DEPARTMENT OF SOFTWARE ENGINEERING

LAB#14

SUBMITTED TO:

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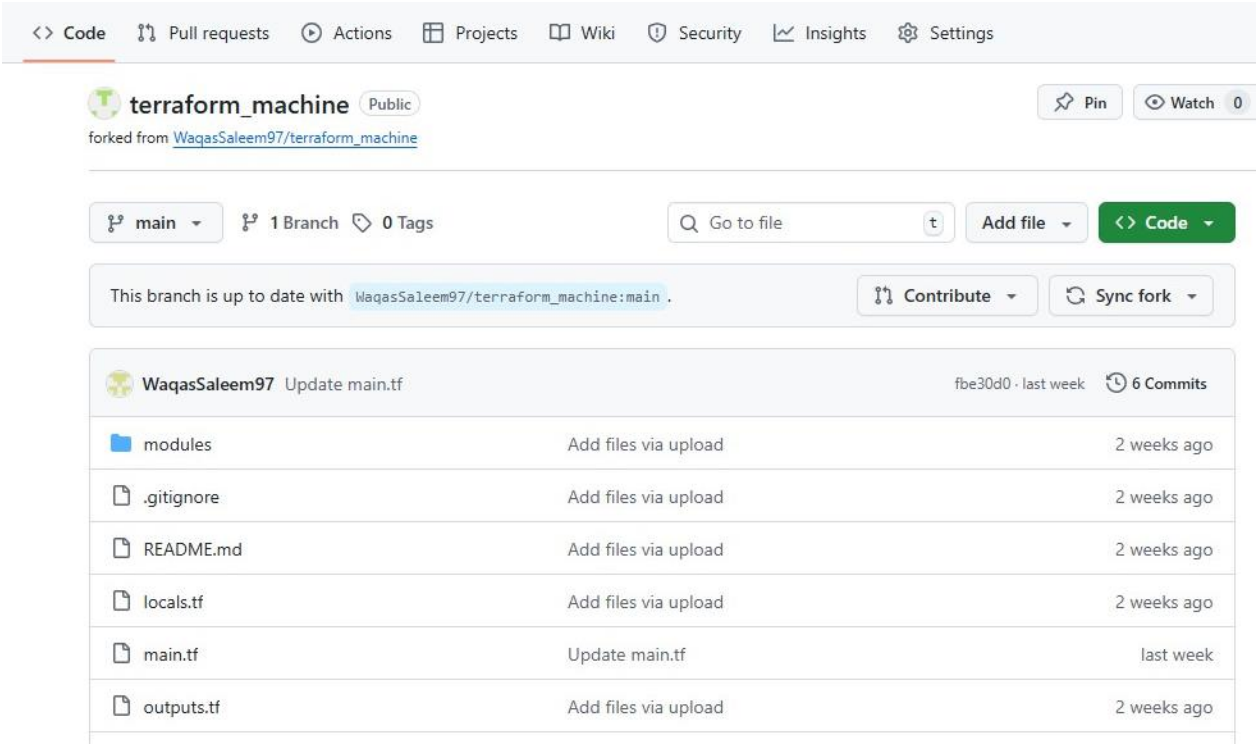
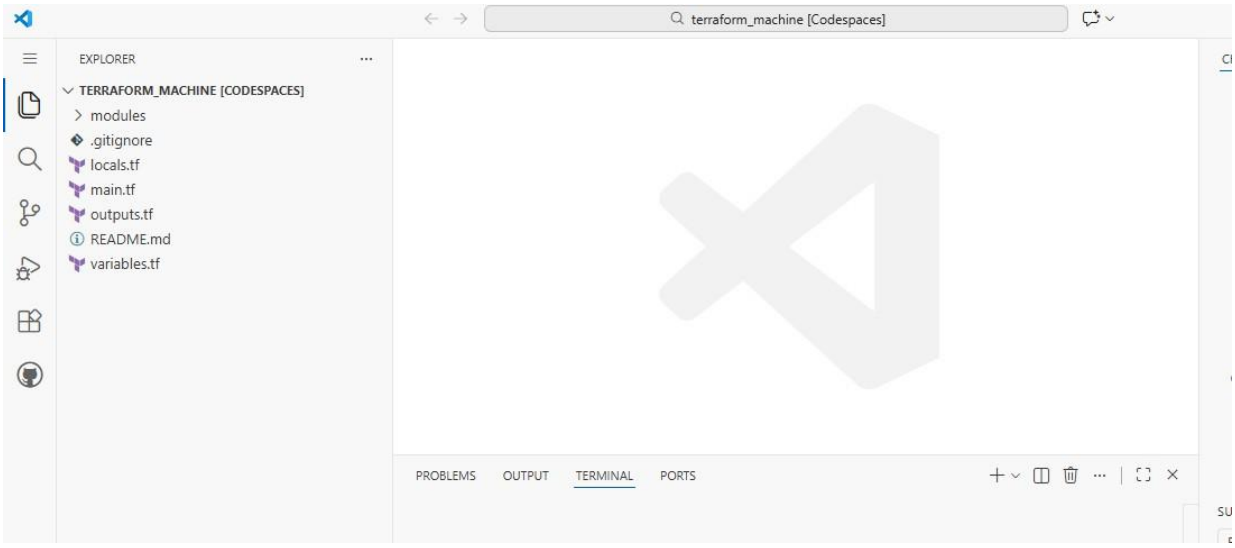
Task 0 – Lab Setup (Codespace & GH CLI)

task0_codespace_open.png





task0_env_check.png

```
terraform --version
aws-cli/2.33.1 Python/3.13.11 Linux/6.8.0-1030-azure exe/x86_64.ubuntu.24
Terraform v1.14.3
on linux_amd64
```

task0_aws_config.png

```
{
    "UserId": "368002277745",
    "Account": "368002277745",
    "Arn": "arn:aws:iam::368002277745:root"
}
```

Task 1 – Generate ssh key and Initial Terraform apply

task1_ssh_keygen_before.png

```
total 20
drwx------ 2 codespace codespace 4096 Jan 16 14:44 .
drwxr-x--- 1 codespace codespace 4096 Jan 16 14:44 ..
-rw------- 1 codespace codespace  419 Jan 16 14:44 id_ed25519
-rw-r--r-- 1 codespace codespace  109 Jan 16 14:44 id_ed25519.pub
```

task1_ssh_keygen.png

```
Generating public/private ed25519 key pair.
Created directory '/home/codespace/.ssh'.
Your identification has been saved in /home/codespace/.ssh/id_ed25519
Your public key has been saved in /home/codespace/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:8s9rB8zI0NsXrUJ+zlqenvDnbXjC35A7aPSN4K9BC+Y codespace@codespaces-feaa13
The key's randomart image is:
```

task1_ssh_keygen_after.png

```
total 20
drwx------ 2 codespace codespace 4096 Jan 16 14:44 .
drwxr-x--- 1 codespace codespace 4096 Jan 16 14:44 ..
-rw------- 1 codespace codespace  419 Jan 16 14:44 id_ed25519
-rw-r--r-- 1 codespace codespace  109 Jan 16 14:44 id_ed25519.pub
```

task1_terraform_tfvars_created.png

```
➜ /workspaces/terraform_machine (main) $ touch terraform.tfvars
➜ /workspaces/terraform_machine (main) $
```

task1_terraform_tfvars.png

terraform.tfvars

```
1  vpc_cidr_block      = "10.0.0.0/16"
2  subnet_cidr_block   = "10.0.10.0/24"
3  availability_zone   = "me-central-1a"
4  env_prefix          = "dev"
5  instance_type       = "t3.micro"
6  public_key          = "~/.ssh/id_ed25519.pub"
7  private_key         = "~/.ssh/id_ed25519"
```

task1_terraform_init.png

```
Initializing the backend...
Initializing modules...
- myapp-subnet in modules/subnet
- myapp-webserver in modules/webserver
Initializing provider plugins...
- Finding latest version of hashicorp/aws...
- Finding latest version of hashicorp/http...
- Installing hashicorp/aws v6.28.0...
```

task1_terraform_apply_2_instances.png

```
module.myapp-webserver[0].aws_instance.myapp-server: Creation complete after 13s [id=i-0208ef0ce1
8a8ce67]

Apply complete! Resources: 10 added, 0 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "51.112.228.98",
  "51.112.178.49",
]
```

task1_terraform_output_ips.png

```
webserver_public_ips = [
  "51.112.228.98",
  "51.112.178.49",
]
```

Task 2 – Static Ansible inventory with two EC2 instances

task2_ansible_install.png

```
ansible [core 2.20.1]
  config file = None
  configured module search path = ['/home/codespace/.ansible/plugins/modules', '/usr/share/ansibl
e/plugins/modules']
  ansible python module location = /usr/local/py-utils/venvs/ansible-core/lib/python3.12/site-pac
kages/ansible
  ansible collection location = /home/codespace/.ansible/collections:/usr/share/ansible/collecti
ns
  executable location = /usr/local/py-utils/bin/ansible
```

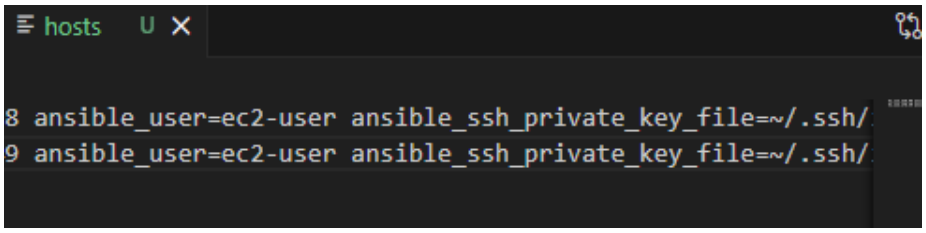
task2_terraform_output_ips.png

```
webserver_public_ips = [
  "51.112.228.98",
  "51.112.178.49",
]
```

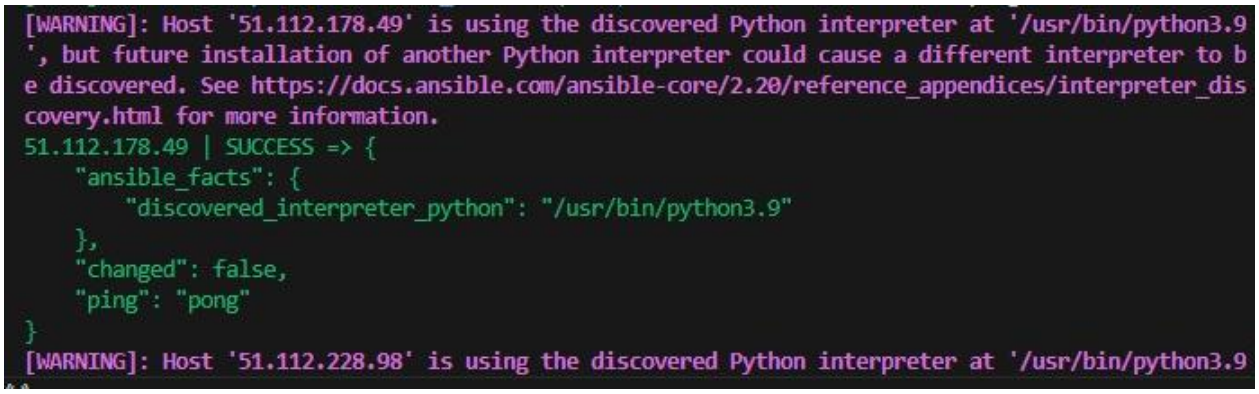
task2_hosts_created.png

```
→/workspaces/terraform_machine (main) $ touch hosts
→/workspaces/terraform_machine (main) $
```

task2_hosts_initial.png



task2_ansible_ping_success.png



Task 3 – Scale to three instances & group-based inventory

task3_main_tf_count_3.png

main.tf

```
module "myapp-webserver" {
  source = "./modules/webserver"
  env_prefix = var.env_prefix
  instance_type = var. instance_type
  availability_zone = var.availability_zone
  public_key = var.public_key
  my_ip = local.my_ip
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_id = module.myapp-subnet.subnet.id

  # Loop count
  count             = 3
  # Use count.index to differentiate instances
  instance_suffix   = count.index

}
```

task3_terraform_apply_3_instances.png

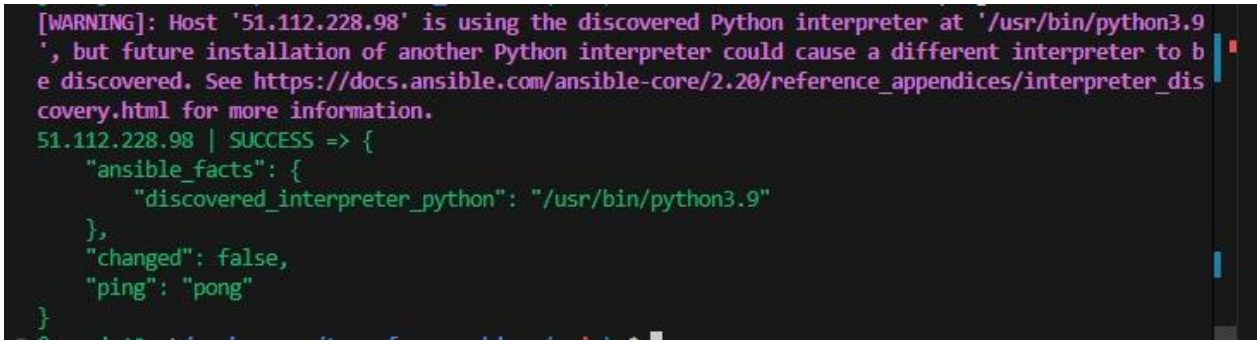
```
836cdb5]

Apply complete! Resources: 3 added, 0 changed, 0 destroyed.
```

task3_terraform_output_3_ips.png

```
836cdb5]

Apply complete! Resources: 3 added, 0 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "51.112.228.98",
  "51.112.178.49",
  "3.29.232.128",
]
```

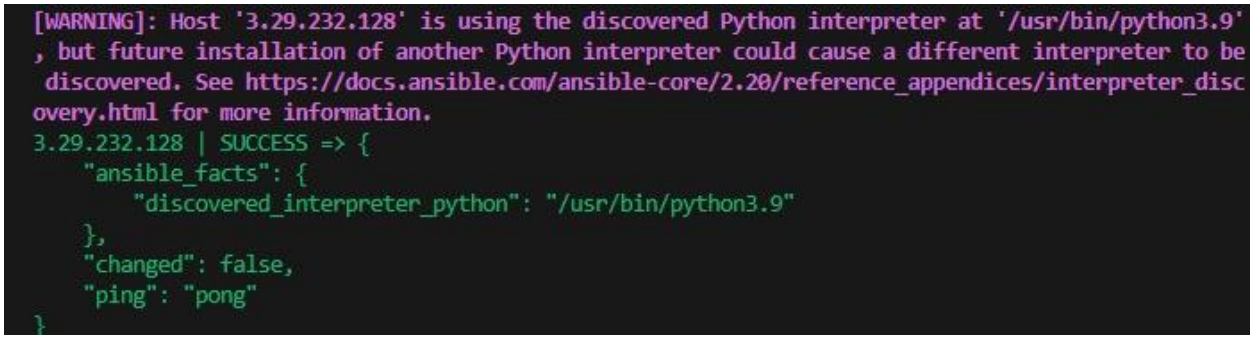
task3_hosts_grouped.png

task3_ansible_ec2_ping.png



task3_ansible_single_ip_ping.png

task3_ansible_droplet_ping.png



task3_ansible_all_ping.png

```
[WARNING]: Host '51.112.228.98' is using the discovered Python interpreter at '/usr/bin/python3.9
', but future installation of another Python interpreter could cause a different interpreter to b
e discovered. See https://docs.ansible.com/ansible-core/2.20/reference_appendices/interpreter_dis
covery.html for more information.
51.112.228.98 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

Task 4 – Global ansible.cfg & first nginx playbook

task4_global_ansible_cfg.png

```
": "pong"

➜ /workspaces/terraform_machine (main) $ vim ~/.ansible.cfg
➜ /workspaces/terraform_machine (main) $
```

task4_hosts_without_common_args.png

terraform.tfvars | hosts U | main.tf M

hosts

```
1   [ec2]
2   51.112.228.98
3   51.112.178.49
4
5   [droplet]
6   3.29.232.128
7
8   [all:vars]
9   ansible_user=ec2-user
10  ansible_ssh_private_key_file=~/.ssh/id_ed25519
```

task4_ansible_ping_after_cfg.png

```
3.29.232.128 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
51.112.228.98 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
51.112.178.49 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
```

task4_my_playbook_created.png

```
➜ /workspaces/terraform_machine (main) $ touch my-playbook.yaml
playbook.yaml
- 1 codespace codespace 0 Jan 16 15:37 my-playbook.yaml
➜ /workspaces/terraform_machine (main) $
```

task4_my_playbook_ec2.png

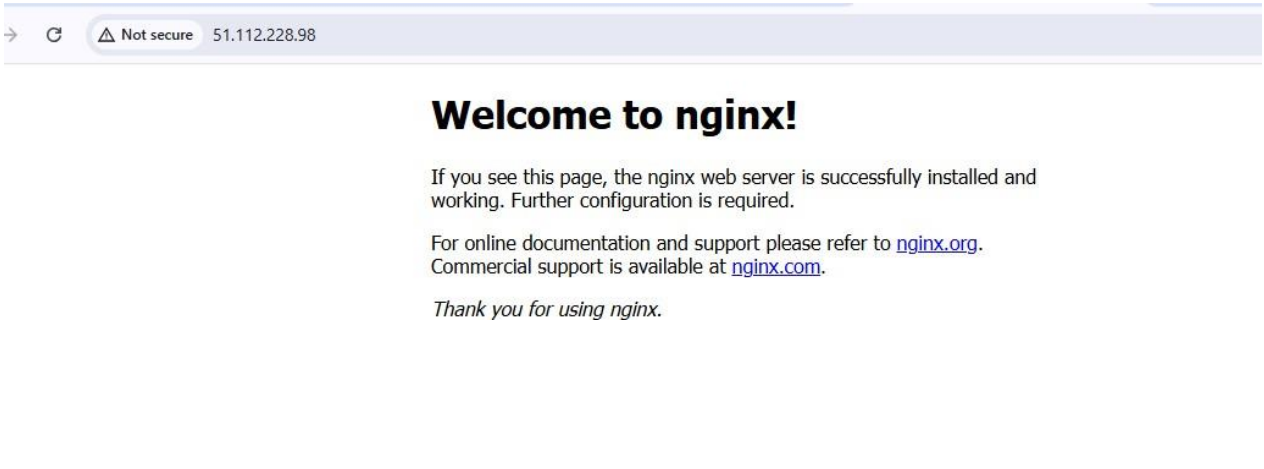
my-playbook.yaml

```yaml
---
- name: Configure nginx web server
  hosts: ec2
  become: true
  tasks:
    - name: install nginx and update cache
      yum:
        name: nginx
        state: present
        update_cache: yes

    - name: start nginx server
      service:
        name: nginx
        state: started
```

task4_ansible_play_ec2.png

```
TASK [start nginx server] ******************************************************************************
changed: [51.112.178.49]
changed: [51.112.228.98]

PLAY RECAP *********************************************************************************************
51.112.178.49              : ok=3    changed=2    unreachable=0    failed=0    skipped=0    rescu
ed=0    ignored=0
51.112.228.98              : ok=3    changed=2    unreachable=0    failed=0    skipped=0    rescu
ed=0    ignored=0
```

task4_nginx_browser_ec2.png



task4_my_playbook_droplet.png

terraform.tfvars | hosts U | my-playbook.yaml U | main.tf M

my-playbook.yaml

```yaml
---
- name: Configure nginx web server
  hosts: droplet
  become: true
  tasks:
    - name: install nginx and update cache
      yum:
        name: nginx
        state: present
        update_cache: yes

    - name: start nginx server
      service:
        name: nginx
        state: started
```

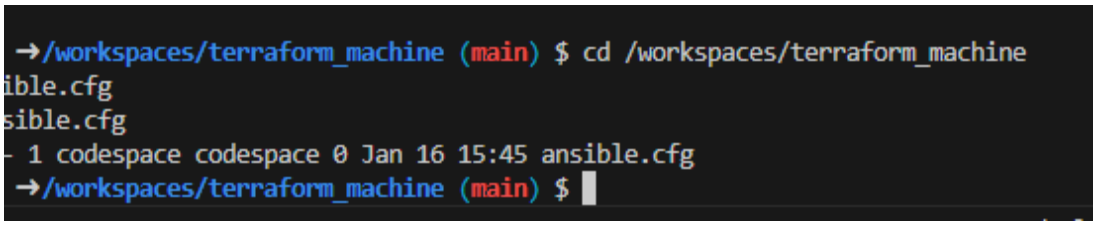
task4_ansible_play_droplet.png

```
TASK [install nginx and update cache] ***************************************************
changed: [3.29.232.128]

TASK [start nginx server] ***************************************************************
changed: [3.29.232.128]

PLAY RECAP ******************************************************************************
3.29.232.128               : ok=3    changed=2    unreachable=0    failed=0    skipped=0    rescu
ed=0    ignored=0
```

task4_nginx_browser_droplet.png

Task 5 – Single nginx target group & HTTPS prerequisites

task5_project_ansible_cfg_created.png



task5_project_ansible_cfg.png

task5_main_tf_count_1.png

main.tf

```
module "myapp-webserver" {
  source = "./modules/webserver"
  env_prefix = var.env_prefix
  instance_type = var. instance_type
  availability_zone = var.availability_zone
  public_key = var.public_key
  my_ip = local.my_ip
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_id = module.myapp-subnet.subnet.id

  # Loop count
  count             = 1
  # Use count.index to differentiate instances
  instance_suffix   = count.index

}
```

task5_terraform_apply_one_instance.png

```
differences, so no changes are needed.

Apply complete! Resources: 0 added, 0 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "51.112.228.98",
  "51.112.178.49",
  "3.29.232.128",
]
```

task5_terraform_output_single_ip.png

```
webserver_public_ips = [
  "51.112.228.98",
```

task5_hosts_nginx_group.png

terraform.tfvars | hosts U | my-playbook.yaml U | main.tf M

hosts

```
1  [nginx]
2  51.112.178.49
3
4  [nginx:vars]
5  ansible_ssh_private_key_file=~/.ssh/id_ed25519
6  ansible_user=ec2-user
```

task5_my_playbook_nginx_group.png

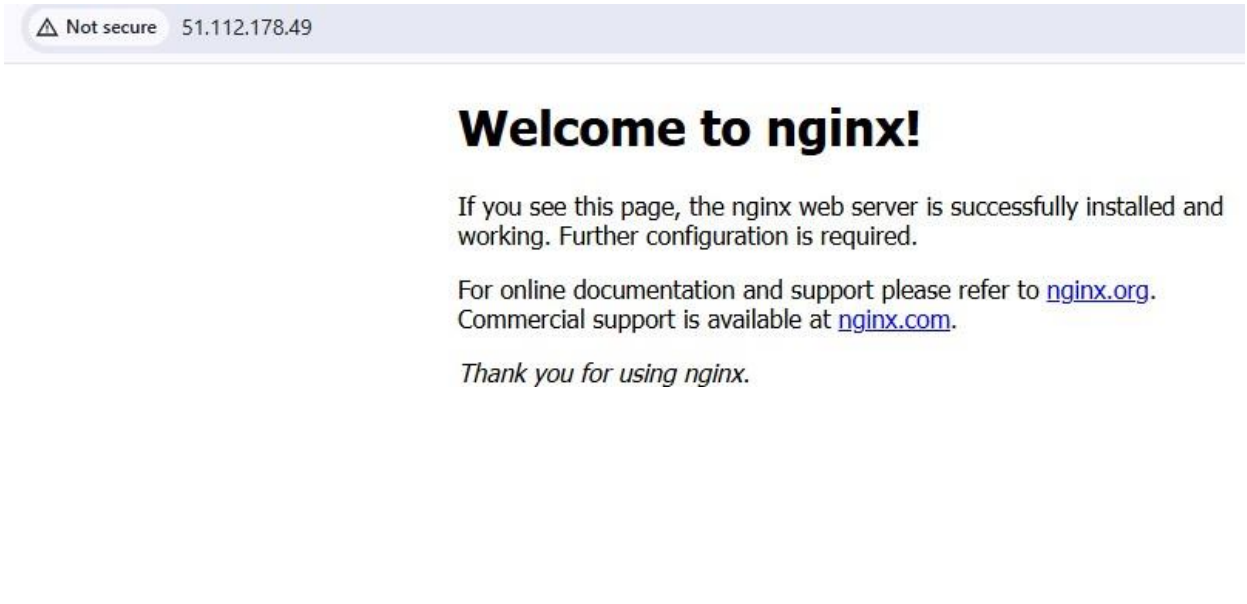
my-playbook.yaml

```
1  ---
2  - name: Configure nginx web server
3    hosts: nginx
4    become: true
5    tasks:
6      - name: install nginx and update cache
7        yum:
8          name: nginx
9          state: present
10         update_cache: yes
11
12     - name: install openssl
13       yum:
14         name: openssl
15         state: present
16
17     - name: start nginx server
18       service:
```

task5_ansible_play_nginx_group.png

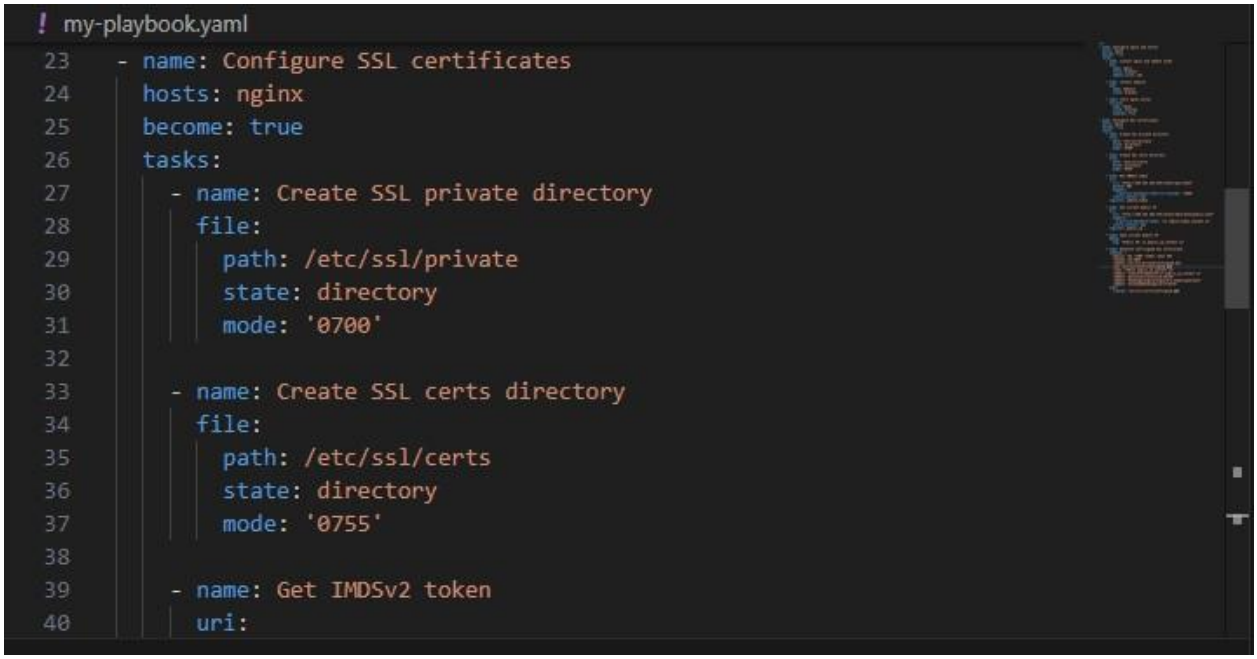
```
TASK [install openssl] *********************************************************************
ok: [51.112.178.49]

TASK [start nginx server] ******************************************************************
changed: [51.112.178.49]

PLAY RECAP *********************************************************************************
51.112.178.49              : ok=4    changed=1    unreachable=0    failed=0    skipped=0    rescu
ed=0    ignored=0
```

task5_nginx_browser_single.png



Task 6 – Ansible-managed SSL certificates

task6_my_playbook_ssl_section.png



task6_ansible_play_ssl.png

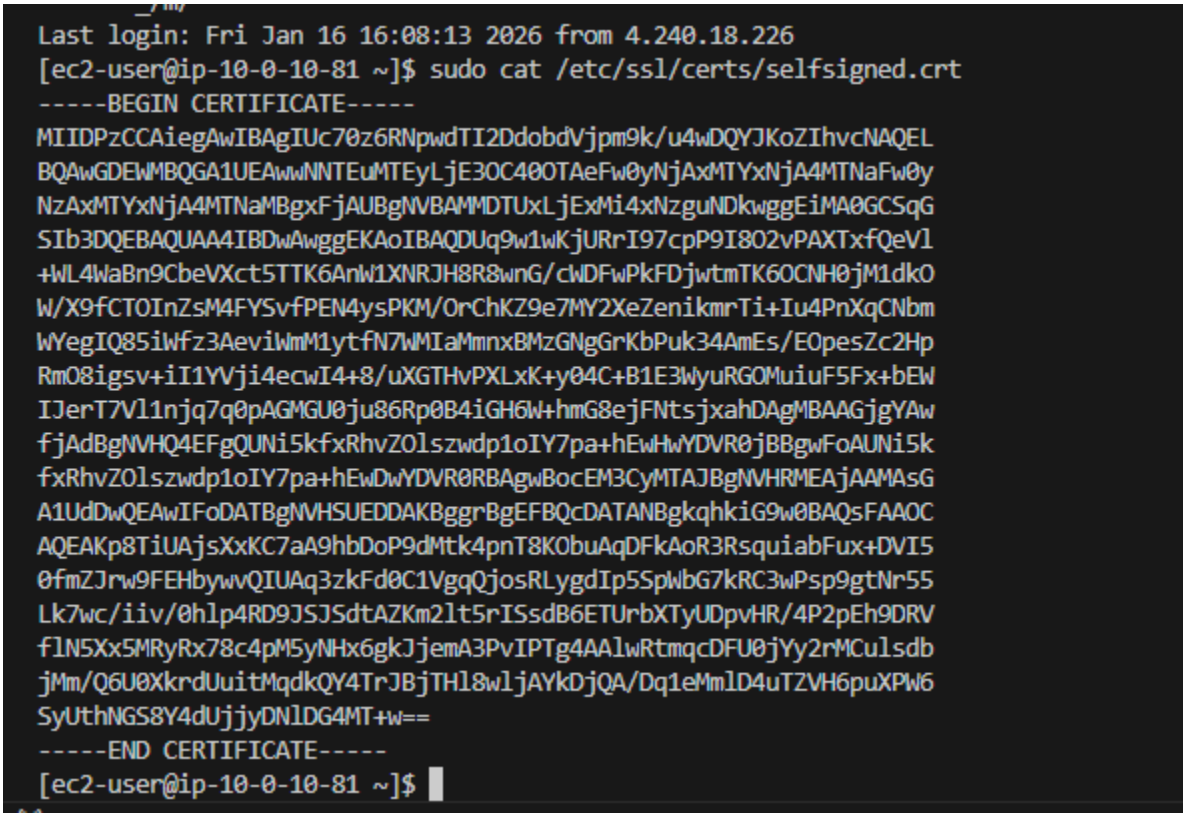
```
ok: [51.112.178.49] => {
    "msg": "Public IP: 51.112.178.49"
}

TASK [Generate self-signed SSL certificate] ************************************************
changed: [51.112.178.49]

PLAY RECAP *********************************************************************************
51.112.178.49              : ok=11   changed=3    unreachable=0    failed=0    skipped=0    rescu
ed=0    ignored=0
```

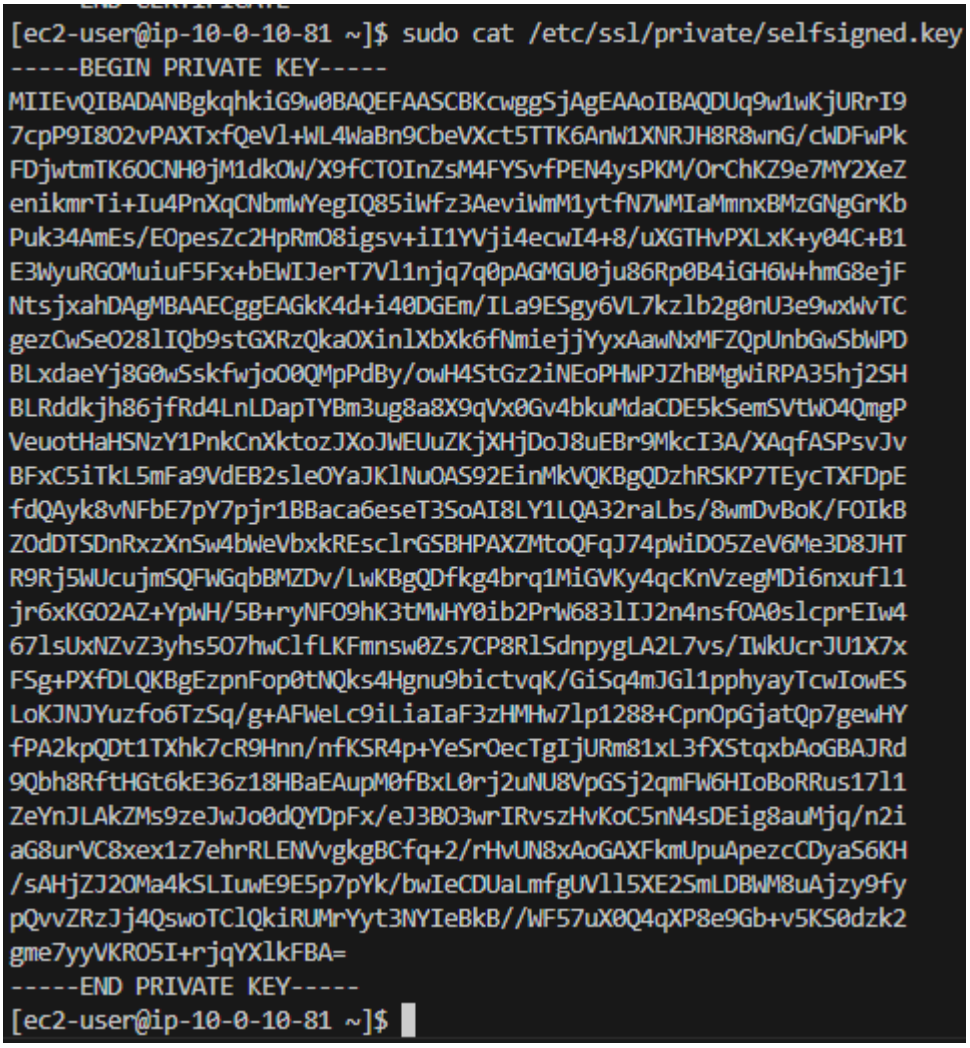
task6_ssl_cert_file.png

```
ssh ec2-user@51.112.178.49 -i ~/.ssh/id_ed25519
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
```

```
        _/m/'
Last login: Fri Jan 16 16:08:13 2026 from 4.240.18.226
[ec2-user@ip-10-0-10-81 ~]$
```

task6_ssl_key_file.png


Last login: Fri Jan 16 16:08:13 2026 from 4.240.18.226
[ec2-user@ip-10-0-10-81 ~]$ sudo cat /etc/ssl/certs/selfsigned.crt
-----BEGIN CERTIFICATE-----
MIIDPzCCAiegAwIBAgIUc70z6RNpwdTI2DdobdVjpm9k/u4wDQYJKoZIhvcNAQEL
BQAwGDEWMBQGA1UEAwwNNTEuMTEyLjE3OC40OTAeFw0yNjAxMTYxNjA4MTNaFw0y
NzAxMTYxNjA4MTNaMBgxFjAUBgNVBAMMDTUxLjExMi4xNzguNDkwggEiMA0GCSqG
SIb3DQEBAQUAA4IBDwAwggEKAoIBAQDUq9w1wKjURrI97cpP9I8O2vPAXTxfQeVl
+WL4WaBn9CbeVXct5TTK6AnW1XNRJH8R8wnG/cWDFwPkFDjwtmTK6OCNH0jM1dkO
W/X9fCTOInZsM4FYSvfPEN4ysPKM/OrChKZ9e7MY2XeZenikmrTi+Iu4PnXqCNbm
WYegIQ85iWfz3AeviWmM1ytfN7WMIaMmnxBMzGNgGrKbPuk34AmEs/EOpesZc2Hp
RmO8igsv+iI1YVji4ecwI4+8/uXGTHvPXLxK+y04C+B1E3WyuRGOMuiuF5Fx+bEW
IJerT7Vl1njq7q0pAGMGU0ju86Rp0B4iGH6W+hmG8ejFNtsjxahDAgMBAAGjgYAw
fjAdBgNVHQ4EFgQUNi5kfxRhvZOlszwdp1oIY7pa+hEwHwYDVR0jBBgwFoAUNi5k
fxRhvZOlszwdp1oIY7pa+hEwDwYDVR0RBAgwBocEM3CyMTAJBgNVHRMEAjAAMAsG
A1UdDwQEAwIFoDATBgNVHSUEDDAKBggrBgEFBQcDATANBgkqhkiG9w0BAQsFAAOC
AQEAKp8TiUAjsXxKC7aA9hbDoP9dMtk4pnT8KObuAqDFkAoR3RsquiabFux+DVI5
0fmZJrw9FEHbywvQIUAq3zkFd0C1VgqQjosRLygdIp5SpWbG7kRC3wPsp9gtNr55
Lk7wc/iiv/0hlp4RD9JSJSdtAZKm2lt5rISsdB6ETUrbXTyUDpvHR/4P2pEh9DRV
flN5Xx5MRyRx78c4pM5yNHx6gkJjemA3PvIPTg4AAlwRtmqcDFU0jYy2rMCulsdb
jMm/Q6U0XkrdUuitMqdkQY4TrJBjTHl8wljAYkDjQA/Dq1eMmlD4uTZVH6puXPW6
SyUthNGS8Y4dUjjyDNlDG4MT+w==
-----END CERTIFICATE-----
[ec2-user@ip-10-0-10-81 ~]$



Task 7 – PHP front-end deployment with templates

task7_files_templates_created.png

```
touch files/index.php
touch templates/nginx.conf.j2
ls -R
.:
README.md    hosts      modules           templates                 terraform.tfvars
ansible.cfg  locals.tf  my-playbook.yaml  terraform.tfstate         variables.tf
files        main.tf    outputs.tf        terraform.tfstate.backup

./files:
index.php

./modules:
subnet  webserver

./modules/subnet:
main.tf  outputs.tf  variables.tf

./modules/webserver:
main.tf  outputs.tf  variables.tf

./templates:
nginx.conf.j2
```

task7_index_php_content.png

```
        <div class="info"><span class="label">Public IP:</span> <?= htmlspecialchars($public_ip)
?></div>
        <div class="info"><span class="label">Public DNS:</span>
            <a href="https://<?= htmlspecialchars($public_dns) ?>" target="_blank">
            https://<?= htmlspecialchars($public_dns) ?></a>
        </div>
        <div class="info"><span class="label">Deployed:</span> <?= $deployed_date ?></div>
        <div class="info"><span class="label">Status:</span> ✅ Active and Running</div>
        <div class="info"><span class="label">Managed By:</span> Terraform + Ansible</div>
    </div>
</body>
```

task7_nginx_conf_template.png

templates > nginx.conf.j2

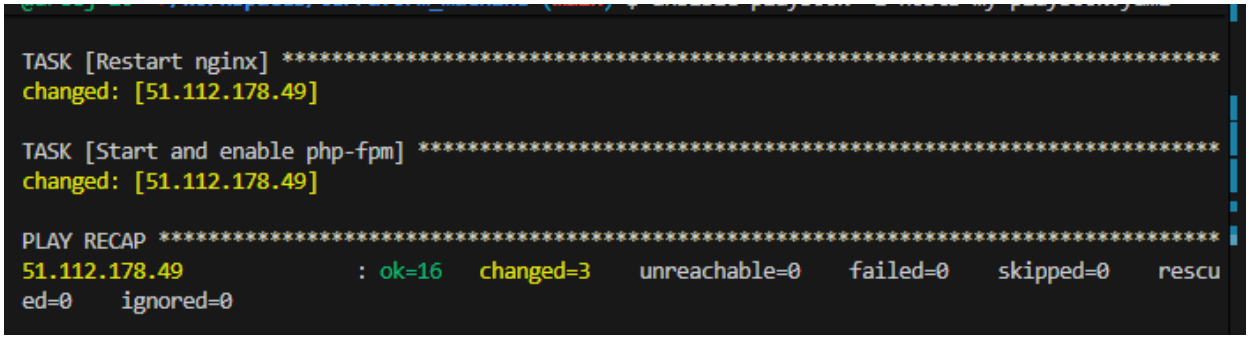
```
user nginx;
worker_processes auto;
error_log /var/log/nginx/error.log notice;
pid /run/nginx.pid;

events {
    worker_connections 1024;
}

http {
    log_format  main  '$remote_addr - $remote_user [$time_local] "$reque
                      '$status $body_bytes_sent "$http_referer"'
                      '"$http_user_agent" "$http_x_forwarded_for"';

    access_log  /var/log/nginx/access.log  main;

    sendfile            on;
    tcp_nopush          on;
```

task7_my_playbook_web_deploy.png

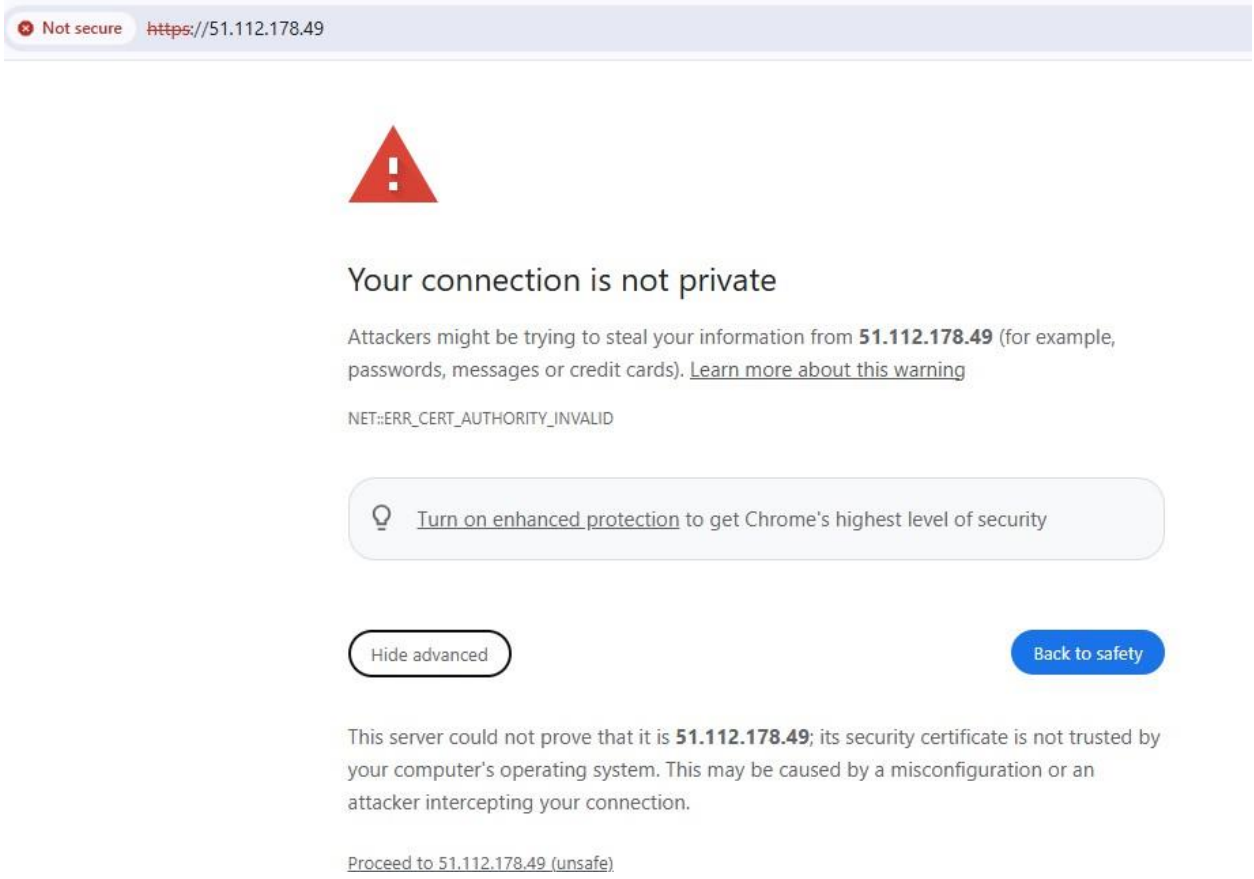
my-playbook.yaml

```
  - name: Configure SSL certificates

- name: Deploy Nginx website and configuration files
  hosts: nginx
  become: true
  tasks:
    - name: install php-fpm and php-curl
      yum:
        name:
          - php-fpm
          - php-curl
        state: present

    - name: Copy website files
      copy:
        src: files/index.php
        dest: /usr/share/nginx/html/index.php
        owner: nginx
```

task7_ansible_play_web_deploy.png



task7_php_https_browser.png



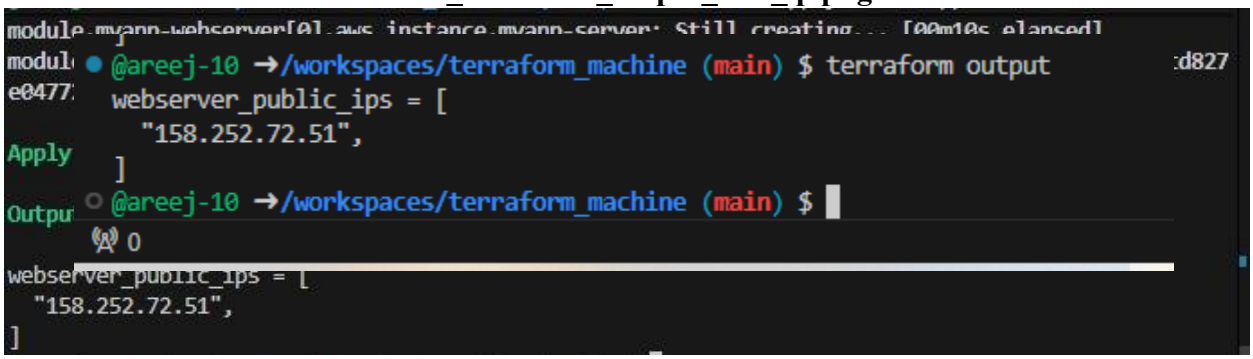
Task 8 – Docker & Docker Compose provisioning via Ansible

task8_terraform_destroy_old.png

```
module.myapp-webserver[0].aws_instance.myapp-server: Destruction complete after 31s
module.myapp-webserver[0].aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-0]
module.myapp-webserver[0].aws_security_group.web_sg: Destroying... [id=sg-0ecd1cb1aba9b8eb2]
module.myapp-webserver[1].aws_key_pair.ssh-key: Destruction complete after 1s
module.myapp-webserver[0].aws_key_pair.ssh-key: Destruction complete after 0s
module.myapp-webserver[1].aws_security_group.web_sg: Destruction complete after 1s
module.myapp-webserver[0].aws_security_group.web_sg: Destruction complete after 0s
module.myapp-webserver[2].aws_instance.myapp-server: Still destroying... [id=i-0cf6ca868d836cdb5,
 00m40s elapsed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Still destroying... [id=igw-036e2fb927ea9ba06
, 00m40s elapsed]
```

task8_terraform_apply_docker_instance.png

task8_terraform_output_new_ip.png



task8_hosts_docker_servers.png

hosts

```
[docker_servers]
158.252.72.51

[docker_servers:vars]
ansible_ssh_private_key_file=~/.ssh/id_ed25519
ansible_user=ec2-user
```

task8_my_playbook_docker.png

my-playbook.yaml

```
---
- name: Configure Docker
  hosts: all
  become: true
  tasks:
    - name: install docker and update cache
      yum:
        name: docker
        state: present
        update_cache: yes

- name: Install Docker Compose
  hosts: all
  become: true
  gather_facts: true
  tasks:
    - name: create docker cli-plugins directory
      file:
```

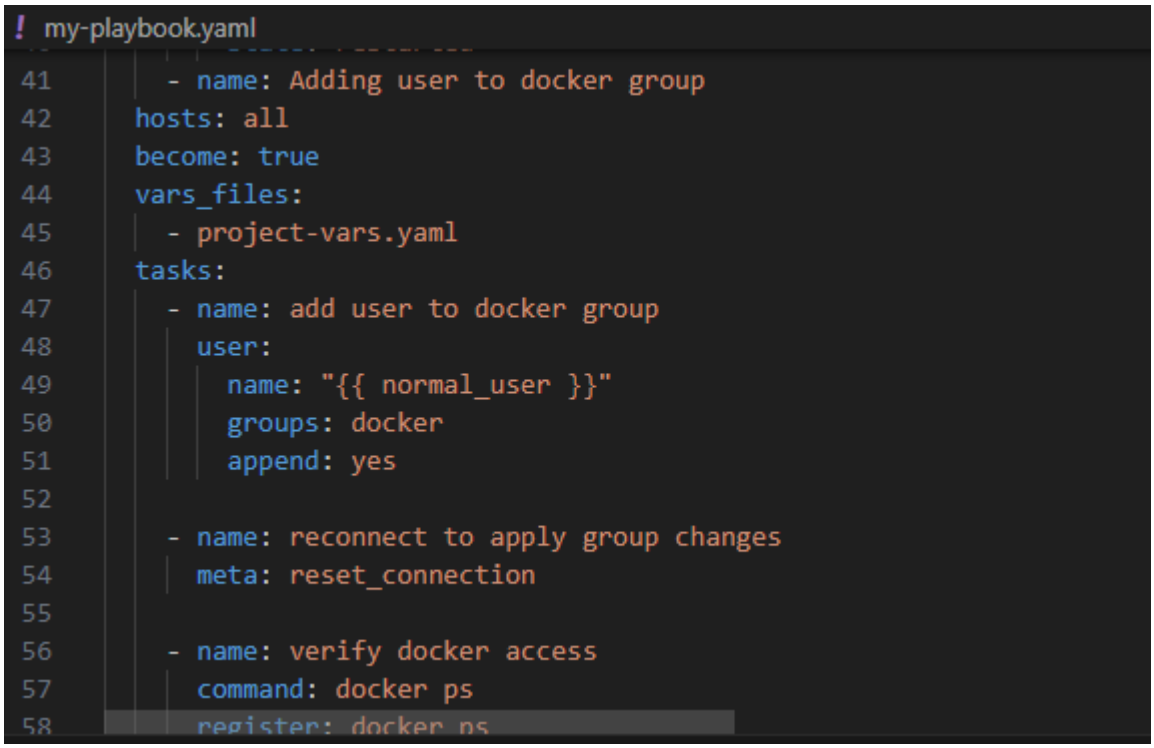
task8_ansible_play_docker.png

```
/workspaces/terraform_machine (main) $ terraform output
/workspaces/terraform_machine (main) $ ansible-playbook -i hosts my-playbook.yaml

PLAY [Configure Docker] ********************************************************************

TASK [Gathering Facts] *********************************************************************
ok: [158.252.72.51]

TASK [install docker and update cache] *****************************************************
```

task8_docker_ps_remote.png

Task 9 – Gitea Docker stack via Ansible + Terraform security group update

task9_my_playbook_add_user_to_docker.png



task9_project_vars.png

index.php U | nginx.conf.j2 U | my-playbook.yaml U | project-v

project-vars.yaml

```
1   normal_user: ec2-user
2   docker_compose_file_location: "."
```

task9_my_playbook_deploy_containers.png

```
  - name: Deploy Docker Containers
hosts: all
become: true
user: "{{ normal_user }}"
vars_files:
  - project-vars.yaml
tasks:
  - name: check if docker-compose file exists
    stat:
      path: /home/{{ normal_user }}/compose.yaml
    register: compose_file

  - name: copy docker-compose file
    copy:
      src: "{{ docker_compose_file_location }}/compose.yaml"
      dest: /home/{{ normal_user }}/compose.yaml
      mode: '0644'
    when: not compose_file.stat.exists
```

task9_compose_yaml.png

compose.yaml

```yaml
services:
  gitea:
    image: gitea/gitea:latest
    container_name: gitea
    environment:
      - DB_TYPE=postgres
      - DB_HOST=db:5432
      - DB_NAME=gitea
      - DB_USER=gitea
      - DB_PASSWD=gitea
    restart: always
    volumes:
      - gitea:/data
    ports:
      - 3000:3000
    extra_hosts:
      - "www.jenkins.com:host-gateway"
    networks:
```

PROBLEMS OUTPUT TERMINAL ··· bash - terraform_machine

task9_ansible_play_gitea.png

```
TASK [copy docker-compose file] ************************************************************
skipping: [158.252.72.51]

TASK [deploy containers using docker-compose] **********************************************
ok: [158.252.72.51]

PLAY RECAP *********************************************************************************
158.252.72.51              : ok=5    changed=0    unreachable=0    failed=0    skipped=1    rescu
ed=0    ignored=0
```

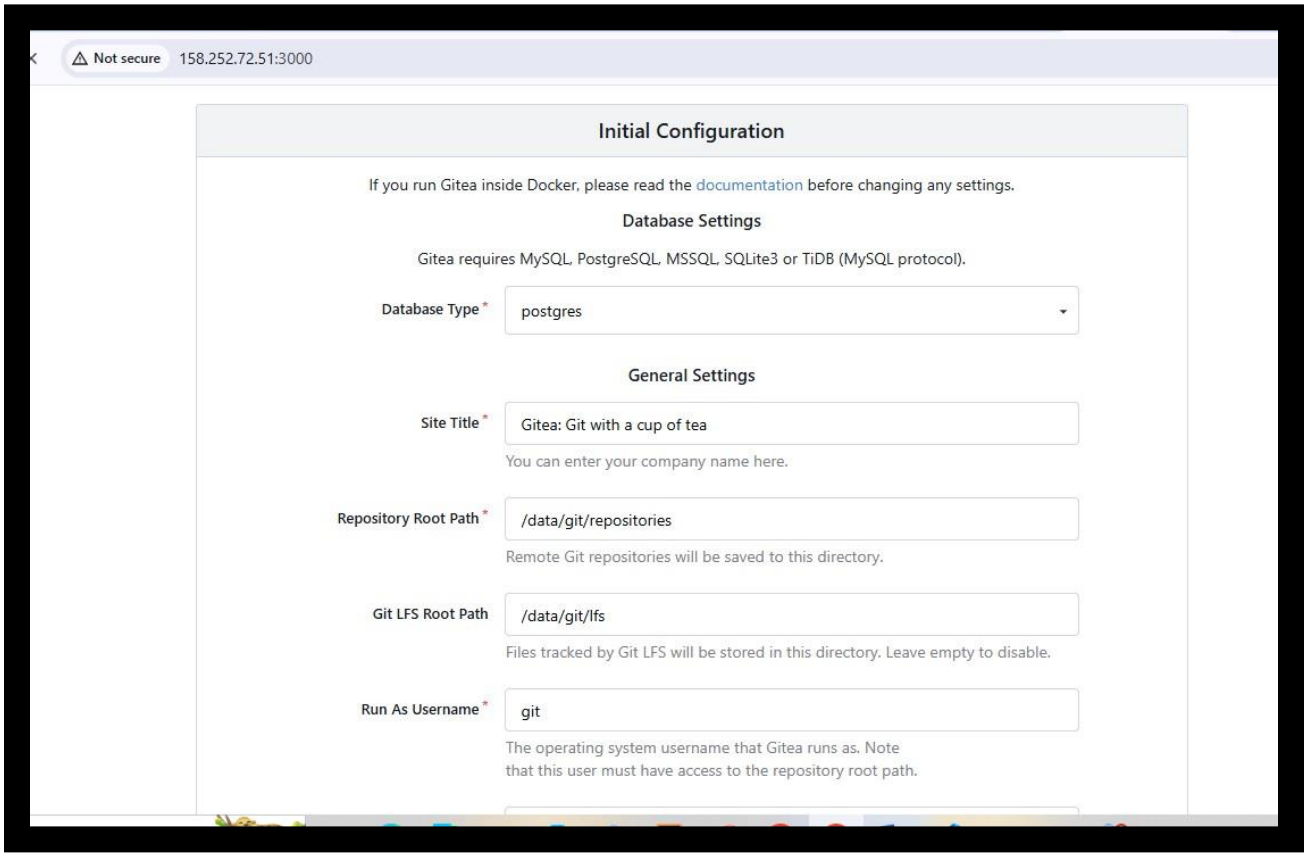
task9_sg_ingress_3000.png

```
}
 ingress {
  from_port   = 3000
  to_port     = 3000
  protocol    = "tcp"
  cidr_blocks = ["0.0.0.0/0"]
}
```

task9_terraform_apply_sg_3000.png

```
module.myapp-webserver[0].aws_security_group.web_sg: Modifying... [id=sg-04563a7d2eb42fa67]
module.myapp-webserver[0].aws_security_group.web_sg: Modifications complete after 2s [id=sg-04563
a7d2eb42fa67]

Apply complete! Resources: 0 added, 1 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "158.252.72.51",
]
```

task9_gitea_browser.png



Task 10 – Automating Ansible with Terraform (null_resource)

task10_null_resource_main_tf.png

main.tf

```
}
resource "null_resource" "configure_server" {
  triggers = {
    webserver_public_ips_for_ansible = join(",", [for i in module.myapp-
  }

  depends_on = [module.myapp-webserver]

  provisioner "local-exec" {
    command = <<-EOT
      ansible-playbook -i ${self.triggers.webserver_public_ips_for_ansib
      --private-key "${var.private_key}" --user ec2-user \
      my-playbook.yaml
    EOT
  }
}
```

task10_terraform_destroy_before_null.png

```
module.myapp-webserver[0].aws_instance.myapp-server: Destruction complete after 30s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destroying... [id=subnet-094eafdd3b8c854ce]
module.myapp-webserver[0].aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-0]
module.myapp-webserver[0].aws_security_group.web_sg: Destroying... [id=sg-04563a7d2eb42fa67]
module.myapp-webserver[0].aws_key_pair.ssh-key: Destruction complete after 1s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destruction complete after 1s
module.myapp-webserver[0].aws_security_group.web_sg: Destruction complete after 1s
aws_vpc.myapp_vpc: Destroying... [id=vpc-0999dcc606103fb9a]
aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 7 destroyed.
```

task10_terraform_apply_with_local_exec.png

```
Error: local-exec provisioner error

  with null_resource.configure_server,
  on main.tf line 46, in resource "null_resource" "configure_server":
  46:   provisioner "local-exec" {

Error running command 'ansible-playbook -i 3.28.39.62, \
--private-key "~/.ssh/id_ed25519" --user ec2-user \
my-playbook.yaml
': exit status 127. Output: [WARNING]: Ansible is being run in a world writable directory
(/workspaces/terraform_machine), ignoring it as an ansible.cfg source. For more information
see
```

task10_my_playbook_wait_for_ssh.png

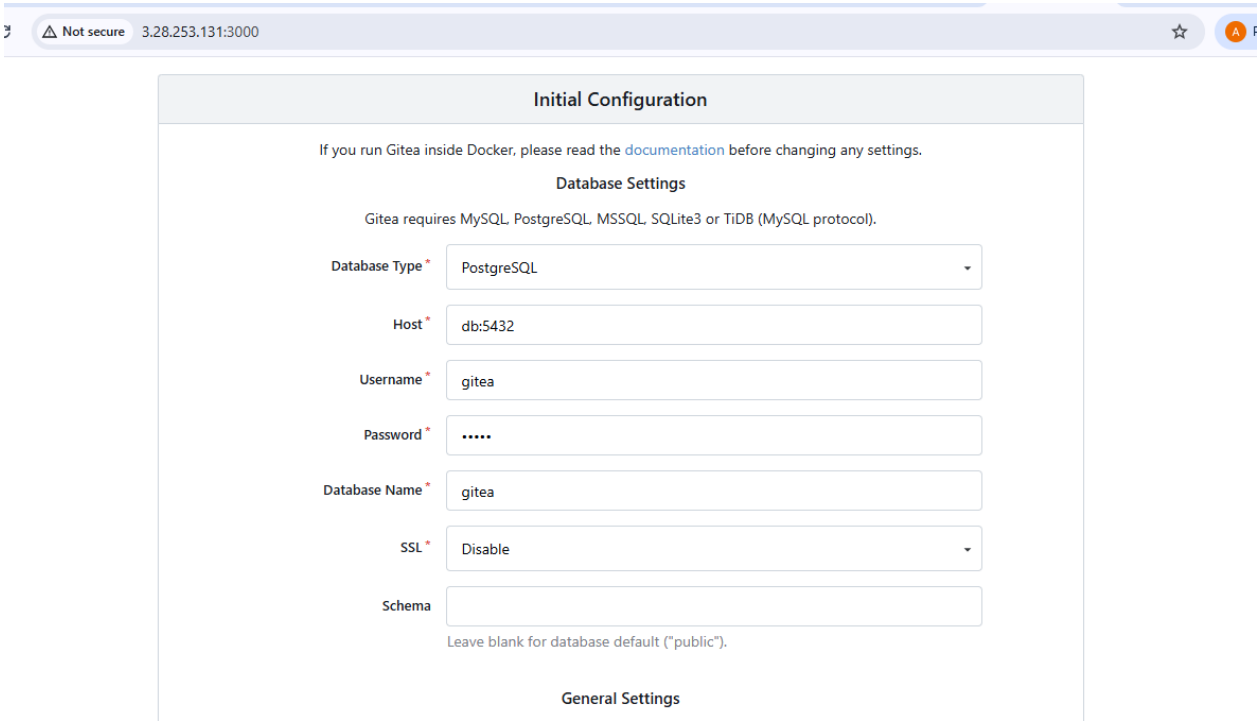
my-playbook.yaml

```yaml
---
- name: Wait for some time to ensure system readiness
  hosts: all
  tasks:
    - name: Wait 300 seconds for port 22 to become open and contain "Ope
      wait_for:
        port: 22
        host: "{{ inventory_hostname }}"
        delay: 10
        timeout: 300
      delegate_to: localhost

- name: Configure Docker
  hosts: all
  become: true
  tasks:
    - name: install docker and update cache
      yum:
```

task10_terraform_apply_after_wait.png

```
terraform apply -auto-approve

null_resource.configure_server: Creation complete after 1m56s [id=7563915408642739819]

Apply complete! Resources: 8 added, 0 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "3.28.253.131",
]
```

task10_app_browser_post_null_resource.png



Task 11 – Dynamic inventory with aws_ec2 plugin

task11_ansible_cfg_aws_ec2.png

ansible.cfg

```
[defaults]
host_key_checking=False
interpreter_python = /usr/bin/python3
deprecation_warnings = False
enable_plugins = aws_ec2
private_key_file = ~/.ssh/id_ed25519
```

task11_inventory_aws_ec2_created.png

task11_inventory_aws_ec2_initial.png

```
ls -la inventory_aws_ec2.yaml
-rw-rw-rw- 1 codespace codespace 0 Jan 16 18:24 inventory_aws_ec2.yaml
```

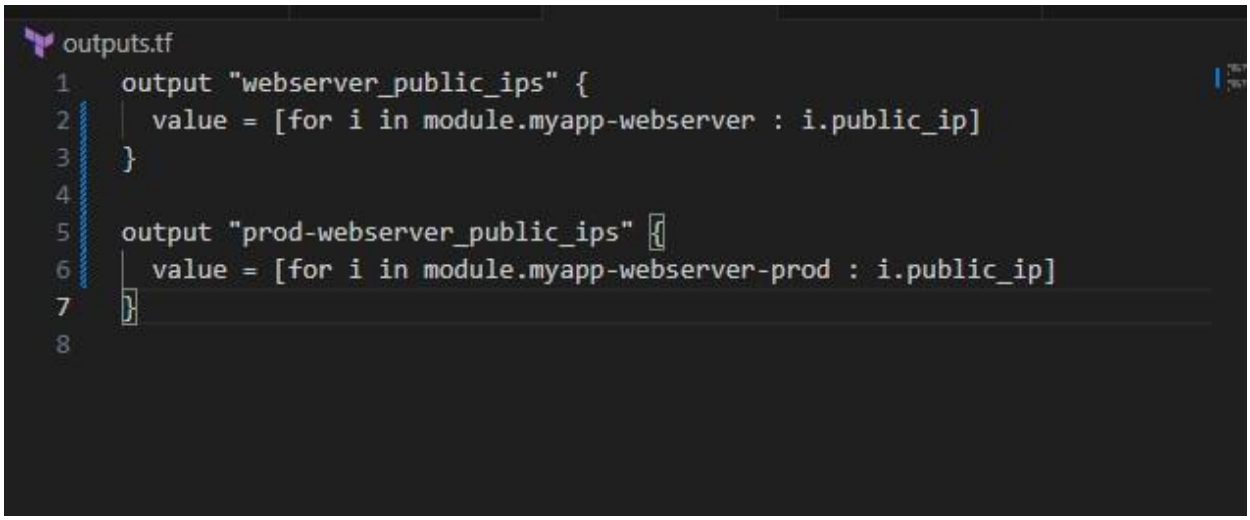
inventory_aws_ec2.yaml

```
---
plugin: aws_ec2
regions:
  - me-central-1
```

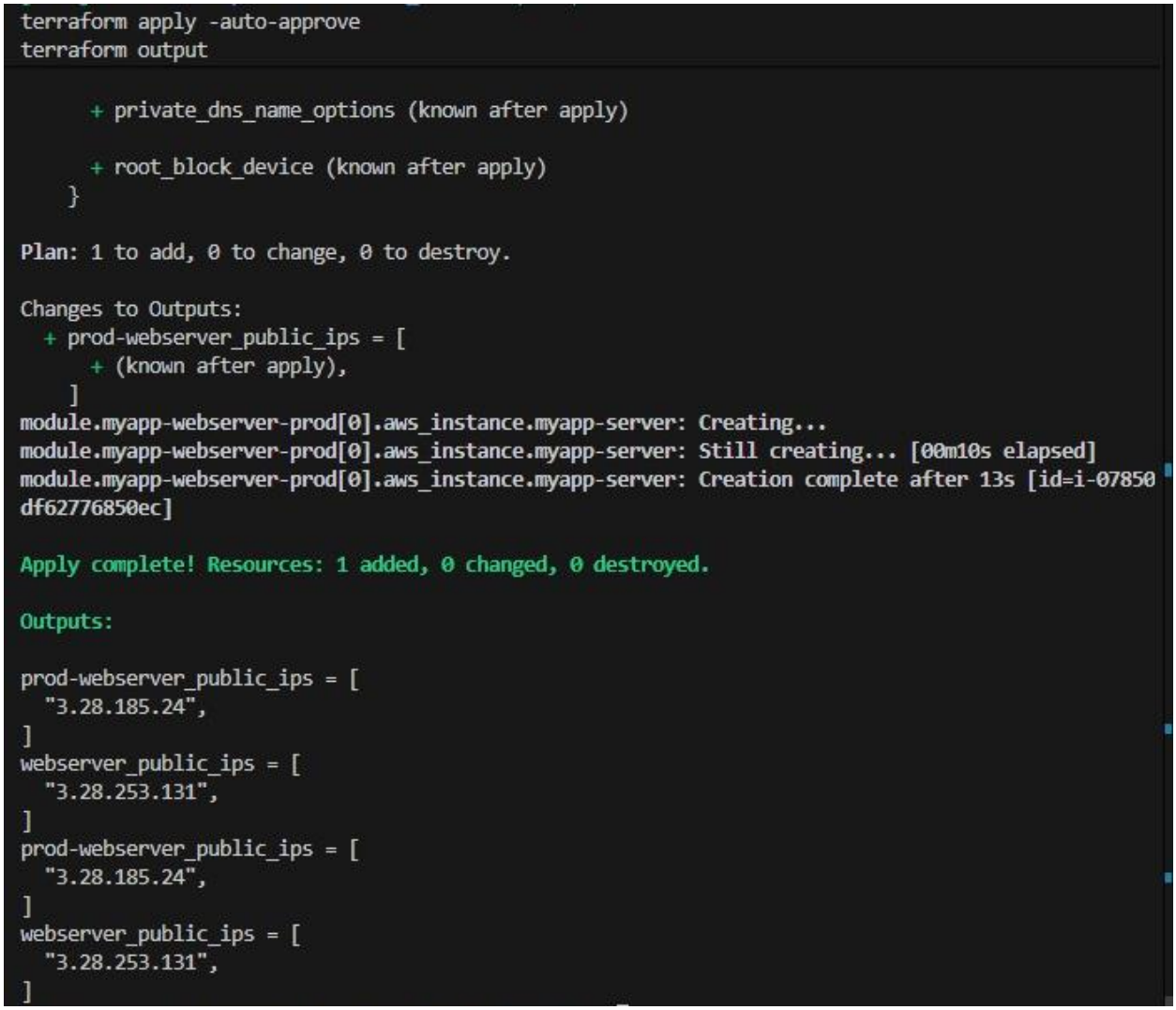
task11_main_tf_dev_prod_modules.png

```
# PROD Webserver Module
module "myapp-webserver-prod" {
  source = "./modules/webserver"
  env_prefix = "prod"
  instance_type = "t3.nano"
  availability_zone = var.availability_zone
  public_key = var.public_key
  my_ip = local.my_ip
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_id = module.myapp-subnet.subnet.id

  count             = 1
  instance_suffix   = count.index
}
```

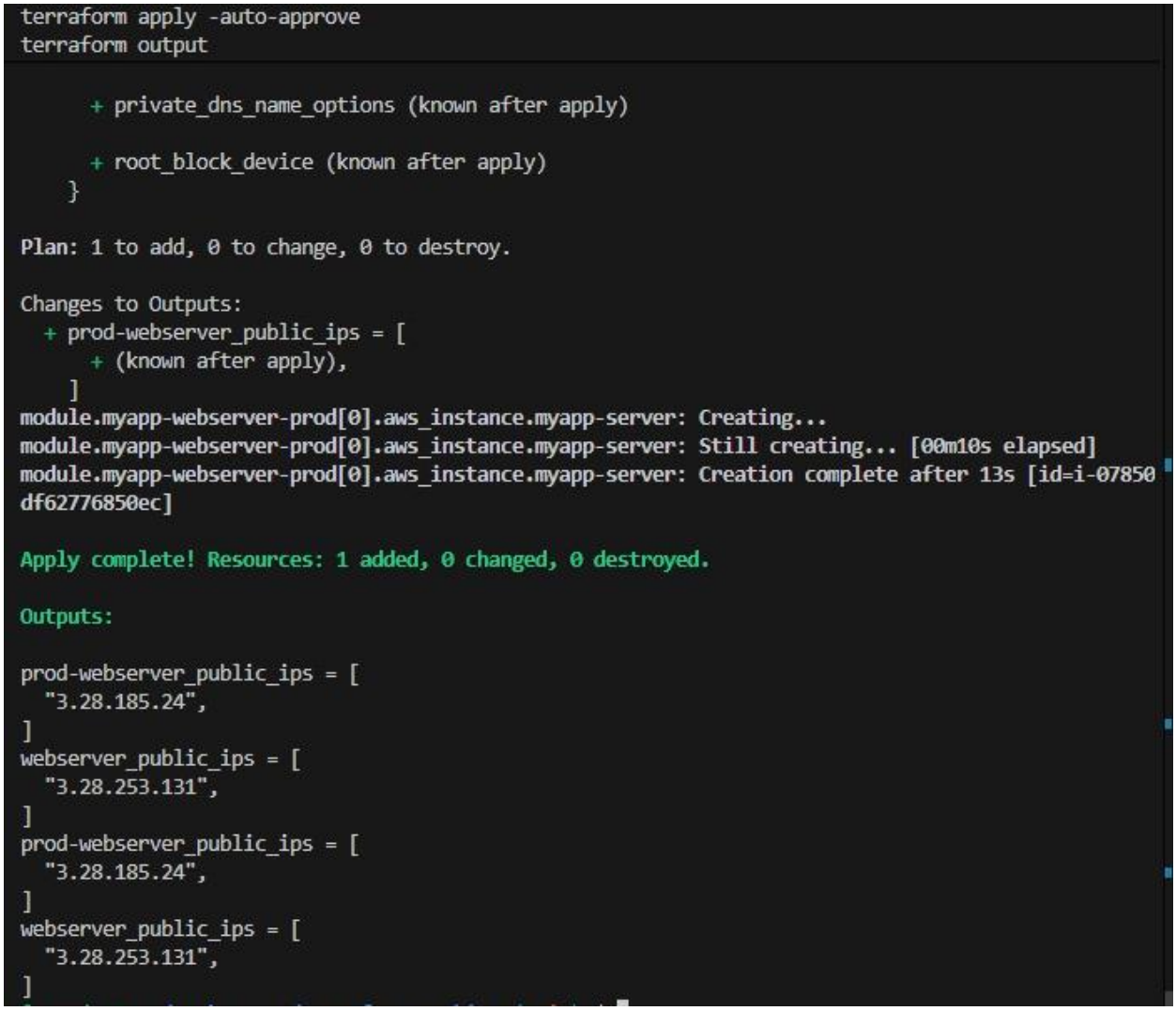
task11_outputs_tf_dev_prod_ips.png



task11_terraform_apply_dynamic_setup.png



task11_terraform_output_dynamic_ips.png



task11_boto_install.png

```
Collecting boto3
  Downloading boto3-1.42.29-py3-none-any.whl.metadata (6.8 kB)
Collecting botocore
  Downloading botocore-1.42.29-py3-none-any.whl.metadata (5.9 kB)
Collecting jmespath<2.0.0,>=0.7.1 (from boto3)
  Downloading jmespath-1.0.1-py3-none-any.whl.metadata (7.6 kB)
Collecting s3transfer<0.17.0,>=0.16.0 (from boto3)
  Downloading s3transfer-0.16.0-py3-none-any.whl.metadata (1.7 kB)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /home/codespace/.local/lib/python3.
12/site-packages (from botocore) (2.9.0.post0)
Requirement already satisfied: urllib3!=2.2.0,<3,>=1.25.4 in /home/codespace/.local/lib/python3.1
2/site-packages (from botocore) (2.5.0)
Requirement already satisfied: six>=1.5 in /home/codespace/.local/lib/python3.12/site-packages (f
rom python-dateutil<3.0.0,>=2.1->botocore) (1.17.0)
Downloading boto3-1.42.29-py3-none-any.whl (140 kB)
Downloading botocore-1.42.29-py3-none-any.whl (14.6 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 14.6/14.6 MB 27.7 MB/s  0:00:00
Downloading jmespath-1.0.1-py3-none-any.whl (20 kB)
Downloading s3transfer-0.16.0-py3-none-any.whl (86 kB)
Installing collected packages: jmespath, botocore, s3transfer, boto3
Successfully installed boto3-1.42.29 botocore-1.42.29 jmespath-1.0.1 s3transfer-0.16.0
```

task11_boto_version.png

```
➜ /workspaces/terraform machine (main) $ $(which python) -c "import boto3, botocore; pr
int(boto3.__version__)"
1.42.29
```

task11_ansible_inventory_graph_initial.png

```
<<< caused by >>>

inventory config '/workspaces/terraform_machine/inventory_aws_ec2.yaml' specifies unknown plugin
'aws_ec2'
Origin: <inventory plugin 'auto' with source '/workspaces/terraform_machine/inventory_aws_ec2.yam
l'>

[WARNING]: Failed to parse inventory with 'yaml' plugin: Plugin configuration YAML file, not YAML
 inventory

Failed to parse inventory with 'yaml' plugin.

<<< caused by >>>

Plugin configuration YAML file, not YAML inventory
Origin: <inventory plugin 'yaml' with source '/workspaces/terraform_machine/inventory_aws_ec2.yam
l'>

[WARNING]: Failed to parse inventory with 'ini' plugin: Failed to parse inventory: Invalid host p
attern '---' supplied, '---' is normally a sign this is a YAML file.

Failed to parse inventory with 'ini' plugin.

<<< caused by >>>

Failed to parse inventory: Invalid host pattern '---' supplied, '---' is normally a sign this is
a YAML file.
Origin: /workspaces/terraform_machine/inventory_aws_ec2.yaml

[WARNING]: Unable to parse /workspaces/terraform_machine/inventory_aws_ec2.yaml as an inventory s
ource
[WARNING]: No inventory was parsed, only implicit localhost is available
@all:
  |--@ungrouped:
```

Task 12 – Filtering EC2 instances by tags & instance type

task12_inventory_aws_ec2_tag_groups.png

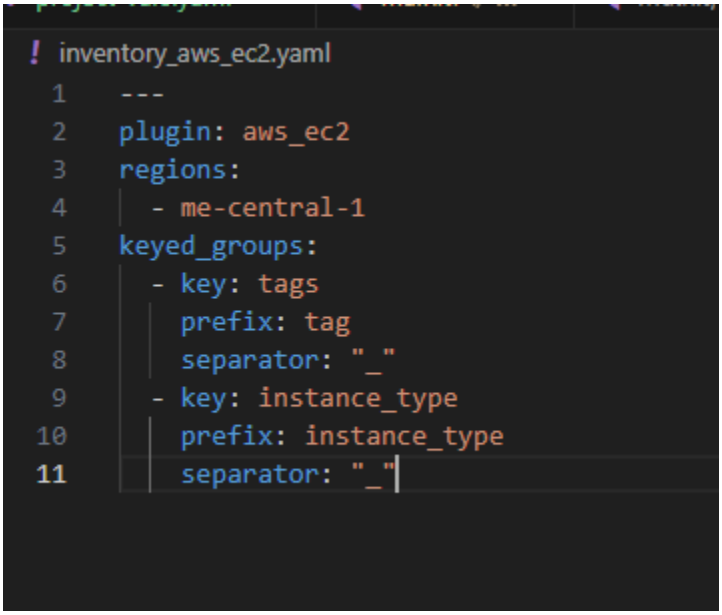
! inventory_aws_ec2.yaml

```yaml
---
plugin: aws_ec2
regions:
  - me-central-1
keyed_groups:
  - key: tags
    prefix: tag
    separator: "_"
```

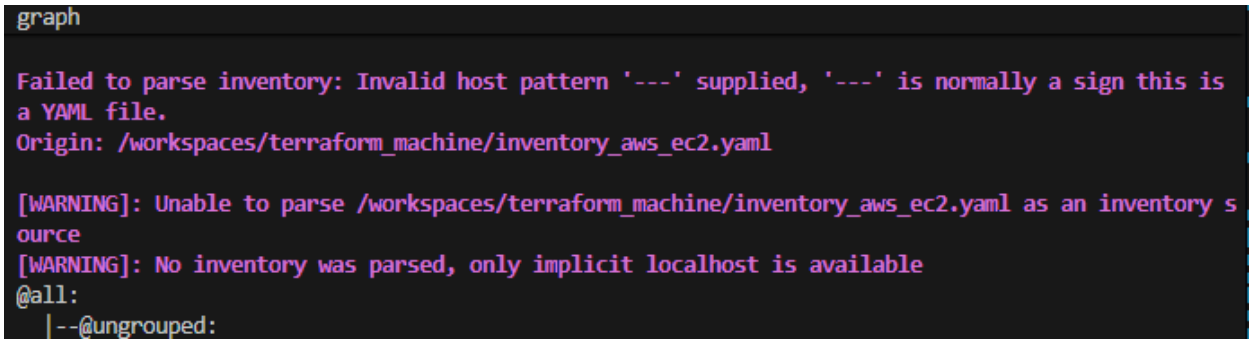
task12_inventory_graph_tag_groups.png

```
graph

Failed to parse inventory: Invalid host pattern '---' supplied, '---' is normally a sign this is
a YAML file.
Origin: /workspaces/terraform_machine/inventory_aws_ec2.yaml

[WARNING]: Unable to parse /workspaces/terraform_machine/inventory_aws_ec2.yaml as an inventory s
ource
[WARNING]: No inventory was parsed, only implicit localhost is available
@all:
  |--@ungrouped:
```

task12_inventory_aws_ec2_instance_type_groups.png



task12_inventory_graph_full.png



task12_my_playbook_all_hosts.png

my-playbook.yaml U | compose.yaml U | main.tf .../webserver M | project-vars

my-playbook.yaml

```yaml
---
- name: Configure nginx web server
  hosts: all
  become: true
  tasks:
    - name: install nginx and update cache
      yum:
        name: nginx
        state: present
        update_cache: yes

    - name: install openssl
      yum:
        name: openssl
        state: present

    - name: start nginx server
```

task12_ansible_play_all.png

```
playbook.yaml
skipping: no hosts matched

PLAY [Configure SSL certificates] **********************************************
skipping: no hosts matched

PLAY [Deploy Nginx website and configuration files] ****************************
skipping: no hosts matched

PLAY RECAP *********************************************************************
```

task12_ansible_play_dev_only.png

```
tag_Name_dev_* my-playbook.yaml
skipping: no hosts matched

PLAY [Configure SSL certificates] ***********************************************************
skipping: no hosts matched

PLAY [Deploy Nginx website and configuration files] ******************************************
skipping: no hosts matched

PLAY RECAP **********************************************************************************
```

task12_ansible_play_prod_only.png

task12_ansible_play_t3_micro.png

```
tag_Name_prod_* my-playbook.yaml
skipping: no hosts matched
tag_Name_prod_* my-playbook.yaml
skipping: no hosts matched

PLAY [Configure SSL certificates] ***********************************************************
skipping: no hosts matched

PLAY [Deploy Nginx website and configuration files] ******************************************
skipping: no hosts matched

PLAY RECAP **********************************************************************************
```

task12_ansible_play_t3_nano.png

```
tag_Name_prod_* my-playbook.yaml
skipping: no hosts matched

PLAY [Configure SSL certificates] *********************************************************
skipping: no hosts matched

PLAY [Deploy Nginx website and configuration files] ***************************************
skipping: no hosts matched

PLAY RECAP ********************************************************************************
```

task12_ansible_cfg_inventory_default.png

```
aybook.yaml
kipping: no hosts matched

LAY [Configure SSL certificates] **********************************************************
kipping: no hosts matched

LAY [Deploy Nginx website and configuration files] ****************************************
kipping: no hosts matched

LAY RECAP *********************************************************************************
```

Task 13 – Ansible roles: nginx, ssl, webapp

task13_main_tf_single_dev.png

main.tf M | main.tf .../subnet | outputs.tf M | ansible.cfg U | inventor

main.tf

```
provider "aws" {
  shared_config_files      = ["~/.aws/config"]
  shared_credentials_files = ["~/.aws/credentials"]
}

resource "aws_vpc" "myapp_vpc" {
  cidr_block = var.vpc_cidr_block
  enable_dns_hostnames = true
  tags = {
    Name = "${var.env_prefix}-vpc"
  }
}

module "myapp-subnet" {
  source = "./modules/subnet"
  vpc_id = aws_vpc.myapp_vpc.id
  subnet_cidr_block = var.subnet_cidr_block
  availability_zone = var.availability_zone
```

task13_ansible_structure_created.png

task13_ansible_cfg_project.png

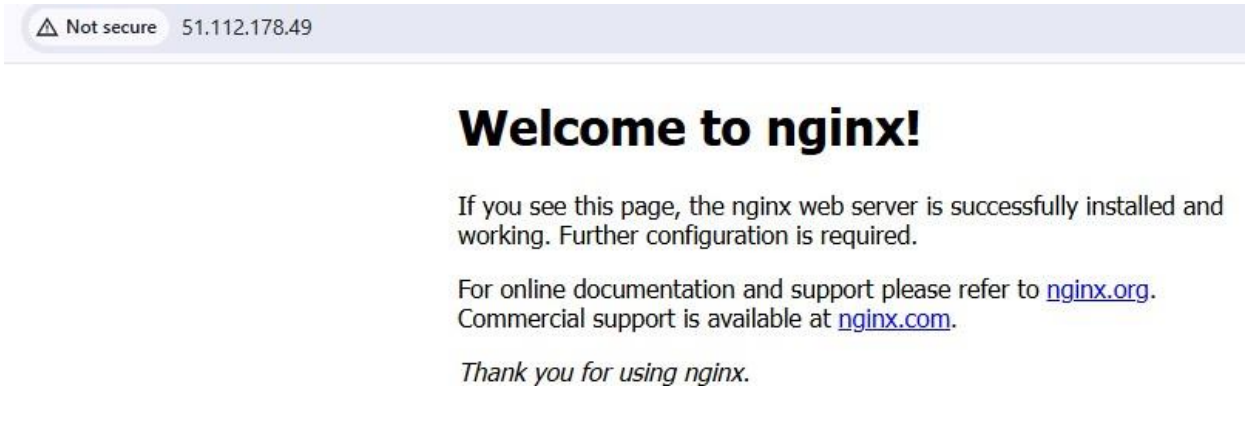
```
mkdir inventory roles
touch ansible.cfg my-playbook.yaml
ls -R
.:
ansible.cfg  inventory  my-playbook.yaml  roles

./inventory:

./roles:
```

ansible.cfg

```
[defaults]
host_key_checking = False
interpreter_python = /usr/bin/python3
```

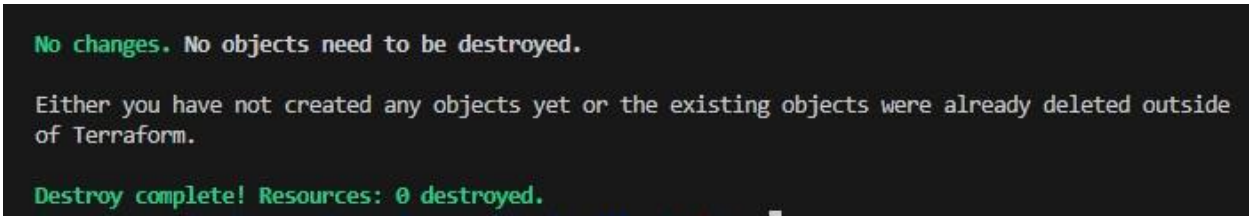
task13_webapp_tasks_main.png

task13_php_https_browser_roles.png



Cleanup

cleanup_terraform_destroy.png



cleanup_tfstate.png

cleanup_aws_console.png