CLOUD COMPUTING

LAB 14

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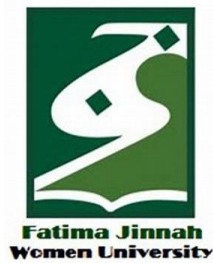
Submitted To:

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Submitted By:

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BSE V-A

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Task 1 – Generate ssh key and Initial Terraform apply

task1_ssh_keygen_before.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ls ~/.ssh
ls: cannot access '/home/codespace/.ssh': No such file or directory
```

task1_ssh_keygen.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ssh-keygen -t ed25519 -f ~/.ssh/id_ed25519 -N ""
Generating public/private ed25519 key pair.
Created directory '/home/codespace/.ssh'.
Your identification has been saved in /home/codespace/.ssh/id_ed25519
Your public key has been saved in /home/codespace/.ssh/id_ed25519.pub
The key fingerprint is:
SHA256:ippEeqT1doZ4QkxTIv6A8DBK2t2nrm3EWhP7X2VpalE codespace@codespaces-fe0986
The key's randomart image is:
+--[ED25519 256]--+
|=.. .            |
|B* + .           |
|+o= . . .      E |
| oo.  .o     . . |
|  *. ..oS   . =  |
|  B o +*.     *  |
|o = *+=o     +   |
| o *.=. .  o     |
|  o ... ..       |
+----[SHA256]-----+
```

task1_ssh_keygen_after.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ls -la ~/.ssh
total 20
drwx------ 2 vscode vscode 4096 Jan 28 16:17 .
drwxr-xr-x 1 vscode vscode 4096 Jan 28 16:17 ..
-rw------- 1 vscode vscode  419 Jan 28 16:17 id_ed25519
-rw-r--r-- 1 vscode vscode  106 Jan 28 16:17 id_ed25519.pub
```

task1_terraform_tfvars_created.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ touch terraform.tfvars
ls -la terraform.tfvars
-rw-rw-rw- 1 vscode vscode 0 Jan 28 16:37 terraform.tfvars
```

task1_terraform_tfvars.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

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ terraform init

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

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ terraform apply -auto-approve

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

Outputs:

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

task1_terraform_output_ips.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ terraform output

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

Task 2 – Static Ansible inventory with two EC2 instances

task2_ansible_install.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ pipx install ansible-core
ansible --version
    - ansible-doc
    - ansible-galaxy
    - ansible-inventory
    - ansible-playbook
    - ansible-pull
    - ansible-test
    - ansible-vault
done! ✨ ⭐ ✨
ansible [core 2.20.2]
  config file = None
  configured module search path = ['/home/codespace/.ansible/plugins/modules', '/usr/share/ansible/plugin
s/modules']
  ansible python module location = /usr/local/py-utils/venvs/ansible-core/lib/python3.12/site-packages/an
sible
  ansible collection location = /home/codespace/.ansible/collections:/usr/share/ansible/collections
  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/venvs/ansible-c
ore/bin/python)
  jinja version = 3.1.6
  pyyaml version = 6.0.3 (with libyaml v0.2.5)
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $
```

task2_terraform_output_ips.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ terraform output

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

task2_hosts_created.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ touch hosts
ls -la hosts
-rw-rw-rw- 1 vscode vscode 0 Jan 28 17:51 hosts
```

task2_hosts_initial.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ cat hosts
3.28.74.36      ansible_user=ec2-user    ansible_ssh_private_key_file=~/.ssh/id_ed25519
158.252.33.79   ansible_user=ec2-user    ansible_ssh_private_key_file=~/.ssh/id_ed25519
```

task2_ansible_ping_initial.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible all -i hosts -m ping
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', bu
t future installation of another Python interpreter could cause a different interpreter to be disco
vered. See https://docs.ansible.com/ansible-core/2.20/reference_appendices/interpreter_discovery.ht
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

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible_ssh_common_args='-o StrictHostKeyChecking=n
o'
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ []
```

task2_ansible_ping_success.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible all -i hosts -m ping
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', bu
t future installation of another Python interpreter could cause a different interpreter to be disco
vered. See https://docs.ansible.com/ansible-core/2.20/reference_appendices/interpreter_discovery.ht
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 three instances & group-based inventory

task3_main_tf_count_3.png

```
module "myapp-webserver" {
  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

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ terraform apply -auto-approve
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

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ terraform output

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

task3_hosts_grouped.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ cat hosts
[ec2]
3.28.74.36
158.252.33.79

[ec2:vars]
ansible_user=ec2-user
ansible_ssh_private_key_file=~/.ssh/id_ed25519
ansible_ssh_common_args='-o StrictHostKeyChecking=no'

[droplet]
40.172.100.131

[droplet:vars]
ansible_user=ec2-user
ansible_ssh_private_key_file=~/.ssh/id_ed25519
ansible_ssh_common_args='-o StrictHostKeyChecking=no'
```

task3_ansible_ec2_ping.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible all -i hosts -m ping
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"
     "ping": "pong"
```

task3_ansible_single_ip_ping.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible 3.28.74.36 -i hosts
 -m ping
3.28.74.36 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/bin/python3.9"
    },
    "changed": false,
    "ping": "pong"
```

task3_ansible_droplet_ping.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible droplet -i hosts -m
 _ping
40.172.100.131 | 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

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

task4_hosts_without_common_args.png

```
@KomalKashif ➜ /workspaces/CC_KomalKashif_031-Lab-14 $ cat hosts
[ec2]
3.28.74.36
158.252.33.79

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

[droplet]
40.172.100.131

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

task4_ansible_ping_after_cfg.png

```
@KomalKashif ➜ /workspaces/CC_KomalKashif_031-Lab-14 $ ansible all -i hosts -m ping
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"
     "ping": "pong"
```

task4_my_playbook_created.png

```
@KomalKashif ➜ /workspaces/CC_KomalKashif_031-Lab-14 $ touch my-playbook.yaml
ls -la my-playbook.yaml
-rw-rw-rw- 1 vscode vscode 0 Jan 28 18:33 my-playbook.yaml
```

task4_my_playbook_ec2.png

```
Task > ! 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:
```
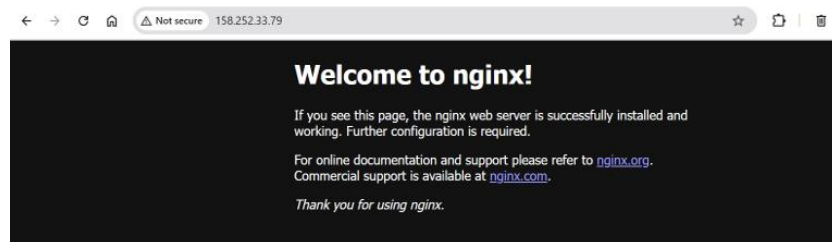
task4_ansible_play_ec2.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible-playbook -i hosts my-playb
ook.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    res
 ued=0    ignored=0
 3.28.74.36               : ok=3    changed=2    unreachable=0    failed=0    skipped=0    res
 ued=0    ignored=0
```

task4_nginx_browser_ec2.png

← → C ⌂ ⚠ Not secure 158.252.33.79

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.

task4_my_playbook_droplet.png

```
Task > ! my-playbook.yaml
---
- name: Configure nginx web server
  hosts: droplet
  become: true
  tasks:
    - name: install nginx and update cache
      yum:
```
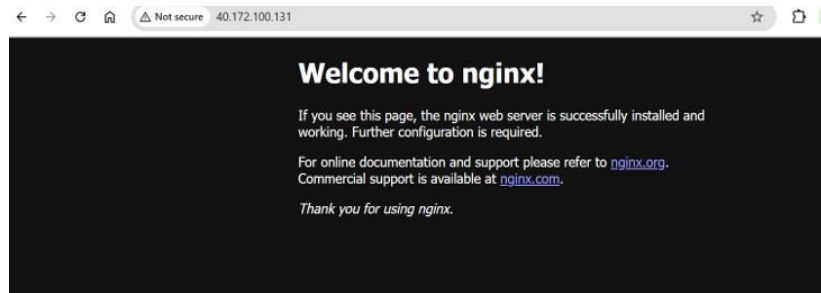
task4_ansible_play_droplet.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible-playbook -i hosts my-playbook
.yaml
TASK [install nginx and update cache] ***************************************************
changed: [40.172.100.131]

TASK [start nginx server] ***************************************************************
changed: [40.172.100.131]

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

task4_nginx_browser_droplet.png

Task 5 – Single nginx target group & HTTPS prerequisites

task5_project_ansible_cfg_created.png

task5_project_ansible_cfg.png

task5_main_tf_count_1.png

task5_terraform_apply_one_instance.png

task5_terraform_output_single_ip.png

task5_hosts_nginx_group.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ cat hosts
[nginx]
3.28.74.36

[nginx:vars]
ansible_ssh_private_key_file=~/.ssh/id_ed25519
ansible_user=ec2-user
```
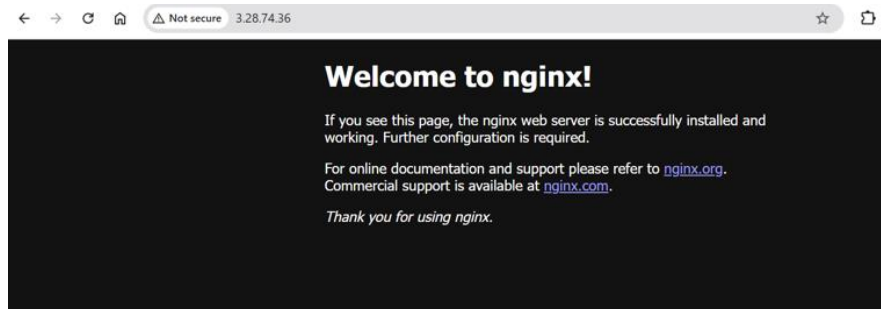
task5_my_playbook_nginx_group.png

```
---
- name: Configure nginx web server
  hosts: nginx
  become: true
  tasks:
    - name: install nginx and update cache
      yum:
```

task5_ansible_play_nginx_group.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible-playbook -i hosts my-playb
ook.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

Welcome to nginx!

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

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

Thank you for using nginx.

Task 6 - Ansible-managed SSL certificates

task6_my_playbook_ssl_section.png

```
- 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
```

task6_ansible_play_ssl.png

```
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
```

Task 7 - PHP front-end deployment with templates

task7_files_templates_created.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ mkdir -p files templates
touch files/index.php
touch templates/nginx.conf.j2
ls -R
.:
ansible.cfg  locals.tf  my-playbook.yaml  terraform.tfstate        variables.tf
files        main.tf    outputs.tf        terraform.tfstate.backup
hosts        modules    templates         terraform.tfvars

./files:
index.php

./modules:
subnet  webserver

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

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

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

task7_index_php_content.png

```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
```

task7_nginx_conf_template.png

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

events {
    worker_connections 1024;
}

http {
```

task7_my_playbook_web_deploy.png

```
- name: Configure SSL certificates
  tasks:

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

task7_ansible_play_web_deploy.png

```
@KomalKashif →/workspaces/CC_KomalKashif_031-Lab-14 $ ansible-playbook -i hosts my-playbook.yam
l
TASK [install php-fpm and php-curl] ********************************************************
ok: [3.28.74.36]

TASK [Copy website files] *****************************************************************
ok: [3.28.74.36]

TASK [Copy nginx.conf template] ***********************************************************
changed: [3.28.74.36]

TASK [Restart nginx] **********************************************************************
changed: [3.28.74.36]

TASK [Start and enable php-fpm] ***********************************************************
changed: [3.28.74.36]

PLAY RECAP ********************************************************************************
3.28.74.36                 : ok=19   changed=3   unreachable=0   failed=0   skipped=0   resc
ued=0    ignored=0
```

task7_php_https_browser.png