DevOps Project

Deploying web applications in a multi-cloud environment using CI / CD process

Volodymyr Verholyak
EPAM [OnlineUA] Summer 2020

what I'm trying to solve ?

- How to build a user-friendly CI / CD process?
- How to build an environment for project deployment
- Which technology is most appropriate for the project
- how to make it cheaper
- How to make a high availability service

Used tools and services

Cloud Provider:

Operationtions System:

Automation:

Bucket secret:

Integration:

Containers:

Cluster Manager:

Web Servers:

Build:

Monitoring:

Testing:

Virtualizations:

amazon web services

Google Cloud Platform

ubuntu

CentOS

HashiCorp Terraform

ANSIBLE

Jenkins

docker

kubernetes

HTML 5

Apache Tomcat

GitHub

docker hub

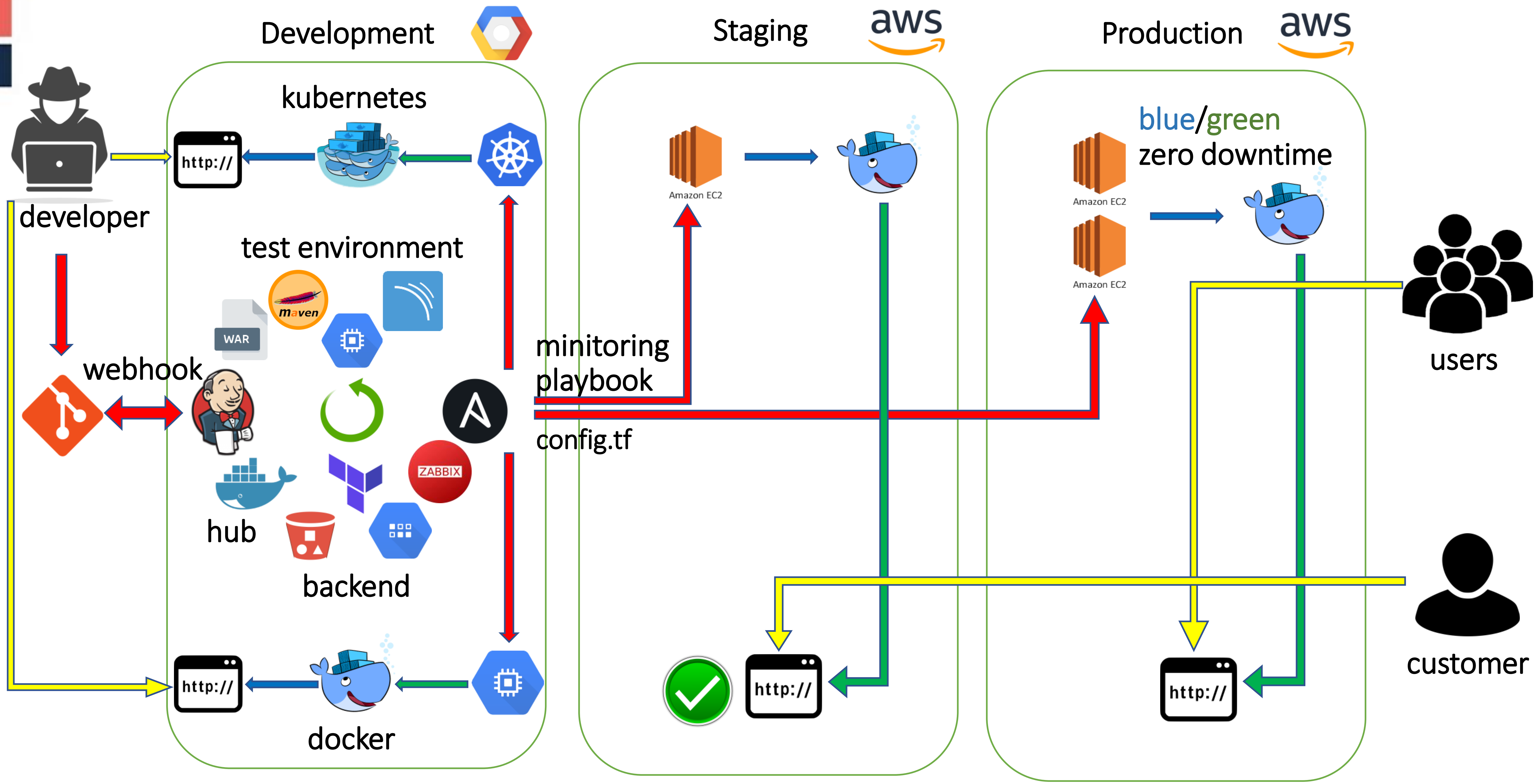
ZABBIX

sonarqube

maven

VirtualBox

CI / CD process



Development

Staging

Production

kubernetes

http://

developer

test environment

webhook

hub

backend

docker

minitoring
playbook

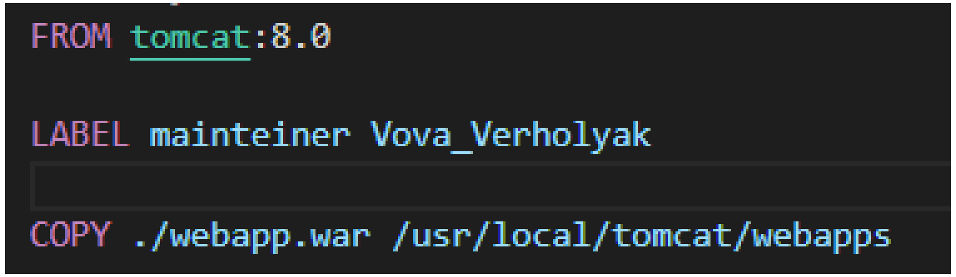
config.tf

blue/green
zero downtime

users

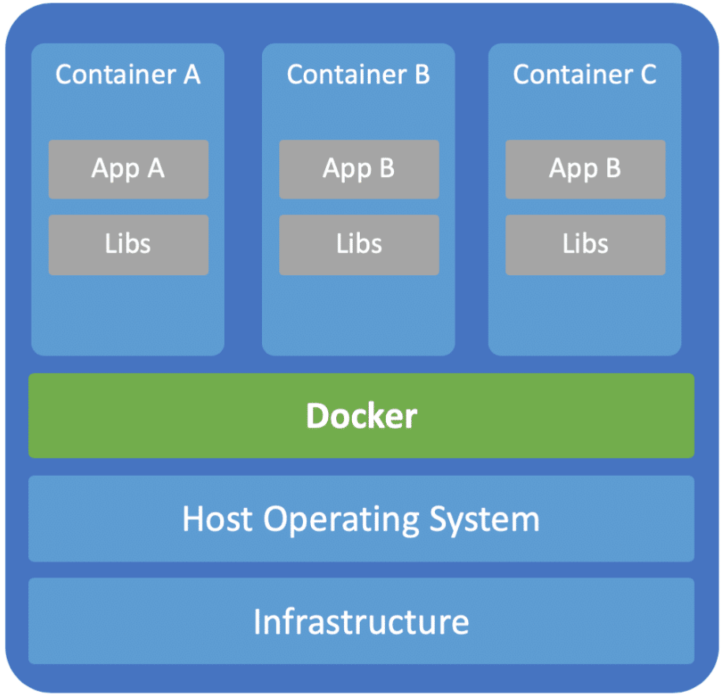
customer

A few words about: Docker Container and VM



```
FROM tomcat:8.0

LABEL mainteiner Vova_Verholyak

COPY ./webapp.war /usr/local/tomcat/webapps
```

Container



Container A
App A
Libs

Container B
App B
Libs

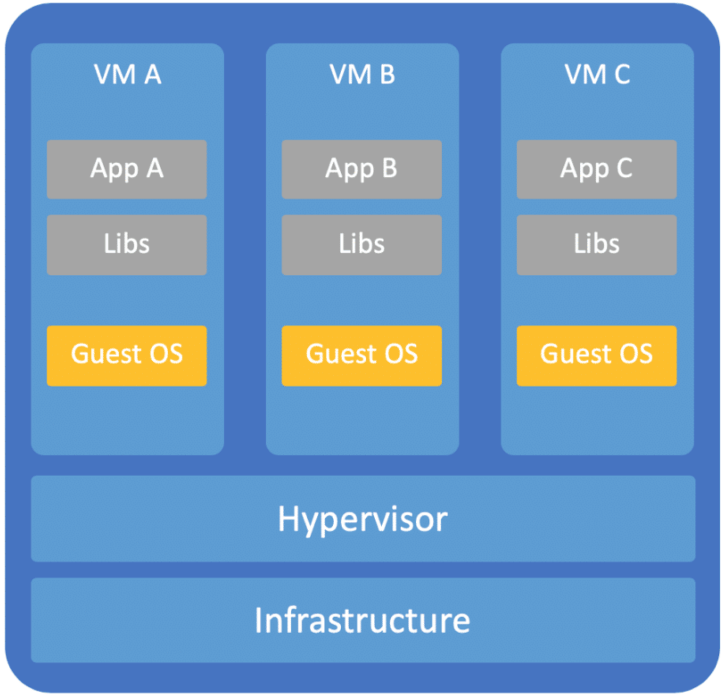
Container C
App B
Libs

Docker

Host Operating System

Infrastructure

Virtual Machines



VM A
App A
Libs
Guest OS

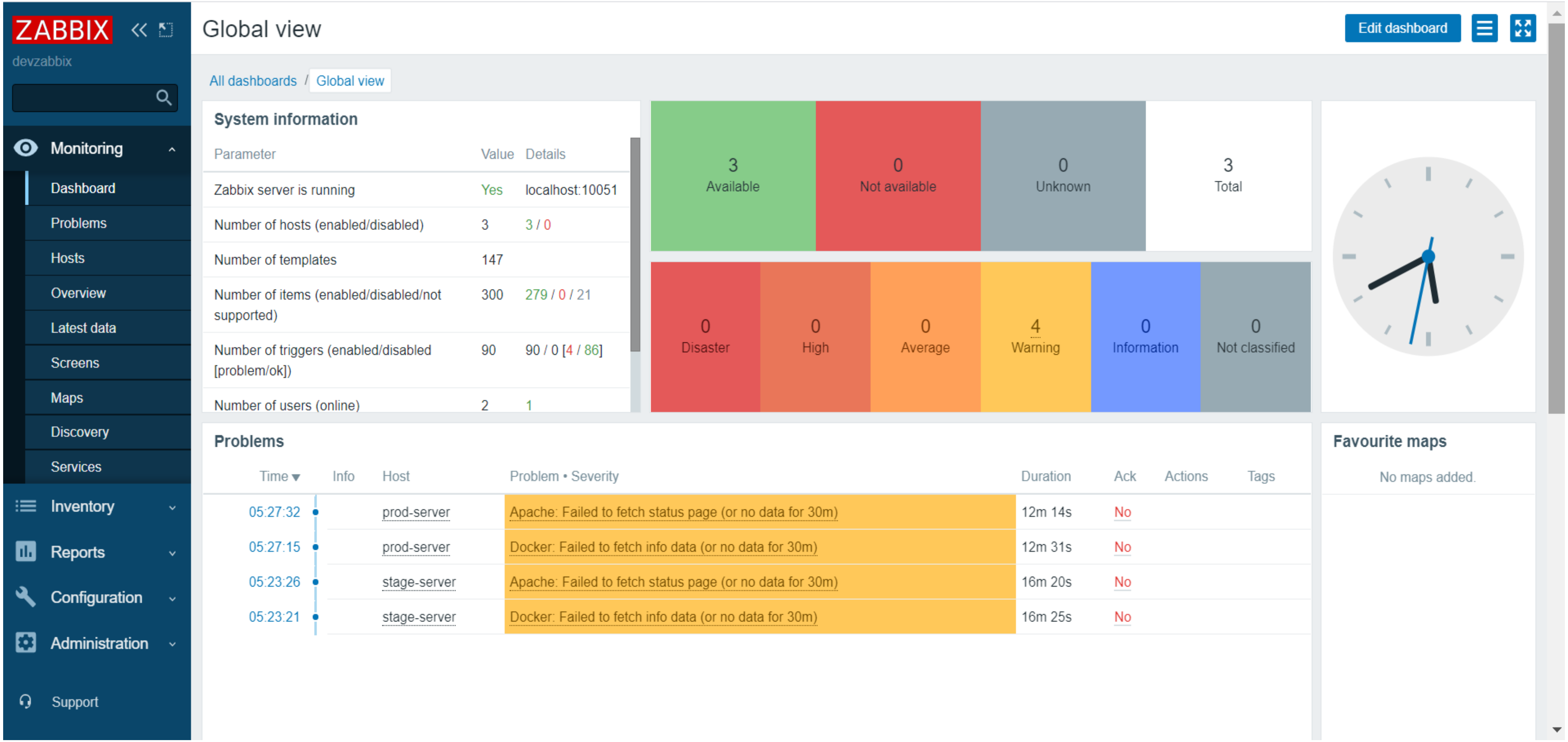
VM B
App B
Libs
Guest OS

VM C
App C
Libs
Guest OS

Hypervisor

Infrastructure

Zabbix monitoring



System information

Parameter	Value	Details
Zabbix server is running	Yes	localhost:10051
Number of hosts (enabled/disabled)	3	3 / 0
Number of templates	147	
Number of items (enabled/disabled/not supported)	300	279 / 0 / 21
Number of triggers (enabled/disabled [problem/ok])	90	90 / 0 [4 / 86]
Number of users (online)	2	1

3 Available	0 Not available	0 Unknown	3 Total

0 Disaster	0 High	0 Average	4 Warning	0 Information	0 Not classified

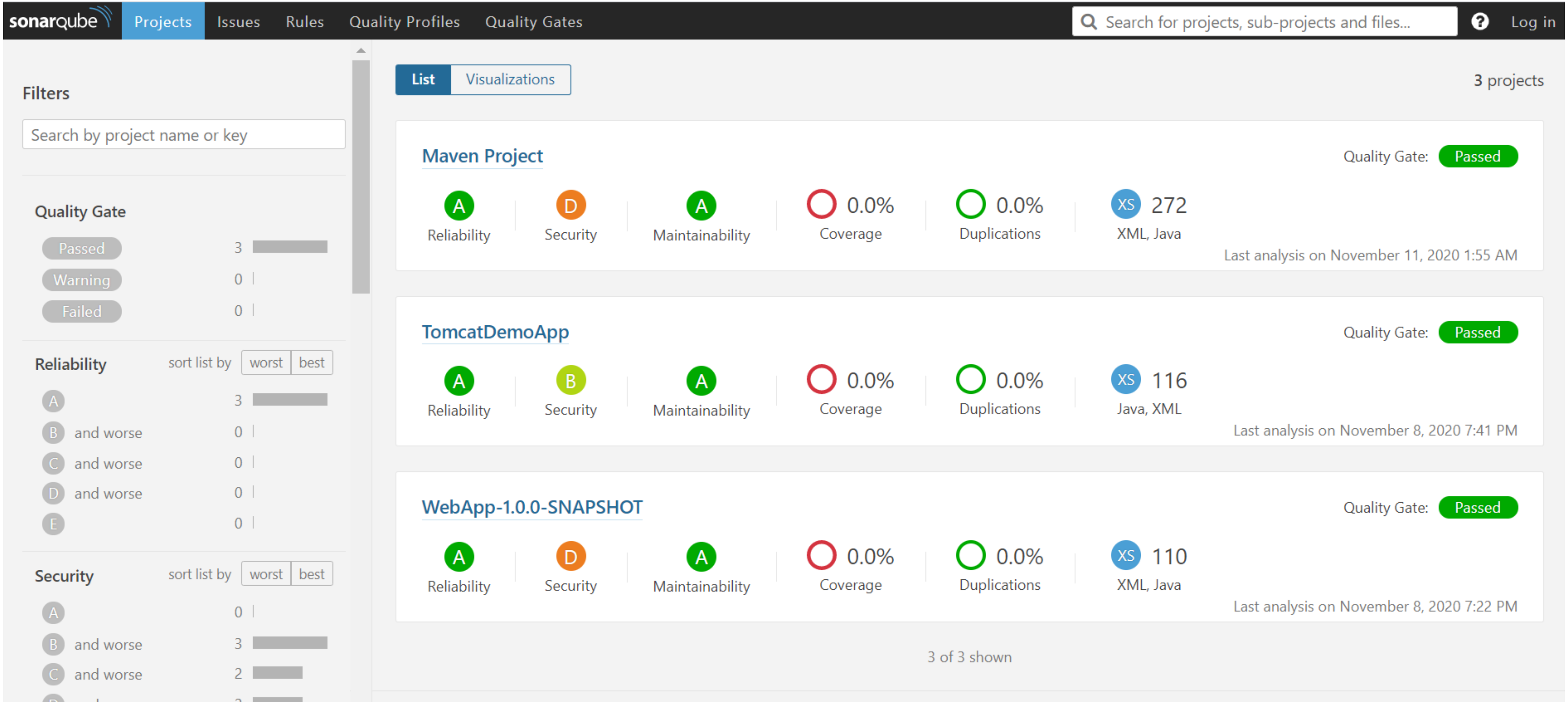
Problems

Time ▾	Info	Host	Problem • Severity	Duration	Ack	Actions	Tags
05:27:32		prod-server	Apache: Failed to fetch status page (or no data for 30m)	12m 14s	No		
05:27:15		prod-server	Docker: Failed to fetch info data (or no data for 30m)	12m 31s	No		
05:23:26		stage-server	Apache: Failed to fetch status page (or no data for 30m)	16m 20s	No		
05:23:21		stage-server	Docker: Failed to fetch info data (or no data for 30m)	16m 25s	No		

Favourite maps

No maps added.

SonarQube test



3 projects

Filters

Search by project name or key

Quality Gate

Passed	3	
Warning	0	
Failed	0	

Reliability sort list by worst best

A		3
B	and worse	0
C	and worse	0
D	and worse	0
E		0

Security sort list by worst best

A		0
B	and worse	3
C	and worse	2

Maven Project Quality Gate: Passed

Reliability	Security	Maintainability	Coverage	Duplications	XML, Java
A	D	A	0.0%	0.0%	XS 272

Last analysis on November 11, 2020 1:55 AM

TomcatDemoApp Quality Gate: Passed

Reliability	Security	Maintainability	Coverage	Duplications	Java, XML
A	B	A	0.0%	0.0%	XS 116

Last analysis on November 8, 2020 7:41 PM

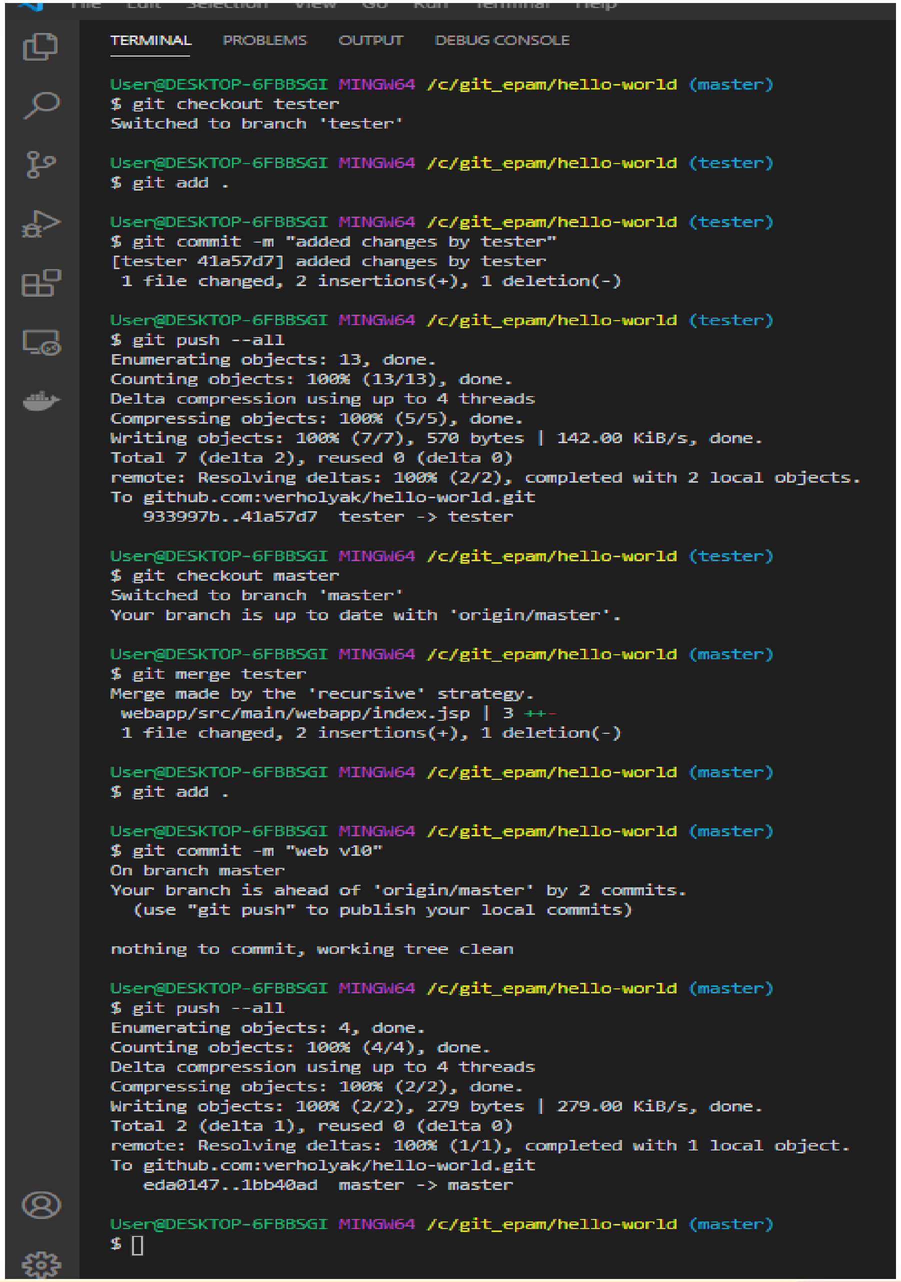
WebApp-1.0.0-SNAPSHOT Quality Gate: Passed

Reliability	Security	Maintainability	Coverage	Duplications	XML, Java
A	D	A	0.0%	0.0%	XS 110

Last analysis on November 8, 2020 7:22 PM

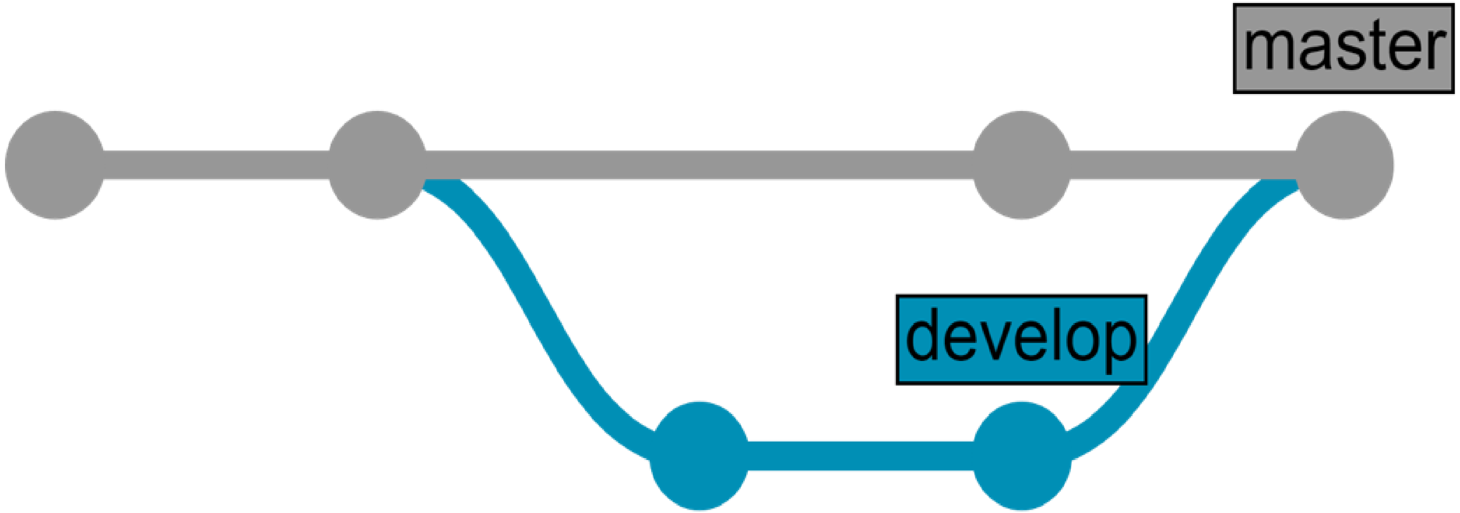
3 of 3 shown

Step 1. Deploy code or changes



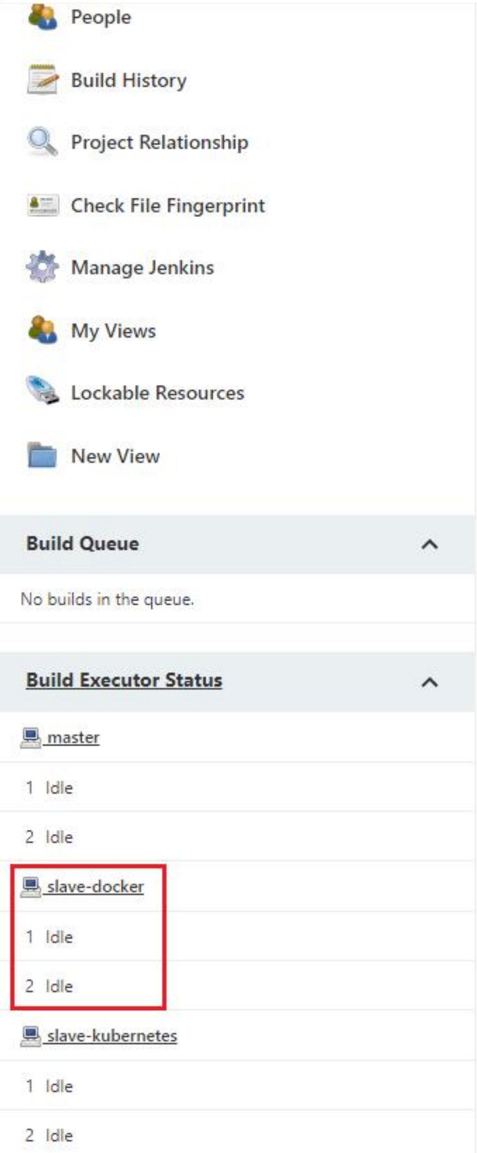
```
User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (master)
$ git checkout tester
Switched to branch 'tester'

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (tester)
$ git add .

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (tester)
$ git commit -m "added changes by tester"
[tester 41a57d7] added changes by tester
 1 file changed, 2 insertions(+), 1 deletion(-)

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (tester)
$ git push --all
Enumerating objects: 13, done.
Counting objects: 100% (13/13), done.
Delta compression using up to 4 threads
Compressing objects: 100% (5/5), done.
Writing objects: 100% (7/7), 570 bytes | 142.00 KiB/s, done.
Total 7 (delta 2), reused 0 (delta 0)
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To github.com:verholyak/hello-world.git
   933997b..41a57d7  tester -> tester

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (tester)
$ git checkout master
Switched to branch 'master'
Your branch is up to date with 'origin/master'.

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (master)
$ git merge tester
Merge made by the 'recursive' strategy.
 webapp/src/main/webapp/index.jsp | 3 ++-
 1 file changed, 2 insertions(+), 1 deletion(-)

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (master)
$ git add .

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (master)
$ git commit -m "web v10"
On branch master
Your branch is ahead of 'origin/master' by 2 commits.
  (use "git push" to publish your local commits)

nothing to commit, working tree clean

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (master)
$ git push --all
Enumerating objects: 4, done.
Counting objects: 100% (4/4), done.
Delta compression using up to 4 threads
Compressing objects: 100% (2/2), done.
Writing objects: 100% (2/2), 279 bytes | 279.00 KiB/s, done.
Total 2 (delta 1), reused 0 (delta 0)
remote: Resolving deltas: 100% (1/1), completed with 1 local object.
To github.com:verholyak/hello-world.git
   eda0147..1bb40ad  master -> master

User@DESKTOP-6FBBSGI MINGW64 /c/git_epam/hello-world (master)
$ 
```

Developer wants to make some changes to the code and he wants to see the changes → let's start !!!



Webhook to Jenkins →

Step 2. Deploy to Docker Dev-Server using Ansible playbook



- People
- Build History
- Project Relationship
- Check File Fingerprint
- Manage Jenkins
- My Views
- Lockable Resources
- New View

Build Queue

No builds in the queue.

Build Executor Status

master

1 Idle

2 Idle

slave-docker

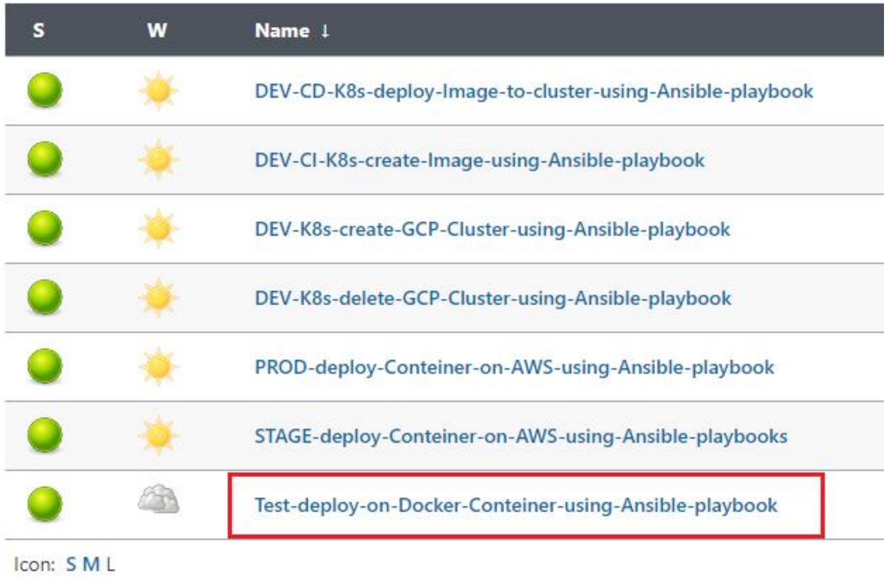
1 Idle

2 Idle

slave-kubernetes

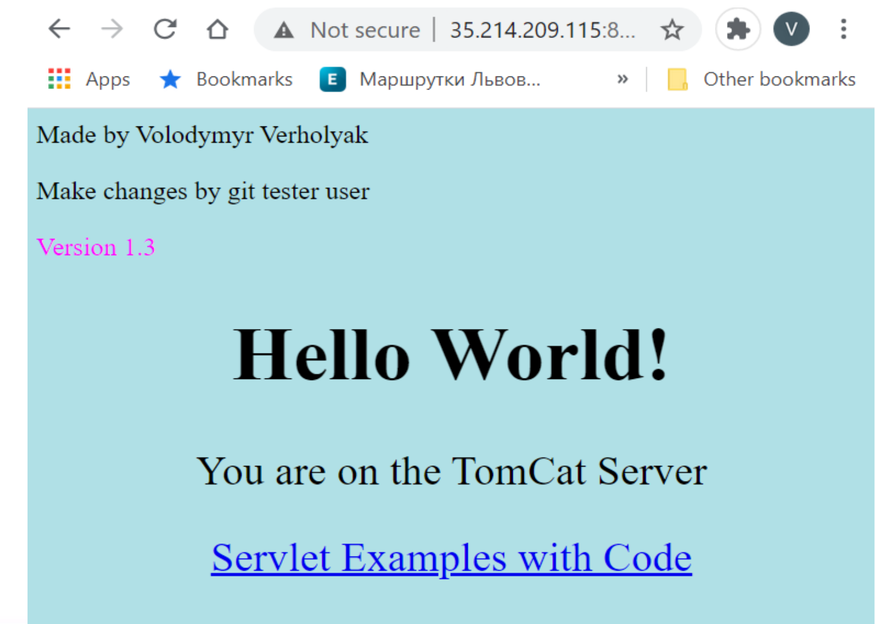
1 Idle

2 Idle



S	W	Name ↓
●	☀	DEV-CD-K8s-deploy-Image-to-cluster-using-Ansible-playbook
●	☀	DEV-CI-K8s-create-Image-using-Ansible-playbook
●	☀	DEV-K8s-create-GCP-Cluster-using-Ansible-playbook
●	☀	DEV-K8s-delete-GCP-Cluster-using-Ansible-playbook
●	☀	PROD-deploy-Conteiner-on-AWS-using-Ansible-playbook
●	☀	STAGE-deploy-Conteiner-on-AWS-using-Ansible-playbooks
●	☁	Test-deploy-on-Docker-Conteiner-using-Ansible-playbook

Icon: S M L



Made by Volodymyr Verholyak

Make changes by git tester user

Version 1.3

Hello World!

You are on the TomCat Server

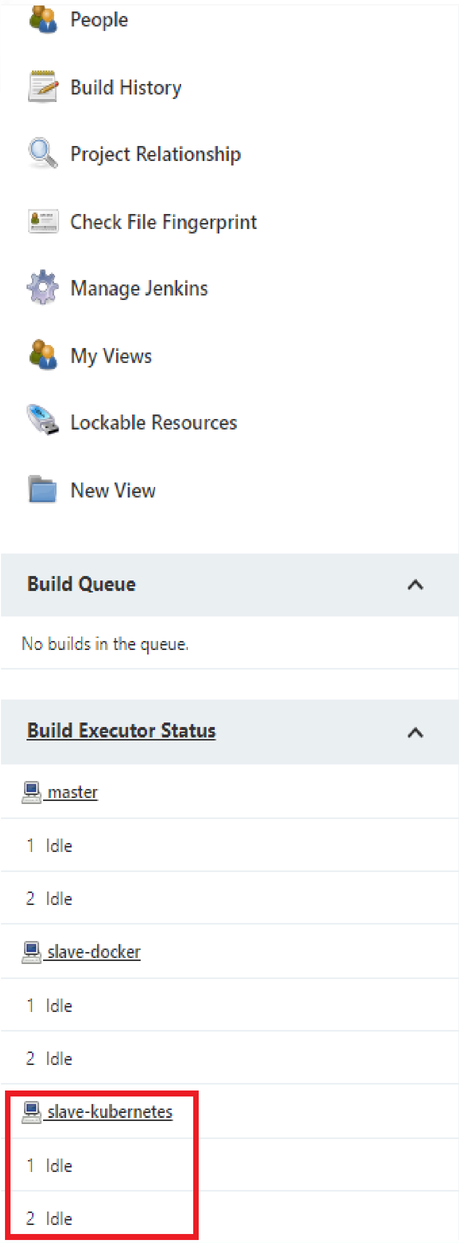
Servlet Examples with Code

what I used here:

- GitHub webhook and services ngrok
- Maven, SonarQube test
- Create artifact “webapp.war” file
- Ansible playbook, create image and push to DockerHub repository
- Ansible playbook, deploy image from DockerHub repository to Dev-Server
- Use GCP cloud provider
- http://35.214.209.115:8081/webapp/

Deploy to Kubernetes →

Step 3. Deploy changes to Kubernetes from Jenkins job (manual)



- People
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No builds in the queue.

Build Executor Status

master

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2 Idle

slave-docker

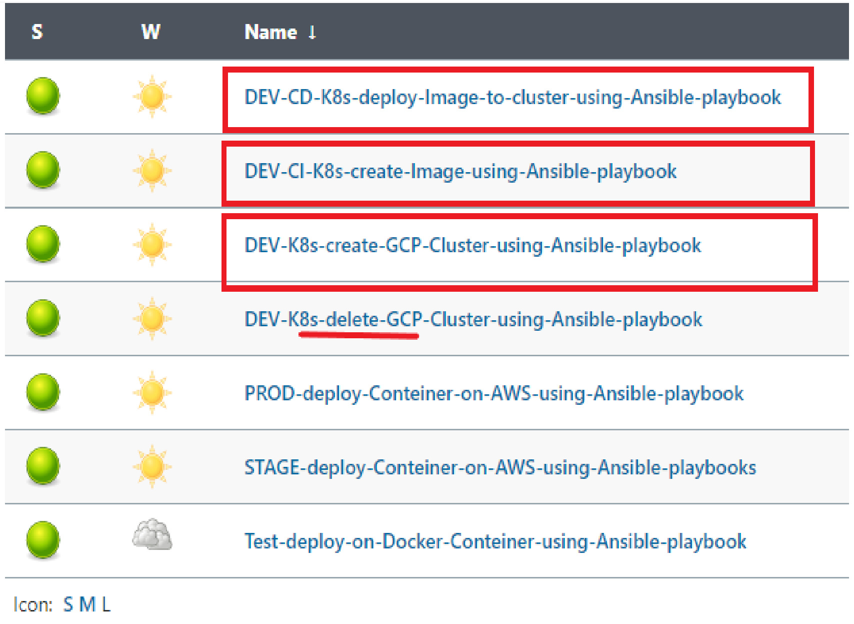
1 Idle

2 Idle

slave-kubernetes

1 Idle

2 Idle



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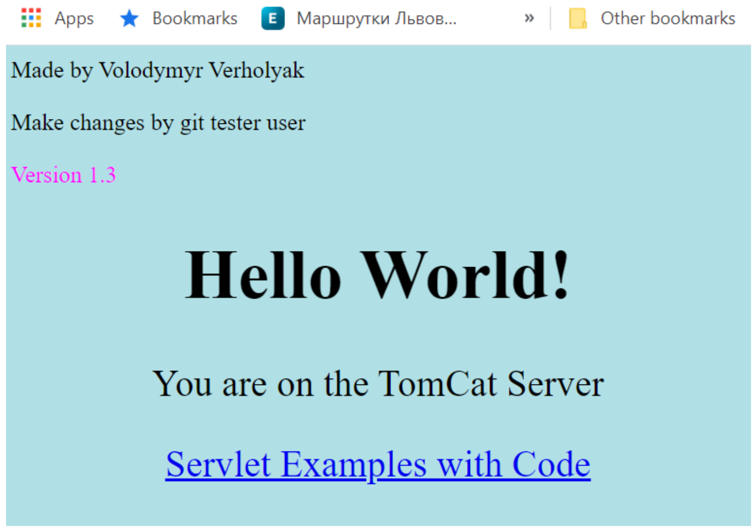
Icon: S M L



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Make changes by git tester user

Version 1.3

Hello World!

You are on the TomCat Server

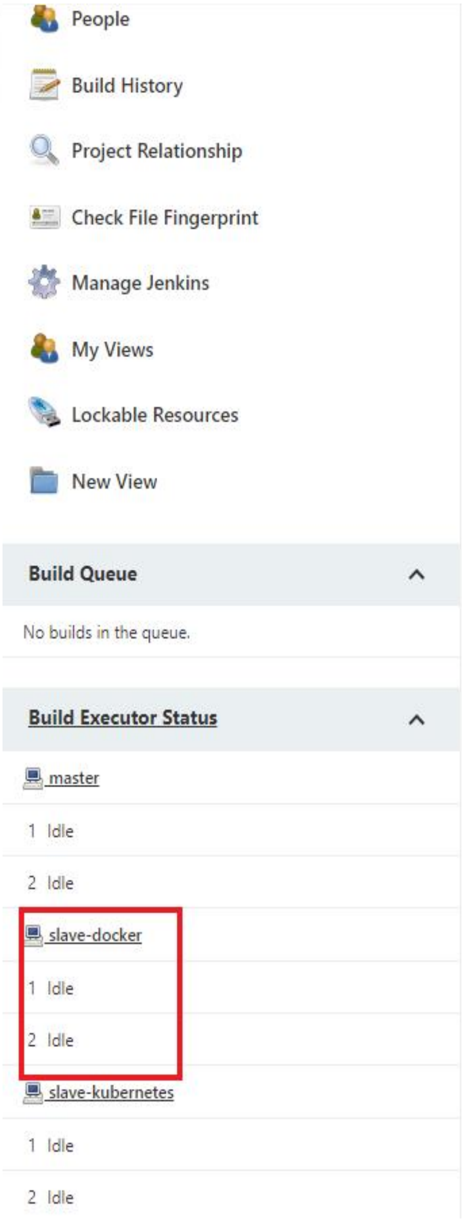
Servlet Examples with Code

what I used here:

- Maven, SonarQube test
- Create artifact “webapp.war” file
- Ansible playbook, create Kubernetes Cluster, using parameters
- Ansible playbook, create image and push to DockerHub repository
- Ansible playbook, deploy image from DockerHub repository to Kubernetes Cluster using yaml config
- Use GCP cloud provider
- http://35.204.36.248:8081/webapp/

Deploy to STAG using Jenkins →

Step 3. Deploy to STAGE WebServer using Jenkins job (manual)



Build Queue

No builds in the queue.

Build Executor Status

master

1 Idle

2 Idle

slave-docker

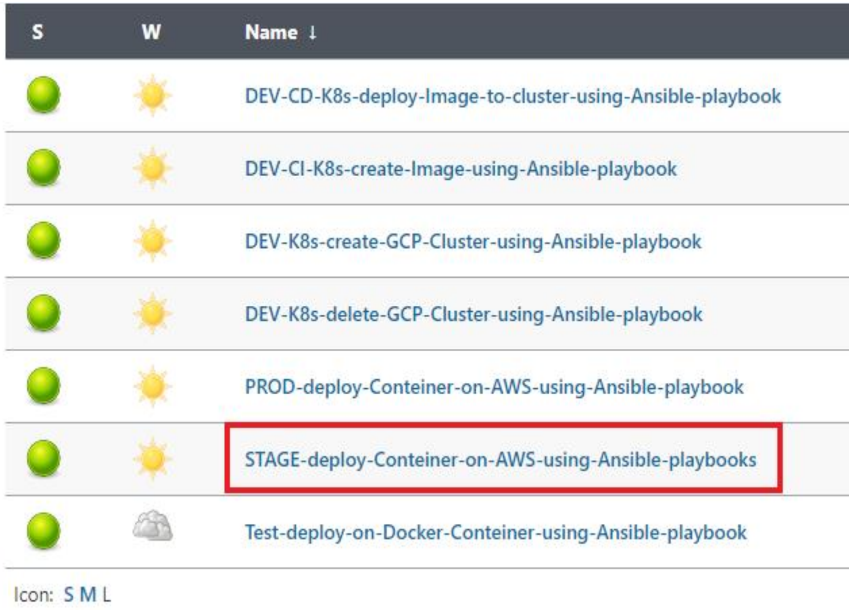
1 Idle

2 Idle

slave-kubernetes

1 Idle

2 Idle



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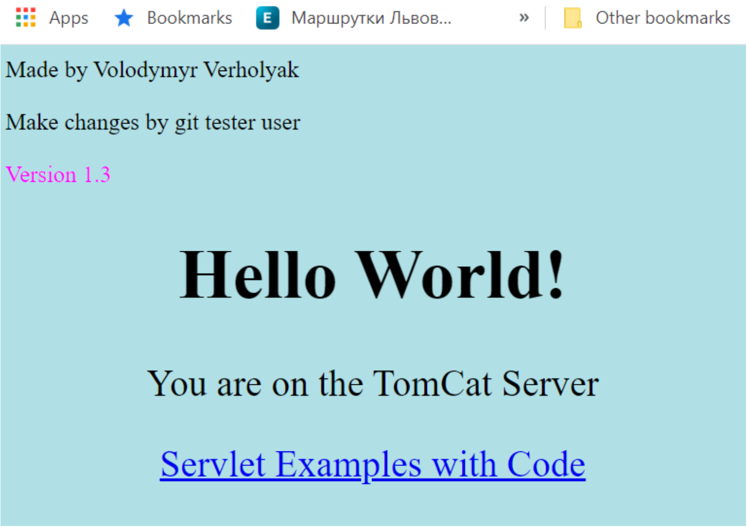
●	☀	STAGE-deploy-Conteiner-on-AWS-using-Ansible-playbooks
●	☁	Test-deploy-on-Docker-Conteiner-using-Ansible-playbook



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Make changes by git tester user

Version 1.3

Hello World!

You are on the TomCat Server

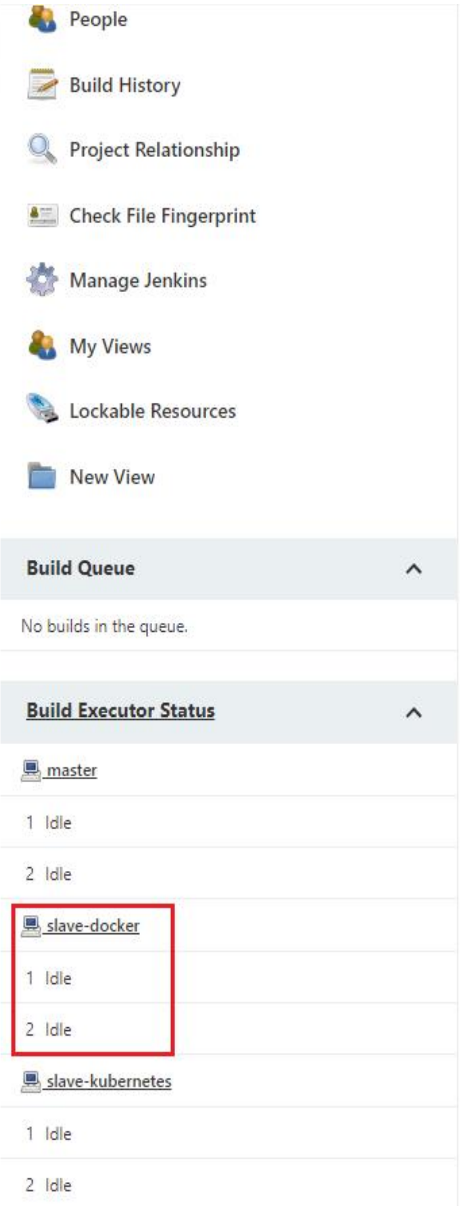
Servlet Examples with Code

what I used here:

- Maven, SonarQube test
- Create artifact “webapp.war” file
- Ansible playbook, create image and push to DockerHub repository
- Ansible playbook, deploy image from DockerHub repository to STAGE-Server
- Use AWS cloud provider
- http://18.198.63.214:8081/webapp/

Deploy to PROD using Jenkins →

Step 4. Deploy to PROD WebServer using Jenkins job (manual)



Build Queue

No builds in the queue.

Build Executor Status

master

1 Idle

2 Idle

slave-docker

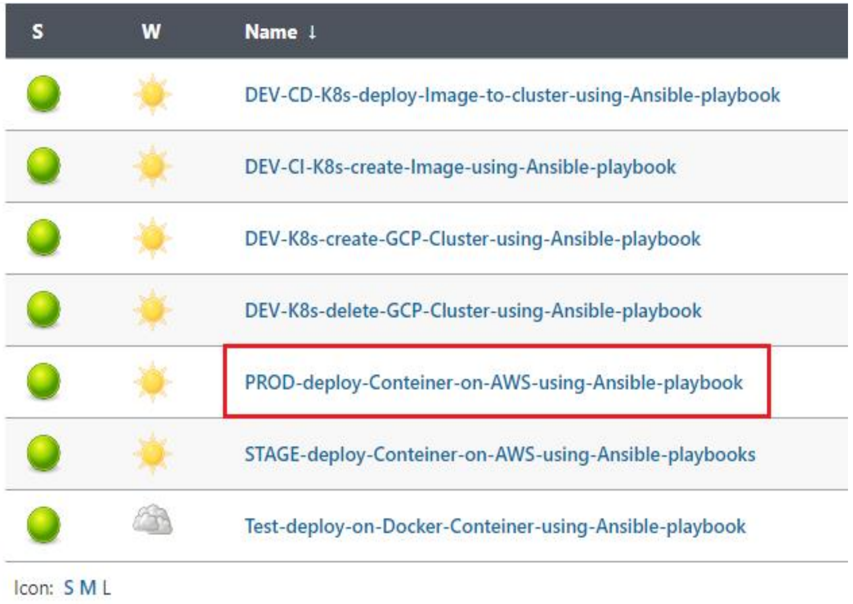
1 Idle

2 Idle

slave-kubernetes

1 Idle

2 Idle



S	W	Name ↓
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●	☀	DEV-CI-K8s-create-Image-using-Ansible-playbook
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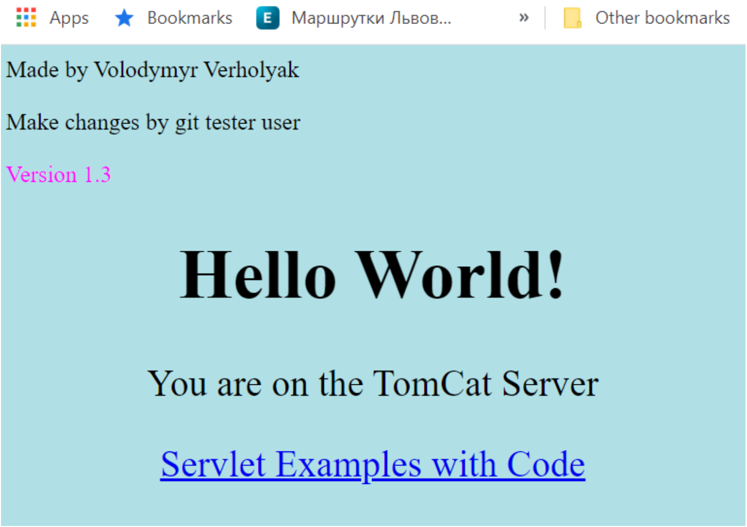
●	☁	Test-deploy-on-Docker-Conteiner-using-Ansible-playbook

Icon: S M L



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Make changes by git tester user

Version 1.3

Hello World!

You are on the TomCat Server

Servlet Examples with Code

what I used here:

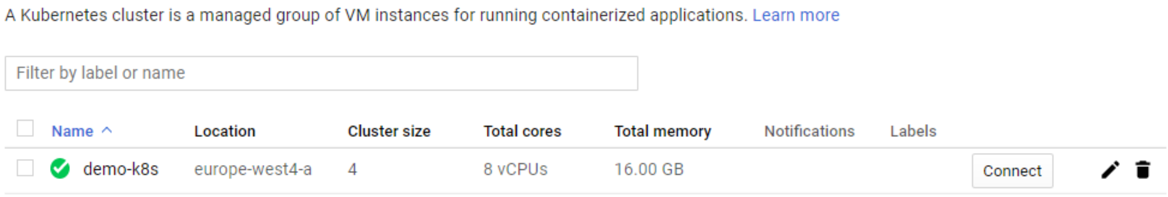
- Maven, SonarQube test
- Create artifact “webapp.war” file
- Ansible playbook, deploy image from DockerHub repository to STAGE-Server
- Use AWS cloud provider
- http://18.159.26.114:8081/webapp/

Deploy to DEV using Jenkins →

developer, customer and users are happy because their service works well :)

Infrastructure in pictures

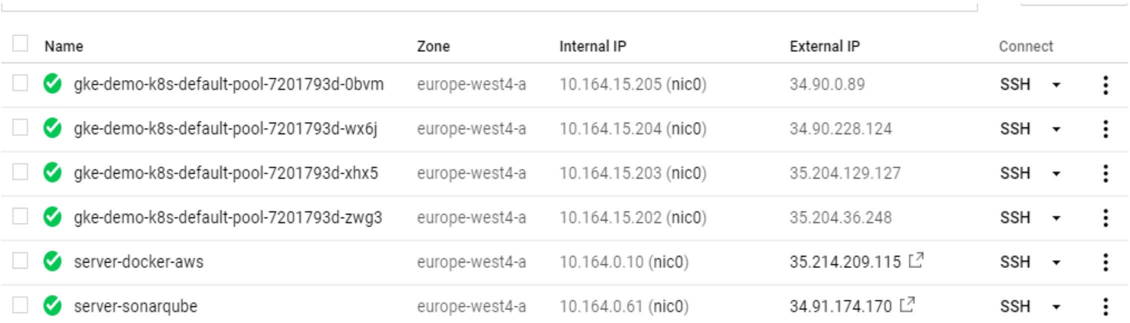
Google Cloud Platform



A Kubernetes cluster is a managed group of VM instances for running containerized applications. Learn more

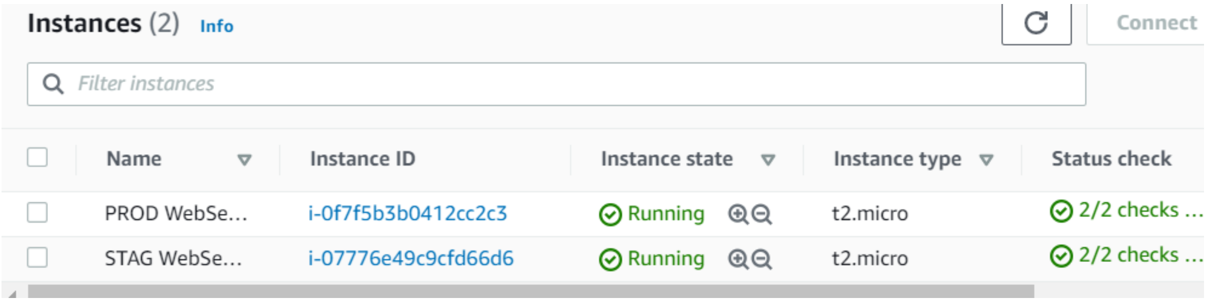
Filter by label or name

□	Name ^	Location	Cluster size	Total cores	Total memory	Notifications	Labels		
□	✓ demo-k8s	europe-west4-a	4	8 vCPUs	16.00 GB			Connect	



□	Name	Zone	Internal IP	External IP	Connect
□	✓ gke-demo-k8s-default-pool-7201793d-0bvm	europe-west4-a	10.164.15.205 (nic0)	34.90.0.89	SSH ▾
□	✓ gke-demo-k8s-default-pool-7201793d-wx6j	europe-west4-a	10.164.15.204 (nic0)	34.90.228.124	SSH ▾
□	✓ gke-demo-k8s-default-pool-7201793d-xhx5	europe-west4-a	10.164.15.203 (nic0)	35.204.129.127	SSH ▾
□	✓ gke-demo-k8s-default-pool-7201793d-zwg3	europe-west4-a	10.164.15.202 (nic0)	35.204.36.248	SSH ▾
□	✓ server-docker-aws	europe-west4-a	10.164.0.10 (nic0)	35.214.209.115	SSH ▾
□	✓ server-sonarqube	europe-west4-a	10.164.0.61 (nic0)	34.91.174.170	SSH ▾

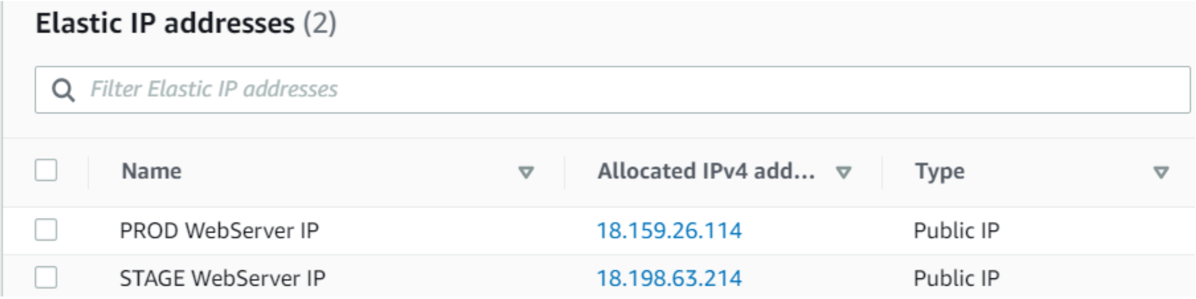
amazon web services



Instances (2) Info

Filter instances

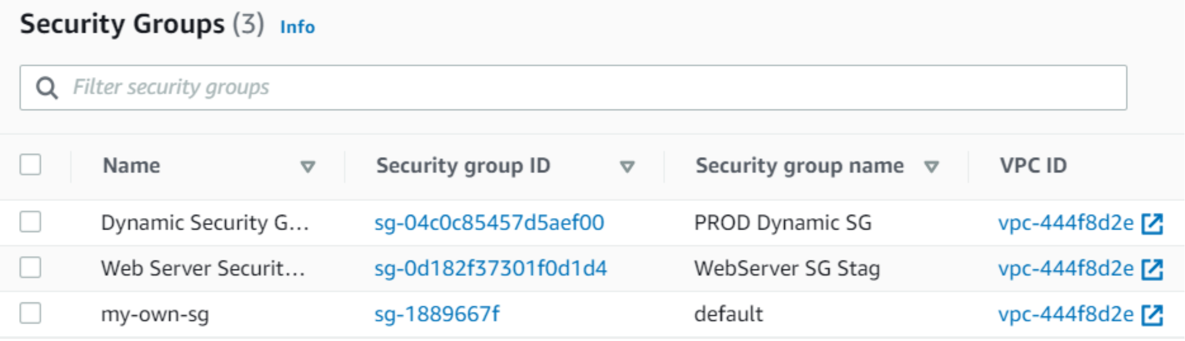
□	Name	Instance ID	Instance state	Instance type	Status check
□	PROD WebSe...	i-0f7f5b3b0412cc2c3	✓ Running	t2.micro	✓ 2/2 checks ...
□	STAG WebSe...	i-07776e49c9cfd66d6	✓ Running	t2.micro	✓ 2/2 checks ...



Elastic IP addresses (2)

Filter Elastic IP addresses

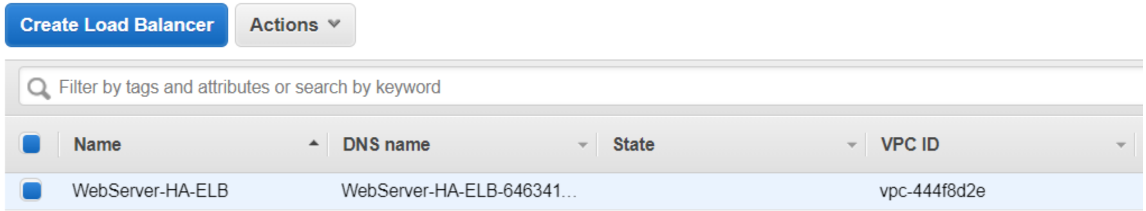
□	Name	Allocated IPv4 add...	Type
□	PROD WebServer IP	18.159.26.114	Public IP
□	STAGE WebServer IP	18.198.63.214	Public IP



Security Groups (3) Info

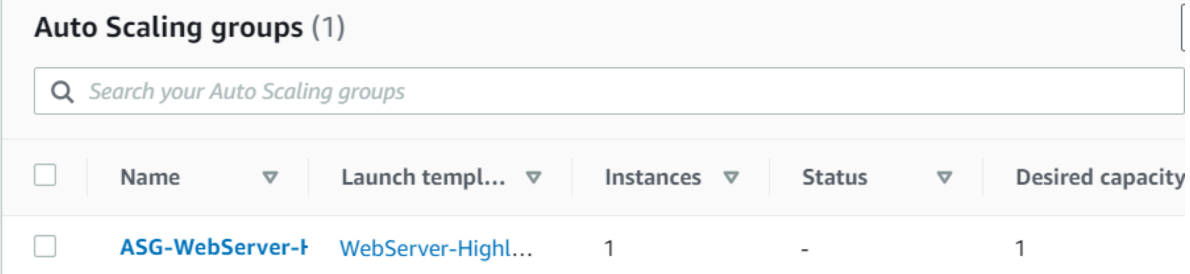
Filter security groups

□	Name	Security group ID	Security group name	VPC ID
□	Dynamic Security G...	sg-04c0c85457d5aef00	PROD Dynamic SG	vpc-444f8d2e
□	Web Server Securit...	sg-0d182f37301f0d1d4	WebServer SG Stag	vpc-444f8d2e
□	my-own-sg	sg-1889667f	default	vpc-444f8d2e



Filter by tags and attributes or search by keyword

■	Name	DNS name	State	VPC ID
■	WebServer-HA-ELB	WebServer-HA-ELB-646341...		vpc-444f8d2e

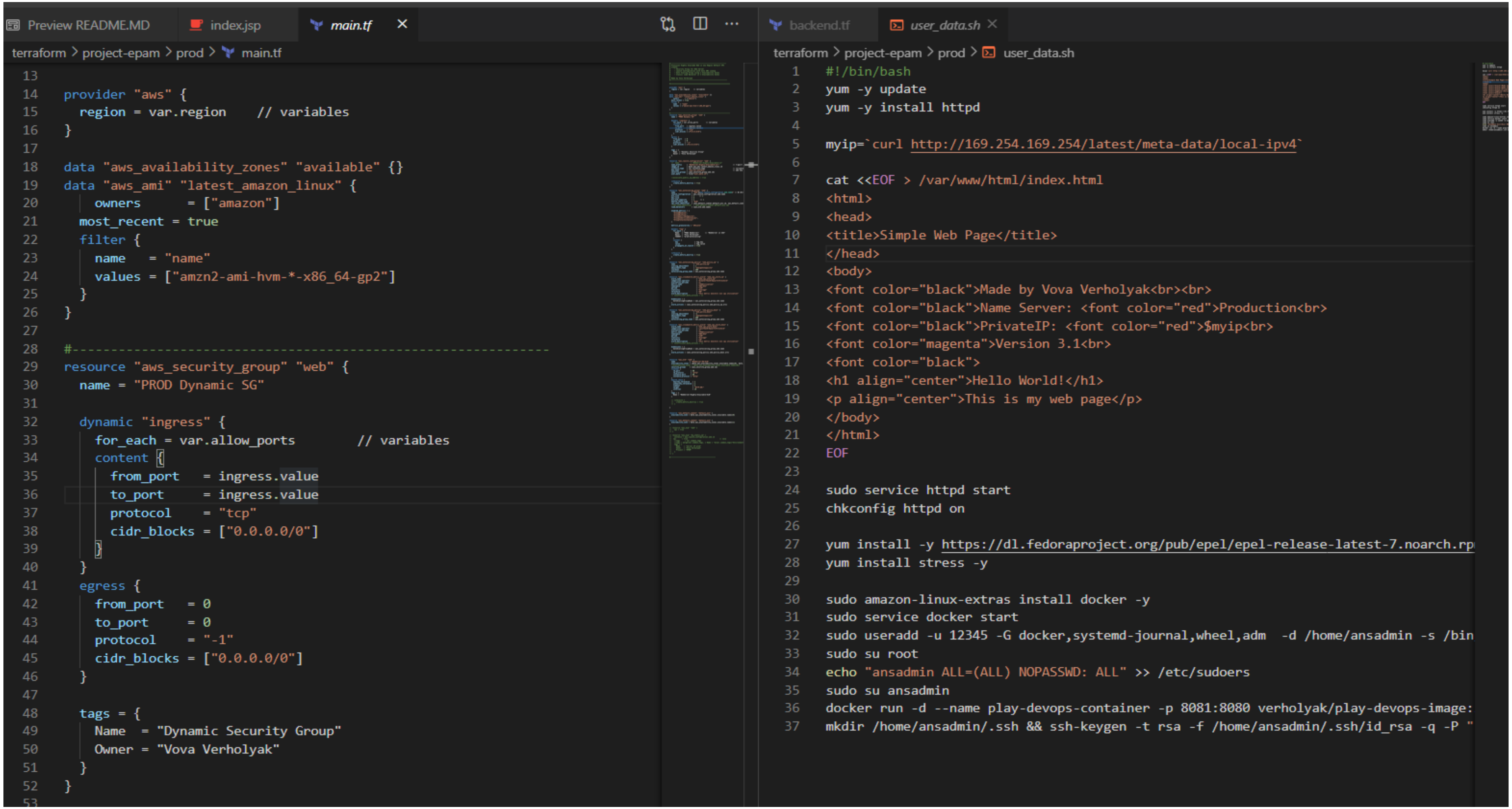


Auto Scaling groups (1)

Search your Auto Scaling groups

□	Name	Launch templ...	Instances	Status	Desired capacity
□	ASG-WebServer-H	WebServer-Highl...	1	-	1

Terraform: infrastructure as code

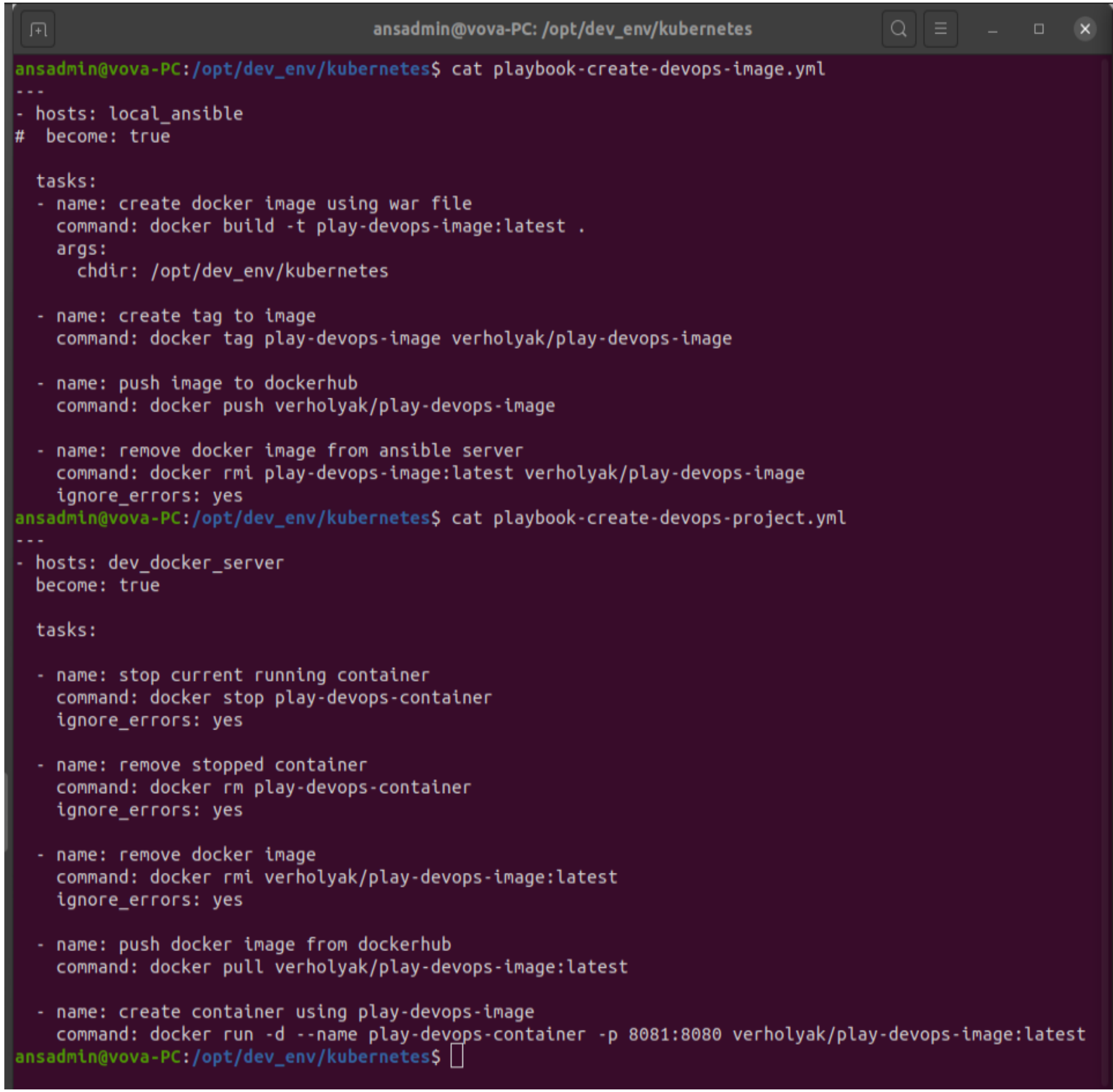

Preview README.MD
index.jsp
main.tf
terraform > project-epam > prod > main.tf
backend.tf
user_data.sh
terraform > project-epam > prod > user_data.sh

```
provider "aws" {
  region = var.region    // variables
}

data "aws_availability_zones" "available" {}
data "aws_ami" "latest_amazon_linux" {
    owners      = ["amazon"]
  most_recent = true
  filter {
    name   = "name"
    values = ["amzn2-ami-hvm-*-x86_64-gp2"]
  }
}

#-------------------------------------------------------------
resource "aws_security_group" "web" {
  name = "PROD Dynamic SG"

  dynamic "ingress" {
    for_each = var.allow_ports        // variables
    content {
      from_port   = ingress.value
      to_port     = ingress.value
      protocol    = "tcp"
      cidr_blocks = ["0.0.0.0/0"]
    }
  }
  egress {
    from_port   = 0
    to_port     = 0
    protocol    = "-1"
    cidr_blocks = ["0.0.0.0/0"]
  }

  tags = {
    Name  = "Dynamic Security Group"
    Owner = "Vova Verholyak"
  }
}
```

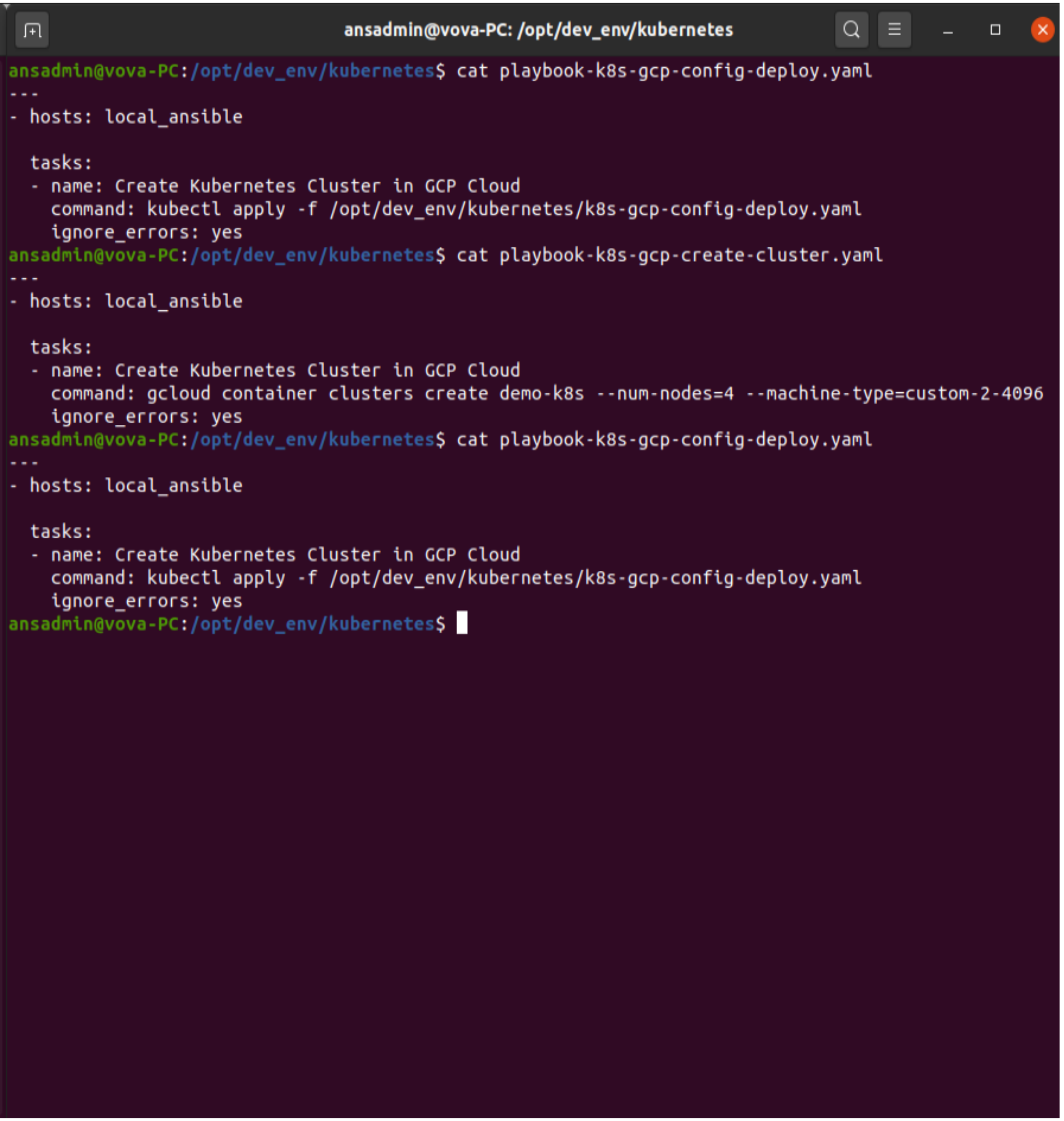
```
#!/bin/bash
yum -y update
yum -y install httpd

myip=`curl http://169.254.169.254/latest/meta-data/local-ipv4`

cat <<EOF > /var/www/html/index.html
<html>
<head>
<title>Simple Web Page</title>
</head>
<body>
<font color="black">Made by Vova Verholyak<br><br>
<font color="black">Name Server: <font color="red">Production<br>
<font color="black">PrivateIP: <font color="red">$myip<br>
<font color="magenta">Version 3.1<br>
<font color="black">
<h1 align="center">Hello World!</h1>
<p align="center">This is my web page</p>
</body>
</html>
EOF

sudo service httpd start
chkconfig httpd on

yum install -y https://dl.fedoraproject.org/pub/epel/epel-release-latest-7.noarch.rp
yum install stress -y

sudo amazon-linux-extras install docker -y
sudo service docker start
sudo useradd -u 12345 -G docker,systemd-journal,wheel,adm  -d /home/ansadmin -s /bin
sudo su root
echo "ansadmin ALL=(ALL) NOPASSWD: ALL" >> /etc/sudoers
sudo su ansadmin
docker run -d --name play-devops-container -p 8081:8080 verholyak/play-devops-image:
mkdir /home/ansadmin/.ssh && ssh-keygen -t rsa -f /home/ansadmin/.ssh/id_rsa -q -P "
```

This is only a part of the code, you can see the whole project source code in my private repository by following the link: https://github.com/verholyak/Epam_External_Project

Ansible playbook



```
ansadmin@vova-PC:/opt/dev_env/kubernetes$ cat playbook-create-devops-image.yml
---
- hosts: local_ansible
#  become: true

  tasks:
  - name: create docker image using war file
    command: docker build -t play-devops-image:latest .
    args:
      chdir: /opt/dev_env/kubernetes

  - name: create tag to image
    command: docker tag play-devops-image verholyak/play-devops-image

  - name: push image to dockerhub
    command: docker push verholyak/play-devops-image

  - name: remove docker image from ansible server
    command: docker rmi play-devops-image:latest verholyak/play-devops-image
    ignore_errors: yes
ansadmin@vova-PC:/opt/dev_env/kubernetes$ cat playbook-create-devops-project.yml
---
- hosts: dev_docker_server
  become: true

  tasks:

  - name: stop current running container
    command: docker stop play-devops-container
    ignore_errors: yes

  - name: remove stopped container
    command: docker rm play-devops-container
    ignore_errors: yes

  - name: remove docker image
    command: docker rmi verholyak/play-devops-image:latest
    ignore_errors: yes

  - name: push docker image from dockerhub
    command: docker pull verholyak/play-devops-image:latest

  - name: create container using play-devops-image
    command: docker run -d --name play-devops-container -p 8081:8080 verholyak/play-devops-image:latest
ansadmin@vova-PC:/opt/dev_env/kubernetes$
```



```
ansadmin@vova-PC:/opt/dev_env/kubernetes$ cat playbook-k8s-gcp-config-deploy.yaml
---
- hosts: local_ansible

  tasks:
  - name: Create Kubernetes Cluster in GCP Cloud
    command: kubectl apply -f /opt/dev_env/kubernetes/k8s-gcp-config-deploy.yaml
    ignore_errors: yes
ansadmin@vova-PC:/opt/dev_env/kubernetes$ cat playbook-k8s-gcp-create-cluster.yaml
---
- hosts: local_ansible

  tasks:
  - name: Create Kubernetes Cluster in GCP Cloud
    command: gcloud container clusters create demo-k8s --num-nodes=4 --machine-type=custom-2-4096
    ignore_errors: yes
ansadmin@vova-PC:/opt/dev_env/kubernetes$ cat playbook-k8s-gcp-config-deploy.yaml
---
- hosts: local_ansible

  tasks:
  - name: Create Kubernetes Cluster in GCP Cloud
    command: kubectl apply -f /opt/dev_env/kubernetes/k8s-gcp-config-deploy.yaml
    ignore_errors: yes
ansadmin@vova-PC:/opt/dev_env/kubernetes$
```

DEMO

Question ?