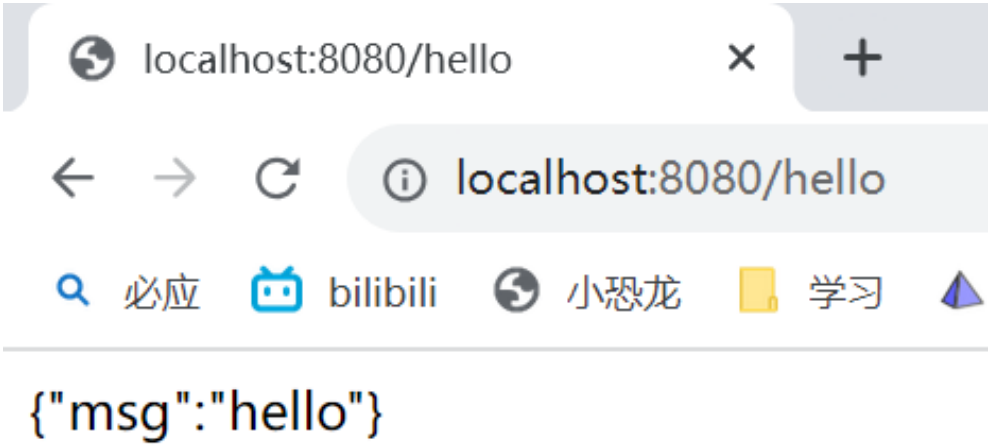
云原生大作业说明文档

变更人	变更时间	变更内容	版本号
王艺羲	2023-08-07	完成初始文档	v1.1
孙兆葳	2023-08-08	修改限流内容	v1.2
陈鹏霖	2023-08-08	完成限流功能	v1.3
陈鹏霖	2023-08-13	完成DevOps要求	v2.1
王艺羲	2023-08-14	完成扩容场景	v3.1
王艺羲	2023-08-15	整理并完成全部文档	v4.1

1.功能要求

1.1 实现一个REST接口



1.2 实现限流功能

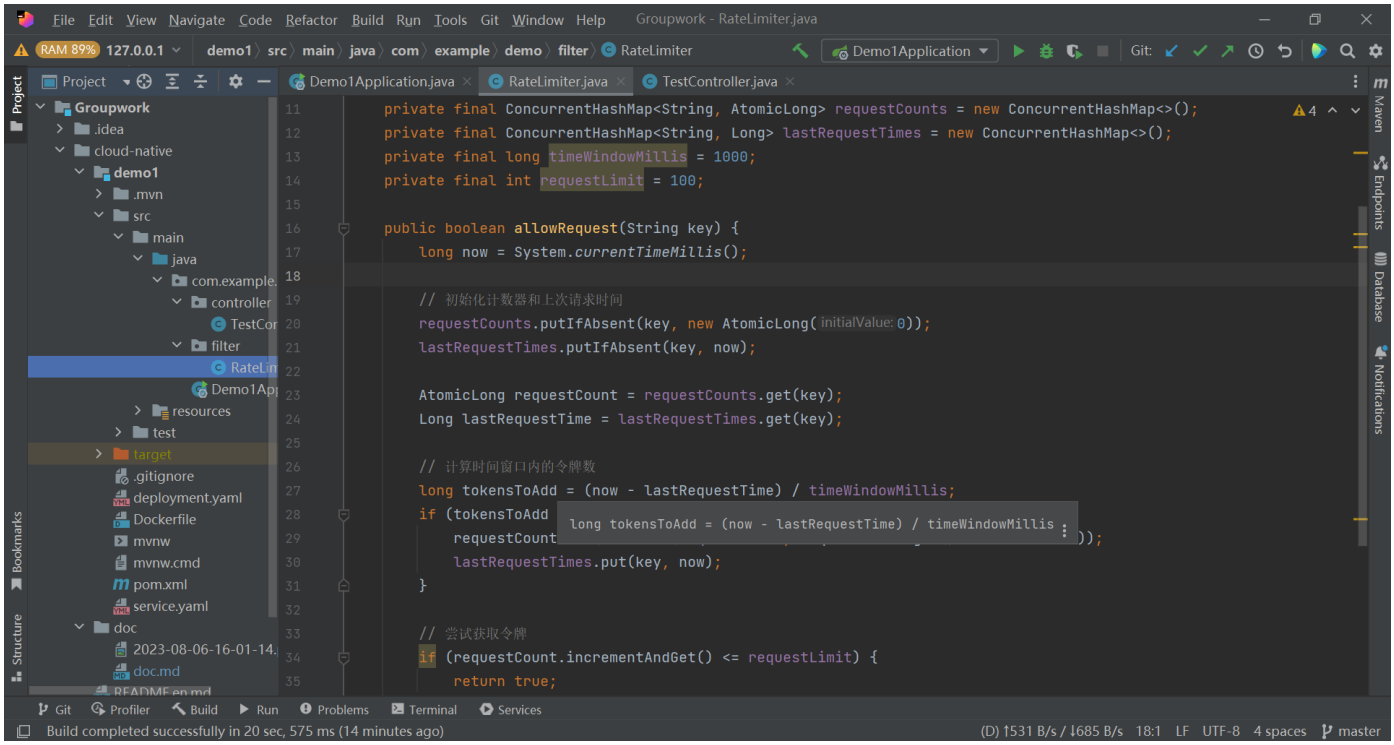
1.2.1 Ratelimiter

限流功能类Ratelimiter

```
package com.example.demo.filter;

import org.springframework.stereotype.Component;

import java.time.Duration;
import java.util.concurrent.ConcurrentHashMap;
import java.util.concurrent.atomic.AtomicLong;
```

```java
@Component
public class RateLimiter {
    private final ConcurrentHashMap<String, AtomicLong> requestCounts = new
ConcurrentHashMap<>();
    private final ConcurrentHashMap<String, Long> lastRequestTimes = new
ConcurrentHashMap<>();
    private final long timeWindowMillis = 1000;
    private final int requestLimit = 100;

    public boolean allowRequest(String key) {
        long now = System.currentTimeMillis();

        // 初始化计数器和上次请求时间
        requestCounts.putIfAbsent(key, new AtomicLong(0));
        lastRequestTimes.putIfAbsent(key, now);

        AtomicLong requestCount = requestCounts.get(key);
        Long lastRequestTime = lastRequestTimes.get(key);

        // 计算时间窗口内的令牌数
        long tokensToAdd = (now - lastRequestTime) / timeWindowMillis;
        if (tokensToAdd > 0) {
            requestCount.set(Math.min(requestLimit, requestCount.get() + tokensToAdd));
            lastRequestTimes.put(key, now);
        }

        // 尝试获取令牌
        if (requestCount.incrementAndGet() <= requestLimit) {
            return true;
        } else {
            return false;
        }
    }
}
```

以下为代码截图



1.2.2 TestController

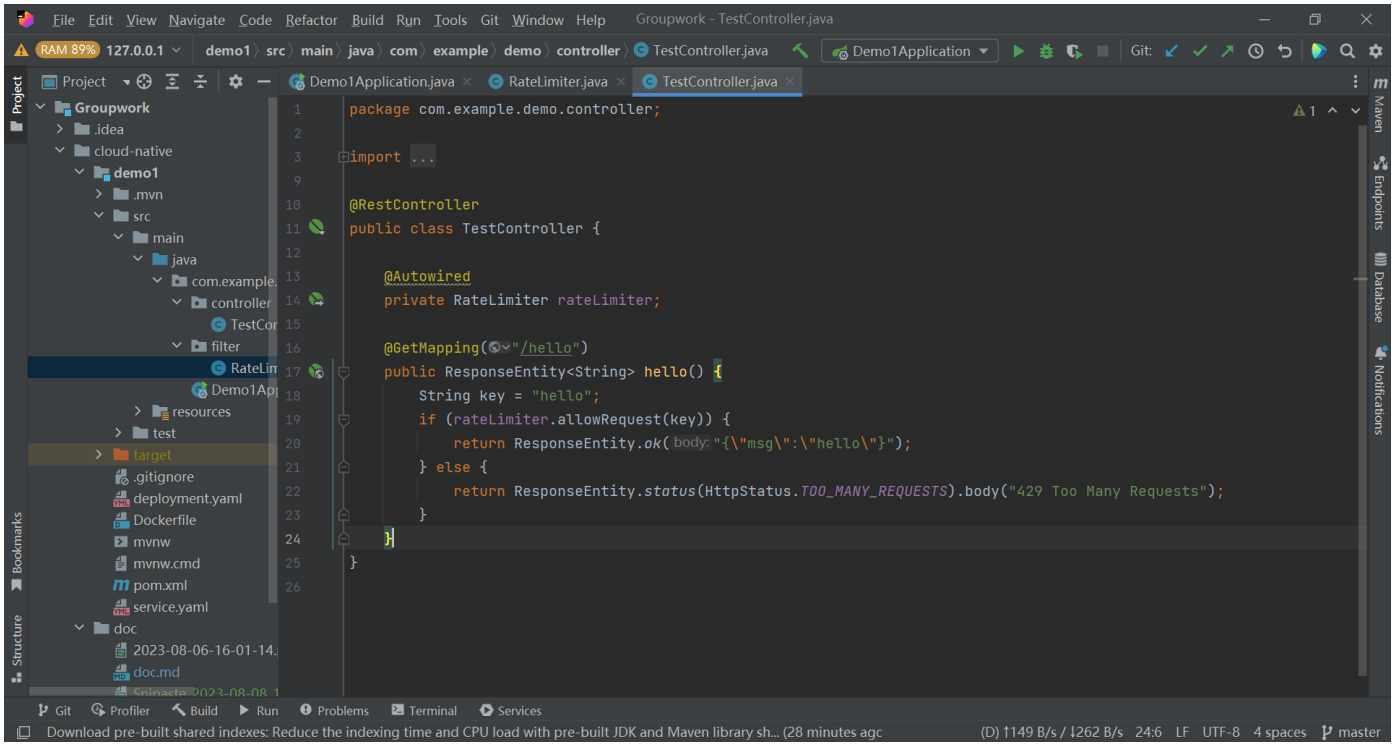
创建controller类TestController

使用RateLimiter限流功能

```
package com.example.demo.controller;

import com.example.demo.filter.RateLimiter;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.http.HttpStatus;
import org.springframework.http.ResponseEntity;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.RestController;

@RestController
public class TestController {

    @Autowired
    private RateLimiter rateLimiter;

    @GetMapping("/hello")
    public ResponseEntity<String> hello() {
        String key = "hello";
        if (rateLimiter.allowRequest(key)) {
            return ResponseEntity.ok("{\"msg\":\"hello\"}");
        } else {
            return ResponseEntity.status(HttpStatus.TOO_MANY_REQUESTS).body("429 Too
Many Requests");
        }
    }
```

```
}
```

以下为代码截图

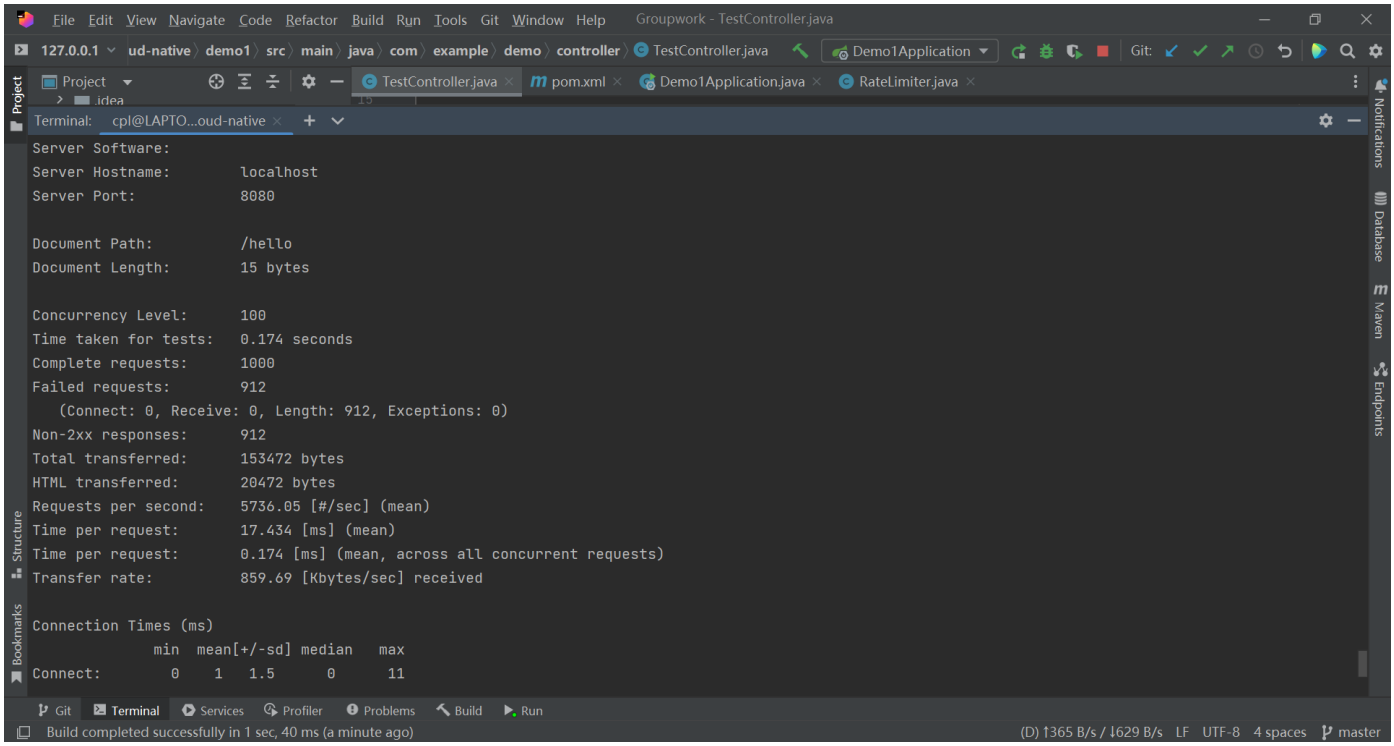


1.3 测试限流功能

使用Apache Bench (ab) 工具测试限流

在终端输入 ab -n 1000 -c 100 http://localhost:8080/hello 发送1000个请求，每次并发100个请求

得到如下控制台输出



上面的输出中，`Failed requests` 显示有 912 个请求失败，而 `Non-2xx responses` 显示有 912 个请求返回了非2xx的响应，也就是 429 Too Many Requests 响应。

这说明限流功能是成功实现的。

2.DevOps要求

2.1 Dockerfile 用于构建镜像

```
# Dockerfile
FROM openjdk:17

RUN ln -sf /usr/share/zoneinfo/Asia/shanghai /etc/localtime
RUN echo 'Asia/shanghai' >/etc/timezone

WORKDIR /app
ADD target/demo1-0.0.1-SNAPSHOT.jar .

ENTRYPOINT ["java", "-jar", "demo1-0.0.1-SNAPSHOT.jar"]
```

2.2 Kubernetes 编排文件

```
# prometheus-test-demo.yaml
apiVersion: apps/v1
kind: Deployment #对象类型
metadata:
  labels:
    app: prometheus-test-demo
  name: prometheus-test-demo
  namespace: nju05
spec:
  replicas: 3 #运行容器的副本数
  selector:
    matchLabels:
      app: prometheus-test-demo
  template:
    metadata:
      annotations:
        prometheus.io/path: /actuator/prometheus
        prometheus.io/port: "8080"
        prometheus.io/scheme: http
        prometheus.io/scrape: "true"
      labels:
        app: prometheus-test-demo
    spec:
      containers: #docker容器的配置
```

```
        - image: harbor.edu.cn/nju05/prometheus-test-demo:{VERSION} #pull镜像的地址,本地测试时注销
          #      - image: demo:latest  # win下本地测试用
          name: prometheus-test-demo
      #      imagePullPolicy: Always # 本地测试用
      imagePullSecrets: # 本地测试时注销
        - name: docker-harbor-nju05 # 本地测试时注销
---
apiVersion: v1
kind: Service
metadata:
  name: prometheus-test-demo
  namespace: nju05
  labels:
    app: prometheus-test-demo
spec:
  type: NodePort
  selector:
    app: prometheus-test-demo
  ports:
    - name: tcp
      nodePort: 31999
      protocol: TCP
      port: 8080
      targetPort: 8080
```

2.3 持续集成流水线

2.4 持续部署流水线

见 JenkinsFile 文件

```
#JenkinsFile.groovy
pipeline {
    agent none
    environment {
        REGISTRY = "harbor.edu.cn/nju05"
    }
    stages {
        // 克隆代码
        stage('Clone Code') {
            agent {
                label 'master'
            }
            steps {
                echo "1.Git Clone Code"
                git url: "https://gitee.com/cpllouis1127/prometheus-test-demo.git"
            }
```

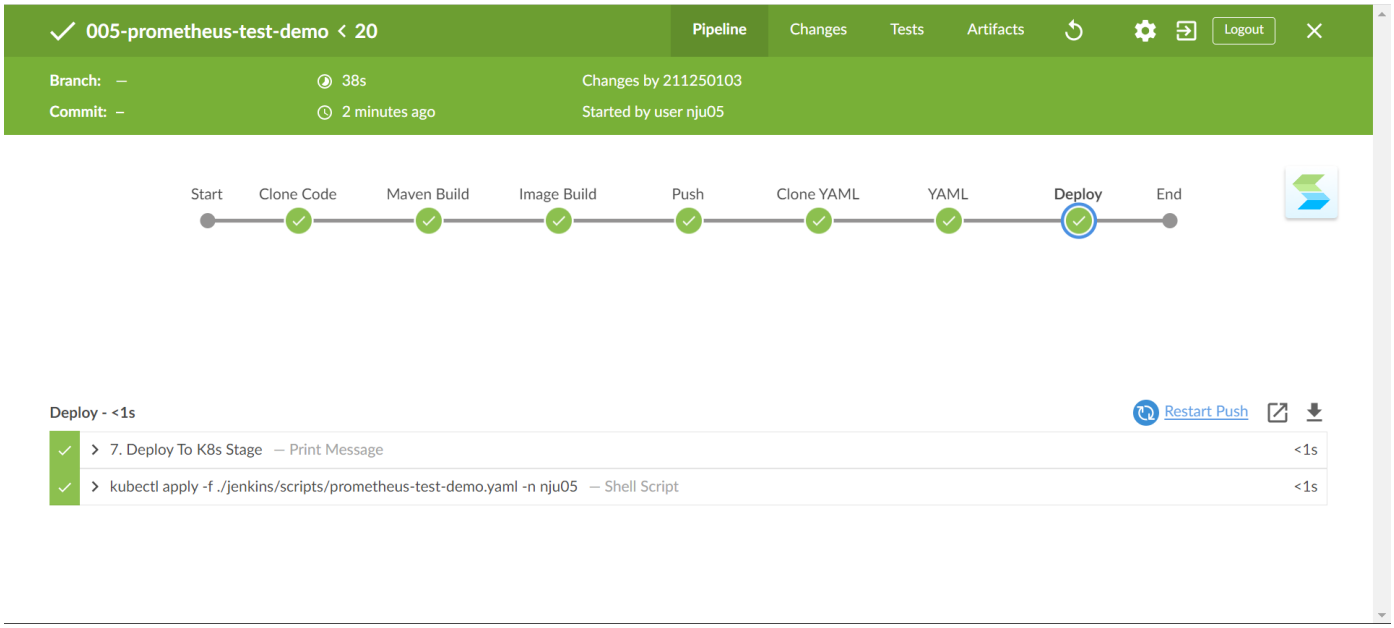
```
        }

        // maven 打包
        stage('Maven Build') {
            agent {
                docker {
                    image 'maven:latest'
                    args '-v /root/.m2:/root/.m2'
                }
            }
            steps {
                echo "2.Maven Build Stage"
                sh 'mvn -B clean package -Dmaven.test.skip=true'
            }
        }

        // 构建镜像
        stage('Image Build') {
            agent {
                label 'master'
            }
            steps {
                echo "3.Image Build Stage"
                sh 'docker build -f Dockerfile --build-arg jar_name=target/demo1-0.0.1-
SNAPSHOT.jar -t prometheus-test-demo:${BUILD_ID} . '
                sh 'docker tag prometheus-test-demo:${BUILD_ID} ${REGISTRY}/prometheus-
test-demo:${BUILD_ID}'
            }
        }

        // 推送镜像
        stage('Push') {
            agent {
                label 'master'
            }
            steps {
                echo "4.Push Docker Image Stage"
                sh "docker login --username=nju05 harbor.edu.cn -p nju052023"
                sh "docker push ${REGISTRY}/prometheus-test-demo:${BUILD_ID}"
            }
        }
    }
}


node('slave') {
    container('jnlp-kubectl') {

        stage('Clone YAML') {
```

```
            echo "5. Git Clone YAML To Slave"
            git url: "https://gitee.com/cpllouis1127/prometheus-test-demo.git"
        }

        stage('YAML') {
            echo "6. Change YAML File Stage"
            sh 'sed -i "s#{VERSION}#${BUILD_ID}#g" ./jenkins/scripts/prometheus-test-
demo.yaml'
        }

        stage('Deploy') {
            echo "7. Deploy To K8s Stage"
            sh 'kubectl apply -f ./jenkins/scripts/prometheus-test-demo.yaml -n nju05'
        }


    }
}
```

2.5 部署流水线

Jenkins 流程

	Stage	step
持续集成	1.Git Clone Code	拉取spring boot代码
	2.Maven Build Stage	maven构建jar包
	3.Image Build Stage	构建镜像
	4.Push Docker Image Stage	push镜像至docker仓库
持续部署	5.Git Clone YAML To Slave	拉取部署所需yaml文件
	6.Change YAML File Stage	改变Yaml环境变量
	7.Deploy To K8s Stage	部署spring boot应用
集成测试	8.Test	测试

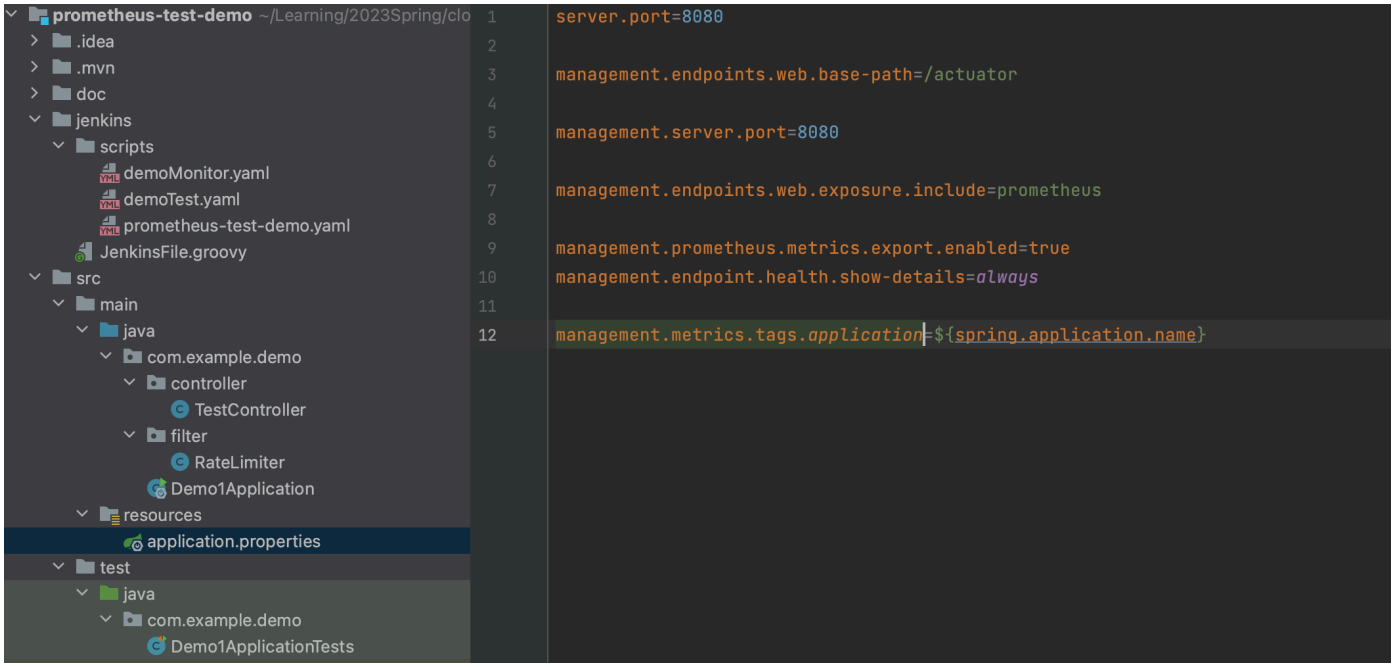


3. 扩容场景

1. 为该 Java 项目提供 Prometheus metrics 接口，可以供 Prometheus 采集监控指标

提供 Prometheus Metrics 接口
在SpringBoot项目中配置Prometheus Metrics 接口

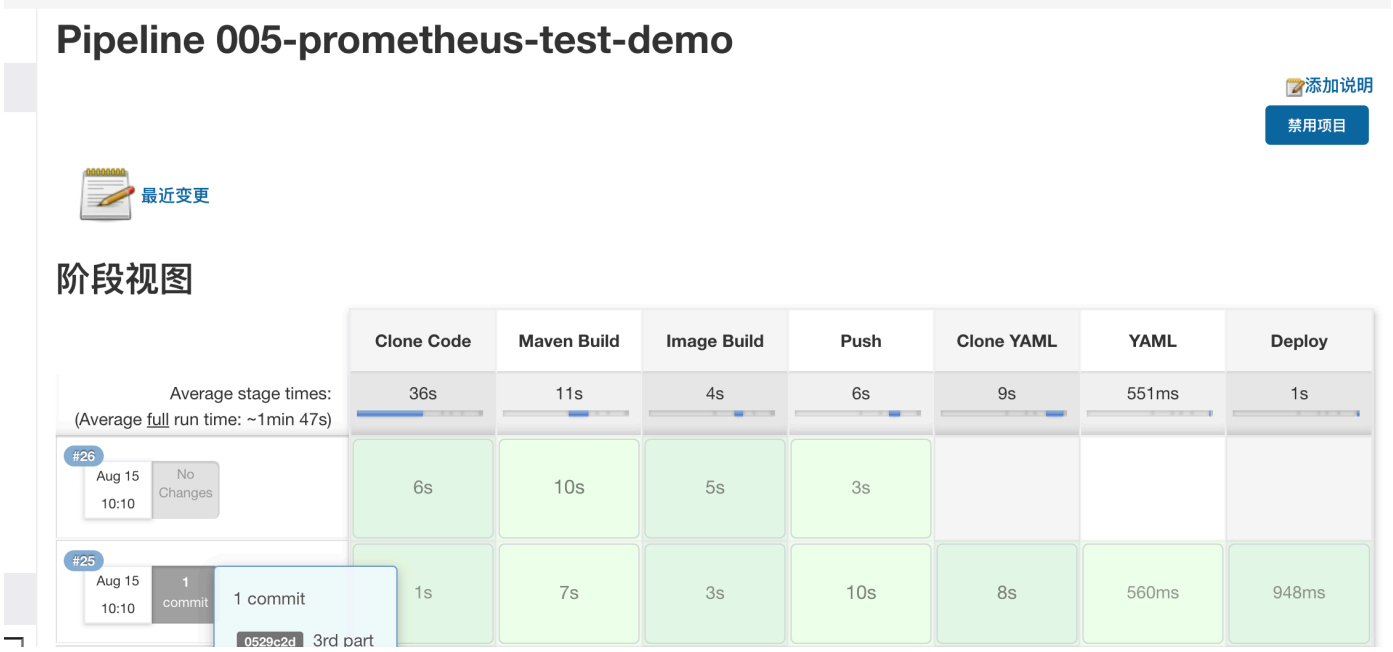
```
server.port=8080

management.endpoints.web.base-path=/actuator

management.server.port=8080

management.endpoints.web.exposure.include=prometheus

management.prometheus.metrics.export.enabled=true
management.endpoint.health.show-details=always

management.metrics.tags.application=${spring.application.name}
```



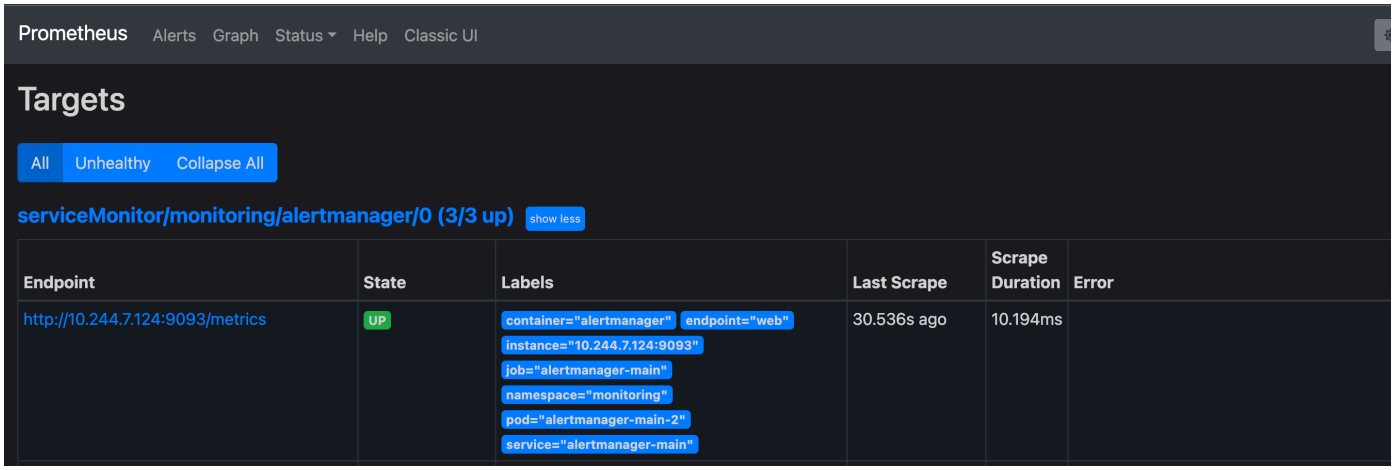
部署k8s - monitor对象

```yaml
apiVersion: monitoring.coreos.com/v1
kind: ServiceMonitor
metadata:
  labels:
    k8s-app: prometheus-test-demo
  name: prometheus-test-demo
  namespace: monitoring
spec:
  endpoints:
    - interval: 30s
      port: tcp
      path: /actuator/prometheus
      scheme: 'http'
  selector:
    matchLabels:
      app: prometheus-test-demo
  namespaceSelector:
    matchNames:
      - nju05
```

放入流水线中部署



在Prometheus的UI界面验证部署是否成功



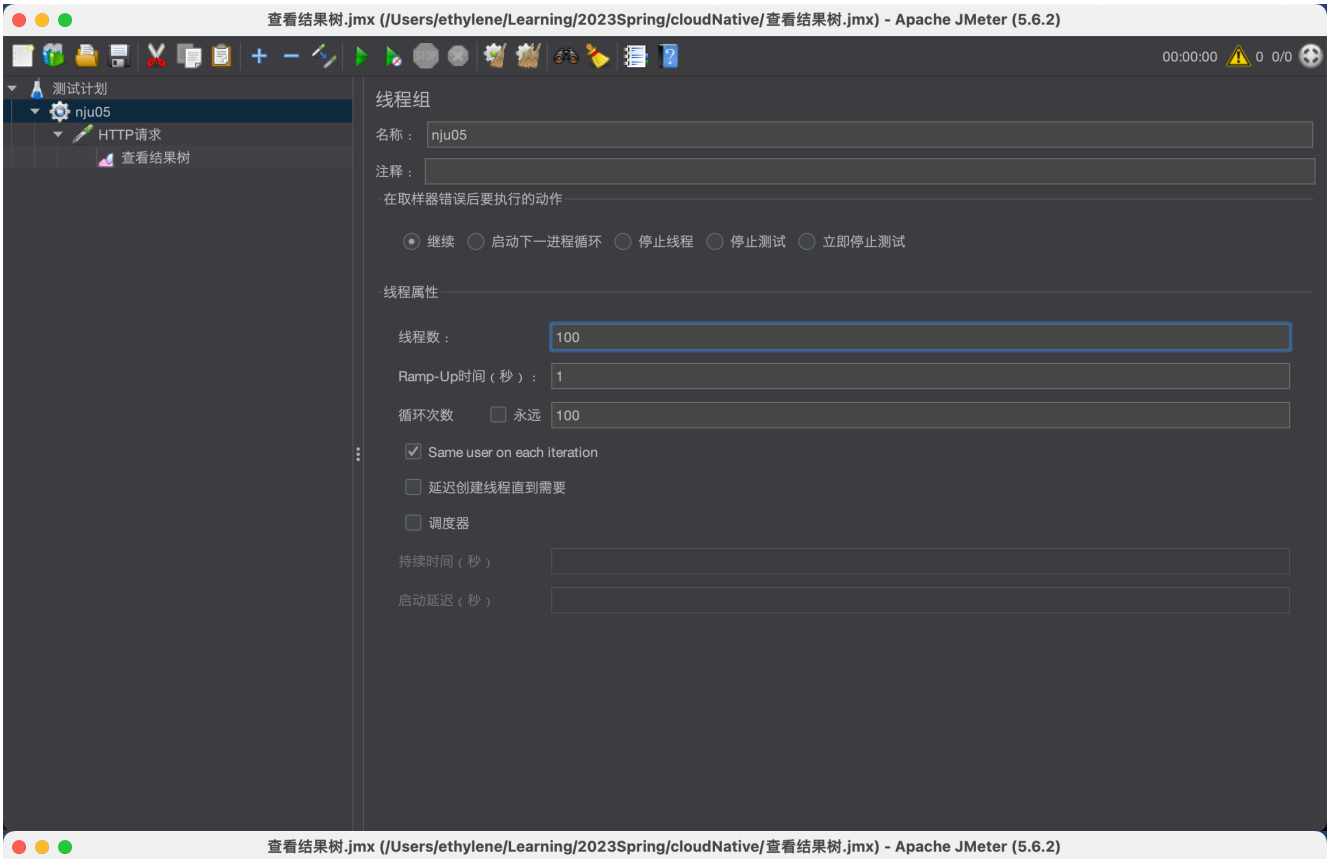
2.在 Grafana 中的定制应用的监控大屏（CPU/内存/JVM）

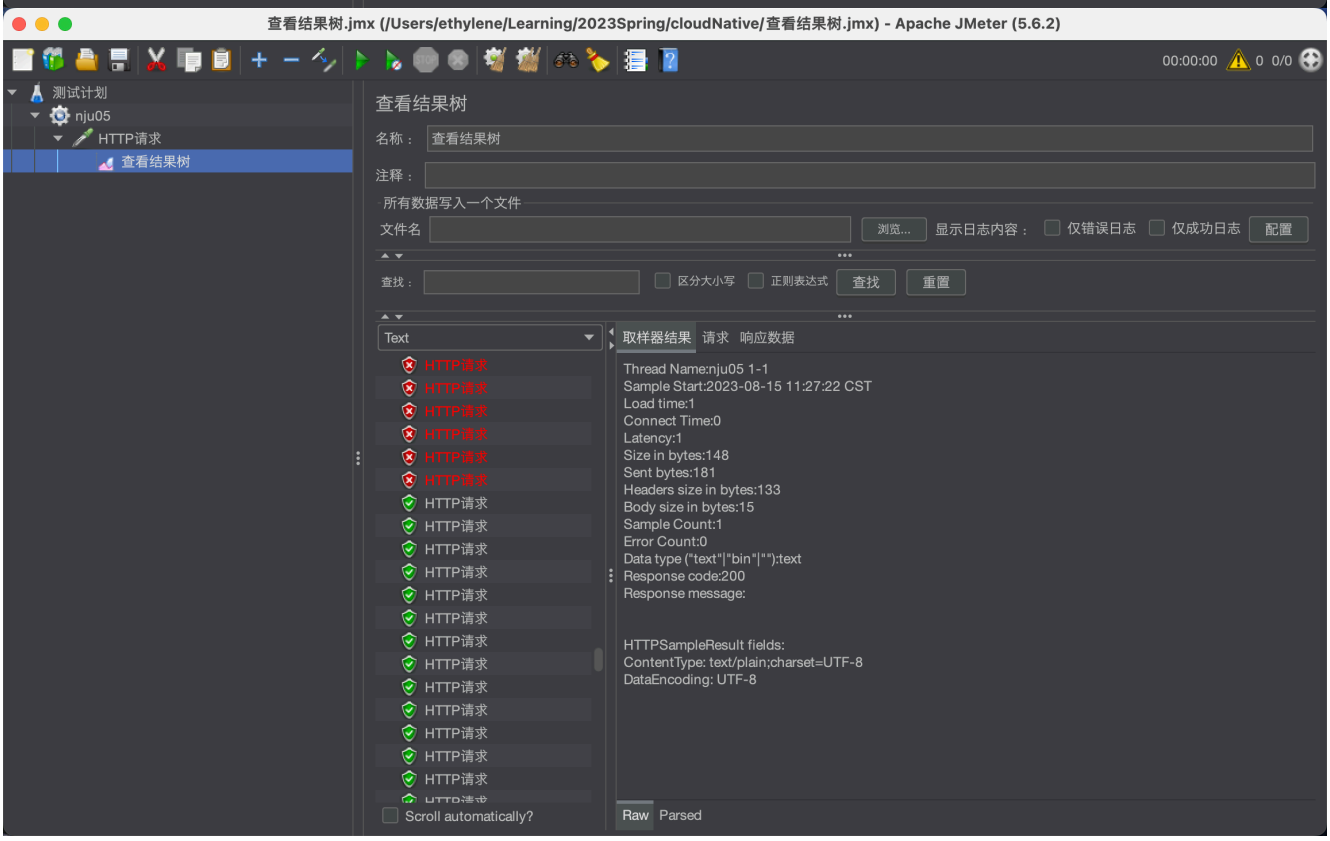
- 在Grafana 中的定制监控应用prometheus-test-demo的各种性能
  - 容器CPU使用情况
  - 容器内存使用情况
  - 网络请求情况
  - 

3.使用压测工具（例如 Jmeter）对接口进压测，在 Grafana 中观察监控数据

- 使用Jmeter，向172.29.4.18:30332/hello 用100个进程同时发送 100个GET请求

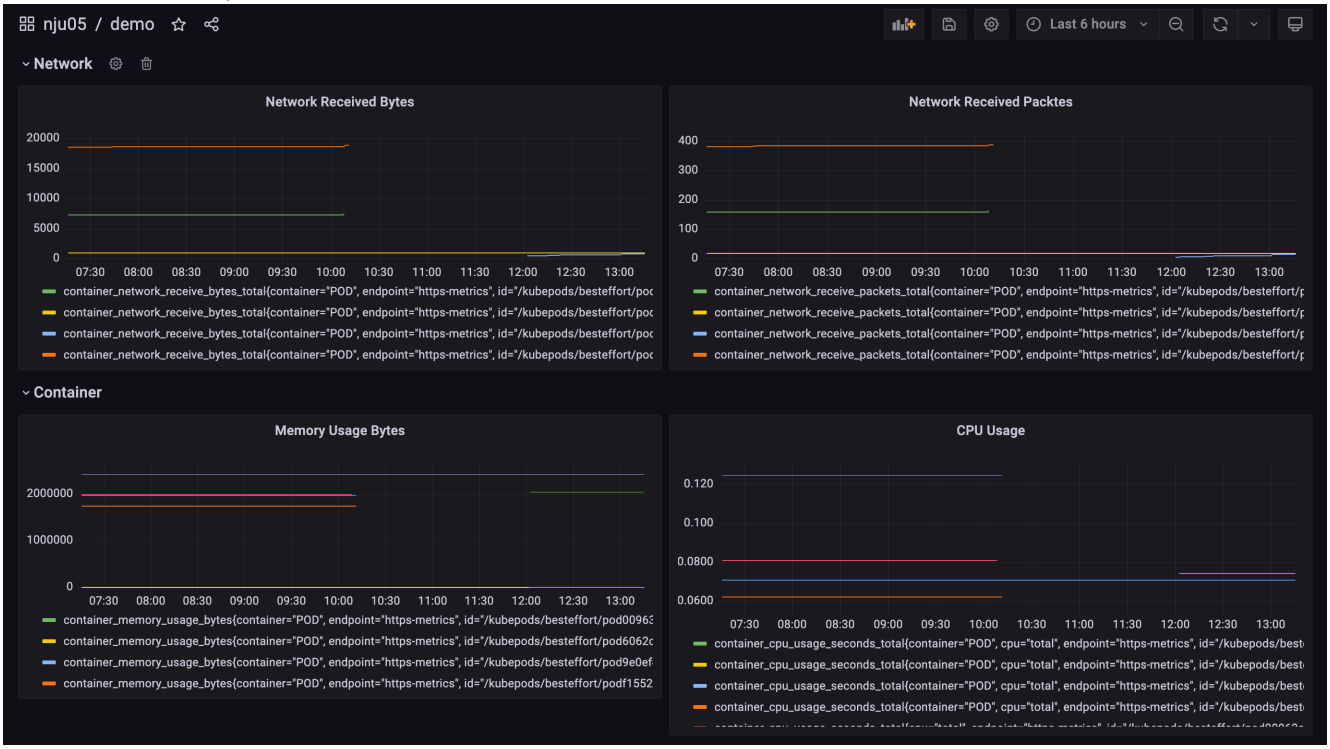
- 配置和结果如下





  - 部分请求错误，证明限流成功

- Grafana 监控应用prometheus-test-demo结果如下，明显可看出变化



4.通过 Kubernetes 命令进行手工扩容，并再次观察 Grafana 中的监控数据

- 命令行扩容发现权限不足，故只能更改yaml文件重新构建流水线

```
ethylene@wangyixideMacBook-Pro prometheus-test-demo % ssh nju05@172.29.4.18
nju05@172.29.4.18's password:
Last login: Tue Aug 15 12:09:07 2023 from 172.29.56.104
-bash: warning: setlocale: LC_CTYPE: cannot change locale (UTF-8): No such file
or directory
[nju05@host-172-29-4-18 ~]$ kubectl get deployment
NAME                   READY   UP-TO-DATE   AVAILABLE   AGE
prometheus-test-demo   0/1     1            0           2d21h
[nju05@host-172-29-4-18 ~]$ kubectl get deployment prometheus-test-demo -n nju05
 -o=jsonpath='{.spec.replicas}'
1[nju05@host-172-29-4-18 ~]$kubectl scale deployment prometheus-test-demo -n nju
05 --replicas=3
Error from server (Forbidden): deployments.apps "prometheus-test-demo" is forbid
den: User "nju05" cannot patch resource "deployments/scale" in API group "apps"
in the namespace "nju05"
[nju05@host-172-29-4-18 ~]$
```

```yaml
# prometheus-test-demo.yaml
apiVersion: apps/v1
kind: Deployment #对象类型
metadata:
  labels:
    app: prometheus-test-demo
  name: prometheus-test-demo
  namespace: nju05
spec:
  replicas: 3 #运行容器的副本数
  selector:
    matchLabels:
      app: prometheus-test-demo
  template:
    metadata:
      annotations:
        prometheus.io/path: /actuator/prometheus
        prometheus.io/port: "8080"
        prometheus.io/scheme: http
        prometheus.io/scrape: "true"
      labels:
        app: prometheus-test-demo
    spec:
```

- 扩容后观察Grafana可见，Cpu和Memory的监控面板新增两个Container的曲线