CLOUD COMPUTING LAB

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Women University
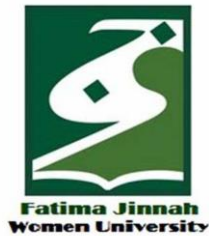
SUBMITTED TO

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SUBMITTED BY
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2023-BSE-025

BSE V-A

Lab 14 – Terraform + Ansible: Dynamic Inventory, Roles & Automated Nginx/PHP & Docker Deployment

Task 0 – Lab Setup (Codespace & GH CLI)

- task0_codespace_open.png

- task0_env_check.png

- task0_aws_config.png

Task 1 – Generate SSH key & Initial Terraform

- task1_ssh_keygen_before.png

- task1_ssh_keygen.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $
ssh-keygen -t ed25519 -f ~/.ssh/id_ed25519 -N ""
Generating public/private ed25519 key pair.
/home/codespace/.ssh/id_ed25519 already exists.
Overwrite (y/n)? y
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:HfX9oADM89vBLTPuAnBIJf2e237uZ1FXxELpRnH1iVc codespace@codespaces-79bf37
The key's randomart image is:
+--[ED25519 256]--+
|      .=o    ..o=E|
|      ..=. . .=o*|
|     . . +o. =o++|
|      o ..oo*.=.+|
|       oS..=.*  +|
|        . + o  . |
|        . +    .|
|         o o . o|
|          o.+oo |
+----[SHA256]-----+
```

- task1_ssh_keygen_after.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ls -la ~/.ssh
total 32
drwx------ 2 codespace codespace 4096 Jan 30 15:24 .
drwxr-x--- 1 codespace codespace 4096 Jan 30 21:28 ..
```

- task1_terraform_tfvars_created.png

```
vpc_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

- task1_terraform_apply_2_instances.png

- task1_terraform_output_ips.png

Task 2 – Static ansible inventory with 2 instances

- task2_ansible_install.png

- task2_terraform_output_ips.png

- task2_hosts_created.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ touch hosts
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ls -ls hosts
0 -rw-rw-rw- 1 codespace codespace 0 Jan 30 21:42 hosts
```

- task2_ansible_ping_initial.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ 20.92.21.55    ansible_us
er=ec2-user      ansible_ssh_private_key_file=~/.ssh/id_ed25519
158.252.33.79 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '3.28.74.36' is using the discovered Python interpreter at '/usr/bin/python3.9',
t future installation of another Python interpreter could cause a different interpreter to be di
vered. See https://docs.ansible.com/ansible-core/2.20/reference_appendices/interpreter_discovery
ml for more information.
3.28.74.36 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

- task2_hosts_with_common_args.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible_ssh_common_args=
'-o StrictHostKeyChecking=no'
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $
```

- task2_ansible_ping_success.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible all -i hosts -m ping
.html for more information.
158.252.33.79 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '3.28.74.36' is using the discovered Python interpreter at '/usr/bin/python3.9',
t future installation of another Python interpreter could cause a different interpreter to be di
vered. See https://docs.ansible.com/ansible-core/2.20/reference_appendices/interpreter_discovery
ml for more information.
3.28.74.36 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
```

Task 3 – Scale to 3 instances & group based inventory

- task3_terraform_apply_3_instances.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-appro
ve
Apply complete! Resources: 3 added, 0 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "3.28.74.36",
  "158.252.33.79",
  "40.172.100.131",
]
```

- task3_terraform_output_3_ips.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform output
webserver_public_ips = [
  "3.28.74.36",
  "158.252.33.79",
  "40.172.100.131",
```

- task3_ansible_single_ip_ping.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible ec2 -i hosts -m pin
g
3.28.74.36 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '158.252.33.79' 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.
158.252.33.79 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
```

- task3_ansible_droplet_ping.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible droplet -i hosts-m
ping
40.172.100.131 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
```

- task3_ansible_all_ping.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible all -i hosts -m pin
g
158.252.33.79 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '40.172.100.131' is using the discovered Python interpreter at '/usr/bin/python3
.9', but future installation of another Python interpreter could cause a different interpreter t
o be discovered. See https://docs.ansible.com/ansible-core/2.20/reference_appendices/interpreter
_discovery.html for more information.
40.172.100.131 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
}
[WARNING]: Host '3.28.74.36' 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_dis
covery.html for more information.
3.28.74.36 | SUCCESS => {
    "ansible facts": {
```

Task 4 – Global Ansible.cfg & first nginx playbook

- task4_global_ansible_cfg.png


```
[default]
host_key_checking = False
interpreter_python = /usr/bin/python3
~
~
```

- task4_my_playbook_created.png


```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ touch my-playbook.yml
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ls -la my-playbook.yml
-rw-rw-rw- 1 codespace codespace 0 Jan 30 22:02 my-playbook.yml
```

- task4_ansible_play_ec2.png


```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible-playbook -i hosts m
y-playbook.yaml
TASK [install nginx and update cache] **********************************************************
changed: [3.28.74.36]
changed: [158.252.33.79]

TASK [start nginx server] *********************************************************************
changed: [158.252.33.79]
changed: [3.28.74.36]

PLAY RECAP ***********************************************************************************
158.252.33.79              : ok=3    changed=2    unreachable=0    failed=0    skipped=0    resc
ued=0    ignored=0
3.28.74.36                 : ok=3    changed=2    unreachable=0    failed=0    skipped=0    resc
ued=0    ignored=0
```

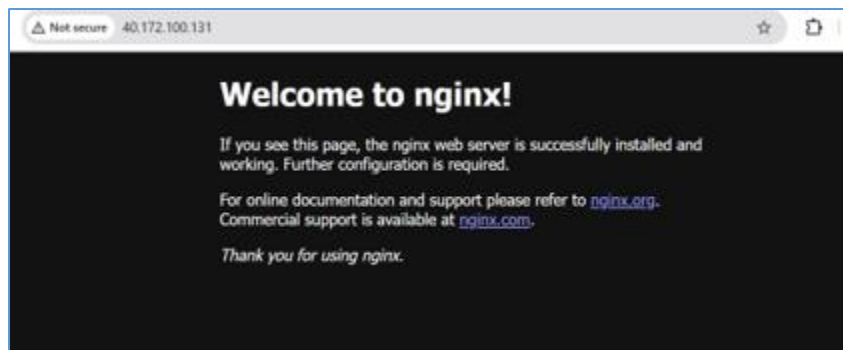- task4_nginx_browser_ec2.png

- task4_my_playbook_droplet.png

- task4_nginx_browser_droplet.png

Task 5- Single Nginx Target Group

- task5_project_ansible_cfg_created.png

- task5_project_ansible_cfg.png

- task5_main_tf_count_1.png

```
lab_14 > Task > ᵞ main.tf
  23    module "myapp-webserver" {
  30      vpc_id = aws_vpc.myapp_vpc.id
  31      subnet_id = module.myapp-subnet.subnet.id
  32
  33      # Loop count
  34      count            = 1
  35      # Use count.index to differentiate instances
  36      instance_suffix = count.index
```

- task5_terraform_output_single_ip.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform apply -auto-appro
ve
Apply complete! Resources: 0 added, 0 changed, 6 destroyed.
```

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ terraform output
  webserver_public_ips = [
    "3.28.74.36",
```

- task5_my_playbook_nginx_group.png

```
Task > ! my-playbook.yaml
---
- name: Configure nginx web server
  hosts: nginx
  become: true
  tasks:
    - name: install nginx and update cache
      yum:
        name: nginx
```

- task5_ansible_play_nginx_group.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible-playbook -i hosts m
y-playbook.yaml
changed: [3.28.74.36]

PLAY RECAP *********************************************************************************
3.28.74.36                 : ok=4    changed=1    unreachable=0    failed=0    skipped=0    resc
ued=0    ignored=0
```

- task5_nginx_browser_single.png

```
🏠  ⚠ Not secure  3.28.74.36                                              ☆  ↻  ⊟  📦

                     Welcome to nginx!

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

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

        Thank you for using nginx.
```

Task 6- Ansible Managed SSL

- task6_my_playbook_ssl_section.png

```
- name: Configure nginx web server

- 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:
```
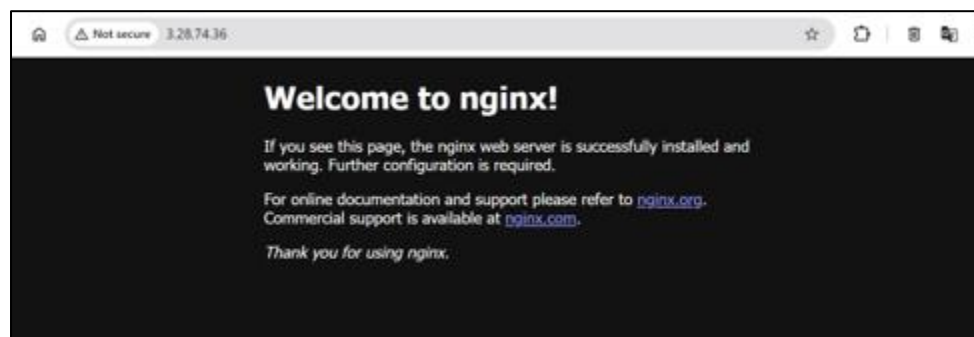
- task6_ansible_play_ssl.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ansible-playbook -i hosts m
y-playbook.yaml
TASK [Get IMDSv2 token] ********************************************************************
ok: [3.28.74.36]

TASK [Get current public IP] **************************************************************
ok: [3.28.74.36]

TASK [Show current public IP] *************************************************************
ok: [3.28.74.36] => {
    "msg": "Public IP: 3.28.74.36"
}

TASK [Generate self-signed SSL certificate] ***********************************************
changed: [3.28.74.36]

PLAY RECAP ********************************************************************************
3.28.74.36                 : ok=11    changed=3    unreachable=0    failed=0    skipped=0    resc
ued=0    ignored=0
```

- task6_ssl_cert_file.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA (main) $ ssh ec2-user@3.28.74.36 -i
~/.ssh/id ed25519
 -----BEGIN CERTIFICATE-----
 MIIDOTCCAiGgAwIBAgIUdHsr1NBx7xjvonqcIFzoyCz+nIowDQYJKoZIhvcNAQEL
 BQAwFTETMBEGA1UEAwwKMy4yOC43NC4zNjAeFw0yNjAxMjgxOTA3MzBaFw0yNzAx
 MjgxOTA3MzBaMBUxEzARBgNVBAMMCjMuMjguNzQuMzYwggEiMA0GCSqGSIb3DQEB
 AQUAA4IBDwAwggEKAoIBAQCYS+o/3Yf87MvBGbnA8pN/FuyxitkkiCD6bhY5WVOA
 AwVvKrPH28TBs3PDDD2aREM7yWi5hqZMUfdWxkT9GDznEK9dBedHCGmXiGtvoHGH
 RNQwlfcWfRdBwz9gHdvQw5W0uWpyobK+hkB8/mfElGiTr1hrX/cYBsyJrVA2Q2Ts
```

- task6_ssl_key_file.png

```
[ec2-user@ip-10-0-10-145 ~]$ sudo cat /etc/ssl/private/selfsigned.key
 -----BEGIN PRIVATE KEY-----
 MIIEvgIBADANBgkqhkiG9w0BAQEFAASCBKgwggSkAgEAAoIBAQCYS+o/3Yf87MvB
 GbnA8pN/FuyxitkkiCD6bhY5WVOAAwVvKrPH28TBs3PDDD2aREM7yWi5hqZMUfdW
 xkT9GDznEK9dBedHCGmXiGtvoHGHRNQwlfcWfRdBwz9gHdvQw5W0uWpyobK+hkB8
```

Task 7 – PHP Frontend Deployment with Templates

- task7_files_templates_created.png

- task7_my_playbook_web_deploy.png

- task7_ansible_play_web_deploy.png

- task7_php_https_browser.png
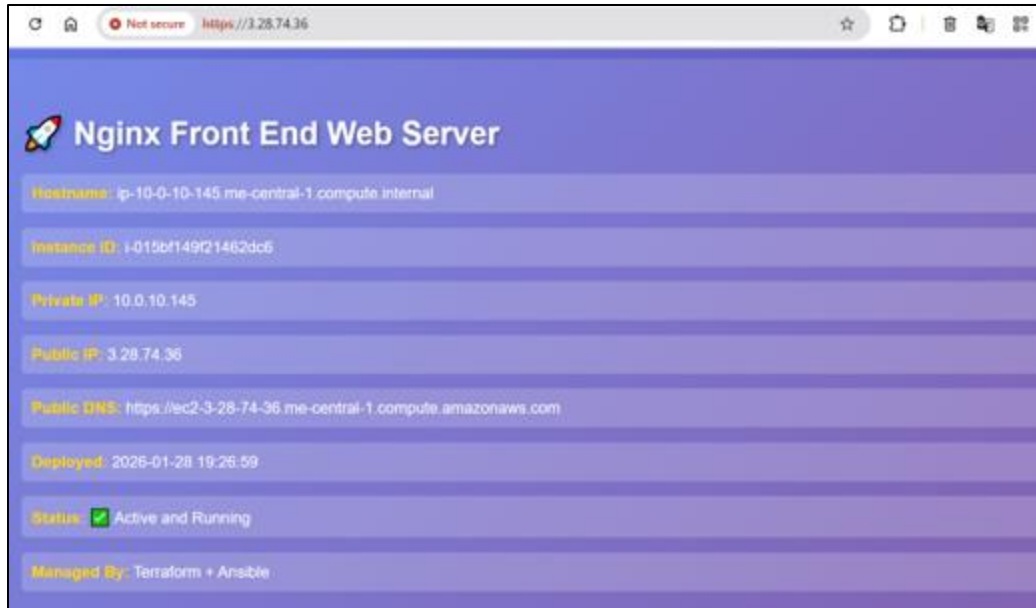
Task 8 – Docker & Docker Compose

- task8_terraform_apply_docker_instance.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ terraform apply -auto-appro
ve
Apply complete! Resources: 7 added, 0 changed, 0 destroyed.
```

- task8_terraform_output_new_ip.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ terraform output
  webserver_public_ips = [
    "40.172.234.49",
```

- task8_hosts_docker_servers.png

```
[docker_servers]
40.172.234.49

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

- task8_my_playbook_docker.png

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

- task8_ansible_play_docker.png


```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ ansible-playbook -i hosts m
y-playbook.yaml
TASK [restart docker service] ********************************************************************
changed: [40.172.234.49]

PLAY RECAP ***************************************************************************************
40.172.234.49              : ok=8     changed=4    unreachable=0    failed=0    skipped=0    resc
ued=0    ignored=0
```

- task8_docker_ps_remote.png


```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ ssh ec2-user@40.172.234.49
-i ~/.ssh/id_ed25519
** The server may need to be upgraded. See https://openssh.com/pq.html
       ,      #_
    ~\_  ####_          Amazon Linux 2023
   ~~  \_#####\
   ~~     \###|
   ~~      \#/ ___       https://aws.amazon.com/linux/amazon-linux-2023
    ~~      V~' '->
     ~~~         /
       ~~._.   _/
          _/ _/
        _/m/'
Last login: Wed Jan 28 19:37:09 2026 from 4.240.39.194
[ec2-user@ip-10-0-10-136 ~]$ sudo docker ps
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
[ec2-user@ip-10-0-10-136 ~]$ exit
logout
```

Task 9 – Gitea Docker

- task9_my_playbook_add_user_to_docker.png


```
lab_14 > Task > ! my-playbook.yaml
  12     - name: Install Docker Compose
  16       tasks:
  41
  42     - name: Adding user to docker group
  43       hosts: all
  44       become: true
  45       vars_files:
  46         - project-vars.yaml
  47       tasks:
  48         - name: add user to docker group
  49           user:
```

- task9_my_playbook_deploy_containers.png

```
lab_14 > Task > ! my-playbook.yaml
  42    - name: Adding user to docker group
  47      tasks:
  66        - name: fail if docker is not accessible
  70
  71    - name: Deploy Docker Containers
  72      hosts: all
  73      become: true
  74      user: "{{ normal_user }}"
  75      vars_files:
  76        - project-vars.yaml
  77      tasks:
  78        - name: check if docker-compose file exists
```

    o   task9_compose_yaml.png

```
Task > ❤ 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
```

- task9_ansible_play_gitea.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ ansible-playbook -i host
 y-playbook.yaml
PLAY RECAP *********************************************************************
40.172.234.49              : ok=16    changed=2    unreachable=0    failed=0    skipped=1    resc
ued=0    ignored=0
```

- task9_sg_ingress_3000.png

```
4 > Task > modules > webserver > ❤ main.tf
  resource "aws_security_group" "web_sg" {
    ingress {
    }
    ingress {
      from_port   = 3000
      to_port     = 3000
      protocol    = "tcp"
      cidr blocks = ["0.0.0.0/0"]
```

- task9_terraform_apply_sg_3000.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ terraform apply -auto-appro
ve
Apply complete! Resources: 0 added, 1 changed, 0 destroyed.

Outputs:

webserver_public_ips = [
  "40.172.234.49",
]
```

- task9_gitea_browser.png

Task 10 – Automating Ansible

- task10_null_resource_main_tf.png


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

  depends_on = [module.myapp-webserver]

  provisioner "local-exec" {
    command = <<-EOT
```

- task10_terraform_destroy_before_null.png


```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ terraform destroy -auto-app
rove

aws_vpc.myapp_vpc: Destruction complete after 1s

Destroy complete! Resources: 7 destroyed.
```

- task10_terraform_apply_with_local_exec.png

```
@HamnaMahmood20 →/workspaces/CC-Hamna-Mahmood-25-BSE-VA/lab_14/Task (main) $ terraform apply -auto-appro
ve

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

Outputs:

webserver_public_ips = [
  "158.252.83.213",
]
```