Fatima Jinnah Women University

Department of Software Engineering

SUBJECT: CC LAB

SUBMITTED TO: SIR SHOAIB

SUBMITTED BY: ZUNAIRA NOOR

REGISTRATION NO: 2023-BSE-075

SEMESTER: V-B

STEP 0: Prerequisites

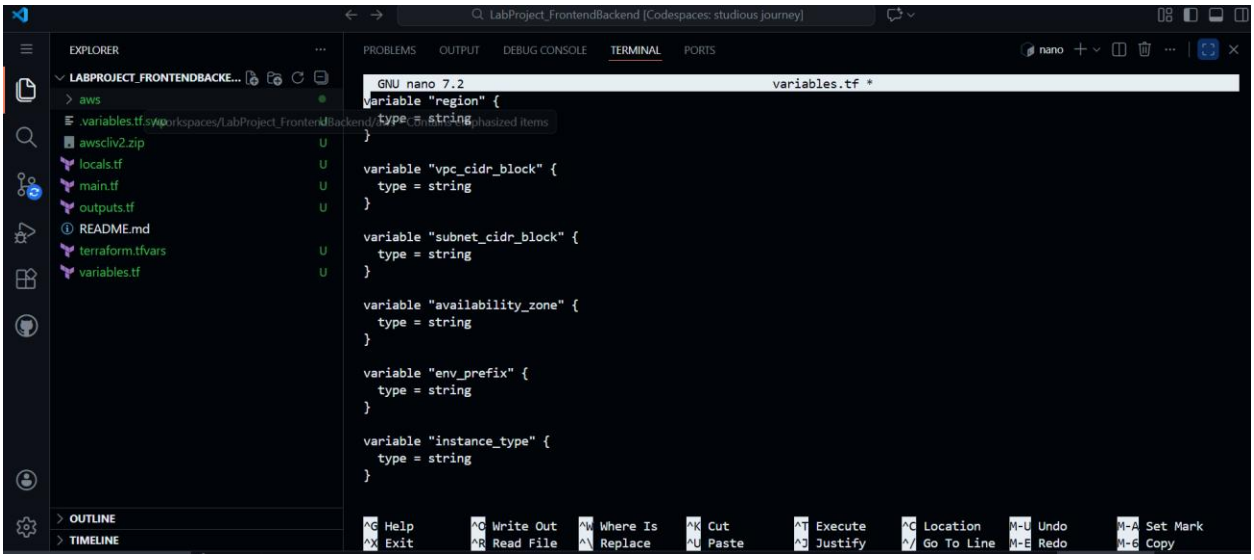
```
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ terraform --version
Terraform v1.14.3
on linux_amd64
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ ansible --version
ansible [core 2.16.3]
  config file = None
  configured module search path = ['/home/codespace/.ansible/plugins/modules', '/usr/share/ansible/plugins/modules']
  ansible python module location = /usr/lib/python3/dist-packages/ansible
  ansible collection location = /home/codespace/.ansible/collections:/usr/share/ansible/collections
  executable location = /usr/bin/ansible
  python version = 3.12.3 (main, Jan  8 2026, 11:30:50) [GCC 13.3.0] (/usr/bin/python3)
  jinja version = 3.1.6
  libyaml = True
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ aws --version
aws-cli/2.33.0 Python/3.13.11 Linux/6.8.0-1030-azure exe/x86_64.ubuntu.24
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ python3 --version
Python 3.12.1
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $
```

STEP 1 – Terraform: Networking & Common Settings

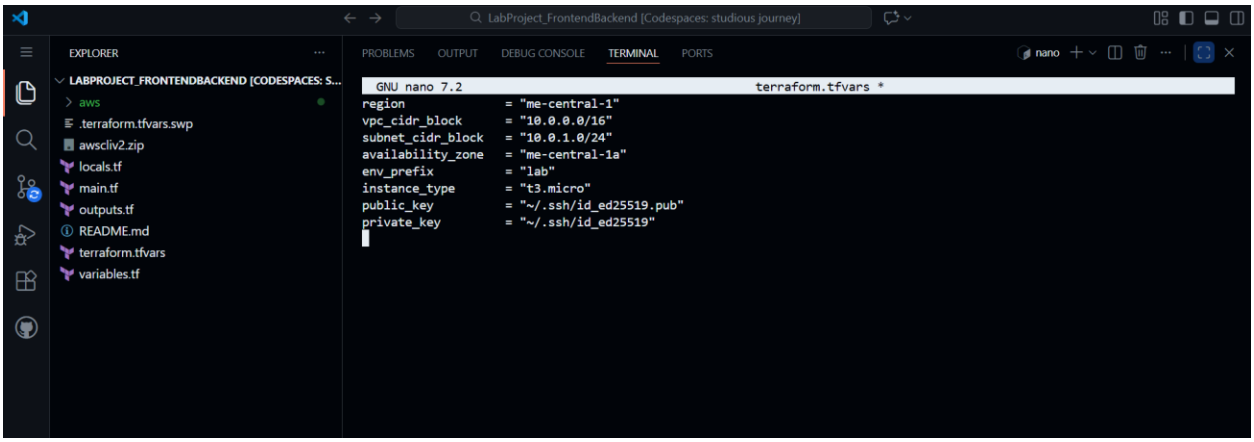
STEP 1.0 – Confirm Root Files Exist

```
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ touch main.tf
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ touch variables.tf
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ touch locals.tf
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ touch outputs.tf
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ touch terraform.tfvars
```

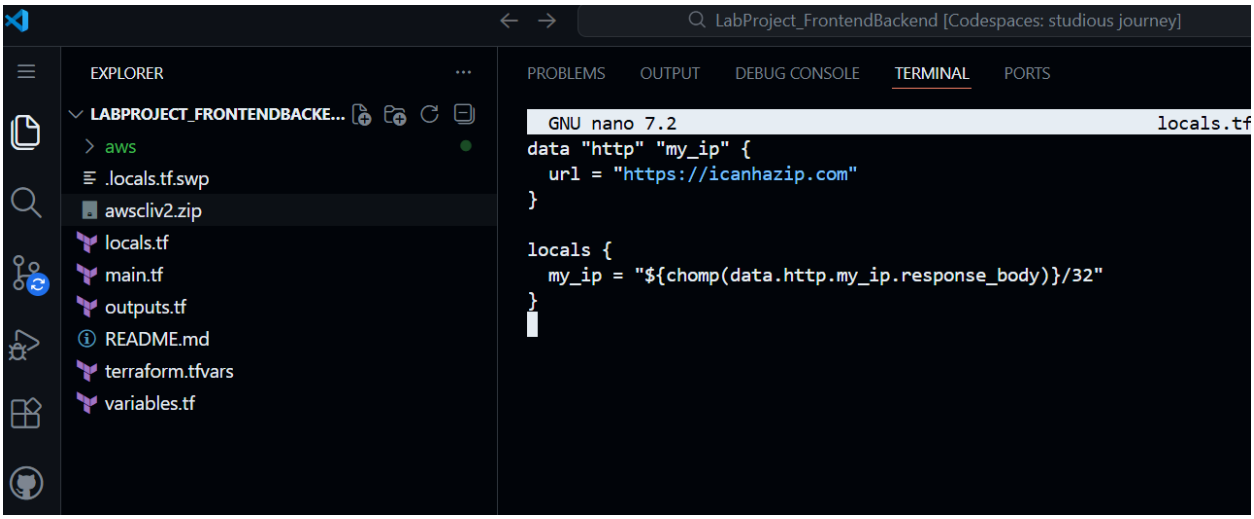
STEP 1.1 – variables.tf



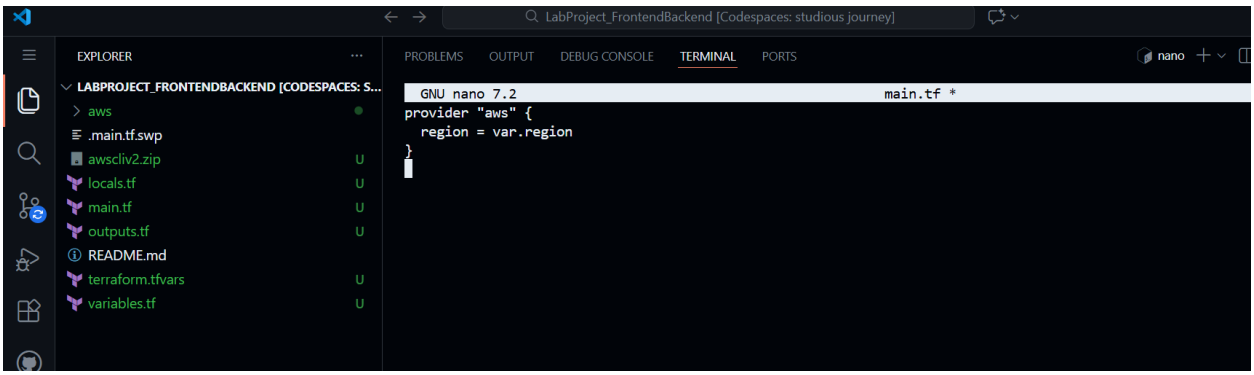
STEP 1.2 – terraform.tfvars (me-central-1)



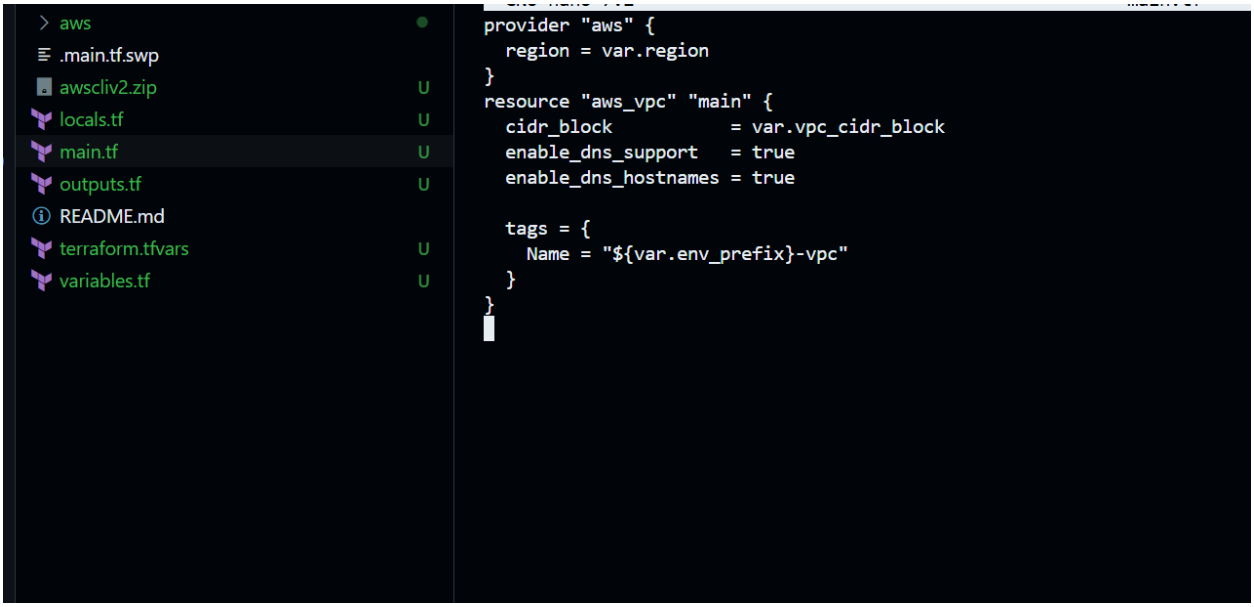
STEP 1.3 – locals.tf



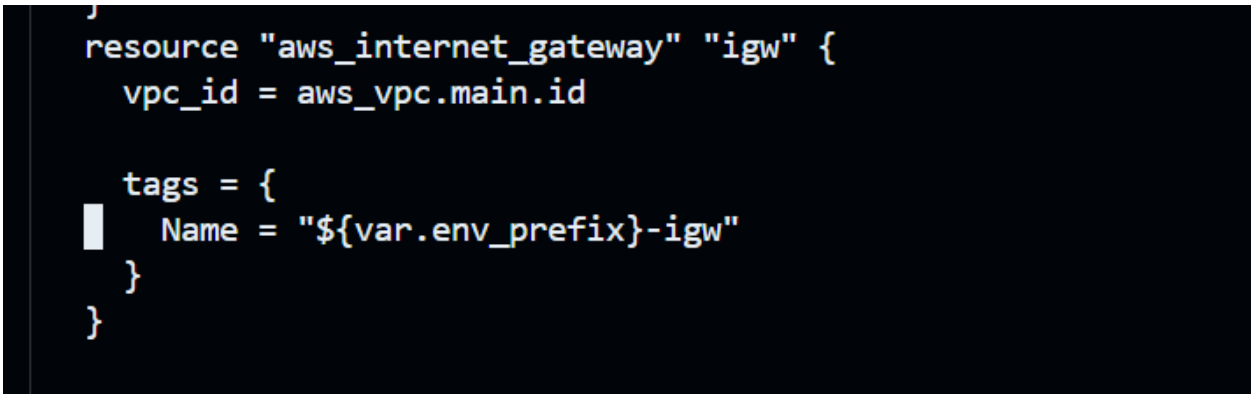
STEP 1.4 – Provider Setup



STEP 1.5 – Create VPC



STEP 1.6 – Internet Gateway



STEP 1.7 – Route Table with Internet Access

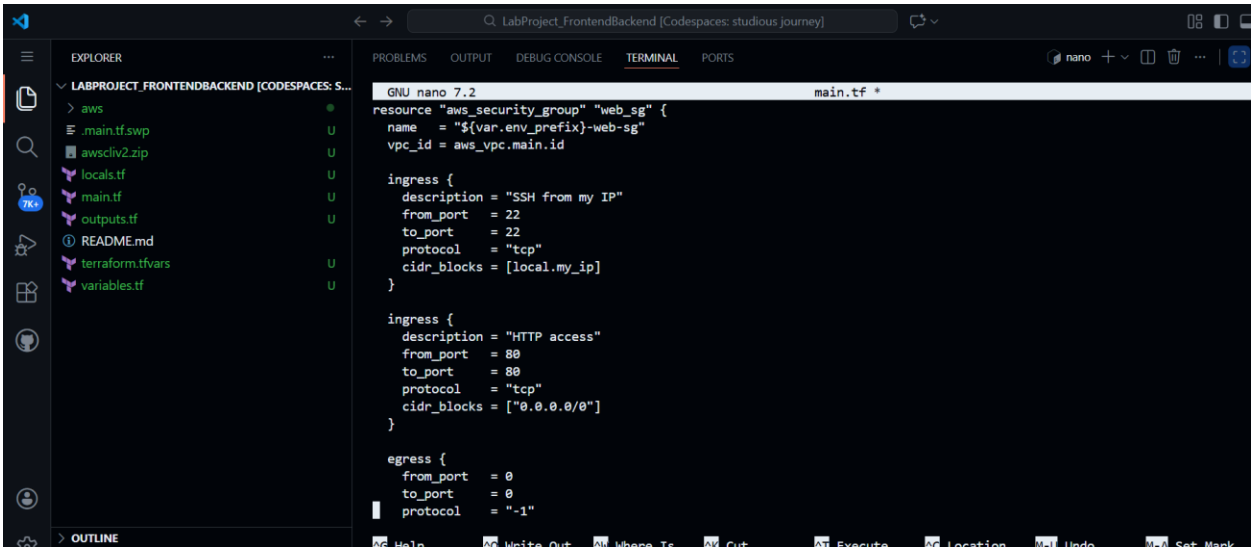
STEP 1.8 – Public Subnet

```
resource "aws_route_table" "public_rt" {
  vpc_id = aws_vpc.main.id

  route {
    cidr_block = "0.0.0.0/0"
    gateway_id = aws_internet_gateway.igw.id
  }

  tags = {
    Name = "${var.env_prefix}-public-rt"
  }
}
resource "aws_subnet" "public" {
  vpc_id                  = aws_vpc.main.id
  cidr_block              = var.subnet_cidr_block
  availability_zone       = var.availability_zone
  map_public_ip_on_launch = true

  tags = {
    Name = "${var.env_prefix}-public-subnet"
  }
}
```

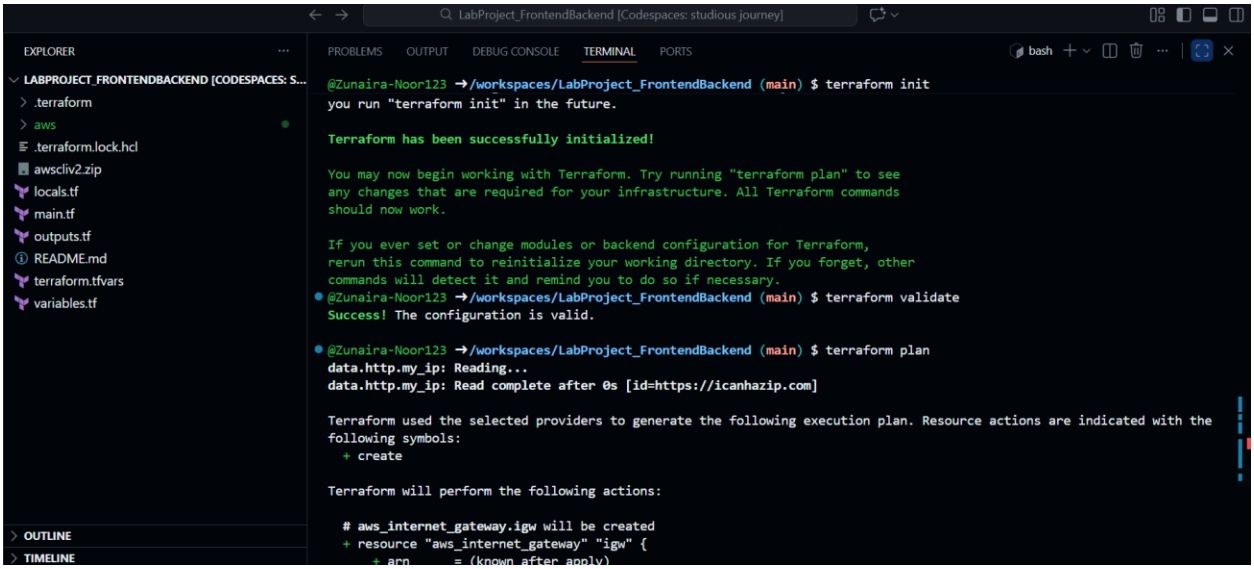
STEP 1.9 – Route Table Association

```
}
resource "aws_route_table_association" "public_assoc" {
  subnet_id      = aws_subnet.public.id
  route_table_id = aws_route_table.public_rt.id
}
```

STEP 1.10 – Security Group



STEP 1.11 – Test Terraform



STEP 2 – Terraform: Frontend & Backend EC2 Instances

STEP 2.1 – Find Amazon Linux 2 AMI

```
  region = var.region
}
data "aws_ami" "amazon_linux" {
  most_recent = true
  owners      = ["amazon"]

  filter {
    name   = "name"
    values = ["amzn2-ami-hvm-*-x86_64-gp2"]
  }

  filter {
    name   = "virtualization-type"
```

STEP 2.2 – Create Key Pair Resource

```
}
resource "aws_key_pair" "deployer" {
  key_name   = "${var.env_prefix}-key"
  public_key = file(var.public_key)
}
```

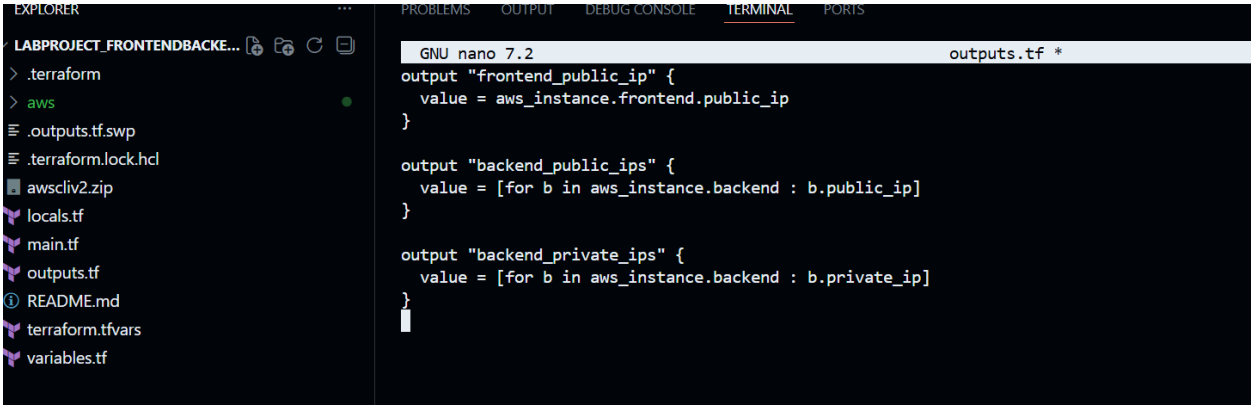
STEP 2.3 – Frontend EC2 Instance

```
resource "aws_instance" "frontend" {
  ami                    = data.aws_ami.amazon_linux.id
  instance_type          = var.instance_type
  subnet_id              = aws_subnet.public.id
  vpc_security_group_ids = [aws_security_group.web_sg.id]
  key_name               = aws_key_pair.deployer.key_name

  tags = {
    Name = "${var.env_prefix}-frontend"
    Role = "frontend"
  }
}
```

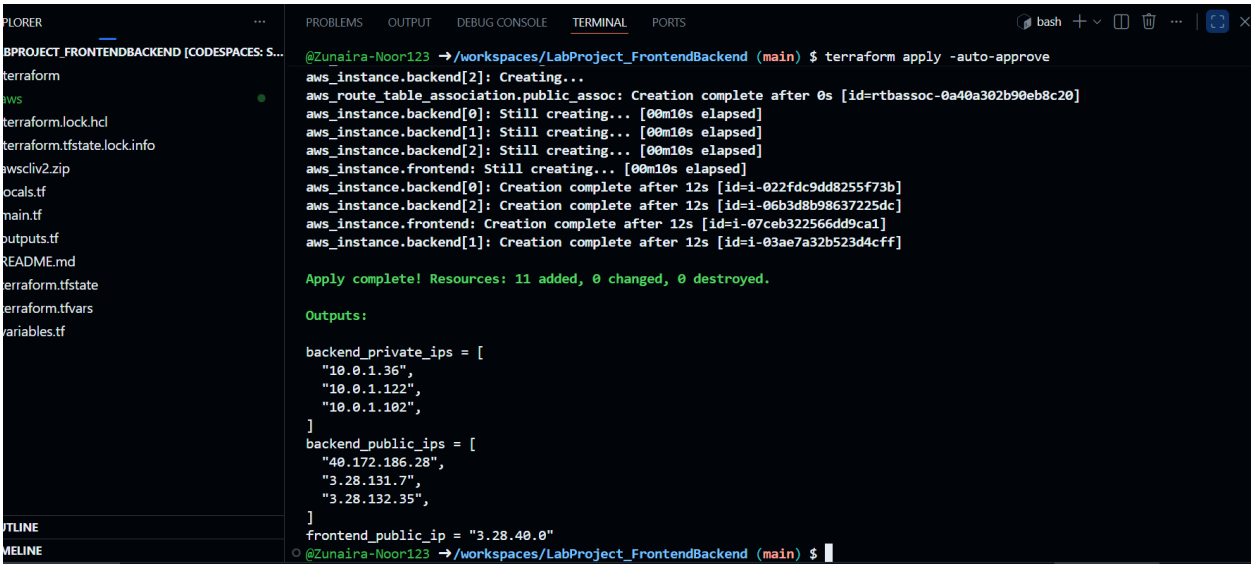
STEP 2.4 – Backend EC2 Instances (Count = 3)

```
}
resource "aws_instance" "backend" {
  count                  = 3
  ami                    = data.aws_ami.amazon_linux.id
  instance_type          = var.instance_type
  subnet_id              = aws_subnet.public.id
  vpc_security_group_ids = [aws_security_group.web_sg.id]
  key_name               = aws_key_pair.deployer.key_name

  tags = {
    Name = "${var.env_prefix}-backend-${count.index}"
    Role = "backend"
  }
}
```

STEP 2.5 – Outputs



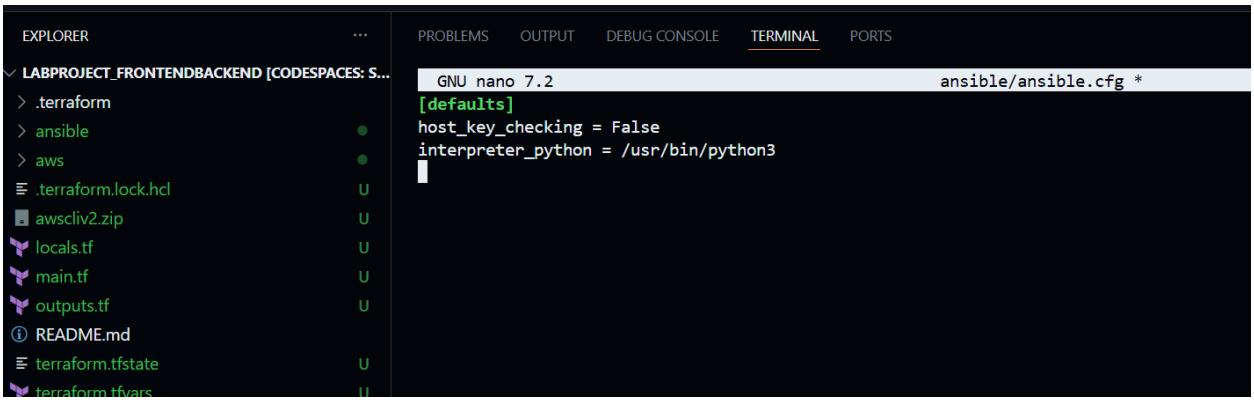
STEP 2.6 – Terraform Test



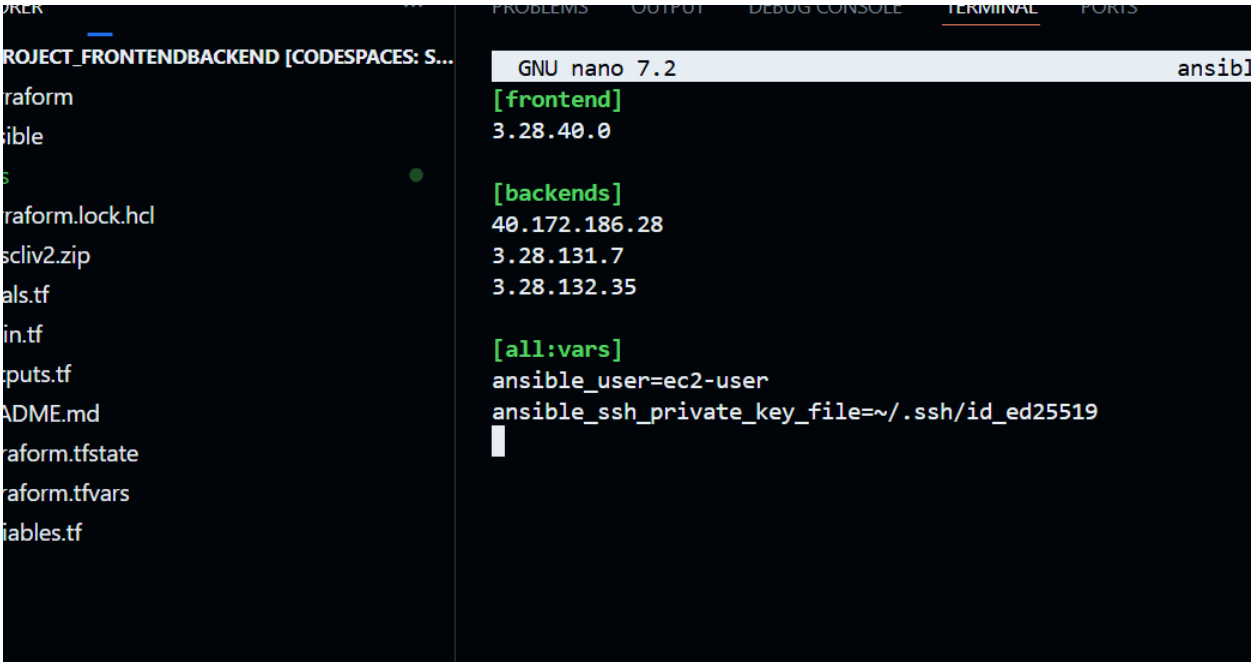
STEP 3 – Ansible: Global Config & Inventory

STEP 3.1 – Create Ansible Folder Structure

STEP 3.2 – ansible.cfg



STEP 3.3 – Inventory File



STEP 3.5 – Main Playbook

```
  GNU nano 7.2                                ansible/playbooks/site.yaml *
---
- name: Configure backend HTTPD servers
  hosts: backends
  become: true
  roles:
    - backend

- name: Configure frontend Nginx load balancer
  hosts: frontend
  become: true
  vars:
    backend1_private_ip: "{{ hostvars[groups['backends'][0]].ansible_default_ipv4.address }}"
    backend2_private_ip: "{{ hostvars[groups['backends'][1]].ansible_default_ipv4.address }}"
    backup_backend_private_ip: "{{ hostvars[groups['backends'][2]].ansible_default_ipv4.address }}"
  roles:
    - frontend

^G Help      ^O Write Out  ^W Where Is   ^K Cut       ^T Execute   ^C Location  M-U Undo      M-A Set
```

STEP 3.6 – Test Inventory

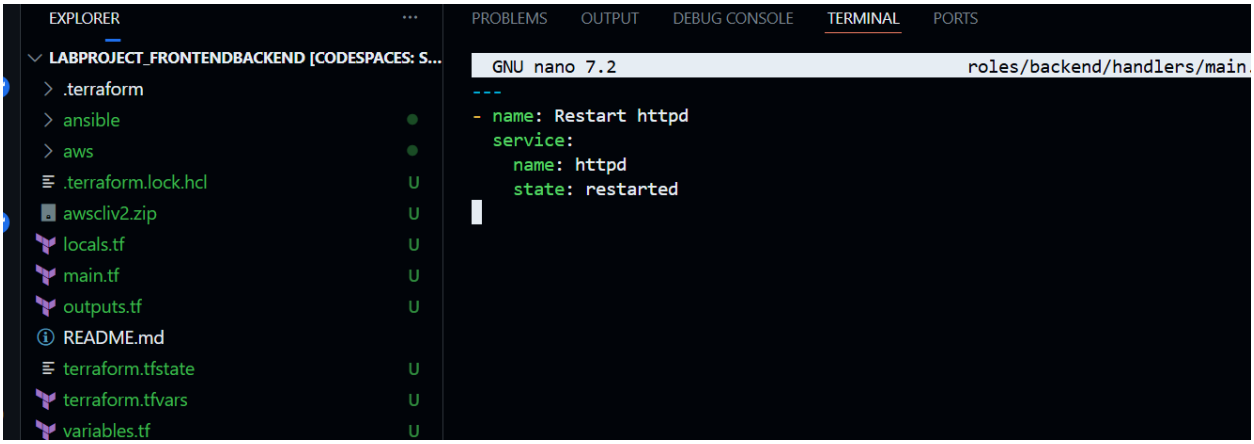
```
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend/ansible (main) $ chmod 755 /workspaces/LabProject_FrontendBack
d/ansible
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend/ansible (main) $ ansible -i inventory/hosts all -m ping
3.28.40.0 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
40.172.186.28 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
3.28.131.7 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
3.28.132.35 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend/ansible (main) $
0                                                                  Finish Setup  Layout: US
```

STEP 4 – Backend Role (HTTPD)

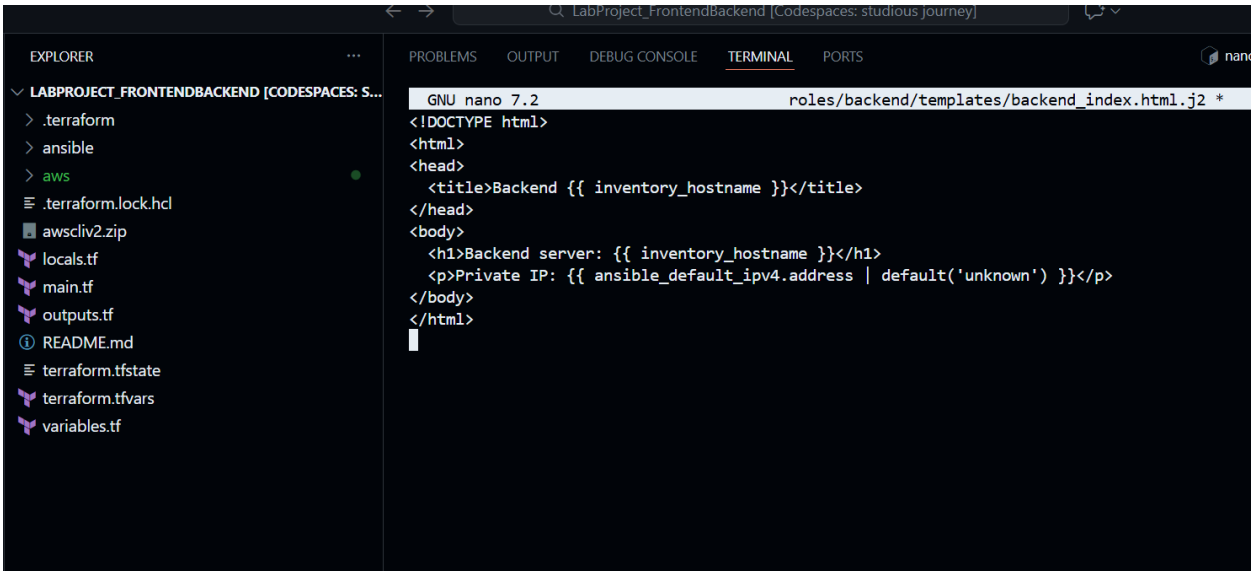
4.1 – roles/backend/tasks/main.yml

```
 GNU nano 7.2                                  roles/backend/tasks/main
---
- name: Install httpd
  yum:
    name: httpd
    state: present
    update_cache: yes

- name: Enable and start httpd
  service:
    name: httpd
    state: started
    enabled: true

- name: Deploy backend index page
  template:
    src: backend_index.html.j2
    dest: /var/www/html/index.html
    owner: apache
    group: apache
    mode: '0644'
  notify: Restart httpd

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

4.2 – roles/backend/handlers/main.yml



4.3 – roles/backend/templates/backend_index.html.j2



4.4 – Test Backend Role

```
@Zunaira-Noor123 →/workspaces/LabProject_FrontendBackend/ansible (main) $ ansible-playbook -i inventory/hosts playbooks/s
ite.yaml

PLAY [Configure backend HTTPD servers] ***************************************************************************

TASK [Gathering Facts] *******************************************************************************************
ok: [3.28.132.35]
ok: [40.172.186.28]
ok: [3.28.131.7]

TASK [backend : Install httpd] ***********************************************************************************
changed: [3.28.132.35]
changed: [3.28.131.7]
changed: [40.172.186.28]

TASK [backend : Enable and start httpd] **************************************************************************
changed: [3.28.131.7]
changed: [40.172.186.28]
changed: [3.28.132.35]

TASK [backend : Deploy backend index page] ***********************************************************************
changed: [40.172.186.28]
changed: [3.28.132.35]
changed: [3.28.131.7]

RUNNING HANDLER [backend : Restart httpd] ************************************************************************
changed: [3.28.131.7]
```

After success, you can visit the backend public IPs in a browser:

Backend server: 3.28.131.7

Private IP: 10.0.1.122

Backend server: 3.28.132.35

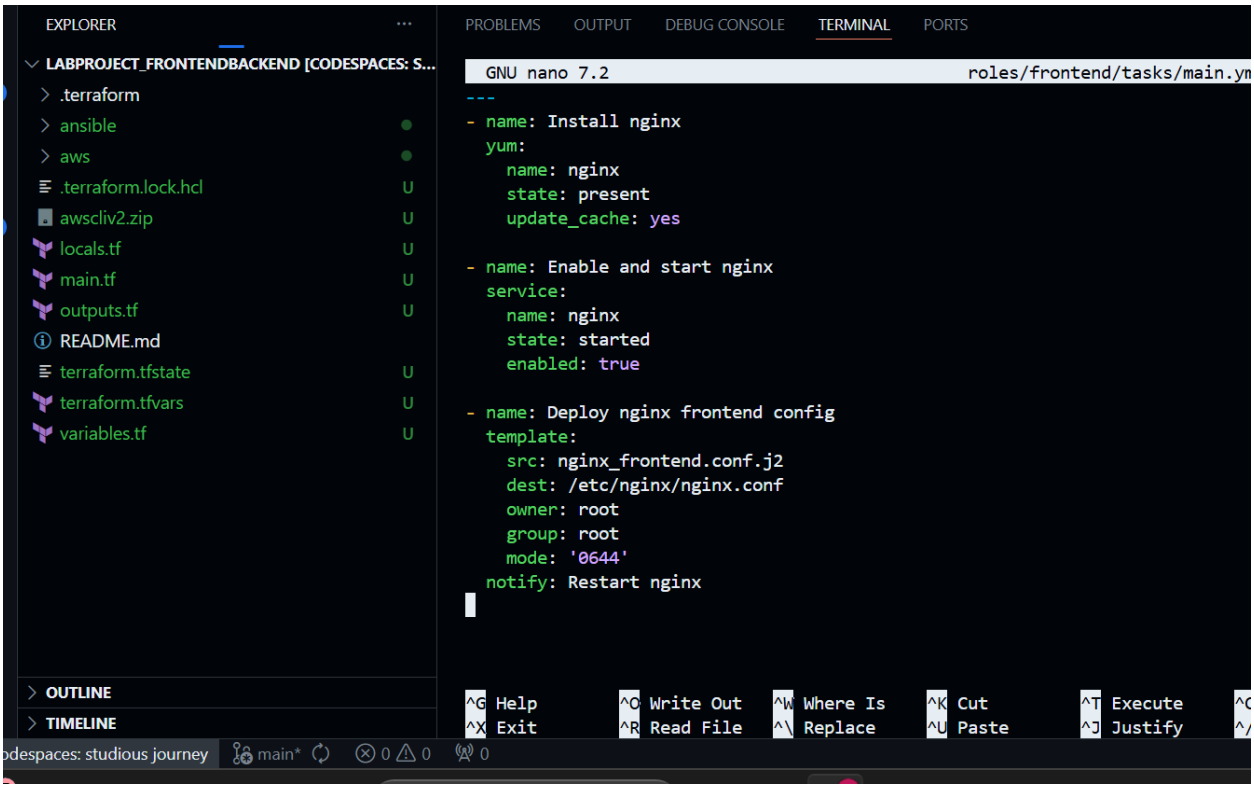
Private IP: 10.0.1.102

Backend server: 40.172.186.28

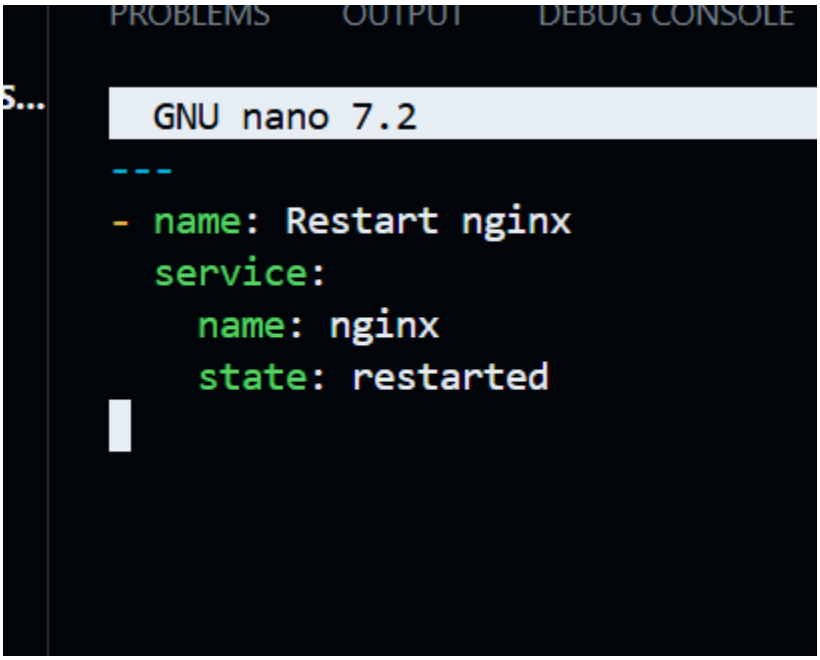
Private IP: 10.0.1.36

STEP 5 – Frontend Role (Nginx Load Balancer)

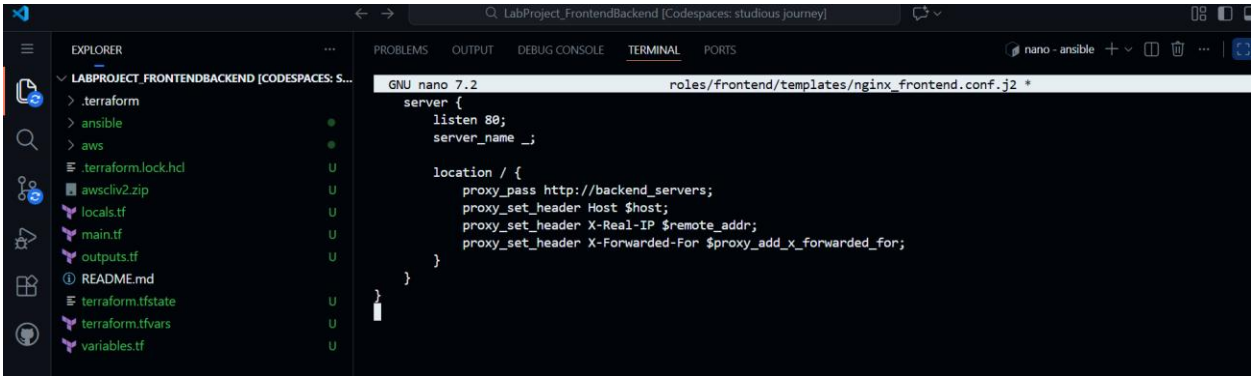
5.1 – roles/frontend/tasks/main.yml



5.2 – roles/frontend/handlers/main.yml

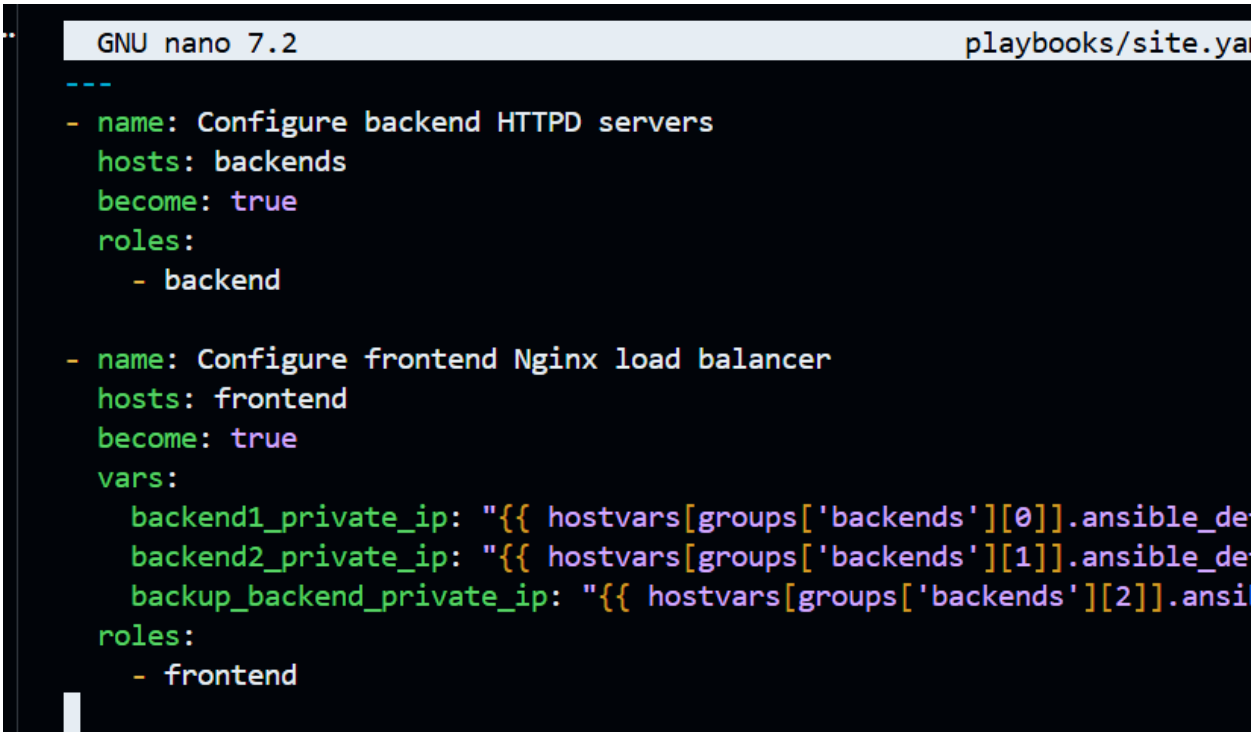


5.3 – roles/frontend/templates/nginx_frontend.conf.j2



Ansible Main Playbook Using Roles

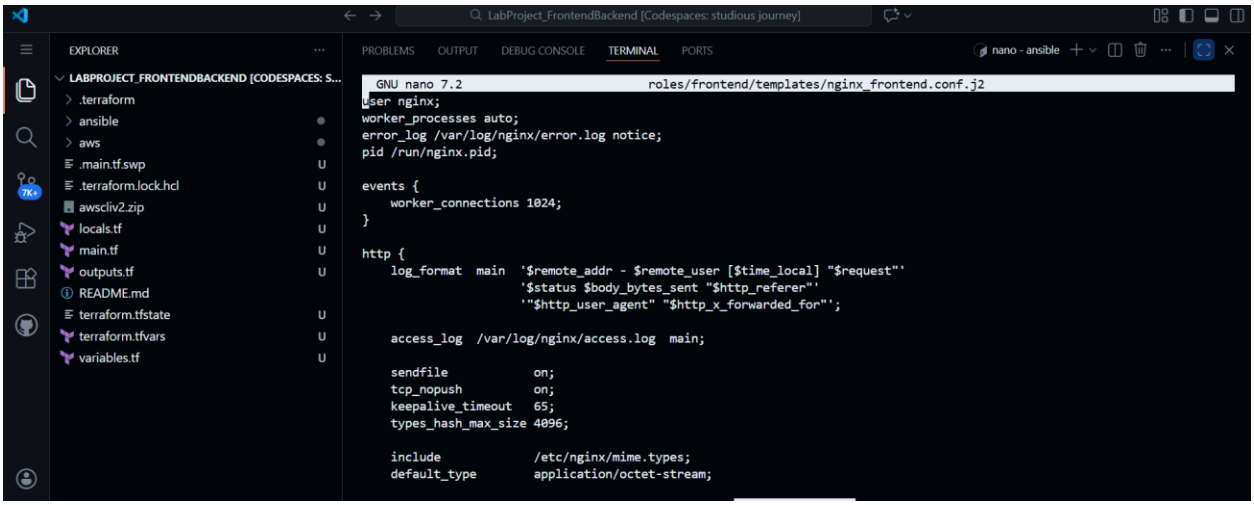
5.4 – Update playbooks/site.yaml for Frontend



5.5 – Run Full Playbook

```
@Zunaira-Noor123 ➜ /workspaces/LabProject_FrontendBackend/ansible (main) $ ansible-playbook -i inventory/hosts playbooks/site.yaml --tags frontend

PLAY [Configure backend HTTPD servers] ***************************************************************************

TASK [Gathering Facts] *******************************************************************************************
ok: [40.172.186.28]
ok: [3.28.132.35]
ok: [3.28.131.7]

PLAY [Configure frontend Nginx load balancer] ********************************************************************

TASK [Gathering Facts] *******************************************************************************************
ok: [3.28.40.0]

PLAY RECAP *******************************************************************************************************
3.28.131.7                 : ok=1    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
3.28.132.35                : ok=1    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
3.28.40.0                  : ok=1    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
40.172.186.28              : ok=1    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

@Zunaira-Noor123 ➜ /workspaces/LabProject_FrontendBackend/ansible (main) $
```

roles/frontend/templates/nginx_frontend.conf.j2



Terraform Test

```
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ terraform init
Initializing the backend...
Initializing provider plugins...
- Reusing previous version of hashicorp/aws from the dependency lock file
- Reusing previous version of hashicorp/http from the dependency lock file
- Using previously-installed hashicorp/aws v6.28.0
- Using previously-installed hashicorp/http v3.5.0

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.
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ terraform validate
Success! The configuration is valid.

@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $
```

```
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ terraform apply -auto-approve
        name                   = "lab-web-sg"
        tags                   = {
            "Name" = "lab-sg"
        }
        # (9 unchanged attributes hidden)
    }

Plan: 0 to add, 1 to change, 0 to destroy.
aws_security_group.web_sg: Modifying... [id=sg-09430f46473ac8ee3]
aws_security_group.web_sg: Modifications complete after 1s [id=sg-09430f46473ac8ee3]

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

Outputs:

backend_private_ips = [
  "10.0.1.36",
  "10.0.1.122",
  "10.0.1.102",
]
backend_public_ips = [
  "40.172.186.28",
  "3.28.131.7",
  "3.28.132.35",
]
frontend_public_ip = "3.28.40.0"
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $
```

Connection through ssh

Backend server: 40.172.186.28

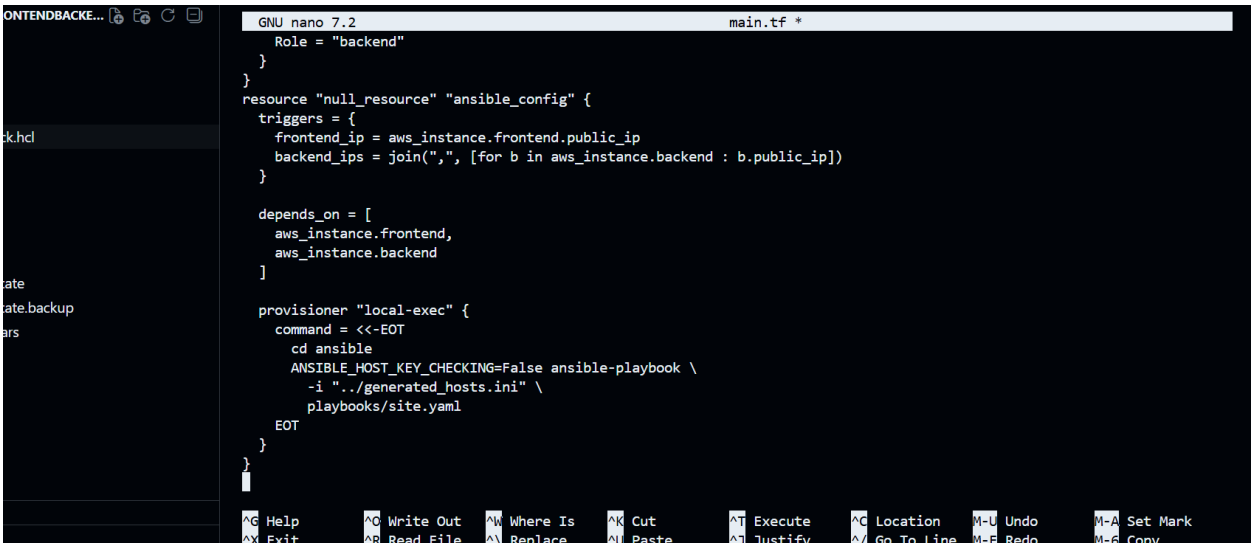
Private IP: 10.0.1.36

Backend server: 3.28.131.7

Private IP: 10.0.1.122

Terraform–Ansible Integration (Automation)

Use null_resource with local-exec



Generate generated_hosts.ini dynamically

```
        -i "../generated_hosts.ini" \
        playbooks/site.yaml
    EOT
  }
}
data "template_file" "hosts_ini" {
  template = <<EOT
[frontend]
${aws_instance.frontend.public_ip}

[backend]
%{ for ip in aws_instance.backend[*].public_ip ~}
${ip}
%{ endfor ~}
EOT
}

resource "local_file" "hosts_ini" {
  content  = data.template_file.hosts_ini.rendered
  filename = "${path.module}/generated_hosts.ini"
}
```

```
@Zunaira-Noor123 ➜/workspaces/LabProject_FrontendBackend (main) $ terraform apply -auto-approve

Plan: 2 to add, 0 to change, 0 to destroy.
local_file.hosts_ini: Creating...
null_resource.ansible_config: Creating...
local_file.hosts_ini: Creation complete after 0s [id=3f5c2b637a033ae0c766008ade65244ab86cf9e5]
null_resource.ansible_config: Provisioning with 'local-exec'...
null_resource.ansible_config (local-exec): Executing: ["/bin/sh" "-c" "cd ansible\nANSIBLE_HOST_KEY_CHECKING=False ansible
-playbook \\\n  -i \"../generated_hosts.ini\" \\\n  playbooks/site.yaml\n"]
null_resource.ansible_config (local-exec): [WARNING]: Could not match supplied host pattern, ignoring: backends

null_resource.ansible_config (local-exec): PLAY [Configure backend HTTPD servers] ************************************
*
null_resource.ansible_config (local-exec): skipping: no hosts matched

null_resource.ansible_config (local-exec): PLAY [Configure frontend Nginx load balancer] *******************************
*

null_resource.ansible_config (local-exec): TASK [Gathering Facts] ***************************************************
*
null_resource.ansible_config (local-exec): fatal: [3.28.40.0]: UNREACHABLE! => {"changed": false, "msg": "Failed to connec
t to the host via ssh: codespace@3.28.40.0: Permission denied (publickey,gssapi-keyex,gssapi-with-mic).", "unreachable": t
rue}

null_resource.ansible_config (local-exec): PLAY RECAP *****************************************************************
*
null_resource.ansible_config (local-exec): 3.28.40.0                  : ok=0    changed=0    unreachable=1    failed=0
skipped=0    rescued=0    ignored=0
```