        Controller
        Model
        Repository
        Service
        RtChatApplication
    resources
  test
.gitignore
build.gradle
Dockerfile
gradlew
gradlew.bat
```

Ф2: Докеризација

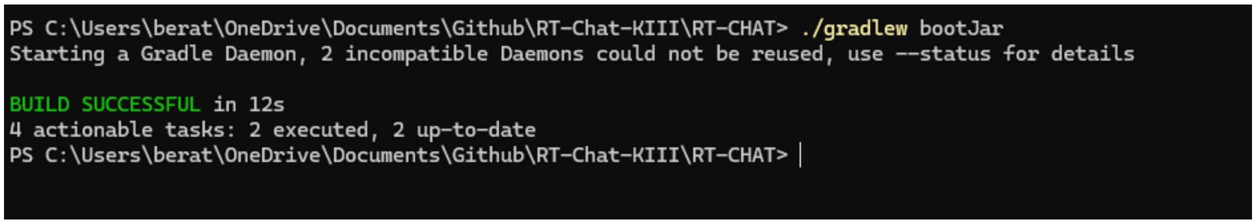
Пред да се направи докеризација, потребно е да добиеме .Jar фајл од секој Build, бидејќи користам Gradle потребно е да се додаваат овие линии во gradle.build

```
jar {
   enabled = true
}

springBoot {
   mainClass.set('org.example.rtchat.RtChatApplication') //Main App Class
}
```

Build gradle + JAR command in cmd (windows)

```
./gradlew bootJar
```

Result:



```
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT> ./gradlew bootJar
Starting a Gradle Daemon, 2 incompatible Daemons could not be reused, use --status for details

BUILD SUCCESSFUL in 12s
4 actionable tasks: 2 executed, 2 up-to-date
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT> |
```

DOCKERFILE

```
FROM gradle:7.6.0-jdk17 AS build

WORKDIR /app

COPY . .

RUN ./gradlew bootJar

FROM openjdk:17-jdk-slim

WORKDIR /app

COPY --from=build /app/build/libs/RT-CHAT-0.0.1-SNAPSHOT.jar
/app/RT-CHAT-0.0.1-SNAPSHOT.jar

EXPOSE 8080

CMD ["java", "-jar", "/app/RT-CHAT-0.0.1-SNAPSHOT.jar"]
```

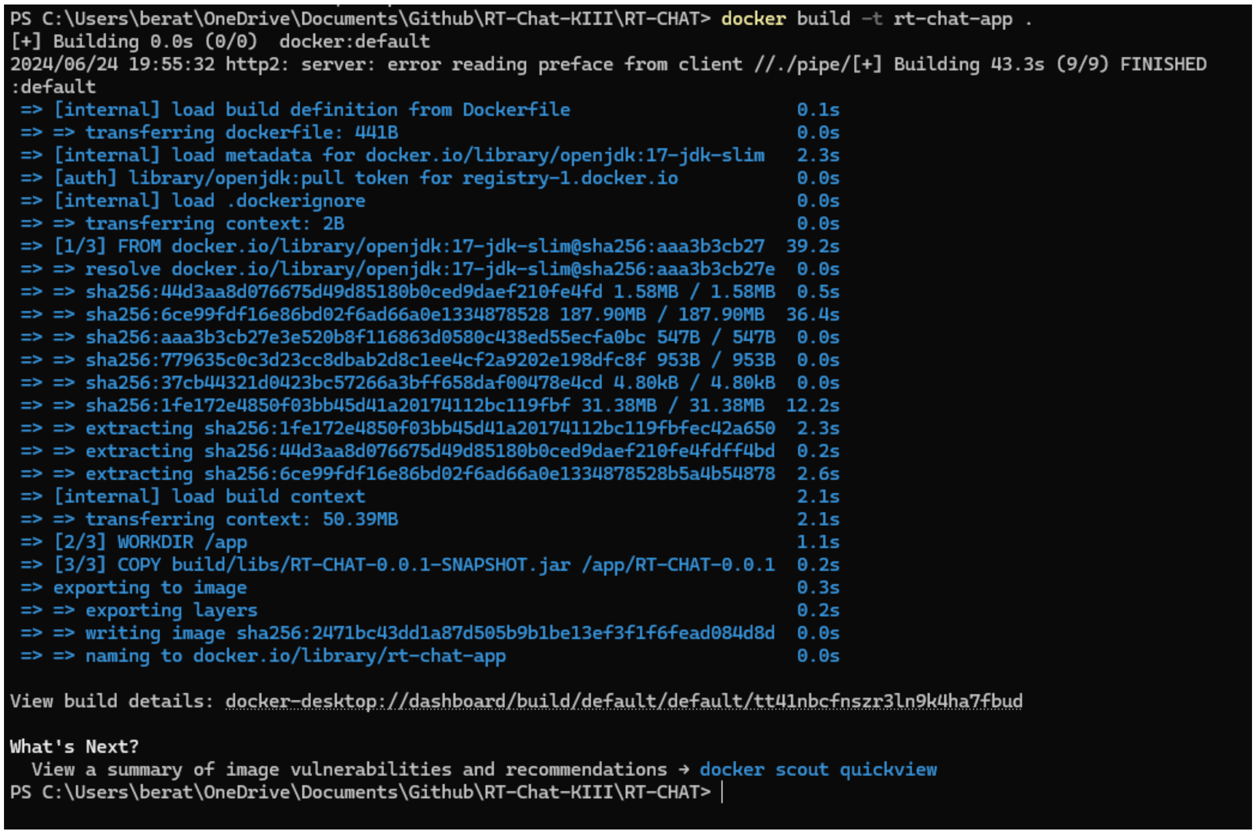
Gradle Build команда за да земе Jar

Java SDK 17 како base image

Docker Build:

```
docker build -t rt-chat-app .
```

Result:

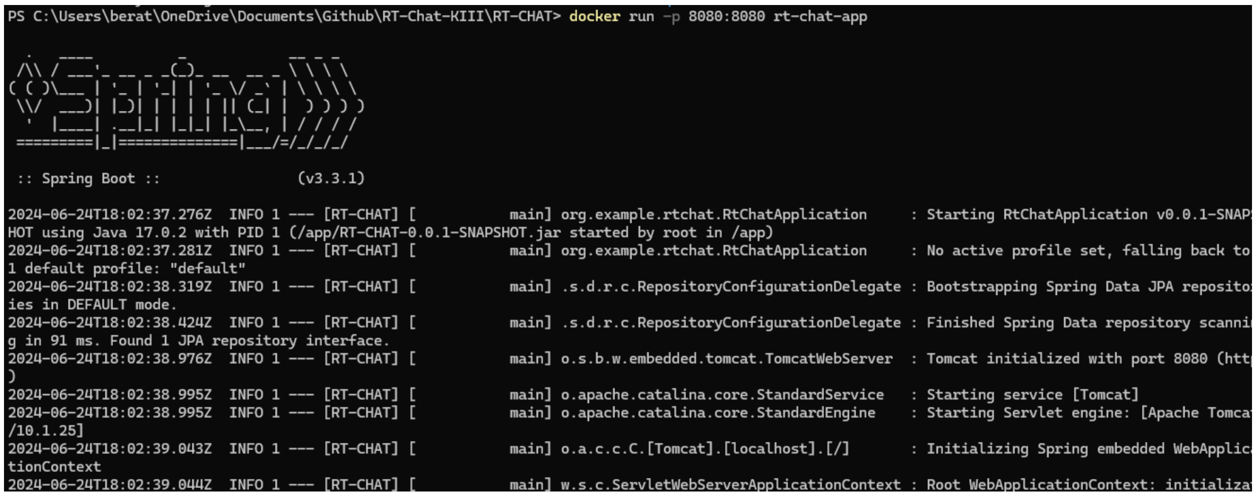


```
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT> docker build -t rt-chat-app .
[+] Building 0.0s (0/0)  docker:default
2024/06/24 19:55:32 http2: server: error reading preface from client //./pipe/[+] Building 43.3s (9/9) FINISHED
:default
 => [internal] load build definition from Dockerfile                         0.1s
 => => transferring dockerfile: 441B                                          0.0s
 => [internal] load metadata for docker.io/library/openjdk:17-jdk-slim      2.3s
 => [auth] library/openjdk:pull token for registry-1.docker.io               0.0s
 => [internal] load .dockerignore                                             0.0s
 => => transferring context: 2B                                               0.0s
 => [1/3] FROM docker.io/library/openjdk:17-jdk-slim@sha256:aaa3b3cb27      39.2s
 => => resolve docker.io/library/openjdk:17-jdk-slim@sha256:aaa3b3cb27e      0.0s
 => => sha256:44d3aa8d076675d49d85180b0ced9daef210fe4fd 1.58MB / 1.58MB      0.5s
 => => sha256:6ce99fdf16e86bd02f6ad66a0e1334878528 187.90MB / 187.90MB      36.4s
 => => sha256:aaa3b3cb27e3e520b8f116863d0580c438ed55ecfa0bc 547B / 547B      0.0s
 => => sha256:779635c0c3d23cc8dbab2d8c1ee4cf2a9202e198dfc8f 953B / 953B      0.0s
 => => sha256:37cb44321d0423bc57266a3bff658daf00478e4cd 4.80kB / 4.80kB      0.0s
 => => sha256:1fe172e4850f03bb45d41a20174112bc119fbf 31.38MB / 31.38MB      12.2s
 => => extracting sha256:1fe172e4850f03bb45d41a20174112bc119fbfec42a650      2.3s
 => => extracting sha256:44d3aa8d076675d49d85180b0ced9daef210fe4fdff4bd      0.2s
 => => extracting sha256:6ce99fdf16e86bd02f6ad66a0e1334878528b5a4b54878      2.6s
 => [internal] load build context                                             2.1s
 => => transferring context: 50.39MB                                          2.1s
 => [2/3] WORKDIR /app                                                        1.1s
 => [3/3] COPY build/libs/RT-CHAT-0.0.1-SNAPSHOT.jar /app/RT-CHAT-0.0.1      0.2s
 => exporting to image                                                        0.3s
 => => exporting layers                                                       0.2s
 => => writing image sha256:2471bc43dd1a87d505b9b1be13ef3f1f6fead084d8d      0.0s
 => => naming to docker.io/library/rt-chat-app                                0.0s

View build details: docker-desktop://dashboard/build/default/default/tt41nbcfnszr3ln9k4ha7fbud

What's Next?
  View a summary of image vulnerabilities and recommendations → docker scout quickview
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT> |
```

Docker Run

```
docker run -p 8080:8080 rt-chat-app
```

Result:



```
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT> docker run -p 8080:8080 rt-chat-app

  .   ____          _            __ _ _
 /\\ / ___'_ __ _ _(_)_ __  __ _ \ \ \ \
( ( )\___ | '_ | '_| | '_ \/ _` | \ \ \ \
 \\/  ___)| |_)| | | | | || (_| |  ) ) ) )
  '  |____| .__|_| |_|_| |_\__, | / / / /
 =========|_|==============|___/=/_/_/_/

 :: Spring Boot ::                (v3.3.1)

2024-06-24T18:02:37.276Z  INFO 1 --- [RT-CHAT] [           main] org.example.rtchat.RtChatApplication     : Starting RtChatApplication v0.0.1-SNAP
HOT using Java 17.0.2 with PID 1 (/app/RT-CHAT-0.0.1-SNAPSHOT.jar started by root in /app)
2024-06-24T18:02:37.281Z  INFO 1 --- [RT-CHAT] [           main] org.example.rtchat.RtChatApplication     : No active profile set, falling back to
1 default profile: "default"
2024-06-24T18:02:38.319Z  INFO 1 --- [RT-CHAT] [           main] .s.d.r.c.RepositoryConfigurationDelegate : Bootstrapping Spring Data JPA reposito
ies in DEFAULT mode.
2024-06-24T18:02:38.424Z  INFO 1 --- [RT-CHAT] [           main] .s.d.r.c.RepositoryConfigurationDelegate : Finished Spring Data repository scanni
g in 91 ms. Found 1 JPA repository interface.
2024-06-24T18:02:38.976Z  INFO 1 --- [RT-CHAT] [           main] o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat initialized with port 8080 (htt
)
2024-06-24T18:02:38.995Z  INFO 1 --- [RT-CHAT] [           main] o.apache.catalina.core.StandardService   : Starting service [Tomcat]
2024-06-24T18:02:38.995Z  INFO 1 --- [RT-CHAT] [           main] o.apache.catalina.core.StandardEngine    : Starting Servlet engine: [Apache Tomca
/10.1.25]
2024-06-24T18:02:39.043Z  INFO 1 --- [RT-CHAT] [           main] o.a.c.c.C.[Tomcat].[localhost].[/]       : Initializing Spring embedded WebApplic
tionContext
2024-06-24T18:02:39.044Z  INFO 1 --- [RT-CHAT] [           main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initializa
```

Ф3: Docker-compose Оркестрација

Docker-compose.yml

```yaml
version: '3.8'

services:
 app:
   build: .
   ports:
     - "8080:8080"
   environment:
     SPRING_APPLICATION_NAME: ${SPRING_APPLICATION_NAME}
     SERVER_PORT: ${SERVER_PORT}
     SPRING_DATASOURCE_URL: ${SPRING_DATASOURCE_URL}
     SPRING_DATASOURCE_USERNAME: ${SPRING_DATASOURCE_USERNAME}
     SPRING_DATASOURCE_PASSWORD: ${SPRING_DATASOURCE_PASSWORD}
     SPRING_DATASOURCE_DRIVER_CLASS_NAME: ${SPRING_DATASOURCE_DRIVER_CLASS_NAME}
     SPRING_JPA_DATABASE_PLATFORM: ${SPRING_JPA_DATABASE_PLATFORM}
     SPRING_JPA_HIBERNATE_DDL_AUTO: ${SPRING_JPA_HIBERNATE_DDL_AUTO}
   depends_on:
     - db

 db:
   image: mcr.microsoft.com/mssql/server:2019-latest
   environment:
     ACCEPT_EULA: "Y"
     SA_PASSWORD: ${DB_SA_PASSWORD}
     MSSQL_PID: "Express"
   ports:
     - "1433:1433"
   volumes:
     - db-data:/var/opt/mssql

volumes:
 db-data:
```

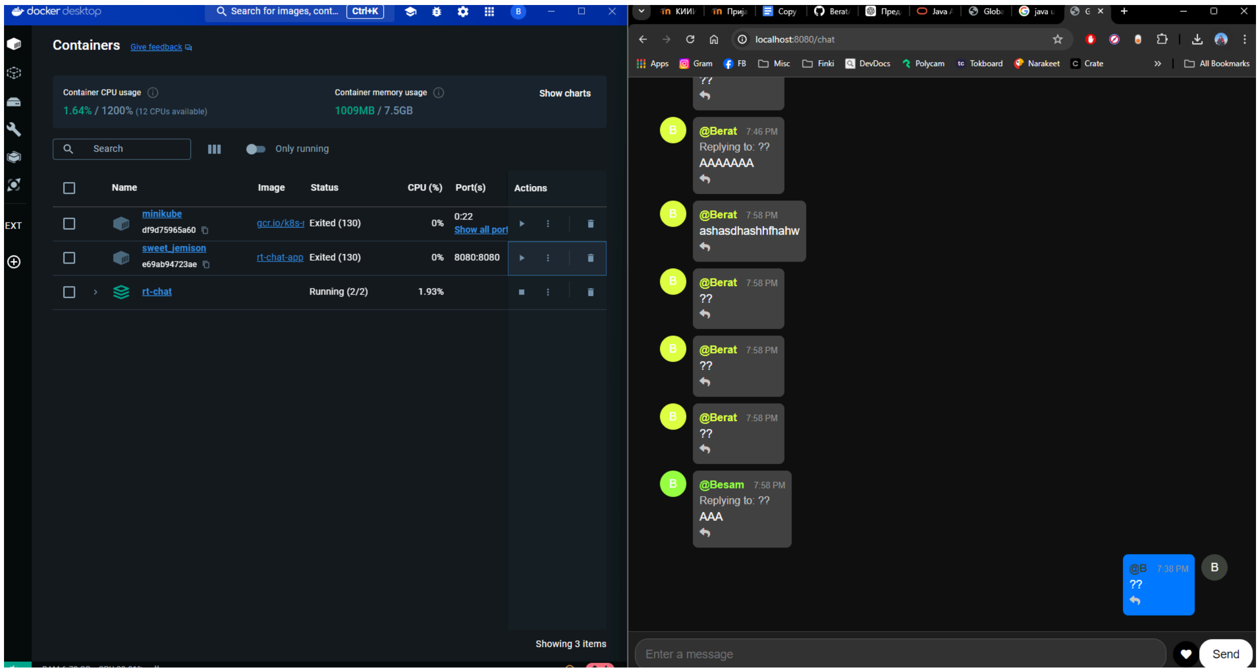
Користам .env фајл за на безбеден начин да пренесам информации за passwords и usernames во Dockercompose

.env е ставено во .gitignore

Run docker-compose and build the image

```
docker-compose up --build
```

Result:



Containers

Container CPU usage 1.64% / 1200% (12 CPUs available)
Container memory usage 1009MB / 7.5GB

Name	Image	Status	CPU (%)	Port(s)
minikube df9d75965a60	gcr.io/k8s-i	Exited (130)	0%	0:22 Show all port
sweet_jemison e69ab94723ae	rt-chat-app	Exited (130)	0%	8080:8080
rt-chat		Running (2/2)	1.93%	

Showing 3 items

localhost:8080/chat

@Berat 7:46 PM
Replying to: ??
AAAAAAA

@Berat 7:58 PM
ashasdhashhfhahw

@Berat 7:58 PM
??

@Berat 7:58 PM
??

@Berat 7:58 PM
??

@Besam 7:58 PM
Replying to: ??
AAA

@B 7:38 PM
??

Additional commands:

```
docker-compose logs -f
```

```
docker-compose down
```

Ф4: Pipeline CI/CD

Github Action:
започнува со билд на Java апликацијата на секој push на гранката `main`. Потоа се креира Docker слика од апликацијата и се врши нејзино push на DockerHub. Во последен чекор, се користи `kubectl` апликацијата на локалното Minikube Kubernetes, користејќи манифести за Deployment и Service. Ова е корисно за локално тестирање и развој на Kubernetes апликации во Minikube.

ci-cd-pipeline.yml

```
name: CI/CD Pipeline

on:
 push:
   branches:
     - main

jobs:
 build:
   runs-on: ubuntu-latest

   steps:
     - name: Checkout code
       uses: actions/checkout@v2

     - name: Set up JDK 17
       uses: actions/setup-java@v2
       with:
         java-version: 17

     - name: Cache Gradle packages
       uses: actions/cache@v2
```

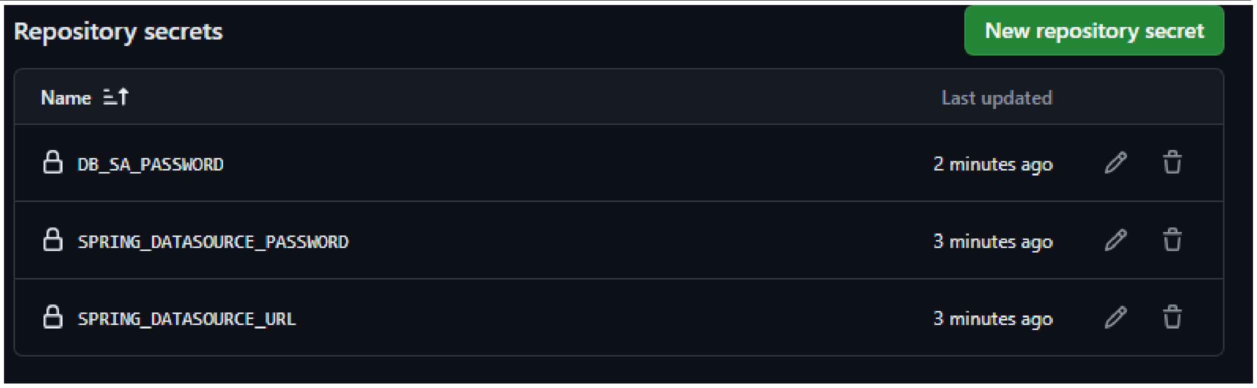
```
 - name: Log in DockerHub
       uses: docker/login-action@v1
       with:
         username: ${{ secrets.DOCKER_USERNAME }}
         password: ${{ secrets.DOCKER_PASSWORD }}

     - name: Build and push Docker image
       uses: docker/build-push-action@v2
       with:
         context: .
         push: true
         tags: ${{ secrets.DOCKER_USERNAME }}/rt-chat:latest

deploy:
   runs-on: ubuntu-latest
   needs: build
   steps:
     - name: Install kubectl
       run: |
         curl -LO
https://storage.googleapis.com/kubernetes-release/release/$(curl -s
https://storage.googleapis.com/kubernetes-release/release/stable.tx
```

```
      with:
        path: |
          ~/.gradle/caches
          ~/.gradle/wrapper
        key: ${{ runner.os }}-gradle-${{ hashFiles('**/*.gradle*',
'**/gradle-wrapper.properties') }}
        restore-keys: ${{ runner.os }}-gradle

    - name: Gradle Build
      run: ./gradlew bootJar

    - name: Docker Buildx
      uses: docker/setup-buildx-action@v1
```

```
t)/bin/linux/amd64/kubectl
         chmod +x ./kubectl
         sudo mv ./kubectl /usr/local/bin/kubectl

     - name: Configure kubectl to use Minikube
       run: minikube kubectl -- get po -A

     - name: Deploy to Minikube
       run: |
         kubectl apply -f k8s/deployment.yaml -f k8s/service.yaml
```

Github Secrets:
Со цел pipeline-от безбедно да се завршува, користам Github Action Secrets, и .env за локално кога старувам оркестрација

```
SPRING_DATASOURCE_URL: ${SPRING_DATASOURCE_URL}
SPRING_DATASOURCE_USERNAME: beratahmetaj02@berat-finki
SPRING_DATASOURCE_PASSWORD: ${SPRING_DATASOURCE_PASSWORD}
```


Repository secrets

Name	Last updated
DB_SA_PASSWORD	2 minutes ago
SPRING_DATASOURCE_PASSWORD	3 minutes ago
SPRING_DATASOURCE_URL	3 minutes ago

Ф5: Deployment за апликацијата со потребните ConfigMaps/Secrets

Namespace
Првин треба да се креира Namespace

```
kubectl create namespace rt-chat-local
```

Deployment.yaml

```
apiVersion: apps/v1
kind: Deployment
metadata:
 name: my-app-deployment
 namespace: rt-chat-local  # NAMESPACE
spec:
 replicas: 3
 selector:
   matchLabels:
     app: my-app
 template:
   metadata:
     labels:
       app: my-app
   spec:
     containers:
       - name: my-app
         image: rt-chat-application:latest  # DOCKER IMAGE NAME
         ports:
           - containerPort: 8080
         env:
           - name: DB_URL
             value:
jdbc:sqlserver://berat-finki.database.windows.net:1433;databaseName=RT-CHAT;encrypt=true;trustServerCertificate=false;hostNameInCertific
ate=*.database.windows.net;
           - name: SPRING_DATASOURCE_USERNAME
             value: beratahmetaj02@berat-finki
           - name: SPRING_DATASOURCE_PASSWORD # USE OF SECRETS
             valueFrom:
               secretKeyRef:
                 name: db-secrets
                 key: db-sa-password
           - name: SPRING_DATASOURCE_DRIVER_CLASS_NAME
             value: com.microsoft.sqlserver.jdbc.SQLServerDriver
           - name: SPRING_JPA_DATABASE_PLATFORM
             value: org.hibernate.dialect.SQLServerDialect
           - name: SPRING_JPA_HIBERNATE_DDL_AUTO
             value: update
         envFrom:
           - secretRef:
               name: my-app-secrets  # GitHub secret name
---
apiVersion: v1
kind: ConfigMap
metadata:
 name: app-config
 namespace: rt-chat-local  # Use your specific namespace here
data:
 app.properties: |
   app.name=RT-CHAT-APP
   app.version=1.0.0
```

Github Action Pipeline модификација (користејќи манифести)

```
deploy:
 runs-on: ubuntu-latest
 needs: build
 steps:
   - name: Install kubectl
     run: |
       curl -LO https://storage.googleapis.com/kubernetes-release/release/$(curl -s
https://storage.googleapis.com/kubernetes-release/release/stable.txt)/bin/linux/amd64/kubectl
       chmod +x ./kubectl
       sudo mv ./kubectl /usr/local/bin/kubectl

   - name: Configure kubectl to use Minikube
     run: minikube kubectl -- get po -A

   - name: Deploy to Minikube
     run: |
       kubectl apply -f k8s/deployment.yaml -f k8s/service.yaml
```

Ф6: Service за апликацијата

При правење на Servie.yaml пазев на истите Labels да се користат како што се на Deployment, и точниот Namespace да се користи

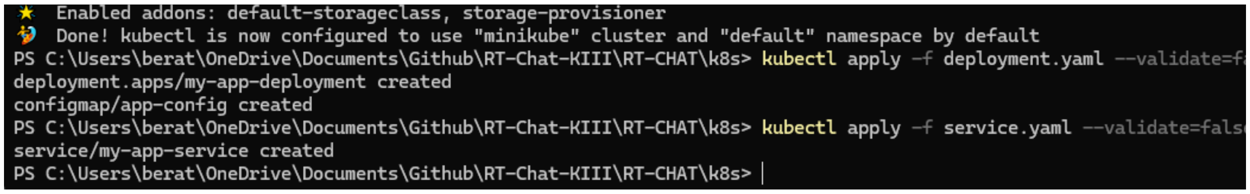
Service.yaml

```
apiVersion: v1
kind: Service
metadata:
 name: my-app-service
 namespace: rt-chat-local  # NAMESPACE SPECIFIED
spec:
 selector:
   app: my-app  # label match from deployment.yaml
 ports:
   - protocol: TCP
     port: 80
     targetPort: 8080
 type: LoadBalancer  # nodeport za minikube
```

Apply Manifests:

```
kubectl apply -f deployment.yaml --validate=false
kubectl apply -f service.yaml --validate=false
```

Result:



```
★  Enabled addons: default-storageclass, storage-provisioner
🏄  Done! kubectl is now configured to use "minikube" cluster and "default" namespace by default
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT\k8s> kubectl apply -f deployment.yaml --validate=f
deployment.apps/my-app-deployment created
configmap/app-config created
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT\k8s> kubectl apply -f service.yaml --validate=fals
service/my-app-service created
PS C:\Users\berat\OneDrive\Documents\Github\RT-Chat-KIII\RT-CHAT\k8s> |
```

Dockerhub push

```
docker push beratahmetaj/rt-chat-application:latest
```

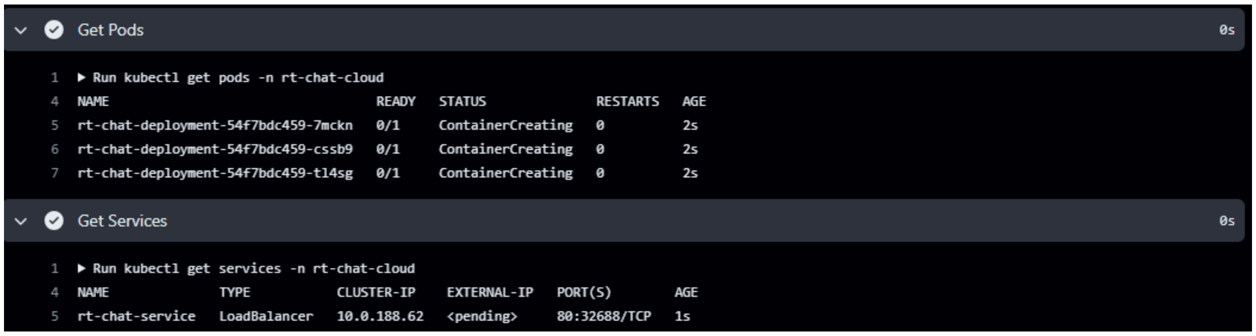
Run the docker image

```
docker run -p 8080:8080 beratahmetaj/rt-chat-application:latest
```

Get pods + Get Service

```
kubectl get pods -n rt-chat-cloud
kubectl get services -n rt-chat-cloud
```

Result:

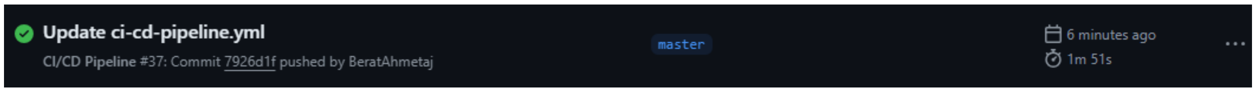


Get Pods 0s

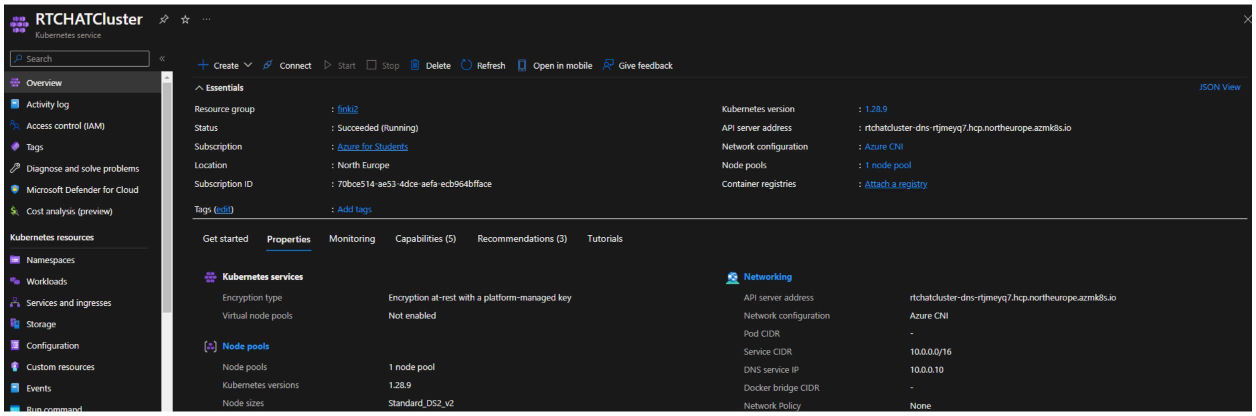
```
▶ Run kubectl get pods -n rt-chat-cloud
NAME                                 READY   STATUS              RESTARTS   AGE
rt-chat-deployment-54f7bdc459-7mckn  0/1     ContainerCreating   0          2s
rt-chat-deployment-54f7bdc459-cssb9  0/1     ContainerCreating   0          2s
rt-chat-deployment-54f7bdc459-t14sg  0/1     ContainerCreating   0          2s
```

Get Services 0s

```
▶ Run kubectl get services -n rt-chat-cloud
NAME             TYPE           CLUSTER-IP    EXTERNAL-IP   PORT(S)        AGE
rt-chat-service  LoadBalancer   10.0.188.62   <pending>     80:32688/TCP   1s
```



Update ci-cd-pipeline.yml
CI/CD Pipeline #37: Commit 7926d1f pushed by BeratAhmetaj
master
6 minutes ago
1m 51s



Essentials

Resource group	: finki2
Status	: Succeeded (Running)
Subscription	: Azure for Students
Location	: North Europe
Subscription ID	: 70bce514-ae53-4dce-aefa-ecb964bfface
Tags (edit)	: Add tags
Kubernetes version	: 1.28.9
API server address	: rtchatcluster-dns-rtjmeyq7.hcp.northeurope.azmk8s.io
Network configuration	: Azure CNI
Node pools	: 1 node pool
Container registries	: Attach a registry

Kubernetes services

Encryption type	Encryption at-rest with a platform-managed key
Virtual node pools	Not enabled

Node pools

Node pools	1 node pool
Kubernetes versions	1.28.9
Node sizes	Standard_DS2_v2

Networking

API server address	rtchatcluster-dns-rtjmeyq7.hcp.northeurope.azmk8s.io
Network configuration	Azure CNI
Pod CIDR	-
Service CIDR	10.0.0.0/16
DNS service IP	10.0.0.10
Docker bridge CIDR	-
Network Policy	None