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Course/Section: CPE31S4	**Date Submitted:** 12/09/2023
Instructor: Dr. Jonathan Taylar	**Semester and SY:** 1st/2023-2024

Activity 14: OpenStack Installation (Keystone, Glance, Nova)

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)

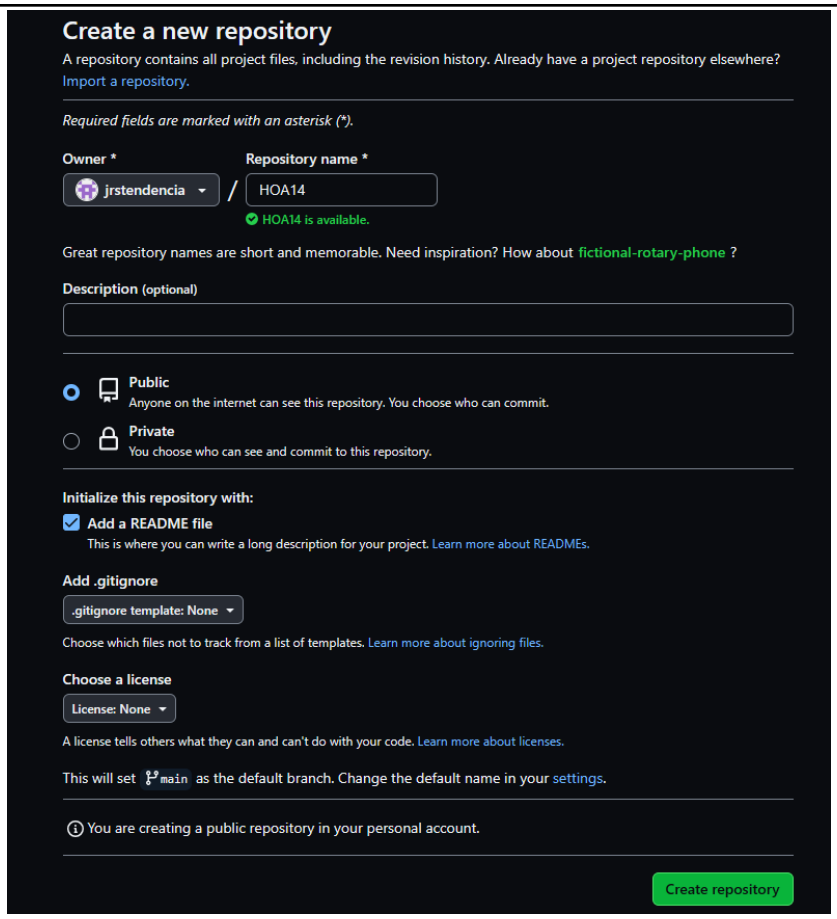
1x Ubuntu VM or Centos VM

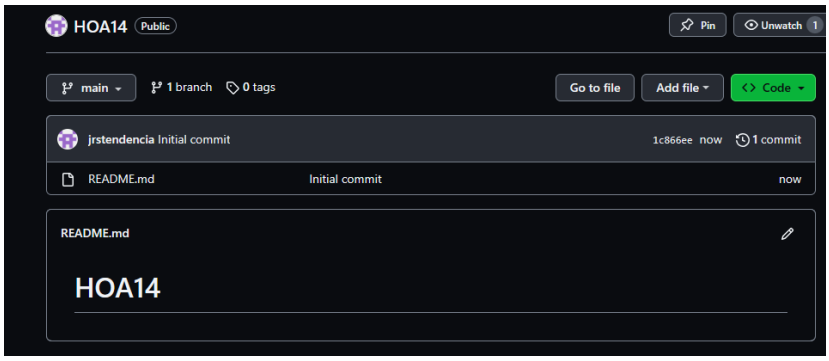
4. Tasks

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. Keystone (Identity Service)
    b. Glance (Imaging Service)
    c. Nova (Compute Service)
    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)

1. Create a new repository in Github.






```
tendencia@workstation:~$ git clone git@github.com:jrstendencia/HOA14.git
Cloning into 'HOA14'...
remote: Enumerating objects: 3, done.
remote: Counting objects: 100% (3/3), done.
remote: Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (3/3), done.
tendencia@workstation:~$ ls
Ansible_S4              HOA10  HOA4           HOA9        Templates
CPE232_JasminTendencia  HOA11  HOA5           HOA9_Final  Tendencia_PrelimExam
CPE_MIDEXAM_TENDENCIA   HOA12  HOA6           Music       Videos
Desktop                 HOA13  HOA7           Pictures
Documents               HOA14  HOA8           Public
Downloads               HOA2   HOA8_Tendencia  snap
tendencia@workstation:~$
```

2. Setup the ansible environment by creating an inventory file to specify the target hosts (Ubuntu and CentOS) to be configured. Also, create the ansible.cfg.

   ansible.cfg:

```
[defaults]

inventory = inventory
host_key_checking = false

deprecation_warnings = false

remote_user = tendencia
private_key_file = ~/.ssh/
```

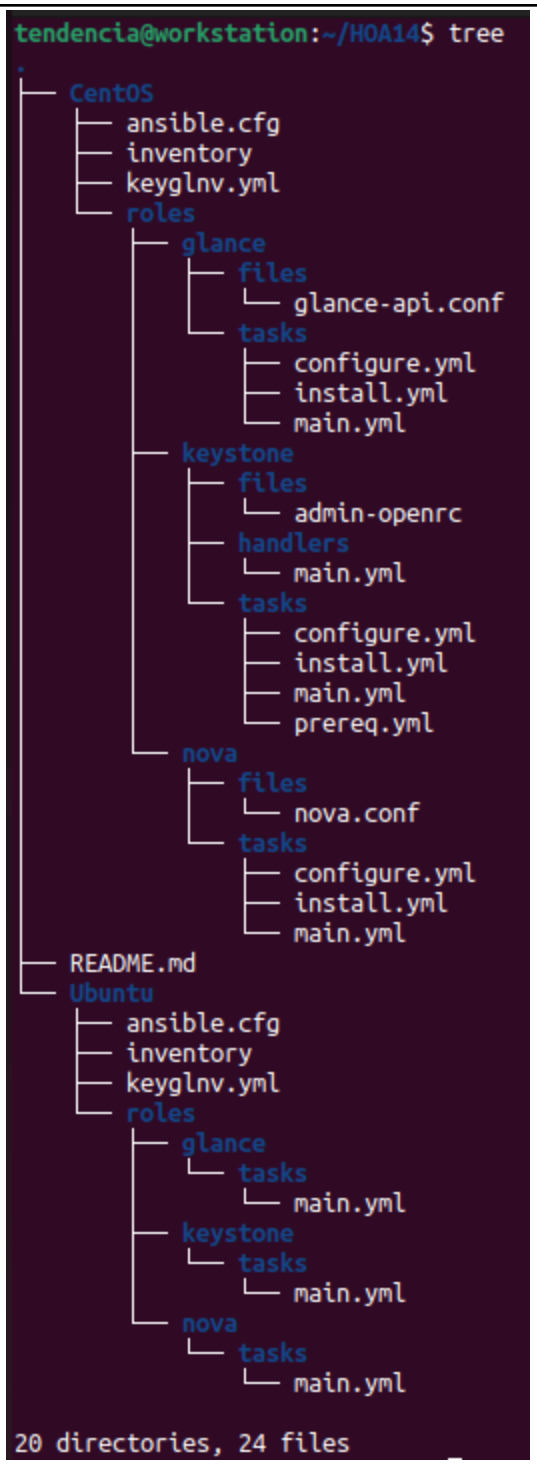
   inventory:

Ubuntu	`192.168.56.103 ansible_python_interpreter=/usr/bin/python3`
	
	`[controller]`
	`192.168.56.103`
	
	`[compute]`
	`192.168.56.103`

CentOS	`192.168.56.104 ansible_python_interpreter=/usr/bin/python3`
	
	`[controller_node]`
	`192.168.56.104`

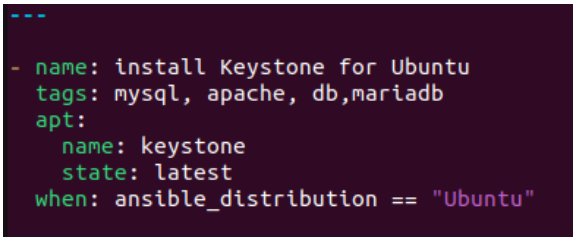
3. Create a role for Keystone (Identity Service), Glance (Imaging Service), Nova (Compute Service) installation for Ubuntu and CentOS by generating the role structure. Then, create directories need that contains either a .conf or *.yml* file.

   tree:

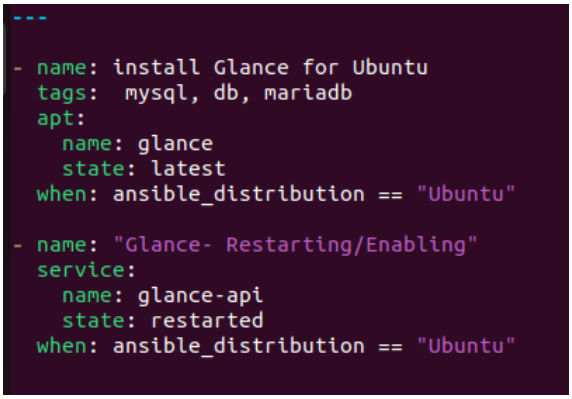


4. The scripts should define the tasks for Keystone (Identity Service), Glance (Imaging Service), Nova (Compute Service) installation for both Ubuntu and CentOS.

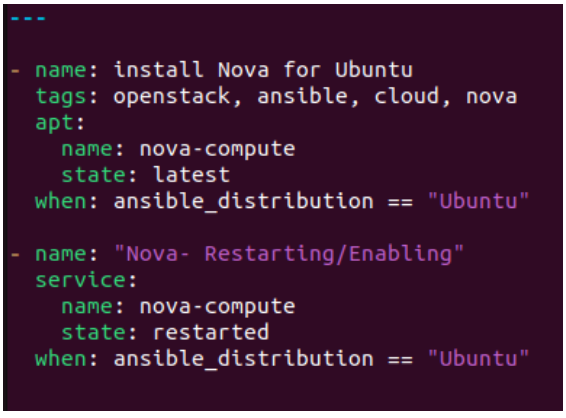
   Ubuntu:

Keystone		
Directory	File	Ansible Script
tasks	main.yml	

```
---

- name: install Keystone for Ubuntu
  tags: mysql, apache, db,mariadb
  apt:
    name: keystone
    state: latest
  when: ansible_distribution == "Ubuntu"
```

Glance		
Directory	File	Ansible Script
tasks	main.yml	

```
---

- name: install Glance for Ubuntu
  tags:  mysql, db, mariadb
  apt:
    name: glance
    state: latest
  when: ansible_distribution == "Ubuntu"

- name: "Glance- Restarting/Enabling"
  service:
    name: glance-api
    state: restarted
  when: ansible_distribution == "Ubuntu"
```

Nova		
Directory	File	Ansible Script
tasks	main.yml	

```
---

- name: install Nova for Ubuntu
  tags: openstack, ansible, cloud, nova
  apt:
    name: nova-compute
    state: latest
  when: ansible_distribution == "Ubuntu"

- name: "Nova- Restarting/Enabling"
  service:
    name: nova-compute
    state: restarted
  when: ansible_distribution == "Ubuntu"
```

CentOS:

<table>
<tr><th colspan="3">Keystone</th></tr>
<tr><th>Directory</th><th>File</th><th>Ansible Script</th></tr>
<tr><td>files</td><td>admin-openrc</td><td>

```
export OS_USERNAME=admin
export OS_PASSWORD=adminpass
export OS_PROJECT_NAME=admin
export OS_USER_DOMAIN_NAME=Default
export OS_PROJECT_DOMAIN_NAME=Default
export OS_AUTH_URL=http://controller:5000/v3
export OS_IDENTITY_API_VERSION=3
```

</td></tr>
<tr><td>handlers</td><td>main.yml</td><td>

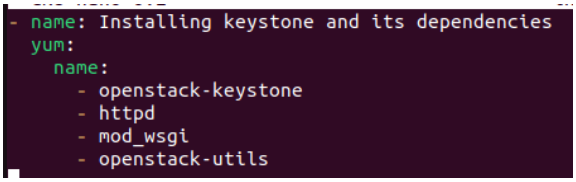
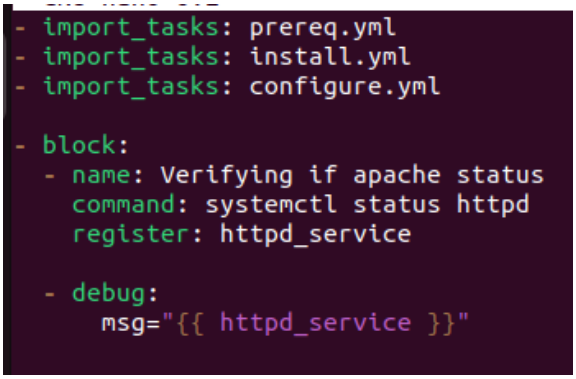
```
- name: Creating link
  command: ln -s /usr/share/keystone/wsgi-keystone.conf /etc/httpd/conf.d/
  failed_when: false
  no_log: true


- name: Reloading firewall
  command: firewall-cmd --reload
```

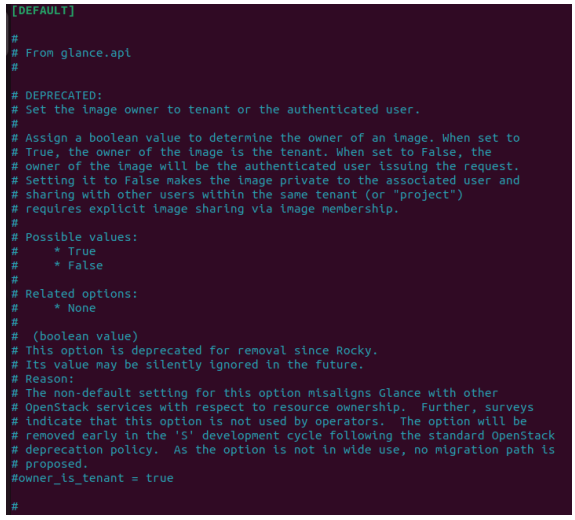
</td></tr>
<tr><td>tasks</td><td>configure.yml</td><td>

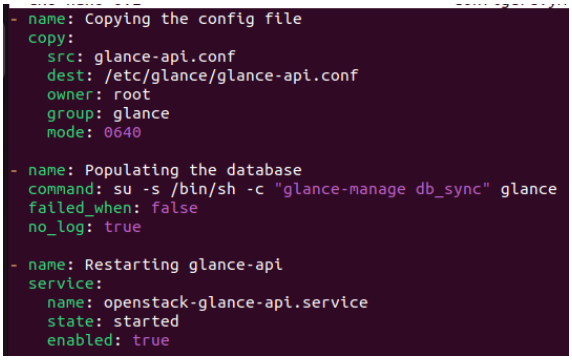
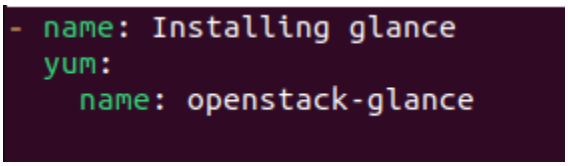
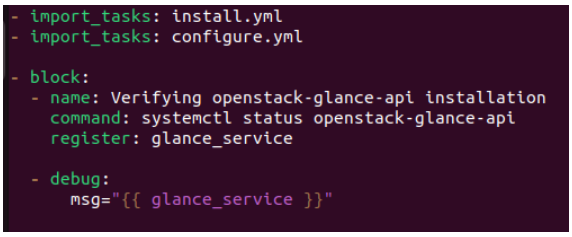
```
- name: Configuring the connection variable
  replace:
    path: /etc/keystone/keystone.conf
    regexp: '#connection = <None>'
    replace: 'connection = mysql+pymysql://keystone:keystonepass@controller/keystone'

- name: Configuring memcached variable
  replace:
    path: /etc/keystone/keystone.conf
    regexp: '#memcache_servers = localhost:11211'
    replace: 'memcache_servers = controller:11211'

- name: Configuring the fernet variable
  replace:
    path: /etc/keystone/keystone.conf
    regexp: '#provider = fernet'
    replace: 'provider = fernet'

- name: Initialize fernet repositories
  shell: |
    keystone-manage fernet_setup --keystone-user keystone --keystone-group keystone
    keystone-manage credential_setup --keystone-user keystone --keystone-group keystone

- name: Configuring setbools
  shell: |
    setsebool -P httpd_use_openstack on
    setsebool -P httpd_can_network_connect on
    setsebool -P httpd_can_network_connect_db on

- name: Opening firewall for port 5000
  ansible.builtin.shell:
    cmd: "firewall-cmd --permanent --add-port=5000/tcp && firewall-cmd --reload"

  notify: Reloading firewall

- name: Configuring apache
  replace:
    path: /etc/httpd/conf/httpd.conf
    regexp: '#ServerName www.example.com:80'
    replace: 'ServerName controller'

  notify: Creating link

- name: Starting and enabling service
  service:
    name: httpd
    state: started
    enabled: true
```

```
- name: Copying admin-openrc
  copy:
    src: admin-openrc
    dest: /home/cserver/
    owner: root
    group: root

- name: Changing permission
  shell: |
    sudo chmod 755 /home/cserver/admin-openrc
    source /home/cserver/admin-openrc
```

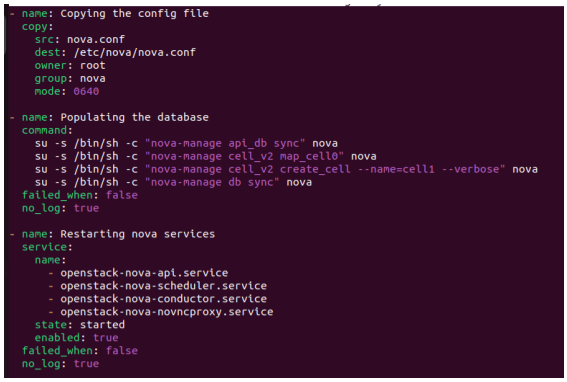
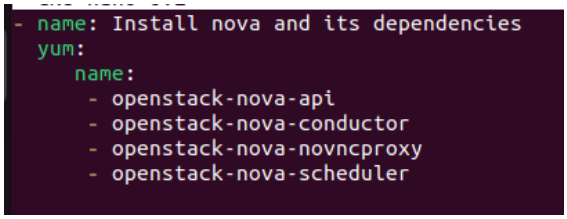
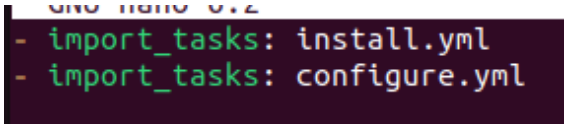
</td></tr>
</table>

		install.yml	
		main.yml	
		prereq.yml	

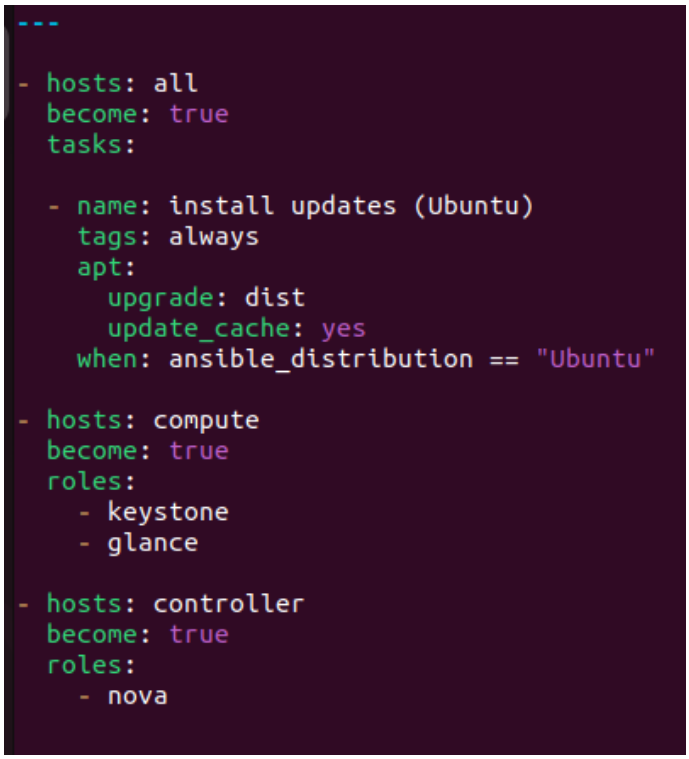
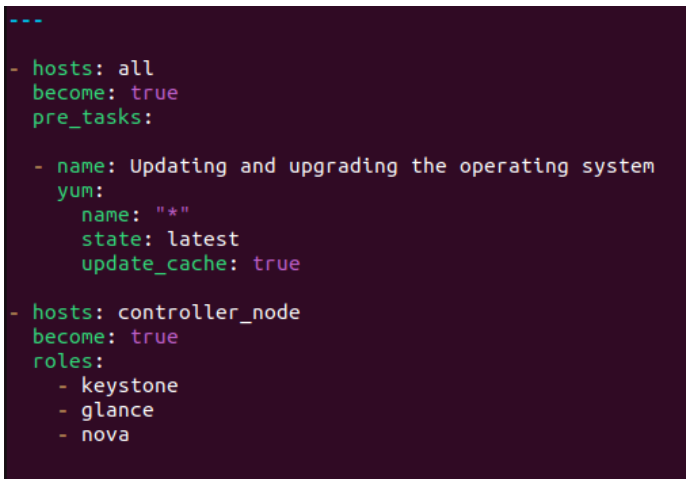
Glance		
Directory	File	Ansible Script
files	glance-api.conf	 *Note: too long to be displayed*

	tasks	configure.yml	
		install.yml	
		main.yml	

Nova		
Directory	File	Ansible Script
files	nova.conf	 *Note: too long to be displayed*

	tasks	configure.yml	
		install.yml	
		main.yml	

5. Create a playbook in the current working directory. This playbook will use the created roles for Keystone (Identity Service), Glance (Imaging Service), Nova (Compute Service).

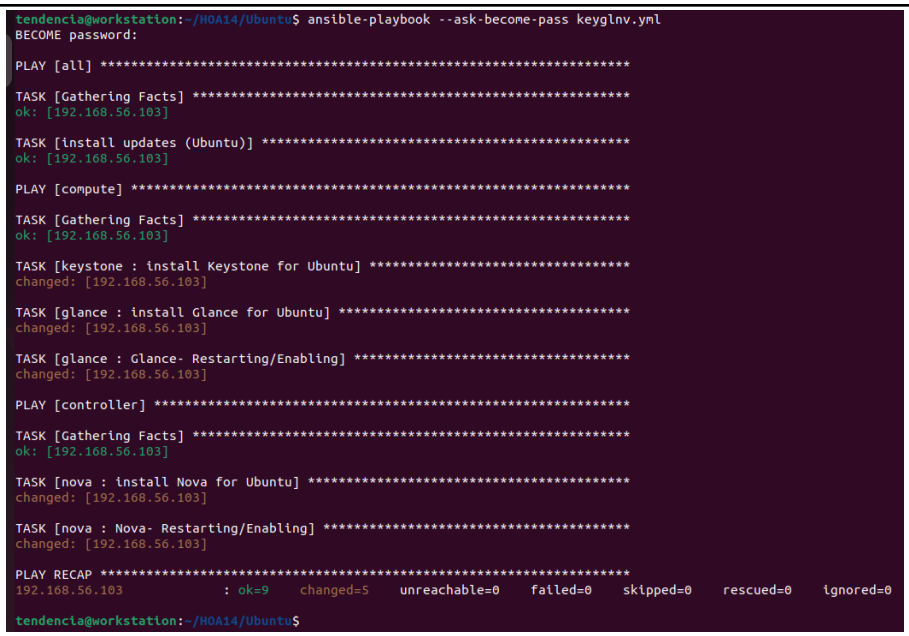
Ubuntu	
CentOS	

```yaml
---

- hosts: all
  become: true
  tasks:

  - name: install updates (Ubuntu)
    tags: always
    apt:
      upgrade: dist
      update_cache: yes
    when: ansible_distribution == "Ubuntu"

- hosts: compute
  become: true
  roles:
    - keystone
    - glance

- hosts: controller
  become: true
  roles:
    - nova
```

```yaml
---

- hosts: all
  become: true
  pre_tasks:

  - name: Updating and upgrading the operating system
    yum:
      name: "*"
      state: latest
      update_cache: true

- hosts: controller_node
  become: true
  roles:
    - keystone
    - glance
    - nova
```

6. Run the playbook to install on the target hosts using the command *ansible-playbook –ask-become-pass name-of-playbook.yml*.

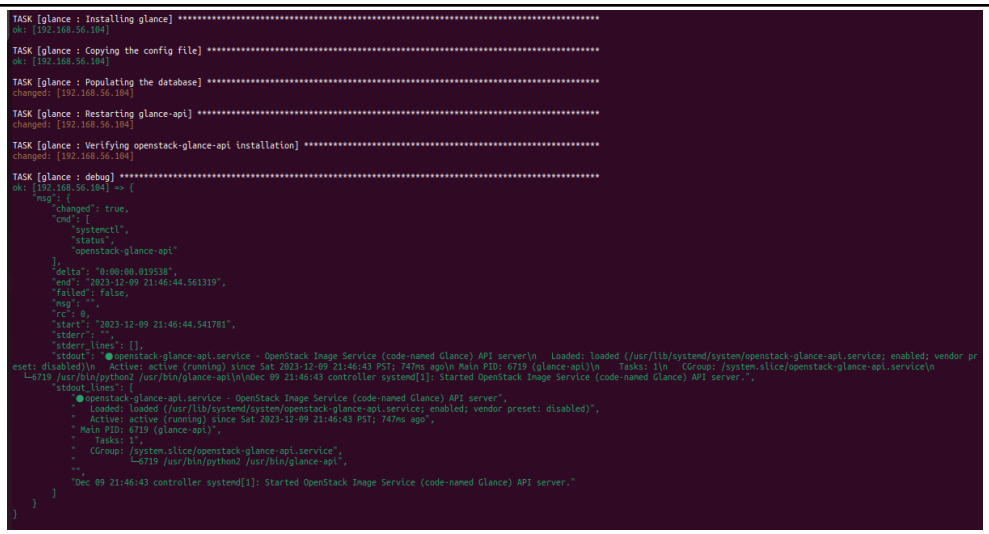
   Ubuntu:

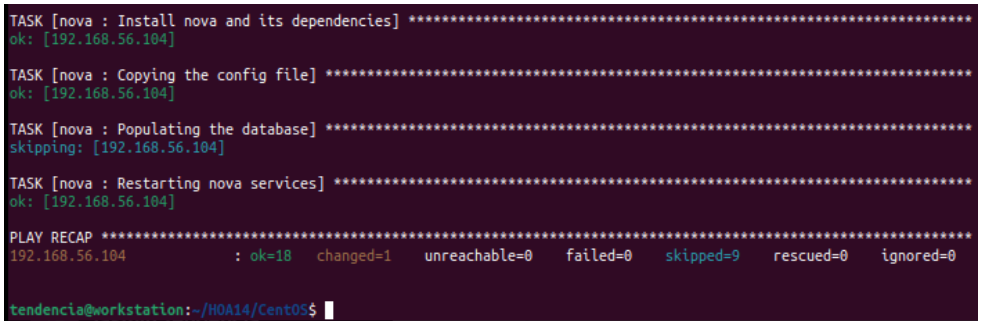

tendencia@workstation:~/HOA14/Ubuntu$ ansible-playbook --ask-become-pass keyglnv.yml
BECOME password:
PLAY [all] ***
TASK [Gathering Facts] ***
ok: [192.168.56.103]
TASK [install updates (Ubuntu)] **
ok: [192.168.56.103]
PLAY [compute] ***
TASK [Gathering Facts] ***
ok: [192.168.56.103]
TASK [keystone : install Keystone for Ubuntu] ************************************
changed: [192.168.56.103]
TASK [glance : install Glance for Ubuntu] **
changed: [192.168.56.103]
TASK [glance : Glance- Restarting/Enabling] ***************************************
changed: [192.168.56.103]
PLAY [controller] **
TASK [Gathering Facts] ***
ok: [192.168.56.103]
TASK [nova : install Nova for Ubuntu] **
changed: [192.168.56.103]
TASK [nova : Nova- Restarting/Enabling] **
changed: [192.168.56.103]
PLAY RECAP ***
192.168.56.103 : ok=9 changed=5 unreachable=0 failed=0 skipped=0 rescued=0 ignored=0
tendencia@workstation:~/HOA14/Ubuntu$

CentOS:

```
tendencia@workstation:~/HOA14/CentOS$ ansible-playbook --ask-become-pass keyglnv.yml
BECOME password:

PLAY [all] *********************************************************************************************************

TASK [Gathering Facts] *********************************************************************************************
ok: [192.168.56.104]

TASK [Updating and upgrading the operating system] *****************************************************************
ok: [192.168.56.104]

PLAY [controller_node] *********************************************************************************************

TASK [Gathering Facts] *********************************************************************************************
ok: [192.168.56.104]

TASK [keystone : Creating keystone database] ***********************************************************************
ok: [192.168.56.104]

TASK [keystone : Installing keystone and its dependencies] *********************************************************
ok: [192.168.56.104]

TASK [keystone : Configuring the connection variable] **************************************************************
ok: [192.168.56.104]

TASK [keystone : Configuring memcached variable] *******************************************************************
ok: [192.168.56.104]

TASK [keystone : Configuring the fernet variable] ******************************************************************
ok: [192.168.56.104]

TASK [keystone : Initialize fernet repositories] *******************************************************************
changed: [192.168.56.104]

TASK [keystone : Configuring setbools] *****************************************************************************
changed: [192.168.56.104]

TASK [keystone : Opening firewall for port 5000] *******************************************************************
changed: [192.168.56.104]

TASK [keystone : Configuring apache] *******************************************************************************
ok: [192.168.56.104]

TASK [keystone : Starting and enabling service] ********************************************************************
ok: [192.168.56.104]

TASK [keystone : Copying admin-openrc] *****************************************************************************
ok: [192.168.56.104]

TASK [keystone : Changing permission] ******************************************************************************
changed: [192.168.56.104]
```

```
TASK [keystone : Verifying if apache status] ***********************************************************************
changed: [192.168.56.104]

TASK [keystone : debug] ********************************************************************************************
ok: [192.168.56.104] => {
    "msg": {
        "changed": true,
        "cmd": [
            "systemctl",
            "status",
            "httpd"
        ],
        "delta": "0:00:00.013000",
        "end": "2023-12-09 21:46:34.684000",
        "failed": false,
        "msg": "",
        "rc": 0,
        "start": "2023-12-09 21:46:34.671000",
        "stderr": "",
        "stderr_lines": [],
        "stdout": "● httpd.service - The Apache HTTP Server\n   Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; vendor preset: disabled)\n   Active: active (running) since Sat 2023-12
-09 21:44:33 PST; 2min 1s ago\n     Docs: man:httpd(8)\n           man:apachectl(8)\n Main PID: 1545 (httpd)\n   Status: \"Total requests: 1; Current requests/sec: 0.1; Current traffic:   0 B/sec\"\n
    Tasks: 7\n   CGroup: /system.slice/httpd.service\n           ├─1545 /usr/sbin/httpd -DFOREGROUND\n           ├─1791 /usr/sbin/httpd -DFOREGROUND\n           ├─1793 /usr/sbin/httpd -DFOREGROUND\n
           ├─1795 /usr/sbin/httpd -DFOREGROUND\n           ├─1796 /usr/sbin/httpd -DFOREGROUND\n           ├─1797 /usr/sbin/httpd -DFOREGROUND\n           └─5707 /usr/sbin/httpd -DFOREGROUND\n\nDec 09
21:44:31 controller systemd[1]: Starting The Apache HTTP Server...\nDec 09 21:44:33 controller systemd[1]: Started The Apache HTTP Server.",
        "stdout_lines": [
            "● httpd.service - The Apache HTTP Server",
            "   Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; vendor preset: disabled)",
            "   Active: active (running) since Sat 2023-12-09 21:44:33 PST; 2min 1s ago",
            "     Docs: man:httpd(8)",
            "           man:apachectl(8)",
            " Main PID: 1545 (httpd)",
            "   Status: \"Total requests: 1; Current requests/sec: 0.1; Current traffic:   0 B/sec\"",
            "    Tasks: 7",
            "   CGroup: /system.slice/httpd.service",
            "           ├─1545 /usr/sbin/httpd -DFOREGROUND",
            "           ├─1791 /usr/sbin/httpd -DFOREGROUND",
            "           ├─1793 /usr/sbin/httpd -DFOREGROUND",
            "           ├─1795 /usr/sbin/httpd -DFOREGROUND",
            "           ├─1796 /usr/sbin/httpd -DFOREGROUND",
            "           ├─1797 /usr/sbin/httpd -DFOREGROUND",
            "           └─5707 /usr/sbin/httpd -DFOREGROUND",
            "",
            "Dec 09 21:44:31 controller systemd[1]: Starting The Apache HTTP Server...",
            "Dec 09 21:44:33 controller systemd[1]: Started The Apache HTTP Server."
        ]
    }
}
```





7. Verification of installation in both Ubuntu and CentOS by using the command *systemctl status* <>.

Ubuntu	

Keystone	`tendencia@server2:~$ pip show keystone`
	`Name: keystone`
	`Version: 21.0.1`
	`Summary: OpenStack Identity`
	`Home-page: https://docs.openstack.org/keystone/latest`
	`Author: OpenStack`
	`Author-email: openstack-discuss@lists.openstack.org`
	`License: UNKNOWN`
	`Location: /usr/lib/python3/dist-packages`
	`Requires:`
	`Required-by:`

Glance	`tendencia@server2:~$ systemctl status glance-api`
	`● glance-api.service - OpenStack Image Service API`
	`Loaded: loaded (/lib/systemd/system/glance-api.service; enabled; vendor pr>`
	`Active: active (running) since Sat 2023-12-09 22:02:09 PST; 2min 57s ago`
	`Docs: man:glance-api(1)`
	`Main PID: 2156 (glance-api)`
	`Tasks: 5 (limit: 3432)`
	`Memory: 29.0M`
	`CPU: 8.523s`
	`CGroup: /system.slice/glance-api.service`
	`├─2156 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gla>`
	`├─3150 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gla>`
	`├─3151 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gla>`
	`├─3152 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gla>`
	`└─3157 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gla>`
	`Dec 09 22:02:09 server2 systemd[1]: Started OpenStack Image Service API.`
	`lines 1-16/16 (END)`

Nova

```
tendencia@server2: ~$ systemctl status nova-compute
● nova-compute.service - OpenStack Compute
     Loaded: loaded (/lib/systemd/system/nova-compute.service; enabled; vendor >
     Active: active (running) since Sat 2023-12-09 22:02:37 PST; 2min 6s ago
   Main PID: 3508 (nova-compute)
      Tasks: 1 (limit: 3432)
     Memory: 40.3M
        CPU: 7.731s
     CGroup: /system.slice/nova-compute.service
             └─3508 /usr/bin/python3 /usr/bin/nova-compute --config-file=/etc/n>

Dec 09 22:02:37 server2 systemd[1]: Started OpenStack Compute.
Dec 09 22:02:40 server2 nova-compute[3508]: Modules with known eventlet monkey >
lines 1-12/12 (END)
```

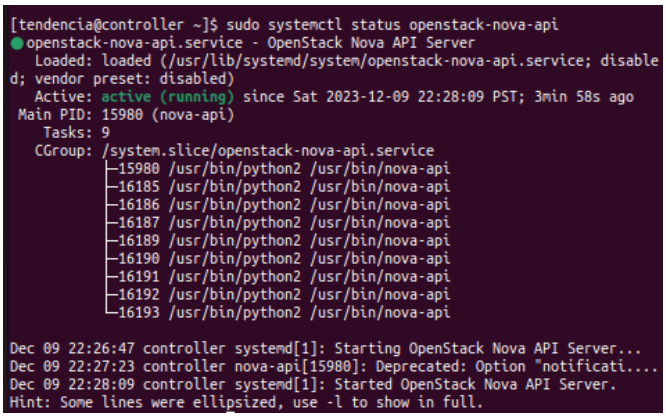
CentOS

Keystone

```
[tendencia@controller ~]$ pip show keystone
---
Metadata-Version: 1.1
Name: keystone
Version: 14.2.0
Summary: OpenStack Identity
Home-page: https://docs.openstack.org/keystone/latest
Author: OpenStack
Author-email: openstack-dev@lists.openstack.org
License: UNKNOWN
Location: /usr/lib/python2.7/site-packages
Requires:
Classifiers:
  Environment :: OpenStack
  Intended Audience :: Information Technology
  Intended Audience :: System Administrators
  License :: OSI Approved :: Apache Software License
  Operating System :: POSIX :: Linux
  Programming Language :: Python
  Programming Language :: Python :: 2
  Programming Language :: Python :: 2.7
  Programming Language :: Python :: 3
  Programming Language :: Python :: 3.5
Entry-points:
  [console_scripts]
  keystone-manage = keystone.cmd.manage:main
  [keystone.application_credential]
  sql = keystone.application_credential.backends.sql:ApplicationCredential
  [keystone.assignment]
  sql = keystone.assignment.backends.sql:Assignment
  [keystone.auth.application_credential]
  default = keystone.auth.plugins.application_credential:ApplicationCredential
  [keystone.auth.external]
  DefaultDomain = keystone.auth.plugins.external:DefaultDomain
  Domain = keystone.auth.plugins.external:Domain
  default = keystone.auth.plugins.external:DefaultDomain
  [keystone.auth.kerberos]
  default = keystone.auth.plugins.external:KerberosDomain
  [keystone.auth.mapped]
  default = keystone.auth.plugins.mapped:Mapped
  [keystone.auth.oauth1]
  default = keystone.auth.plugins.oauth1:OAuth
  [keystone.auth.openid]
  default = keystone.auth.plugins.mapped:Mapped
  [keystone.auth.password]
  default = keystone.auth.plugins.password:Password
  [keystone.auth.saml2]
```

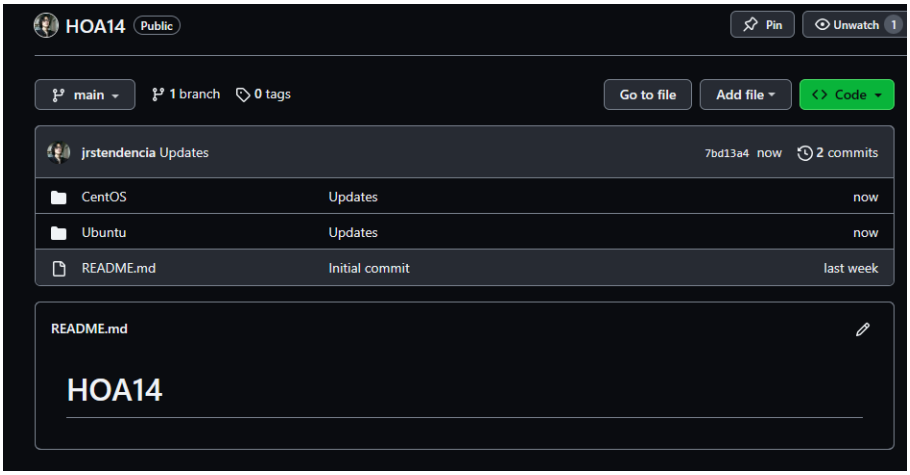
Glance

```
[tendencia@controller ~]$ sudo systemctl status openstack-glance-api
● openstack-glance-api.service - OpenStack Image Service (code-named Glance) A
PI server
   Loaded: loaded (/usr/lib/systemd/system/openstack-glance-api.service; enabl
ed; vendor preset: disabled)
   Active: active (running) since Sat 2023-12-09 22:21:31 PST; 344ms ago
 Main PID: 15064 (glance-api)
    Tasks: 1
   CGroup: /system.slice/openstack-glance-api.service
           └─15064 /usr/bin/python2 /usr/bin/glance-api

Dec 09 22:21:31 controller systemd[1]: Started OpenStack Image Service (co....
Hint: Some lines were ellipsized, use -l to show in full.
[tendencia@controller ~]$
```

	Nova	

8. Sync changes in github.

```
tendencia@workstation:~/HOA14$ git add *
tendencia@workstation:~/HOA14$ git commit -m "Updates"
[main 7bd13a4] Updates
 23 files changed, 18534 insertions(+)
 create mode 100644 CentOS/ansible.cfg
 create mode 100644 CentOS/inventory
 create mode 100644 CentOS/keyglnv.yml
 create mode 100644 CentOS/roles/glance/files/glance-api.conf
 create mode 100644 CentOS/roles/glance/tasks/configure.yml
 create mode 100644 CentOS/roles/glance/tasks/install.yml
 create mode 100644 CentOS/roles/glance/tasks/main.yml
 create mode 100644 CentOS/roles/keystone/files/admin-openrc
 create mode 100644 CentOS/roles/keystone/handlers/main.yml
 create mode 100644 CentOS/roles/keystone/tasks/configure.yml
 create mode 100644 CentOS/roles/keystone/tasks/install.yml
 create mode 100644 CentOS/roles/keystone/tasks/main.yml
 create mode 100644 CentOS/roles/keystone/tasks/prereq.yml
 create mode 100644 CentOS/roles/nova/files/nova.conf
 create mode 100644 CentOS/roles/nova/tasks/configure.yml
 create mode 100644 CentOS/roles/nova/tasks/install.yml
 create mode 100644 CentOS/roles/nova/tasks/main.yml
 create mode 100644 Ubuntu/ansible.cfg
 create mode 100644 Ubuntu/inventory
 create mode 100644 Ubuntu/keyglnv.yml
 create mode 100644 Ubuntu/roles/glance/tasks/main.yml
 create mode 100644 Ubuntu/roles/keystone/tasks/main.yml
 create mode 100644 Ubuntu/roles/nova/tasks/main.yml
tendencia@workstation:~/HOA14$ git push origin main
Enumerating objects: 45, done.
Counting objects: 100% (45/45), done.
Delta compression using up to 2 threads
Compressing objects: 100% (34/34), done.
Writing objects: 100% (44/44), 145.26 KiB | 546.00 KiB/s, done.
Total 44 (delta 2), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (2/2), done.
To github.com:jrstendencia/HOA14.git
   1c866ee..7bd13a4  main -> main
tendencia@workstation:~/HOA14$ git status
On branch main
Your branch is up to date with 'origin/main'.

nothing to commit, working tree clean
tendencia@workstation:~/HOA14$
```



Reflections:

Answer the following:

1. Describe Keystone, Glance and Nova services
    - In the preceding task, the student gained an introduction to OpenStack, an open-source cloud software platform offering both private and public cloud infrastructure as a service (IaaS) solution. This platform comprises components that empower users to manipulate various elements, including the Identity Service, Compute Service, and Imaging Service. In the current activity, three specific components are explored: Keystone, serving as an OpenStack Identity management service, implements customizable authentication and authorization. It validates user/project credentials, manages user databases similar to Apache2, and facilitates service discovery for users. Simultaneously, it collaborates with Imaging/Virtual Machine Image Management Services like Glance. Glance allows users to discover, retrieve, and register Virtual Machine Images and Container Images, usable as storage backend services between Switch or Ceph. Given that Glance exclusively supports image services, the introduction of Nova becomes necessary. Nova is a key element of the IaaS system, designed to handle computing, networking, storage, image services, and provide swift access to computing resources. This functionality is integral to managing the virtual machine server.

Conclusions:

This current task, titled 'OpenStack Installation (Keystone, Glance, Nova),' builds upon the preceding task, 'OpenStack Prerequisite Installation.' In the prior activity, students installed specific OpenStack components, namely keystone, serving as the Identity Management Service. Keystone facilitates customizable authentication and authorization for verification purposes, managing user databases using Apache in this instance. Additionally, glance, functioning as the Image Management Service, enables users to discover, retrieve, and register Virtual Machine Images and Container Images. Lastly, nova, the Computation Management Service, was essential because Glance solely supports image services. Nova is utilized to perform image services and ensure quick access to resources for the Virtual Machine Server.