

Hands-on Final Exam
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CPE212-CPE31S2

14/11/2025

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**Tools Needed:**

## 1. VM with Ubuntu, CentOS and Ansible installed

## 2. Web browser

**Procedure:**

**1. Create a repository and label it as "Final\_Exam\_Surname"**

1

## Create a new repository

Repositories contain a project's files and version history. Have a project elsewhere? [Import a repository](#).

*Required fields are marked with an asterisk (\*).*

General

Owner \*

AlexanderReyes

Repository name \*

Final\_Exam\_Reyes

Final\_Exam\_Reyes is available.

Description

0 / 350 characters

2

Configuration

Choose visibility \*

Choose who can see and commit to this repository

Public

Add README

READMEs can be used as longer descriptions. [About READMEs](#)

On

Add .gitignore

.gitignore tells git which files not to track. [About ignoring files](#)

No .gitignore

Add license

Licenses explain how others can use your code. [About licenses](#)

Apache License 2.0

Create repository

Final\_Exam\_Reyes

Public

Pin

Watch 0

Fork 0

Star 0

main 1 Branch 0 Tags

Go to file

Add file

Code

AlexanderReyes

Initial commit

133122e · 1 minute ago

1 Commit

LICENSE

Initial commit

1 minute ago

README.md

Initial commit

1 minute ago

README

Apache-2.0 license

Final\_Exam\_Reyes

Releases

No releases published

Create a new release

Packages

No packages published

Publish your first package

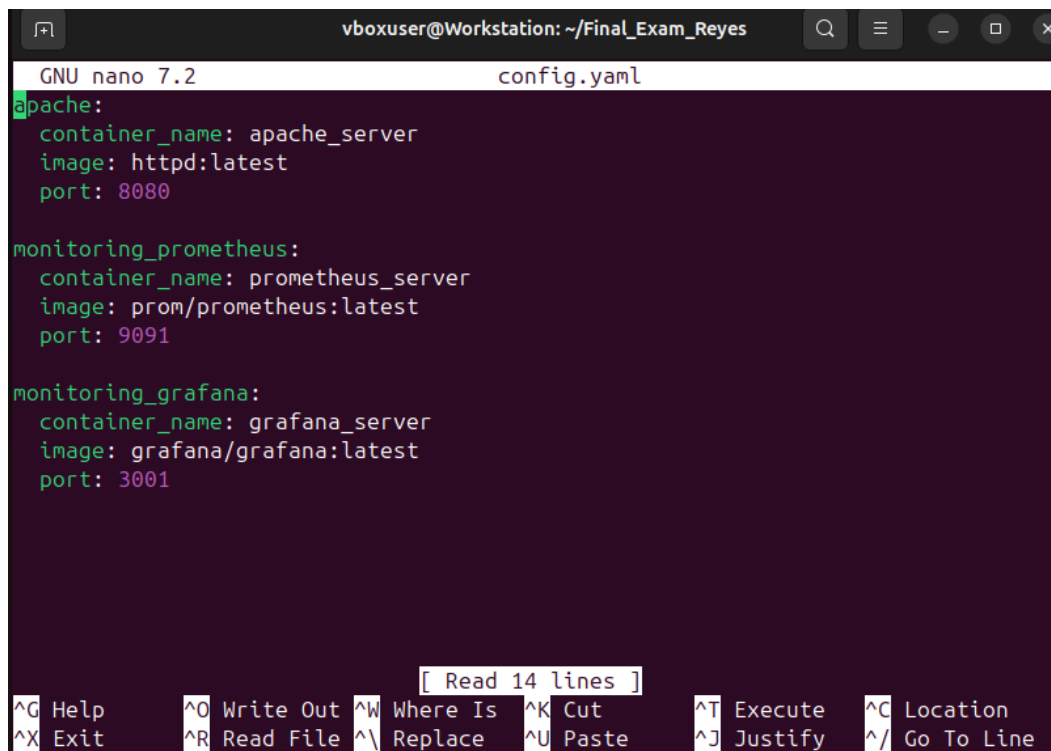
## 2. Clone your new repository in your VM

```
vboxuser@Workstation:~$ git clone git@github.com:AlexzanderReyes/Final_Exam_Reyes.git
Cloning into 'Final_Exam_Reyes'...
remote: Enumerating objects: 4, done.
remote: Counting objects: 100% (4/4), done.
remote: Compressing objects: 100% (3/3), done.
Receiving objects: 100% (4/4), 4.76 KiB | 2.38 MiB/s, done.
remote: Total 4 (delta 0), reused 0 (delta 0), pack-reused 0 (from 0)
vboxuser@Workstation:~$ ls
control-node      Desktop           hosts.ini        Reyes_PrelimExam
CPE212_CONTAINERIZATION  Documents        Music            snap
CPE212_REYES_ALEXZANDER-LAPTOP-  Downloads        Pictures         Templates
CPE_MIDEXAM_REYES      Final_Exam_Reyes Public           Videos
vboxuser@Workstation:~$ cd Final_Exam_Reyes/
vboxuser@Workstation:~/Final_Exam_Reyes$
```

3. Create an Ansible playbook that does the following with an input of a config.yaml file and structure inventory file.

```
vboxuser@Workstation:~/Final_Exam_Reyes$ ls
config.yaml  inventory.ini  LICENSE  playbook.yml  README.md  roles
```

### config.yaml



The screenshot shows a terminal window with the title 'vboxuser@Workstation: ~/Final\_Exam\_Reyes'. Inside the terminal, the GNU nano 7.2 editor is open, displaying the contents of the 'config.yaml' file. The file contains three sections: 'apache', 'monitoring\_prometheus', and 'monitoring\_grafana', each with 'container\_name', 'image', and 'port' attributes. At the bottom of the terminal, a status bar shows '[ Read 14 lines ]' and a list of keyboard shortcuts: ^G Help, ^O Write Out, ^W Where Is, ^K Cut, ^T Execute, ^C Location, ^X Exit, ^R Read File, ^\ Replace, ^U Paste, ^J Justify, and ^\_ Go To Line.

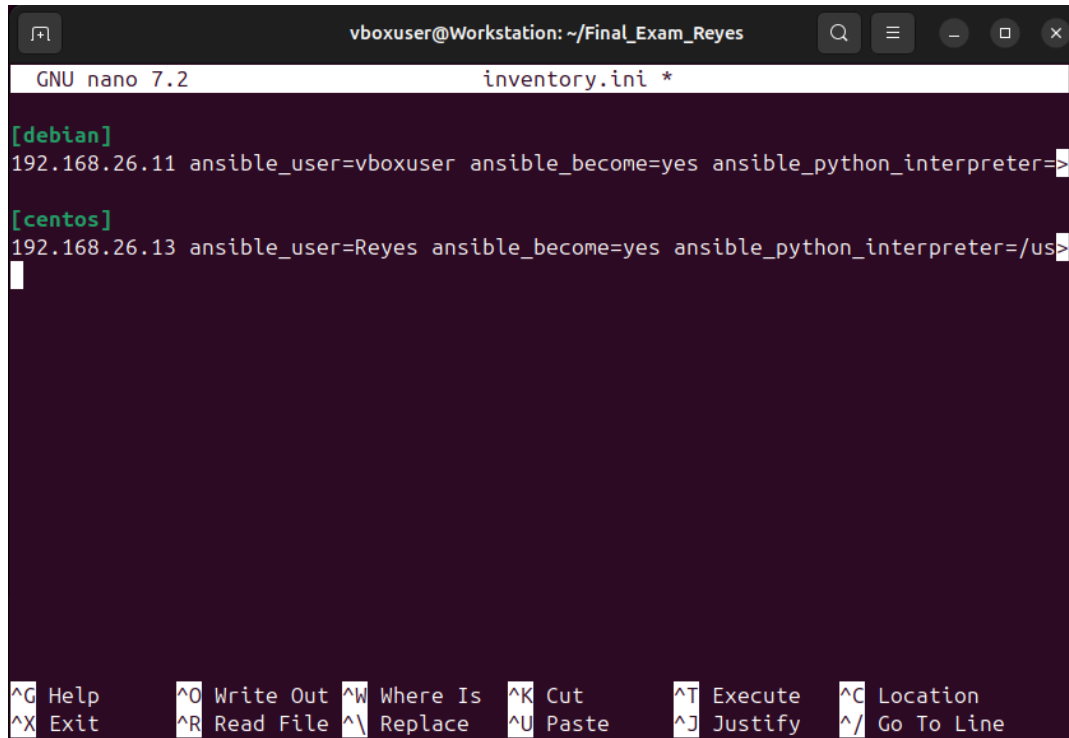
```
GNU nano 7.2 config.yaml
apache:
  container_name: apache_server
  image: httpd:latest
  port: 8080

monitoring_prometheus:
  container_name: prometheus_server
  image: prom/prometheus:latest
  port: 9091

monitoring_grafana:
  container_name: grafana_server
  image: grafana/grafana:latest
  port: 3001

[ Read 14 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line
```

## inventory.ini



```
vboxuser@Workstation: ~/Final_Exam_Reyes
GNU nano 7.2 inventory.ini *
[debian]
192.168.26.11 ansible_user=vboxuser ansible_become=yes ansible_python_interpreter=python3
[centos]
192.168.26.13 ansible_user=Reyes ansible_become=yes ansible_python_interpreter=python3
^G Help      ^O Write Out ^W Where Is  ^K Cut      ^T Execute  ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste    ^J Justify  ^_ Go To Line
```

## playbook.yml

```
vboxuser@Workstation: ~/Final_Exam_Reyes
GNU nano 7.2 playbook.yml
--
- hosts: all
  become: yes
  vars_files:
    - config.yaml
  roles:
    - motd
    - apache
    - prometheus+grafana

[ Read 9 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line
```

roles (directory)

```
vboxuser@Workstation:~/Final_Exam_Reyes$ ls
config.yaml  inventory.ini  LICENSE  playbook.yml  README.md  roles
vboxuser@Workstation:~/Final_Exam_Reyes$ cd roles
vboxuser@Workstation:~/Final_Exam_Reyes/roles$ ls
apache  motd  prometheus+grafana
```

3.1 Install and configure one enterprise service that can be installed in Debian and Centos servers.

APACHE

roles/apache/tasks/main.yml

```
vboxuser@Workstation: ~/Final_Exam_Reyes/roles/apache/tasks
GNU nano 7.2 main.yml *
--
- name: Ensure required apt packages are installed
  ansible.builtin.apt:
    name:
      - ca-certificates
      - curl
      - gnupg
      - lsb-release
    state: present
    update_cache: yes
  when: ansible_os_family == "Debian"

- name: Add Docker GPG key (Debian/Ubuntu)
  ansible.builtin.apt_key:
    url: "https://download.docker.com/linux/{{ ansible_distribution | lower }}/gpg"
    state: present
  when: ansible_os_family == "Debian"

- name: Add Docker repository (Debian/Ubuntu)
  ansible.builtin.apt_repository:
    repo: "deb [arch=amd64] https://download.docker.com/linux/{{ ansible_distribut>
    state: present
  when: ansible_os_family == "Debian"

- name: Install Docker engine (Debian/Ubuntu)
  ansible.builtin.apt:

^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line
```

```
vboxuser@Workstation: ~/Final_Exam_Reyes/roles/apache/tasks
GNU nano 7.2 main.yml *
  name:
    - docker-ce
    - docker-ce-cli
    - containerd.io
  state: present
  update_cache: yes
when: ansible_os_family == "Debian"

- name: Install yum utils (CentOS)
  ansible.builtin.yum:
    name: yum-utils
    state: present
  when: ansible_os_family == "RedHat"

- name: Add Docker repository (CentOS)
  ansible.builtin.get_url:
    url: https://download.docker.com/linux/centos/docker-ce.repo
    dest: /etc/yum.repos.d/docker-ce.repo
  when: ansible_os_family == "RedHat"

- name: Install Docker engine (CentOS)
  ansible.builtin.yum:
    name:
      - docker-ce
      - docker-ce-cli
```

<b>^G</b> Help	<b>^O</b> Write Out	<b>^W</b> Where Is	<b>^K</b> Cut	<b>^T</b> Execute	<b>^C</b> Location
<b>^X</b> Exit	<b>^R</b> Read File	<b>^_</b> Replace	<b>^U</b> Paste	<b>^J</b> Justify	<b>^/</b> Go To Line

```
- containerd.io
  state: present
when: ansible_os_family == "RedHat"

- name: Enable and start Docker service
  ansible.builtin.service:
    name: docker
    state: started
    enabled: yes

- name: Deploy Apache container
  community.docker.docker_container:
    name: "{{ apache.container_name }}"
    image: "{{ apache.image }}"
    state: started
    restart_policy: always
    ports:
      - "{{ apache.port }}:80"
    docker_host: "unix:///var/run/docker.sock"
```

**3.2 Install and configure one monitoring tool that can be installed in Debian and Centos servers (if it is a stack there should be option of different host)**

**PROMETHEUS & GRAFANA**

**roles/prometheus+grafana/tasks/main.yml**

```
vboxuser@Workstation: ~/Final_Exam_Reyes/roles/prometheus+grafana/tasks
GNU nano 7.2 main.yml
- name: Remove Podman Docker wrapper if present
  ansible.builtin.yum:
    name: podman-docker
    state: absent
  ignore_errors: true
  when: ansible_os_family == "RedHat"

- name: Add Docker repository (Debian/Ubuntu)
  ansible.builtin.apt_repository:
    repo: "deb [arch=amd64] https://download.docker.com/linux/{{ ansible_distribut
    state: present
  when: ansible_os_family == "Debian"

- name: Add Docker repository (CentOS/RHEL 9)
  ansible.builtin.command: >
    dnf config-manager --add-repo https://download.docker.com/linux/centos/docker-
  args:
    creates: /etc/yum.repos.d/docker-ce.repo
  when: ansible_os_family == "RedHat"

- name: Install Docker engine (Debian)
  ansible.builtin.apt:
    name:
      - docker-ce
      - docker-ce-cli
      - containerd.io

[ Wrote 89 lines ]
^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line
```



```
vboxuser@Workstation: ~/Final_Exam_Reyes/roles/prometheus+grafana/tasks
GNU nano 7.2 main.yml
  state: present
  update_cache: yes
when: ansible_os_family == "Debian"

- name: Install Docker engine (CentOS)
  ansible.builtin.yum:
    name:
      - docker-ce
      - docker-ce-cli
      - containerd.io
    state: present
  when: ansible_os_family == "RedHat"

- name: Enable and start Docker service
  ansible.builtin.service:
    name: docker
    state: started
    enabled: yes

- name: Install Python3 pip (Debian)
  ansible.builtin.apt:
    name: python3-pip
    state: present
  when: ansible_os_family == "Debian"

- name: Install Python3 pip (CentOS)
```

<b>^G</b> Help	<b>^O</b> Write Out	<b>^W</b> Where Is	<b>^K</b> Cut	<b>^T</b> Execute	<b>^C</b> Location
<b>^X</b> Exit	<b>^R</b> Read File	<b>^\</b> Replace	<b>^U</b> Paste	<b>^J</b> Justify	<b>^_</b> Go To Line

```
vboxuser@Workstation: ~/Final_Exam_Reyes/roles/prometheus+grafana/tasks
GNU nano 7.2 main.yml
  name: python3-pip
  state: present
when: ansible_os_family == "RedHat"

- name: Install Docker SDK for Python (Debian via APT)
  ansible.builtin.apt:
    name: python3-docker
    state: present
  when: ansible_os_family == "Debian"

- name: Install Docker SDK for Python (CentOS via pip)
  ansible.builtin.pip:
    name: docker
    executable: pip3
    state: latest
  when: ansible_os_family == "RedHat"

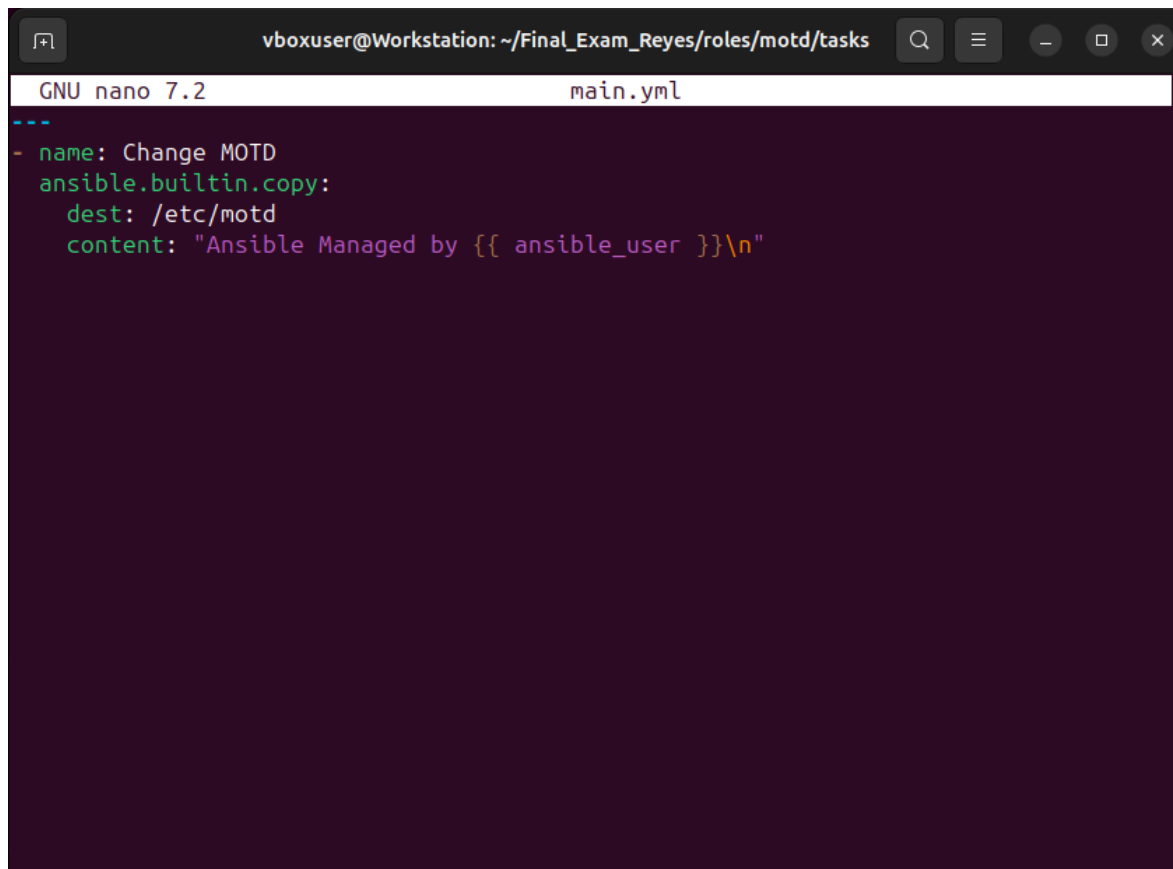
- name: Deploy Prometheus container
  community.docker.docker_container:
    name: "{{ monitoring_prometheus.container_name }}"
    image: "{{ monitoring_prometheus.image }}"
    state: started
    restart_policy: always
    ports:
      - "{{ monitoring_prometheus.port }}:9090"
    docker_host: "unix:///var/run/docker.sock"

^G Help      ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit      ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^_ Go To Line
```

```
- name: Deploy Grafana container
  community.docker.docker_container:
    name: "{{ monitoring_grafana.container_name }}"
    image: "{{ monitoring_grafana.image }}"
    state: started
    restart_policy: always
    ports:
      - "{{ monitoring_grafana.port }}:3000"
    docker_host: "unix:///var/run/docker.sock"
```

### 3.4 Change Motd as "Ansible Managed by <username>"

roles/motd/tasks



The image shows a terminal window with a dark theme. The title bar at the top reads 'vboxuser@Workstation: ~/Final\_Exam\_Reyes/roles/motd/tasks'. Below the title bar, the nano editor interface is visible, showing the file 'main.yml'. The content of the file is an Ansible task named 'Change MOTD' using the 'ansible.builtin.copy' module. The task specifies the destination as '/etc/motd' and the content as a string that includes a Jinja2 variable for the user name. The text is color-coded: green for the task name, cyan for the module name, yellow for the destination, and magenta for the content string.

```
GNU nano 7.2 main.yml
---
- name: Change MOTD
  ansible.builtin.copy:
    dest: /etc/motd
    content: "Ansible Managed by {{ ansible_user }}\n"
```

#### 4. Push and commit your files in GitHub

```

vboxuser@Workstation:~/Final_Exam_Reyes$ ls
config.yaml inventory.ini LICENSE playbook.yml README.md roles
vboxuser@Workstation:~/Final_Exam_Reyes$ git add .
vboxuser@Workstation:~/Final_Exam_Reyes$ git commit -m "FINAL_EXAM_REYES"
[main 1d01d75] FINAL_EXAM_REYES
 6 files changed, 195 insertions(+)
 create mode 100644 config.yaml
 create mode 100644 inventory.ini
 create mode 100644 playbook.yml
 create mode 100644 roles/apache/tasks/main.yml
 create mode 100644 roles/motd/tasks/main.yml
 create mode 100644 roles/prometheus+grafana/tasks/main.yml
vboxuser@Workstation:~/Final_Exam_Reyes$ git push
Enumerating objects: 16, done.
Counting objects: 100% (16/16), done.
Delta compression using up to 2 threads
Compressing objects: 100% (9/9), done.
Writing objects: 100% (15/15), 2.23 KiB | 761.00 KiB/s, done.
Total 15 (delta 1), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (1/1), done.
To github.com:AlexzanderReyes/Final_Exam_Reyes.git
133122e..1d01d75 main -> main

```

AlexzanderReyes / Final\_Exam\_Reyes

<> Code

Issues

Pull requests

Actions

Projects

Wiki

Security

Final\_Exam\_Reyes

Public

Pin

Watch 0

Fork 0

Star 0

main

Go to file

Code

About

AlexzanderReyes FINAL\_EXAM\_REYES 1d01d75 · 1 minute ago

roles	FINAL_EXAM_REYES	1 minute ago
LICENSE	Initial commit	18 hours ago
README.md	Initial commit	18 hours ago
config.yaml	FINAL_EXAM_REYES	1 minute ago
inventory.ini	FINAL_EXAM_REYES	1 minute ago
playbook.yml	FINAL_EXAM_REYES	1 minute ago

README

Apache-2.0 license

Final\_Exam\_Reyes

No description, website, or topics provided.

Readme

Apache-2.0 license

Activity

0 stars

0 watching

0 forks

Releases

No releases published

Create a new release

Packages

No packages published

Publish your first package

5. Make sure to show evidence of input (codes) process (codes successfully running) and output (evidence of installation)

### Running the playbook

```
vboxuser@Workstation: ~/Final_Exam_Reyes
vboxuser@Workstation:~/Final_Exam_Reyes$ ansible-playbook -i inventory.ini playbook.yml -K
BECOME password:
[WARNING]: Collection community.docker does not support Ansible version 2.16.3

PLAY [all] *****

TASK [Gathering Facts] *****
ok: [192.168.26.11]
ok: [192.168.26.13]

TASK [motd : Change MOTD] *****
ok: [192.168.26.11]
ok: [192.168.26.13]

TASK [apache : Ensure required apt packages are installed] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]

TASK [apache : Add Docker GPG key (Debian/Ubuntu)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]

TASK [apache : Add Docker repository (Debian/Ubuntu)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]

TASK [apache : Install Docker engine (Debian/Ubuntu)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]
```

```
TASK [apache : Install yum utils (CentOS)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [apache : Add Docker repository (CentOS)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [apache : Install Docker engine (CentOS)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [apache : Enable and start Docker service] *****
ok: [192.168.26.11]
ok: [192.168.26.13]

TASK [apache : Deploy Apache container] *****
changed: [192.168.26.13]
changed: [192.168.26.11]

TASK [prometheus+grafana : Remove Podman Docker wrapper if present] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [prometheus+grafana : Add Docker repository (Debian/Ubuntu)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]
```

```
TASK [prometheus+grafana : Add Docker repository (CentOS/RHEL 9)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [prometheus+grafana : Install Docker engine (Debian)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]

TASK [prometheus+grafana : Install Docker engine (CentOS)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [prometheus+grafana : Enable and start Docker service] *****
ok: [192.168.26.11]
ok: [192.168.26.13]

TASK [prometheus+grafana : Install Python3 pip (Debian)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]

TASK [prometheus+grafana : Install Python3 pip (CentOS)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [prometheus+grafana : Install Docker SDK for Python (Debian via APT)] *****
skipping: [192.168.26.13]
ok: [192.168.26.11]
```

```

TASK [prometheus+grafana : Install Docker SDK for Python (CentOS via pip)] *****
skipping: [192.168.26.11]
ok: [192.168.26.13]

TASK [prometheus+grafana : Deploy Prometheus container] *****
changed: [192.168.26.11]
changed: [192.168.26.13]

TASK [prometheus+grafana : Deploy Grafana container] *****
changed: [192.168.26.13]
changed: [192.168.26.11]

PLAY RECAP *****
192.168.26.11      : ok=15   changed=3    unreachable=0    failed=0    skip
ped=8   rescued=0   ignored=0
192.168.26.13      : ok=15   changed=3    unreachable=0    failed=0    skip
ped=8   rescued=0   ignored=0

```

### MOTD IN Ubuntu (Server 1)

```

vboxuser@Workstation:~/Final_Exam_Reyes$ ssh vboxuser@server1
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.14.0-33-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/pro

Expanded Security Maintenance for Applications is not enabled.

12 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

*** System restart required ***
Ansible Managed by vboxuser
Last login: Fri Nov 14 09:17:17 2025 from 192.168.26.10

```

### MOTD IN CentOS (Reyes)

```

vboxuser@Workstation:~/Final_Exam_Reyes$ ssh Reyes@CentOS
Ansible Managed by Reyes
Activate the web console with: systemctl enable --now cockpit.socket

Last login: Fri Nov 14 17:17:18 2025 from 192.168.26.10

```

Apache and Prometheus & Grafana docker ps and docker images Ubuntu (Server 1)

Before playing the playbook

```
*** System restart required ***
Ansible Managed by vboxuser
Last login: Fri Nov 14 09:07:35 2025 from 192.168.26.10
vboxuser@Server1:~$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED        STATUS        PORTS          NAMES
vboxuser@Server1:~$ docker images
REPOSITORY    TAG            IMAGE ID            CREATED        SIZE
```

After playing the playbook

```
vboxuser@Server1:~$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED        STATUS        PORTS          NAMES
e2da3eb55f22   grafana/grafana:latest   "/run.sh"              2 minutes ago   Up           0.0.0.0:3001->3000/tcp   grafana_server
b7f2563d5c88   prom/prometheus:latest   "/bin/prometheus --c..."  8 minutes ago   Up           0.0.0.0:9091->9090/tcp   prometheus_server
794623cac1fc   httpd:latest      "httpd-foreground"      12 minutes ago   Up           0.0.0.0:8080->80/tcp     apache_server
vboxuser@Server1:~$ docker images
REPOSITORY    TAG            IMAGE ID            CREATED        SIZE
httpd         latest        6a4fe18d08d2       10 days ago   117MB
prom/prometheus  latest       a683da769912       2 weeks ago   370MB
grafana/grafana  latest       bac4f177a0d5       3 weeks ago   730MB
```

Apache and Prometheus & Grafana docker ps and docker images CentOS (Reyes Server)

Before playing the playbook

```
vboxuser@Workstation:~/Final_Exam_Reyes$ ssh Reyes@CentOS
Ansible Managed by Reyes
Activate the web console with: systemctl enable --now cockpit.socket

Last login: Fri Nov 14 16:58:58 2025 from 192.168.26.10
[Reyes@CentOS ~]$ docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED        STATUS        PORTS          NAMES
[Reyes@CentOS ~]$ docker images
REPOSITORY    TAG            IMAGE ID            CREATED        SIZE
```

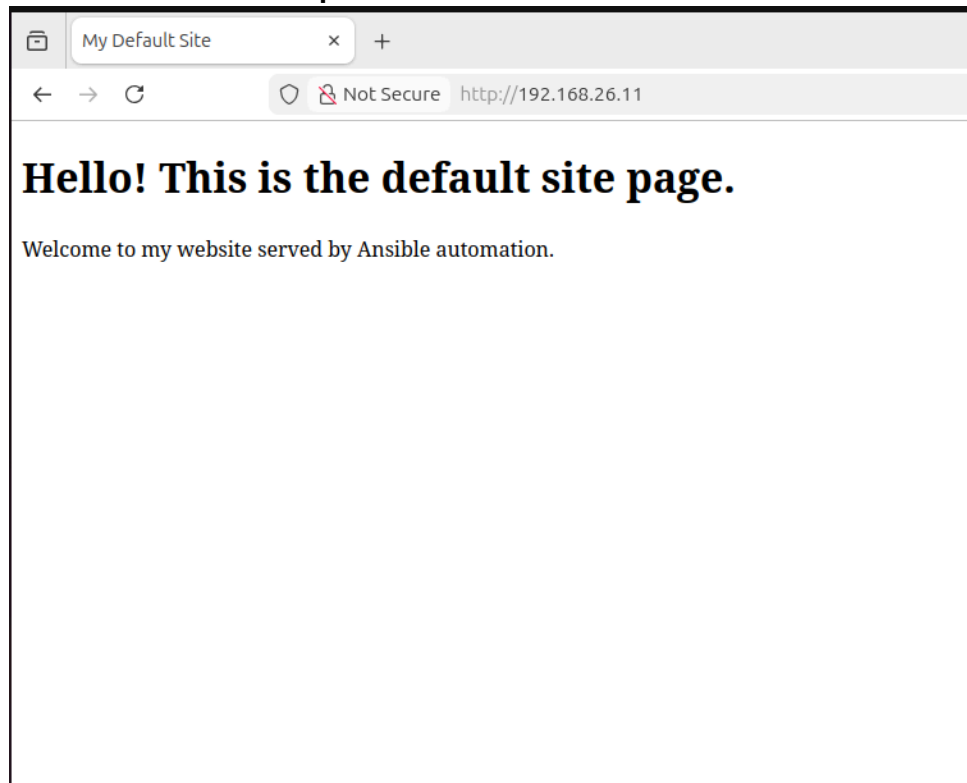


### After playing the playbook

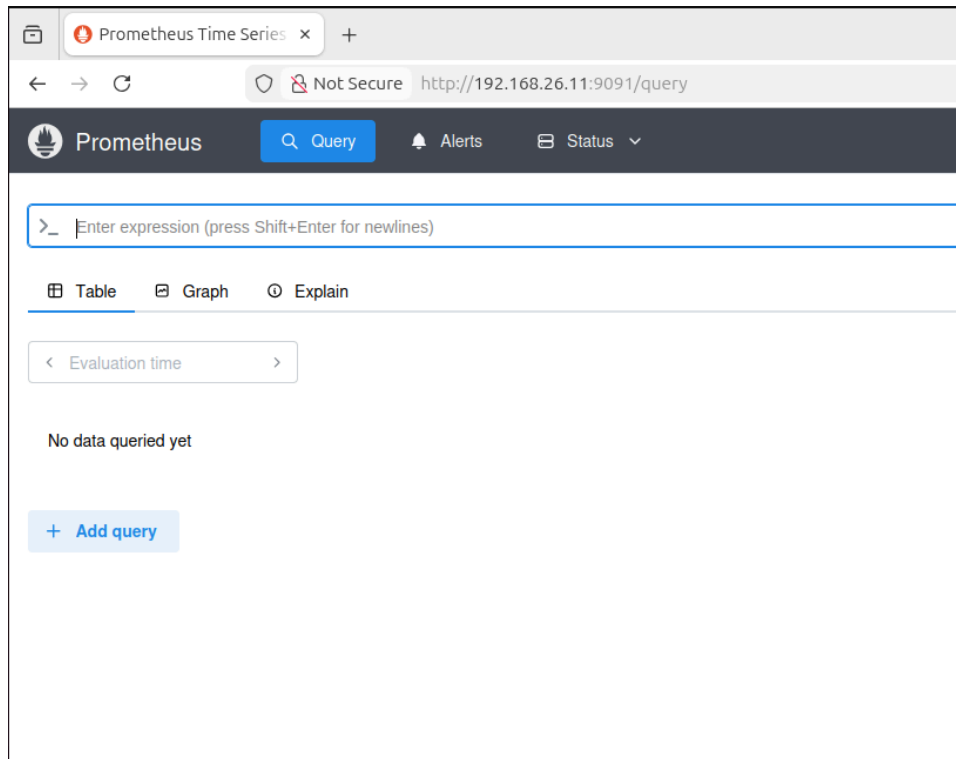
```
[Reyes@CentOS ~]$ docker ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED        STATUS
71b00a3a2127   grafana/grafana:latest             "/run.sh"               35 seconds ago Up
p 34 seconds   0.0.0.0:3001->3000/tcp              grafana_server
127096c20099   prom/prometheus:latest            "/bin/prometheus -c..." 6 minutes ago  Up
p 6 minutes   0.0.0.0:9091->9090/tcp              prometheus_server
0795a8689087   httpd:latest                       "httpd-foreground"      10 minutes ago Up
p 10 minutes   0.0.0.0:8080->80/tcp                apache_server

[Reyes@CentOS ~]$ docker images
REPOSITORY      TAG         IMAGE ID      CREATED        SIZE
httpd           latest     6a4fe18d08d2  10 days ago   117MB
prom/prometheus latest     a683da769912  2 weeks ago   370MB
grafana/grafana latest     bac4f177a0d5  3 weeks ago   730MB
```

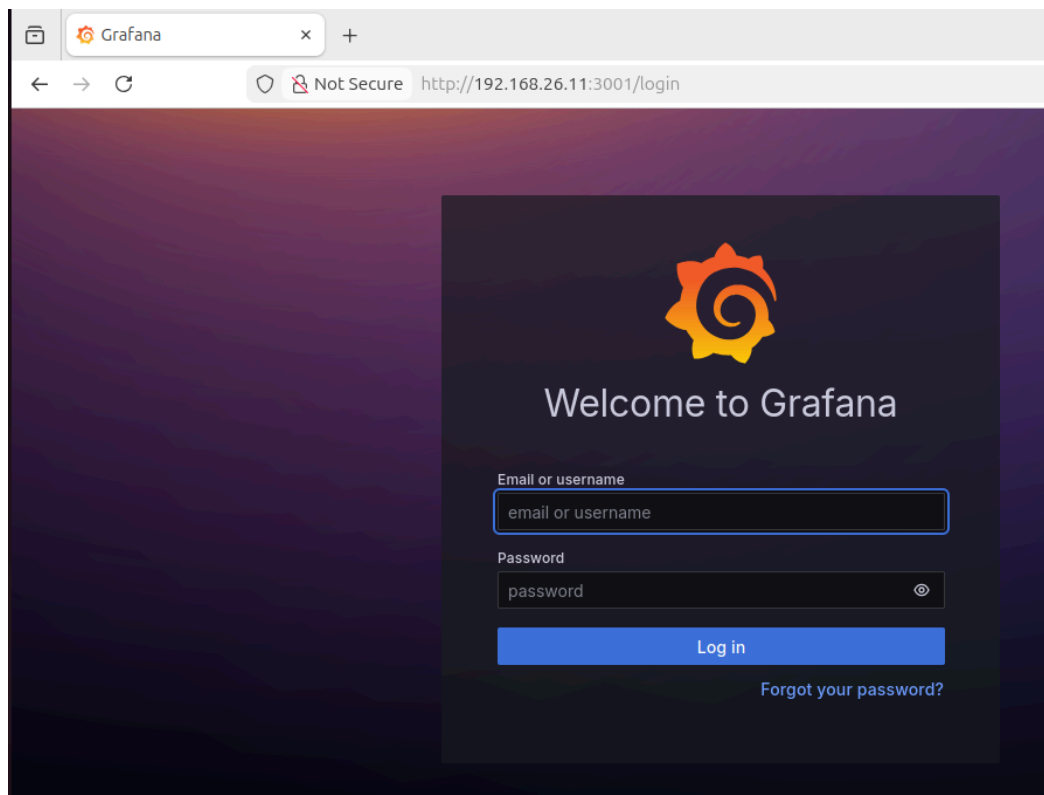
### Checking Apache (Ubuntu) Ip address = 192.168.26.11



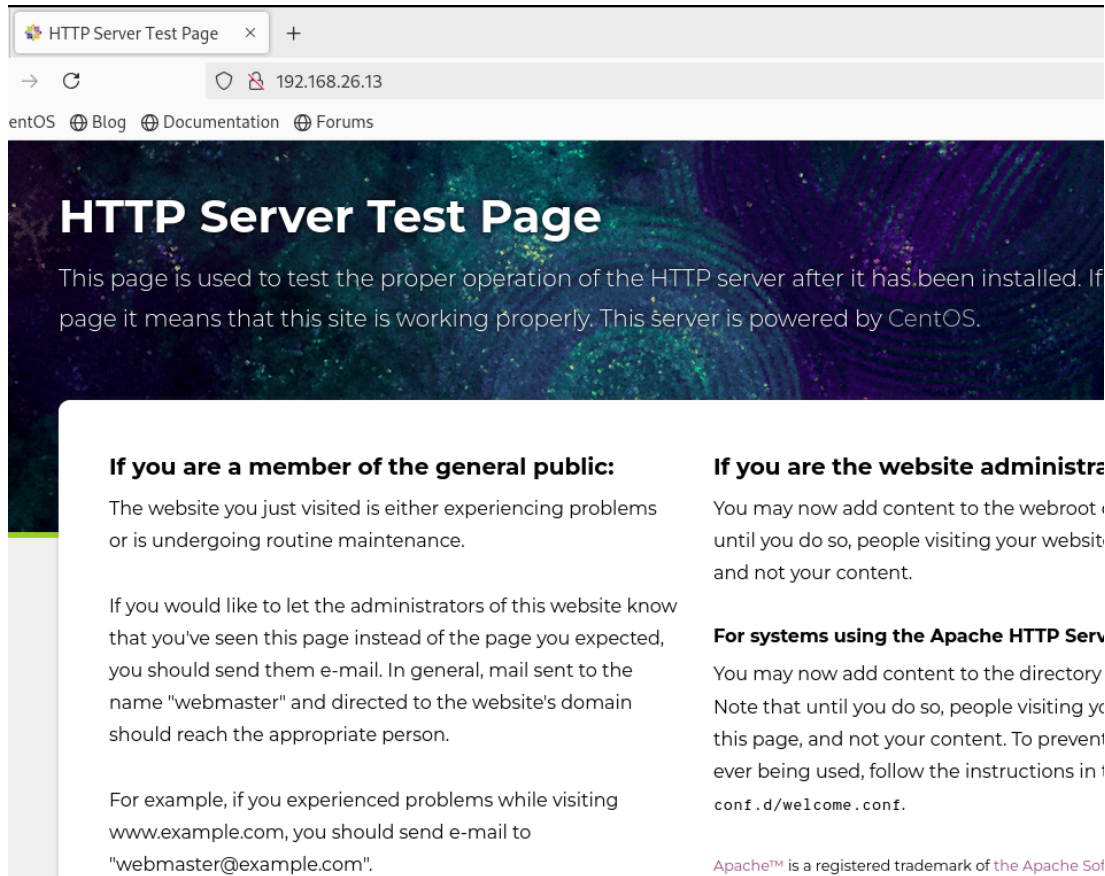
### Checking Apache (Ubuntu) Ip address = 192.168.26.11



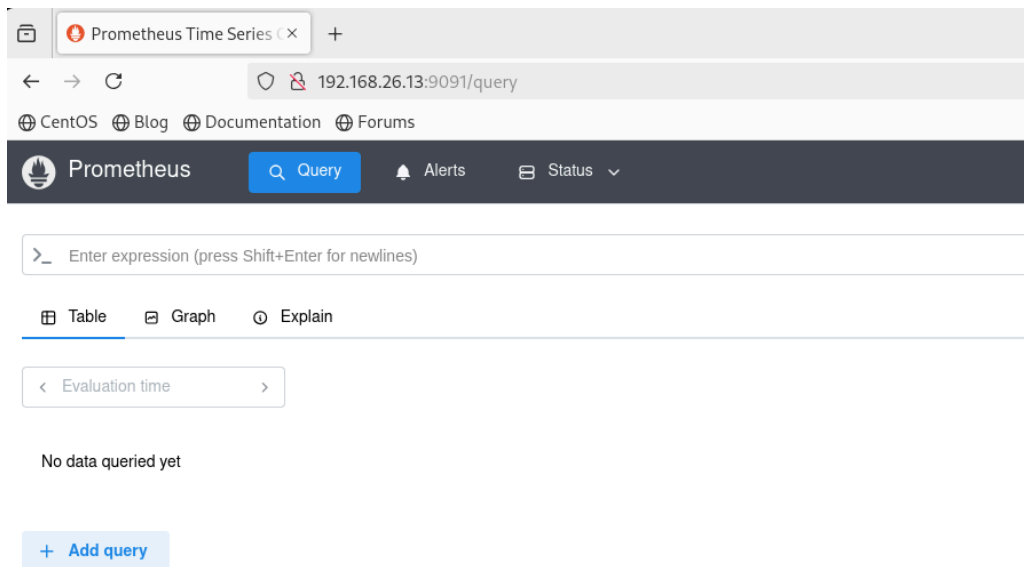
**Checking Apache (Ubuntu)  
Ip address = 192.168.26.11**



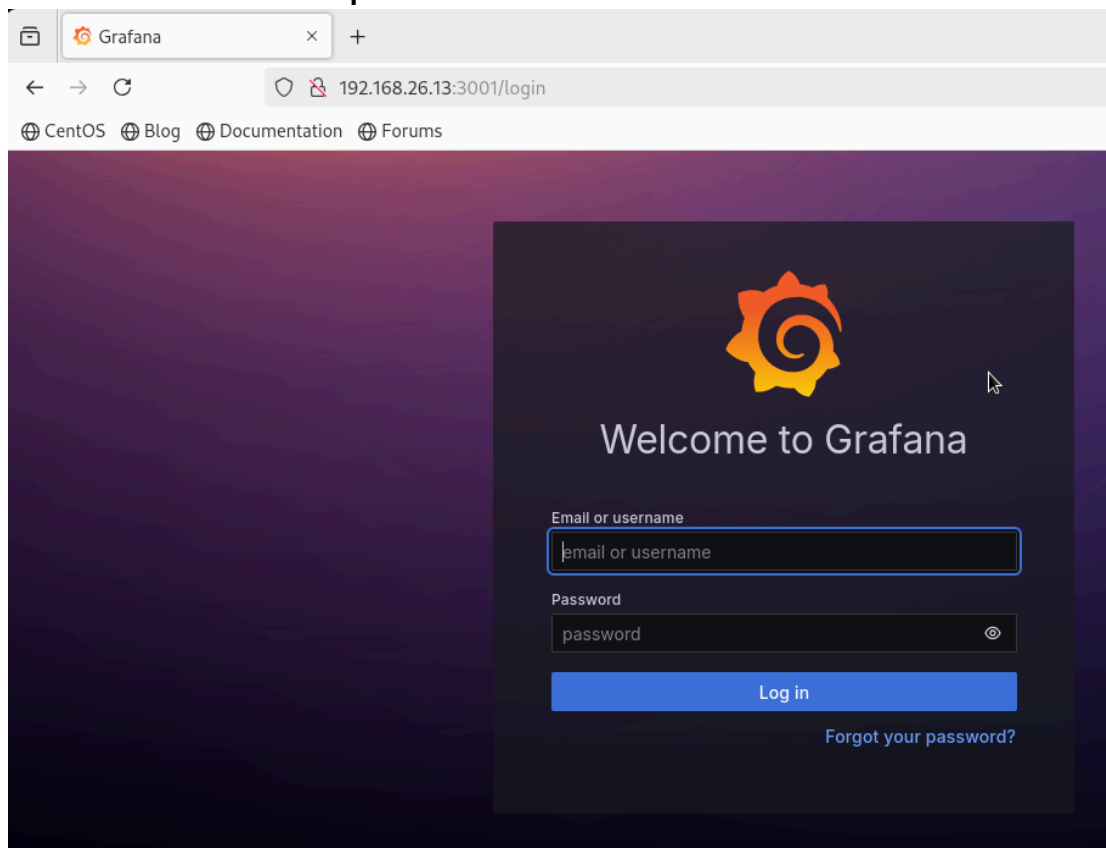
## Checking Apache (CentOS) Ip address = 192.168.26.13



## Checking Prometheus (CentOS) Ip address = 192.168.26.13:9091



### Checking Grafana (CentOS) Ip address = 192.168.26.13:3001



**6. For your final exam to be counted, please paste your repository link as an answer in this exam.**

- [AlexzanderReyes/Final Exam Reyes](#)

Note: Extra points if you will implement the said services via containerization.

