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Course/Section: CPE 232-CPE31S1	Date Submitted: 5/7/2024
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Activity 15: OpenStack Installation (Neutron, Horizon, Cinder)

1. Objectives

Create a workflow to install OpenStack using Ansible as your Infrastructure as Code (IaC).

2. Intended Learning Outcomes

1. Analyze the advantages and disadvantages of cloud services
2. Evaluate different Cloud deployment and service models
3. Create a workflow to install and configure OpenStack base services using Ansible as documentation and execution.

3. Resources

Oracle VirtualBox (Hypervisor)

1x Ubuntu VM or Centos VM

4. Tasks

1. Create a new repository for this activity.
2. Create a playbook that converts the steps in the following items in https://docs.openstack.org/install-guide/
   a. Neutron
   b. Horizon
   c. Cinder
   d. Create different plays in installing per server type (controller, compute etc.) and identify it as a group in the Inventory file.
   e. Add, commit and push it to your GitHub repo.

5. Output (screenshots and explanations)

INVENTORY

```
emncuygn@workstation:~/Group2_HOA15$ cat inventory
[ubuntu]
192.168.56.101
```

MAIN PLAYBOOK (install_openstack.yml)

```
emncuygn@workstation:~/Group2_HOA15$ cat install_openstack.yml
---
- hosts: all
  become: true
  pre_tasks:

  - name: Install Updates (Ubuntu)
    tags: always
    apt:
      update_cache: yes
    changed_when: false
    when: ansible_distribution == "Ubuntu"

  - name: Install packages on Ubuntu for OpenStack base Services
    apt:
      name:
        - vim
        - htop
        - curl
        - wget
      state: present
    when: ansible_distribution == "Ubuntu"

- hosts: ubuntu
  become: true
  roles:
    - neutron
    - horizon
    - cinder
```

NEUTRON (main.yml)

```
emncuygn@workstation:~/Group2_HOA15$ cat roles/neutron/tasks/main.yml
---
- name: installing  the components for neutron
  apt:
    name: neutron-openvswitch-agent
  when: ansible_distribution == "Ubuntu"

- name: configuring RabbitMQ message queue access
  copy:
    dest: /etc/neutron/neutron.conf
    content: |
      [DEFAULT]
      transport_url = rabbit://openstack:1234@controller
- name: configuring Identity service access
  copy:
    dest: /etc/neutron/neutron.conf
    content: |
      [DEFAULT]
      auth_strategy = keystone
      [keystone_authtoken]
      www_authenticate_uri = http://controller:5000
      auth_url = http://controller:5000
      memcached_servers = controller:11211
      auth_type = password
      project_domain_name = default
      user_domain_name = default
      project_name = service
      username = neutron
      password = 1234
- name: configuring the lock path
  copy:
    dest: /etc/neutron/neutron.conf
    content: |
      [oslo_currency]
      lock_path = /var/lib/neutron/tmp
- name: configuring the access parameters
  copy:
    dest: /etc/nova/nova.conf
    content: |
      [neutron]
      auth_url = http://controller:5000
      auth_type = password
      project_domain_name = default
      user_domain_name = default
      region_name = RegionOne
      project_name = service
      username = neutron
      password = 1234
- name: restarting the compute service
  shell: service nova-compute restart
  when: ansible_distribution == "Ubuntu"
```

```
- name: restarting the linux bridge agent
  shell: service neutron-openvswitch-agent restart
  when: ansible_distribution == "Ubuntu"

- block:
  - name: Verifying if already running and active the nova-compute.
    shell: systemctl status nova-compute
    register: novacompute_service

- block:
  - name: Verifying if already running and active the neutron-openvswitch-agent
    shell: systemctl status neutron-openvswitch-agent
    register: neutron_service
```

HORIZON (main.yml)

```
emncuygn@workstation:~/Group2_HOA15$ cat roles/horizon/tasks/main.yml
---
- name: Installation of openstack-dashboard
  apt:
   name: openstack-dashboard

- name: configuring the dashboard to use Openstack services
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_HOST = "controller"
- name: Allowing all hosts to access dashboard
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      ALLOWED_HOSTS = ['*']
- name: configure the memcached session storage service
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      SESSION_ENGINE = 'django.contrib.sessions.backends.cache'
      CACHES = {
          'default': {
               'BACKEND': 'django.core.cache.backends.memcached.MemcachedCache', 'LOCATION': 'controller:11211',
               }
               }
- name: enable the identity API version 3
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_KEYSTONE_URL = "http://%s/identity/v3" % OPENSTACK_HOST
- name: enable support for domains
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_KEYSTONE_MULTIDOMAIN_SUPPORT = True
- name: configure API versions
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_API_VERSIONS = {
          "identity": 3,
          "image": 2,
          "volume": 3,
      }
- name: configure default as the default domain for users that you create via the dashboard
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_KEYSTONE_DEFAULT_DOMAIN = "Default"
- name: configure user as the default role for users that your create via the dashboard
```

```
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_KEYSTONE_DEFAULT_ROLE = "user"
- name: if you choose network 1, disable support for layer-3 networking services
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      OPENSTACK_NEUTRON_NETWORK = {
          'enable_router': False,
          'enable_quotas': False,
          'enable_ipv6': False,
          'enable_distributed_router': False,
          'enable_ha_router': False,
          'enable_fip_topology_check': False
      }
- name: add the following line if not added yet
  copy:
    dest: /etc/openstack-dashboard/local_settings.py
    content: |
      CACHES = {
          'default': {
              'BACKEND': 'django.core.cache.backends.memcached.MemcachedCache', 'LOCATION': 192.168.56.108:11211',
             },
             }
      SESSION_ENGINE = "django.contrib.sessions.backends.cache"
      OPENSTACK_HOST = "192.168.56.109"
      OPENSTACK_KEYSTONE_URL = "http://%s/identity/v3" % OPENSTACK_HOST
      TIME_ZONE = "Asia/Manila"
      OPENSTACK_KEYSTONE_MULTIDOMAIN_SUPPORT = True
      OPENSTACK_KEYSTONE_DEFAULT_DOMAIN = 'Default'
      OPENSTACK_API_VERSIONS = {
          "identity": 3,
          "volume": 3,
          "compute": 2,
      }
      WSGIApplicationGroup %{GLOBAL}
- name: install apache2
  apt:
    name: apache2

- name: finalize installation by starting the apache2 service
  shell: |
     sudo systemctl stop apache2.service
     sudo systemctl start apache2.service
- name: finalize installation by reloading the apache2 service
  shell: sudo systemctl reload apache2.service

- block:
  - name: Verifying the apache2.service
    shell: systemctl status apache2.service
```

```
    register: apache2_service
```

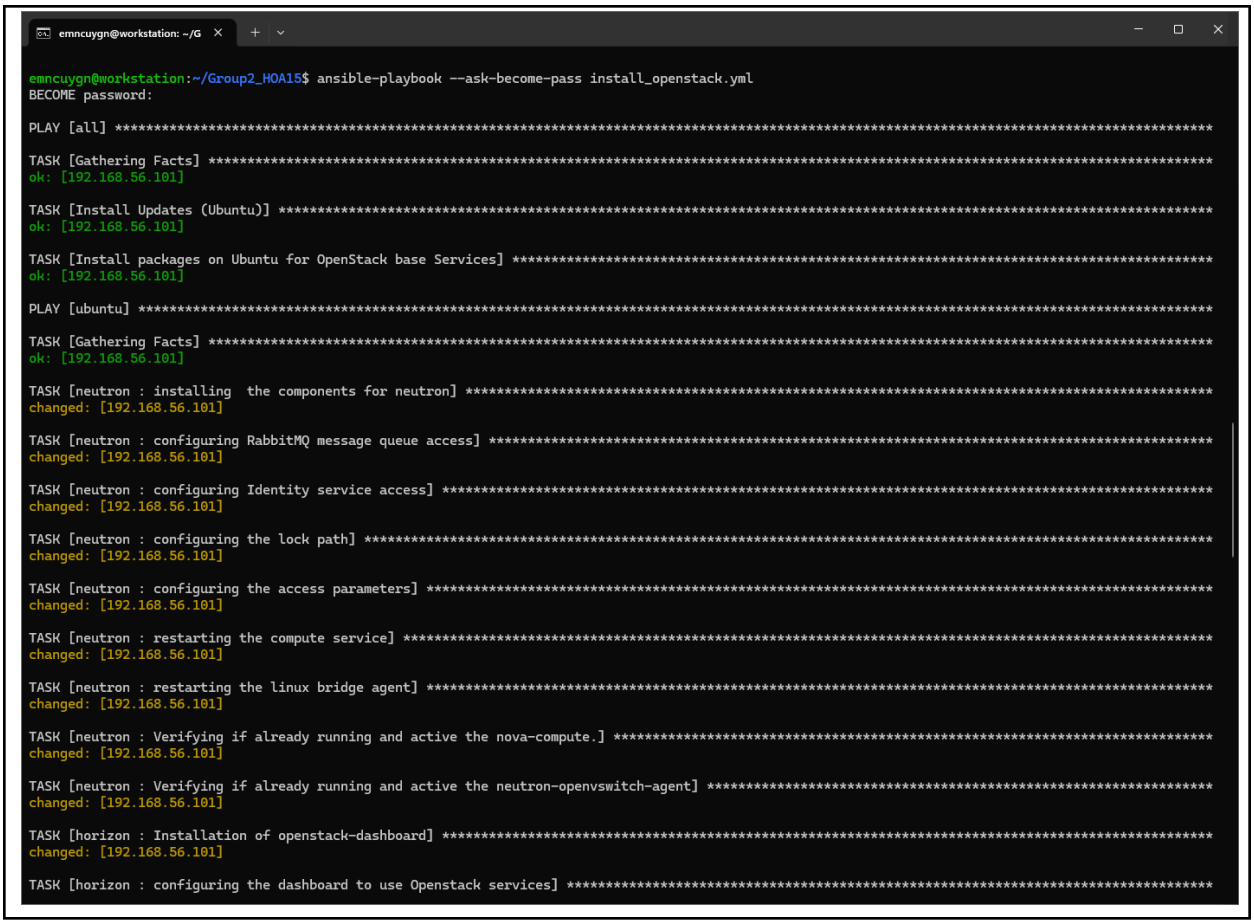
CINDER (main.yml)

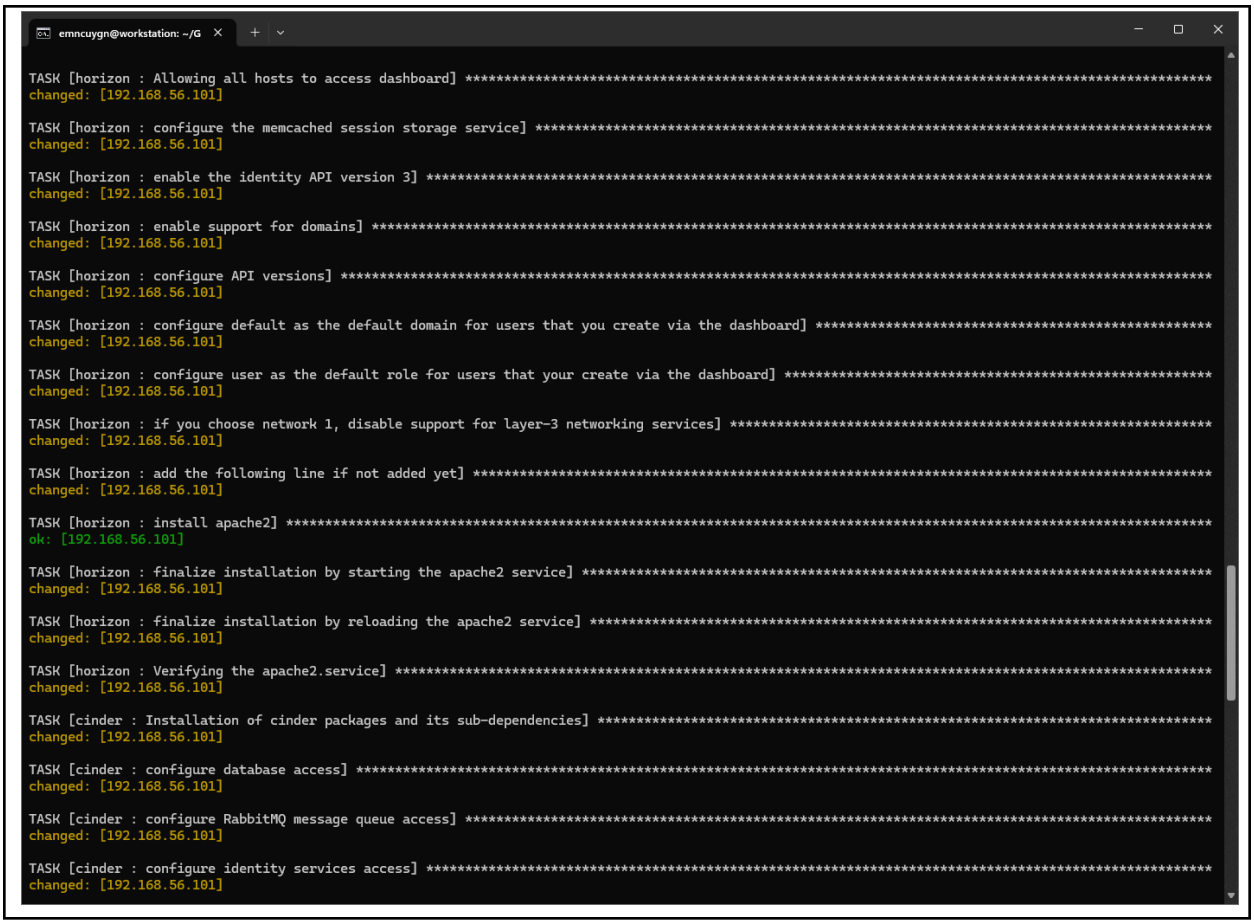
```
emncuygn@workstation:~/Group2_HOA15$ cat roles/cinder/tasks/main.yml
---
- name: Installation of cinder packages and its sub-dependencies
  apt:
    name:
      - cinder-api
      - cinder-scheduler

- name: configure database access
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [database]
      connection = mysql+pymysql://cinder:1234@controller/cinder
- name: configure RabbitMQ message queue access
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [DEFAULT]
      transport_url = rabbit://openstack:1234@controller
- name: configure identity services access
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [DEFAULT]
      auth_strategy = keystone
      [keystone_authtoken]
      www_authenticate_uri = http://controller:5000
      auth_url = http://controller:5000
      memcached_servers = controller:11211
      auth_type = password
      project_domain_name = default
      user_domain_name = default
      project_name = service
      username = cinder
      password = 1234
- name: configure my_ip option to use the management interface IP add of controller node
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [DEFAULT]
      my_ip = 192.168.56.109
- name: configure the lock path
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [oslo_concurrency]
      lock_path = /var/lib/cinder/tmp
- name: populate the block storage database
  shell: su -s /bin/sh -c "cinder-manage db sync" cinder
```

```
- name: adding the following line for block storage
  copy:
    dest: /etc/nova/nova.conf
    content: |
      [cinder]
      os_region_name = RegionOne
- name: install nova-api
  shell: sudo apt install nova-api

- name: restarting the compute API service
  shell: service nova-api start

- name: restart the block storage services
  shell: |
      service cinder-scheduler start
      sudo systemctl start apache2
- name: install the supporting utility packages
  apt:
    name:
       - lvm2
       - thin-provisioning-tools

- name: create the LVM physical volume /dev/sdb
  file:
    path: /dev/sdb
    state: directory

- name: create the LVM volume group cinder-volume
  shell: sudo touch cinder-volumes /dev/sdb

- name: install the packages for cinder storage node
  apt:
    name:
       - cinder-volume
       - tgt


- name: configure the LVM backend with the LVM driver
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [lvm]
      volume_driver = cinder.volume.drivers.lvm.LVMVolumeDriver
      volume_group = cinder-volumes
      target_protocol = iscsi
      target_helper = tgtadm
- name: enabling the LVM backend
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [DEFAULT]
```

```
      [DEFAULT]
      enabled_backends = lvm
- name: configuring the location of the image service API
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [DEFAULT]
      glance_api_servers = http://controller:9292
- name: configuring the lock path
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [oslo_concurrency]
      lock_path = /var/lib/cinder/tmp
- name: Restarting the block storage volume service including its dependencies (1)
  shell: service tgt restart

- name: Restarting the block storage volume service including its dependencies (2)
  shell: service cinder-volume restart

- name: install the packages for cinder backup service
  apt:
    name: cinder-backup

- name: configuring the backup options
  copy:
    dest: /etc/cinder/cinder.conf
    content: |
      [DEFAULT]
      backup_driver = cinder.backup.drivers.swift.SwiftBackupDriver
      backup_swift_url = SWIFT_URL
- name: restart the block storage backup service
  shell: service cinder-backup start

- block:
  - name: Verifying the cinder-backup.
    shell: systemctl status cinder-backup
    register: cinder_service
emncuygn@workstation:~/Group2_HOA15$
```

INSTALLATION THROUGH install_openstack.yml


emncuygn@workstation: ~/G
emncuygn@workstation:~/Group2_HOA15$ ansible-playbook --ask-become-pass install_openstack.yml
BECOME password:
PLAY [all] **
TASK [Gathering Facts] **
ok: [192.168.56.101]
TASK [Install Updates (Ubuntu)] ***
ok: [192.168.56.101]
TASK [Install packages on Ubuntu for OpenStack base Services] ***
ok: [192.168.56.101]
PLAY [ubuntu] ***
TASK [Gathering Facts] **
ok: [192.168.56.101]
TASK [neutron : installing the components for neutron] **
changed: [192.168.56.101]
TASK [neutron : configuring RabbitMQ message queue access] **
changed: [192.168.56.101]
TASK [neutron : configuring Identity service access] **
changed: [192.168.56.101]
TASK [neutron : configuring the lock path] ***
changed: [192.168.56.101]
TASK [neutron : configuring the access parameters] **
changed: [192.168.56.101]
TASK [neutron : restarting the compute service] ***
changed: [192.168.56.101]
TASK [neutron : restarting the linux bridge agent] **
changed: [192.168.56.101]
TASK [neutron : Verifying if already running and active the nova-compute.] **
changed: [192.168.56.101]
TASK [neutron : Verifying if already running and active the neutron-openvswitch-agent] **
changed: [192.168.56.101]
TASK [horizon : Installation of openstack-dashboard] **
changed: [192.168.56.101]
TASK [horizon : configuring the dashboard to use Openstack services] **


emncuygn@workstation: ~/G
TASK [horizon : Allowing all hosts to access dashboard] ********
changed: [192.168.56.101]
TASK [horizon : configure the memcached session storage service] ********
changed: [192.168.56.101]
TASK [horizon : enable the identity API version 3] ********
changed: [192.168.56.101]
TASK [horizon : enable support for domains] ********
changed: [192.168.56.101]
TASK [horizon : configure API versions] ********
changed: [192.168.56.101]
TASK [horizon : configure default as the default domain for users that you create via the dashboard] ********
changed: [192.168.56.101]
TASK [horizon : configure user as the default role for users that your create via the dashboard] ********
changed: [192.168.56.101]
TASK [horizon : if you choose network 1, disable support for layer-3 networking services] ********
changed: [192.168.56.101]
TASK [horizon : add the following line if not added yet] ********
changed: [192.168.56.101]
TASK [horizon : install apache2] ********
ok: [192.168.56.101]
TASK [horizon : finalize installation by starting the apache2 service] ********
changed: [192.168.56.101]
TASK [horizon : finalize installation by reloading the apache2 service] ********
changed: [192.168.56.101]
TASK [horizon : Verifying the apache2.service] ********
changed: [192.168.56.101]
TASK [cinder : Installation of cinder packages and its sub-dependencies] ********
changed: [192.168.56.101]
TASK [cinder : configure database access] ********
changed: [192.168.56.101]
TASK [cinder : configure RabbitMQ message queue access] ********
changed: [192.168.56.101]
TASK [cinder : configure identity services access] ********
changed: [192.168.56.101]

```
emncuygn@workstation: ~/G
changed: [192.168.56.101]

TASK [cinder : configure my_ip option to use the management interface IP add of controller node] ***********************************************
changed: [192.168.56.101]

TASK [cinder : configure the lock path] ****************************************************************************************************
changed: [192.168.56.101]

TASK [cinder : populate the block storage database] ****************************************************************************************
changed: [192.168.56.101]

TASK [cinder : adding the following line for block storage] ********************************************************************************
changed: [192.168.56.101]

TASK [cinder : install nova-api] ***********************************************************************************************************
changed: [192.168.56.101]

TASK [cinder : restarting the compute API service] *****************************************************************************************
changed: [192.168.56.101]

TASK [cinder : restart the block storage services] *****************************************************************************************
changed: [192.168.56.101]

TASK [cinder : install the supporting utility packages] ************************************************************************************
ok: [192.168.56.101]

TASK [cinder : create the LVM physical volume /dev/sdb] ************************************************************************************
changed: [192.168.56.101]

TASK [cinder : create the LVM volume group cinder-volume] **********************************************************************************
changed: [192.168.56.101]

TASK [cinder : install the packages for cinder storage node] *******************************************************************************
changed: [192.168.56.101]

TASK [cinder : configure the LVM backend with the LVM driver] ******************************************************************************
changed: [192.168.56.101]

TASK [cinder : enabling the LVM backend] ***************************************************************************************************
changed: [192.168.56.101]

TASK [cinder : configuring the location of the image service API] **************************************************************************
changed: [192.168.56.101]

TASK [cinder : configuring the lock path] **************************************************************************************************
changed: [192.168.56.101]

TASK [cinder : Restarting the block storage volume service including its dependencies (1)] *************************************************
changed: [192.168.56.101]

TASK [cinder : Restarting the block storage volume service including its dependencies (2)] *************************************************
```

```
TASK [cinder : Restarting the block storage volume service including its dependencies (2)] *************************************************
changed: [192.168.56.101]

TASK [cinder : install the packages for cinder backup service] *****************************************************************************
changed: [192.168.56.101]

TASK [cinder : configuring the backup options] *********************************************************************************************
changed: [192.168.56.101]

TASK [cinder : restart the block storage backup service] ***********************************************************************************
changed: [192.168.56.101]

TASK [cinder : Verifying the cinder-backup.] ***********************************************************************************************
changed: [192.168.56.101]

PLAY RECAP *********************************************************************************************************************************
192.168.56.101             : ok=53   changed=47   unreachable=0    failed=0    skipped=0    rescued=0    ignored=0

emncuygn@workstation:~/Group2_HOA15$
```

NEUTRON

```
emncuygn@workstation:~$ service neutron-openvswitch-agent status
● neutron-openvswitch-agent.service - Openstack Neutron Open vSwitch Plugin Agent
     Loaded: loaded (/usr/lib/systemd/system/neutron-openvswitch-agent.service; enabled; preset: enabled)
     Active: active (running) since Tue 2024-05-07 16:08:36 PST; 31min ago
   Main PID: 8927 (neutron-openvsw)
      Tasks: 1 (limit: 9441)
     Memory: 130.5M (peak: 131.0M)
        CPU: 11.433s
     CGroup: /system.slice/neutron-openvswitch-agent.service
             └─8927 "neutron-openvswitch-agent (/usr/bin/python3 /usr/bin/neutron-openvswitch-agent --config-file=/etc/neutron/neutron.conf --config-fi>

May 07 16:08:36 workstation systemd[1]: Starting neutron-openvswitch-agent.service - Openstack Neutron Open vSwitch Plugin Agent...
May 07 16:08:36 workstation systemd[1]: Started neutron-openvswitch-agent.service - Openstack Neutron Open vSwitch Plugin Agent.
May 07 16:08:37 workstation neutron-openvswitch-agent[8927]: 3 RLock(s) were not greened, to fix this error make sure you run eventlet.monkey_patch() b>
lines 1-13/13 (END)
```

HORIZON

```
emncuygn@workstation:~/Group2_HOA15$ service apache2 status
● apache2.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; preset: enabled)
     Active: active (running) since Tue 2024-05-07 16:10:36 PST; 27min ago
       Docs: https://httpd.apache.org/docs/2.4/
   Main PID: 11740 (apache2)
      Tasks: 114 (limit: 9441)
     Memory: 52.4M (peak: 52.6M)
        CPU: 3.462s
     CGroup: /system.slice/apache2.service
             ├─11740 /usr/sbin/apache2 -k start
             ├─12566 "(wsgi:cinder-wsgi" -k start
             ├─12567 "(wsgi:cinder-wsgi" -k start
             ├─12568 "(wsgi:cinder-wsgi" -k start
             ├─12569 "(wsgi:cinder-wsgi" -k start
             ├─12570 "(wsgi:cinder-wsgi" -k start
             ├─12571 "(wsgi:horizon)   " -k start
             ├─12572 "(wsgi:horizon)   " -k start
             ├─12573 "(wsgi:horizon)   " -k start
             ├─12574 /usr/sbin/apache2 -k start
             └─12575 /usr/sbin/apache2 -k start

May 07 16:10:36 workstation systemd[1]: Starting apache2.service - The Apache HTTP Server...
May 07 16:10:36 workstation apachectl[11738]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1.>
May 07 16:10:36 workstation systemd[1]: Started apache2.service - The Apache HTTP Server.
May 07 16:10:37 workstation systemd[1]: Reloading apache2.service - The Apache HTTP Server...
May 07 16:10:37 workstation apachectl[11877]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1.>
May 07 16:10:37 workstation systemd[1]: Reloaded apache2.service - The Apache HTTP Server.
May 07 16:11:12 workstation systemd[1]: Reloading apache2.service - The Apache HTTP Server...
May 07 16:11:12 workstation apachectl[12558]: AH00558: apache2: Could not reliably determine the server's fully qualified domain name, using 127.0.0.1.>
May 07 16:11:12 workstation systemd[1]: Reloaded apache2.service - The Apache HTTP Server.
lines 1-30/30 (END)
```

```
emncuygn@workstation:~$ netstat -nltp | egrep ':80|:443'
(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
tcp6       0      0 :::80                   :::*                    LISTEN      -
```

CINDER

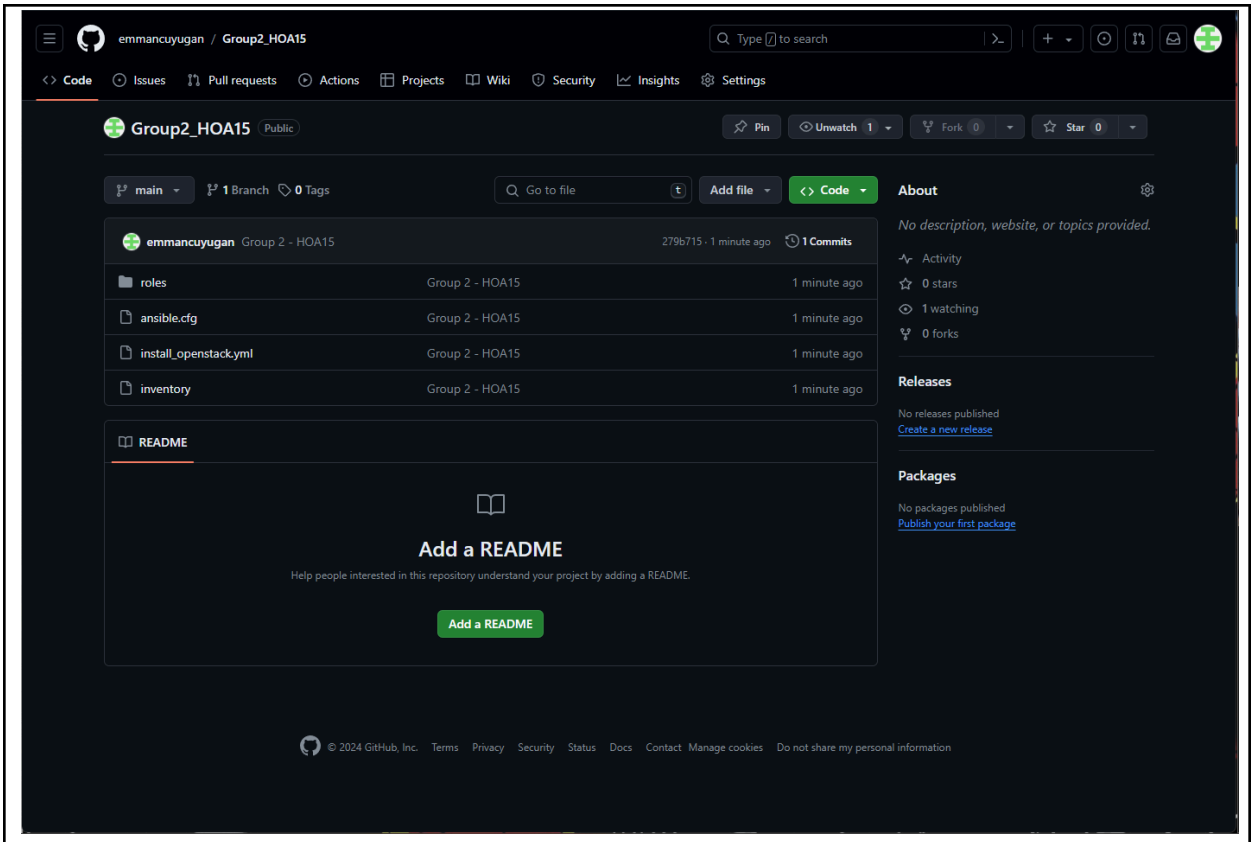
```
emncuygn@workstation:~$ service cinder-volume status
● cinder-volume.service - OpenStack Cinder Volume
     Loaded: loaded (/usr/lib/systemd/system/cinder-volume.service; enabled; preset: enabled)
     Active: active (running) since Tue 2024-05-07 16:42:37 PST; 2s ago
       Docs: man:cinder-volume(1)
   Main PID: 25960 (cinder-volume)
      Tasks: 1 (limit: 9441)
     Memory: 81.4M (peak: 81.4M)
        CPU: 2.560s
     CGroup: /system.slice/cinder-volume.service
             └─25960 /usr/bin/python3 /usr/bin/cinder-volume --config-file=/etc/cinder/cinder.conf --log-file=/var/log/cinder/cinder-volume.log

May 07 16:42:37 workstation systemd[1]: cinder-volume.service: Scheduled restart job, restart counter is at 592.
May 07 16:42:37 workstation systemd[1]: Started cinder-volume.service - OpenStack Cinder Volume.
May 07 16:42:38 workstation cinder-volume[25960]: 1 RLock(s) were not greened, to fix this error make sure you run eventlet.monkey_patch() before impor>
lines 1-14/14 (END)
```

```
emncuygn@workstation:~$ service cinder-backup status
● cinder-backup.service - OpenStack Cinder Backup
     Loaded: loaded (/usr/lib/systemd/system/cinder-backup.service; enabled; preset: enabled)
     Active: active (running) since Tue 2024-05-07 16:12:33 PST; 30min ago
       Docs: man:cinder-backup(1)
   Main PID: 15828 (cinder-backup)
      Tasks: 1 (limit: 9441)
     Memory: 90.4M (peak: 90.9M)
        CPU: 7.308s
     CGroup: /system.slice/cinder-backup.service
             └─15828 /usr/bin/python3 /usr/bin/cinder-backup --config-file=/etc/cinder/cinder.conf --log-file=/var/log/cinder/cinder-backup.log

May 07 16:12:33 workstation systemd[1]: Started cinder-backup.service - OpenStack Cinder Backup.
May 07 16:12:34 workstation cinder-backup[15828]: 1 RLock(s) were not greened, to fix this error make sure you run eventlet.monkey_patch() before impor>
lines 1-13/13 (END)
```

ADD, COMMIT, AND PUSH TO GitHub REPO

```
emncuygn@workstation:~/Group2_HOA15$ git status
On branch main

No commits yet

Changes to be committed:
  (use "git rm --cached <file>..." to unstage)
        new file:   ansible.cfg
        new file:   install_openstack.yml
        new file:   inventory
        new file:   roles/cinder/tasks/main.yml
        new file:   roles/horizon/tasks/main.yml
        new file:   roles/neutron/tasks/main.yml
```

```
emncuygn@workstation:~/Group2_HOA15$ git commit -m "Group 2 - HOA15"
[main (root-commit) 279b715] Group 2 - HOA15
 6 files changed, 344 insertions(+)
 create mode 100644 ansible.cfg
 create mode 100644 install_openstack.yml
 create mode 100644 inventory
 create mode 100644 roles/cinder/tasks/main.yml
 create mode 100644 roles/horizon/tasks/main.yml
 create mode 100644 roles/neutron/tasks/main.yml
emncuygn@workstation:~/Group2_HOA15$ git push
Enumerating objects: 15, done.
Counting objects: 100% (15/15), done.
Delta compression using up to 3 threads
Compressing objects: 100% (8/8), done.
Writing objects: 100% (15/15), 3.53 KiB | 1.76 MiB/s, done.
Total 15 (delta 1), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (1/1), done.
To github.com:emmancuyugan/Group2_HOA15.git
 * [new branch]      main -> main
emncuygn@workstation:~/Group2_HOA15$
```



REPOSITORY LINK:

https://github.com/emmancuyugan/Group2_HOA15

Reflections:

Answer the following:

1. Describe Neutron, Horizon and Cinder service

Neutron is the networking service that provides “network connectivity as a service” between interface devices like virtual NICs managed by other OpenStack services such as Nova. It offers a pluggable architecture to support various networking models across different environments. **Horizon** is the dashboard service, offering a web-based user interface to manage and interact with various OpenStack services, including Nova, Swift, and Keystone. It simplifies the management of OpenStack resources and services through a visual interface. **Cinder** is the block storage service, providing persistent block storage for instances. It’s designed to be highly available and fault-tolerant, with a focus on scalability and integration with a variety of back-end storage providers.

Conclusions:

This activity is a good learning experience for the group. As we made our activity we have learned the uses of each of the services used. **Neutron** is responsible for connecting all the networks across OpenStack. It manages all networks and IP addresses. However, managing complex network configurations can be challenging and may require specialized knowledge. **Horizon** then provides a web-based interface for OpenStack services. It is used to manage, provision, and monitor cloud resources. The downside is that it might not offer the same level of flexibility or control as using the command line or APIs.Lastly, **Cinder** provides persistent block storage that is made accessible using an API. It allows users to define and manage the amount of cloud storage required. However, performance can vary based on the underlying hardware and network infrastructure. The activity overall is done and understood by each member of the group because of its connections to the previous Hands-On Activities (13 and 14).