

# Cloud Computing Lab

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BSE-V B

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## LAB 14

### Task 0 – Lab Setup (Codespace & GH CLI)

- task0\_codespace\_open.png

```
C:\Users\sweng>gh codespace ssh -c organic-fishstick-q757q7rg6qwqfxqr@  
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-1030-azure x86_64)  
  
 * Documentation: https://help.ubuntu.com  
 * Management: https://landscape.canonical.com  
 * Support: https://ubuntu.com/pro  
  
The programs included with the Ubuntu system are free software;  
the exact distribution terms for each program are described in the  
individual files in /usr/share/doc/*copyright.  
  
Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by  
applicable law.  
  
@NayabKhazin653 → /workspaces/terraform_machine (main) $
```

- task0\_env\_check.png

```
@NayabKhazin653 → /workspaces/terraform_machine (main) $ aws --version  
aws-cli/2.33.0 Python/3.13.11 Linux/6.8.0-1030-azure exe/x86_64.ubuntu.24  
@NayabKhazin653 → /workspaces/terraform_machine (main) $ terraform --version  
Terraform v1.14.3  
on linux_amd64  
@NayabKhazin653 → /workspaces/terraform_machine (main) $ ansible --version || echo "ansible not yet installed"  
-bash: ansible: command not found  
ansible not yet installed
```

- task0\_aws\_config.png

```
@NayabKhazin653 → /workspaces/terraform_machine (main) $ aws sts get-caller-identity  
{  
    "UserId": "AIDAZCUSI5S7IFMHUH7UB",  
    "Account": "624150768830",  
    "Arn": "arn:aws:iam::624150768830:user/Admin"
```

# Task 1 – Generate ssh key and Initial Terraform apply

- task1\_ssh\_keygen\_before.png

```
@NayabKhazin653  /workspaces/terraform_machine (main) $ ls ~/.ssh  
authorized_keys
```

- task1\_ssh\_keygen.png

```
@NayabKhazin653  /workspaces/terraform_machine (main) $ ssh-keygen -t ed25519 -f ~/.ssh/id_ed25519 -N ""  
Generating public/private ed25519 key pair.  
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:uL8ct/bAB4PjoZwT49jzz7BVyvMCH6UFH6n7QagZG08 codespace@codespaces-9d59c4  
The key's randomart image is:  
+--[ED25519 256]--  
| . . o |  
| + = . |  
| ..o.o = |  
| +.S+o*. |  
|= BE==+. |  
. X +oOo.. |  
. * B+*. |  
. *++oo |  
+---[SHA256]---
```

- task1\_ssh\_keygen\_after.png

```
@NayabKhazin653  /workspaces/terraform_machine (main) $ ls -la ~/.ss  
total 24  
drwxr-xr-x 2 codespace codespace 4096 Jan 15 05:13 .  
drwxr-x--- 1 codespace codespace 4096 Jan 15 05:12 ..  
-rw-r--r-- 1 codespace codespace 486 Jan 15 04:54 authorized_keys  
-rw----- 1 codespace codespace 419 Jan 15 05:13 id_ed25519  
-rw-r--r-- 1 codespace codespace 109 Jan 15 05:13 id_ed25519.pub
```

- task1\_terraform\_tfvars\_created.png

```
@NayabKhazin653  /workspaces/terraform_machine (main) $ touch terraform.tfvars  
@NayabKhazin653  /workspaces/terraform_machine (main) $ ls -la terraform.tfvars  
-rw-rw-rw- 1 codespace codespace 0 Jan 15 05:15 terraform.tfvars
```

- task1\_terraform\_tfvars.png

```
@NayabKhazin653  /workspaces/terraform_machine (main) $ cat terraform.tfvar  
cidr_block = "10.0.0.0/16"  
subnet_cidr_block = "10.0.10.0/24"  
availability_zone = "me-central-1a"  
env_prefix = "dev"  
instance_type = "t3.micro"  
public_key = "~/.ssh/id_ed25519.pub"  
private_key = "~/.ssh/id_ed25519"
```

- task1\_terraform\_init.png

```
NayabKhazin653 eworkspaces/terraform_machine (main) $ terraform init
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...
- Installed hashicorp/aws v6.28.0 (signed by HashiCorp)
- Installing hashicorp/http v3.5.0...
- Installed hashicorp/http v3.5.0 (signed by HashiCorp)
Terraform has created a lock file .terraform.lock.hcl to record the provider
selections it made above. Include this file in your version control repository
so that Terraform can guarantee to make the same selections by default when
you run "terraform init" in the future.

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.

If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
```

- task1\_terraform\_apply\_2\_instances.png

```
Plan: 3 to add, 0 to change, 0 to destroy.

Changes to Outputs:
+ webserver_public_ips = [
  + (known after apply),
  + (known after apply),
]

module.myapp-webserver[0].aws_key_pair.ssh-key: Creating...
module.myapp-webserver[0].aws_key_pair.ssh-key: Creation complete after
module.myapp-webserver[1].aws_instance.myapp-server: Creating...
module.myapp-webserver[0].aws_instance.myapp-server: Creating...
module.myapp-webserver[1].aws_instance.myapp-server: Still creating... []
module.myapp-webserver[0].aws_instance.myapp-server: Still creating... []
module.myapp-webserver[1].aws_instance.myapp-server: Creation complete a
module.myapp-webserver[0].aws_instance.myapp-server: Creation complete a

Warning: Value for undeclared variable

The root module does not declare a variable named "cidr_block" but a value
"terraform.tfvars". If you meant to use this value, add a "variable" block
with type "string" to the root module.

To silence these warnings, use TF_VAR_... environment variables to provide
configurations in your organization. To reduce the verbosity of these
warnings, use the -no-undeclared-variable option.

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

- task1\_terraform\_output\_ips.png

```
NayabKhazin653 eworkspaces/terraform_machine (main) $ terraform output
webserver_public_ips = [
  "51.112.49.3",
  "158.252.77.243",
]
```

## Task 2 – Static Ansible inventory with two EC2 instances

- task2\_ansible\_install.png

```
NayabKhazin653 ② /workspaces/terraform_machine (main) $ pipx install ansible-core
  installed package ansible-core 2.20.1, installed using Python 3.12.1
  These apps are now globally available
    - ansible
    - ansible-config
    - ansible-console
    - ansible-doc
    - ansible-galaxy
    - ansible-inventory
    - ansible-playbook
    - ansible-pull
    - ansible-test
    - ansible-vault
done! ② ② ②
NayabKhazin653 ② /workspaces/terraform_machine (main) $ ansible --version
ansible [core 2.20.1]
  config file = None
  configured module search path = ['~/home/codespace/.ansible/plugins/modules', '~/usr/lib/python3.12/site-packages/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
  executable location = ~/usr/local/py-utils/bin/ansible
  python version = 3.12.1 (main, Nov 27 2025, 10:47:52) [GCC 13.3.0] (/usr/local/py-utils/python)
  jinja version = 3.1.6
  pyyaml version = 6.0.3 (with libyaml v0.2.5)
```

- task2\_terraform\_output\_ips.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ terraform output
webserver_public_ips = [
  "51.112.49.3",
  "158.252.77.243",
]
```

- task2\_hosts\_created.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ touch hosts
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ls -la hosts
-rw-rw-rw- 1 codespace codespace 0 Jan 15 05:35 hosts
```

- task2\_hosts\_initial.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat hosts
51.112.49.3 ansible_user=ec2-user ansible_ssh_private_key_file=~/ssh/id_ed25519
158.252.77.243 ansible_user=ec2-user ansible_ssh_private_key_file=~/ssh/id_ed25519
```

- task2\_ansible\_ping\_initial.png

```
[MayabKhazin653: /workspaces/terraform_machine (main) $ ansible all -i hosts -m ping
[ERROR]: Task failed: Failed to connect to the host via ssh: Host key verification failed.
Origin: <adhoc 'ping' task>

{'action': 'ping', 'args': {}, 'timeout': 0, 'async_val': 0, 'poll': 15}

51.112.49.3 | UNREACHABLE! => {
    "changed": false,
    "msg": "Task failed: Failed to connect to the host via ssh: Host key verification failed.",
    "unreachable": true
}
158.252.77.243 | UNREACHABLE! => {
    "changed": false,
    "msg": "Task failed: Failed to connect to the host via ssh: Host key verification failed.",
    "unreachable": true
}
```

- task2\_hosts\_with\_common\_args.png

```
[MayabKhazin653: /workspaces/terraform_machine (main) $ cat hosts
51.112.49.3 ansible_user=ec2-user ansible_ssh_private_key_file=~/ssh/id_ed25519 ansible_ssh_common_args=''-o StrictHostKeyChecking=no'
158.252.77.243 ansible_user=ec2-user ansible_ssh_private_key_file=~/ssh/id_ed25519 ansible_ssh_common_args=''-o StrictHostKeyChecking=no'
```

- task2\_ansible\_ping\_success.png

```
[MayabKhazin653: /workspaces/terraform_machine (main) $ ansible all -i hosts -m ping
[WARNING]: Host '51.112.49.3' 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/2.28/reference_appendices/interpreter_discovery.html for more information.
51.112.49.3 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '158.252.77.243' 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/2.28/reference_appendices/interpreter_discovery.html for more information.
158.252.77.243 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

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

- task3\_main\_tf\_count\_3.png

```
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

```

Plan: 3 to add, 0 to change, 0 to destroy.

Changes to Outputs:
  ~ webserver_public_ips = [
      # (1 unchanged element hidden)
      "158.252.77.243",
      + (known after apply),
    ]
module.myapp-webserver[2].aws_key_pair.ssh-key: Creating...
module.myapp-webserver[2].aws_security_group.web_sg: Creating...
module.myapp-webserver[2].aws_key_pair.ssh-key: Creation complete after 1s [id=dev-serverkey-2]
module.myapp-webserver[2].aws_security_group.web_sg: Creation complete after 3s [id=sg-065d85b]
module.myapp-webserver[2].aws_instance.myapp-server: Creating...
module.myapp-webserver[2].aws_instance.myapp-server: Still creating... [00m10s elapsed]
module.myapp-webserver[2].aws_instance.myapp-server: Creation complete after 13s [id=i-06cacd3]

Warning: Value for undeclared variable

The root module does not declare a variable named "cidr_block" but a value was found in file
meant to use this value, add a "variable" block to the configuration.

To silence these warnings, use TF_VAR_... environment variables to provide certain "global"
in your organization. To reduce the verbosity of these warnings, use the -compact-warnings c

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

```

- task3\_terraform\_output\_3\_ips.png

```
@NayabKhazin653 eworkspaces/terraform_machine (main) $ terraform output
webserver_public_ips = [
  "51.112.49.3",
  "158.252.77.243",
  "51.112.186.47",
]
```

- task3\_hosts\_grouped.png

```
@NayabKhazin653 eworkspaces/terraform_machine (main) $ cat <<EOF > hosts
> [ec2]
> 51.112.49.3
> 158.252.77.243
>
> [ec2:vars]
> ansible_user=ec2-user
> ansible_ssh_private_key_file=~/ssh/id_ed25519
> ansible_ssh_common_args=' -o StrictHostKeyChecking=no'
>
> [droplet]
> 51.112.186.47
>
> [droplet:vars]
> ansible_user=ec2-user
> ansible_ssh_private_key_file=~/ssh/id_ed25519
> ansible_ssh_common_args=' -o StrictHostKeyChecking=no'
> EOF
```

- task3\_ansible\_ec2\_ping.png

```
@NayabKhzain653 ② /workspaces/terraform_machine (main) $ ansible ec2 -i hosts -m ping
[WARNING]: Host '158.252.77.243' is using the discovered Python interpreter at '/usr/bin/python3.9', but future ins
of another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/an
2.20/reference_appendices/interpreter_discovery.html for more information.
158.252.77.243 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '51.112.49.3' is using the discovered Python interpreter at '/usr/bin/python3.9', but future instal
another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/ansib
2.20/reference_appendices/interpreter_discovery.html for more information.
51.112.49.3 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

- task3\_ansible\_single\_ip\_ping.png

```
@NayabKhzain653 ② /workspaces/terraform_machine (main) $ ansible 158.252.77.243 -i hosts -m ping
[WARNING]: Host '158.252.77.243' is using the discovered Python interpreter at '/usr/bin/python3.9', but future ins
of another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/an
2.20/reference_appendices/interpreter_discovery.html for more information.
158.252.77.243 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

- task3\_ansible\_droplet\_ping.png

```
@NayabKhzain653 ② /workspaces/terraform_machine (main) $ ansible droplet -i hosts -m ping
[WARNING]: Host '51.112.186.47' is using the discovered Python interpreter at '/usr/bin/python3.9', but futur
f another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.c
2.20/reference_appendices/interpreter_discovery.html for more information.
51.112.186.47 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

- task3\_ansible\_all\_ping.png

```
@NayabKhzain653 ② /workspaces/terraform_machine (main) $ ansible all -i hosts -m ping
[WARNING]: Host '51.112.186.47' is using the discovered Python interpreter at '/usr/bin/python3.9', but future inst
f another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/ans
2.20/reference_appendices/interpreter_discovery.html for more information.
51.112.186.47 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '51.112.49.3' is using the discovered Python interpreter at '/usr/bin/python3.9', but future instal
another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/ansib
2.20/reference_appendices/interpreter_discovery.html for more information.
51.112.49.3 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '158.252.77.243' is using the discovered Python interpreter at '/usr/bin/python3.9', but future ins
of another Python interpreter could cause a different interpreter to be discovered. See https://docs.ansible.com/an
2.20/reference_appendices/interpreter_discovery.html for more information.
158.252.77.243 | 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

```
st_key_checking = False
interpreter_python = /usr/bin/python3
~
```

- task4\_hosts\_without\_common\_args.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat <<EOF > hosts
> [ec2]
> 51.112.49.3
> 158.252.77.243
>
> [ec2:vars]
> ansible_user=ec2-user
> ansible_ssh_private_key_file=~/ssh/id_ed25519
>
> [droplet]
> 51.112.186.47
>
> [droplet:vars]
> ansible_user=ec2-user
> ansible_ssh_private_key_file=~/ssh/id_ed25519
> EOF
```

- task4\_ansible\_ping\_after\_cfg.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ansible all -i hosts -m ping
ERROR: Error reading config file ('/home/codespace/.ansible.cfg'): File contains no section headers.
file: '<string>', line: 2
'st_key_checking = False\n'

Traceback (most recent call last):
  File "/usr/local/py-utils/venvs/ansible-core/lib/python3.12/site-packages/ansible/config/manager.py", line 436, in
onfig_file
    self._parsers[file].read_string(cfg_text)
  File "/usr/local/python/3.12.1/lib/python3.12/configparser.py", line 710, in read_string
    self.read_file(fobj, source)
  File "/usr/local/python/3.12.1/lib/python3.12/configparser.py", line 705, in read_file
    self._read(f, source)
  File "/usr/local/python/3.12.1/lib/python3.12/configparser.py", line 1063, in _read
    raise MissingSectionHeaderError(fpname, lineno, line)
configparser.MissingSectionHeaderError: File contains no section headers.
```

- task4\_my\_playbook\_created.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ touch my-playbook.yaml
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ls -la my-playbook.yaml
-rw-rw-rw- 1 codespace codespace 0 Jan 15 05:54 my-playbook.yaml
```

task4\_my\_playbook\_ec2.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat my-playbook.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

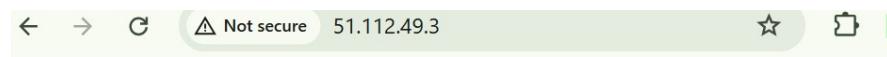
```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ansible-playbook -i hosts my-playbook.yaml
PLAY [Configure nginx web server] ****
TASK [Gathering Facts] ****
[WARNING]: Host '51.112.49.3' is using the discovered Python interpreter at '/usr/bin/python3.9', but future installation of another 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.
ok: [51.112.49.3]
[WARNING]: Host '158.252.77.243' 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.
ok: [158.252.77.243]

TASK [install nginx and update cache] ****
changed: [51.112.49.3]
changed: [158.252.77.243]

TASK [start nginx server] ****
changed: [158.252.77.243]
changed: [51.112.49.3]

PLAY RECAP ****
158.252.77.243 : ok=3    changed=2    unreachable=0   failed=0    skipped=0    rescued=0    ignored=0
51.112.49.3    : ok=3    changed=2    unreachable=0   failed=0    skipped=0    rescued=0    ignored=0
```

- task4\_nginx\_browser\_ec2.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](https://nginx.org).  
Commercial support is available at [nginx.com](https://nginx.com).

*Thank you for using nginx.*

- task4\_my\_playbook\_droplet.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat my-playbook.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

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ansible-playbook -i hosts my-playbook.yaml
PLAY [Configure nginx web server] ****
TASK [Gathering Facts] ****
[WARNING]: Host '51.112.186.47' is using the discovered Python interpreter at '/usr/bin/python3.9', but future installations 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.
ok: [51.112.186.47]

TASK [install nginx and update cache] ****
changed: [51.112.186.47]

TASK [start nginx server] ****
changed: [51.112.186.47]

PLAY RECAP ****
51.112.186.47 : ok=3    changed=2    unreachable=0    failed=0    skipped=0    rescued=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](https://nginx.org).  
Commercial support is available at [nginx.com](https://nginx.com).

*Thank you for using nginx.*

## Task 5 – Single nginx target group & HTTPS prerequisites

- task5\_project\_ansible\_cfg\_created.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ touch ansible.cfg
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ls -la ansible.cfg
-rw-rw-rw- 1 codespace codespace 0 Jan 15 06:05 ansible.cfg
```

- task5\_project\_ansible\_cfg.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat ansible.cfg
[defaults]
host_key_checking=False
interpreter_python = /usr/bin/python3
```

- task5\_main\_tf\_count\_1.png

```
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

}

:wq_
```

- task5\_terraform\_apply\_one\_instance.png

```
Apply complete! Resources: 0 added, 0 changed, 6 destroyed.
```

- task5\_terraform\_output\_single\_ip.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ terraform output
webserver_public_ips = [
  "51.112.49.3",
]
```

- task5\_hosts\_nginx\_group.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat <<EOF > hosts
> [nginx]
> 51.112.49.3
>
> [nginx:vars]
> ansible_user=ec2-user
> ansible_ssh_private_key_file=~/ssh/id_ed25519
> EOF
```

- task5\_my\_playbook\_nginx\_group.png

```
@NayabKhazin653 [~/workspaces/terraform_machine (main)] $ cat <<EOF > my-playbook.yaml
> ---
> - name: Configure nginx web server
>   hosts: nginx
>   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
>       service:
>         name: nginx
>         state: started
>         enabled: true
> EOF
```

- task5\_ansible\_play\_nginx\_group.png

```
@NayabKhazin653 [~/workspaces/terraform_machine (main)] $ ansible-playbook -i hosts my-playbook.yaml
[WARNING]: Ansible is being run in a world writable directory (/workspaces/terraform_machine), ignoring it as an ansible.cfg source. For more information see https://docs.ansible.com/ansible-devel/reference_appendices/config.html#cfg-in-world-writable-dir

PLAY [Configure nginx web server] ****
TASK [Gathering Facts] ****
[WARNING]: Host '51.112.49.3' 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/2.9/reference_appendices/interpreter_discovery.html for more information.
ok: [51.112.49.3]

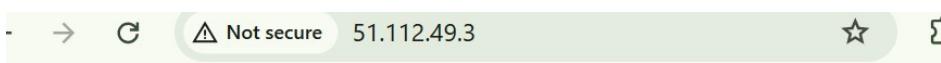
TASK [install nginx and update cache] ****
ok: [51.112.49.3]

TASK [install openssl] ****
ok: [51.112.49.3]

TASK [start nginx server] ****
changed: [51.112.49.3]

PLAY RECAP ****
51.112.49.3 : ok=4    changed=1    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

- task5\_nginx\_browser\_single.png



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](https://nginx.org).  
Commercial support is available at [nginx.com](https://nginx.com).

*Thank you for using nginx.*

## Task 6 - Ansible-managed SSL certificates

- task6\_my\_playbook\_ssl\_section.png

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

- name: Configure SSL certificates
  hosts: nginx
  become: true
  tasks:
    - name: Create SSL private directory
      file:
        path: /etc/ssl/private
        state: directory
        mode: '0700'

    - name: Create SSL certs directory
      file:
        path: /etc/ssl/certs
        state: directory
        mode: '0755'

    - name: Get IMDSv2 token
      uri:
        url: "http://169.254.169.254/latest/api/token"
        method: PUT
        headers:
          X-aws-ec2-metadata-token-ttl-seconds: "3600"
        return_content: yes
      register: imdsv2_token

    - name: Get current public IP
      uri:
        url: "http://169.254.169.254/latest/meta-data/public-ipv4"
        headers:
          X-aws-ec2-metadata-token: "{{ imdsv2_token.content }}"
        return_content: yes
      register: public_ip

    - name: Show current public IP
```

- task6\_ansible\_play\_ssl.png

```
TASK [Create SSL certs directory] ****
changed: [51.112.49.3]

TASK [Get IMDSv2 token] ****
ok: [51.112.49.3]

TASK [Get current public IP] ****
ok: [51.112.49.3]

TASK [Show current public IP] ****
ok: [51.112.49.3] => {
    "msg": "Public IP: 51.112.49.3"
}

TASK [Generate self-signed SSL certificate] ****
changed: [51.112.49.3]

PLAY RECAP ****
51.112.49.3 : ok=11  changed=3    unreachable=0   failed=0    skipped=0   rescued=0   ignored=0
```

- task6\_ssl\_cert\_file.png

```
[ec2-user@ip-10-0-10-175 ~]$ sudo cat /etc/ssl/certs/selfsigned.crt
-----BEGIN CERTIFICATE-----
MIIDOzCCAiOgAwIBAgIUCTHDpFm83qh3+G+1Gj3kYk1RHDcwDQYJKoZIhvcNAQEL
BQAwFjEUMBIGA1UEAwLNTEuMTEyLjQ5LjMwHhcNMjYwMTE1MDYxNzQyWhcNMjcw
MTE1MDYxNzQyWjAwMRQwEgYDVQQDDAs1MS4xMTIuNDkuMzCCASIwDQYJKoZIhvcN
AQEBBQADggEPADCCAQoCggEBAJeLKhu/6EcFxntimshKgnXrFlGYoMe20NKyE
hJqaSOeIvauEyHw9WuiZ8FlLxmAu8WYIjIQvBVuZ6vMle6bH9RPFCylIkdr1Ffn
ueUBDQwfAoAa5q4XGmuMQtPfPRpxf8GUdEdHn4abGIJpF++9yVEgknRG12ckQ89mCT
z1fcz+/TceWSqv0E826mYcfFVj8zOh/JVcDCqJ4Fzf3ikKcd4eaQ3iuGhaIx7eiP
AqOVdc1ZENXfvMAhtWsDs9oerD2YzAUf7RIEVk8Ao9y4fQ60k517vdzSuVjFA9ph
x7HssNbQ8WgCvWEGD3ZLJ4ohVKKguBxLn9HhI8p0Sj4+vZcCAwEAAaOBgDB+MB0G
A1UdDgQWBETEXk2JROKxWS6v9T7t0NpKk5P3NTAfBgNVHSMEGDAwgBTEXk2JROKx
WS6v9T7t0NpKk5P3NTAPBgnVHREECDAGhwQzcDEDMAkGA1UdEwQCMAAwCwYDVR0P
BAQDAgWgMBMGA1UdJQQMMAoGCCsGAQUFBwMBMA0GCSqGSIb3DQEBCwUA4IBAQBJ
m0bX2kassSRTnwfb8ciFum5c5zaVheqZJ2uKzFz7L+NWR5/bdqevBydsUrLO+mDr
+dw54x1c4F/5N3GF/REgy6RSPOAKr7N5J01BN74cr4RCKfu3WY5Fk1rM94RDtzk7
IAJKXtf8AXiYg1IkIM98sT1dZqnH4hTNwE1W9kdu/3M/0m2KHWowlOKKF13v/G25
ECH2gmlzzTtXEbynEDGwULZQ3twzDe3UYr0R9fPdmQua0guBVRGw11VGjenVN75B
Jx46rt47uaTAwfXLpcWv8Hbdmz9pmSpPLTwCw76g6alr6aDSqy07DvDKnaAgo1G
xEf9/EgCyDrCckP3tsyJ
-----END CERTIFICATE-----
```

- task6\_ssl\_key\_file.png

```
[ec2-user@ip-10-0-10-175 ~]$ sudo cat /etc/ssl/private/selfsigned.key
-----BEGIN PRIVATE KEY-----
MIIEvAIBADANBgkqhkiG9w0BAQEFAASCBKYwggSiAgEAAoIBAQCXiyobv+hHBcZ7
YptZrISoJ10axZRmkDHTtDSshISamkjnl2rhMh1vVromfBVi8ZgLvFmCIyELwVb
merzJXumx/UTxQspSJHaq9RX57n1AQ0MH6AGuauFxprjELxz0acX/B1HRHR5+Gmx
iCaRfvvc1RIJJ0RpdnJEPPZgk89X3M/v03H1kqr9BPNupmHHxVY/MzofyVXAwqie
Bc394pCnHeHmkN4rholMe3ojwKj1Q3NWRDV37zAIbVrA7PaHqw9mMwFH+0SBFZP
AKPcuH00jpOZe73c0r1YxQPaYcex7LDW0PFoAr1hBg92SyeKIVSiolgcS5/R4SPK
dEo+Pr2XAgMBAECggEABgHoS21SIe6iraV9DxL9t0TInhv7ComxYQDxzZz7PL29
AiCz1CcRY018XxgrJNkDpjB2NvtFzsAoCFErTPZMQVg08Z16N8NmSOSqlFwRxnB
kKd4Sov1trnmzfWNoPrAqvy9a8vU6jjkx7rj/ISSK251ZqN93MhrQzU/dxiK8ZCp
ruig+SMRqgFj6zd0Rh2tBYI0SvwMcJ7ujR8SpQ/qi44q/xJXTzvH5QAsOPhS1cwb
RF0uq0ra01kC6q7pzKr/Aug73w05H0vZkBrsB1su+G+pKwdnZ96Qh2H987j/ke0w
yzw4p2JzNGB4DvEepRu00FckWU4fxcdCiFdVtWIPAQKBgQDSi9TkRLT9IrPmwn1A
M+n1voxQnt4PWJrHBaeefA1V6p/pxm55tXEjHysX4brxGS7QEoV0wfpb9t6toHck
2b54VzgT6DVst8PBMKzkiUGDTrKjhfuObfVgJa/F087YTQndNUYqj6s+soRrAXB
Dxqziq2J+1q0jDVZ2ahxlg1vwQKBgQC4QnX9++kHx1+j907s1826rtgA1pz1YVHw
ku9tkotsc4ERbLghg/gR1M5aJrNfkf4Usg/Q/qiq3cYPHPFpy62vRzdBvdF0rIig
ijkRdZtsOrUwcbHehnGROKyYPJmgK5VwftXGC2wVvTtCK9CHFQEcu1t7QRu4+BjMF
tRia41qDwvKBgAfNsPVI6qBbMenCmZvQkMG4H0E5sidFdG8d8Y15Nwtex9CFT0Dp
jaajs1c9LyX74HPkPRqz+J4ZTDwvGX8QY4etZ6DUsrRY7dWdqqe3KfIgeWZaf96Pe
xxJr0yj04by4kBm6Rc+1N693mBex1YEDS00OPcJYc5HG9o8+9vRgyFDBAoGAQ9By
DKACC9XOpVIHuIoWNXbUGLrj06gVuCxCx1j/51I7VmZk/jDLxARGTfegXLQmhwdh
utF+0iP9GOLWFtHXgoL7Wz65L++v+SdjEd0hEi3DSMB8JwagBATtZPYFpLz1QtZM
iJSdu4v2RK3FIAugHxJVW5FkJ2uaCUGd6k1TtECgYAahioPGRGt0aU11aXTudXU
7Nje8aLXPZZxtBP+NnpN7tKwbjNgXamvayMgoIJ6/4Ds7RH/RplbpUvNky/SKIxc
5t9X0Q1+9S+w138VfbJ39u7gU8ah40eGFmnG925WWQJPJRBUChmk1N3LiounrOuJ
g35fZVw1k2ImgW9UG7uNnA==
-----END PRIVATE KEY-----
[ec2-user@ip-10-0-10-175 ~]$ exit
logout
Connection to 51.112.49.3 closed.
```

## Task 7 - PHP front-end deployment with templates

- task7\_files\_templates\_created.png

```
NayabKhazin653 @ /workspaces/terraform_machine (main) $ mkdir -p files/templates
NayabKhazin653 @ /workspaces/terraform_machine (main) $ touch files/index.php
NayabKhazin653 @ /workspaces/terraform_machine (main) $ touch templates/nginx.conf.j2
NayabKhazin653 @ /workspaces/terraform_machine (main) $ ls -R
.:
 README.md  files  locals.tf  modules      outputs.tf  terraform.tfstate      terraform.tfvars
 ansible.cfg  hosts  main.tf   my-playbook.yaml  templates  terraform.tfstate.backup  variables.tf

./files:
index.php

./modules:
  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

```
NayabKhazin653 @ /workspaces/terraform_machine (main) $ cat <<'EOF' > files/index.php
> <?php
> // Get hostname
> $hostname = gethostname();
> // Deployment date
> $deployed_date = date("Y-m-d H:i:s");
> // Metadata base URL
> $metadata_base = "http://169.254.169.254/latest/";
> // Function to get IMDSv2 token
> function getImdsV2Token() {
>     $ch = curl_init("http://169.254.169.254/latest/api/token");
>     curl_setopt_array($ch, [
>         CURLOPT_RETURNTRANSFER => true,
>         CURLOPT_CUSTOMREQUEST => "PUT",
>         CURLOPT_HTTPHEADER => [
>             "X-aws-ec2-metadata-token-ttl-seconds: 21600"
>         ],
>         CURLOPT_TIMEOUT       => 2
>     ]);
>     $token = curl_exec($ch);
>     curl_close($ch);
>     return $token ?: null;
> }
> // Function to fetch metadata using token
> function getMetadata($path, $token) {
>     $url = "http://169.254.169.254/latest/meta-data/" . $path;
>     $ch = curl_init($url);
```

- task7\_nginx\_conf\_template.png

```
NayabKhazin653 🐧 /workspaces/terraform_machine (main) $ cat << EOF >> 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] "$request"'
>     '$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;
>   keepalive_timeout 65;
>   types_hash_max_size 4096;
>   include /etc/nginx/mime.types;
>   default_type application/octet-stream;
>   upstream backend_servers {
>     server 158.252.94.241:80;
>     server 158.252.94.242:80 backup;
>   }
>   server {
>     listen 443 ssl;
>     server_name {{ server_public_ip }};
>     ssl_certificate /etc/ssl/certs/selfsigned.crt;
>     ssl_certificate_key /etc/ssl/private/selfsigned.key;
>     location / {
>       root /usr/share/nginx/html;
>       index index.php index.html index.htm;
>       location ~ \.php$ {
>         include fastcgi_params;
>         fastcgi_pass unix:/run/php-fpm/www.sock;
>         fastcgi_index index.php;
>         fastcgi_param SCRIPT_FILENAME $document_root$fastcgi_script_name;
>       }
>     }
>   }
> }
```

- task7\_my\_playbook\_web\_deploy.png

```
NayabKhazin653 🐧 /workspaces/terraform_machine (main) $ cat <<EOF >> my-playbook.yaml
>
> - name: Deploy Nginx website and configuration files
>   hosts: nginx
>   become: true
>   vars:
>     server_public_ip: "51.112.49.3"
>   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
>         group: nginx
>
```

- task7\_ansible\_play\_web\_deploy.png

```

TASK [install php-fpm and php-curl] ****
changed: [51.112.49.3]

TASK [Copy website files] ****
changed: [51.112.49.3]

TASK [Copy nginx.conf template] ****
changed: [51.112.49.3]

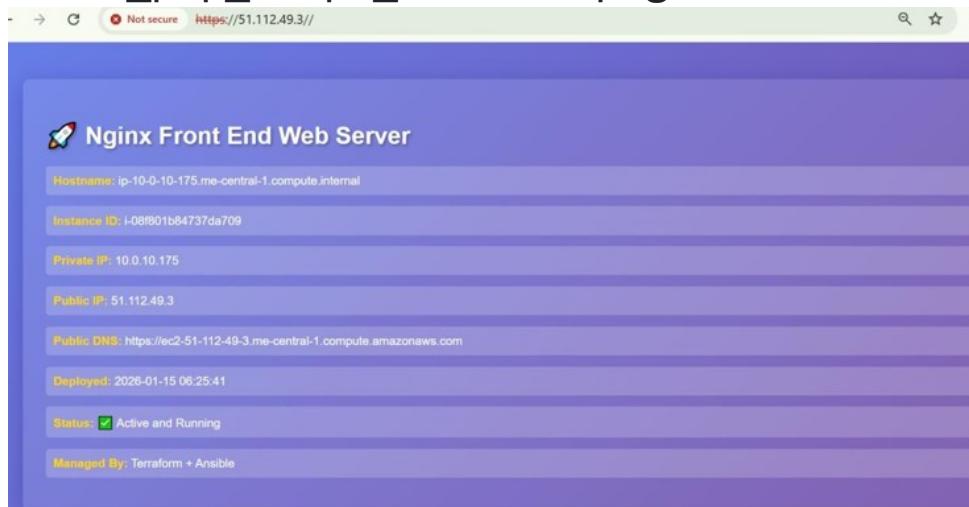
TASK [Restart nginx] ****
changed: [51.112.49.3]

TASK [Start and enable php-fpm] ****
changed: [51.112.49.3]

PLAY RECAP ****
51.112.49.3 : ok=17   changed=5    unreachable=0   failed=0    skipped=0   rescued=0   ignored=0

```

- task7\_php\_https\_browser.png



## Task 8 – Docker & Docker Compose provisioning via Ansible

- task8\_terraform\_destroy\_old.png

```

| in your organization. To reduce the verbosity of
|
Destroy complete! Resources: 7 destroyed.
[Output]

```

- task8\_terraform\_apply\_docker\_instance.png

```

| Apply complete! Resources: 7 added, 0 changed, 0 destroyed.
|
[Output]

```

- task8\_terraform\_output\_new\_ip.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ terraform output  
webserver_public_ips = [  
    "51.112.186.239",  
]
```

- task8\_hosts\_docker\_servers.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat <<EOF > hosts  
[docker_servers]  
51.112.186.239  
  
[docker_servers:vars]  
ansible_user=ec2-user  
ansible_ssh_private_key_file=~/.ssh/id_ed25519  
EOF
```

- task8\_my\_playbook\_docker.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat <<EOF > 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:  
>         path: /usr/local/lib/docker/cli-plugins  
>         state: directory  
>         mode: '0755'  
>  
>     - name: install docker-compose  
>       get_url:  
>         url: https://github.com/docker/compose/releases/latest/download/docker-compose-linux-{{ lookup('pipe', 'uname -m') }}  
>       dest: /usr/local/lib/docker/cli-plugins/docker-compose  
>       mode: +x  
>  
>     - name: View architecture of the system  
>       debug:  
>         msg: "System architecture of {{ inventory_hostname }} is {{ ansible_facts['architecture'] }}"
```

- task8\_ansible\_play\_docker.png

```
}  
  
TASK [Alternate method to view architecture of the system] ****  
ok: [51.112.186.239] => {  
    "msg": "System architecture of 51.112.186.239 is x86_64"  
}  
  
TASK [restart docker service] ****  
changed: [51.112.186.239]  
  
PLAY RECAP ****  
51.112.186.239 : ok=8    changed=4    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

- task8\_docker\_ps\_remote.png

```
NayabKhazin653 [ /workspaces/terraform_machine (main) $ ssh ec2-user@51.112.186.239 -i ~/.ssh/id_ed25519
,      #
~\_ #####_      Amazon Linux 2023
~~ \_\#####\
~~  \###|
~~   \#/  ____ https://aws.amazon.com/linux/amazon-linux-2023
~~    \~' '-'>
~~     /
~~..-.
~/`/
~/m'
last login: Thu Jan 15 06:33:23 2026 from 20.192.21.54
[ec2-user@ip-10-0-10-86 ~]$ sudo docker ps
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
[ec2-user@ip-10-0-10-86 ~]$ exit
logout
Connection to 51.112.186.239 closed.
```

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

- task9\_my\_playbook\_add\_user\_to\_docker.png

```
NayabKhasin653 ✘ /workspaces/terraform_machine (main) $ cat <<EOF >> my-playbook.yaml
>
> - name: Adding user to docker group
>   hosts: all
>   become: true
>   vars_files:
>     - project-vars.yaml
>   tasks:
>     - name: add user to docker group
>       user:
>         name: "{{ normal_user }}"
>         groups: docker
>         append: yes
>
>     - name: reconnect to apply group changes
>       meta: reset_connection
>
>     - name: verify docker access
>       command: docker ps
>       register: docker_ps
>       changed_when: false
>
>     - name: display docker ps output
>       debug:
>         var: docker_ps.stdout
>
>     - name: fail if docker is not accessible
>       fail:
>         msg: "Docker is not accessible on this host"
>       when: docker_ps.rc != 0
>
> EOF
```

- task9\_project\_vars.png

```
[nayabkhazin653 ~] /workspaces/terraform_machine (main) $ cat <<EOF > project-vars.yaml
> normal_user: ec2-user
> docker_compose_file_location: /home/ec2-user/docker-compose.yaml
> EOF
```

- task9\_my\_playbook\_deploy\_containers.png

```
NayabKhazin653 [?] /workspaces/terraform_machine (main) $ cat <<EOF >> my-playbook.yaml
>
> - 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
>
>     - name: deploy containers using docker-compose
>       command: docker compose up -d
>       register: compose_result
>       changed_when: "'Creating' in compose_result.stdout or 'Recreating' in compose_result.stderr"
>
> EOF
```

- task9\_compose\_yaml.png

```
NayabKhazin653 [?] /workspaces/terraform_machine (main) $ cat compose.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_PASSWORD=gitea
    restart: always
    volumes:
      - gitea:/data
    ports:
      - 3000:3000
    extra_hosts:
      - "www.jenkins.com:host-gateway"
    networks:
      - webnet
  db:
    image: postgres:alpine
    container_name: gitea_db
```

- task9\_ansible\_play\_gitea.png

```
PLAY [Deploy Docker Containers] ****
TASK [Gathering Facts] ****
ok: [51.112.186.239]

TASK [check if docker-compose file exists] ****
ok: [51.112.186.239]

TASK [copy docker-compose file] ****
changed: [51.112.186.239]

TASK [deploy containers using docker-compose] ****
ok: [51.112.186.239]

PLAY RECAP ****
51.112.186.239 : ok=16    changed=2    unreachable=0    failed=0    skipped=1    rescued=0    ignored=0
```

- task9\_sg\_ingress\_3000.png

```

    protocol      = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
}
ingress {
    from_port    = 80
    to_port      = 80
    protocol    = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
}
ingress {
    from_port    = 3000
    to_port      = 3000
    protocol    = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
}

egress {
    from_port    = 0

```

- task9\_terraform\_apply\_sg\_3000.png

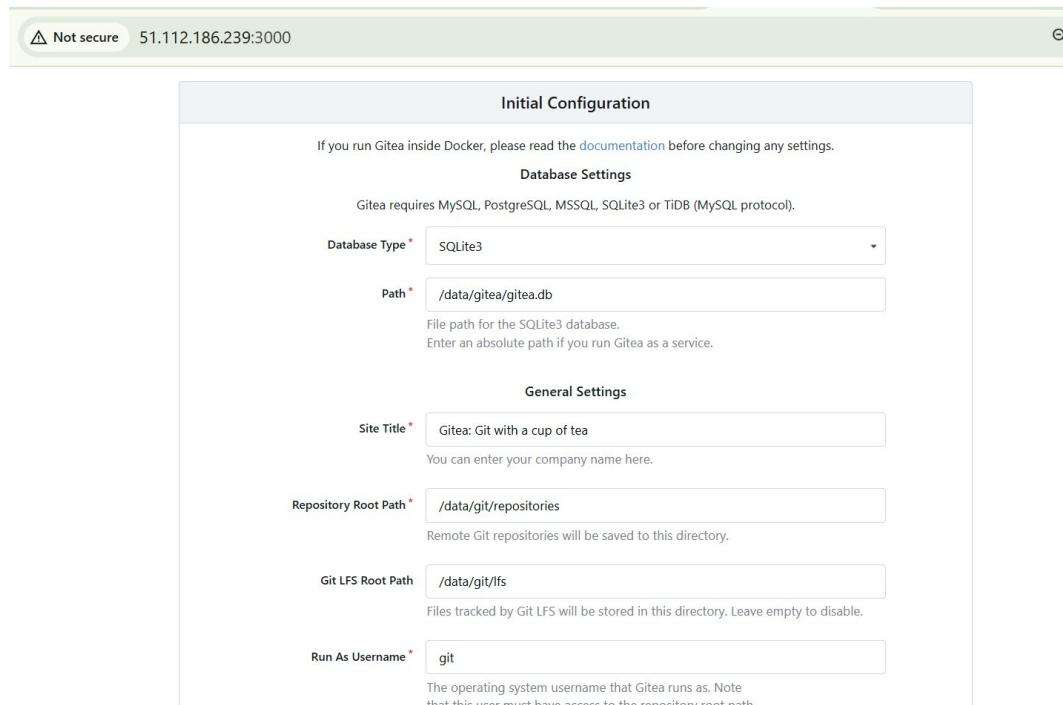
```

| option.

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


```

- task9\_gitea\_browser.png



## Task 10 – Automating Ansible with Terraform (null\_resource)

- task10\_null\_resource\_main\_tf.png

```
subnet_id = module.myapp-subnet.subnet.id

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

}
resource "null_resource" "configure_server" {
  triggers = {
    webserver_public_ips_for_ansible = join(",", [for i in module.myapp-webserver : i.aws_instance_ip])
  }

  depends_on = [module.myapp-webserver]

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

- task10\_terraform\_destroy\_before\_null.png

```
[ed]
module.myapp-subnet.aws_internet_gateway.myapp_igw: Destruction complete after 17s
module.myapp-webserver[0].aws_instance.myapp-server: Destruction complete after 20s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destroying... [id=subnet-06a58827fc648df39]
module.myapp-webserver[0].aws_security_group.web_sg: Destroying... [id=sg-04117cb6dc46533a8]
module.myapp-webserver[0].aws_key_pair.ssh-key: Destroying... [id=dev-serverkey-0]
module.myapp-webserver[0].aws_key_pair.ssh-key: Destruction complete after 0s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destruction complete after 0s
module.myapp-webserver[0].aws_security_group.web_sg: Destruction complete after 0s
aws_vpc.myapp_vpc: Destroying... [id=vpc-018246efc594ab2e7]
aws_vpc.myapp_vpc: Destruction complete after 1s

Warning: Value for undeclared variable

The root module does not declare a variable named "cidr_block" but a value was found in file
"terraform.tfvars". If you meant to use this value, add a "variable" block to the configuration.

To silence these warnings, use TF_VAR_... environment variables to provide certain "global" settings
configurations in your organization. To reduce the verbosity of these warnings, use the -compact-warnings
option.

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 3.28.42.182, \
--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
https://docs.ansible.com/ansible/devel/reference_appendices/config.html#cfg-in-world-writable-dir
could not be foundbook:
/bin/sh: 2: --private-key: not found
: not found3: my-playbook.yaml
```

- task10\_my\_playbook\_wait\_for\_ssh.png

```
- name: Wait for some time to ensure system readiness
  hosts: all
  tasks:
    - name: Wait 300 seconds for port 22 to become open and contain "OpenSSH"
      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:
        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
```

- task10\_terraform\_apply\_after\_wait.png

```
full_resource.configure_server (local-exec): TASK [deploy config]
*****
full_resource.configure_server: Still creating... [01m50s elapsed]
full_resource.configure_server: Still creating... [02m00s elapsed]
full_resource.configure_server (local-exec): ok: [158.252.83.246]

full_resource.configure_server (local-exec): PLAY RECAP *****
*****
full_resource.configure_server (local-exec): 158.252.83.246
  failed=0    skipped=1    rescued=0    ignored=0

full_resource.configure_server: Creation complete after 2m1s

Warning: Value for undeclared variable

The root module does not declare a variable named "cidr_block".
"terraform.tfvars". If you meant to use this value, add a "cidr_block"
variable to your configuration.

To silence these warnings, use TF_VAR_cidr_block environment variable
configurations in your organization. To reduce the verbosity of these
warnings, use the --no-warnings option.

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

Outputs:
```

- task10\_app\_browser\_post\_null\_resource.png

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).

**General Settings**

**Site Title**: Gitea: Git with a cup of tea

**Repository Root Path**: /data/git/repositories

**Git LFS Root Path**: /data/git/lfs

**Run As Username**: git

## Task 11 – Dynamic inventory with aws\_ec2 plugin

- task11\_ansible\_cfg\_aws\_ec2.png

```
@NayabKhazin653 [~/workspaces/terraform_machine (main)]$ cat 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 interpreter_python = /usr/bin/python3
```

- task11\_inventory\_aws\_ec2\_created.png

```
@NayabKhazin653 [~/workspaces/terraform_machine (main)]$ touch inventory_aws_ec2.yaml
@NayabKhazin653 [~/workspaces/terraform_machine (main)]$ ls -la inventory_aws_ec2.yaml
-rw-rw-rw- 1 codespace codespace 0 Jan 15 08:02 inventory_aws_ec2.yaml
```

- task11\_inventory\_aws\_ec2\_initial.png

```
@NayabKhazin653 [~/workspaces/terraform_machine (main)]$ cat inventory_aws_ec2.yaml
---
plugin: aws_ec2
regions:
  - me-central-1
@NayabKhazin653 [~/workspaces/terraform_machine (main)]$
```

- task11\_main\_tf\_dev\_prod\_modules.png

```

}

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

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

```

- task11\_outputs\_tf\_dev\_prod\_ips.png

```
@NayabKhazin653 eworkspaces/terraform_machine (main) $ cat outputs.tf
output "webserver_public_ips" {
  value = [for i in module.myapp-webserver : i.aws_instance.public_ip]
}

output "prod-webserver_public_ips" {
  value = [for i in module.myapp-webserver-prod : i.aws_instance.public_ip]
```

- task11\_terraform\_apply\_dynamic\_setup.png

```
Apply complete! Resources: 3 added, 0 changed, 1 destroyed.

Outputs:
```

- task11\_terraform\_output\_dynamic\_ips.png

```
@NayabKhazin653 eworkspaces/terraform_machine (main) $ terraform output
prod-webserver_public_ips = [
  "40.172.232.211",
]
webserver_public_ips = [
  "158.252.83.246",
]
```

- task11\_boto\_install.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ $(which python) -m pip install boto3 botocore
Collecting boto3
  Downloading boto3-1.42.28-py3-none-any.whl.metadata (6.8 kB)
Collecting botocore
  Downloading botocore-1.42.28-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 boto3-1.42.28-py3-none-any.whl (140 kB)
Downloaded boto3-1.42.28-py3-none-any.whl (14.6 MB)
14.6/14.6 MB 27.2 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 boto3-1.42.28 botocore-1.42.28 jmespath-1.0.1 s3transfer-0.16.0
```

- task11\_boto\_version.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ $(which python) -c "import boto3, botocore; print(boto3.__version__)"
1.42.28
```

- task11\_ansible\_inventory\_graph\_initial.png

```
@all:
  |--@ungrouped:
  |--@aws_ec2:
    |   |--ec2-158-252-83-246.me-central-1.compute.amazonaws.com
    |   |--ec2-40-172-232-211.me-central-1.compute.amazonaws.com
```

## Task 12 – Filtering EC2 instances by tags & instance type

- task12\_inventory\_aws\_ec2\_tag\_groups.png

```
@NayabKhazin653 ② /workspaces/terraform_machine (main) $ cat inventory_aws_ec2.yaml
---
plugin: aws_ec2
regions:
  - me-central-1
keyed_groups:
  - key: tags
    prefix: tag
    separator: "_"
```

- task12\_inventory\_graph\_tag\_groups.png

```

[NayabKhazin653 @ /workspaces/terraform_machine (main) $ ansible-inventory -i inventory_aws_ec2.yaml --graph
[WARNING]: Ansible is being run in a world writable directory (/workspaces/terraform_machine), ignoring it as an ansible.cfg file is present in the directory.
[DEPRECATION WARNING]: Deprecation warnings can be disabled by setting 'deprecation_warnings=False' in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core@2.11.0.
@all:
  - @ungrouped:
    - @aws_ec2:
      |--ec2-158-252-83-246.me-central-1.compute.amazonaws.com
      |--ip-10-0-1-115.me-central-1.compute.internal
      |--ip-10-0-1-46.me-central-1.compute.internal
      |--ec2-40-172-232-211.me-central-1.compute.amazonaws.com
      |--ip-10-0-1-119.me-central-1.compute.internal
      |--ip-10-0-1-199.me-central-1.compute.internal
    - @tag_Name_dev_ec2_instance_0:
      |--ec2-158-252-83-246.me-central-1.compute.amazonaws.com
    - @tag_Name_dev_backend_0:
      |--ip-10-0-1-115.me-central-1.compute.internal
      |--ip-10-0-1-119.me-central-1.compute.internal
      |--ip-10-0-1-199.me-central-1.compute.internal
    - @tag_Name_dev_frontend_0:
      |--ip-10-0-1-46.me-central-1.compute.internal
    - @tag_Name_prod_ec2_instance_0:
      |--ec2-40-172-232-211.me-central-1.compute.amazonaws.com

```

- task12\_inventory\_aws\_ec2\_instance\_type\_groups.png

```

[NayabKhazin653 @ /workspaces/terraform_machine (main) $ cat inventory_aws_ec2.yaml
---
plugin: aws_ec2
regions:
  - me-central-1
keyed_groups:
  - key: tags
    prefix: tag
    separator: "_"

  - key: instance_type
    prefix: instance_type
    separator: "_"

```

- task12\_inventory\_graph\_full.png

```

[DEPRECATION WARNING]: Using 'text.converters' instead.
[DEPRECATION WARNING]: Passing `disable_lookups` to `template` is deprecated. This feature will be removed from ansible-core@2.11.0.
@all:
  - @ungrouped:
    - @aws_ec2:
      |--ec2-158-252-83-246.me-central-1.compute.amazonaws.com
      |--ip-10-0-1-115.me-central-1.compute.internal
      |--ip-10-0-1-46.me-central-1.compute.internal
      |--ec2-40-172-232-211.me-central-1.compute.amazonaws.com
      |--ip-10-0-1-119.me-central-1.compute.internal
      |--ip-10-0-1-199.me-central-1.compute.internal
    - @tag_Name_dev_ec2_instance_0:
      |--ec2-158-252-83-246.me-central-1.compute.amazonaws.com
    - @instance_type_t3_micro:
      |--ec2-158-252-83-246.me-central-1.compute.amazonaws.com
      |--ip-10-0-1-115.me-central-1.compute.internal
      |--ip-10-0-1-46.me-central-1.compute.internal
      |--ip-10-0-1-119.me-central-1.compute.internal
      |--ip-10-0-1-199.me-central-1.compute.internal
    - @tag_Name_dev_backend_0:
      |--ip-10-0-1-115.me-central-1.compute.internal
      |--ip-10-0-1-119.me-central-1.compute.internal
      |--ip-10-0-1-199.me-central-1.compute.internal
    - @tag_Name_dev_frontend_0:
      |--ip-10-0-1-46.me-central-1.compute.internal
    - @tag_Name_prod_ec2_instance_0:
      |--ec2-40-172-232-211.me-central-1.compute.amazonaws.com
    - @instance_type_t3_nano:
      |--ec2-40-172-232-211.me-central-1.compute.amazonaws.com

```

- task12\_my\_playbook\_all\_hosts.png

```

GNU nano 7.2                                         my-playbook.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
      service:
        name: nginx
        state: started
        enabled: true

    - name: Configure SSL certificates
      hosts: all
      become: true
      tasks:

```

- task12\_ansible\_play\_all.png

```

Mayabkhazin653 ~ /workspaces/terraform_machine (main) $ ansible-playbook -i inventory_aws_ec2.yaml my-playbook.yaml
[WARNING]: Deprecation warnings can be disabled by setting 'deprecation_warnings=False' in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core version 2.23.

PLAY [Wait for some time to ensure system readiness] ****
[WARNING]: Found variable using reserved name 'tags'.
Origin: <unknown>

tags

TASK [Wait for port 22] ****
ok: [51.112.180.29 -> localhost]

PLAY [Configure Docker] ****

```

```

Mayabkhazin653 ~ /workspaces/terraform_machine (main) $ ansible-playbook -i inventory_aws_ec2.yaml -l tag_Name_dev_* my-playbook.yaml
[WARNING]: Deprecation warnings can be disabled by setting 'deprecation_warnings=False' in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core version 2.23.

PLAY [Wait for some time to ensure system readiness] ****
[WARNING]: Found variable using reserved name 'tags'.
Origin: <unknown>

tags

TASK [Wait for port 22] ****
ok: [51.112.180.29 -> localhost]

PLAY [Configure Docker] ****

```

- task12\_ansible\_play\_dev\_only.png

```

TASK [Copy website files] ****
ok: [51.112.52.187]
ok: [51.112.180.29]

TASK [Copy nginx.conf template] ****
ok: [51.112.52.187]
ok: [51.112.180.29]

TASK [Restart nginx] ****
changed: [51.112.52.187]
changed: [51.112.180.29]

TASK [Start and enable php-fpm] ****
ok: [51.112.52.187]
ok: [51.112.180.29]

PLAY RECAP ****
51.112.180.29 : ok=34   changed=2    unreachable=0   failed=0    skipped=2    rescued=0   ignored=0
51.112.52.187 : ok=34   changed=2    unreachable=0   failed=0    skipped=2    rescued=0   ignored=0

```

```

TASK [install php-fpm and php-curl] *****
ok: [51.112.180.29]

TASK [Copy website files] *****
ok: [51.112.180.29]

TASK [Copy nginx.conf template] *****
ok: [51.112.180.29]

TASK [Restart nginx] *****
changed: [51.112.180.29]

TASK [Start and enable php-fpm] *****
ok: [51.112.180.29]

PLAY RECAP *****
51.112.180.29      : ok=34   changed=2    unreachable=0   failed=0    skipped=2   rescued=0   ignored=0

```

- task12\_ansible\_play\_prod\_only.png

```

!NayabKhazin653 @ /workspaces/terraform_machine (main) $ ansible-playbook -i inventory_aws_ec2.yaml -l tag_Name_prod_* my-playbook.yaml
[WARNING]: Deprecation warnings can be disabled by setting 'deprecation_warnings=False' in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core version 2.23.

PLAY [Wait for some time to ensure system readiness] *****
[WARNING]: Found variable using reserved name 'tags'.
Origin: <unknown>

tags

TASK [Wait for port 22] *****
ok: [51.112.52.187]

TASK [Copy website files] *****
ok: [51.112.52.187]

TASK [Copy nginx.conf template] *****
ok: [51.112.52.187]

TASK [Restart nginx] *****
changed: [51.112.52.187]

TASK [Start and enable php-fpm] *****
ok: [51.112.52.187]

PLAY RECAP *****
51.112.52.187      : ok=34   changed=2    unreachable=0   failed=0    skipped=2   rescued=0   ignored=0

```

- task12\_ansible\_play\_t3\_micro.png

```

!NayabKhazin653 @ /workspaces/terraform_machine (main) $ ansible-playbook -i inventory_aws_ec2.yaml -l instance_type_t3_micro my-playbook.yaml
[WARNING]: Deprecation warnings can be disabled by setting 'deprecation_warnings=False' in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core version 2.23.

PLAY [Wait for some time to ensure system readiness] *****
[WARNING]: Found variable using reserved name 'tags'.
Origin: <unknown>

tags

ASK [Wait for port 22] *****
ok: [51.112.180.29]

TASK [Install php-fpm and php-curl] *****
ok: [51.112.180.29]

TASK [Copy website files] *****
ok: [51.112.180.29]

TASK [Copy nginx.conf template] *****
ok: [51.112.180.29]

TASK [Restart nginx] *****
changed: [51.112.180.29]

TASK [Start and enable php-fpm] *****
ok: [51.112.180.29]

PLAY RECAP *****
51.112.180.29      : ok=34   changed=2    unreachable=0   failed=0    skipped=2   rescued=0   ignored=0

```

- task12\_ansible\_play\_t3\_nano.png

```

@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ansible-playbook -i inventory_aws_ec2.yaml -i instance_type_t3_nano my-playbook.yaml
[WARNING]: Deprecation warnings can be disabled by setting `deprecation_warnings=False` in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible-core version 2.24. Use ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core version 2.23.

PLAY [Wait for some time to ensure system readiness] *****
[WARNING]: Found variable using reserved name 'tags'.
  origin: <unknown>
  tags

ASK [Wait for port 22]
ok: [51.112.52.187 -> localhost]

PLAY [Configure Docker]
ok: [51.112.52.187]

ASK [Gathering Facts]
ok: [51.112.52.187]

ok: [51.112.52.187]

TASK [Copy website files]
ok: [51.112.52.187]

TASK [Copy nginx.conf template]
ok: [51.112.52.187]

TASK [Restart nginx]
changed: [51.112.52.187]

TASK [Start and enable php-fpm]
ok: [51.112.52.187]

PLAY RECAP *****
51.112.52.187      : ok=34    changed=2     unreachable=0    failed=0    skipped=2    rescued=0    ignored=0

```

- task12\_ansible\_cfg\_inventory\_default.png

```

@NayabKhazin653 ② /workspaces/terraform_machine (main) $ echo "[defaults]"
> inventory = ./inventory_aws_ec2.yaml" > ansible.cfg

```

- task12\_ansible\_play\_t3\_nano\_no\_i.png

```

@NayabKhazin653 ② /workspaces/terraform_machine (main) $ ansible-playbook -i instance_type_t3_nano my-playbook.yaml
[WARNING]: Deprecation warnings can be disabled by setting `deprecation_warnings=False` in ansible.cfg.
[DEPRECATION WARNING]: Importing 'to_text' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Importing 'to_native' from 'ansible.module_utils._text' is deprecated. This feature will be removed from ansible.module_utils.common.text.converters instead.
[DEPRECATION WARNING]: Passing 'disable_lookups' to 'template' is deprecated. This feature will be removed from ansible-core version 2.23.

PLAY [Wait for some time to ensure system readiness] *****
[WARNING]: Found variable using reserved name 'tags'.
  origin: <unknown>
  tags

TASK [Wait for port 22]
ok: [51.112.180.29]
ok: [51.112.52.187]


```

## Task 13 – Ansible roles: nginx, ssl, webapp

```

TASK [Copy nginx.conf template]
ok: [51.112.180.29]
ok: [51.112.52.187]

TASK [Restart nginx]
changed: [51.112.180.29]
changed: [51.112.52.187]

TASK [Start and enable php-fpm]
ok: [51.112.180.29]
ok: [51.112.52.187]

PLAY RECAP *****
51.112.180.29      : ok=34    changed=2     unreachable=0    failed=0    skipped=2    rescued=0    ignored=0
51.112.52.187      : ok=34    changed=2     unreachable=0    failed=0    skipped=2    rescued=0    ignored=0

```

- task13\_main\_tf\_single\_dev.png

```
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

}
```

- task13\_ansible\_structure\_created.png

```
@NayabKhazin653 2 /workspaces/terraform_machine/ansible (main) $ ls -R
.:
ansible.cfg  inventory  my-playbook.yaml  roles

./inventory:

./roles:
```

- task13\_ansible\_cfg\_project.png

```
GNU nano 7.2                                         ansible.cfg
[defaults]
host_key_checking=False
interpreter_python = /usr/bin/python3
```

- task13\_ansible\_inventory\_hosts.png

```
GNU nano 7.2                                         inventory/hosts *
[nginx]
51.112.180.29

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

- task13\_roles\_created.png

```
Maya@Khazin:~/WorkSpaces/terraform_machine/ansible (main)$ ls -R
.
+-- ansible.cfg
+-- inventory
+-- my-playbook.yaml
+-- roles
+-- README.md
+-- tasks
+-- templates
+-- vars

-- ./roles:
+-- nginx
+-- webapp

-- ./roles/nginx:
+-- defaults
+-- main.yml
+-- files
+-- handlers
+-- meta
+-- tasks
+-- templates
+-- vars
```

- task13\_nginx\_handlers\_main.png

```
GNU nano 7.2                                         ansible/roles/nginx/handlers/main.yml
- name: Restart nginx
  service:
    name: nginx
    state: restarted
```

- task13\_nginx\_tasks\_main.png

```
GNU nano 7.2                                         ansible/roles/nginx/tasks/main.yml
- name: Install nginx
  yum:
    name: nginx
    state: present
    update_cache: yes
  notify: Restart nginx

- name: Install openssl
  yum:
    name: openssl
    state: present

- name: Start and enable nginx
  service:
    name: nginx
    state: started
    enabled: true
```

- task13\_my\_playbook\_nginx\_only.png

```

GNU nano 7.2                               ansible/my-playbook.yaml
---
- name: Deploy NGINX Web Stack with SSL and PHP
  hosts: nginx
  become: true
  roles:
    - nginx

```

- task13\_ansible\_play\_nginx\_only.png

```

maya@rhazin653:~/workspaces/terraform_machine/ansible (main) $ ansible-playbook -i inventory/hosts my-playbook.yaml
[WARNING]: Ansible is being run in a world writable directory (/workspaces/terraform_machine/ansible), ignoring it as
an ansible.cfg source. For more information see https://docs.ansible.com/ansible/devel/reference_appendices/config/
tm1#cfg-in-world-writable-dir

PLAY [Deploy NGINX Web Stack with SSL and PHP] ****
* TASK [Gathering Facts] ****
* [WARNING]: Host '51.112.52.187' is using the discovered Python interpreter at '/usr/bin/python3.9', but future insta
llation 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.
  ok: [51.112.52.187]

TASK [nginx : Install nginx] ****
* ok: [51.112.52.187]

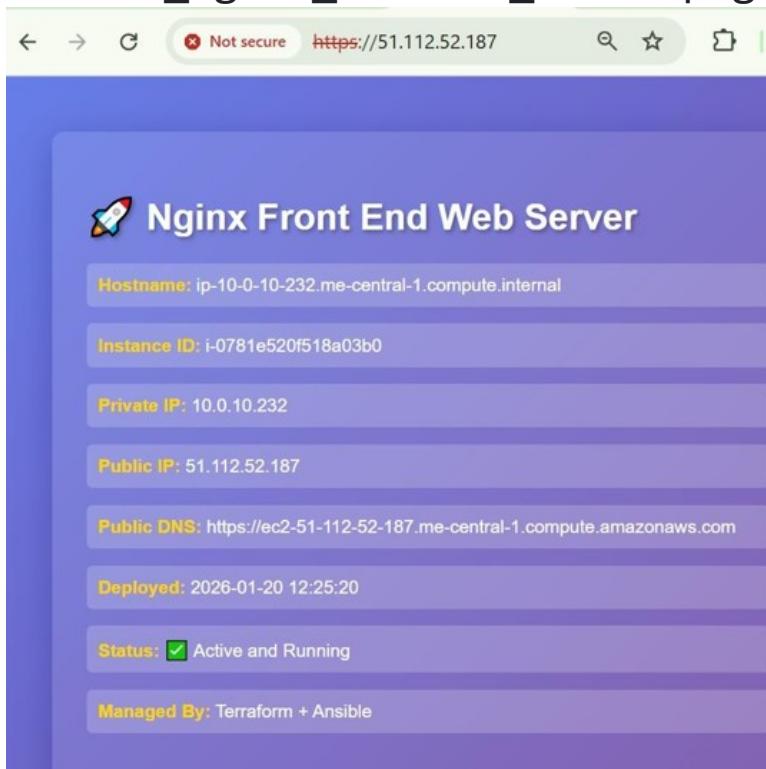
TASK [nginx : Install openssl] ****
* ok: [51.112.52.187]

TASK [nginx : Start and enable nginx] ****
* ok: [51.112.52.187]

PLAY RECAP ****
51.112.52.187 : ok=4    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

```

- task13\_nginx\_browser\_roles.png



- task13\_ssl\_defaults\_main.png

```
GNU nano 7.2                                         ansible/roles/ssl/defaults/main.yml
imdsv2_token_ttl: "3600"
ssl_days_valid: 365
```

- task13\_ssl\_tasks\_main.png

```
GNU nano 7.2                                         ansible/roles/ssl/tasks/main.yml
- name: Create SSL certs directory
  file:
    path: /etc/ssl/certs
    state: directory
    mode: '0755'

- name: Get IMDSv2 token
  uri:
    url: http://169.254.169.254/latest/api/token
    method: PUT
    headers:
      X-aws-ec2-metadata-token-ttl-seconds: "{{ imdsv2_token_ttl }}"
    return_content: yes
  register: imds_token

- name: Get public IP
  uri:
    url: http://169.254.169.254/latest/meta-data/public-ipv4
    headers:
      X-aws-ec2-metadata-token: "{{ imds_token.content }}"
    return_content: yes
  register: public_ip

- name: Save public IP as fact
  set_fact:
    server_public_ip: "{{ public_ip.content }}"

- name: Generate self-signed certificate
  command: >
    openssl req -x509 -nodes -days {{ ssl_days_valid }}
    -newkey rsa:2048
    -keyout /etc/ssl/private/selfsigned.key
    -out /etc/ssl/certs/selfsigned.crt
    -subj "/CN={{ server_public_ip }}"
    -addext "subjectAltName=IP:{{ server_public_ip }}"
  args:
    creates: /etc/ssl/certs/selfsigned.crt
```

[ Wrote 43 lines ]

- task13\_webapp\_defaults\_main.png

```
GNU nano 7.2                                         ansible/roles/webapp/defaults/main.yml
nginx_user: nginx
nginx_worker_processes: auto
nginx_worker_connections: 1024
nginx_error_log_level: notice

# Webapp settings
web_root: /usr/share/nginx/html
web_index_file: index.php
```

- task13\_webapp\_files\_index\_php.png

```

GNU nano 7.2                                         ansible/roles/webapp/files/index.php
    background: rgba(255,255,255,0.2);
    border-radius: 5px;
}
.label {
    font-weight: bold;
    color: #ffd700;
}
.info a {
    color: white;          /* same as other values */
    text-decoration: none; /* remove underline */
    font-weight: normal;
}

.info a:hover {
    text-decoration: underline; /* optional: underline on hover */
}
</style>
</head>
<body>
<div class="container">
    <h1> Nginx Front End Web Server </h1>

    <div class="info"><span class="label">Hostname:</span> <?= htmlspecialchars($hostname) ?></div>
    <div class="info"><span class="label">Instance ID:</span> <?= htmlspecialchars($instance_id) ?></div>
    <div class="info"><span class="label">Private IP:</span> <?= htmlspecialchars($private_ip) ?></div>
    <div class="info"><span class="label">Public IP:</span> <?= htmlspecialchars($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>
</html>

```

[ Wrote 117 lines ]

- task13\_webapp\_handlers\_main.png

```

GNU nano 7.2                                         ansible/roles/webapp/handlers/main.yml
- name: Restart nginx
  service:
    name: nginx
    state: restarted

- name: Restart php-fpm
  service:
    name: php-fpm
    state: restarted

```

- task13\_webapp\_templates\_nginx\_conf.png

```

GNU nano 7.2                               ansible/roles/webapp/templates/nginx.conf.j2
server 158.252.94.241:80;
server 158.252.94.242:80 backup;
}

server {
    listen 443 ssl;
    server_name {{ server_public_ip }};

    ssl_certificate /etc/ssl/certs/selfsigned.crt;
    ssl_certificate_key /etc/ssl/private/selfsigned.key;

    location / {
        root {{ web_root }};
        index {{ web_index_file }} index.html index.htm;
        # proxy_pass http://158.252.94.241:80;
        # proxy_pass http://backend_servers;

        location / {
            try_files $uri $uri/ =404;
        }

        # This block is necessary for Php Website
        location ~ \.php$ {
            include fastcgi_params;
            fastcgi_pass unix:/run/php-fpm/www.sock;
            fastcgi_index index.php;
            fastcgi_param SCRIPT_FILENAME $document_root$fastcgi_script_name;
        }
    }
}

server {
    listen 80;
    server_name _;
    return 301 https://$host$request_uri;
}
}

```

[ Wrote 62 lines ]

- task13\_webapp\_tasks\_main.png

```

GNU nano 7.2                               ansible/roles/webapp/tasks/main.yml
name: Install PHP packages
yum:
  name:
    - php-fpm
    - php-curl
  state: present
  notify: Restart php-fpm

name: Copy PHP website
copy:
  src: index.php
  dest: "{{ web_root }}/{{ web_index_file }}"
  owner: nginx
  group: nginx
  mode: '0644'
  notify: Restart nginx

name: Deploy nginx config
template:
  src: nginx.conf.j2
  dest: /etc/nginx/nginx.conf
  notify: Restart nginx

name: Start and enable php-fpm
service:
  name: php-fpm
  state: started
  enabled: true

```

- task13\_my\_playbook\_roles.png

```
GNU nano 7.2                                         ansible/my-playbook.yaml

- name: Deploy NGINX Web Stack with SSL and PHP
  hosts: nginx
  become: true
  roles:
    - nginx
    - ssl
    - webapp
```

- task13\_ansible\_play\_roles.png

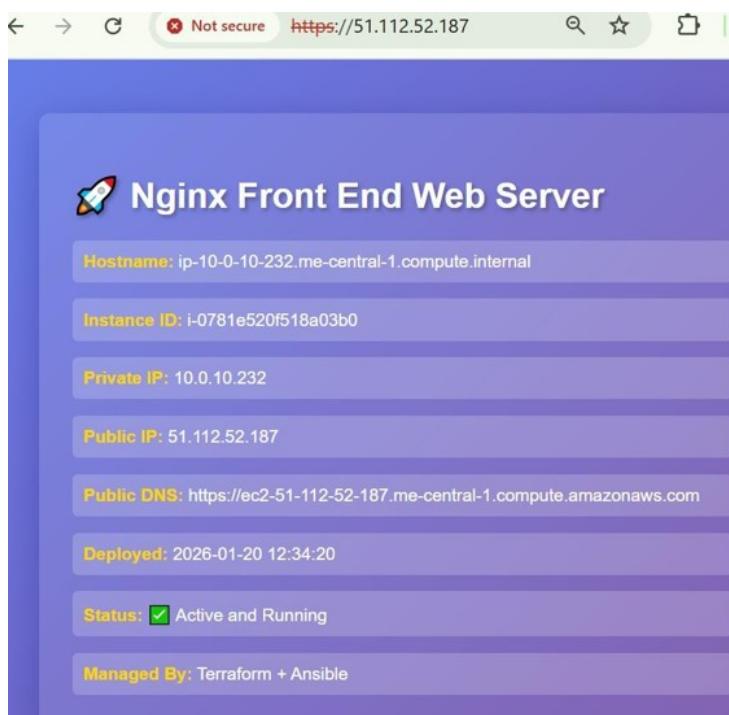
```
TASK [webapp : Deploy nginx config] ****
changed: [51.112.52.187]

TASK [webapp : Start and enable php-fpm] ****
ok: [51.112.52.187]

RUNNING HANDLER [webapp : Restart nginx] ****
changed: [51.112.52.187]

PLAY RECAP ****
51.112.52.187      : ok=15   changed=3    unreachable=0    failed=0     skipped=0    rescued=0    ignored=0
```

- task13\_php\_https\_browser\_roles.png



## Cleanup

- cleanup\_terraform\_destroy.png

```

]
module.myapp-webserver-prod[0].aws_instance.myapp-server: Destruction complete after 1m
module.myapp-webserver-prod[0].aws_key_pair.ssh-key: Destroying... [id=prod-serverkey-0
module.myapp-webserver-prod[0].aws_security_group.web_sg: Destroying... [id=sg-035dfcd2
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destroying... [id=subnet-0de50a150c03db9
module.myapp-webserver-prod[0].aws_key_pair.ssh-key: Destruction complete after 1s
module.myapp-subnet.aws_subnet.myapp_subnet_1: Destruction complete after 2s
module.myapp-webserver-prod[0].aws_security_group.web_sg: Destruction complete after 2s
aws_vpc.myapp_vpc: Destroying... [id=vpc-03529dae2d24d71e0]
aws_vpc.myapp_vpc: Destruction complete after 1s

Warning: Value for undeclared variable

The root module does not declare a variable named "cidr_block" but a value was found
If you meant to use this value, add a "variable" block to the configuration.

To silence these warnings, use TF_VAR_... environment variables to provide certain "g
configurations in your organization. To reduce the verbosity of these warnings, use t

Destroy complete! Resources: 10 destroyed.

```

- **cleanup\_tfstate.png**

```
NayabKhazin653 /workspaces/terraform_machine (main) $ cat terraform.tfstate
{
  "version": 4,
  "terraform_version": "1.14.3",
  "serial": 164,
  "lineage": "a64ec9f4-8bc2-bfab-9643-136f957a3fe3",
  "outputs": {},
  "resources": [],
  "check_results": null
}
```

- **cleanup\_aws\_console.png**

Instances (2) <a href="#">Info</a>		Last updated <span>less than a minute ago</span>	<a href="#">Connect</a>	<a href="#">Instance state ▾</a>	<a href="#">Actions ▾</a>	<a href="#">Launch instances</a>	▼
				<a href="#">All states ▾</a>			
<input type="checkbox"/>	Name <a href="#">🔗</a>	Instance ID	Instance state	Instance type	Status check	Alarm status	Avail
<input type="checkbox"/>	dev-ec2-insta...	i-04098a7b6e225f33a	<span>Terminated</span> <a href="#">🔗</a> <a href="#">🔗</a>	t3.micro	-	<a href="#">View alarms +</a>	me-c
<input type="checkbox"/>	prod-ec2-insta...	i-0781e520f518a03b0	<span>Terminated</span> <a href="#">🔗</a> <a href="#">🔗</a>	t3.nano	-	<a href="#">View alarms +</a>	me-c