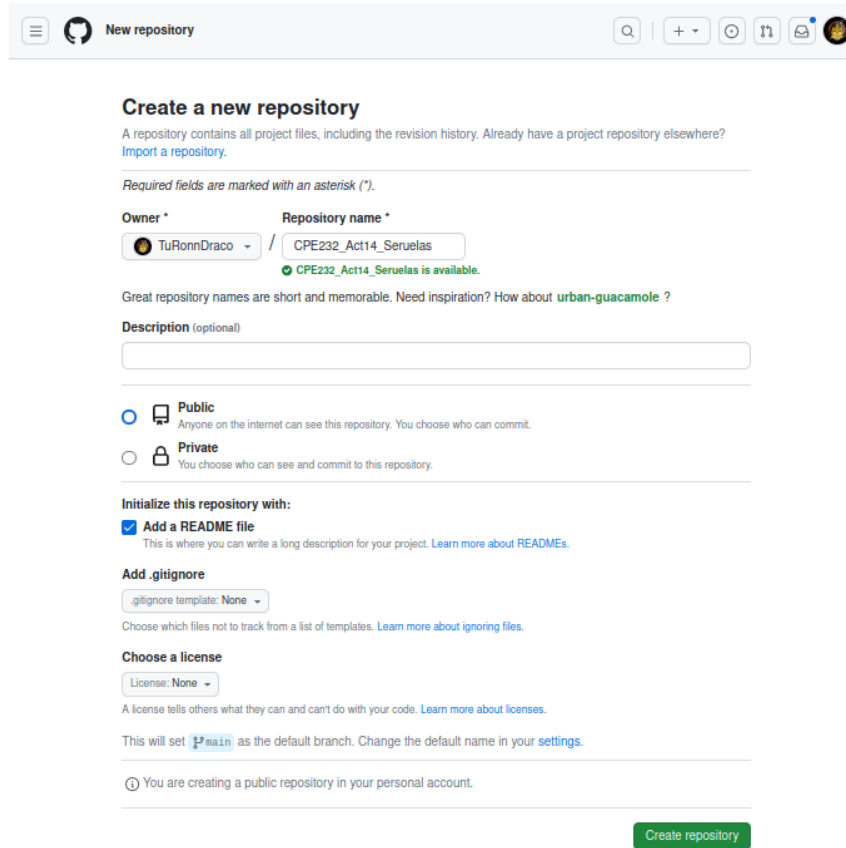


| | |
|--|---|
| Name: Seruelas, Ronn Kristoper H. | Date Performed: 11-21-2023 |
| Course/Section: CPE 232 - CPE31S4 | Date Submitted: 12-05-2023 |
| Instructor: Dr. Jonathan V. Taylar | Semester and SY: 1st Sem. 2023-2024 |
| Activity 14: OpenStack Installation (Keystone, Glance, Nova) | |
| 1. Objectives | |
| Create a workflow to install OpenStack using Ansible as your Infrastructure as Code (IaC). | |
| 2. Intended Learning Outcomes | |
| <ol style="list-style-type: none"> 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 | |
| <p>Oracle VirtualBox (Hypervisor)</p> <p>1x Ubuntu VM or Centos VM</p> | |
| 4. Tasks | |
| <ol style="list-style-type: none"> 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/ <ol style="list-style-type: none"> 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. Setup Github Repository and Clone to Local Repository or Workstation.



The screenshot shows the 'Create a new repository' page on GitHub. The form includes fields for 'Owner' (TuRonDraco), 'Repository name' (CPE232_Act14_Seruelas), and a 'Description' (optional). The repository is set to 'Public'. Under 'Initialize this repository with:', the 'Add a README file' checkbox is checked. The '.gitignore' template is set to 'None'. The 'Choose a license' dropdown is set to 'None'. A green 'Create repository' button is at the bottom right.

Figure 1.1 - Creation of Github Repository

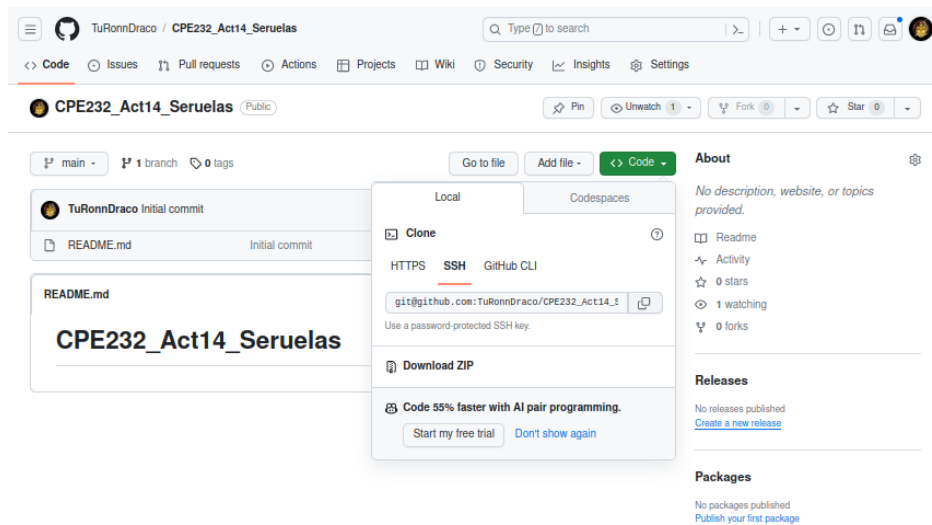


Figure 1.2 - Github Repository creation, with SSH KEY

```
seruelas@Workstation: ~/CPE232_Act14_Seruelas
seruelas@Workstation:~$ git clone git@github.com:TuRonnDraco/CPE232_Act14_Seruelas.git
Cloning into 'CPE232_Act14_Seruelas'...
The authenticity of host 'github.com (20.205.243.166)' can't be established.
ED25519 key fingerprint is SHA256:+DiY3wvV6TuJJhbpZisF/zLDA0zPMSvHdkr4UvCQqU.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'github.com' (ED25519) to the list of known hosts.
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.
seruelas@Workstation:~$ ls
CPE232_Act14_Seruelas  Documents  Music      Public  Templates
Desktop               Downloads  Pictures  snap    Videos
seruelas@Workstation:~$ cd CPE232_Act14_Seruelas
seruelas@Workstation:~/CPE232_Act14_Seruelas$ git status
On branch main
Your branch is up to date with 'origin/main'.

nothing to commit, working tree clean
```

Figure 1.3 - Cloning of Github Repository to Local Workstation

```
seruelas@Workstation: ~/CPE232_Act14_Seruelas
GNU nano 6.2 ansible.cfg
[defaults]

inventory = inventory
host_key_checking = False

deprecation_warning = False

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

Figure 1.4 - Setting up of Ansible Configuration

2. Setup installation of Keystone, Glance, and Nova for Controller (Ubuntu)

```
seruelas@Workstation: ~/CPE232_Act14_Seruelas
GNU nano 6.2 inventory
[Controller]
Ubuntu_Server
```

Figure 2.1 - Specification of Ubuntu_Server as Controller

```
seruelas@Workstation: ~/CPE232_Act14_Seruelas
seruelas@Workstation:~/CPE232_Act14_Seruelas$ mkdir roles roles/Keystone
roles/Keystone/tasks roles/Glance roles/Glance/tasks roles/Nova roles/N
ova/tasks
seruelas@Workstation:~/CPE232_Act14_Seruelas$ touch roles/Keystone/tasks
/main.yml roles/Glance/tasks/main.yml roles/Nova/tasks/main.yml
seruelas@Workstation:~/CPE232_Act14_Seruelas$ tree roles
roles
├── Glance
│   └── tasks
│       └── main.yml
├── Keystone
│   └── tasks
│       └── main.yml
└── Nova
    └── tasks
        └── main.yml
```

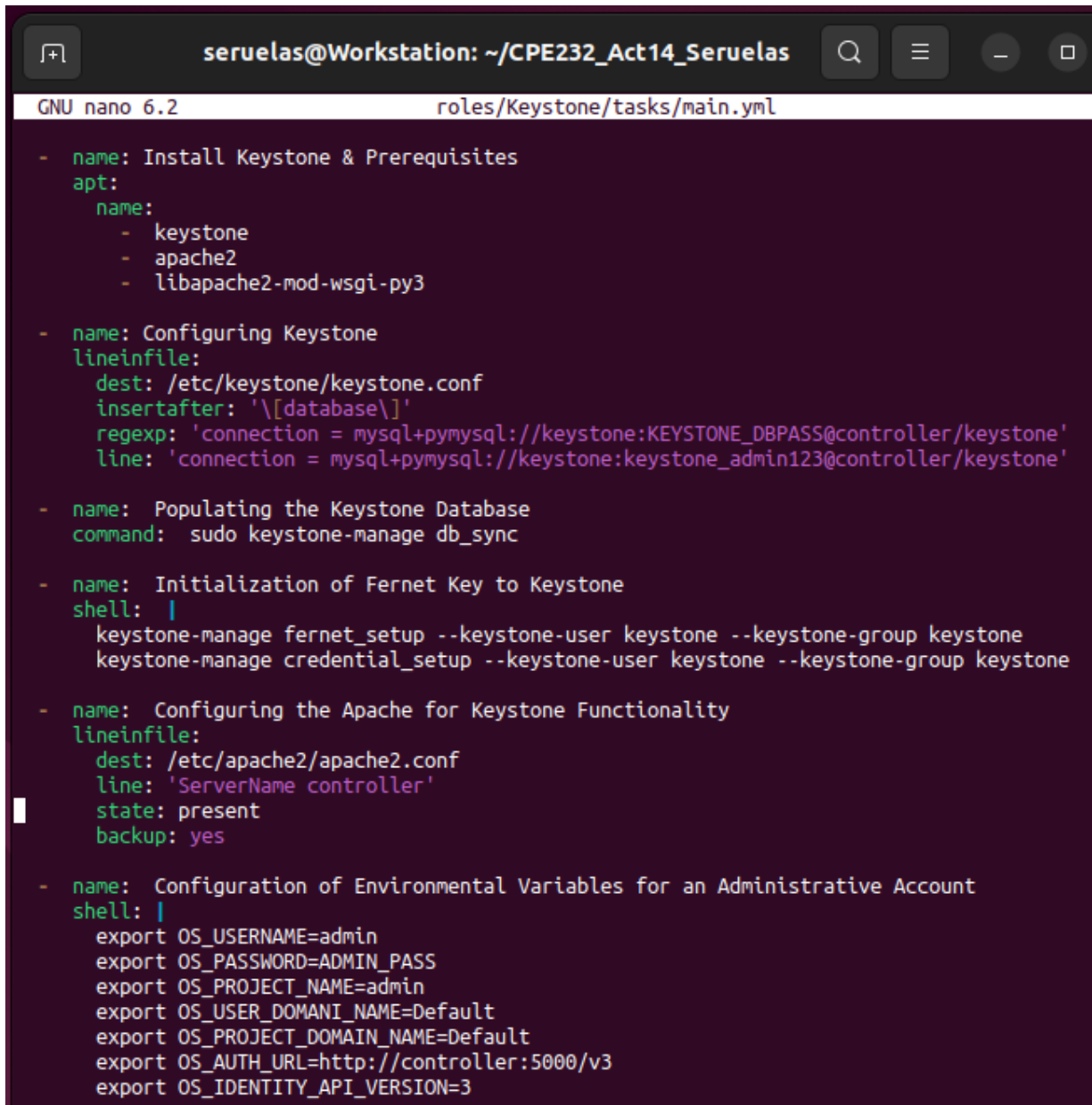
Figure 2.2 - Creation of roles for each installation of Controller

```
GNU nano 6.2      install_openstack_kgn.yaml
--
- hosts: all
  become: true
  pre_tasks:
    - name: Install Updates (Ubuntu)
      apt:
        upgrade: dist
        update_cache: yes
      when: ansible_distribution == "Ubuntu"

- hosts: Controller
  become: true
  roles:
    - Keystone
    - Glance
    - Nova
```

Figure 2.3 - Creation of Playbook with specified roles for Controller

3. Setup the roles for installation of KGN to Controller.



```
GNU nano 6.2 roles/Keystone/tasks/main.yml

- name: Install Keystone & Prerequisites
  apt:
    name:
      - keystone
      - apache2
      - libapache2-mod-wsgi-py3

- name: Configuring Keystone
  lineinfile:
    dest: /etc/keystone/keystone.conf
    insertafter: '\[database\]'
    regexp: 'connection = mysql+pymysql://keystone:KEYSTONE_DBPASS@controller/keystone'
    line: 'connection = mysql+pymysql://keystone:keystone_admin123@controller/keystone'

- name: Populating the Keystone Database
  command: sudo keystone-manage db_sync

- name: Initialization of Fernet Key to Keystone
  shell: |
    keystone-manage fernet_setup --keystone-user keystone --keystone-group keystone
    keystone-manage credential_setup --keystone-user keystone --keystone-group keystone

- name: Configuring the Apache for Keystone Functionality
  lineinfile:
    dest: /etc/apache2/apache2.conf
    line: 'ServerName controller'
    state: present
    backup: yes

- name: Configuration of Environmental Variables for an Administrative Account
  shell: |
    export OS_USERNAME=admin
    export OS_PASSWORD=ADMIN_PASS
    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
```

Figure 3.1 - Installation of Keystone

```
seruelas@Workstation: ~/CPE232_Act14_...
GNU nano 6.2 roles/Glance/tasks/main.yml

- name: Installation of Glance
  apt:
    name: glance

- name: Configuring Glance's Connection
  replace:
    dest: /etc/glance/glance-api.conf
    regexp: connection = mysql+pymysql://glance:GLANCE_DBPASS@controller/glance
    replace: connection = mysql+pymysql://glance:admin123@controller/glance

- name: Configuring Glance's Authentication Token
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[keystone_authtoken\]'
    line: "[[ item ]]"
    state: present
  with_items:
    - 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 = glance
    - password = glance_admin123

- name: Configuring Glance Flavor in paste_deploy
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[paste_deploy\]'
    line: 'flavor = keystone'

- name: Configure Glance glance_store
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[glance_store\]'
    line: "[[ item ]]"
    state: present
  with_items:
    - stores = file,http
    - default_store = file
    - filesystem_store_datadir = /var/lib/glance/images/

- name: Configure Glance oslo_limit
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[oslo_limit\]'
    line: "[[ item ]]"
    state: present
  with_items:
    - auth_url = http://controller:5000
    - auth_type = password
    - user_domain_id = default
    - username = MY_SERVICE
    - system_scope = all
    - password = MY_PASSWORD
    - endpoint_id = ENDPOINT_ID
    - region_name = RegionOne

- name: Configure Glance DEFAULT
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[DEFAULT\]'
    line: 'use_keystone_limits = True'

- name: Populating Image Service Database
  command: sudo glance-manage db_sync

- name: Restart Glance Service
  systemd:
    name: glance-api
    state: restarted
    enabled: true
```

Figure 3.2 - Installation of Glance



seruelas@Workstation: ~/CPE232_Act14_...



GNU nano 6.2

roles/Nova/tasks/main.yml

```
- name: Installing Nova & Prerequisites
  apt:
    name:
      - nova-api
      - nova-conductor
      - nova-novncproxy
      - nova-scheduler
    state: latest

- name: Configuring Nova API Access
  lineinfile:
    dest: /etc/nova/nova.conf
    regexp: connection = mysql+pymysql://nova:NOVA_DBPASS@controller/nova_api
    line: connection = mysql+pymysql://nova:nova_admin123@controller/nova_api

- name: Configure Nova Authentication Strategy
  lineinfile:
    dest: /etc/nova/nova.conf
    insertafter: '\[api\]'
    line: 'auth_strategy = keystone'
    state: present

- name: Configuring Nova Database
  lineinfile:
    dest: /etc/nova/nova.conf
    regexp: mysql+pymysql://nova:NOVA_DBPASS@controller/nova
    line: mysql+pymysql://nova:nova_admin123@controller/nova

- name: Configure Nova Authentication Token (for Keystone)
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[keystone_authtoken\]'
    line: "{{ item }}"
    state: present
  with_items:
    - 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 = nova
    - password = nova_admin123

- name: Configure Nova VNC configuration
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[vnc\]'
    line: "{{ item }}"
    state: present
  with_items:
    - enabled = true
    - server_listen = $my_ip
    - server_proxyclient_address = $my_ip
```

```

- name: Configure Nova placement configuration
  lineinfile:
    dest: /etc/glance/glance-api.conf
    insertafter: '\[placement\]'
    line: "{{ item }}"
    state: present
  with_items:
    - region_name = RegionOne
    - project_domain_name = Default
    - project_name = service
    - auth_type = password
    - user_domain_name = Default
    - auth_url = http://controller:5000/v3
    - username = placement
    - password = placement_admin123

- name: Configure DEFAULT configuration
  lineinfile:
    dest: /etc/nova/nova.conf
    line: 'my_ip = 10.0.0.11'
    state: present

- name: Configure Nova Glance
  lineinfile:
    dest: /etc/nova/nova.conf
    line: 'api_server = http://controller:9292'
    state: present

- name: Configure Nova oslo_concurrency
  lineinfile:
    dest: /etc/nova/nova.conf
    line: 'lock_path = /var/lib/nova/tmp'
    state: present

- name: Population of Nova-API Database
  shell: sudo nova-manage api_db sync

- name: Registration of cell0 Database
  shell: sudo nova-manage cell_v2 map_cell0

- name: Repopulating Nova-API Database
  shell: sudo nova-manage db sync

- name: Verification of Nova-API
  shell: sudo nova-manage cell_v2 list_cells

- name: Restart Nova Services
  systemd:
    name: "{{ item }}"
    state: restarted
    enabled: true
  loop:
    - nova-api
    - nova-scheduler
    - nova-conductor
    - nova-novncproxy

```

Figure 3.3-4 - Installation of Nova

4. Install and Verify the Installations.

```
seruelas@Workstation: ~/CPE232_Act14_...
seruelas@Workstation:~/CPE232_Act14_Seruelas$ ansible-playbook --ask-become-pass install_openstack_kgn.yaml
BECOME password:

PLAY [all] *****

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

TASK [Install Updates (Ubuntu)] *****
ok: [Ubuntu_Server]

PLAY [Controller] *****

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

TASK [Keystone : Install Keystone & Prerequisites] *****
changed: [Ubuntu_Server]

TASK [Keystone : Configuring Keystone] *****
changed: [Ubuntu_Server]

TASK [Keystone : Populating the Keystone Database] *****
[WARNING]: Consider using 'become', 'become_method', and 'become_user' rather than running sudo
changed: [Ubuntu_Server]

TASK [Keystone : Initialization of Fernet Key to Keystone] *****
changed: [Ubuntu_Server]

TASK [Keystone : Configuring the Apache for Keystone Functionality] *****
changed: [Ubuntu_Server]

TASK [Keystone : Configuration of Environmental Variables for an Administrative Account] *****
changed: [Ubuntu_Server]

TASK [Glance : Installation of Glance] *****
changed: [Ubuntu_Server]

TASK [Glance : Configuring Glance's Connection] *****
ok: [Ubuntu_Server]

TASK [Glance : Configuring Glance Flavor in paste_deploy] *****
changed: [Ubuntu_Server]

TASK [Glance : Configure Glance glance_store] *****
changed: [Ubuntu_Server] => (item=stores = file,http)
changed: [Ubuntu_Server] => (item=default_store = file)
changed: [Ubuntu_Server] => (item=filesystem_store_datadir = /var/lib/glance/images/)

TASK [Glance : Configure Glance oslo_limit] *****
ok: [Ubuntu_Server] => (item=auth_url = http://controller:5000)
ok: [Ubuntu_Server] => (item=auth_type = password)
changed: [Ubuntu_Server] => (item=user_domain_id = default)
changed: [Ubuntu_Server] => (item=username = MY_SERVICE)
changed: [Ubuntu_Server] => (item=system_scope = all)
changed: [Ubuntu_Server] => (item=password = MY_PASSWORD)
changed: [Ubuntu_Server] => (item=endpoint_id = ENDPOINT_ID)
changed: [Ubuntu_Server] => (item=region_name = RegionOne)

TASK [Glance : Configure Glance DEFAULT] *****
changed: [Ubuntu_Server]

TASK [Glance : Populating Image Service Database] *****
changed: [Ubuntu_Server]

TASK [Glance : Restart Glance Service] *****
changed: [Ubuntu_Server]
```

```

TASK [Nova : Installing Nova & Prerequisites] *****
changed: [Ubuntu_Server]

TASK [Nova : Configuring Nova API Access] *****
changed: [Ubuntu_Server]

TASK [Nova : Configure Nova Authentication Strategy] *****
changed: [Ubuntu_Server]

TASK [Nova : Configuring Nova Database] *****
changed: [Ubuntu_Server]

TASK [Nova : Configure Nova Authentication Token (for Keystone)] *****
changed: [Ubuntu_Server] => (item=www_authenticate_uri = http://controller:5000/)
changed: [Ubuntu_Server] => (item=auth_url = http://controller:5000/)
ok: [Ubuntu_Server] => (item=memcached_servers = controller:11211)
ok: [Ubuntu_Server] => (item=auth_type = password)
ok: [Ubuntu_Server] => (item=project_domain_name = Default)
ok: [Ubuntu_Server] => (item=user_domain_name = Default)
ok: [Ubuntu_Server] => (item=project_name = service)
changed: [Ubuntu_Server] => (item=username = nova)
changed: [Ubuntu_Server] => (item=password = nova_admin123)

TASK [Nova : Configure Nova VNC configuration] *****
changed: [Ubuntu_Server] => (item=enabled = true)
changed: [Ubuntu_Server] => (item=server_listen = $my_ip)
changed: [Ubuntu_Server] => (item=server_proxyclient_address = $my_ip)

TASK [Nova : Configure Nova placement configuration] *****
ok: [Ubuntu_Server] => (item=region_name = RegionOne)
ok: [Ubuntu_Server] => (item=project_domain_name = Default)
ok: [Ubuntu_Server] => (item=project_name = service)
ok: [Ubuntu_Server] => (item=auth_type = password)
ok: [Ubuntu_Server] => (item=user_domain_name = Default)
changed: [Ubuntu_Server] => (item=auth_url = http://controller:5000/v3)
changed: [Ubuntu_Server] => (item=username = placement)
changed: [Ubuntu_Server] => (item=password = placement_admin123)

TASK [Nova : Configure DEFAULT configuration] *****
changed: [Ubuntu_Server]

TASK [Nova : Configure Nova Glance] *****
changed: [Ubuntu_Server]

TASK [Nova : Configure Nova oslo_concurrency] *****
changed: [Ubuntu_Server]

TASK [Nova : Population of Nova-API Database] *****
changed: [Ubuntu_Server]

TASK [Nova : Registration of cell0 Database] *****
changed: [Ubuntu_Server]

TASK [Nova : Repopulating Nova-API Database] *****
changed: [Ubuntu_Server]

TASK [Nova : Verification of Nova-API] *****
changed: [Ubuntu_Server]

TASK [Nova : Restart Nova Services] *****
changed: [Ubuntu_Server] => (item=nova-api)
changed: [Ubuntu_Server] => (item=nova-scheduler)
changed: [Ubuntu_Server] => (item=nova-conductor)
changed: [Ubuntu_Server] => (item=nova-novncproxy)

PLAY RECAP *****
Ubuntu_Server      : ok=33  changed=29  unreachable=0  failed=0  skipped=0  rescue=0
ed=0  ignored=0

```

Figure 4.1-2 - Play Recap of Playbook

```
seruelas@Ubuntu: ~  
seruelas@Ubuntu:~$ keystone-manage --version  
21.0.1
```

Figure 4.3 - Verification of Keystone through Version

```
seruelas@Ubuntu: ~  
seruelas@Ubuntu:~$ 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 08:38:13 +08; 29min ago  
     Docs: man:glance-api(1)  
  Main PID: 32557 (glance-api)  
    Tasks: 3 (limit: 2261)  
  Memory: 53.0M  
     CPU: 20.441s  
   CGroup: /system.slice/glance-api.service  
           └─32557 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gl>  
             └─32593 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gl>  
               └─32594 /usr/bin/python3 /usr/bin/glance-api --config-file=/etc/gl>
```

Figure 4.4 - Verification of Glance through SystemCTL

```
seruelas@Ubuntu: ~  
seruelas@Ubuntu:~$ systemctl status nova-api  
● nova-api.service - OpenStack Compute API  
   Loaded: loaded (/lib/systemd/system/nova-api.service; enabled; vendor pres>  
   Active: active (running) since Sat 2023-12-09 08:43:01 +08; 25min ago  
     Docs: man:nova-api(1)  
  Main PID: 42776 (nova-api)  
    Tasks: 5 (limit: 2261)  
  Memory: 198.1M  
     CPU: 21.095s  
   CGroup: /system.slice/nova-api.service  
           └─42776 /usr/bin/python3 /usr/bin/nova-api --config-file=/etc/nova>  
             └─42896 /usr/bin/python3 /usr/bin/nova-api --config-file=/etc/nova>  
               └─42897 /usr/bin/python3 /usr/bin/nova-api --config-file=/etc/nova>  
                 └─42903 /usr/bin/python3 /usr/bin/nova-api --config-file=/etc/nova>  
                   └─42904 /usr/bin/python3 /usr/bin/nova-api --config-file=/etc/nova>
```

```
seruelas@Ubuntu: ~  
seruelas@Ubuntu:~$ systemctl status nova-scheduler  
● nova-scheduler.service - OpenStack Compute Scheduler  
   Loaded: loaded (/lib/systemd/system/nova-scheduler.service; enabled; vendor  
   Active: active (running) since Sat 2023-12-09 09:08:56 +08; 1s ago  
     Docs: man:nova-scheduler(1)  
  Main PID: 48297 (nova-scheduler)  
    Tasks: 1 (limit: 2261)  
   Memory: 49.3M  
      CPU: 1.381s  
   CGroup: /system.slice/nova-scheduler.service  
           └─48297 /usr/bin/python3 /usr/bin/nova-scheduler --config-file=/etc
```

```
seruelas@Ubuntu: ~  
seruelas@Ubuntu:~$ systemctl status nova-conductor  
● nova-conductor.service - OpenStack Compute Conductor  
   Loaded: loaded (/lib/systemd/system/nova-conductor.service; enabled; vendor  
   Active: active (running) since Sat 2023-12-09 09:09:07 +08; 1s ago  
     Docs: man:nova-conductor(1)  
  Main PID: 48334 (nova-conductor)  
    Tasks: 1 (limit: 2261)  
   Memory: 44.5M  
      CPU: 1.397s  
   CGroup: /system.slice/nova-conductor.service  
           └─48334 /usr/bin/python3 /usr/bin/nova-conductor --config-file=/etc
```

```
seruelas@Ubuntu: ~  
seruelas@Ubuntu:~$ systemctl status nova-novncproxy  
● nova-novncproxy.service - OpenStack Compute novncproxy  
   Loaded: loaded (/lib/systemd/system/nova-novncproxy.service; enabled; vendor  
   Active: active (running) since Sat 2023-12-09 08:43:09 +08; 26min ago  
     Docs: man:nova-novncproxy(1)  
  Main PID: 42883 (nova-novncproxy)  
    Tasks: 1 (limit: 2261)  
   Memory: 83.0M  
      CPU: 2.989s  
   CGroup: /system.slice/nova-novncproxy.service  
           └─42883 /usr/bin/python3 /usr/bin/nova-novncproxy --config-file=/etc
```

Figure 4.5-8 - Verification of Nova through SystemCTL

5. Push and Save all to the GitHub Repository.

```
seruelas@Workstation: ~/CPE232_Act14_...
seruelas@Workstation:~/CPE232_Act14_Seruelas$ git status
On branch main
Your branch is up to date with 'origin/main'.

Changes not staged for commit:
  (use "git add <file>..." to update what will be committed)
  (use "git restore <file>..." to discard changes in working directory)
        modified:   roles/Glance/tasks/main.yml

no changes added to commit (use "git add" and/or "git commit -a")
seruelas@Workstation:~/CPE232_Act14_Seruelas$ git add *
seruelas@Workstation:~/CPE232_Act14_Seruelas$ git commit -m "12-09-2023, at 10:22am"
[main 2e38916] 12-09-2023, at 10:22am
Committer: seruelas <seruelas@Workstation.myguest.virtualbox.org>
Your name and email address were configured automatically based
on your username and hostname. Please check that they are accurate.
You can suppress this message by setting them explicitly. Run the
following command and follow the instructions in your editor to edit
your configuration file:

    git config --global --edit

After doing this, you may fix the identity used for this commit with:

    git commit --amend --reset-author

1 file changed, 16 insertions(+), 16 deletions(-)
seruelas@Workstation:~/CPE232_Act14_Seruelas$ git push origin
Enumerating objects: 11, done.
Counting objects: 100% (11/11), done.
Delta compression using up to 2 threads
Compressing objects: 100% (4/4), done.
Writing objects: 100% (6/6), 598 bytes | 598.00 KiB/s, done.
Total 6 (delta 2), reused 0 (delta 0), pack-reused 0
remote: Resolving deltas: 100% (2/2), completed with 2 local objects.
To github.com:TuRonnDraco/CPE232_Act14_Seruelas.git
   5ea7e2b..2e38916  main -> main
```

Figure 5.1 - Pushing the Local Repository to the GitHub Repository.

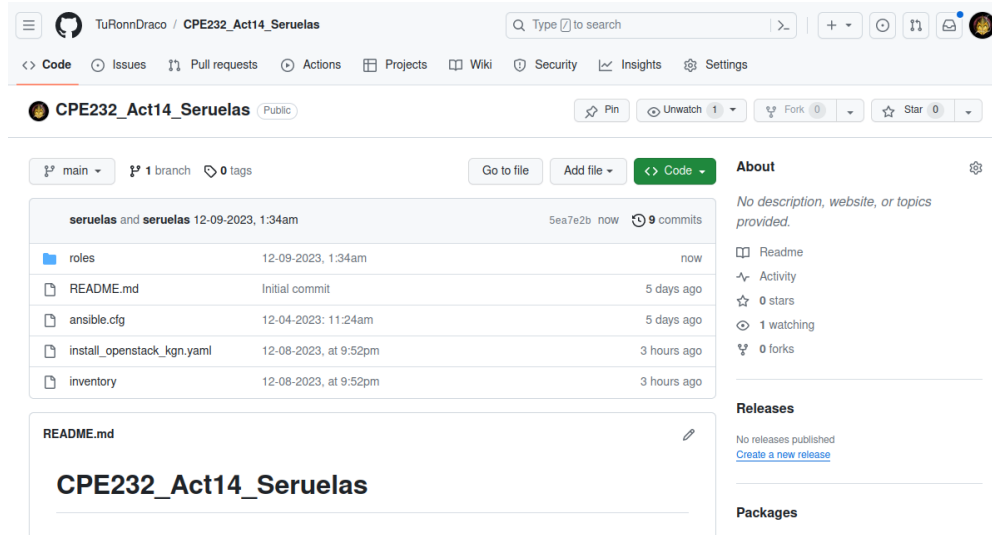


Figure 5.2 - GitHub Repository after Saving

https://github.com/TuRonnDraco/CPE232_Act14_Seruelas

Reflections:

Answer the following:

1. Describe Keystone, Glance and Nova services.

- Keystone offers the administrators an API client authentication and service discovery, while Glance is a storage backend that uses an image service to contain and to host containerization, and Nova is a virtual server service allowing to contain and support different daemons, hosted by Openstack. Keystone, Glance, and Nova require the usage of MariaDB and configuration in order for it to properly work.

Conclusions:

In this activity, we were able to learn the importance of OpenStack and the services that OpenStack offers to an administrator. We learned that Keystone allows authentication, while Glance and Nova is used as a service to hold containerization or virtual services via image. To conclude this activity, we were able to install and to utilize the OpenStack Keystone, Glance and Nova in our Controller node.