Agenda:
==========
1. Introduction to Configuration management
2. CM tool - Ansible
3. Architecture of Ansible
4. Setup Ansible on the lab
5. Ansible Inventory and adhoc commands

==========
Configuration
==========
making a change on a server or set of servers

-> installing package
-> copying files
-> executing commands
-> executing scripts
-> deploying application
-> creation of Users
-> giving permissions

I want to do configuration change on 200 servers - Manually
-> Time Consuming
-> repetitive
-> error prone
-> trouble shooting is time Consuming
-> all updates may not be available
-> keep track of all changes will be difficult

Configuration management: Ansible
==========
> Using an automation tool to make changes on several servers in very less time
> Using an automation tool to bring in consistency across various environments
> A automation tool will ensure our desired changes are always available on the destination servers
> In Configuration management tool we will write code to make changes on various servers
> This code can be maintained in VC tools
> CM tools will also maintain logs of what changes were done on which servers

Infrastructure as a code tool: Terraform

==========
We can write the code to provision(create/modify/delete) infrastructure on the cloud

CM tool - Ansible
==========

- It is an open source tool - Free to use
- It is a simple tools and easy to learn
- Ansible works on a push approach
- Ansible 2 parts:
  - Ansible Core : Ansible is available as Command line tool
  - Ansible Tower/AWX : GUI of ansible or Ansible dashboard
- Ansible will always be installed on linux machine
- Cannot be installed on Windows OS
- Ansible can connect to linux or windows servers and apply changes on them
- It is python based tools- we required python >=2.7
- Ansible automation code is written in YAML
- Ansible is setup as a master and worker node architecture
- Installation of ansible is very easy
- No ansible process will be installed on the worker node - Agentless tool
- Can automate cloud machines or on premise machines

==========
Ansible Components

1. Inventory: WHERE TO DO THE CHANGES
==========
- It is a simple file in which we will write IP address or hostnames of the servers where ansible has to changes
- This file is present by default at location /etc/ansible
- Default name of the file is hosts
- We can create our own inventory file in any directory

There are 2 types of inventory :
==========
Static Inventory:
==========
where the infrastructure is static
This file is manually created by the user
Ip address are manually written by the user
Whenever we have less or limited infra then go for static inventory

Dynamic Inventory :
==========

This inventory file is created by Ansible
The inventory IP address are dynamic and keep changing
This type of inventory is created when your infra is on the cloud
Ansible --> connect to cloud provider --> ansible will go to given region of aws --> check the available VM
-> ftech the hostname/IP and ---> compute the inventory file

2. Modules : What Changes to do
==========
Modules are small-small python programs (ansible pre-written code) provided to us by ansible
These are reusable code which when executed will perform configuration change on the servers.
There 4000+ modules
For example :
==========
Download the file from https://tomcat.apache.org/tomcat-7.0-doc/appdev/sample/sample.war at localtion /opt on all servers

get_url(url=https://tomcat.apache.org/tomcat-7.0-doc/appdev/sample/sample.war dest=/opt)

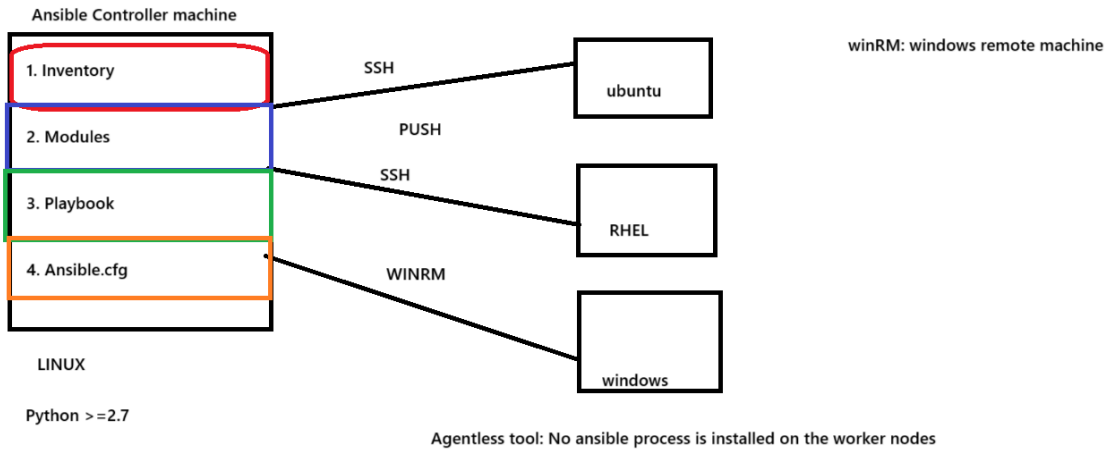
3. Playbook
- ansible code is written inside a playbook
- Playbooks are written in YAML
- Playbook consist of:
  - host IP details(come form Inventory file)
  - Tasks details(modules to be executed)

4. ansible.cfg
==========
This is default file of ansible
This file is present at /etc/ansible directory
The name of the ansible.cfg
This is the main configuration file of ansible
There are 3 main sections in this file
==========
1. defaults: in this section ansible will note
 - inventory location
 - module lib location
 - default ssh user
 -> fork
 -> ssh connection timeout

- ansible log path

2. SSH_Connection
==========
SSh releated details will be written inside this file

3. Privilege Escalation
==========
in this file we provide information related to sudo users and its previliges



==========

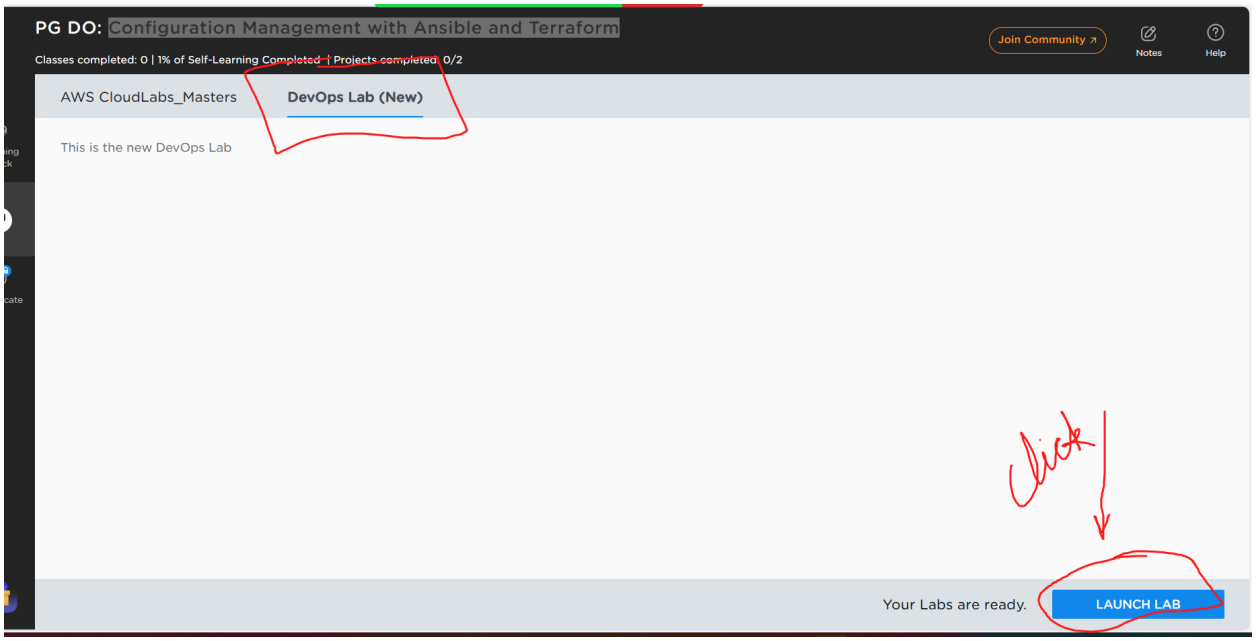
Launch Configuration management LAB
==========
There are 2 labs:

AWS lab
-> Create EC2 virtual Machine - ubuntu
-> Copy the SSH keys of the DevOps Lab(ACM)
-> This machine becomes the host server.

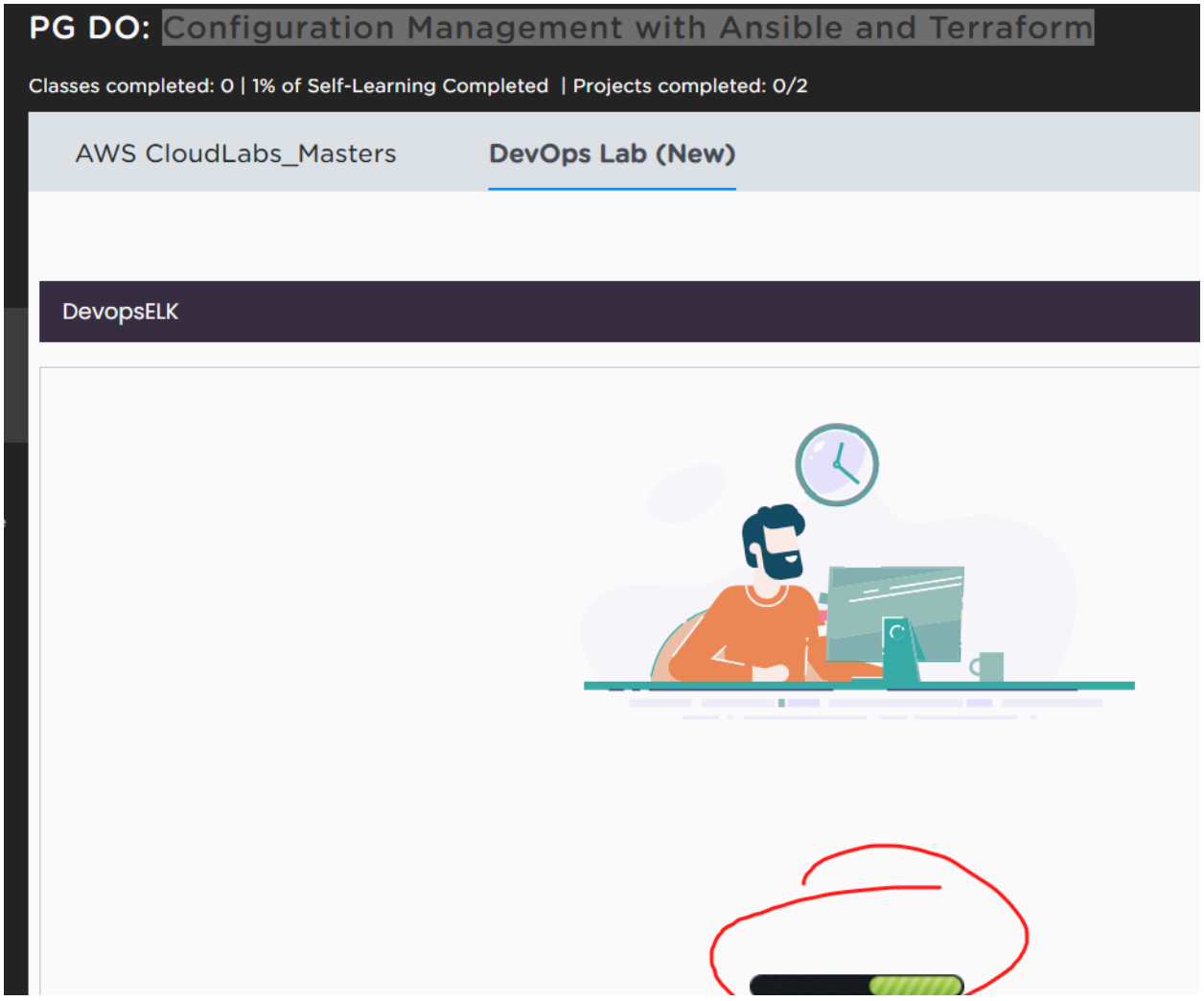
DevOps Lab (New)
ubuntu 22 machine
Python 3
Ansible is already installed
It is Ansible controller machine

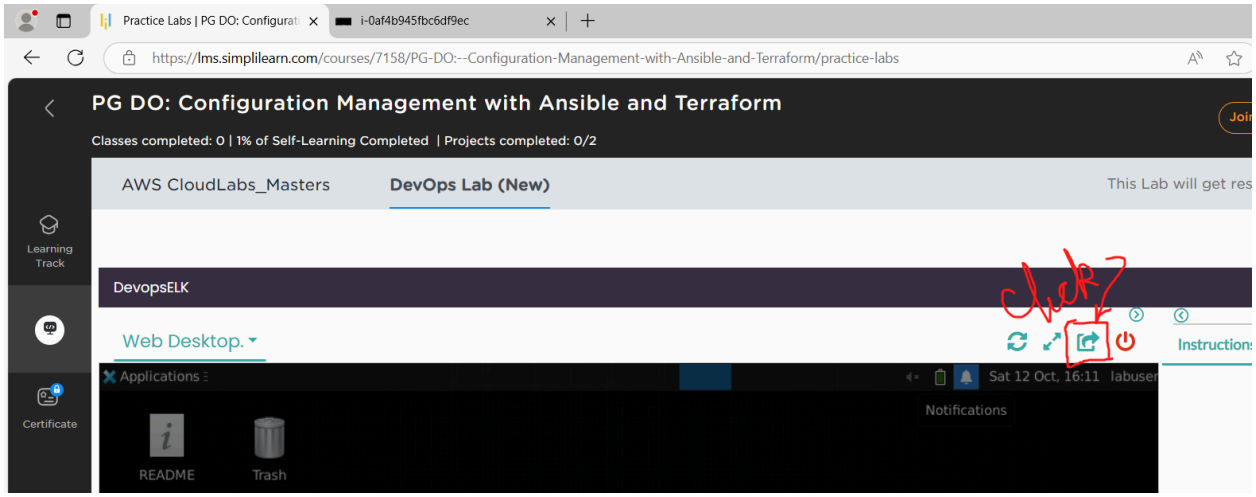
We can create current ACM as an inventory itself -> local host
Ansible can execute playbook on itself

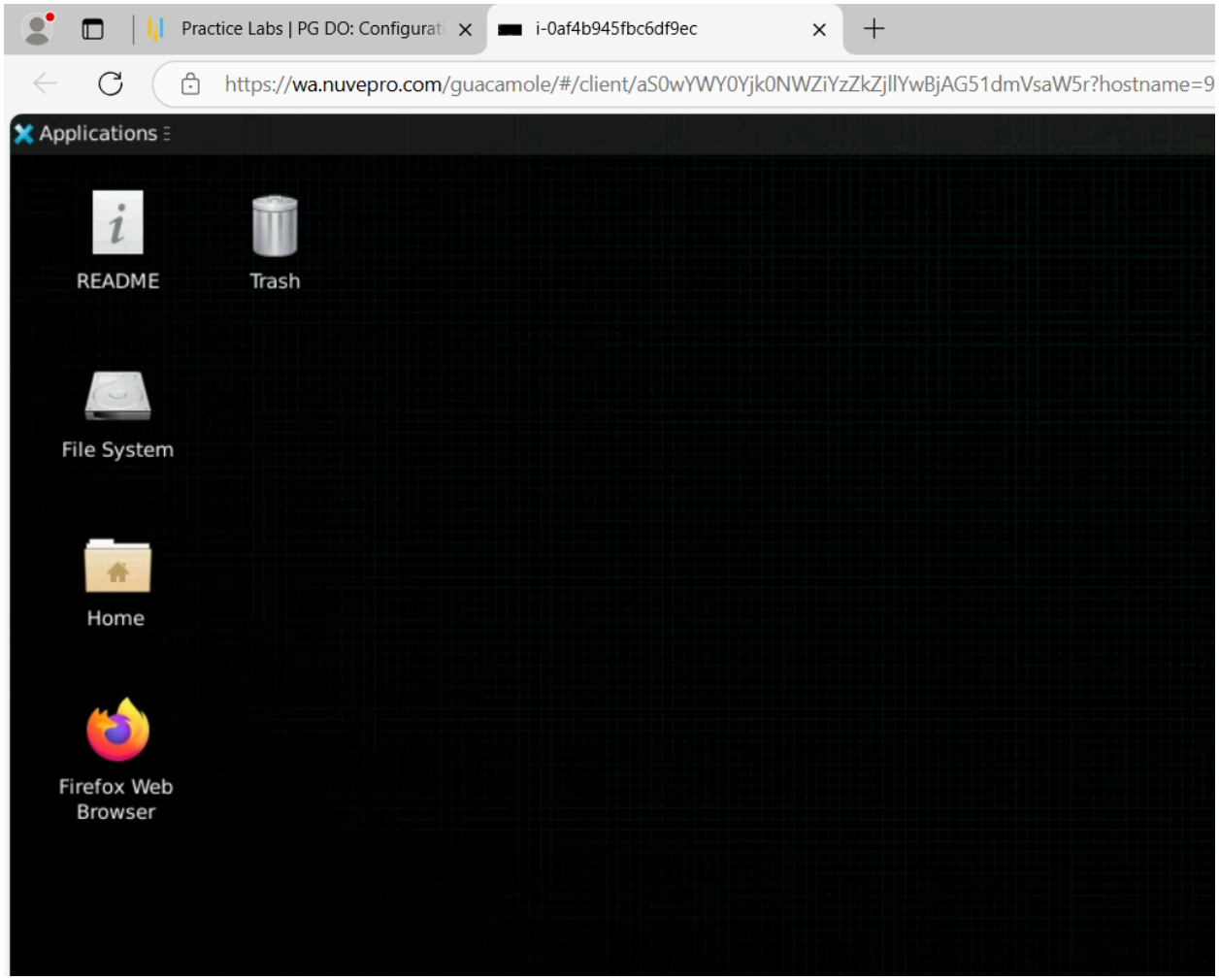
==========
Connect to SL Lab - Configuration Management with Ansible and Terraform



Click on start lab:


PG DO: Configuration Management with Ansible and Terraform
Classes completed: 0 | 1% of Self-Learning Completed | Projects completed: 0/2
AWS CloudLabs_Masters
DevOps Lab (New)
DevopsELK

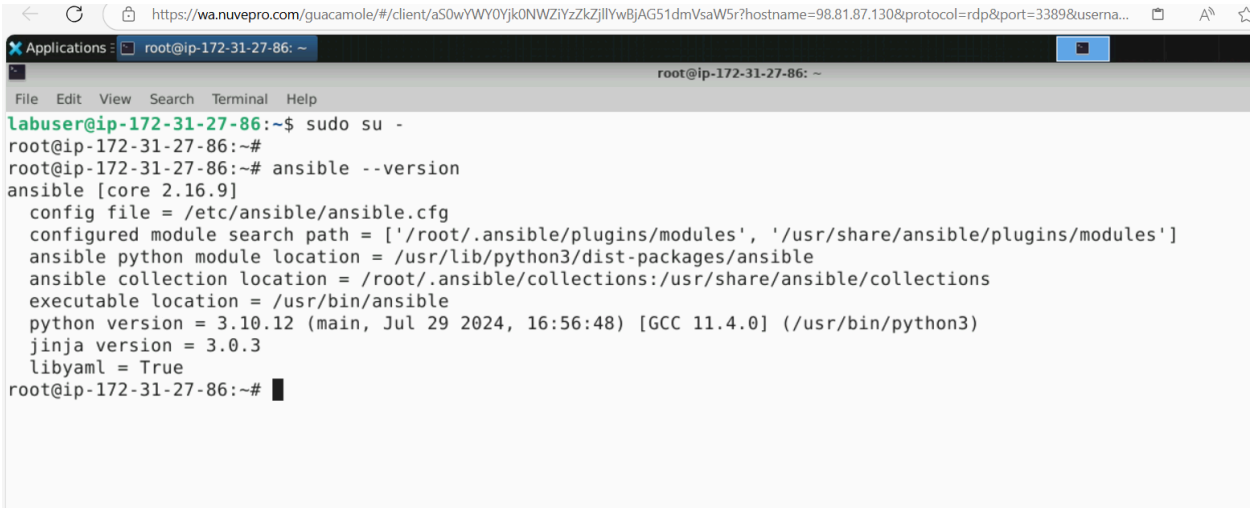

Practice Labs | PG DO: Configurat
i-0af4b945fbc6df9ec
https://lms.simplilearn.com/courses/7158/PG-DO:--Configuration-Management-with-Ansible-and-Terraform/practice-labs
PG DO: Configuration Management with Ansible and Terraform
Classes completed: 0 | 1% of Self-Learning Completed | Projects completed: 0/2
AWS CloudLabs_Masters
DevOps Lab (New)
This Lab will get res
Learning Track
Certificate
DevopsELK
Web Desktop.
Instructions
Applications
Sat 12 Oct, 16:11
labuser
Notifications
README
Trash



Start terminal on the Lab and check if ansible installed or not

sudo su -

ansible --version



Open SSH connection between Controller and worker nodes:

==========

ON the Controller Machine -> DevOps Lab

 # sudo su -

Create a new user on the terminal:

adduser ansiuser

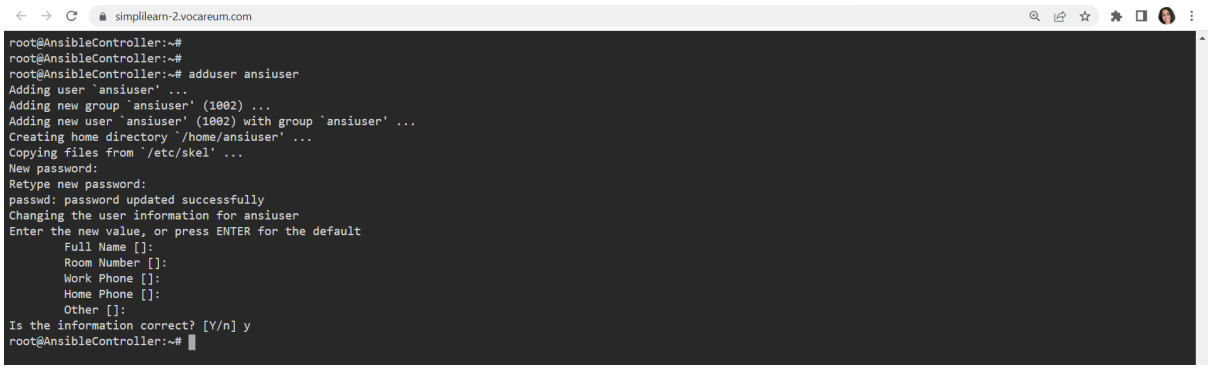
Enter New password : **ansiuser**
Retype new Password: **ansiuser**

Don’t enter any value for fullname, room number, workphone, homephone other

Just keep pressing enter key.

And give Y for

Is the information correct ? [Y/n] : y



User will now be created.

==========

Step 2:

We will give sudo permission to this user so that it can execute linux commands without need of password

Add ansiuser in sudoers files and give all permission

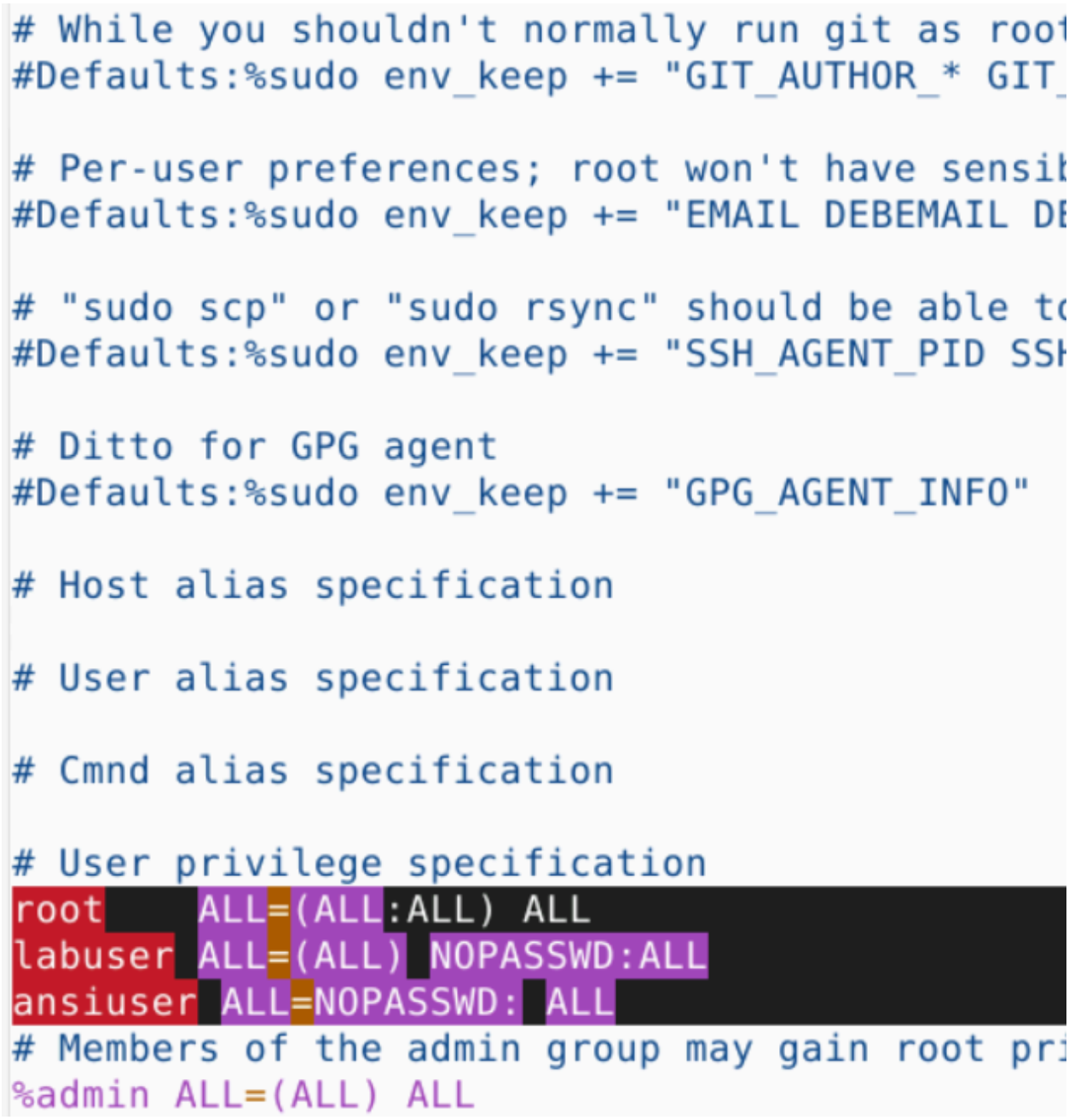
vim /etc/sudoers

Press i

Scroll down until your find : # User privilege specification

Now enter below line under labuser ALL=(ALL) NOPASSWD:ALL

ansiuser ALL=NOPASSWD: ALL



Save the file. (:wq!)

Step 4:

Generate SSH key on Master machine

Step 1:

Change user from root to ansiuser

su - ansiuser

Step 2:

Generate ssh key on Master node for ansiuser

Execute below command:

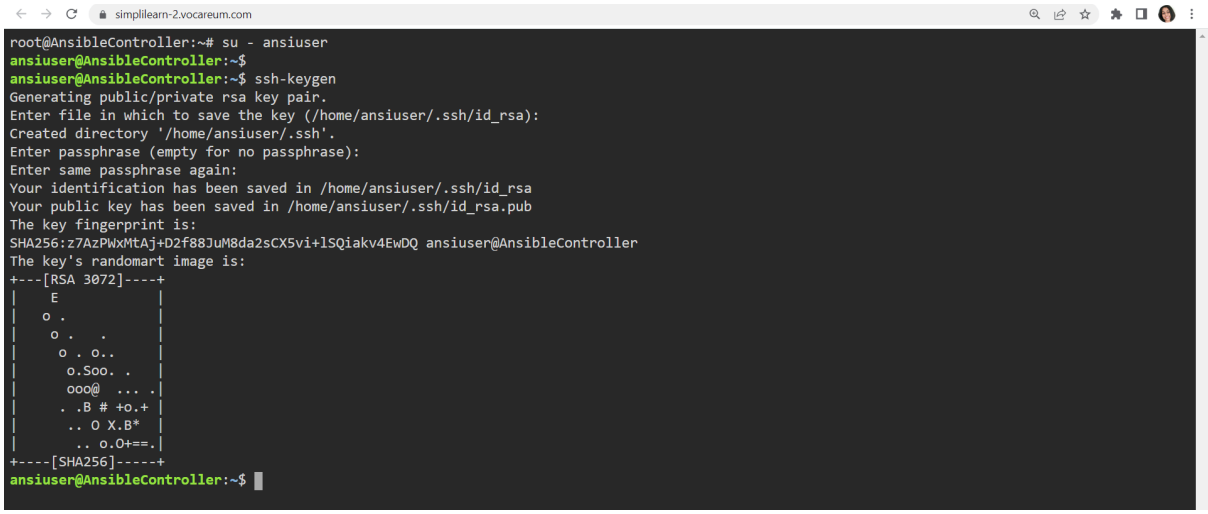
ssh-keygen

press enter

press enter

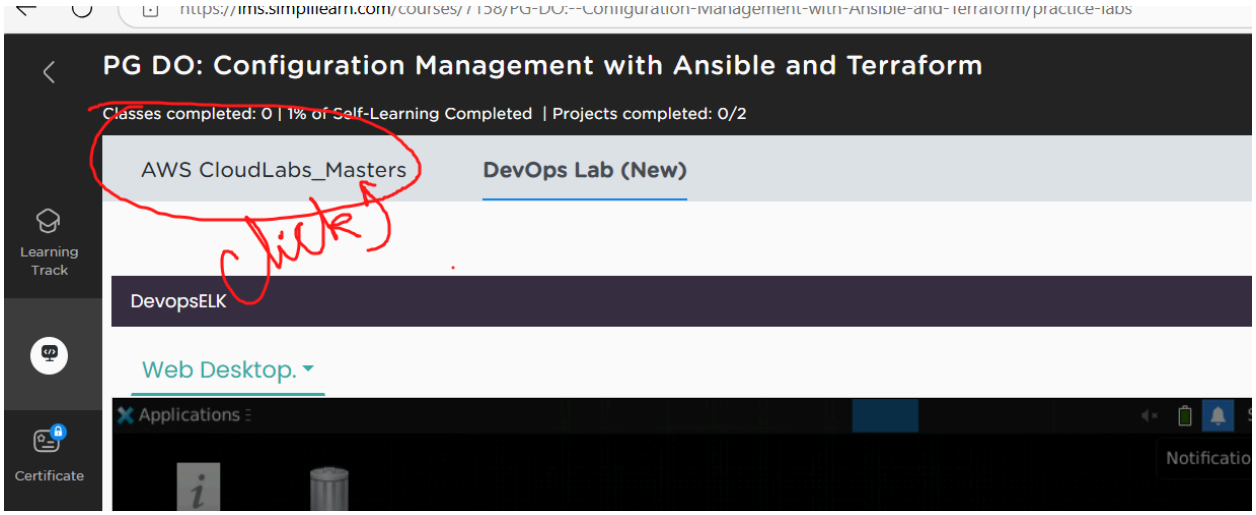
press enter

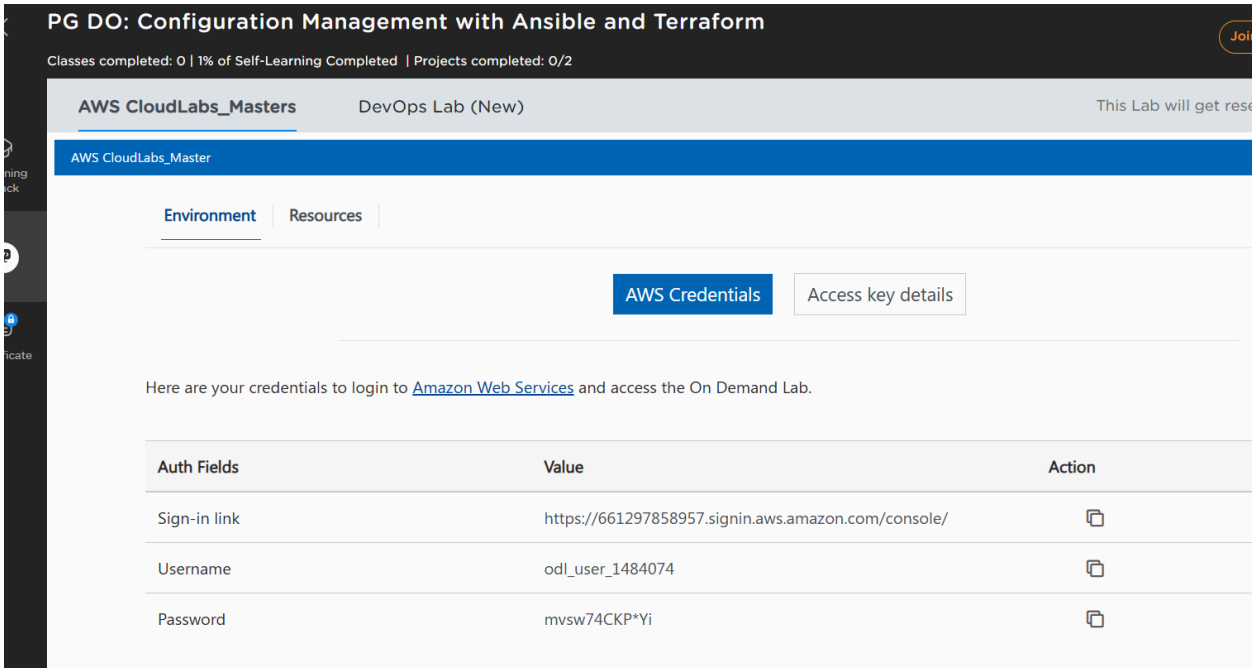
ssh key will be generated



==========

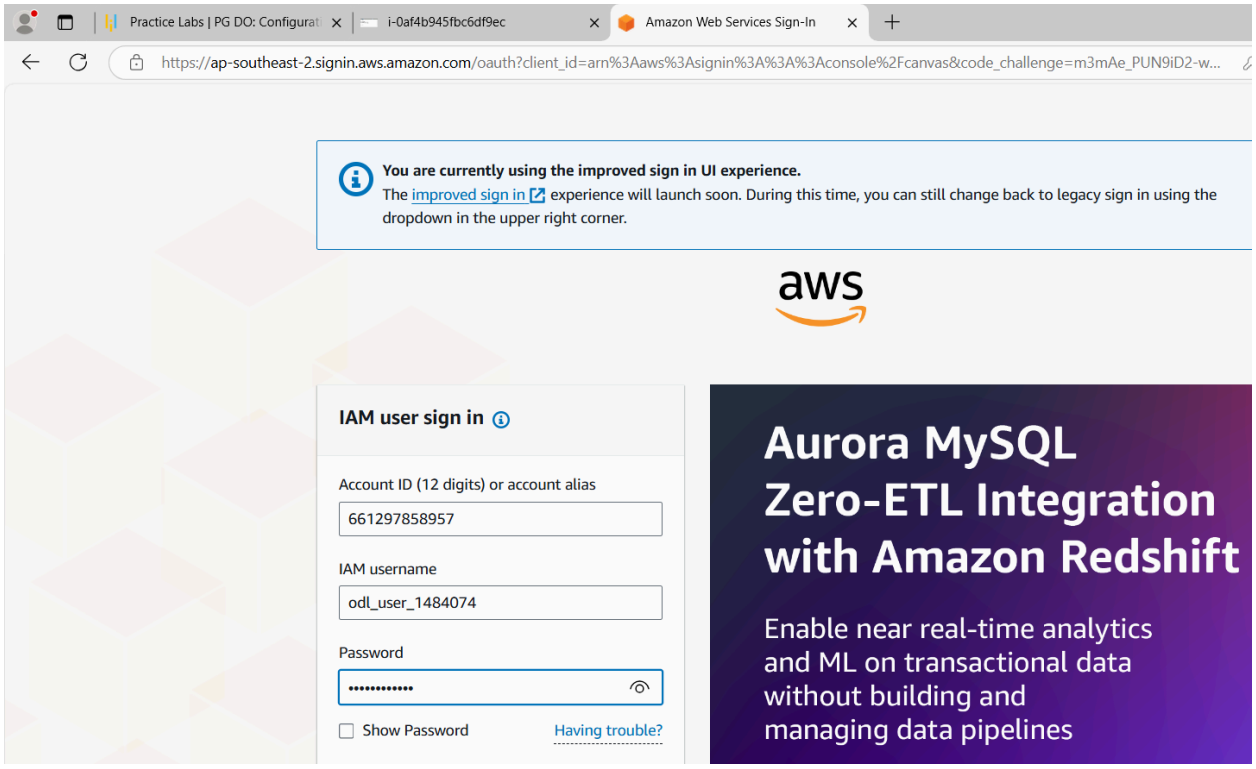
CREATE WORKER NODES on AWS LAB





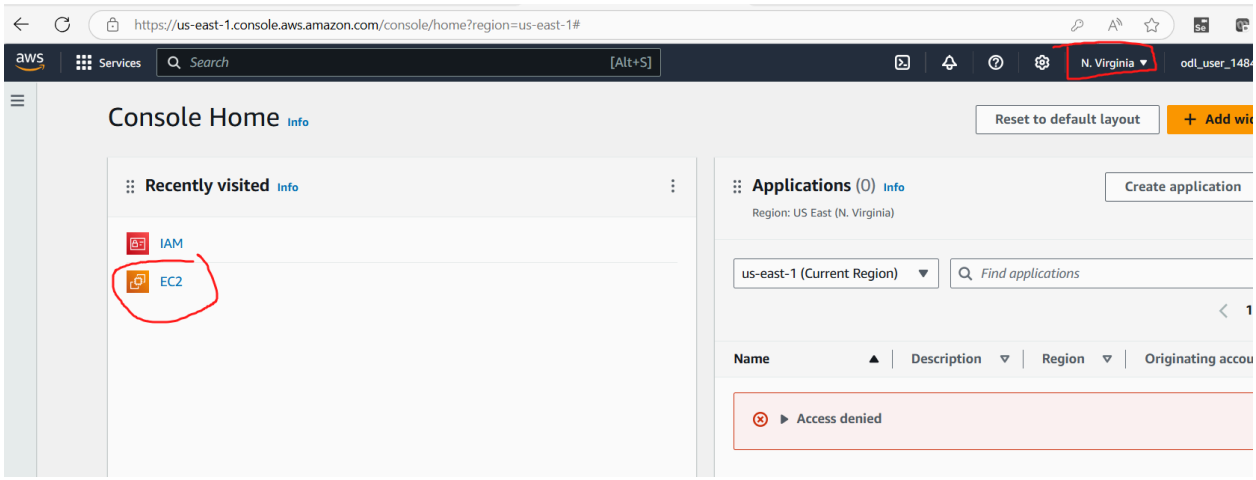
Copy the sign-in link and paste on a new windows tab

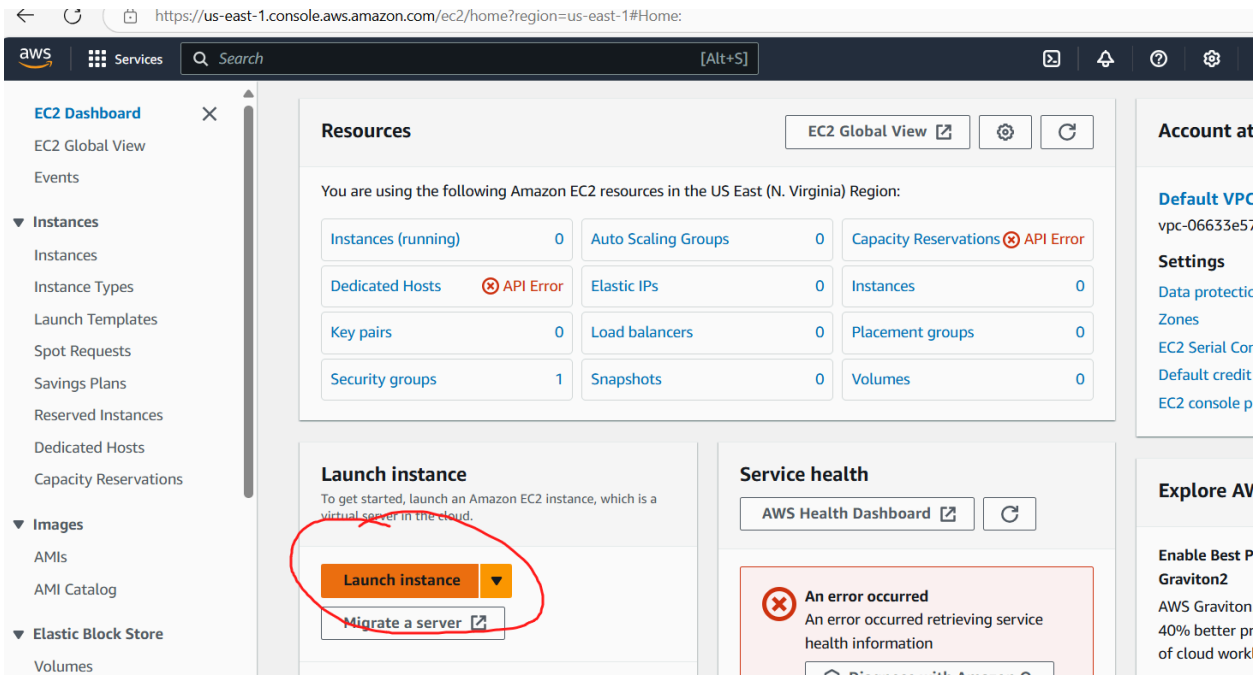
Login with given username and password



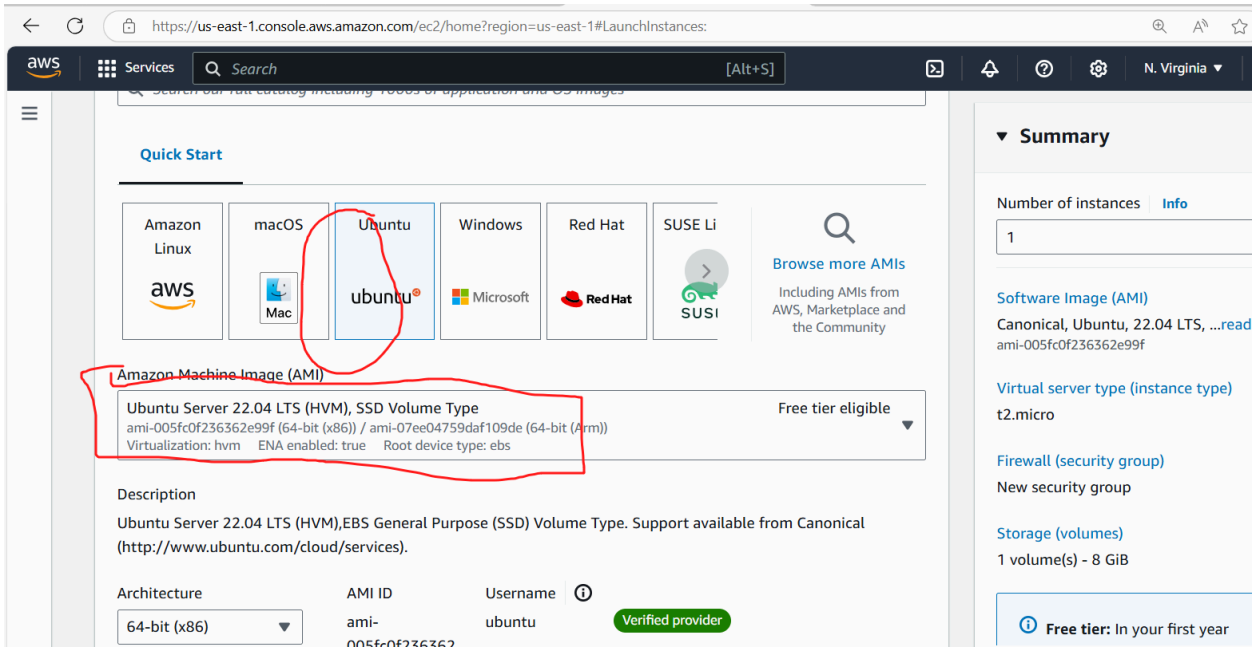
Click on sign -in . We will be on AWS dashboard

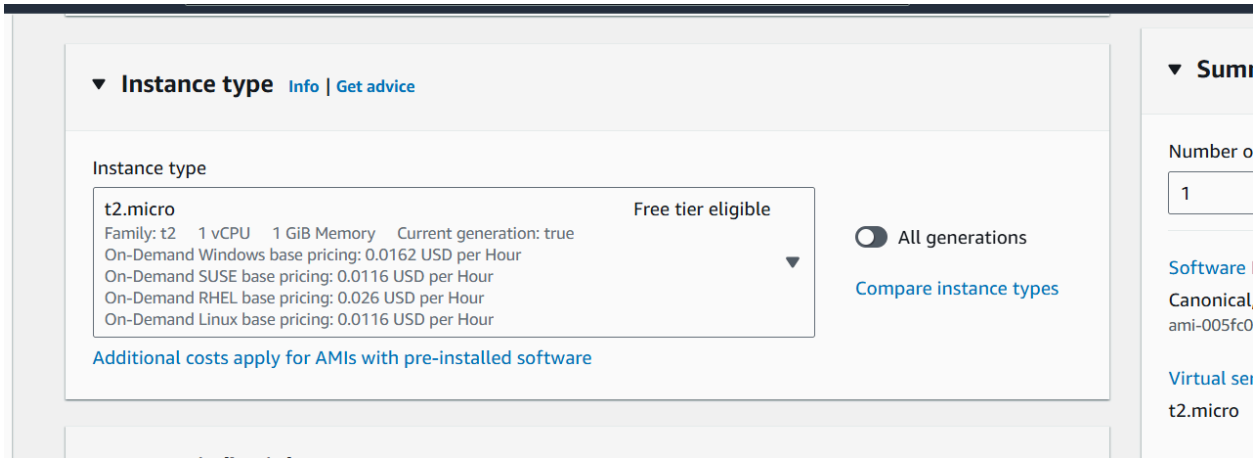
Create an Ec2 server:

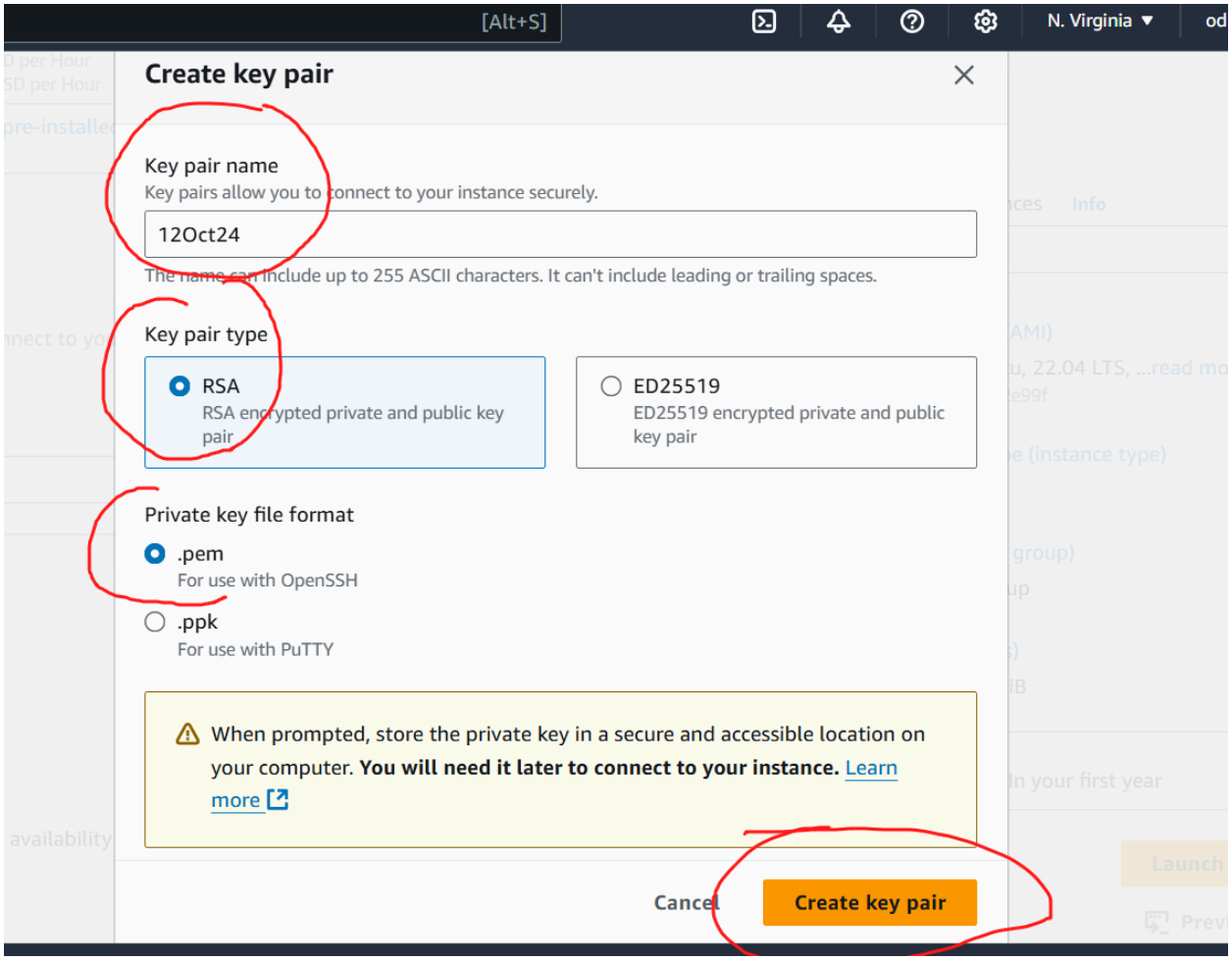


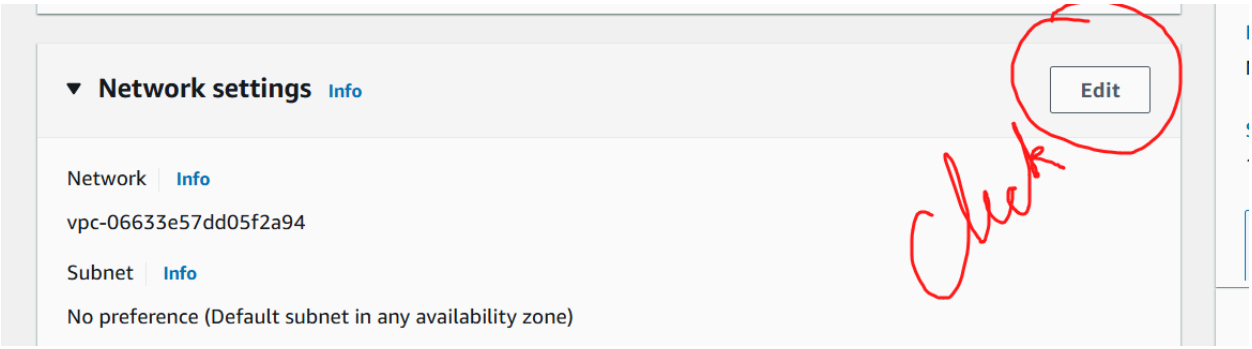


Make sure AWS region is us-east-1

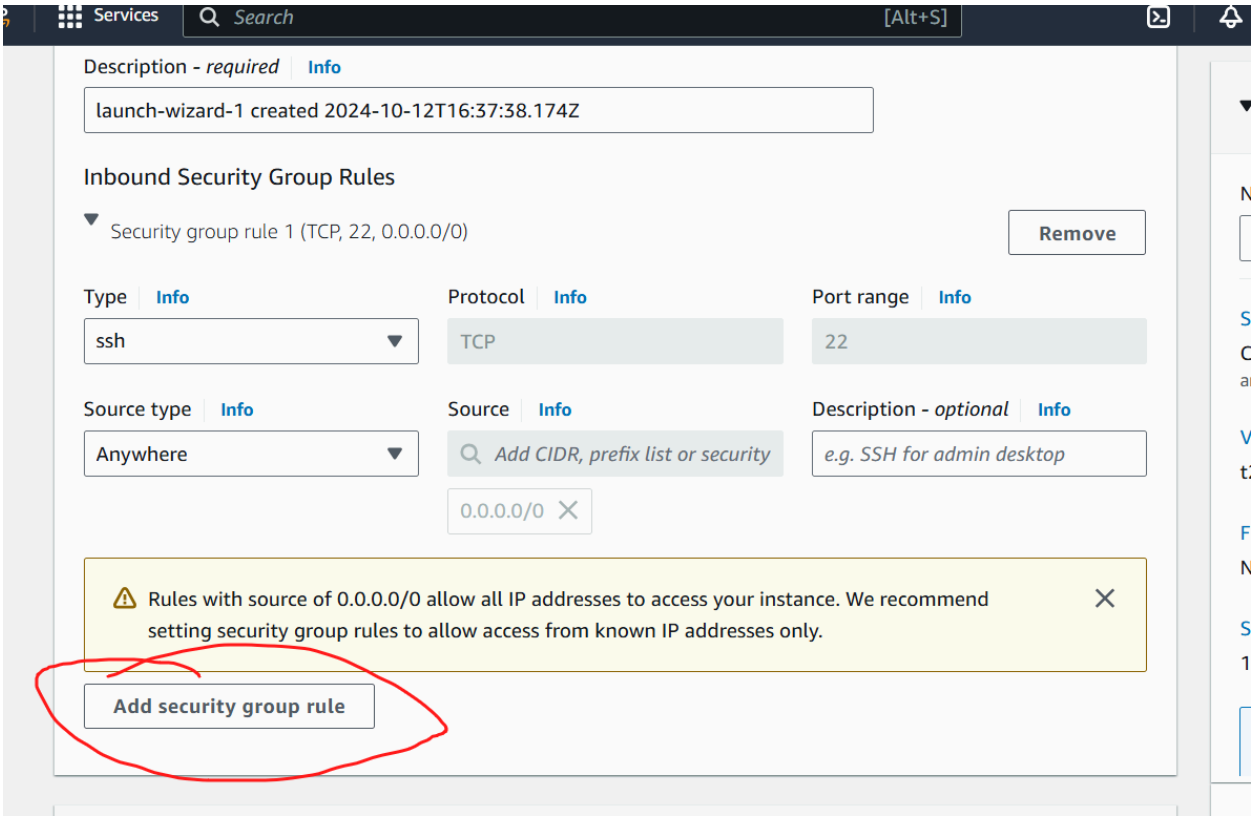


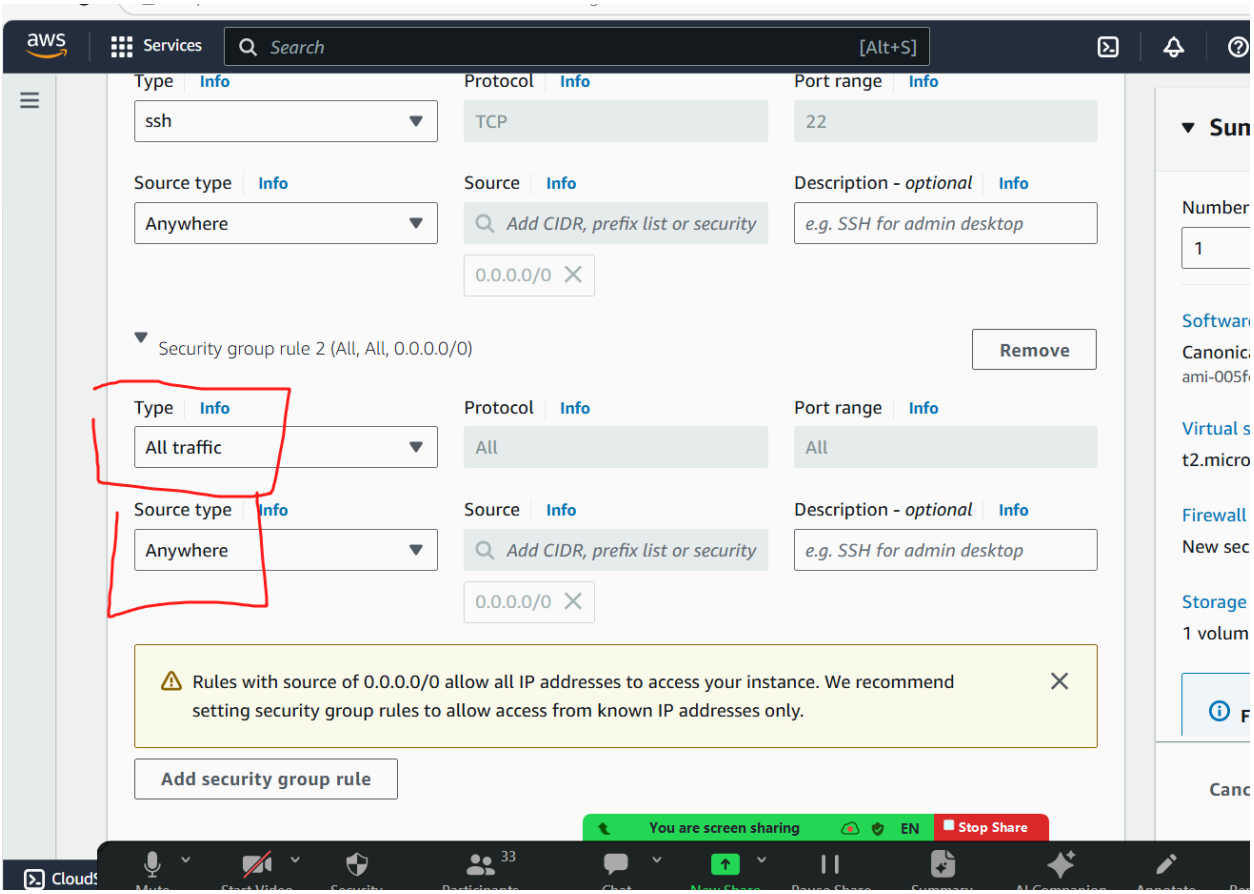

Instance type Info | Get advice
Instance type
t2.micro
Free tier eligible
Family: t2 1 vCPU 1 GiB Memory Current generation: true
On-Demand Windows base pricing: 0.0162 USD per Hour
On-Demand SUSE base pricing: 0.0116 USD per Hour
On-Demand RHEL base pricing: 0.026 USD per Hour
On-Demand Linux base pricing: 0.0116 USD per Hour
All generations
Compare instance types
Additional costs apply for AMIs with pre-installed software
Number o
1
Software
Canonical,
ami-005fc0
Virtual ser
t2.micro


[Alt+S]
N. Virginia
Create key pair
Key pair name
Key pairs allow you to connect to your instance securely.
12Oct24
The name can include up to 255 ASCII characters. It can't include leading or trailing spaces.
Key pair type
RSA
RSA encrypted private and public key pair
ED25519
ED25519 encrypted private and public key pair
Private key file format
.pem
For use with OpenSSH
.ppk
For use with PuTTY
When prompted, store the private key in a secure and accessible location on your computer. You will need it later to connect to your instance. Learn more
Cancel
Create key pair

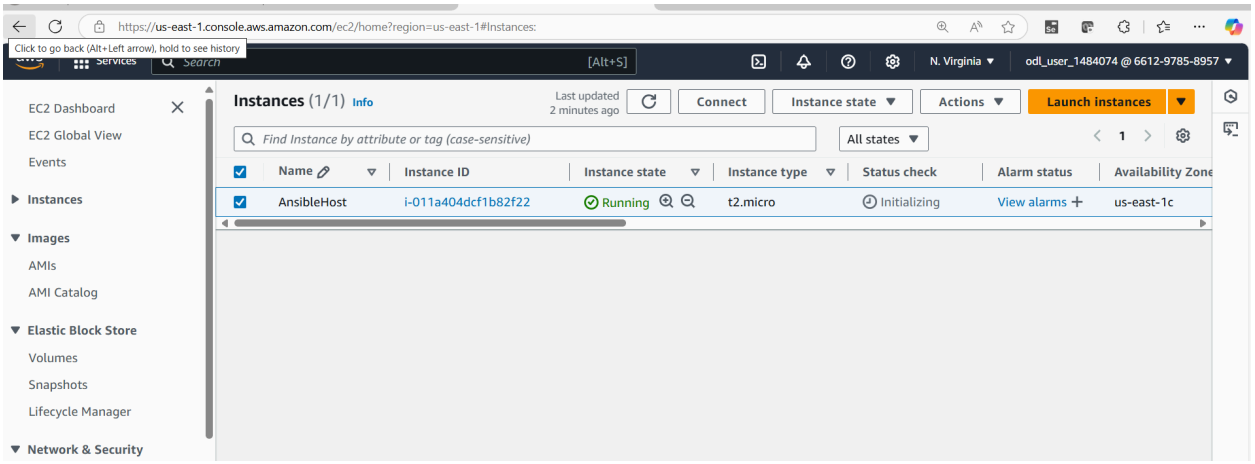


Scroll down: you will see a button for ADD security group rule.

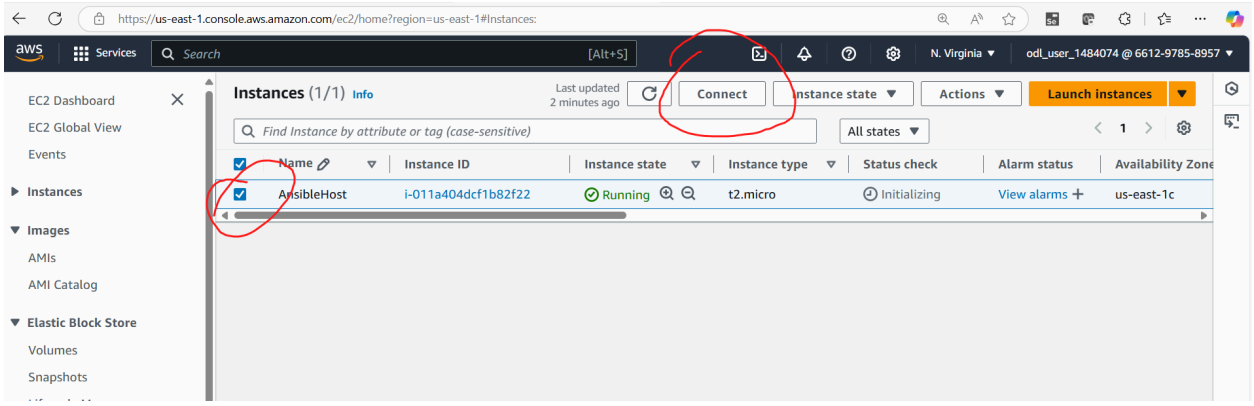


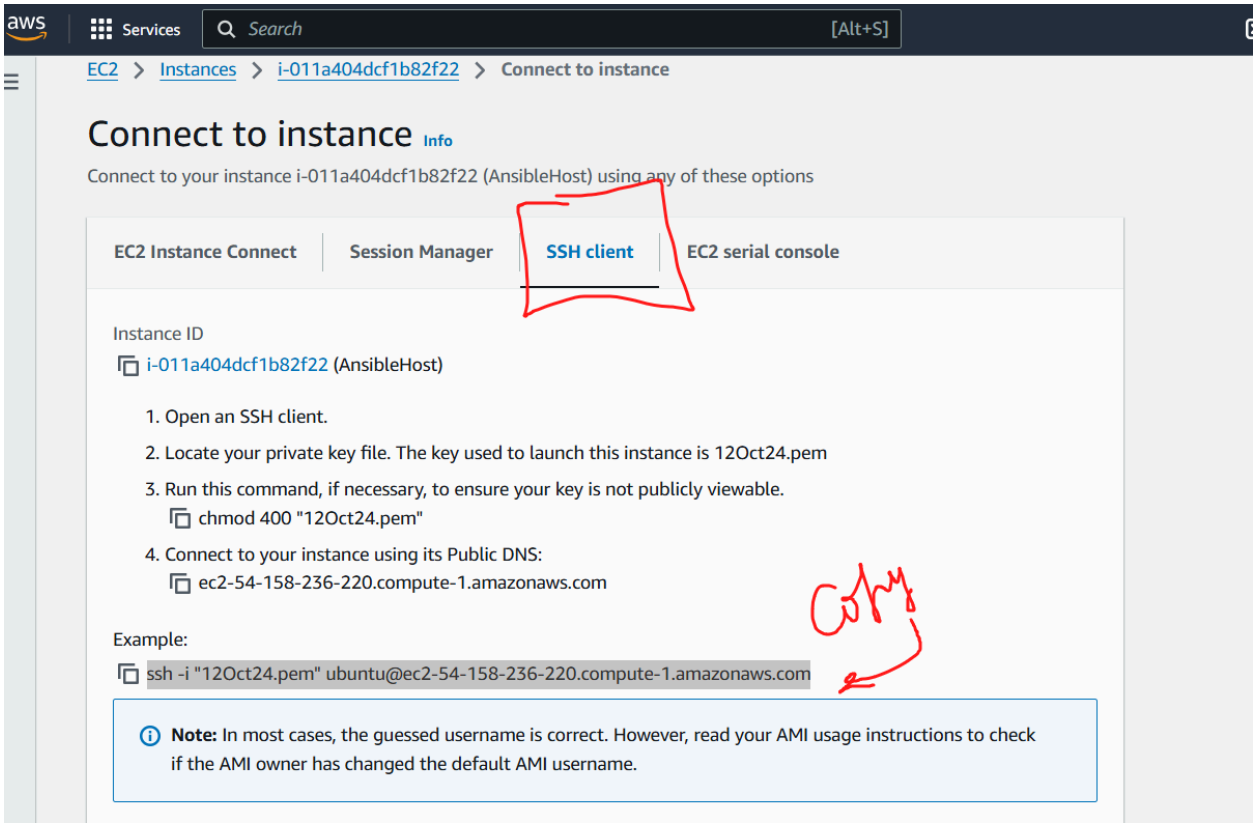


Click on launch instance.



Connect to the server

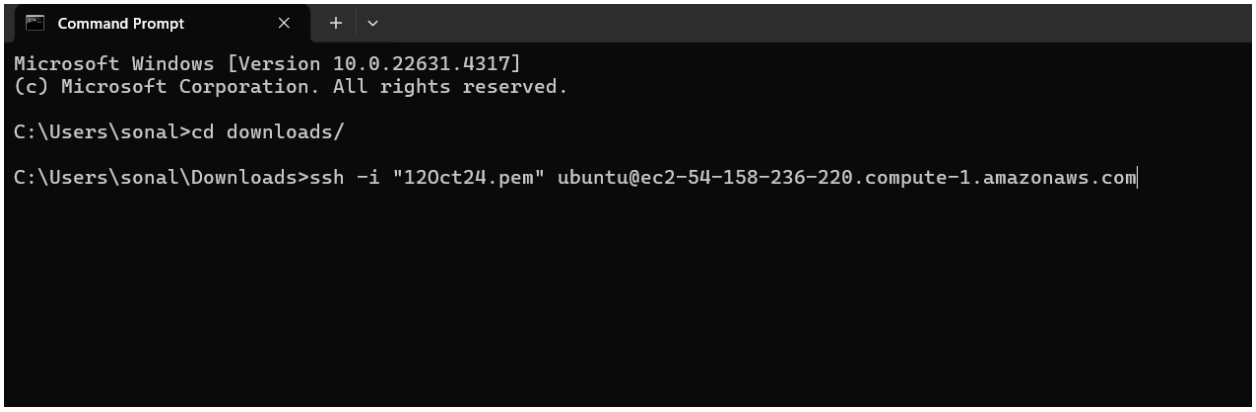




Open command prompt on windows or terminal on Mac

Execute below commands:

 # cd downloads/
 # Paste the AWS ssh command
Example:
ssh -i "12Oct24.pem" ubuntu@ec2-54-158-236-220.compute-1.amazonaws.com



Steps to be executed on Worker Node:

==========

sudo su -

Create a new user on the terminal:

adduser ansiuser

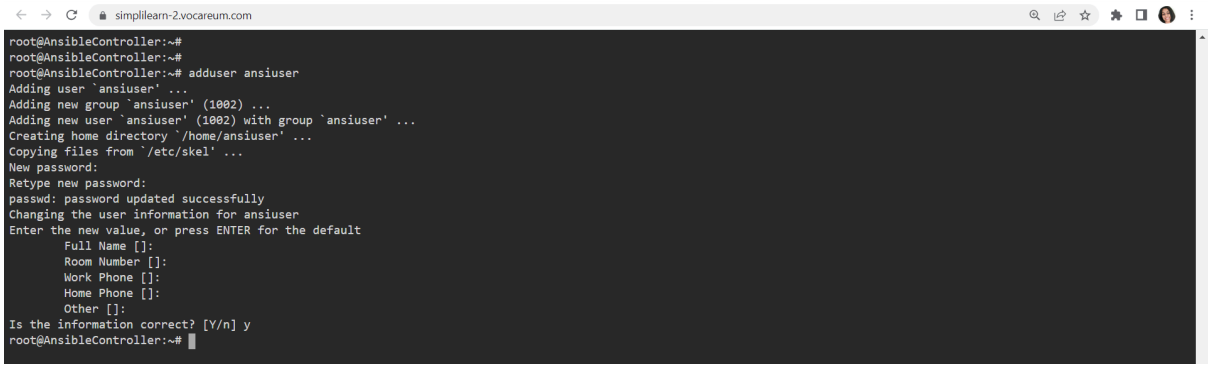
Enter New password : **ansiuser**
Retype new Password: **ansiuser**

Don’t enter any value for fullname, room number, workphone, homephone other

Just keep pressing enter key.

And give Y for

Is the information correct ? [Y/n] : y



User will now be created.

==========

Step 2:

We will give sudo permission to this user so that it can execute linux commands without need of password

Add ansiuser in sudoers files and give all permission

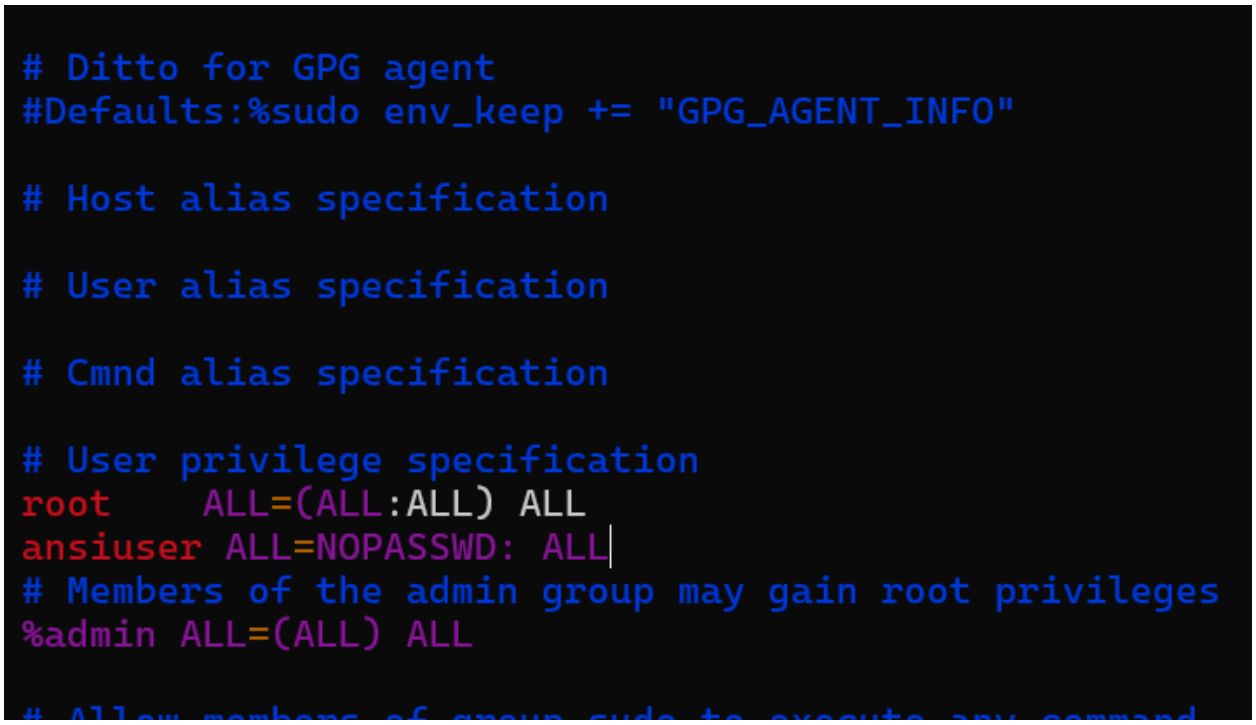
vim /etc/sudoers

Press i

Scroll down until your find : # User privilege specification

Now enter below line under root ALL=(ALL:ALL) ALL

ansiuser ALL=NOPASSWD: ALL



Save the file (:wq!)

Now switch to ansiuser on worker node and create .ssh folder

 # su - ansiuser

 # mkdir .ssh

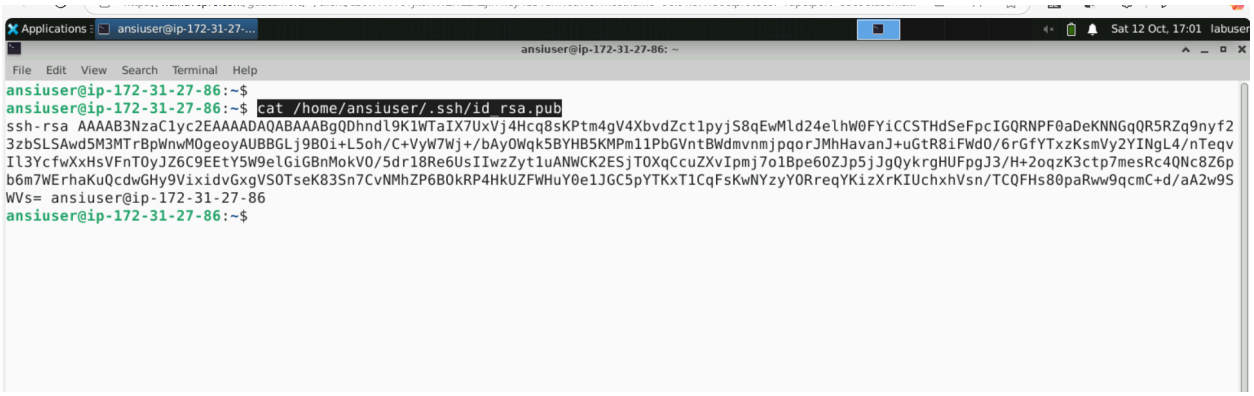
 # ls -al

```
root@ip-172-31-44-99:~#
root@ip-172-31-44-99:~# su - ansiuser
ansiuser@ip-172-31-44-99:~$ ls -al
total 20
drwxr-x--- 2 ansiuser ansiuser 4096 Oct 12 16:56 .
drwxr-xr-x 4 root     root     4096 Oct 12 16:56 ..
-rw-r--r-- 1 ansiuser ansiuser  220 Oct 12 16:56 .bash_logout
-rw-r--r-- 1 ansiuser ansiuser 3771 Oct 12 16:56 .bashrc
-rw-r--r-- 1 ansiuser ansiuser  807 Oct 12 16:56 .profile
ansiuser@ip-172-31-44-99:~$ mkdir .ssh
ansiuser@ip-172-31-44-99:~$ ls -al
total 24
drwxr-x--- 3 ansiuser ansiuser 4096 Oct 12 16:59 .
drwxr-xr-x 4 root     root     4096 Oct 12 16:56 ..
-rw-r--r-- 1 ansiuser ansiuser  220 Oct 12 16:56 .bash_logout
-rw-r--r-- 1 ansiuser ansiuser 3771 Oct 12 16:56 .bashrc
-rw-r--r-- 1 ansiuser ansiuser  807 Oct 12 16:56 .profile
drwxrwxr-x 2 ansiuser ansiuser 4096 Oct 12 16:59 .ssh
ansiuser@ip-172-31-44-99:~$
```

==========

Go to master node(devops lab) and copy the ssh public key of ansiuser

 # cat /home/ansiuser/.ssh/id_rsa.pub



Right click and copy the copy

Carefully copy the key

Go to Worker node (AWS VM)

echo "<give your public key>" >> ~/.ssh/authorized_keys

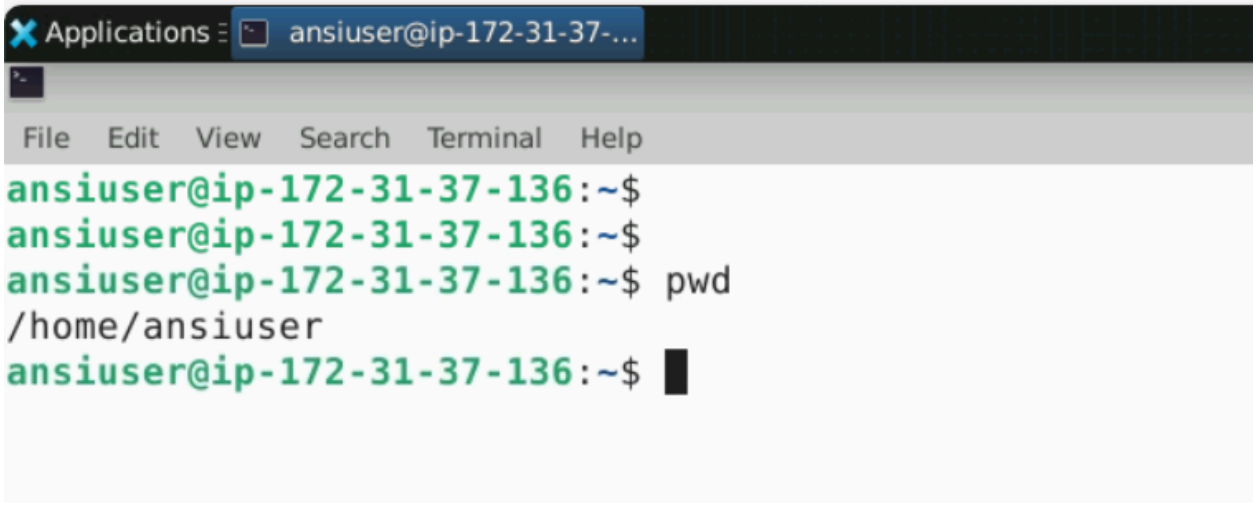
Great job, the setup is complete

 # su - ansiuser

 # cd

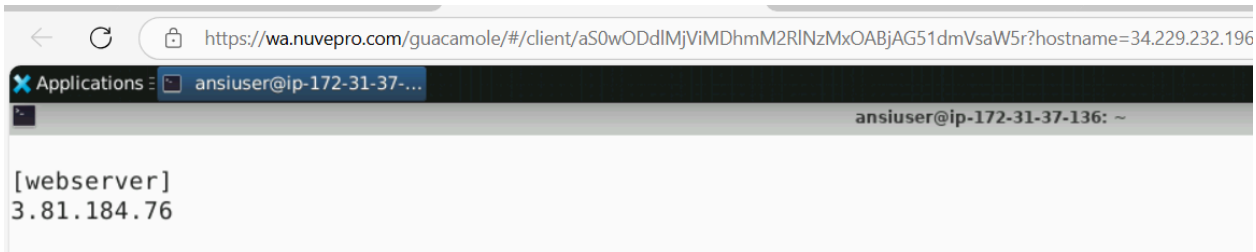
 # pwd

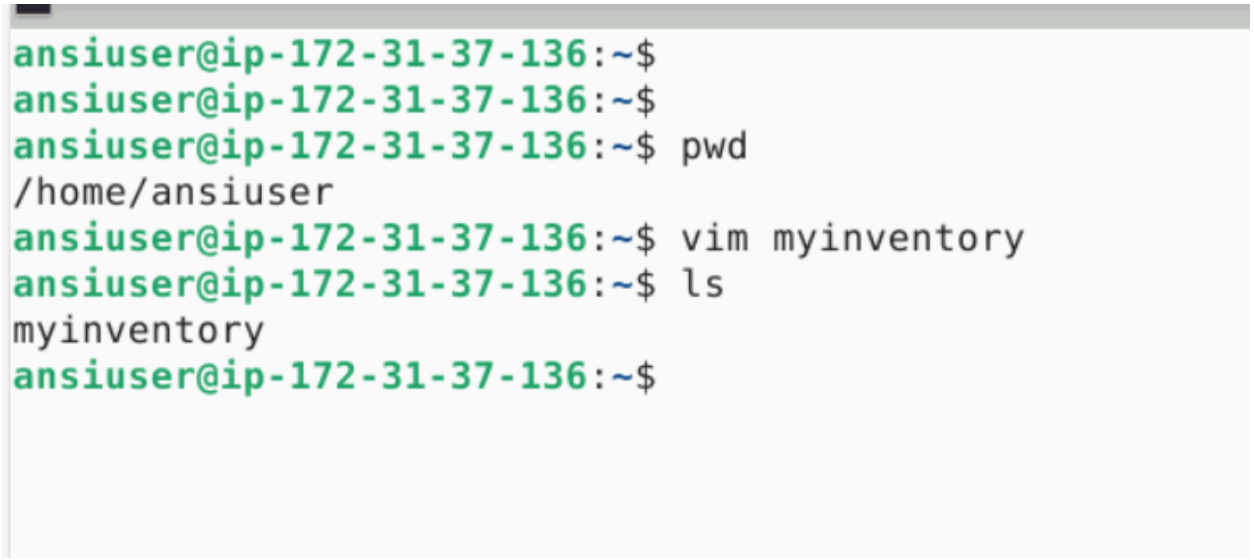
You should be in the ansiuser home directory



 # vim myinventory

[webserver]
Public ipaddress of aws VM





Execute the below command to use the created inventory file for running module

 # ansible -i /home/ansiuser/myinventory webserver -m ping

We will create our own ansible.cfg file now to set myinventory as the default inventory file for ansiuser.

 # vim ansible.cfg

[defaults]

inventory = /home/ansiuser/myinventory
interpreter_python = auto_silent

Save the file.

 # ansible webserver -m ping

==========
AnsibleCode is written in 2 ways:
==========
> Ad Hoc commands
Ad hoc commands are single line commands
Using ad hoc command we execute a single module on the worker nodes
Whenever we have to quickly check something on the worker node we execute an ad hoc command
When wever have to validate an output on worker nodes, we will use adhoc commands.

Syntax:

 # ansible <hostgroupname> -m <moduleName> -a "par1=value par2=value"

Demo:

 # ansible webserver -m command -a "uptime"

 # ansible webserver -m command -a "df -h"

 # ANSIBLE_KEEP_REMOTE_FILES=1 ansible all -m shell -a "uptime"

==========

Create a directory:

 # ansible webserver -m file -a "path=/tmp/mydir state=directory"

Validate:

 # ansible webserver -m command -a "ls /tmp"

Create a file in the directory

 # ansible webserver -m file -a "path=/tmp/mydir/file1 state=touch"

Validate:

 # ansible webserver -m command -a "ls /tmp/mydir"

Add content to the file
 # ansible webserver -m copy -a 'content="Hello form Ansible controller" dest=/tmp/mydir/file1'

Validate it:

 # ansible webserver -m command -a "cat /tmp/mydir/file1"

Agenda - Day 2 - 25 May 2025

==========

> Understand playbook structure
> Write playbooks to execute multiple tasks
> Variables in Ansible
> Fact variables
> Conditions and loops in Ansible

==========

A playbook is -> a set of plays
A play consist of :
  - host server details (which servers we have to do the changes)
  - tasks (which modules have to be executed)
A playbook is written in YAML, its extension will be .yml or .yaml

Recap of YAML
==========

In a YAML file we write the code in format
key: value

A key can store a single value, list of value and map
A YAML file will start with ---
In playbook, the key is given by ansible and value is provided by user

Example 1: A key storing single value

```
name: play1
hosts: webserver
package: git
file: file1
```

Example 2: A key storing a list of values

```
package:
  - git
  - mysql
  - php
  - wordpress
```

```
  - tree
  - wget
```

Example 3: A key storing again a key and value

```
tasks:
- name: Task1
  command: echo "command1"
- name: task2
  package: name=tree

workflow: name
push:
job1:
  runs-on: ubuntu
  steps:
  - name:
    uses:
  - name:
    runs:
```

Various sections of playbook:
==========

```
- name: Give name to the play
  hosts: give the inventory host group
  tasks:
  - name: give a name to the tasks
    module_name: par1=value par2=value
```

==========

Demo 1: Write a playbook that will use a debug module to print statements

vim playbookDebug.yml

- name: Print a message on Console

```
  hosts: webserver
  tasks:
  - name: Print a welcome message
    debug: msg="Hello form Ansible Controller"
```

```
# ansible-playbook playbookDebug.yml --syntax-check
```

```
# ansible-playbook playbookDebug.yml
```

Register Variables:
==========

Variables : are temporary locations where data is stored.

Whenever a module is executed and you want to store its output we will use ansible Register variable

Register variable will store output of the module that was written just above the register keyword

```
# vim playbookRegister.yml
```

```
- name: Register Variables in ansible
  hosts: webserver
  tasks:
  - name: Print a message
    debug: msg="Run a command"
  - name: Execute command on the host server
```

command: hostname -s
register: command_output
- name: print the register variable value
debug: var=command_output.stdout

Save the file and execute

 # ansible-playbook playbookRegister.yml

```
- name: Debug module in ansible
  hosts: webserver
  tasks:
  - name: Print greetings on the console
    debug: msg="Hello form Ansible controller!"
  - name: Run a Linux command
    command: hostname -s
    register: cmd_output
  - name: Print the register variable value
    debug: var=cmd_output.stdout
~
~
~
```

==========

Execute a playbook to install package and create a file

vim playbook2.yml

- name: Install packages on the worker node

```
  hosts: webserver
  become: true
  become_user: root
  tasks:
  - name: update the apt repo
    command: apt-get update
  - name: install php on hostserver
    package: name=php state=present
  - name: Create a file on hostserver
    file: path=/tmp/myfile state=touch
```

Save the file(:wq!)

ansible-playbook playbook2.yml

==========
Variables in Playbooks:
==========

Variables -> temporary memory locations that store data

To make our playbooks reusable use variables
usign variables, we will be able to pass new data to the parameters in the tasks sections

A variable can store a single value or a list of values
variables can store a string, number, boolean value
Variables are 2 types in ansible - Custom and fact variables

Custom variables:
==========
- Variables created by users
- variable name given by user
- variable value given by user
- These variables can be declared in a playbook or in a sperate file or in a inventory file also
- The variable values can be referred in the tasks section as {{ var_name }}

vim playbookvaraibles.yml

```
- name: Custom Variables in Ansible
  hosts: webserver
  become: true
  become_user: root
  vars:
    pkg_name: git
    pkg_state: present
    file_path: /tmp/mydemo
    file_state: directory
  tasks:
  - name: update the apt repo
    command: apt-get update
  - name: install {{ pkg_name }} on hostserver
    package: name={{ pkg_name }} state={{ pkg_state }}
  - name: Create a directory on hostserver
    file: path={{ file_path }} state={{ file_state }}
```

Save the playbook and run it.

==========

Store the variables in a separate file

vim variables.yml

```
    pkg_name: git
    pkg_state: present
    file_path: /tmp/mydemo
    file_state: directory
```

Save the file (:wq!)

vim playbook4.yml

```
- name: Custom Variables in Ansible
  hosts: webserver
  become: true
  become_user: root
  # vars:  local variables-
  vars_files:
    - variables.yml
  tasks:
  - name: update the apt repo
    command: apt-get update
  - name: install {{ pkg_name }} on hostserver
    package: name={{ pkg_name }} state={{ pkg_state }}
  - name: Create a directory on hostserver
```

```
    file: path={{ file_path }} state={{ file_state }}
```

Save the file and run the playbook

==========

Run the playbook by passing values to the variables at runtime.
Use the option : --extra-vars

```
# ansible-playbook playbook4.yml --extra-vars "pkg_name=maven
pkg_state=absent file_path=/tmp/newdemo file_state=touch"
```

==========

FACT Variables:

==========

Whenever ansible controller connects to its worker nodes Always Ansible will gather complete information or details about each worker node
It will gather information like host details, architecture,network,ipaddress, BIOS information,OS,memory etc etc
This gathered information is called as FACTS

Ansible stores each fact in a variable called as fact variables. These variables are created by Ansible and values are also computed by Ansible

These variables will always start with “ansible_variablebName”

These variable values are computed at runtime

Some of these variable values are unique to each host server

These variables are also called dynamic variables.
The value of the variable changes from host to host

In ansible we have a module called as setup module.

Demo 1: See the fact variables:
==========

 # ansible webserver -m setup
 # ansible webserver -m setup -a "filter=ansible_hostname"
 # ansible webserver -m setup -a "filter=ansible_os_family"
 # ansible webserver -m setup -a "filter=ansible_distribution"
 # ansible webserver -m setup -a "filter=ansible_dist*"

vim playbook5.yml

```
- name: Fact variables in Ansible
  hosts: webserver
  become: true
  tasks:
  - name: install httpd package
    package: name=httpd state=present
    when: ansible_os_family == "RHEL"
  - name: install apache2 package
```

```
    package: name=apache2 state=present
    when: ansible_os_family == "Debian"
```

Save the file and run it

Example 2: When keyword
==========

vim playbookWhen.yml

```
- name: When condition in playbook
  hosts: webserver
  become: true
  tasks:
  - name: install package on Debain machines
    package: name=apache2 state=present
    when: ansible_distribution == "Ubuntu" and
ansible_distribution_major_version == "24"
  - name: Execute a command
    command: hostname -s
    when: (ansible_distribution == "Ubuntu") or
              (ansible_distribution == "Amazon") or
              (ansible_distribution == "RHEL")
```

Save the file and execute the file.

==========

Tags in Ansible Playbook:
==========

Tags allows us to run specific tasks in the playbook
If we want set of tasks to be executed together then we can use tags

 # vim playbookTags.yml

```
- name: Tags in ansible
  hosts: webserver
  become: true
  tasks:
  - name: exeucte a command
    command: echo "Hello All"
    tags: cmd
  - name: execute a command to update apt
    command: apt-get update
    tags: cmd
  - name: Install a package
    package: name=tree state=present
    tags: install
  - name: Uninstall tree package
    package: name=tree state=absent
```

ansible-playbook playbookTags.yml --tags untagged

 # ansible-playbook playbookTags.yml --tags install

 # ansible-playbook playbookTags.yml --tags cmd

 # ansible-playbook playbookTags.yml --tags cmd,install

 # ansible-playbook playbookTags.yml --tags untagged

 # ansible-playbook playbookTags.yml --tags tagged

==========

Day 3: 31-May-2025
==========
Agenda:
> Jinja2 templates
> Handlers
> Ansible Roles
> Dynamic Inventory

==========

Problem statement:
==========
We have to always copy config files on each server
These config files with have:
 -> some common content/code/paramters
 -> some content which is unique to each host server
 So it is not a good practice to manually create unique files for each host server

Solution:
Use Templates in Ansible:
==========
A file with text and data

This data is computed by ansible for every worker node
Ansible will update host server specific data in the template file
Ansible will then copy that unique file to the hosts servers

Ansible will perform this task using Jinja2 templates
==========
Jinja2 is a templating engine present in Ansible
It comes preinstalled in ansible controller
There is no jinja2 on worker nodes
Templating happens only on the controller machine.
A jinja2 template is a file with extension .j2
The jinja2 file consist of :
- plain text
- FACT variables
- Custom Static Variable

When we execute the template Ansible will:
  -> keep the text as it is
  -> it will replace the static variables with their values as given by user
  -> it will replace fact variables with values unique to each host

This way unique config file will be copied on each host server.

==========

Demo:
==========

vim file.config.j2

```
This is my application configuration file
This file is created by {{ author }}
This file is present in directory /etc

hostname = {{ ansible_nodename }}
Ip address = {{ ansible_default_ipv4["address"] }}
OS = {{ ansible_os_family }}

For any concerns send an email to {{ email }}
```

Save the file

vim playbookJinja2.yml

```
- name: Jinja2 templates
  hosts: webserver
  become: true
  vars:
    author: admin
    email: admin@gmail.com
  tasks:
  - name: copy jinja2 file on the host
    template: src=file.config.j2 dest=/etc/file.config
```

Run the playbook

Validate:

ansible webserver -m command -a "cat /etc/file.config"

==========

Demo2:
==========

vim myinventory

[webserver]
18.233.160.220 http_port=80

vim ports.conf.j2

 # If you just change the port or add more ports here, you will likely also
 # have to change the VirtualHost statement in
 # /etc/apache2/sites-enabled/000-default.conf

Listen {{ http_port }}

<IfModule ssl_module>
Listen 443
</IfModule>

<IfModule mod_gnutls.c>
Listen 443
</IfModule>

 # vim: syntax=apache ts=4 sw=4 sts=4 sr noet

Save the above file.

```
# vim 000-default.conf.j2
<VirtualHost *:{{http_port}}>
        # The ServerName directive sets the request scheme,
hostname and port that
        # the server uses to identify itself. This is used when
creating
        # redirection URLs. In the context of virtual hosts, the
ServerName
        # specifies what hostname must appear in the request's
Host: header to
        # match this virtual host. For the default virtual host (this
file) this
        # value is not decisive as it is used as a last resort host
regardless.
        # However, you must set it for any further virtual host
explicitly.
        #ServerName www.example.com

        ServerAdmin webmaster@localhost
        DocumentRoot /var/www/html

        # Available loglevels: trace8, ..., trace1, debug, info, notice,
warn,
        # error, crit, alert, emerg.
        # It is also possible to configure the loglevel for particular
        # modules, e.g.
        #LogLevel info ssl:warn
```

```
        ErrorLog ${APACHE_LOG_DIR}/error.log
        CustomLog ${APACHE_LOG_DIR}/access.log combined

        # For most configuration files from conf-available/, which are
        # enabled or disabled at a global level, it is possible to
        # include a line for only one particular virtual host. For
example the
        # following line enables the CGI configuration for this host
only
        # after it has been globally disabled with "a2disconf".
        #Include conf-available/serve-cgi-bin.conf
</VirtualHost>
```

Save the file

```
# vim playbookapache.yml

- name: Update config files of apache2 server
  hosts: webserver
  become: true
  tasks:
  - name: Update the repo
    command: apt-get update
  - name: Install apache2
    package: name=apache2 state=present
  - name: Copy the update apache2 ports.conf file
    template: src=ports.conf.j2 dest=/etc/apache2/ports.conf
  - name: Copy the updated 000-defualt.conf file
```

```
    template: src=000-default.conf.j2
dest=/etc/apache2/sites-enabled/000-default.conf
  - name: Restart apache2 service
    service: name=apache2 state=restarted
```

Save the file and execute

Validate:

```
# ansible webserver -m command -a "cat /etc/apache2/ports.conf"

#  ansible webserver -m command -a " cat /etc/apache2/sites-enabled/000-default.conf"
```

==========
HANDLERS:
==========

Handlers:
============

When we have a set of tasks to be executed only when required then use handlers
Handlers are executed only when notified by the parent tasks - notify keyword
Handler tasks will be notified only and only when the status of the parent task is changed
IF the parent task status is Ok - ansible will not notify the handler to run
Handlers tasks are execute after all the parent task have been executed

As the task is executed - tasks status is chnaged --notify the handler to run- handler executed at this point
We make use of concept of flush_handlers
Using --force-handlers at runtime - notifed handlers will be executed even if playbook has failed Tasks

Observations:
==========
1. Tasks under the handler section of the playbook are not executed by themselves
2. Even though we have added notify keyword under the parent tasks to notify handlers, however the handlers were not executed
3. Handler tasks though notified multiple times during the play but they will execute only once at the end.
4. Using meta and flush handlers task are executed immediately as they are notified
5. If any task fails in the playbook -> all handlers will not execute even though they have been notified by previous successful task.
Using --force-handlers at runtime - notifed handlers will be executed even if playbook has failed Tasks

vim playbookHandlers.yml

```
- name: handlers in Ansible
  hosts: webserver
  become: true
```

```
  tasks:
  - name: To run a command
    command: echo "Trigger a command"
    notify: Run a command
  - name: Start a service
    command: echo "start service"
    notify: Restart apache2 service
  - name: Create a file
    command: echo "File created"
    notify: File Create
  handlers:
  - name: Run a command
    command: hostname -s
  - name: Restart apache2 service
    service: name=apache2 state=restarted
  - name: File Create
    file: path=/tmp/newfile state=touch
```

Save and execute, handlers will run at the last

Demo : Flush the handlers as they are notified

vim playbookhandlers2.yml

```
- name: handlers in Ansible
  hosts: webserver
  become: true
  tasks:
  - name: To run a command
```

```
    command: echo "Trigger a command"
    notify: Run a command
  - meta: flush_handlers  # all handlers notified till here  will get
executed
  - name: Start a service
    command: echo "start service"
    notify: Restart apache2 service
  - name: Create a file
    command: echo "File created"
    notify: File Create
  handlers:
  - name: Run a command
    command: hostname -s
  - name: Restart apache2 service
    service: name=apache2 state=restarted
  - name: File Create
    file: path=/tmp/newfile state=touch
```

Save and run it.

```
# vim playbookHandlers3.yml

- name: handlers in Ansible
  hosts: webserver
  become: true
  tasks:
  - name: To run a command
    command: echo "Trigger a command"
    notify: Run a command
  - name: Start a service
    command: ech "start service"
```

```
    notify: Restart apache2 service
    ignore_errors: true
  - name: Create a file
    command: echo "File created"
    notify: File Create
  handlers:
  - name: Run a command
    command: hostname -s
  - name: Restart apache2 service
    service: name=apache2 state=restarted
  - name: File Create
    file: path=/tmp/newfile state=touch
```

```
# ansible-playbook playbookHandlers3.yml --force-handlers
```

If any task fails in the playbook -> all handlers will not execute even though they have been notified by previous successful task.
Using --force-handlers at runtime - notifed handlers will be executed even if playbook has failed Tasks

==========

Ansible Roles:
==========

```
# mkdir roles

# cd roles
```

 # ansible-galaxy init apache

 # cd apache

 # ls

 # vim tasks/main.yml

```
- name: Update the repo
  command: apt-get update
- name: Install apache2
  package: name={{ pkg_name }} state=present
- name: Copy the update apache2 ports.conf file
  template: src=ports.conf.j2 dest={{ dest_ports_path }}
- name: Copy the updated 000-defualt.conf file
  template: src=000-default.conf.j2 dest={{ dest_default_path }}
  notify: Restart apache2 service
```

Save the file

```
ansiuser@ip-172-31-22-122:~$ cat roles/apache/tasks/main.yml
---
# tasks file for apache

- name: Update the repo
  command: apt-get update
- name: Install apache2
  package: name={{ pkg_name }} state=present
- name: Copy the update apache2 ports.conf file
  template: src=ports.conf.j2 dest={{ dest_ports_path }}
- name: Copy the updated 000-defualt.conf file
  template: src=000-default.conf.j2 dest={{ dest_default_path }}
  notify: Restart apache2 service

ansiuser@ip-172-31-22-122:~$
```

 # vim vars/main.yml

```
pkg_name: apache2
dest_ports_path: /etc/apache2/ports.conf
dest_default_path: /etc/apache2/sites-enabled/000-default.conf
http_port: 80
```

Save the file

vim templates/ports.conf.j2

```
# If you just change the port or add more ports here, you will likely also
# have to change the VirtualHost statement in
# /etc/apache2/sites-enabled/000-default.conf

Listen {{ http_port }}

<IfModule ssl_module>
        Listen 443
</IfModule>

<IfModule mod_gnutls.c>
        Listen 443
</IfModule>

# vim: syntax=apache ts=4 sw=4 sts=4 sr noet
```

Save the file

vim templates/000-default.conf.j2

```
<VirtualHost *:{{http_port}}>
        # The ServerName directive sets the request scheme, hostname and port that
        # the server uses to identify itself. This is used when creating
        # redirection URLs. In the context of virtual hosts, the ServerName
        # specifies what hostname must appear in the request's Host: header to
        # match this virtual host. For the default virtual host (this file) this
        # value is not decisive as it is used as a last resort host regardless.
        # However, you must set it for any further virtual host explicitly.
        #ServerName www.example.com

        ServerAdmin webmaster@localhost
        DocumentRoot /var/www/html

        # Available loglevels: trace8, ..., trace1, debug, info, notice, warn,
        # error, crit, alert, emerg.
        # It is also possible to configure the loglevel for particular
        # modules, e.g.
        #LogLevel info ssl:warn

        ErrorLog ${APACHE_LOG_DIR}/error.log
        CustomLog ${APACHE_LOG_DIR}/access.log combined
```

```
        # For most configuration files from conf-available/, which are
        # enabled or disabled at a global level, it is possible to
        # include a line for only one particular virtual host. For
example the
        # following line enables the CGI configuration for this host
only
        # after it has been globally disabled with "a2disconf".
        #Include conf-available/serve-cgi-bin.conf
</VirtualHost>
```

Save this file

```
# vim handlers/main.yml

- name: Restart apache2 service
  service: name={{ pkg_name }} state=restarted
```

Save the file

```
# cd
```

Create a playbook to run the role

```
# vim playbookRoles.yml

- name: Roles in ansible
  hosts: webserver
  become: true
  roles:
  - apache
```

Save the file and run the playbook.

==========

Roles Demo 2:

==========

cd roles

ansible-galaxy init servers

cd servers

vim tasks/main.yml

```
- name: Install required software
  package: name={{ item }} state=present
  loop:
  - apache2
  - mysql-server
  - php-mysql
  - php
  - libapache2-mod-php
  - python3-mysqldb
```

Save the file

Create another role

 # cd

 # cd roles

 # ansible-galaxy init php

 # cd php

 # vim tasks/main.yml

```
- name: Install php extensions
  package: name={{ item }} state=present
  loop:
  - php-gd
  - php-ssh2
```

Save the file

Now create another role

 # cd

 # cd roles

 # ansible-galaxy init mysql

 # cd mysql

 # vim tasks/main.yml

```
- name: Create mysql database
  mysql_db: name={{ wp_mysql_db }} state=present
- name: Create mysql user
  mysql_user:
   name={{ wp_mysql_user }}
   password={{ wp_mysql_password }}
   priv=*.*:ALL
```

Save the file

vim defaults/main.yml

```
  wp_mysql_db: wordpress
  wp_mysql_user: wordpress
  wp_mysql_password: wordpress
```

Save the file

Come out of the roles directory

cd

vim playbookRoles.yml

```
- name: Roles in ansible
  hosts: webserver
  become: true
  roles:
  - apache
  - servers
  - php
  - mysql
```

Save and run the playbook

==========

Day 4: Agenda:

==========

- **Ansible Roles**
- **Ansible Vault**
- **Ansible dynamic Inventory**
- **Terraform**

Ansible Vault:

==========

1. **Ansible playbook cannot store data in an encrypted format**
2. **So Ansible comes with a utility called as Ansible vault which can be used to store secrets or passwords in an encrypted format**
3. **Ansible vaults are password protected**

4. **Ansible vaults is tool that will take your plain text and convert it to encrypted data**
5. **An encrypted data can decrypted using vault**
6. **The ansible vault will use an algorithm called as AES256 for encryption of data**
7. **Ansible playbook can refer to the encrypted data in the vault only and only if we provide the vault password while executing the playbook**
8. **Ansible vault utility is present on the controller machine only.**

Demo:

1. **Use ansible vault to create a new encrypted file and store it in the vault.**

 # su - ansiuser

 # ansible-vault create vault1.yml

New Vault password: 123
Confirm New Vault password: 123
Now the file with open, press i to insert data

Confidentials data!

Save the file (:wq!)

Now see the content of the file

 # cat vault1.yml

Demo 2: Use ansible-vault command to view the encrypted data of the file:

 # ansible-vault view vault1.yml

Vault password: 123

You should see actual data

Demo 3: use ansible vault to encrypt data of an existing file

 # echo "Text to be encrypted" >> encrypt_me.txt

 # ansible-vault encrypt encrypt_me.txt

New Vault password: 123
Confirm New Vault password: 123

Encryption successful

 # cat encrypt_me.txt

Demo 4: Use ansible-vault to decrypt an encrypted file:

 # ansible-vault decrypt encrypt_me.txt
Vault password: 123
Decryption successful

 # cat encrypt_me.txt

Execution of Ansible playbook using vault secrets
==========

 # ansible-vault create secrets.yml

New Vault password: 123
Confirm New Vault password: 123

Press i

Give data as:

username: ansible123
password: ansible@123

Save the file

 # vim playbookSecrets.yml

```
- name: use ansible vault to fetch variable values
  hosts: webserver
  become: true
  vars_files:
   - secrets.yml
  tasks:
  - name: Create a user on hostserver
    user: name={{username}} password={{password}}
```

Save the file and run the playbook

 # ansible-playbook playbookSecrets.yml --ask-vault-pass

Ansible Dynamic Inventory

==========

By default in ansible we have a hosts file where we write the list of Ip address of the hosts servers where we have to do the changes.
This file is static where the ip address are fixed, user will manually add new ips or remove Ipaddress that are not required.

But consider a use case where your infrastructure on the cloud and the number of servers are scaling up or scaling down dynamically.

Since the inventory on AWS is dynamic, we cannot hard code the inventory/hosts file on Ansible controller. That will not be correct approach

What is the solution then?

We will take help of Ansible where

- **Ansible will connect to AWS securely**
- **We will use an ansible plugin that will check number of VMs in the desired region on AWS and fetch the ip address or hostnames on the ansible controller machine.**

- **Once ansible collects the ipaddress of the VMs on the cloud it will automatically compute an Inventory file for the user**
- **We will use a command to generate this inventory file**
- **Whenever the command is run Ansible → connect to AWS→ go to desired region → collects IP of available VMs→ displays the inventory file on the controller**
- **Now whenever the user will run the playbook, ansible will use the dynamic inventory and execute the changes on the dynamic VMs**

Steps for 1 st part:

==========

1. **First Prepare Ansible Controller to install packages that required to connect to AWS**
2. **Install the ansible Cloud plugin and update its details in ansible.cfg file**
3. **Create a new inventory file ->The name of the inventory file should always end with aws_ec2.yml**

Steps of Part 2:

1. Create credentials on AWS, so ansible can connect to AWS

2. Create some Ec2 Vms on AWS of which ansible will fetch the inventory details.

Steps of Part3:

1. **Ansible Controller connects to those EC2 servers using SSH**
2. **Ansible controller executes playbook on the server**

Note:

The SDK is composed of two key Python packages: Botocore (the library providing the low-level functionality shared between the Python SDK and the AWS CLI) and Boto3 (the package implementing the Python SDK itself).

https://boto3.amazonaws.com/v1/documentation/api/latest/guide/quickstart.html

Execute below steps:
==========

Whichever user you are logged in with the same user you will install the packages and run the ansible inventory command

 # su - ansiuser

Install ansible aws_ec2 plugins
The plugin is part of the amazon.aws collection
We will install the desired collection

 # `ansible-galaxy collection install amazon.aws`

In order to install boto3 and botocore we need python3-pip package

 # sudo apt install python3-pip

 # pip3 install boto3

 # pip show boto3

 # sudo apt-get update

 # sudo apt-get install awscli -y

Update the ansible.cfg file for it to use the aws_ec2 plugin to fetch the inventory

 # vim ansible.cfg

[defaults]

inventory = /home/ansiuser/myinventory

enable_plugins = aws_ec2

Save the file

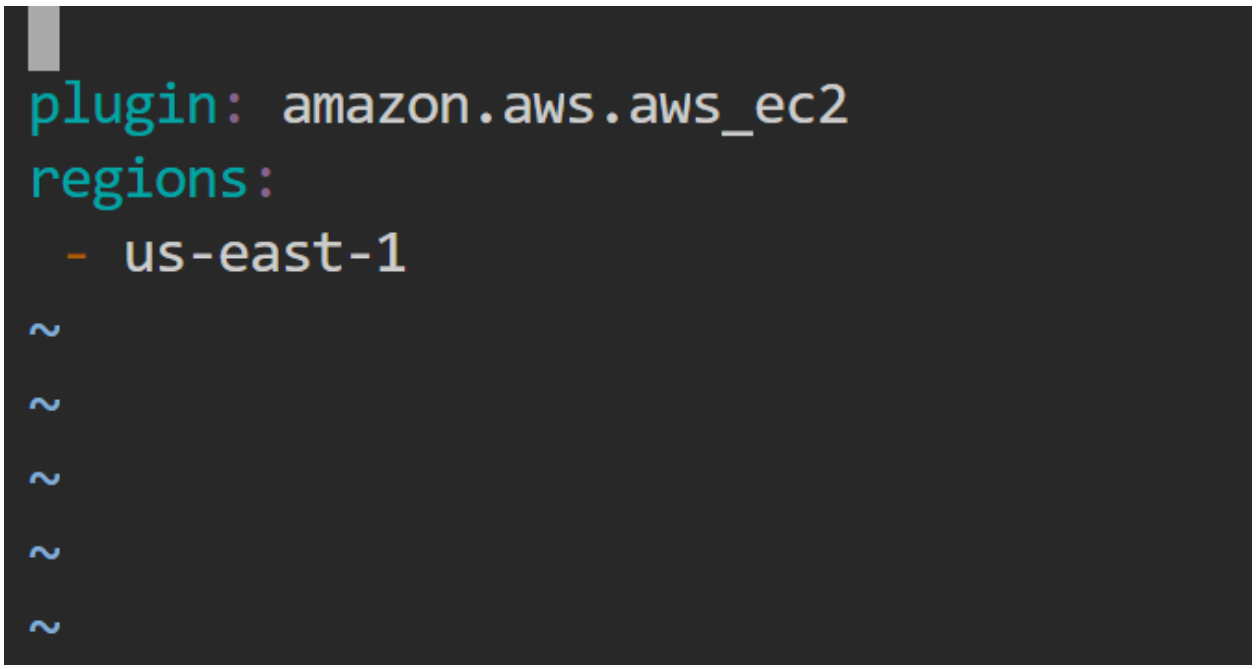
```
[defaults]
inventory = /home/ansiuser/myinventory

enable_plugins = aws_ec2
~
~
~
~
```

Create the aws_ec2 inventory file

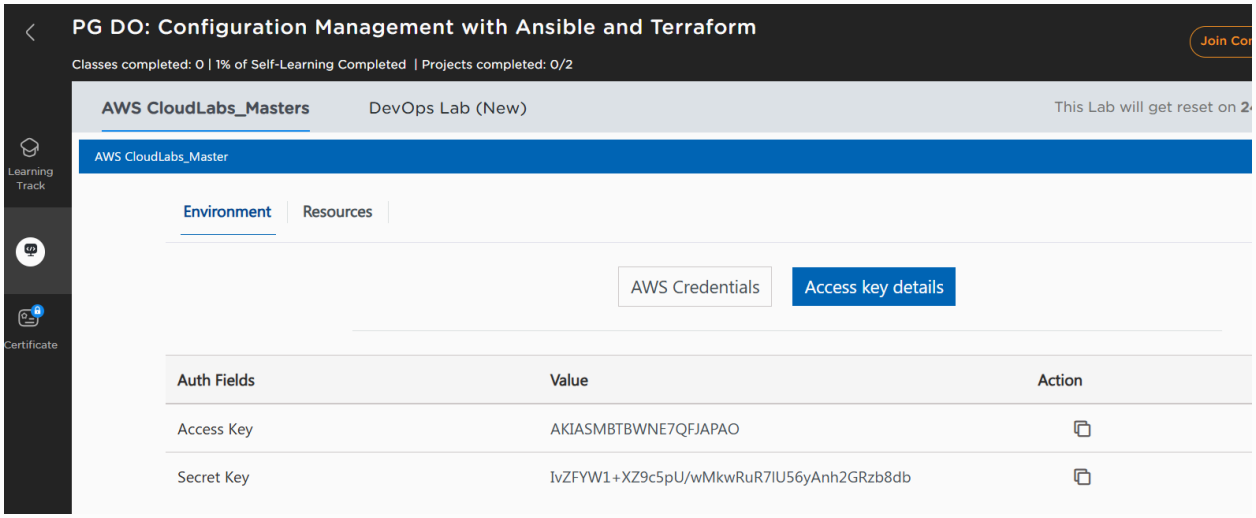
 # vim aws_ec2.yml

```
plugin: amazon.aws.aws_ec2
regions:
 - us-east-1
```

Save the file



Go to AWS LAB AND pick up the accesskey credentials:



On the Ansible Lab:

Take the access key and secret key and save it as environment variables on the Lab:

Run these commands

 # export AWS_ACCESS_KEY_ID=AKIAXYX74ZQAJ2C4XK35
#export AWS_SECRET_ACCESS_KEY=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

Now execute the command to list the inventory:

 # ansible-inventory -i /home/ansiuser/aws_ec2.yml --list

```
ansiuser@ip-172-31-5-209:~$
ansiuser@ip-172-31-5-209:~$ export AWS_ACCESS_KEY_ID=AKIAUJU24ZR3SHDUKZ74
ansiuser@ip-172-31-5-209:~$  export AWS_SECRET_ACCESS_KEY=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
ansiuser@ip-172-31-5-209:~$ ansible-inventory -i /home/ansiuser/aws_ec2.yml --list
[WARNING]: Collection amazon.aws does not support Ansible version 2.12.10
{
    "_meta": {
        "hostvars": {}
    },
    "all": {
        "children": [
            "aws_ec2",
            "ungrouped"
        ]
    }
}
ansiuser@ip-172-31-5-209:~$
```

Create Ec2 instances on AWS

On the master node run the inventory command:

ansible-inventory -i /home/ansiuser/aws_ec2.yml --list

```
                "subnet_id": "subnet-054dac8bc062c8061",
                "tags": {
                    "Name": "AnsibleWorker"
                },
                "usage_operation": "RunInstances",
                "usage_operation_update_time": "2024-07-07T15:28:01+00:00",
                "virtualization_type": "hvm",
                "vpc_id": "vpc-0696fb7329db78a32"
            }
        }
    },
    "all": {
        "children": [
            "aws_ec2",
            "ungrouped"
        ]
    },
    "aws_ec2": {
        "hosts": [
            "ec2-174-129-147-148.compute-1.amazonaws.com",
            "ec2-3-91-81-20.compute-1.amazonaws.com",
            "ec2-34-228-22-225.compute-1.amazonaws.com",
            "ec2-54-196-237-76.compute-1.amazonaws.com",
            "ec2-54-242-112-1.compute-1.amazonaws.com",
            "ec2-54-90-100-196.compute-1.amazonaws.com"
        ]
    }
```

Do these steps as Assignment:

==========

1. Connecting Ansible controller to your cloud machine over SSH

==========

2. Run the Ansible command on the dynamic inventory

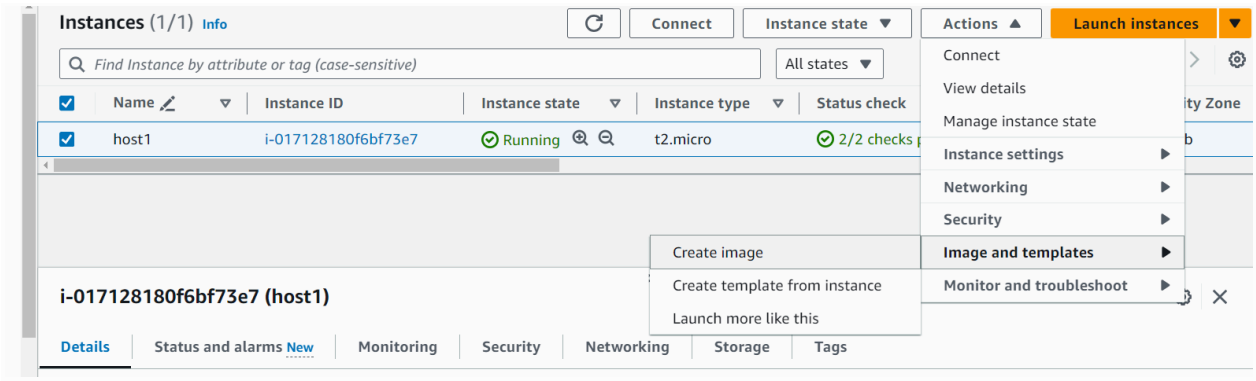
3. If we want to create 10 servers, we would not want to execute steps of creating ansiuser, copying ssh keys and updating config file manually on all server
4. Solution for this is :
    - Take the created ANsible worker to aws that connected to Ansible controller via ssh
    - Convert the node as an AMI
    - So all the worker nodes configuration/softwares/OS/user details will be available as AMI
    - Now we will create new Vms with our custom AMI -> So all the new instances will have
    - Ansible controller SSH keys
    - Will have ansiuser and config file updates

Assignment/homework steps:

==========

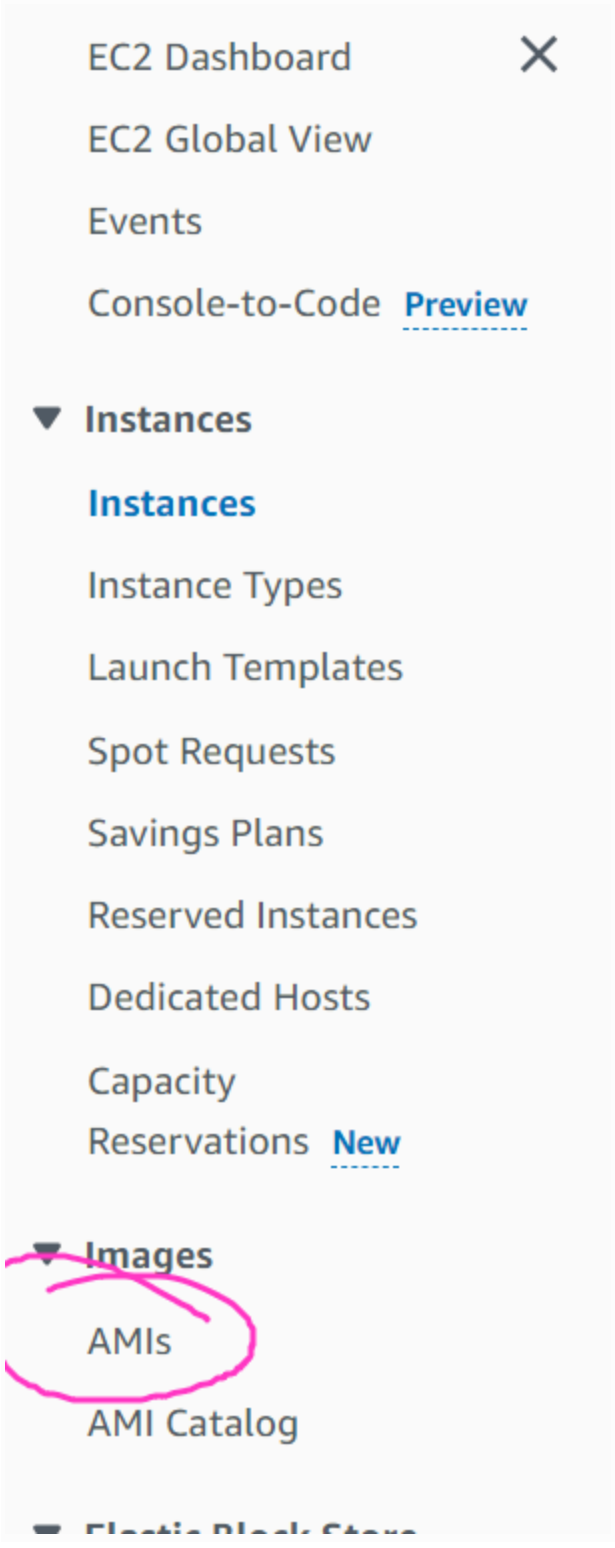
1. Now go to AWS and select your EC2 worker server

   Convert the Ec2 server in to an Image



   Give the Image name as AnsibleHostImage→ click on create Image

   You can see you image by clicking on AMI

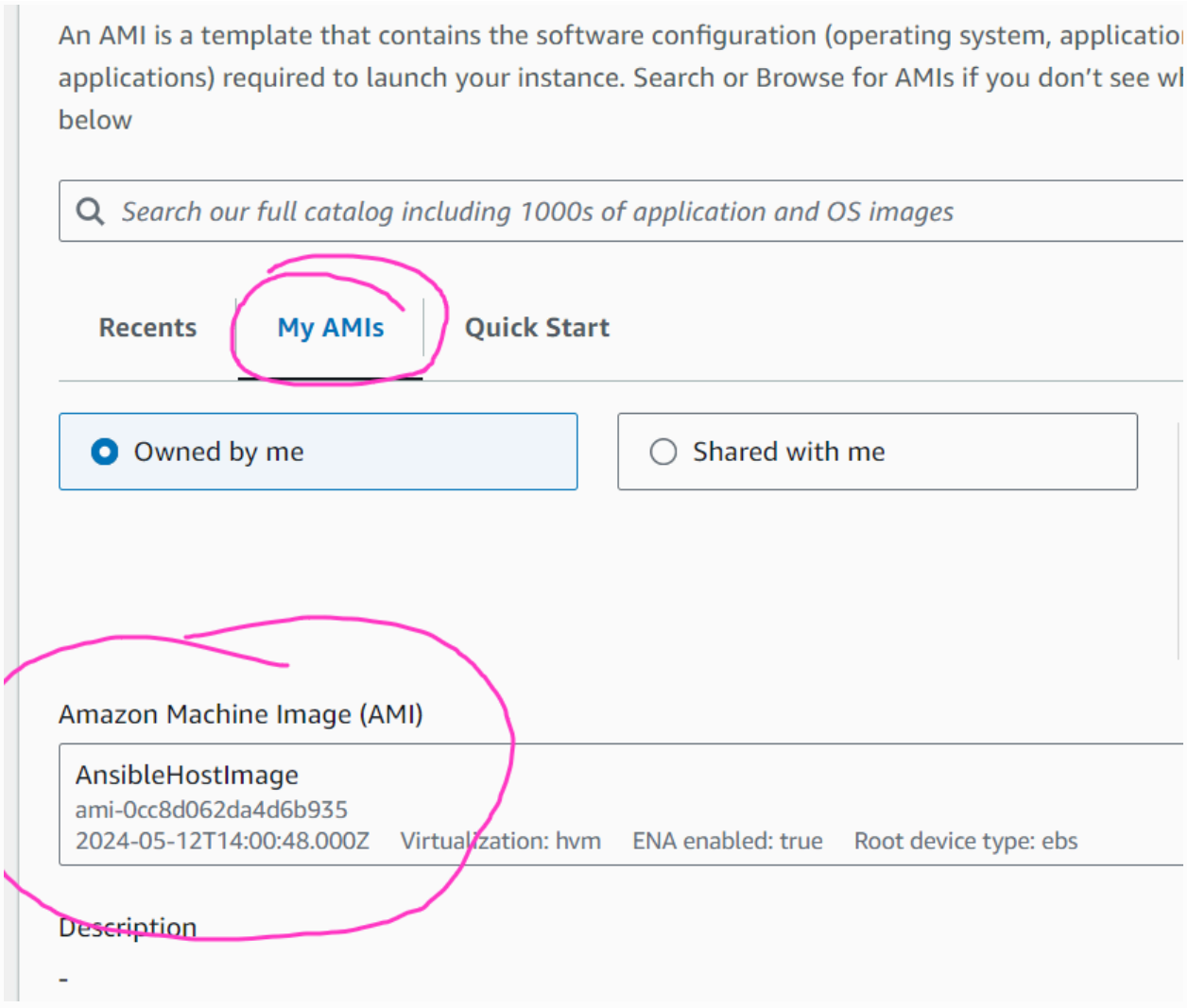

EC2 Dashboard
EC2 Global View
Events
Console-to-Code Preview
Instances
Instances
Instance Types
Launch Templates
Spot Requests
Savings Plans
Reserved Instances
Dedicated Hosts
Capacity Reservations New
Images
AMIs
AMI Catalog

It will take 5 mins to create the AMI

Once the AMi is available.

7. We will now create multiple Instance with the new Image itself

Click on launch Instance → neter the name and selct the AMi that we have created



Launch the instance

8 go to the master node:

 # ansible-inventory -i aws_ec2.yml --list

 # ansible aws_ec2 -i aws_ec2.yml -m ping

==========

Run the playbook

 # vim playbook-dynamic.yml

```
- name: Execute variables from vault
  hosts: aws_ec2
  become: true
  tasks:
  - name: create a user on worker node
    file: path=/tmp/file state=touch
```

Save the file and run it

 # ansible-playbook -i aws_ec2.yml playbook-dynamic.yml

==========

Terraform

==========

Install Terraform on lab:

 # wget -O - https://apt.releases.hashicorp.com/gpg | sudo gpg --dearmor -o /usr/share/keyrings/hashicorp-archive-keyring.gpg

 # echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com $(grep -oP '(?<=UBUNTU_CODENAME=).*' /etc/os-release || lsb_release -cs) main" | sudo tee /etc/apt/sources.list.d/hashicorp.list

sudo apt update && sudo apt install terraform

==========

Terraform Code is always written in the form of blocks:

There are different types of blocks:

- **Provider block**
- **Resource block**
- **Variable block**
- **Output block**
- **Association block**

- **Nested block**
- **Dynamic block**
- **Local block**
- **Provisioner block**
- **Module block**

Type of block “resourceName” “Unique BlockName” {
Desired infra Code
}

1st block is Provider block
==========

Example:

```
provider "aws" {
  region     = "us-west-2"
  access_key = "my-access-key"
  secret_key = "my-secret-key"
}
```

https://registry.terraform.io/providers/hashicorp/aws/latest/docs

Demo 1: Store AWS credentials in a shared credentials file and then use it in the TF config file.
In this way your accesskey and secret key will not be exposed to the outside world.

 # apt-get update

 # apt-get install awscli -y

 # aws configure

Give the valid access key

Give the valid secret key

Press enter, no need to give any region and format option
To verify if the credentials have been set for aws

 # cat ~/.aws/credentials

Now create the provider block for terraform:
==========

 # mkdir myterraformfiles

 # cd myterraformfiles

 # vim aws_infra.tf

```
provider "aws" {
  region = "us-east-1"
  shared_credentials_files =  ["~/.aws/credentials"]
}
```

Save the file and we will install aws provider plugin

terraform init

Demo 3: Create the first resource to create EC2 server via terraform

 # vim aws_infra.tf

Add this block of code

```
resource "aws_instance" "myec2" {

  ami           = "ami-02457590d33d576c3"
  instance_type = "t2.micro"

  tags = {
    Name = "Instance1"
  }
}
```

Save the file.

 # terraform validate

 # terraform plan

terraform apply --auto-approve

terraform destroy --auto-approve

Demo 3:

==========

1. **Write a data block which will filter details and fetch AMI id from AWS**

The fetched Ami id will be present in terraform.tfstate
Data block will not create any resource on AWS.
It is just a block that will filter AWS ami data based on your inputs and fetch it

2. **Pass the fetched AMI ID form data block to aws_instance resource block.**

Add below code in the file

 # vim aws_infra.tf

```
data "aws_ami" "myami" {

most_recent      = true

owners           = ["amazon"]

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


}


resource "aws_instance" "myec2" {

  ami           = data.aws_ami.myami.id
  instance_type = "t2.micro"
```

```
 tags = {
   Name = "Instance1"
 }
```

```
# terraform apply --auto-approve
```

Destroy a specific resource

terraform destroy -target aws_instance.myec2

==========

Variables in Terraform:

==========

Variables are used to store any data

In terraform variables are created using the variable block

A variable can store a single value or a list of values

A variable block can be created with the TF config file or can be created in a separate file

Syntax of variable block:

==========

variable “name_variable” {

default = “variable-value”

}

==========

Demo:

 # sudo su -

 # apt-get update

 # apt-get install awscli -y

 # aws configure

Give the valid access key

Give the valid secret key

Press enter, no need to give any region and format option
To verify if the credentials have been set for aws

 # cat ~/.aws/credentials

 # mkdir myterraformfiles

```
# cd myterraformfiles

# vim variables.tf

variable "region" {

default = "us-east-1"

}

variable "credentials" {

default = "~/.aws/credentials"

}

variable "instance_type" {

default = "t2.micro"
}

variable "env" {

default = "Dev"
}
```

Save the file

vim aws_infra.tf

```
provider "aws" {
  region = var.region
  shared_credentials_files =  [var.credentials]
}



data "aws_ami" "myami" {

most_recent      = true

owners           = ["amazon"]

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


}
```

```
resource "aws_instance" "myec2" {

  ami           = data.aws_ami.myami.id
  instance_type = var.instance_type

  tags = {
    Name = var.env
  }
}
```

Save the file

terraform init

terraform apply

COUNT - META LOOP ARGUMENT

==========

Open the same aws_infra.tf file and update the resource block with highlighted code

vim aws_infra.tf

```
provider "aws" {
  region = var.region
  shared_credentials_files =  [var.credentials]
}



data "aws_ami" "myami" {

most_recent      = true

owners           = ["amazon"]

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


}


resource "aws_instance" "myec2" {

  ami           = data.aws_ami.myami.id
  instance_type = var.instance_type
```

```
count = 5
  tags = {
    Name = "${var.env}-${count.index}"
  }
}
```

Save the file and run it

terraform apply --auto-approve

==========

Terraform Modules:

==========

Modules in terraform are nothing but collection of terraform configuration files that are written in dedicated directories

Modules encapsulates group of resources, variables, output block than this modules can be called again and again to create infrastructure in different directories

In a team one can create modules of various resources and other team members can reuse the module for infra creation.

Modules are reusable terraform code.

There are various types of modules:

- **Root module**
- **Child modules [these are sources in the main.tf file]**
- **Local modules - modules that you write in your local machine and reuse them in your local machine itself**
- **Published modules - modules that are available for free on terraform registry written terraform team**
- **You can also push your local module code to VCS where others can use it. -> published Modules.**

A typical module directory consist :
> TF config file
> variables.tf
> output.tf
> README.md
==========
Demo:
==========

 # cd

 # mkdir modules dev

 # cd modules

```
#  mkdir myec2     ⇒ this is a module name

# cd myec2

# vim myec2.tf


data "aws_ami" "myami" {

  most_recent = true

  owners = ["amazon"]

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

}


resource "aws_instance" "test-ec2" {

ami = data.aws_ami.myami.id
```

```
instance_type = var.instance_type

  tags = {
    Name = "Instance-test"
  }



}
```

Save the file,

```
# vim variables.tf

variable "instance_type" {
default = "t2.micro"
}
```

Save the file

Copy the path of directory

/root/modules/myec2

==========

Now lets call or use the modules in the TF config file:

==========

```
# cd

# cd dev

# vim main.tf

provider "aws" {
  region = "us-east-1"
  shared_credentials_files =  ["~/.aws/credentials"]
}


module "myec2module" {

source = "/root/modules/myec2"



}

module "myec2module-2" {

source = "/root/modules/myec2"
instance_type = "t2.nano"

}
```

Save the file

 # terraform init
This will download the modules in current directory
 # terraform plan
==========

Create a module that will create resources in different regions of AWS

 # cd modules
 # mkdir region_module

 # cd region_module

 # vim region.tf

```
variable "region" {

type = string

}
```

```
provider "aws" {

region = var.region

shared_credentials_files =  ["~/.aws/credentials"]

}

data "aws_ami" "myami"{

most_recent = true

owners = ["amazon"]

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

}

resource "aws_instance" "myec2-1" {
  ami           = data.aws_ami.myami.id
  instance_type = "t2.micro"
```

```
  tags = {
    Name = "terraform1"
  }


}
```

Save the file

The path of module is: /root/modules/region_module

```
# mkdir provider_demo

# cd provider_demo

# vim main.tf


variable "regions" {

type = list(string)

default = ["us-east-1", "us-east-2", "us-west-1"]

}
```

```
module "aws_region_demo" {

source = "/root/modules/region_module"

region = var.regions[0]

}

module "aws_region_demo1" {

source = "/root/modules/region_module"

region = var.regions[1]

}


# terraform init

# terraform plan
```

==========

Dynamic Block

==========

mkdir mydemo2

cd mydemo2

vim sg_aws.tf

```
provider "aws" {
  region = "us-east-1"
  shared_credentials_files =  ["~/.aws/credentials"]
}

variable "sg_ports" {

type = list(number)
```

```
default = [22,443,80,8080]



}




resource "aws_security_group" "mysg" {
  name        = "sl-sg"
  description = "Allow TLS inbound traffic and all outbound traffic"


   dynamic "ingress" {
    for_each = var.sg_ports
    iterator = ports
    content{
    from_port        = ports.value
    to_port          = ports.value
```

```
    protocol         = "tcp"

    cidr_blocks      = ["0.0.0.0/0"]



  }

}
```

```
}
```

```
# terraform init

# terraform plan

================================================

Variable of type Object

================================

# vim demo1.tf
```

```
variable "ec2_data" {


type = object ({
  name = string
  instancetype = string
  instance = number
})


default = {


 name = "Dev"
 instancetype = "t2.micro"
 instance = 2
```

```
}

}

data "aws_ami" "myami"{

most_recent = true

owners = ["amazon"]

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

```
}


resource "aws_instance" "myec2-1" {
  ami           = data.aws_ami.myami.id
  instance_type = var.ec2_data.instancetype
  count = var.ec2_data.instance
  tags = {
    Name = var.ec2_data.name
  }
}


# terraform init
# terraform plan
==========================================
```

```
# mkdir mydemo2

# cd mydemo2

# vim variables.tf
```

variables.tf

```
variable "ec2_object"{

type = map(object ({

  name = string

  Instancetype = string

}))

default = {

  "dev-env"= {

  name = "dev01"

   Instancetype = "t2.micro"
```

```
},

"test-env"= {

name = "test"

 Instancetype = "t2.medium"



},

"prod-env"= {

 name = "prod01"

 Instancetype = "t2.large"



}

}

}
```

Save the file

```
# vim main.tf

provider "aws" {



region = "us-east-1"



shared_credentials_files =  ["~/.aws/credentials"]



}



data "aws_ami" "myami"{



most_recent = true



owners = ["amazon"]
```

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

}
```

```
resource "aws_instance" "myec2-1" {
  ami           = data.aws_ami.myami.id
  for_each = var.ec2_object
  instance_type = each.value.Instancetype

  tags = {
```

```
    Name = each.value.name

  }

}
```

Save the file

```
# terraform init

# terraform plan
```

==========

Setup the lab by installing terraform and setting up AWS credentials

==========

Install Terraform on lab:

```
# wget -O - https://apt.releases.hashicorp.com/gpg | sudo gpg
--dearmor -o /usr/share/keyrings/hashicorp-archive-keyring.gpg

# echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com $(grep -oP
'(?<=UBUNTU_CODENAME=).*' /etc/os-release || lsb_release -cs) main" | sudo tee /etc/apt/sources.list.d/hashicorp.list

# sudo apt update && sudo apt install terraform -y
```

==========

Store AWS credentials in a shared credentials file and then use it in the TF config file.

In this way your accesskey and secret key will not be exposed to the outside world.

 # apt-get update

 # apt-get install awscli -y

 # aws configure

Give the valid access key

Give the valid secret key

Press enter, no need to give any region and format option

To verify if the credentials have been set for aws

 # cat ~/.aws/credentials

==========

Agenda:

==========

Provisioners

- Local-exec provisioner
- Remote-exec provisioner

Backup of Terraform state file

Enables logs in terraform

==========

Provisioners:

==========

If we want terraform to execute any command on the current local machine or on a remote server than we make use of provisioner block

Provisioner block is written inside a resource block

There are 2 types of provisioner blocks:

1. Local-exec
2. Remote- exec

Using local-exec provisioner, you can run any command on the local machine

==========

Demo:

==========

```
# mkdir myterraformfiles
# cd myterraformfiles
# vim aws_infra.tf
```

aws_infra.tf

```
provider "aws" {

region = "us-east-1"
shared_credentials_files =  ["~/.aws/credentials"]
```

```
}

resource "null_resource" "local_cmd"{

provisioner "local-exec" {

command = "echo 'Hello from terraform' > ./myfile.txt"


}

}

resource "tls_private_key" "mykey" {
  algorithm = "RSA"
}

resource "aws_key_pair" "aws-key" {
  key_name   = "web-key"
  public_key =
tls_private_key.mykey.public_key_openssh

 provisioner "local-exec" {
```

```
command = "echo
'${tls_private_key.mykey.private_key_pem}' >
./web-key.pem"


}


}
```

Save and run the commands

```
# terraform init

# terraform apply --auto-approve
```

Check if files have been created in local directory
Check if key is created in AWS

==========

Remote-exec provisioner:

==========

In the same directory as that of local exec , add a new file

vim myinfra.tf

```
resource "aws_vpc" "sl-vpc" {

cidr_block = "10.0.0.0/16"

tags = {
    Name = "sl-vpc"
  }

}


resource "aws_subnet" "sl-subnet" {

  vpc_id     = aws_vpc.sl-vpc.id

  cidr_block = "10.0.1.0/24"

  depends_on = [aws_vpc.sl-vpc]

  map_public_ip_on_launch = true
```

```
  tags = {
    Name = "sl-subnet"
  }
}

resource "aws_route_table" "sl-route-table" {
  vpc_id = aws_vpc.sl-vpc.id

 tags = {
    Name = "sl-route-table"
  }
}

resource "aws_route_table_association" "a" {
  subnet_id      = aws_subnet.sl-subnet.id
  route_table_id = aws_route_table.sl-route-table.id
}


resource "aws_internet_gateway" "gw" {
  vpc_id = aws_vpc.sl-vpc.id
  depends_on = [aws_vpc.sl-vpc]
  tags = {
    Name = "sl-gw"
```

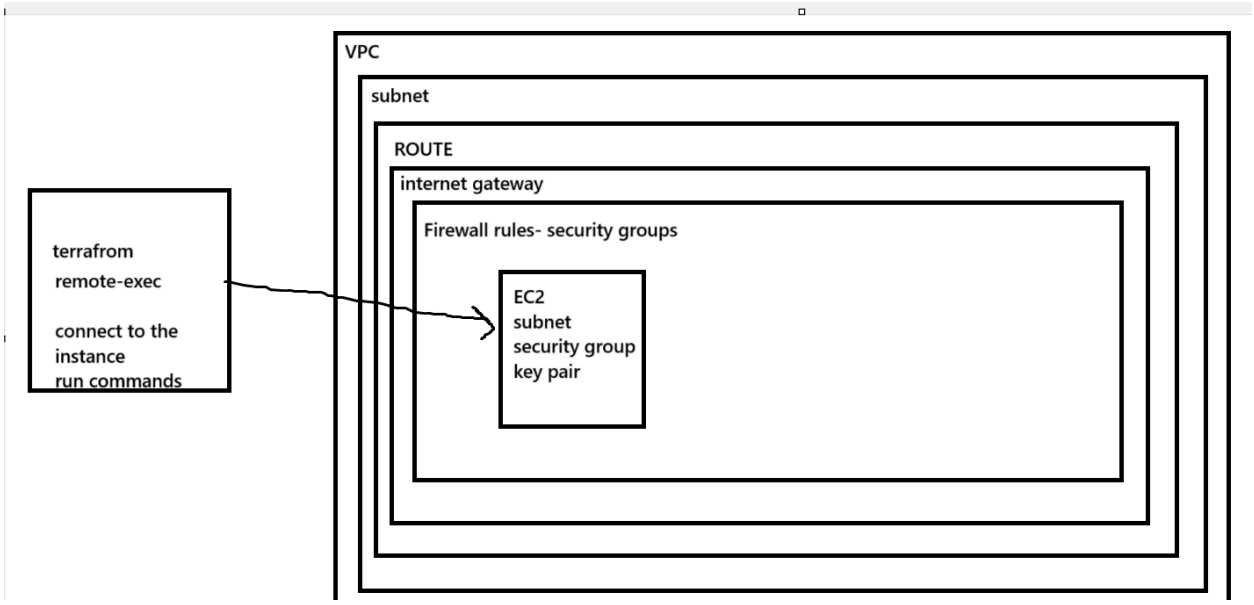
```
  }
}


resource "aws_route" "sl-route" {
  route_table_id            =
aws_route_table.sl-route-table.id
  destination_cidr_block    = "0.0.0.0/0"
  gateway_id = aws_internet_gateway.gw.id

}

variable "sg_ports" {

type = list(number)

default = [22,443,80,8080]

}

resource "aws_security_group" "sl-sg" {
  name        = "sl-sg"
  description = "Allow TLS inbound traffic and all
outbound traffic"
  vpc_id = aws_vpc.sl-vpc.id
```

```
   dynamic "ingress" {
    for_each = var.sg_ports
    iterator = ports
    content{
    from_port        = ports.value
    to_port          = ports.value
    protocol         = "tcp"
    cidr_blocks      = ["0.0.0.0/0"]

  }
}

    egress {
    from_port        = 0
    to_port          = 0
    protocol         = "-1"
    cidr_blocks      = ["0.0.0.0/0"]


      }

}


data "aws_ami" "myami" {
```

```
most_recent      = true

owners           = ["amazon"]

 filter {
    name   = "name"
    values =
["amzn2-ami-kernel-5.10-hvm-2.0.20250610.0-x86_64-
gp2"]
  }


}

resource "aws_instance" "myec2" {

  ami           = data.aws_ami.myami.id
  instance_type = "t2.micro"
  key_name = "web-key"
  subnet_id = aws_subnet.sl-subnet.id
  security_groups = [aws_security_group.sl-sg.id]
  tags = {
    Name = "terraform-instance"
  }
```

```
  provisioner "remote-exec" {

     connection {
      type = "ssh"
      user = "ec2-user"
      private_key =
tls_private_key.mykey.private_key_pem
      host = self.public_ip

                }

     inline = [
      "sudo yum install git -y",
      "sudo yum install httpd -y",
      "sudo systemctl start httpd",
      "sudo systemctl enable httpd"

      ]

 }


}

# terraform init
```

terraform apply --auto-approve



==========

Manage terraform State File:

==========

Terraform we do create or update resources -> we will find a terraform state file created or updated automatically

What ever infrastructure that terraform creates it will be recorded in the terraform state file

In which ever folder we run the terraform command → same folder terraform state file will be present

The terraform state file is created in JSON format storing all parameters of resources created in AWS

The terraform state file is a Private API
==========

The state file format is a private API that is meant to be used with in Terraform only

We should never manually update the terraform state file, it should be automatically managed by Terraform. If we have to do any changes on the terraform state file it is recommended to use terraform state command or terraform import command

It is always better to take back of the terraform state file:
==========
> if we are using terraform for personal practice or use then we can maintain the state file in our local machine itself.

But if we are using terraform with multiple team members in a real time project then in that case:
> we will have to maintain the state file in a shared storage or location so that each team member can access the same terraform state file

> But if multiple people try to run terraform command using the same state file,
then we will get into errors related to state file locking

> Also when multiple people are using the same state file than we may have more 1 person updating the same infrastructure, so we will get conflicts or our file may have data loss or may be corrupted

> this can be resolved by isolating the environments for each team member and each one of them having their copy of state file

The solution could be:
==========

The most common solution is -> to place the file in the version control tool along with the terraform code.

However this may also lead to major issues:

Manual error -> team members may pull the latest code and state file.. Make changes but may forget to push the changes to the VC tool
In VC tool when the team members pull the changes there is concept of lock in VC tool..
Now both the team members may be running the same state file
There are chances that we may expose sensitive data via state file in VC tool

Storing State files in VC tool is not the best solution.

So some other solutions could be:

Using terraform built-in support for remote backends
Remote backends determines how terraform loads and stores the state files
We have been using this default backend in terraform so far,
but that was local backends which has been storing your state file in local disk or directory

Terraform remote backends allows us to store the state file in a remote shared store.
For example in Amazon S3, Azure storage, GCP storage, terraform cloud

Using the remote backend storage we will be able to resolve:

Manual errors: With remote backend, terraofrm will by itself update the state file on remote storage when ever you run terraform apply command
So there is no chance of manual errors.

Locking: Most of the remote backend storage supports Locking. When anybodys run terraform apply command,
terraform will automatically acquire a lock on the state file,
so now if someone else runs a terraform apply, the user will have to wait as the state file is locked.
Here, we can also add a -local-timeout=10 mins parameter to instruct terraform to wait up to 10 mins for the local to be released and then run the next terraform apply

Secrets: Most of the backends store supports encryption in transit and encryption in the state file

Also all the storage on remote also are secure and one should have correct permissions and roles to access the storage

We will use AMazon S3 (Simple storage service) bucket to store out state files remotely.
The reason being:

We already using this provider in our terraform configuration, so no special set up is needed
We already know that S3 bucket is designed in such a way that it is 99.999% always available, which means we dont have to worry about data loss or outages
Its supports encryption so we can easily manage sensitive data
It supports locking of state file using dynamo DB
It supports versioning of the state file, so you can always roll back to older versions if something goes down.
It is inexpensive and available in AWS for free
==========

Demo:

```
# mkdir statedemo
# cd statedemo

# vim state-demo.tf

provider "aws" {
  region = "us-east-1"
  shared_credentials_files = ["~/.aws/credentials"]

}

resource "aws_s3_bucket" "terraform-state" {
  bucket = "terraform-s3-bucket-state-file"
  lifecycle{
   prevent_destroy = true

}
}

resource "aws_s3_bucket_versioning"
"versioning_example" {
  bucket = aws_s3_bucket.terraform-state.id
  versioning_configuration {
    status = "Enabled"
```

```
  }
}

resource
"aws_s3_bucket_server_side_encryption_configuration
" "example" {
  bucket = aws_s3_bucket.terraform-state.id

  rule {
   apply_server_side_encryption_by_default {
       sse_algorithm     = "AES256"

}
}
}


resource "aws_s3_bucket_public_access_block"
"example" {
  bucket = aws_s3_bucket.terraform-state.id

  block_public_acls       = true
  block_public_policy     = true
  ignore_public_acls      = true
  restrict_public_buckets = true
```

```
}
resource "aws_dynamodb_table" "terraform-local" {
  name           = "terraform-state-table"
  billing_mode   = "PAY_PER_REQUEST"
  hash_key  = "LockID"
  attribute{
    name = "LockID"
    type = "S"

   }

}



#  terraform init
# terraform apply
```

Open the same file and add the backend information

```
terraform {
  backend "s3" {
    bucket = "terraform-s3-bucket-state-file"
    key    = "global/s3/terraform.tfstate"
    region = "us-east-1"
```

```
    dynamodb_table = "terraform-state-table"
    encrypt = true
  }
}
```

```
#  terraform init
```

Give yes

Go to aws → search for s3 bucket -> you will see your bucket.

==========

Terraform Cloud:

==========

- Hashicorp provides terraform as a service over the internet which we call as Terraform cloud
- This service is provided with terraform enterprise, however we do have a community version for trial
- On terraform cloud we can login with our gmail account and run our terraform config files
- TF cloud can securely connect to AWS using the provided access key and secret key and create/delete/update infra

- The TF code can be written in local IDE and then maintained in github or VC tool
- TF cloud can connect to VC tool fetch code and run it
- TF cloud will maintain the version of your TF state file and backup of the TF state file
- TF cloud we can create variables of type environment variables or secret variables to store data that will be passed to TF code at runtime
- TF cloud supports creation of workspaces where you can use the same TF config to create infra that is available for different environments like Test, dev, prod. Each workspace is unique and will have its own TF state file
- TF cloud they provide us execution history of terraform init, plan or apply command
- In TF cloud we create projects and we can run TF config file, it can be considered like a container
- TF cloud we can implement RBAC where we can created team, team members and give them roles and permissions.

Features of Terraform Cloud:
==========

1. Organization:

   Organization on TF cloud is a set of projects that can called as a logical environment where we will maintain our configuration file, state file, variables and history
2. Workspaces in terraform:
   Workspaces helps us to isolate TF state files for each environment
   Can be considered as isolated folders for each environment
   They can be considered like git branches
   They are just logical directories that helps us to manage multiple deployments of the same configuration file.
3. Remote State & execution:
   TF cloud we maintain the state file centrally, this state file is version controlled and encrypted. SO there is no need to take backup in S3 bucket and dynamo DB
4. On the dashboard it clearly visible of resource that will created and its cost on AWS
5. Integration with VCS
   As we update they github repo with new TF code, immediately the code will run and latest infra will be created on AWS

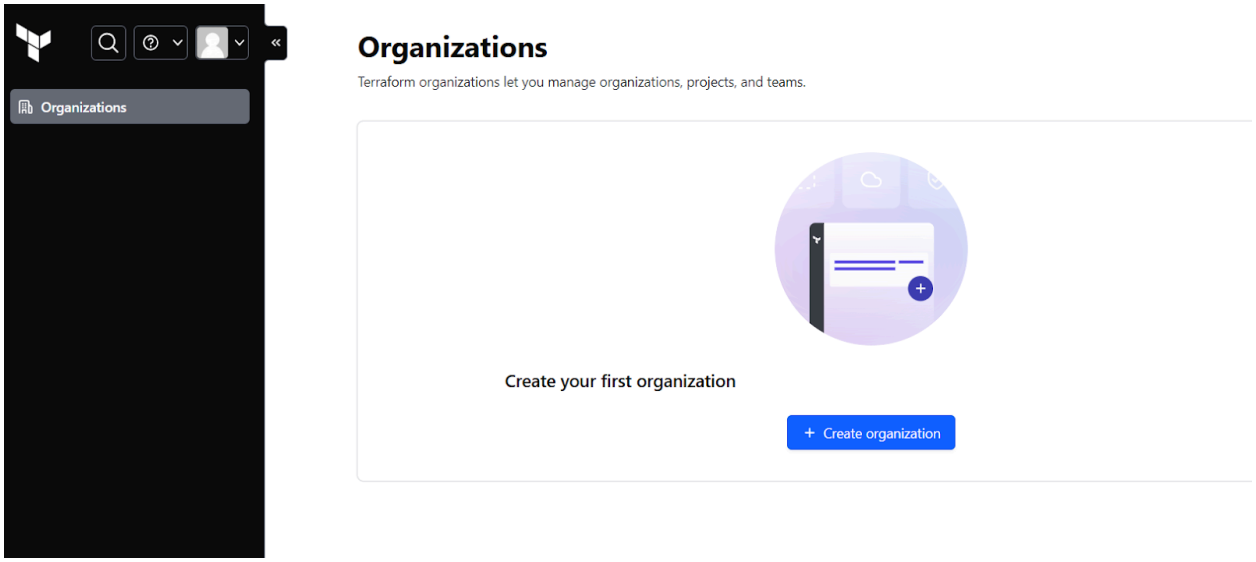
6. Policy enforcement:
   TF cloud implements Sentinel policies which are conditions to be checked before infra is created in AWS
7. TF cloud allows to share our modules with the other workspaces in the organization
8. Displays the Run history and audits logs
9. TF cloud comes with a free version with limited features however we also have a complete enterprise version of TF cloud.

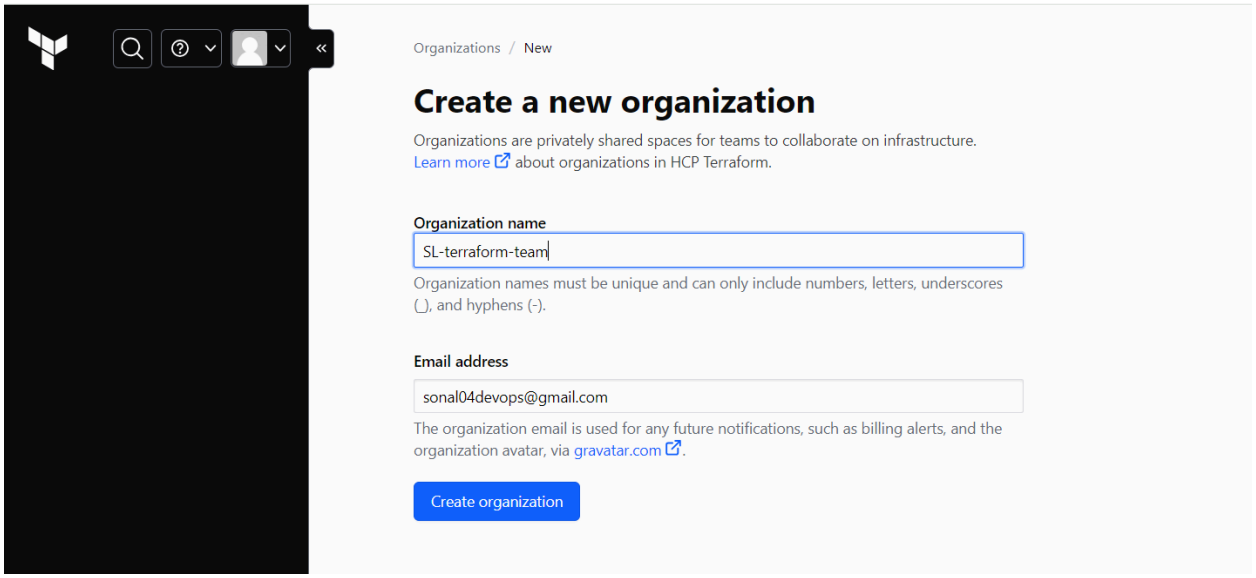
Demo:
==========
Go to this URL and login with your valid Gmail id

https://app.terraform.io/public/signup/account

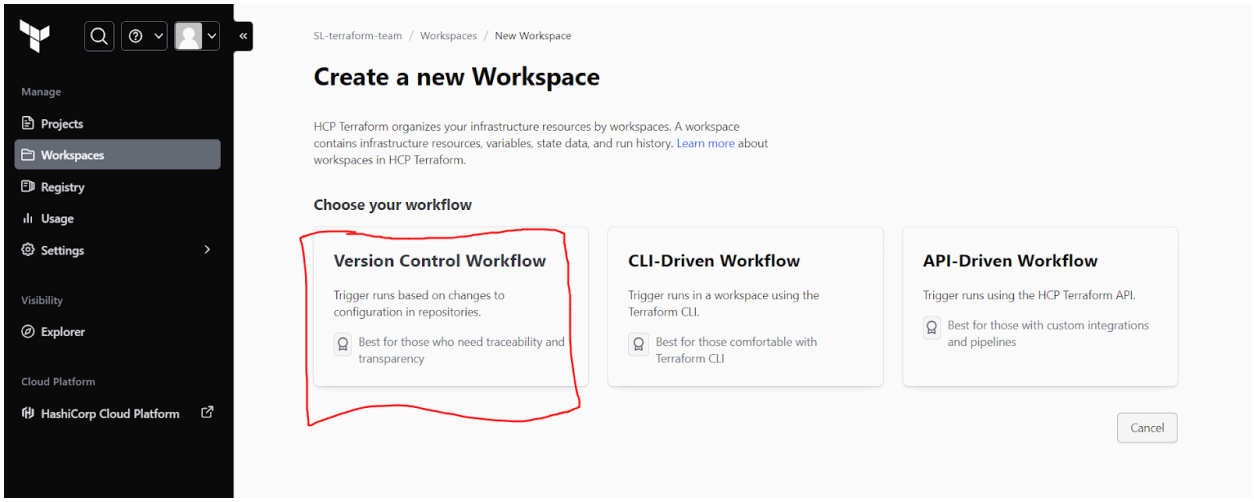
You will be on organizations pge

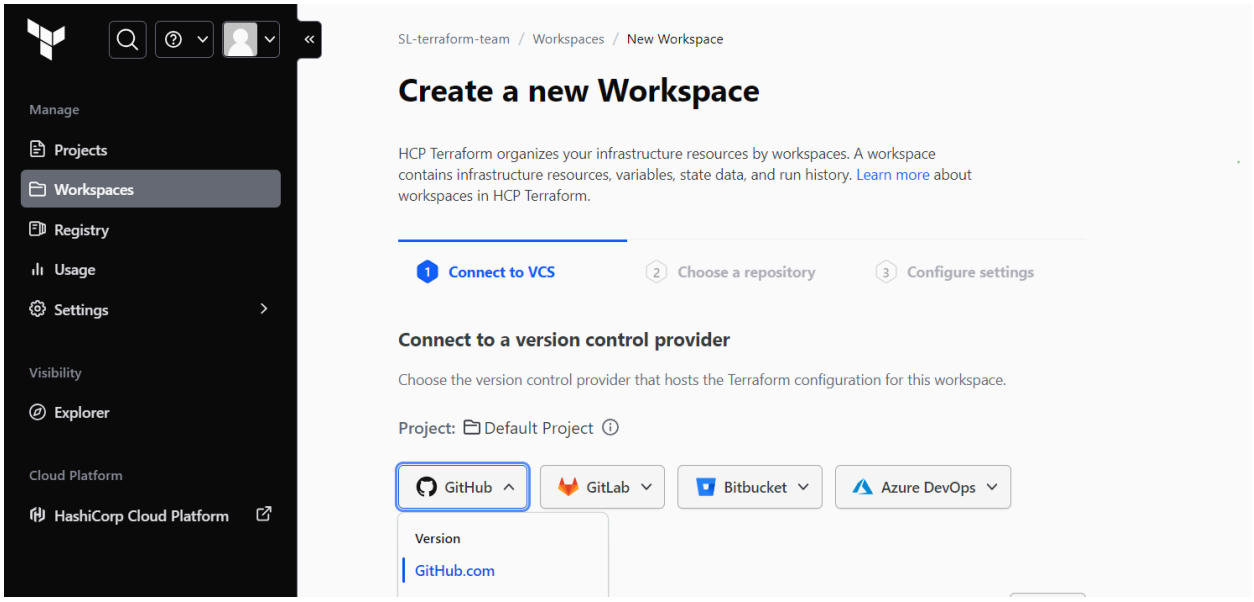
Create organization



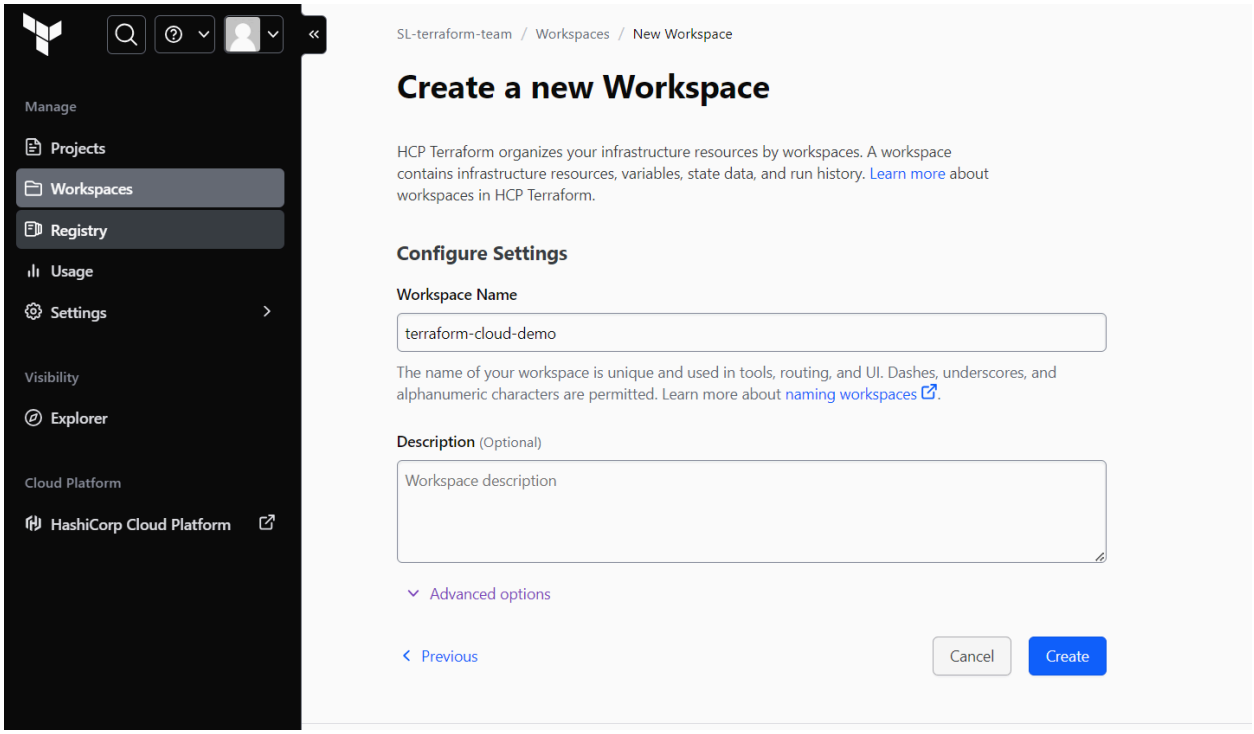


You will be on workspace page
Click on version control workflow

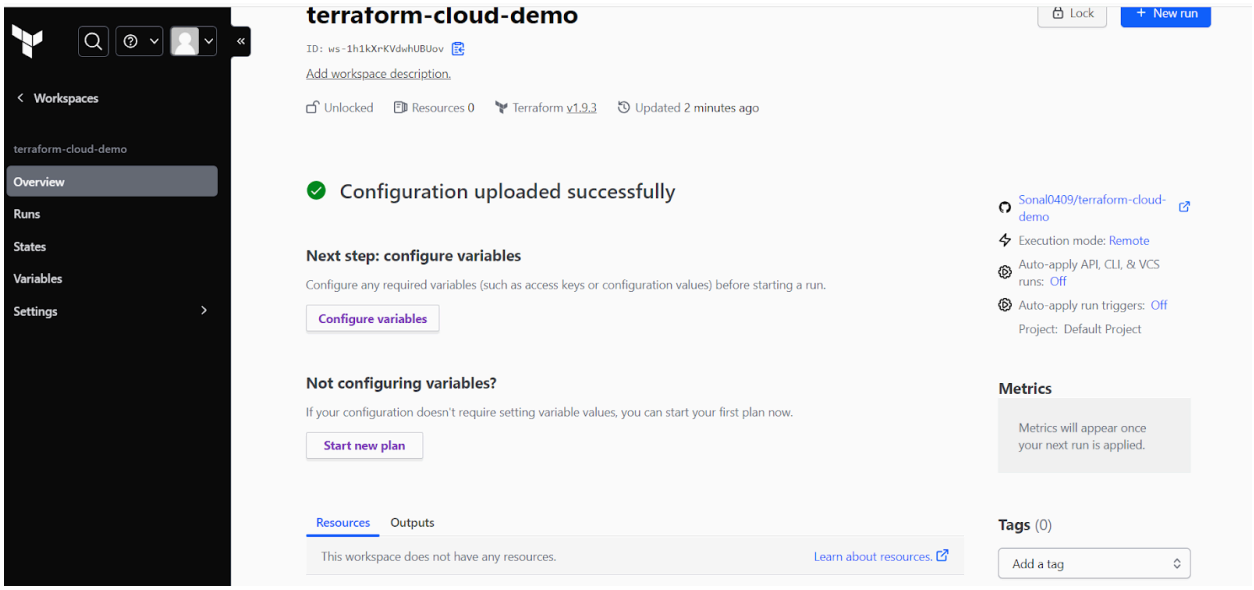




Select github.com→ select your repo→ click on the repo name → you will on configure settings



Click on continue to setup workspace



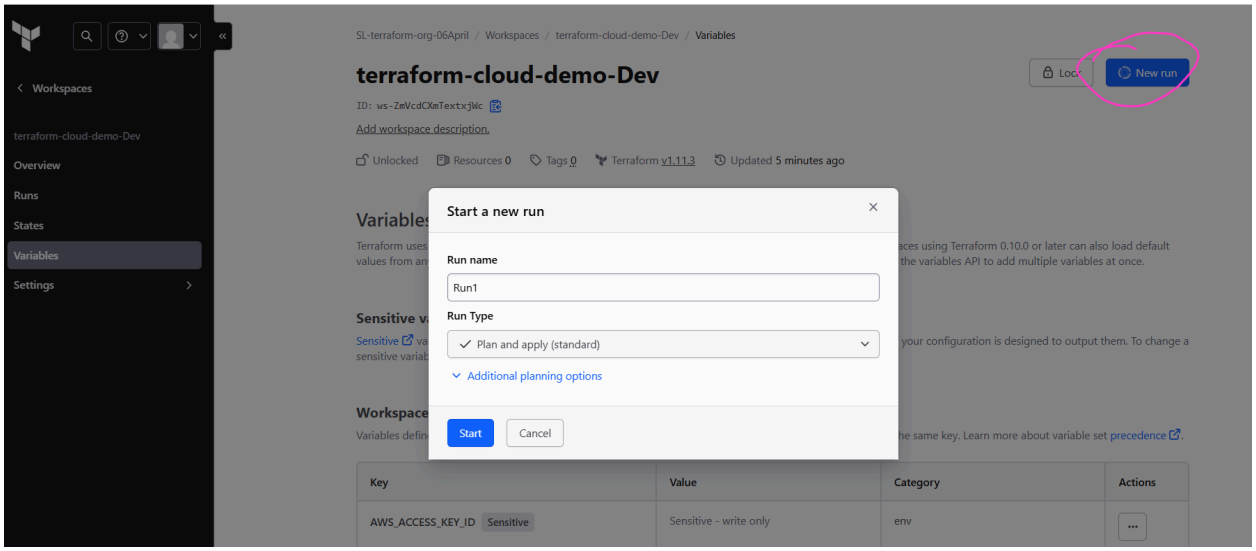
Click on configure variables → Click on add variable→ select environment

Give key as : AWS_ACCESS_KEY_ID
Value as accesskey id create din aws
Select sensitive

Click on add variable

Give key as : AWS_SECRET_ACCESS_KEY
Value as secret key created in aws
Select sensitive
Click on add variable

Now lets click on new run → Give run name →click on start



Sentinel Policy:
==========

It is a powerful method of adding governance rules in the terraform Cloud
These allow organization or workspace to setup rules that have be passed when a terraform run is triggered
Sentinel Policy are rules that ensure correct infra is provisioned.

Sentinel Policy:policy as a code- framework developed by hashicorp
Readymade code for Sentinel Policy is available for aws cloud , we just have to integrate our Sentinel Policy code with the TF cloud organization.

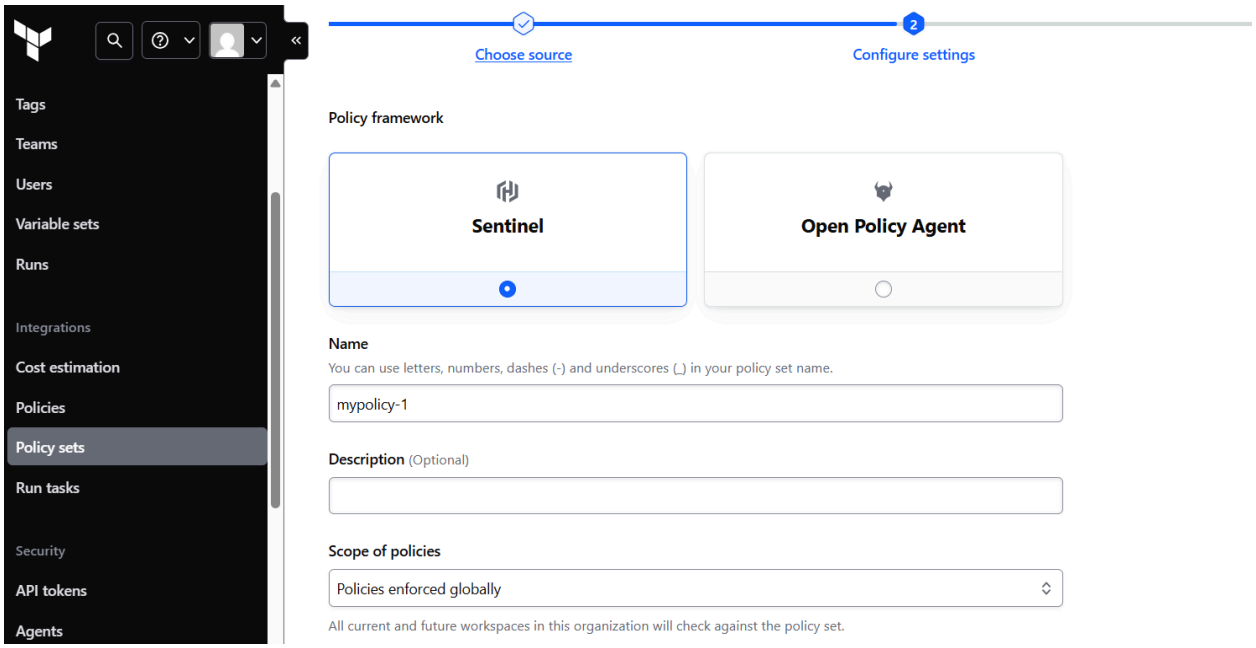
Sentinel Policy tightly integrates with your workspace plan during the runs

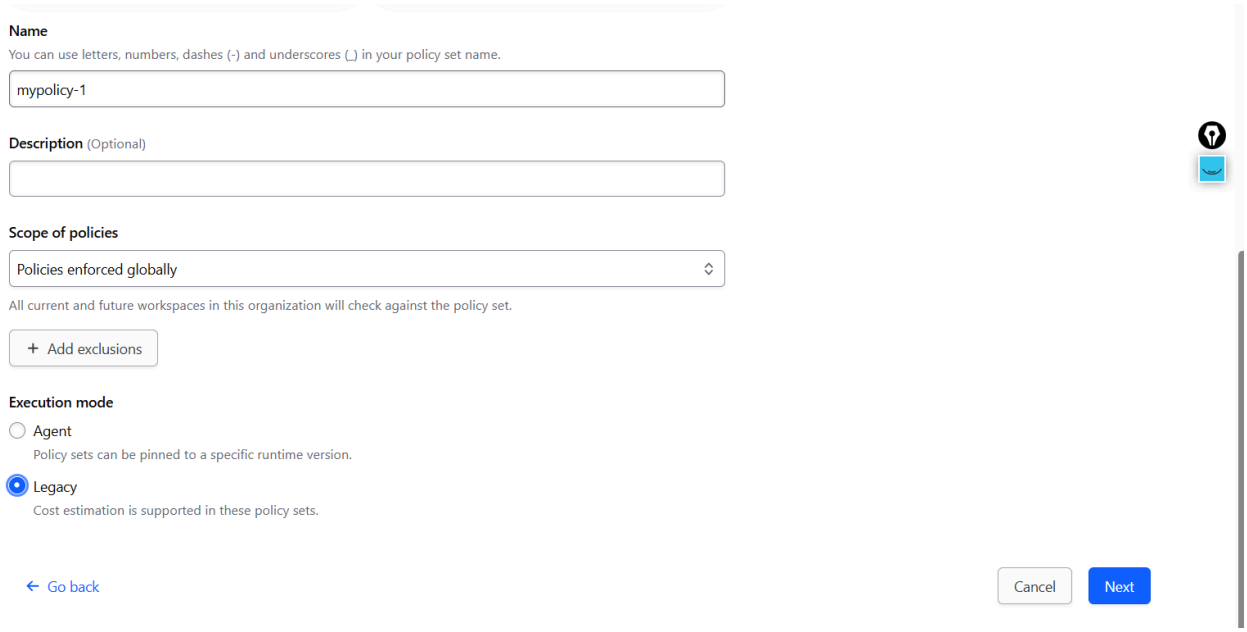
Sentinel policies have to be applied:
==========

1. **When we want to enforce naming conventions**
2. **We want to restrict infra creation to specific regions**
3. **We want to restrict resources type**
4. **We want to restrict instance types**
5. **We want to ensure correct tags are given to resources**
6. **To restrict certain user to only run in a workspace.**

Demo: Sentinel policy creation for an organization in TF cloud

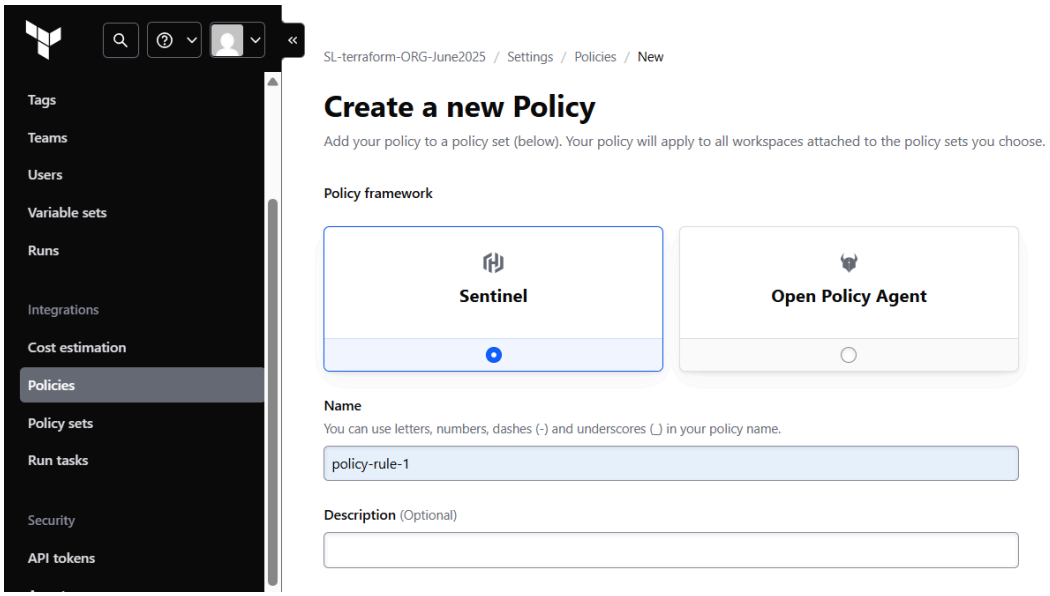
Go to organization → go to settings → go to policy sets Click on new policy set → click on Individaully managed policy → Add below details

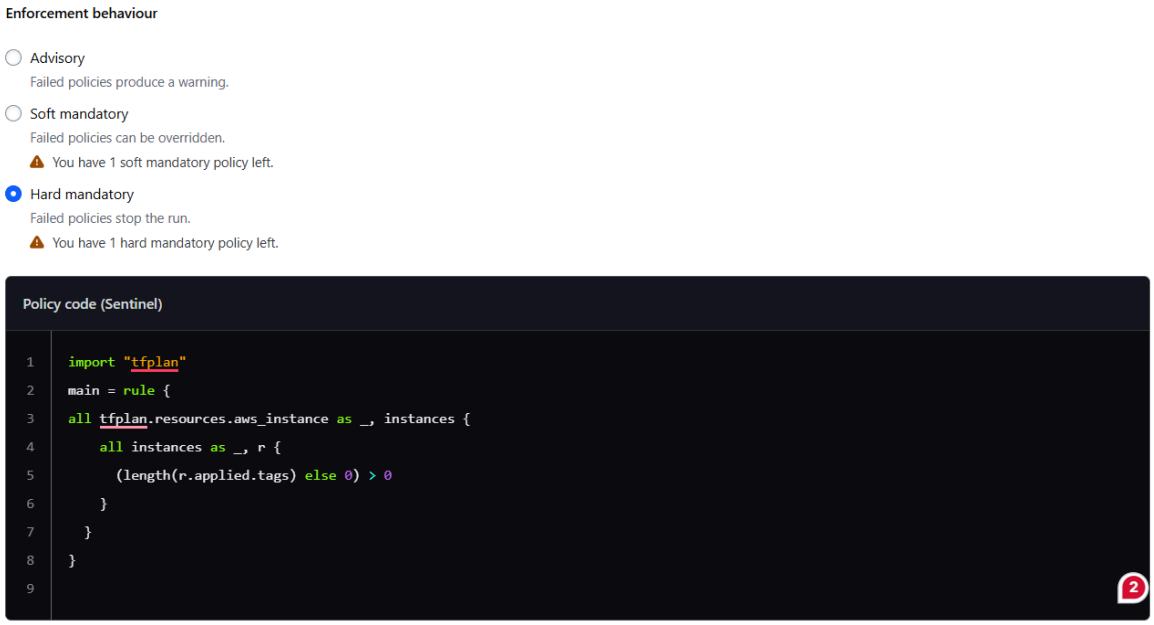




Press next → click on connect policy set

Now go to policy on left side→ click on create policy -> select sentenil -> give a name





Add the below code

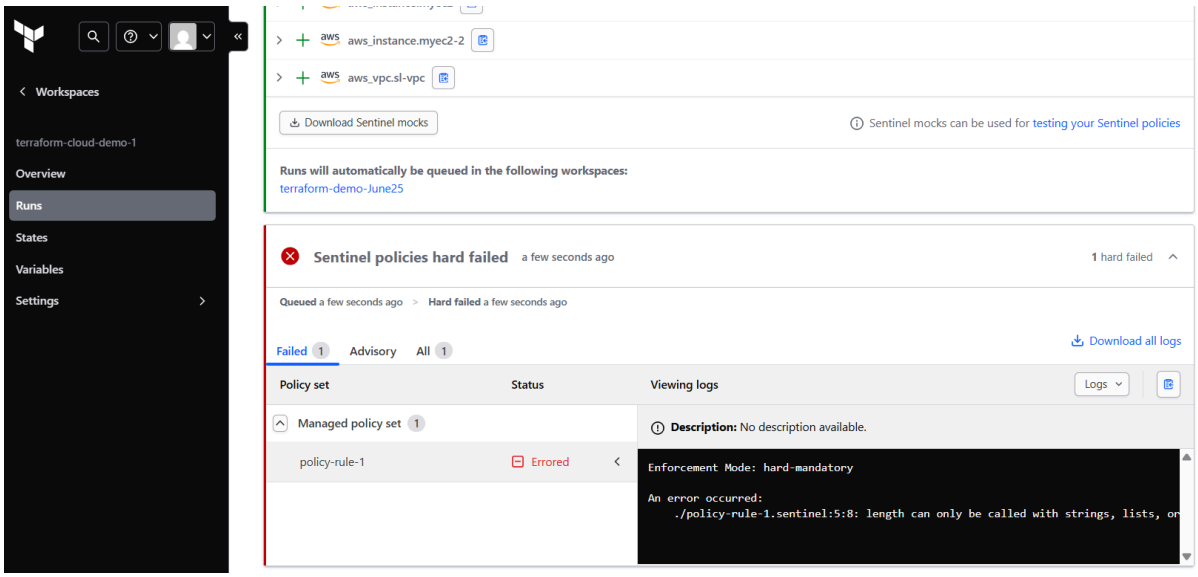
```
import "tfplan"
main = rule {
all tfplan.resources.aws_instance as _, instances {
      all instances as _, r {
     (length(r.applied.tags) else 0) > 0
      }
 }
```

}

Select the policy set → click on add policy set →Click on Create policy

Now go to github repo→ remove tags from the aws instance resource block

Go to Workspace in TF cloud →automatically the run will start → sentinel policy will fail and tag is not available



Add this new code for applying rules for allowed instance type:

```
import "tfplan"

# Get all AWS instances from all modules
get_aws_instances = func() {
    instances = []
    for tfplan.module_paths as path {
        instances +=
values(tfplan.module(path).resources.aws_instance) else []
    }
    return instances
}

# Allowed Types
allowed_types = [
  "t2.small",
  "t2.medium",
  "t2.large",
]

aws_instances = get_aws_instances()

# Rule to restrict instance types
instance_type_allowed = rule {
    all aws_instances as _, instances {
      all instances as index, r {
          r.applied.instance_type in allowed_types
      }
```

```
    }
}

# Main rule that requires other rules to be true
main = rule {
  (instance_type_allowed) else true
}
```

Update the policy

Go to workspace – run it - policy will fail

OR:
==========

```
# This policy restricts the AWS region based on the region set for
# instances of the AWS provider in the root module of the workspace.
# It does not check providers in nested modules.

import "tfconfig"
import "tfplan"
import "strings"

# Initialize array of regions found in AWS providers
region_values = []
```

```
# Allowed Regions
allowed_regions = [
  "us-east-1",
  "us-east-2",
  "us-west-1",
  "us-west-2",
]


# Iterate through all AWS providers in root module
if ((length(tfconfig.providers) else 0) > 0) {
  providers = tfconfig.providers
  if "aws" in keys(providers) {
    aws = tfconfig.providers.aws
    aliases = aws["alias"]
    for aliases as alias, data {
      print ( "alias is: ", alias )
      region = data["config"]["region"]
        if region matches "\\$\\{var\\.(.*)\\}" {
          # AWS provider was configured with variable
          print ( "region is a variable" )
          region_variable =
strings.trim_suffix(strings.trim_prefix(region, "${var."), "}")
          print ( "region variable is: ", region_variable )
          print ( "Value of region is: ",
tfplan.variables[region_variable] )
          region_value = tfplan.variables[region_variable]
          region_values += [region_value]
        } else {
```

```
            print ( "region is a hard-coded value" )
            print ( "Value of region is: ", region )
            region_value = region
            region_values += [region_value]
        }
      }
    }
}

# Print all regions found in AWS providers
print ( "region_values is: ", region_values )

aws_region_valid = rule {
  all region_values as rv {
    rv in allowed_regions
  }
}

main = rule {
  (aws_region_valid) else true
}
```

==========
==========
Terraform Graph:
==========

By default the result is a simplified graph which describes only the dependency ordering of the resources (resource and data blocks) in the configuration.

 # sudo apt-get update

 # sudo apt-get install graphviz -y

Create a TF config file

 # mkdir mydemo

 # cd mydemo

 # vim main.tf

```
provider "aws" {

region = "us-east-1"



}

resource "tls_private_key" "mykey" {
  algorithm = "RSA"

}
```

```
resource "aws_key_pair" "aws_key" {
  key_name   = "web-key"
  public_key = tls_private_key.mykey.public_key_openssh

  provisioner "local-exec" {
  command = "echo
'${tls_private_key.mykey.private_key_openssh}' > ./web-key.pem"

}

}

resource "aws_vpc" "sl-vpc" {
 cidr_block = "10.0.0.0/16"
  tags = {
   Name = "sl-vpc"
}

}

resource "aws_subnet" "subnet-1"{
```

```
vpc_id = aws_vpc.sl-vpc.id
cidr_block = "10.0.1.0/24"
depends_on = [aws_vpc.sl-vpc]
map_public_ip_on_launch = true
  tags = {
   Name = "sl-subnet"
}

}

resource "aws_route_table" "sl-route-table"{
vpc_id = aws_vpc.sl-vpc.id
  tags = {
   Name = "sl-route-table"
}

}

resource "aws_route_table_association" "a" {
  subnet_id      = aws_subnet.subnet-1.id
  route_table_id = aws_route_table.sl-route-table.id
```

```
}


resource "aws_internet_gateway" "gw" {
 vpc_id = aws_vpc.sl-vpc.id
 depends_on = [aws_vpc.sl-vpc]
   tags = {
   Name = "sl-gw"
}

}

resource "aws_route" "sl-route" {

route_table_id = aws_route_table.sl-route-table.id
destination_cidr_block = "0.0.0.0/0"
gateway_id = aws_internet_gateway.gw.id


}
```

Save the file

terraform init

terraform plan -out=myplan.out

Turn the plan into DOT graph

 # terraform graph -plan=myplan.out -type=apply -draw-cycles > graph.dot

Render the graph into an Image using graphviz

 # dot -Tpng graph.dot > /tmp/mygraph.png

Go to lab desktop→ click on Home folder >
→ click on file system on the left side → Click on tmp folder -> click on your mygraph.png file.

Command to see the myplan.out

 # terraform show myplan.out

Demo2:

Come back to the terminal

terraform apply --auto-approve

Run the below command to generate the graph

terraform graph | dot -Tpng > /tmp/demo.png

Go to lab desktop→ click on Home folder >

→ click on file system on the left side → Click on tmp folder -> click on your demo.png file.

You will see the graph

==========

Logging and Debugging
==========
Verbose Output: Use -debug or -trace flags with Terraform commands (terraform plan -debug, terraform apply -debug) to get more detailed logs for debugging.

Provider Logs: Some providers (like AWS) generate detailed logs that can help diagnose issues.
Check provider-specific logs or enable detailed logging where possible.

Demo:
==========
Go to the directory with your main.tf file.

Enable logging

 # export TF_LOG="DEBUG"

Run the command

 # TF_LOG=ERROR terraform plan

 # TF_LOG=TRACE terraform plan

 # TF_LOG=DEBUG terraform plan

Save the log in the file

 # export TF_LOG_PATH="/tmp/terraform-debug.log"

Run the
 # terraform apply
See the log now
cat /tmp/terraform-debug.log

==========

Project 1 : Configuration Management with Ansible and Terraform

Step 1: Configure AWS CLI with access key and secret key to establish connection remotely

 # apt-get update && apt-get install awscli -y

 # aws configure

Step 2: Install Terraform

 # wget -O - https://apt.releases.hashicorp.com/gpg | sudo gpg --dearmor -o /usr/share/keyrings/hashicorp-archive-keyring.gpg

 # echo "deb [arch=$(dpkg --print-architecture) signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg] https://apt.releases.hashicorp.com $(grep -oP '(?<=UBUNTU_CODENAME=).*' /etc/os-release || lsb_release -cs) main" | sudo tee /etc/apt/sources.list.d/hashicorp.list

 # sudo apt update && sudo apt install terraform

==========

Step 3: Configure Terraform with new ssh key which will be used as key pair for launching VMs

mkdir myproject

cd myproject

vim mykey.tf

```
provider "aws" {

region = "us-east-1"
}

resource "tls_private_key" "mykey" {
  algorithm = "RSA"
```

```
}


resource "aws_key_pair" "aws-key" {
  key_name   = "web-key"
  public_key = tls_private_key.mykey.public_key_openssh

 provisioner "local-exec" {

command = "echo
'${tls_private_key.mykey.private_key_pem}' > ./web-key.pem"

}

}

# terraform init

# terraform apply
```

Step 4: Terraform script to provision and empty sandbox, add various setting to the sandbox like VPC, security group, route table, subnets, and key pair

```
# vim main.tf

resource "aws_vpc" "sl-vpc" {

cidr_block = "10.0.0.0/16"
```

```
tags = {
    Name = "sl-vpc"
  }

}
resource "aws_subnet" "sl-subnet" {

  vpc_id     = aws_vpc.sl-vpc.id

  cidr_block = "10.0.1.0/24"

  depends_on = [aws_vpc.sl-vpc]

  map_public_ip_on_launch = true

  tags = {
    Name = "sl-subnet"
  }
}

resource "aws_route_table" "sl-route-table" {
  vpc_id = aws_vpc.sl-vpc.id

 tags = {
    Name = "sl-route-table"
  }
}

resource "aws_route_table_association" "a" {
```

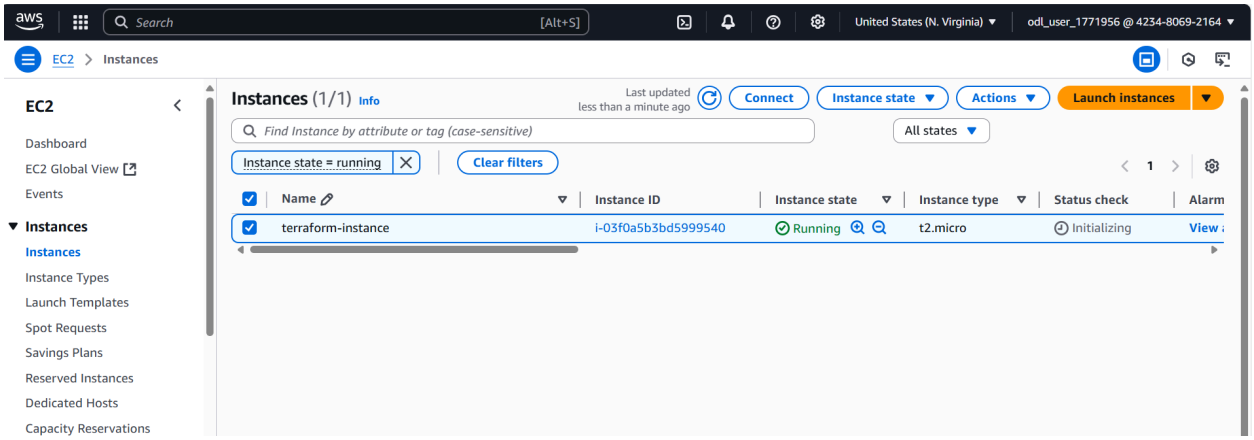
```
  subnet_id      = aws_subnet.sl-subnet.id
  route_table_id = aws_route_table.sl-route-table.id
}


resource "aws_internet_gateway" "gw" {
  vpc_id = aws_vpc.sl-vpc.id
  depends_on = [aws_vpc.sl-vpc]
  tags = {
    Name = "sl-gw"
  }
}

resource "aws_route" "sl-route" {
  route_table_id            = aws_route_table.sl-route-table.id
  destination_cidr_block    = "0.0.0.0/0"
  gateway_id = aws_internet_gateway.gw.id

}

variable "sg_ports" {

type = list(number)

default = [22,443,80,8080]

}

resource "aws_security_group" "sl-sg" {
  name        = "sl-sg"
```

```
  description = "Allow TLS inbound traffic and all outbound
traffic"
  vpc_id = aws_vpc.sl-vpc.id
   dynamic "ingress" {
    for_each = var.sg_ports
    iterator = ports
    content{
    from_port       = ports.value
    to_port         = ports.value
    protocol        = "tcp"
    cidr_blocks     = ["0.0.0.0/0"]

  }
}

egress {
    from_port       = 0
    to_port         = 0
    protocol        = "-1"
    cidr_blocks     = ["0.0.0.0/0"]


      }

}


data "aws_ami" "myami" {

most_recent      = true
```

```
owners           = ["amazon"]

 filter {
    name   = "name"
    values =
["amzn2-ami-kernel-5.10-hvm-2.0.20250610.0-x86_64-gp2"]
  }


}

resource "aws_instance" "myec2" {

  ami           = data.aws_ami.myami.id
  instance_type = "t2.micro"
  key_name = "web-key"
  subnet_id = aws_subnet.sl-subnet.id
  security_groups = [aws_security_group.sl-sg.id]
  tags = {
    Name = "terraform-instance"
  }

}
```

Save the file

```
# terraform apply --auto-approve
```



Step 5: Ansible Setup for running the playbook on above created VM

Generate ssh keys for root user on Lab terminal(Ansible Controller)

 # ssh-keygen

 # cat /root/.ssh/id_rsa.pub

Copy the keys carefully

GO to AWS EC2 server - Ansible worker

 # cd .ssh

 # echo "GIVE YOUR SSH PUBLIC KEY" >> ~/.ssh/authorized_keys

Go back to the lab terminal.

Step 6: Create Ansible Inventory file with IP address of AWS EC2 server

In same directory where the terraform code is create the ansible inventory

 # vim myinventory

[webserver]
54.162.0.24

Save the file

 # pwd

Copy the path of the directory

 # vim ansible.cfg

[defaults]
inventory = /root/myproject/myinventory

Save the file

Validate the setup :

ansible webserver -m ping

Step 7: Write the playbook

vim playbook.yml

```
- name: run playbook using terraform
  hosts: webserver
  become: true
  tasks:
  - name: Install python3
    package: name=python3 state=present
  - name: Install maven
    package: name=maven state=present
  - name: Create a file
    file: path=/tmp/ansible.txt state=touch
```

Save the file

Step 8: Write Terraform code to run the playbook:

vim runplaybook.tf

```
resource "null_resource" "run_playbook" {

provisioner "local-exec" {

command = "ansible-playbook playbook.yml"

}
```

}

Save the file

Step 9: Execute the playbook using terraform command

terraform init

terraform apply -target null_resource.run_playbook

```
null_resource.run_playbook (local-exec): interpreter could change the meaning of that path. See
null_resource.run_playbook (local-exec): https://docs.ansible.com/ansible-
null_resource.run_playbook (local-exec): core/2.16/reference_appendices/interpreter_discovery.html for more informat
ion.
null_resource.run_playbook (local-exec): ok: [54.162.0.24]

null_resource.run_playbook (local-exec): TASK [Install python3] ***************************************************
*****
null_resource.run_playbook (local-exec): ok: [54.162.0.24]

null_resource.run_playbook (local-exec): TASK [Install maven] *****************************************************
*****
null_resource.run_playbook: Still creating... [20s elapsed]
null_resource.run_playbook (local-exec): ok: [54.162.0.24]

null_resource.run_playbook (local-exec): TASK [Create a file] ******************************************************
*****
null_resource.run_playbook (local-exec): changed: [54.162.0.24]

null_resource.run_playbook (local-exec): PLAY RECAP *********************************************************************
*****
null_resource.run_playbook (local-exec): 54.162.0.24               : ok=4    changed=1    unreachable=0    failed=0
    skipped=0    rescued=0    ignored=0

.

Apply complete! Resources: 1 added, 0 changed, 0 destroyed.
root@ip-172-31-30-167:~/myproject# ls
ansible.cfg  myinventory   runplaybook.tf  terraform.tfstate         web-key.pem
main.tf      playbook.yml  sshkey.tf       terraform.tfstate.backup
root@ip-172-31-30-167:~/myproject# cat runplaybook.tf
```

```
[root@ip-10-0-1-226 .ssh]#
[root@ip-10-0-1-226 .ssh]# python --version
Python 2.7.18
[root@ip-10-0-1-226 .ssh]# mvn --version
Apache Maven 3.0.5 (Red Hat 3.0.5-17)
Maven home: /usr/share/maven
Java version: 17.0.15, vendor: Amazon.com Inc.
Java home: /usr/lib/jvm/java-17-amazon-corretto.x86_64
Default locale: en_US, platform encoding: UTF-8
OS name: "linux", version: "5.10.237-230.949.amzn2.x86_64", arch: "amd64", family: "unix"
[root@ip-10-0-1-226 .ssh]# cd /tmp
[root@ip-10-0-1-226 tmp]# ls
ansible.txt  hsperfdata_root  systemd-private-a3b52cb56e7343779d49e900eead131b-chronyd.service-TUlZAK
[root@ip-10-0-1-226 tmp]#
```