



DEPARTMENT OF SOFTWARE ENGINEERING

LAB#14

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Task 0 – Lab Setup (Codespace & GH CLI)

task0_codespace_open.png

The screenshot shows the GitHub repository page for `terraform_machine`, which is a public repository forked from `WaqasSaleem97/terraform_machine`. The repository has 1 branch (main) and 0 tags. The main branch is up to date with the upstream repository. The repository contains the following files:

File	Commit Message	Commit Date
modules	Add files via upload	2 weeks ago
.gitignore	Add files via upload	2 weeks ago
README.md	Add files via upload	2 weeks ago
locals.tf	Add files via upload	2 weeks ago
main.tf	Update main.tf	last week
outputs.tf	Add files via upload	2 weeks ago

The screenshot shows the Visual Studio Code interface with the `terraform_machine` repository open in a Codespace. The Explorer view on the left shows the file structure:

- TERRAFORM_MACHINE [CODESPACES]
 - modules
 - .gitignore
 - locals.tf
 - main.tf
 - outputs.tf
 - README.md
 - variables.tf

The main editor area displays a large, faint watermark of the Visual Studio Code logo. The bottom status bar shows the current file is `main.tf` and the terminal is open.

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+zIqenvDnbXjC35A7aPSN4K9BC+Y codespace@codespaces-feaa13
The key's randomart image is:
+--[ED25519 256]--+
|                 |
|                 |
|                 |
|                 |
|                 |
|                 |
|                 |
|                 |
|                 |
+---+

```

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-0208ef0ce18a8ce67]

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/ansible/plugins/modules']
  ansible python module location = /usr/local/py-utils/venvs/ansible-core/lib/python3.12/site-packages/ansible
  ansible collection location = /home/codespace/.ansible/collections:/usr/share/ansible/collections
  executable location = /usr/local/py-utils/bin/ansible
```

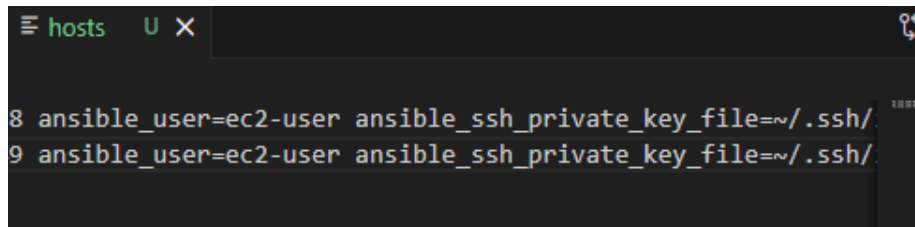
task2_terraform_output_ips.png

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

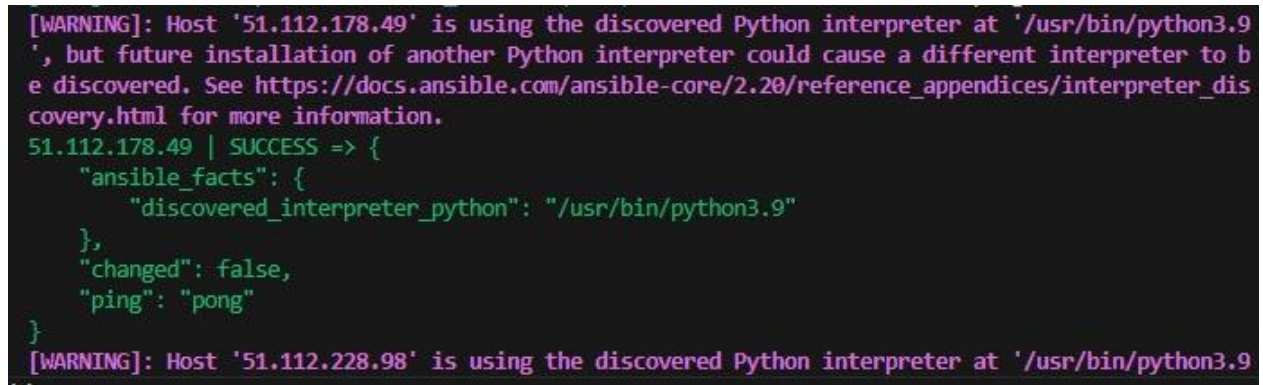
task2_hosts_created.png

```
version 0.0.0 (with libyaml 0.2.5)
→/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
22
23 module "myapp-webserver" {
24     source = "../modules/webserver"
25     env_prefix = var.env_prefix
26     instance_type = var.instance_type
27     availability_zone = var.availability_zone
28     public_key = var.public_key
29     my_ip = local.my_ip
30     vpc_id = aws_vpc.myapp_vpc.id
31     subnet_id = module.myapp-subnet.subnet.id
32
33     # Loop count
34     count = 3
35     # Use count.index to differentiate instances
36     instance_suffix = count.index
37
38 }
39
```

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

```
[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 be discovered. See https://docs.ansible.com/ansible-core/2.20/reference\_appendices/interpreter\_discovery.html for more information.
51.112.228.98 | SUCCESS => {
  "ansible_facts": {
    "discovered_interpreter_python": "/usr/bin/python3.9"
  },
  "changed": false,
  "ping": "pong"
}
```

task3_ansible_single_ip_ping.png

```
[WARNING]: Host '51.112.178.49' is using the discovered Python interpreter at '/usr/bin/python3.9', but future installation of another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/ansible-core/2.20/reference\_appendices/interpreter\_discovery.html for more information.
51.112.178.49 | SUCCESS => {
  "ansible_facts": {
    "discovered_interpreter_python": "/usr/bin/python3.9"
  },
  "changed": false,
  "ping": "pong"
}
```

task3_ansible_droplet_ping.png

```
[WARNING]: Host '3.29.232.128' is using the discovered Python interpreter at '/usr/bin/python3.9', but future installation of another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/ansible-core/2.20/reference\_appendices/interpreter\_discovery.html for more information.
3.29.232.128 | SUCCESS => {
  "ansible_facts": {
    "discovered_interpreter_python": "/usr/bin/python3.9"
  },
  "changed": false,
  "ping": "pong"
}
```

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 be discovered. See https://docs.ansible.com/ansible-core/2.20/reference\_appendices/interpreter\_discovery.html for more information.
51.112.228.98 | SUCCESS => {
  "ansible_facts": {
    "discovered_interpreter_python": "/usr/bin/python3.9"
  },
  "changed": false,
  "ping": "pong"
}
```

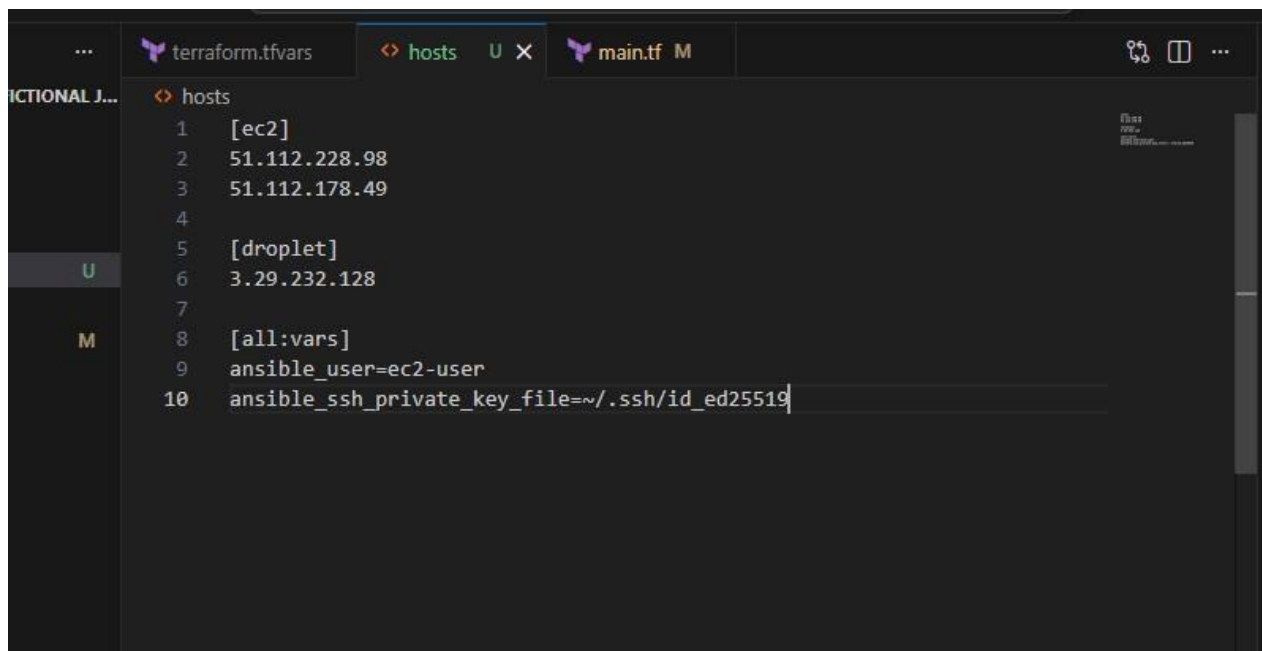
Task 4 – Global ansible.cfg & first nginx playbook

task4_global_nginx_cfg.png

```
": "pong"

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

task4_hosts_without_common_args.png



```
... terraform.tfvars hosts U x main.tf M
FUNCTIONAL J...
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_nginx_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
1  ---
2  - name: Configure nginx web server
3    hosts: ec2
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: start nginx server
13       service:
14         name: nginx
15         state: started

```

task4_ansible_play_ec2.png

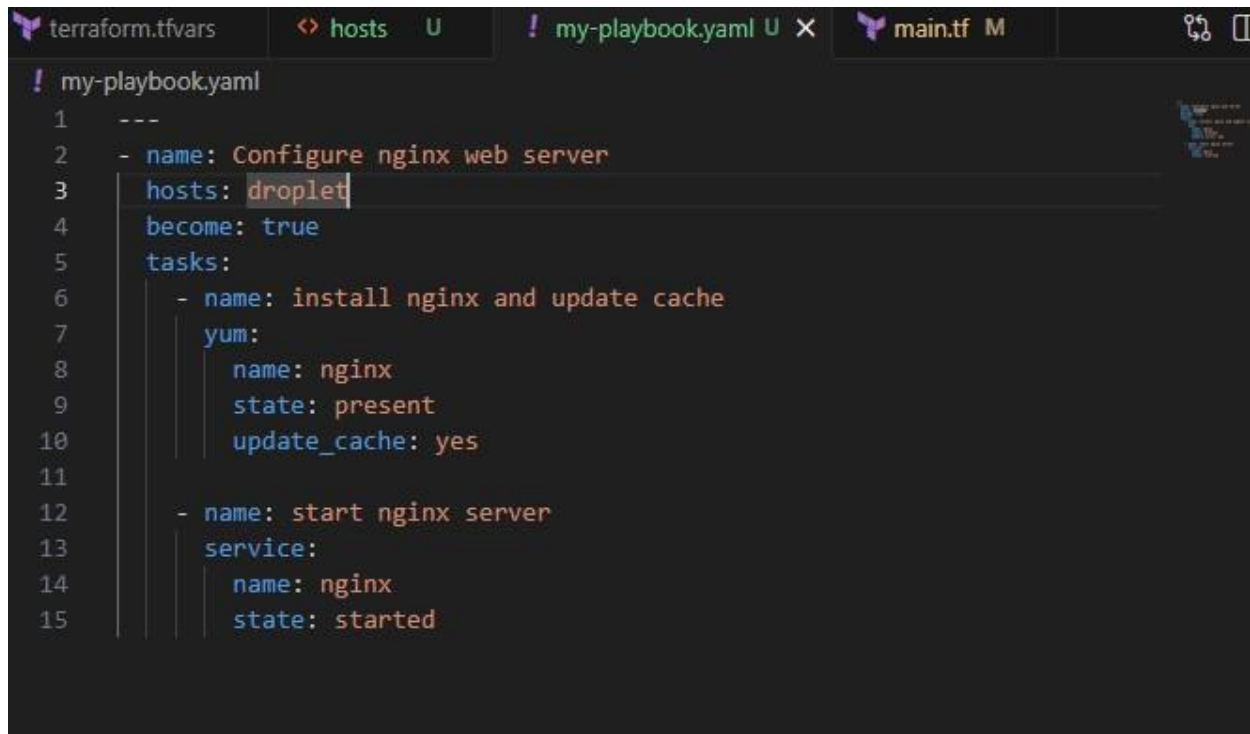
```
TASK [start nginx server] *****
changed: [51.112.178.49]
changed: [51.112.228.98]

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

task4_nginx_browser_ec2.png

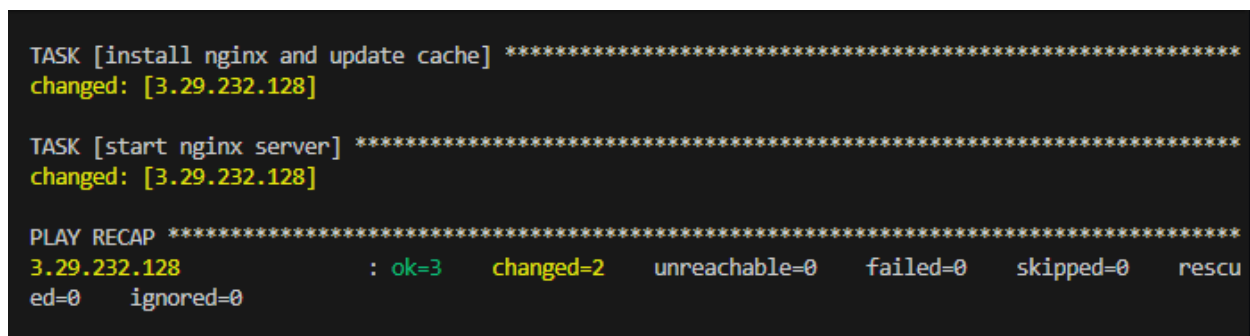


task4_my_playbook_droplet.png



```
! my-playbook.yaml
1  ---
2  - name: Configure nginx web server
3    hosts: droplet
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: start nginx server
13       service:
14         name: nginx
15         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    rescue=0    ignored=0
```

task4_nginx_browser_droplet.png

Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.

Task 5 – Single nginx target group & HTTPS prerequisites

task5_project_ansible_cfg_created.png

```
→/workspaces/terraform_machine (main) $ cd /workspaces/terraform_machine
ible.cfg
sible.cfg
- 1 codespace codespace 0 Jan 16 15:45 ansible.cfg
→/workspaces/terraform_machine (main) $
```

task5_project_ansible_cfg.png

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

task5_main_tf_count_1.png

```

main.tf
22
23 module "myapp-webserver" {
24     source = "../modules/webserver"
25     env_prefix = var.env_prefix
26     instance_type = var.instance_type
27     availability_zone = var.availability_zone
28     public_key = var.public_key
29     my_ip = local.my_ip
30     vpc_id = aws_vpc.myapp_vpc.id
31     subnet_id = module.myapp-subnet.subnet.id
32
33     # Loop count
34     count = 1
35     # Use count.index to differentiate instances
36     instance_suffix = count.index
37
38 }
39

```

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",
]

```

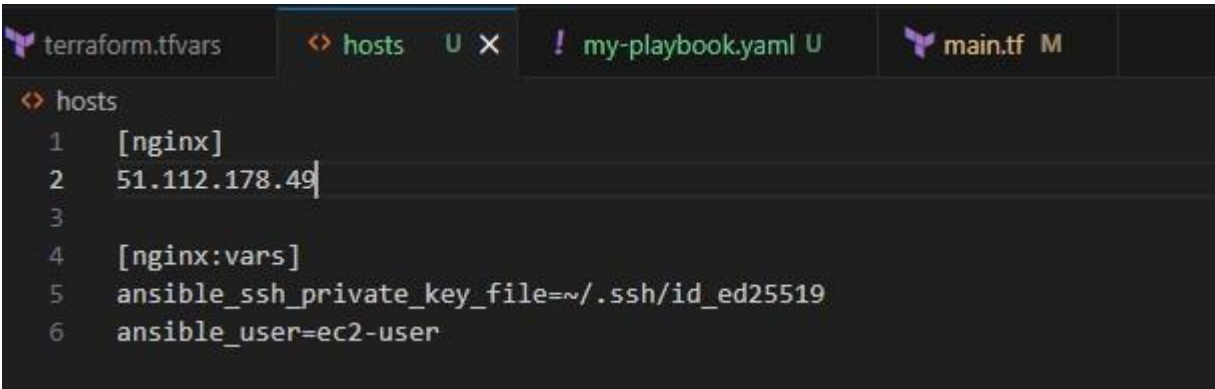
task5_terraform_output_single_ip.png

```

webserver_public_ips = [
    "51.112.228.98",

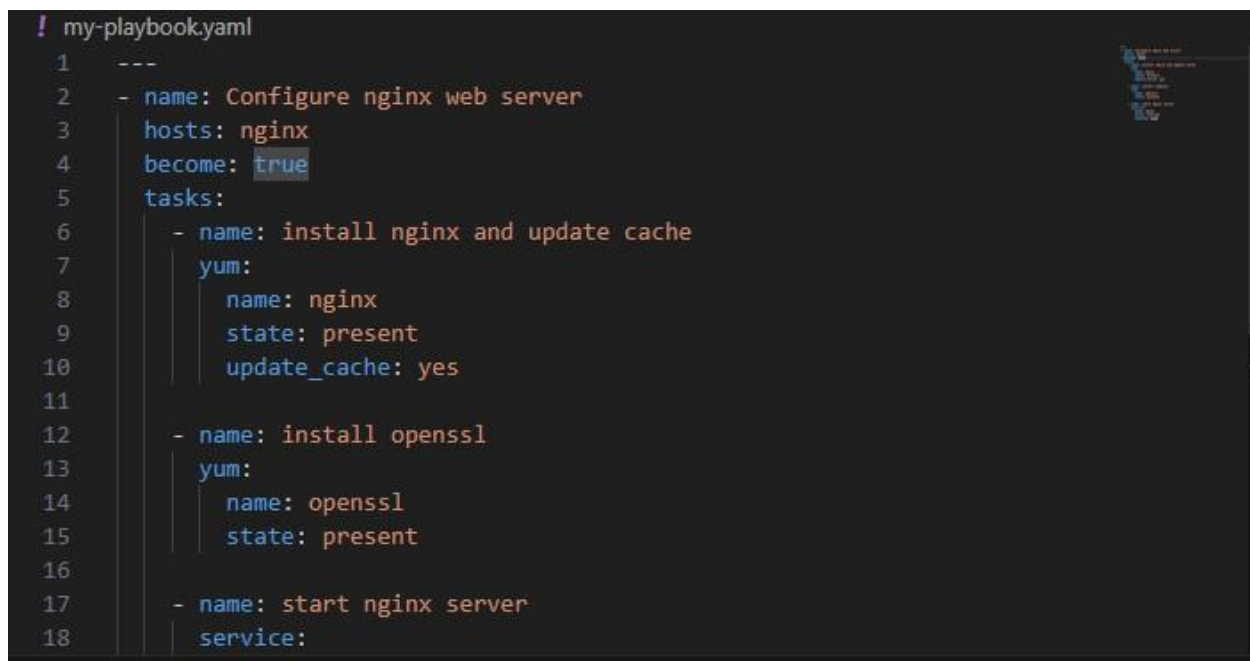
```

task5_hosts_nginx_group.png



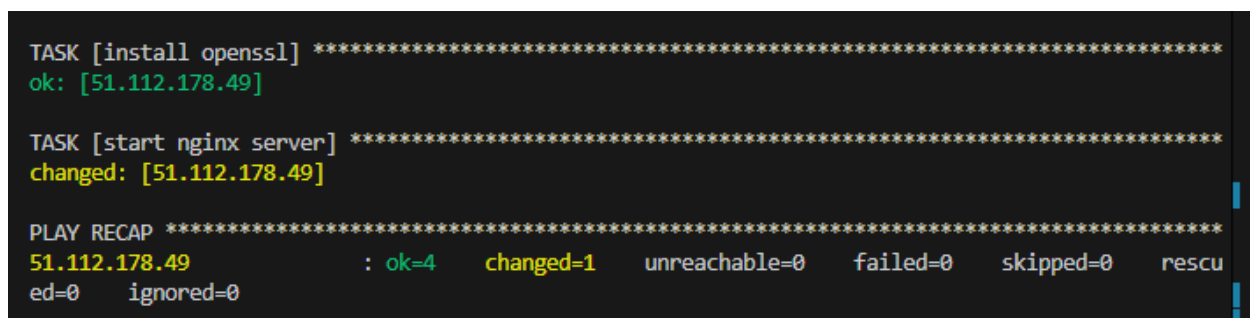
```
terraform.tfvars hosts U X ! my-playbook.yml U main.tf M
<> hosts
1 [nginx]
2 51.112.178.49
3
4 [nginx:vars]
5 ansible_ssh_private_key_file=~/.ssh/id_ed25519
6 ansible_user=ec2-user
```

task5_my_playbook_nginx_group.png



```
! my-playbook.yml
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_nginx_play_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 rescued=0 ignored=0
```

task5_nginx_browser_single.png

Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.

Task 6 – Ansible-managed SSL certificates

task6_my_playbook_ssl_section.png

```
! my-playbook.yaml
23 - name: Configure SSL certificates
24   hosts: nginx
25   become: true
26   tasks:
27     - name: Create SSL private directory
28       file:
29         path: /etc/ssl/private
30         state: directory
31         mode: '0700'
32
33     - name: Create SSL certs directory
34       file:
35         path: /etc/ssl/certs
36         state: directory
37         mode: '0755'
38
39     - name: Get IMDSv2 token
40       uri:
```

task6_ansible_play_ssl.png


```

_7m/
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
BQAwGDEWMBQGA1UEAwNNTEUuMTEyLjE3OC40OTAeFw0yNjA4MTYxNjA4MTNaFw0y
NzA4MTYxNjA4MTNaMBGxFjAUBgNVBAMMDUxLjExMi4xNzguNDkwggEiMA0GCSqG
SIb3DQEBAQUAA4IBDwAwggEKAoIBAQUduq9w1wKjURrI97cpP9I802vPAXTxfQeVl
+WL4WaBn9CbeVXct5TTK6AnW1XNRJH8R8wng/cwDFwPkFDjwTmTK60CNH0jM1dk0
W/X9fCT0InZsM4FYSvfPEN4ysPKM/OrChKZ9e7MY2XeZenikmrTi+Iu4PnXqCNbm
WYegIQ85iWfz3AeviWmM1ytfN7WMIaMmnxBMzGNgGrKbPuk34AmEs/E0pesZc2Hp
Rm08igsV+iI1YVji4ecwI4+8/uXGTHvPXLxK+y04C+B1E3WyuRGOMuiF5Fx+bEW
IJerT7Vl1njq7q0pAGMGU0ju86Rp0B4iGH6W+hmg8ejFNtsjxahDAgMBAAGjgYAw
fjAdBgNVHQ4EFgQUi5kfxRhvZ0lszwdp1oIY7pa+hEwHwYDVR0jBBgwFoAUNI5k
fxRhvZ0lszwdp1oIY7pa+hEwDwYDVR0RBAGwBocEM3CyMTAJBgNVHRMEAjAAMAsG
A1UdDwQEAwIFoDATBgNVHSUEDDAKBggrBgEFBQcDATANBgkqhkiG9w0BAQsFAAOC
AQEAKp8TiUAjsXxKC7aA9hbDoP9dMtk4pnT8K0buAqDFkAoR3RsquiabFux+DVI5
0fmZJrw9FEHbywvQIUaQ3zkFd0C1VgqQjosRLygdIp5SpWbG7kRC3wPsp9gtNr55
Lk7wc/iiv/0hlp4RD9JSJSdtAZKm2lt5rISsdB6ETurbXTyUDpvHR/4P2pEh9DRV
f1N5Xx5MRyRx78c4pM5yNHx6gkJjemA3PvIPTg4AA1wRtmqcDFU0jYy2rMCulsdb
jMm/Q6U0XkrduuitMqdkQY4TrJBjTH18w1jAYkDjQA/Dq1eMm1D4uTZVH6puXPW6
SyUthNGS8Y4dUjjyDN1DG4MT+w==
-----END CERTIFICATE-----
[ec2-user@ip-10-0-10-81 ~]$
```

```
[ec2-user@ip-10-0-10-81 ~]$ sudo cat /etc/ssl/private/selfsigned.key
-----BEGIN PRIVATE KEY-----
MIIEvQIBADANBgkqhkiG9w0BAQEFAASCBAcwggSjAgEAAoIBAQUduq9w1wKjURrI9
7cpP9I802vPAXTxfQeVl+WL4WabN9CbeVXct5TTK6AnW1XNRJH8R8wnG/cwDFwPk
FDjwtkTK60CNH0jM1dkOW/X9fCT0InZsM4FYSvfPEN4ysPKM/OrChKZ9e7MY2XeZ
enikmrTi+Iu4PnXqCNbmWYegIQ85iWfz3AeviWmM1ytfn7WMIaMmnxBMzGNgGrKb
Puk34AmEs/E0pesZc2HpRm08igsv+iI1YVji4ecwI4+8/uXGTHvPXLxK+y04C+B1
E3WyuRGOMuiuf5Fx+bEWIJerT7Vl1njq7q0pAGMGU0ju86Rp0B4iGH6W+hmG8ejF
NtsjxahDagMBAECggEAGkK4d+i40DGEml/La9ESgy6VL7kz1b2g0nU3e9wxlvwTC
gezCwSe0281IQb9stGXRzQka0XinlXbXk6fNmiejYyxAawNxMFZQpUnbGwSbWPD
BLxdaeyj8G0wSskfwjo00QMpPdBy/owH4StGz2iNEoPHWPJZhBMgwiRPA35hj2SH
BLRddkj86jfrd4LnLDapTYBm3ug8a8X9qVx0Gv4bkuMdaCDE5kSemSVtw04QmgP
VeuotHaHSNZY1PnkCnXktozJXoJWEUuZKjXHjDoJ8uEBR9MkcI3A/XAqfASPsvJv
BFxC5iTkL5mFa9VdEB2sle0YaJKlNuOAS92EinMkVQKBgQDzhRSKP7TEycTXFDpE
fdQAYk8vNFB7pY7pjr1BBaca6eseT3SoAI8LY1LQA32raLbs/8wmDvBoK/FOIkB
Z0dDTSdnRxxXnSw4bWeVbxkREsc1rGSBHPAXZMtoQFqJ74pWiD05ZeV6Me3D8JHT
R9Rj5WUcujmSQFWGqbBMZDv/LwKBgQDfkg4brq1MiGVKy4qcKnVzegMDi6nxuf1l
jr6xKG02AZ+YpW/5B+ryNF09hK3tMwHY0ib2PrW6831IJ2n4nsf0A0slcprEiw4
671sUxNZvZ3yhs507hwClfLKFmnsW0Zs7CP8RlSdnpygLA2L7vs/IwUcrJU1X7x
FSg+PXfDLQKBgEzpnFop0tN0ks4Hgnu9bictvqK/GiSq4mJG11pphyayTcwIowES
LoKJNJYuzfo6TzSq/g+AFWeLc9iLiaIaF3zHMhW7lp1288+Cpn0pGjatQp7gewHY
fPA2kpQDt1TXhk7cR9Hnn/nfKSR4p+YeSr0ecTgIjURm81xL3fXStqxbAoGBAJRd
9Qbh8RftHGT6kE36z18HBaEaupM0fBxL0rj2uNU8VpGSj2qmFW6HIoBoRRus1711
ZeYnJLakZMs9zeJwJo0dQYDpFx/eJ3B03wrIRvszHvKoC5nN4sDEig8auMjq/n2i
aG8urVC8xex1z7ehrLENVvgkgBCfq+2/rHvUN8xAoGAXFkmUpuApezCDyaS6KH
/sAHjZJ20Ma4kSLIuwE9E5p7pYk/bwIeCDUaLmfgUV115XE2SmLDBWm8uAjzy9fy
pQvvZRzJj4QswoTC1QkiRUMrYyt3NYIeBkB//WF57uX0Q4qXP8e9Gb+v5KS0dzk2
gme7yyVKR05I+rjqYX1kfBA=
-----END PRIVATE KEY-----
[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
1  user nginx;
2  worker_processes auto;
3  error_log /var/log/nginx/error.log notice;
4  pid /run/nginx.pid;
5
6  events {
7      worker_connections 1024;
8  }
9
10 http {
11     log_format main '$remote_addr - $remote_user [$time_local] "$request
12     ' $status $body_bytes_sent "$http_referer"
13     '"$http_user_agent" "$http_x_forwarded_for"';
14
15     access_log /var/log/nginx/access.log main;
16
17     sendfile on;
18     tcp_nopush on;
```

task7_my_playbook_web_deploy.png

```
! my-playbook.yml
23  - name: Configure SSL certificates
73
74  - name: Deploy Nginx website and configuration files
75    hosts: nginx
76    become: true
77    tasks:
78      - name: install php-fpm and php-curl
79        yum:
80          name:
81            - php-fpm
82            - php-curl
83          state: present
84
85      - name: Copy website files
86        copy:
87          src: files/index.php
88          dest: /usr/share/nginx/html/index.php
89          owner: nginx
```

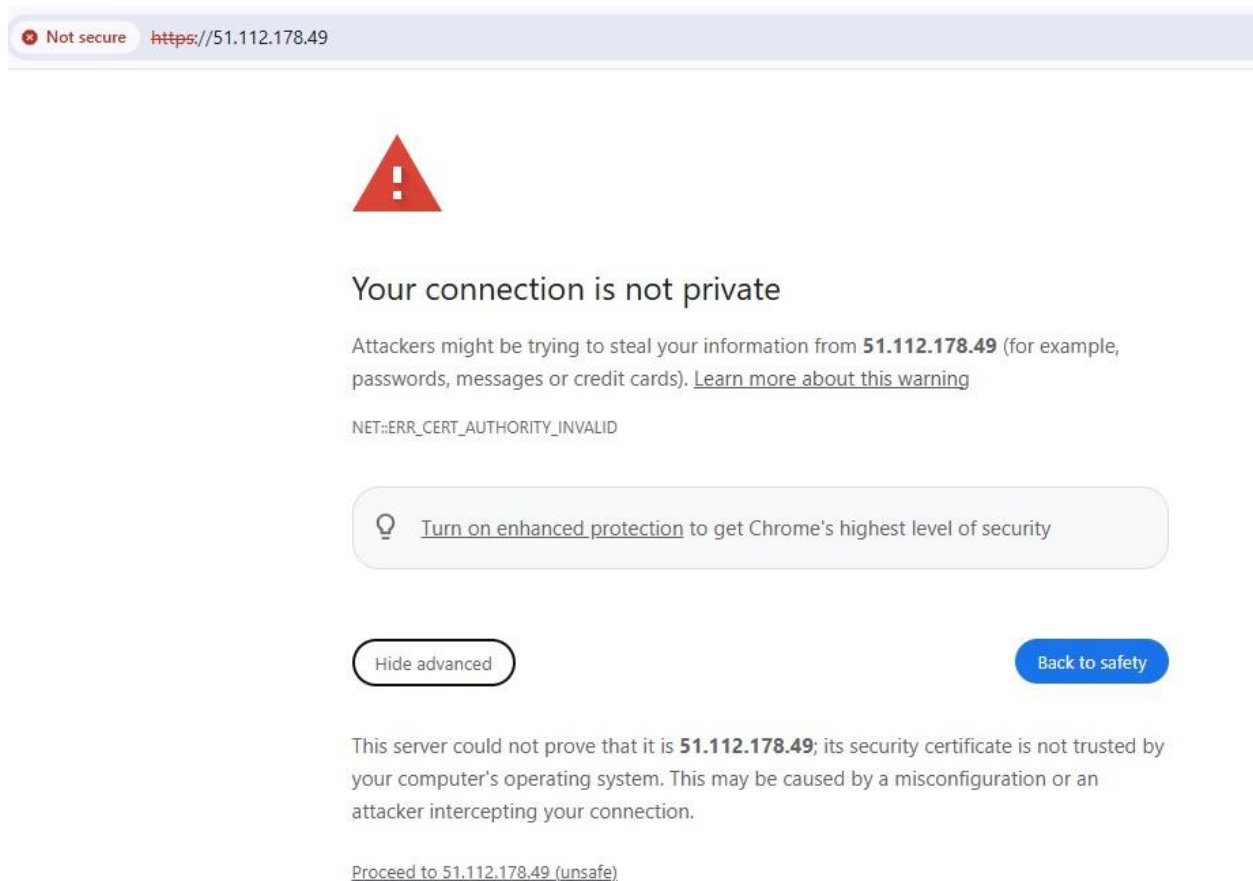
task7_ansible_play_web_deploy.png

```
TASK [Restart nginx] *****
changed: [51.112.178.49]

TASK [Start and enable php-fpm] *****
changed: [51.112.178.49]

PLAY RECAP *****
51.112.178.49      : ok=16  changed=3  unreachable=0  failed=0  skipped=0  rescue=0  ignored=0
```

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

```

module.myapp-webserver[0].aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver[0].aws_instance.myapp-server: Still creating... [00m10s elapsed]
@areej-10 →/workspaces/terraform_machine (main) $ terraform output
webserver_public_ips = [
  "158.252.72.51",
]
Apply complete! Resources: 0 added, 0 changed, 0 destroyed.
@areej-10 →/workspaces/terraform_machine (main) $
Output
webserver_public_ips = [
  "158.252.72.51",
]

```

task8_hosts_docker_servers.png


```

<> hosts
1  [docker_servers]
2  158.252.72.51
3
4  [docker_servers:vars]
5  ansible_ssh_private_key_file=~/.ssh/id_ed25519
6  ansible_user=ec2-user

```

task8_my_playbook_docker.png

```

! my-playbook.yaml
1  ---
2  - name: Configure Docker
3    hosts: all
4    become: true
5    tasks:
6      - name: install docker and update cache
7        yum:
8          name: docker
9          state: present
10         update_cache: yes
11
12 - name: Install Docker Compose
13   hosts: all
14   become: true
15   gather_facts: true
16   tasks:
17     - name: create docker cli-plugins directory
18       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

```
9  
sudo docker ps  
  
NNN \_#####\  
NNN \_###|  
NNN \#/ https://aws.amazon.com/linux/amazon-linux-2023  
NNN Vw' '->  
NNNN /  
NNN _ . /  
NNN _ /  
NNN _ /  
NNN _ /m/'
```


Last login: Fri Jan 16 17:01:37 2026 from 4.240.18.226
[ec2-user@ip-10-0-10-35 ~]\$

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

task9 my_playbook add user to docker.png

```
! my-playbook.yaml
41 |   - name: Adding user to docker group
42 | hosts: all
43 | become: true
44 | vars_files:
45 |   - project-vars.yaml
46 | tasks:
47 |   - name: add user to docker group
48 |     user:
49 |       name: "{{ normal_user }}"
50 |       groups: docker
51 |       append: yes
52 |
53 |   - name: reconnect to apply group changes
54 |     meta: reset_connection
55 |
56 |   - name: verify docker access
57 |     command: docker ps
58 |     register: docker_ps
```

task9_project_vars.png



```
! project-vars.yaml
1  normal_user: ec2-user
2  docker_compose_file_location: "."
```

task9_my_playbook_deploy_containers.png



```
69   - name: Deploy Docker Containers
70   hosts: all
71   become: true
72   user: "{{ normal_user }}"
73   vars_files:
74     - project-vars.yaml
75   tasks:
76     - name: check if docker-compose file exists
77       stat:
78         path: /home/{{ normal_user }}/compose.yaml
79       register: compose_file
80
81     - name: copy docker-compose file
82       copy:
83         src: "{{ docker_compose_file_location }}/compose.yaml"
84         dest: /home/{{ normal_user }}/compose.yaml
85         mode: '0644'
86       when: not compose_file.stat.exists
```

task9_compose_yaml.png

```
compose.yaml
1  services:
2    gitea:
3      image: gitea/gitea:latest
4      container_name: gitea
5      environment:
6        - DB_TYPE=postgres
7        - DB_HOST=db:5432
8        - DB_NAME=gitea
9        - DB_USER=gitea
10       - DB_PASSWD=gitea
11      restart: always
12      volumes:
13        - gitea:/data
14      ports:
15        - 3000:3000
16      extra_hosts:
17        - "www.jenkins.com:host-gateway"
18      networks:
```

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    rescue=0
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

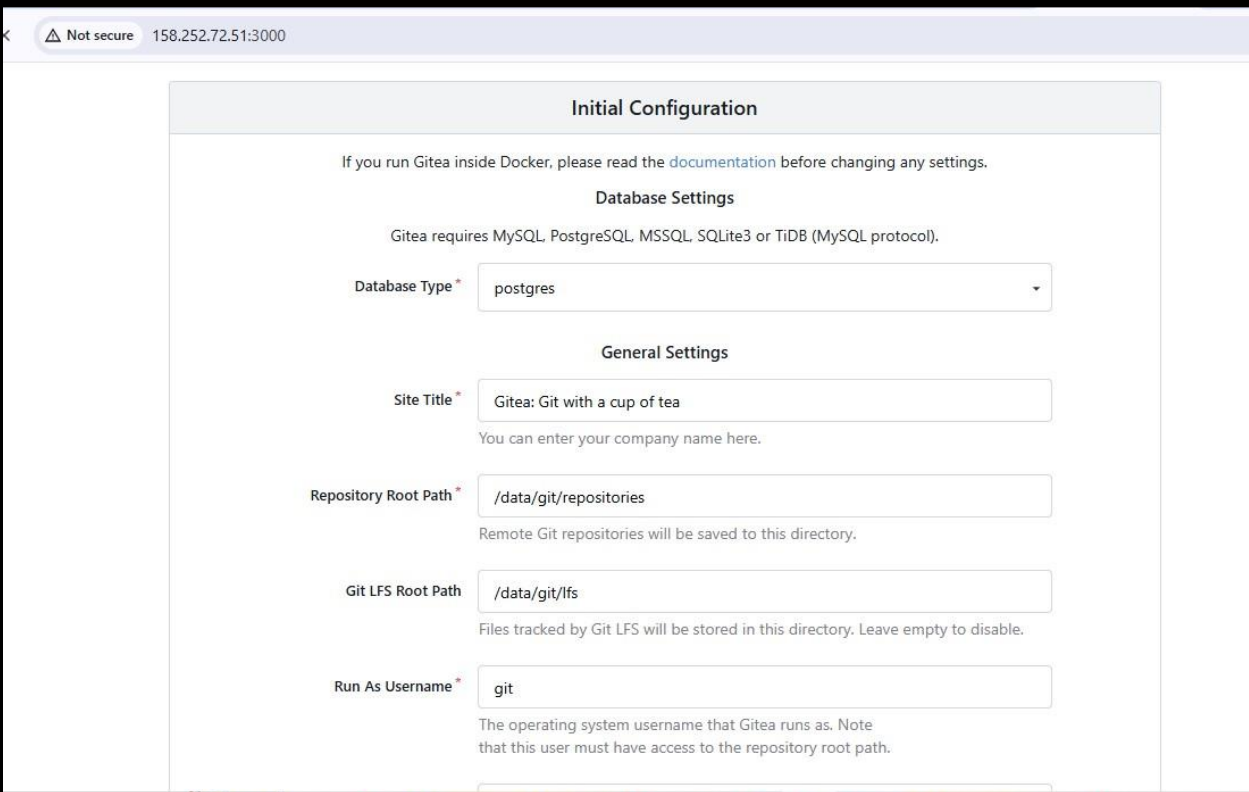
```
module.myapp-webserver[0].aws_security_group.web_sg: Modifying... [id=sg-04563a7d2eb42fa67]
module.myapp-webserver[0].aws_security_group.web_sg: Modifications complete after 2s [id=sg-04563a7d2eb42fa67]

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

Outputs:

webserver_public_ips = [
  "158.252.72.51",
]
```

task9_gitea_browser.png



The screenshot shows a web browser window with the address bar displaying "158.252.72.51:3000". The page title is "Initial Configuration". Below the title, there is a note: "If you run Gitea inside Docker, please read the [documentation](#) before changing any settings." The page is divided into two sections: "Database Settings" and "General Settings".

Database Settings

Gitea requires MySQL, PostgreSQL, MSSQL, SQLite3 or TiDB (MySQL protocol).

Database Type *

General Settings

Site Title *
You can enter your company name here.

Repository Root Path *
Remote Git repositories will be saved to this directory.

Git LFS Root Path
Files tracked by Git LFS will be stored in this directory. Leave empty to disable.

Run As Username *
The operating system username that Gitea runs as. Note that this user must have access to the repository root path.

Task 10 – Automating Ansible with Terraform (null_resource)

task10_null_resource_main_tf.png

```

main.tf
38 }
39 resource "null_resource" "configure_server" {
40   triggers = {
41     webserver_public_ips_for_aws = join(",", [for i in module.myapp-
42   ]
43 }
44 depends_on = [module.myapp-webserver]
45
46   provisioner "local-exec" {
47     command = <<-EOT
48     ansible-playbook -i ${self.triggers.webserver_public_ips_for_aws}
49     --private-key "${var.private_key}" --user ec2-user \
50     my-playbook.yaml
51   EOT
52 }
53 }

```

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  
1  ---  
2  - name: Wait for some time to ensure system readiness  
3    hosts: all  
4    tasks:  
5      - name: Wait 300 seconds for port 22 to become open and contain "OpenSSH" and "sshd" in the output of the command  
6        wait_for:  
7          port: 22  
8          host: "{{ inventory_hostname }}"  
9          delay: 10  
10         timeout: 300  
11         delegate_to: localhost  
12  
13 - name: Configure Docker  
14   hosts: all  
15   become: true  
16   tasks:  
17     - name: install docker and update cache  
18       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

Initial Configuration

If you run Gitea inside Docker, please read the [documentation](#) before changing any settings.

Database Settings

Gitea requires MySQL, PostgreSQL, MSSQL, SQLite3 or TiDB (MySQL protocol).

Database Type *

Host *

Username *

Password *

Database Name *

SSL *

Schema

Leave blank for database default ("public").

General Settings

Task 11 – Dynamic inventory with aws_ec2 plugin

task11_ansible_cfg_aws_ec2.png

```

main.tf .../webserver.tf  project-vars.yaml  ma
ansible.cfg
1  [defaults]
2  host_key_checking=False
3  interpreter_python = /usr/bin/python3
4  deprecation_warnings = False
5  enable_plugins = aws_ec2
6  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
1  ---
2  plugin: aws_ec2
3  regions:
4  - 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



```
1 output "webserver_public_ips" {
2   | value = [for i in module.myapp-webserver : i.public_ip]
3   | }
4
5 output "prod-webserver_public_ips" {
6   | value = [for i in module.myapp-webserver-prod : i.public_ip]
7   | }
8
```

task11_terraform_apply_dynamic_setup.png

```
terraform apply -auto-approve
terraform output

+ private_dns_name_options (known after apply)
+ root_block_device (known after apply)
}

Plan: 1 to add, 0 to change, 0 to destroy.

Changes to Outputs:
+ prod-webserver_public_ips = [
+   (known after apply),
+ ]
module.myapp-webserver-prod[0].aws_instance.myapp-server: Creating...
module.myapp-webserver-prod[0].aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver-prod[0].aws_instance.myapp-server: Creation complete after 13s [id=i-07850df62776850ec]

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

Outputs:

prod-webserver_public_ips = [
  "3.28.185.24",
]
webserver_public_ips = [
  "3.28.253.131",
]
prod-webserver_public_ips = [
  "3.28.185.24",
]
webserver_public_ips = [
  "3.28.253.131",
]
```

task11_terraform_output_dynamic_ips.png

```
terraform apply -auto-approve
terraform output

+ private_dns_name_options (known after apply)
+ root_block_device (known after apply)
}

Plan: 1 to add, 0 to change, 0 to destroy.

Changes to Outputs:
+ prod-webserver_public_ips = [
+   (known after apply),
+ ]
module.myapp-webserver-prod[0].aws_instance.myapp-server: Creating...
module.myapp-webserver-prod[0].aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver-prod[0].aws_instance.myapp-server: Creation complete after 13s [id=i-07850df62776850ec]

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

Outputs:

prod-webserver_public_ips = [
  "3.28.185.24",
]
webserver_public_ips = [
  "3.28.253.131",
]
prod-webserver_public_ips = [
  "3.28.185.24",
]
webserver_public_ips = [
  "3.28.253.131",
]
```

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/python3.12/site-packages (from botocore) (2.5.0)
Requirement already satisfied: six>=1.5 in /home/codespace/.local/lib/python3.12/site-packages (from 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: print(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
1  ---
2  plugin: aws_ec2
3  regions:
4  | - me-central-1
5  keyed_groups:
6  | - key: tags
7  |   prefix: tag
8  |   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

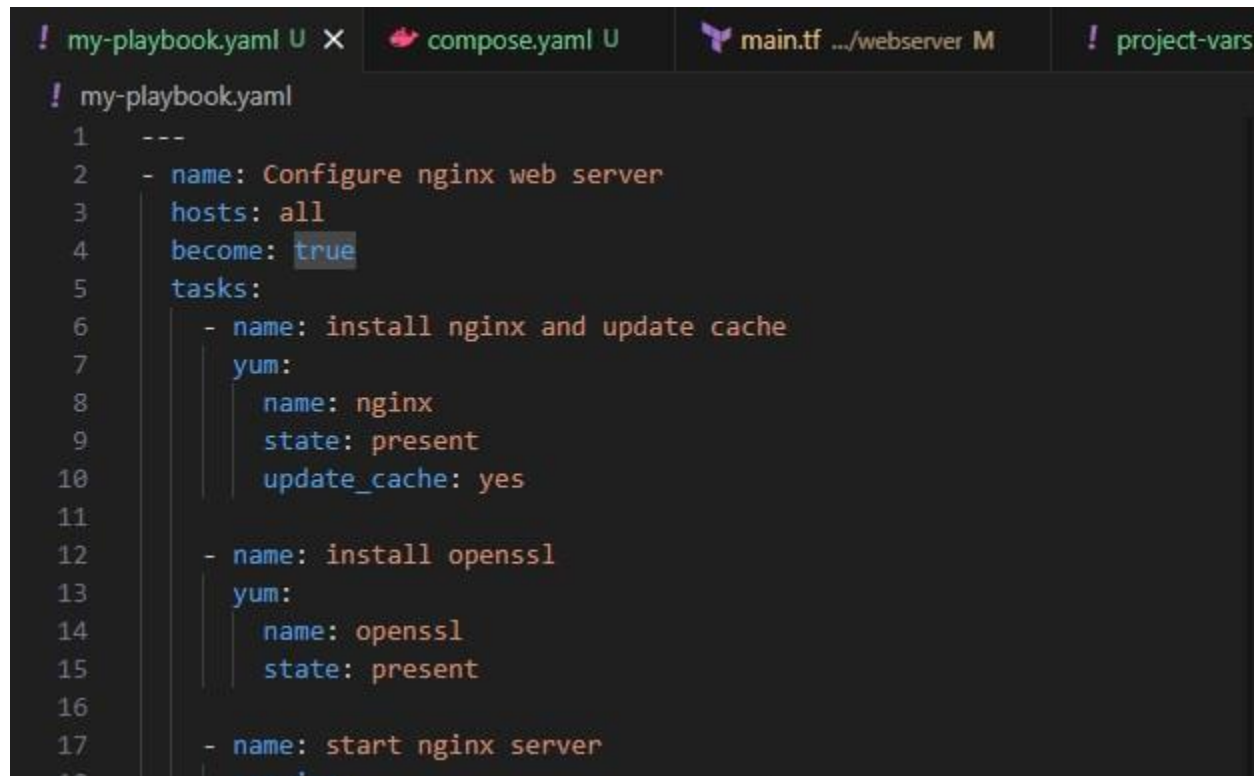
```
! inventory_aws_ec2.yaml
1  ---
2  plugin: aws_ec2
3  regions:
4  | - me-central-1
5  keyed_groups:
6  | - key: tags
7  |   prefix: tag
8  |   separator: "_"
9  | - key: instance_type
10 |   prefix: instance_type
11 |   separator: "_"
```

task12_inventory_graph_full.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:
```

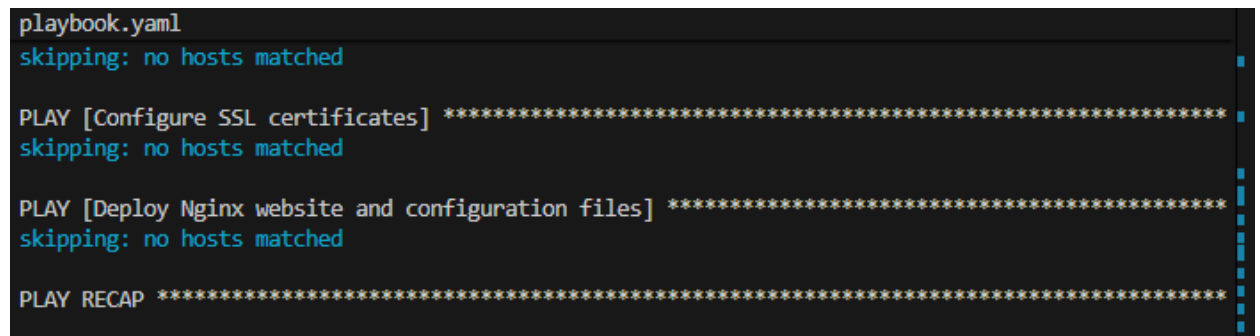
task12_my_playbook_all_hosts.png



The screenshot shows an IDE with four tabs: 'my-playbook.yaml', 'compose.yaml', 'main.tf .../webserver', and 'project-vars'. The 'my-playbook.yaml' tab is active, displaying the following Ansible playbook content:

```
1 ---
2 - name: Configure nginx web server
3   hosts: all
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
```

task12_ansible_play_all.png



The screenshot shows the output of an Ansible command. It indicates that three plays were skipped because no hosts matched:

```
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
skipping: no hosts matched

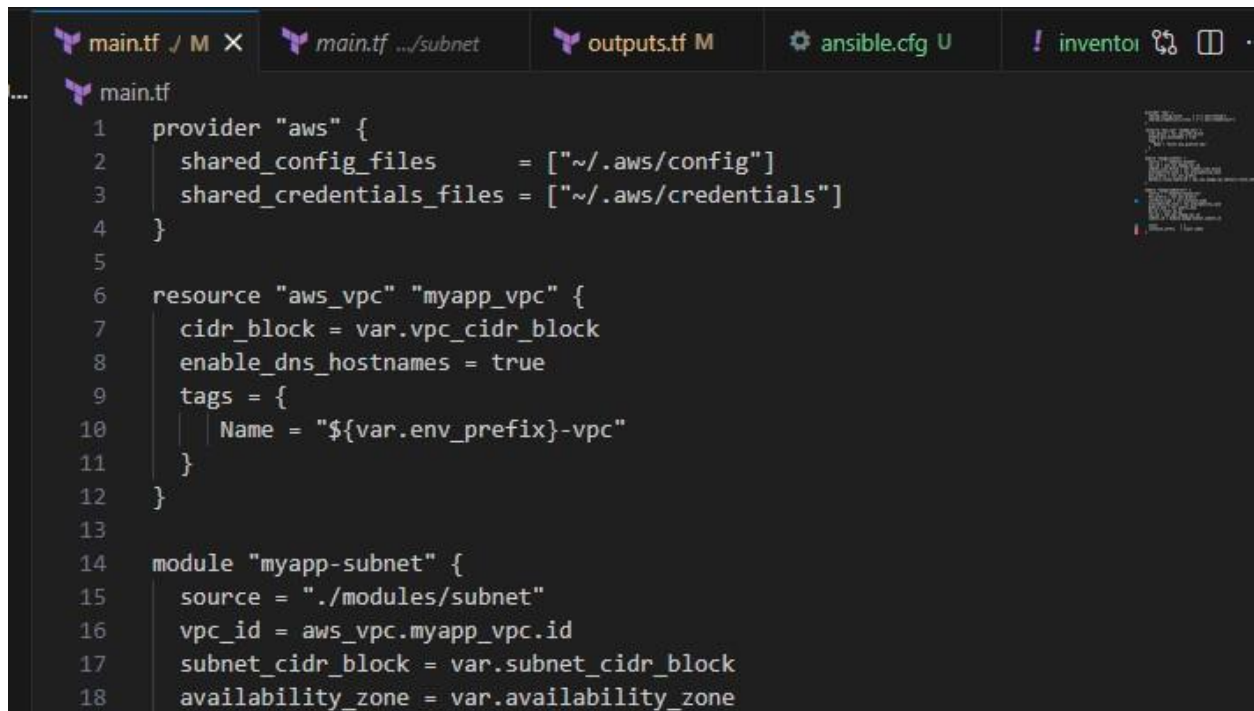
PLAY [Configure SSL certificates] *****
skipping: no hosts matched

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

PLAY RECAP *****
```

Task 13 – Ansible roles: nginx, ssl, webapp

task13_main_tf_single_dev.png



```
1 provider "aws" {
2   shared_config_files   = ["~/.aws/config"]
3   shared_credentials_files = ["~/.aws/credentials"]
4 }
5
6 resource "aws_vpc" "myapp_vpc" {
7   cidr_block = var.vpc_cidr_block
8   enable_dns_hostnames = true
9   tags = {
10     Name = "${var.env_prefix}-vpc"
11   }
12 }
13
14 module "myapp-subnet" {
15   source = "./modules/subnet"
16   vpc_id = aws_vpc.myapp_vpc.id
17   subnet_cidr_block = var.subnet_cidr_block
18   availability_zone = var.availability_zone
19 }
```

task13_aws_structure_created.png

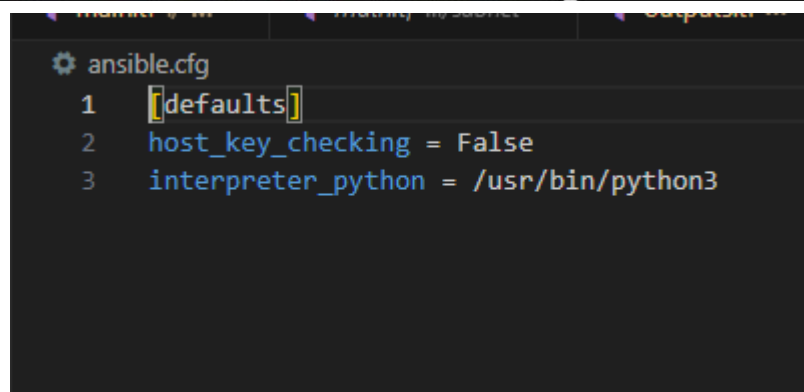
task13_aws_cfg_project.png



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

./inventory:

./roles:
```



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

task13_webapp_tasks_main.png

task13_php_https_browser_roles.png

⚠ Not secure 51.112.178.49

Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.

Cleanup

cleanup_terraform_destroy.png

No changes. No objects need to be destroyed.

Either you have not created any objects yet or the existing objects were already deleted outside of Terraform.

Destroy complete! Resources: 0 destroyed.

cleanup_tfstate.png

cleanup_aws_console.png