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Course/Section: CPE 232 - CPE31S5	**Date Submitted:** December 2, 2023
Instructor: Engr. Roman Richard	**Semester and SY:** 1st semester S.Y 2023-2024

Activity 13: OpenStack Prerequisite Installation

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.

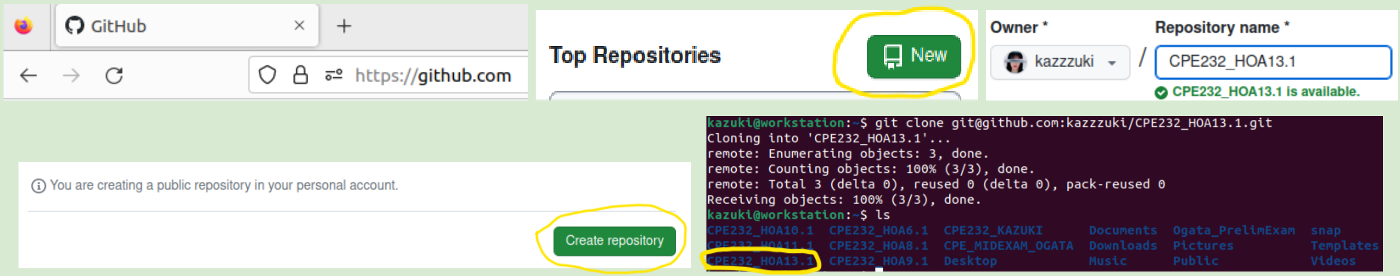
3. Resources

Oracle VirtualBox (Hypervisor)
1x Ubuntu VM or Centos VM

4. Tasks

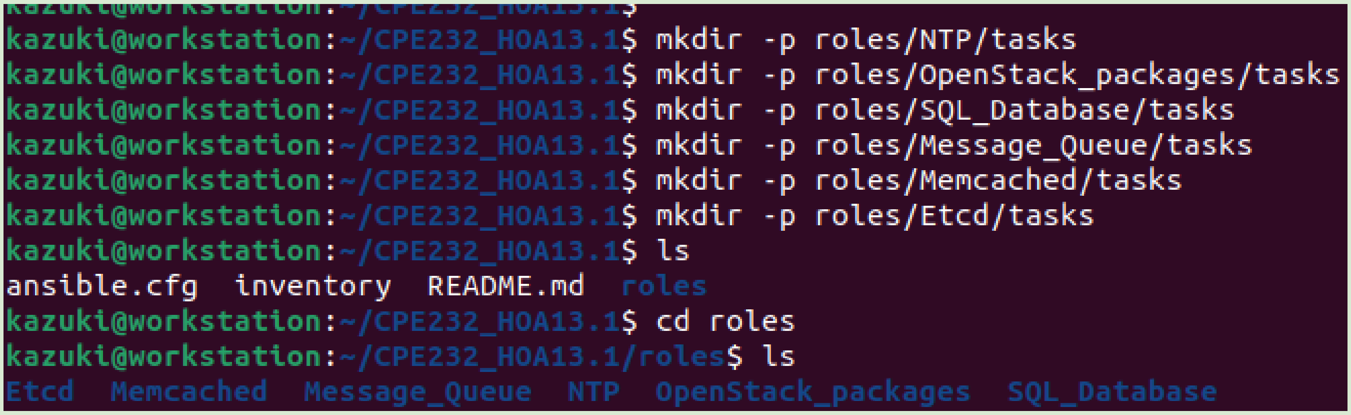
1. Create a new repository for this activity.
2. Create a playbook that converts the steps in the following items in https://docs.openstack.org/install-guide/
    a. NTP
    b. OpenStack packages
    c. SQL Database
    d. Message Queue
    e. Memcached
    f. Etcd
3. Create different plays in installing per server type (controller, compute etc.) and identify it as a group in the Inventory file.
4. Add, commit and push it to your GitHub repo.

5. Output (screenshots and explanations)



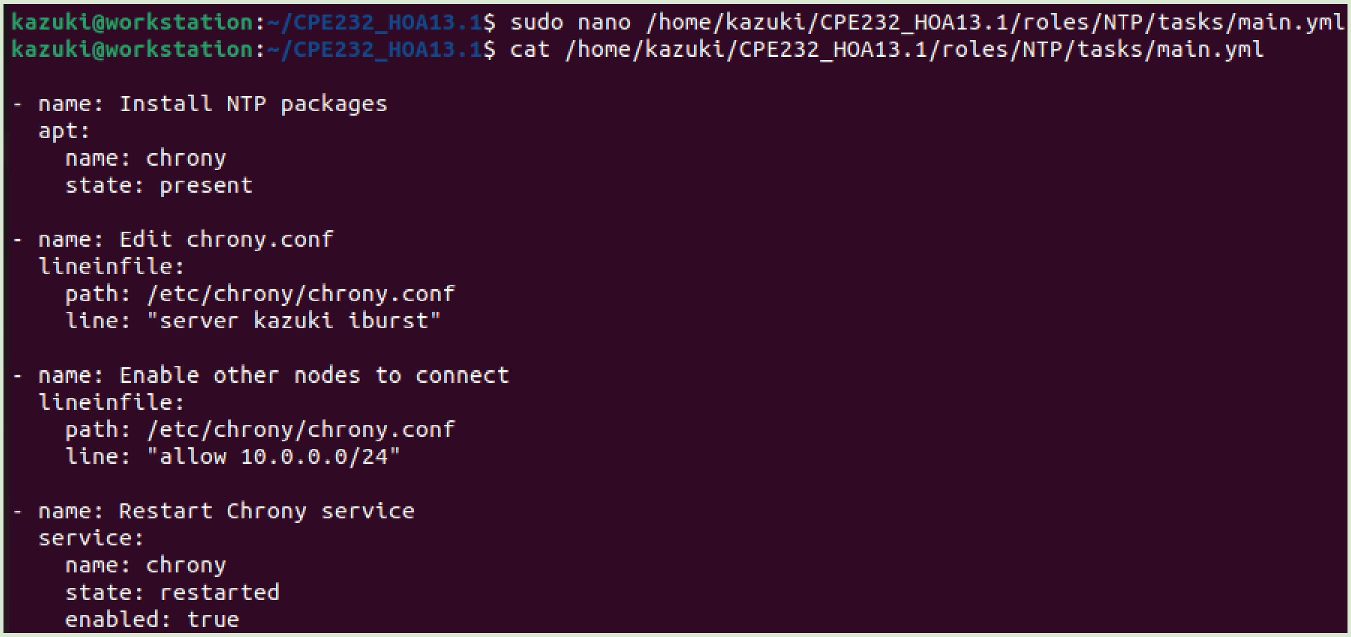
```
kazuki@workstation:~$ git clone git@github.com:kazzzuki/CPE232_HOA13.1.git
Cloning into 'CPE232_HOA13.1'...
remote: Enumerating objects: 3, done.
remote: Counting objects: 100% (3/3), done.
remote: Total 3 (delta 0), reused 0 (delta 0), pack-reused 0
Receiving objects: 100% (3/3), done.
kazuki@workstation:~$ ls
CPE232_HOA10.1  CPE232_HOA6.1  CPE232_KAZUKI       Documents  Ogata_PrelimExam  snap
CPE232_HOA11.1  CPE232_HOA8.1  CPE_MIDEXAM_OGATA   Downloads  Pictures          Templates
CPE232_HOA13.1  CPE232_HOA9.1  Desktop             Music      Public            Videos
```

I created a new repository for this activity and named it “CPE232_HOA13.1”. Before cloning it, I used the command “which git” and “git version” in checking the installed git. Although I already installed git before, it is still a good practice to always check it before cloning so there will not be errors encountered.



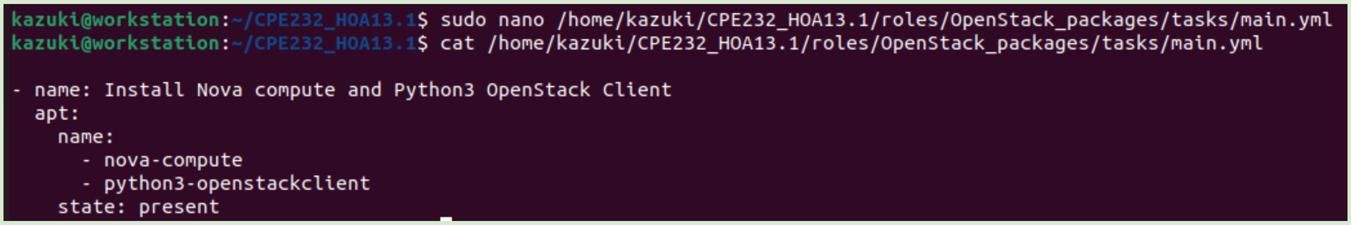
```
kazuki@workstation:~/CPE232_HOA13.1$
kazuki@workstation:~/CPE232_HOA13.1$ mkdir -p roles/NTP/tasks
kazuki@workstation:~/CPE232_HOA13.1$ mkdir -p roles/OpenStack_packages/tasks
kazuki@workstation:~/CPE232_HOA13.1$ mkdir -p roles/SQL_Database/tasks
kazuki@workstation:~/CPE232_HOA13.1$ mkdir -p roles/Message_Queue/tasks
kazuki@workstation:~/CPE232_HOA13.1$ mkdir -p roles/Memcached/tasks
kazuki@workstation:~/CPE232_HOA13.1$ mkdir -p roles/Etcd/tasks
kazuki@workstation:~/CPE232_HOA13.1$ ls
ansible.cfg  inventory  README.md  roles
kazuki@workstation:~/CPE232_HOA13.1$ cd roles
kazuki@workstation:~/CPE232_HOA13.1/roles$ ls
Etcd  Memcached  Message_Queue  NTP  OpenStack_packages  SQL_Database
```

Using the “mkdir” command, I created different directories for the roles per openstack steps.



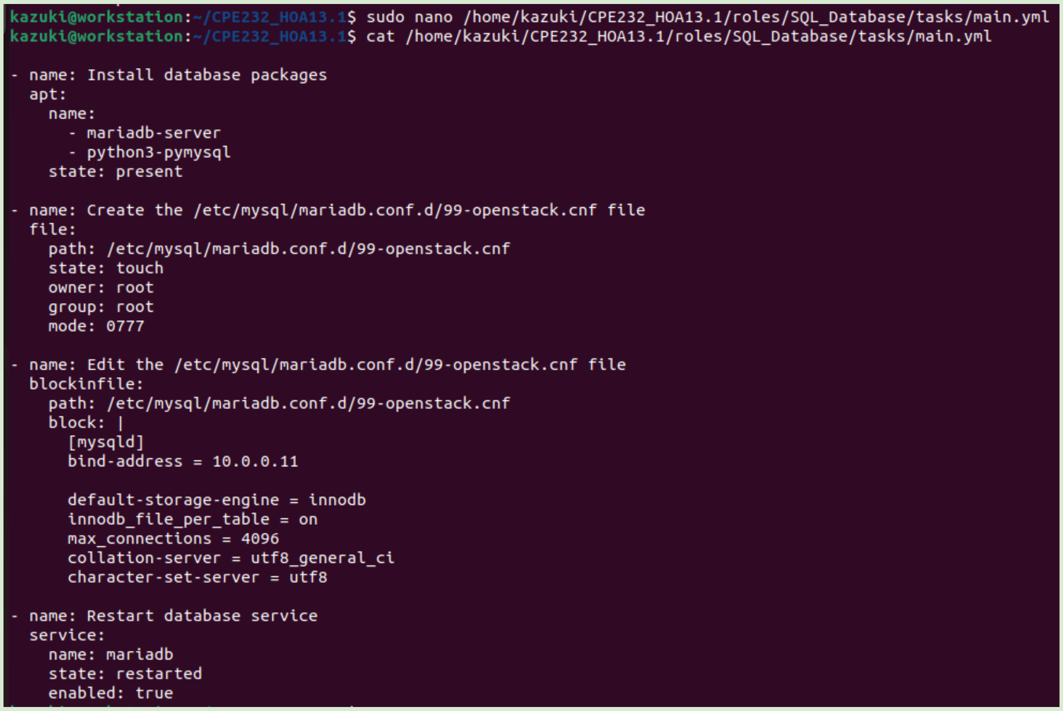
```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano /home/kazuki/CPE232_HOA13.1/roles/NTP/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat /home/kazuki/CPE232_HOA13.1/roles/NTP/tasks/main.yml

- name: Install NTP packages
  apt:
    name: chrony
    state: present

- name: Edit chrony.conf
  lineinfile:
    path: /etc/chrony/chrony.conf
    line: "server kazuki iburst"

- name: Enable other nodes to connect
  lineinfile:
    path: /etc/chrony/chrony.conf
    line: "allow 10.0.0.0/24"

- name: Restart Chrony service
  service:
    name: chrony
    state: restarted
    enabled: true
```

I converted the guide in the document into installing NTP or chrony.



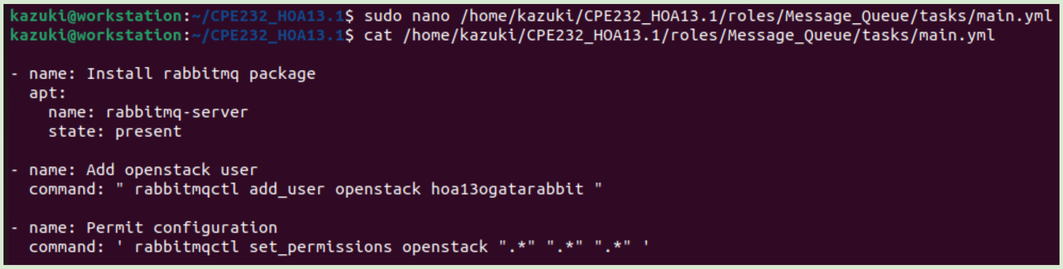
```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano /home/kazuki/CPE232_HOA13.1/roles/OpenStack_packages/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat /home/kazuki/CPE232_HOA13.1/roles/OpenStack_packages/tasks/main.yml

- name: Install Nova compute and Python3 OpenStack Client
  apt:
    name:
      - nova-compute
      - python3-openstackclient
    state: present
```

In installing openstack packages, there is a list of packages in the document but there is already an existing package by default that is existing in my Ubuntu server so I did not include a task for it in this playbook.



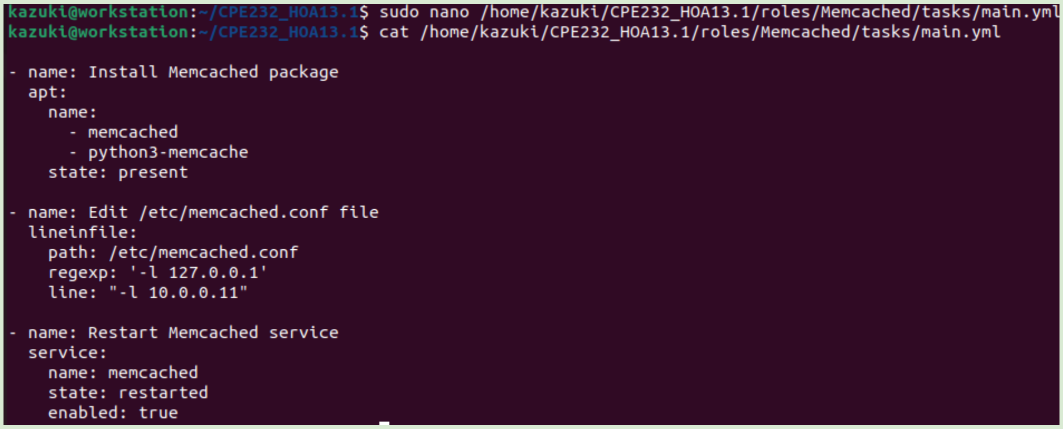
```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano /home/kazuki/CPE232_HOA13.1/roles/SQL_Database/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat /home/kazuki/CPE232_HOA13.1/roles/SQL_Database/tasks/main.yml

- name: Install database packages
  apt:
    name:
      - mariadb-server
      - python3-pymysql
    state: present

- name: Create the /etc/mysql/mariadb.conf.d/99-openstack.cnf file
  file:
    path: /etc/mysql/mariadb.conf.d/99-openstack.cnf
    state: touch
    owner: root
    group: root
    mode: 0777

- name: Edit the /etc/mysql/mariadb.conf.d/99-openstack.cnf file
  blockinfile:
    path: /etc/mysql/mariadb.conf.d/99-openstack.cnf
    block: |
      [mysqld]
      bind-address = 10.0.0.11

      default-storage-engine = innodb
      innodb_file_per_table = on
      max_connections = 4096
      collation-server = utf8_general_ci
      character-set-server = utf8

- name: Restart database service
  service:
    name: mariadb
    state: restarted
    enabled: true
```

I already know the installation of the database server so I applied it by using a task that installed mariadb-server. I also created a file /etc/mysql.mariadb.conf.d/99-openstack.cnf and added a mysqld given code on the document then restarted the service.



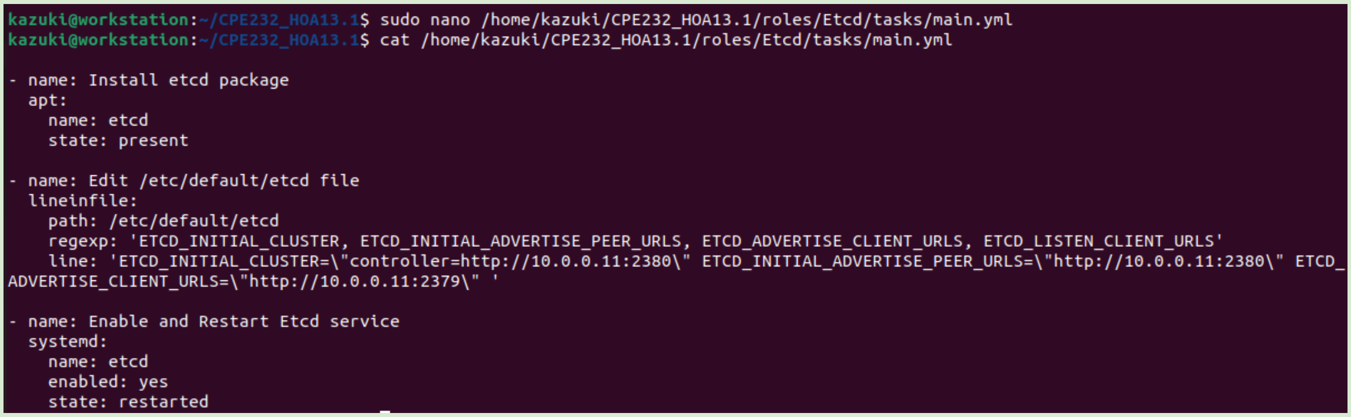
```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano /home/kazuki/CPE232_HOA13.1/roles/Message_Queue/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat /home/kazuki/CPE232_HOA13.1/roles/Message_Queue/tasks/main.yml

- name: Install rabbitmq package
  apt:
    name: rabbitmq-server
    state: present

- name: Add openstack user
  command: " rabbitmqctl add_user openstack hoa13ogatarabbit "

- name: Permit configuration
  command: ' rabbitmqctl set_permissions openstack ".*" ".*" ".*" '
```

In this playbook, I did a task for installing rabbitmq then added a task that uses “command” syntax which is easy where I just copy the given code on the given document and add it here.



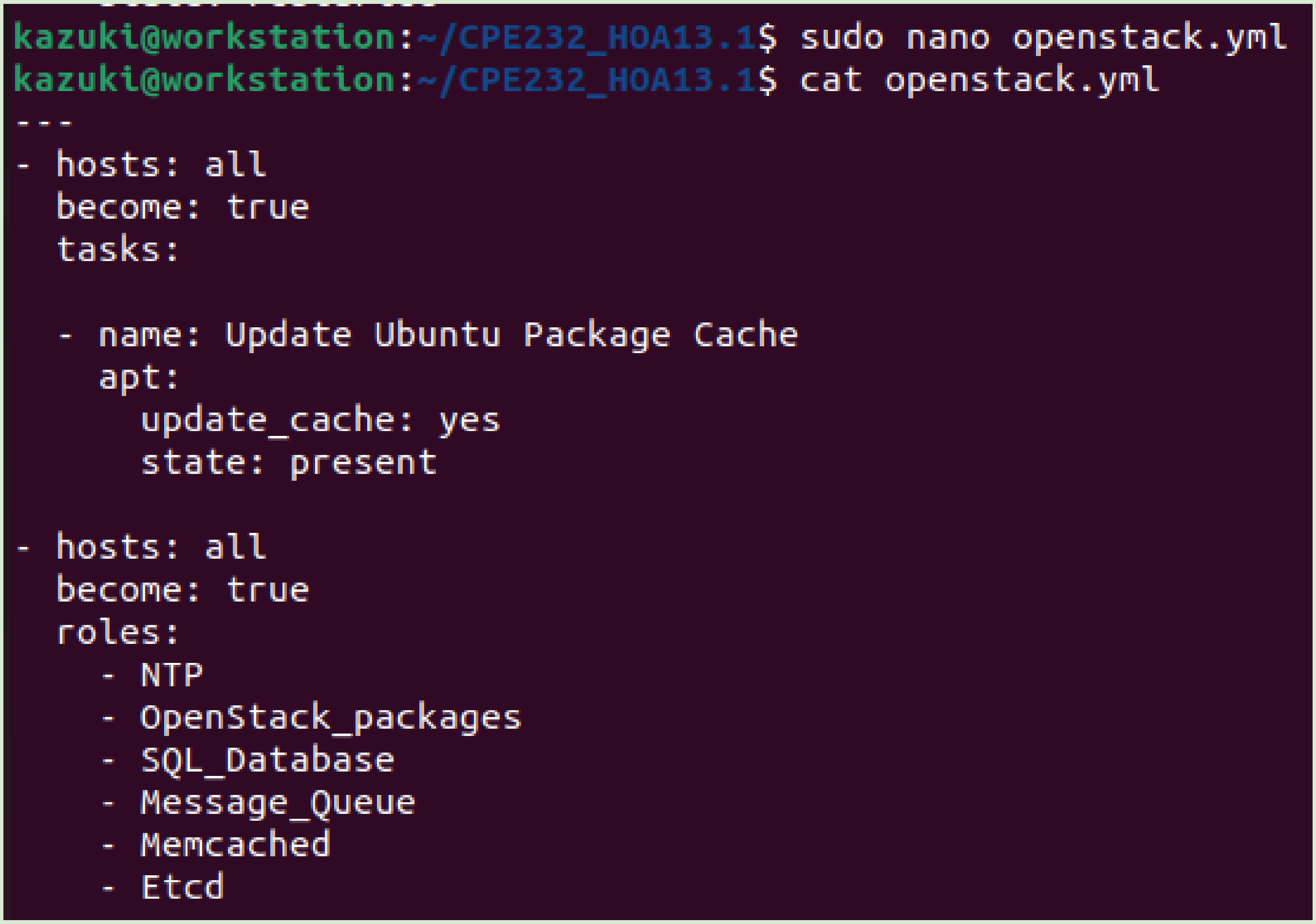
```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano /home/kazuki/CPE232_HOA13.1/roles/Memcached/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat /home/kazuki/CPE232_HOA13.1/roles/Memcached/tasks/main.yml

- name: Install Memcached package
  apt:
    name:
      - memcached
      - python3-memcache
    state: present

- name: Edit /etc/memcached.conf file
  lineinfile:
    path: /etc/memcached.conf
    regexp: '-l 127.0.0.1'
    line: "-l 10.0.0.11"

- name: Restart Memcached service
  service:
    name: memcached
    state: restarted
    enabled: true
```

Same as the other playbooks, I converted the steps/guide in installing Memcached on the given source. I created an installation task, editing file task, and restarting service task.



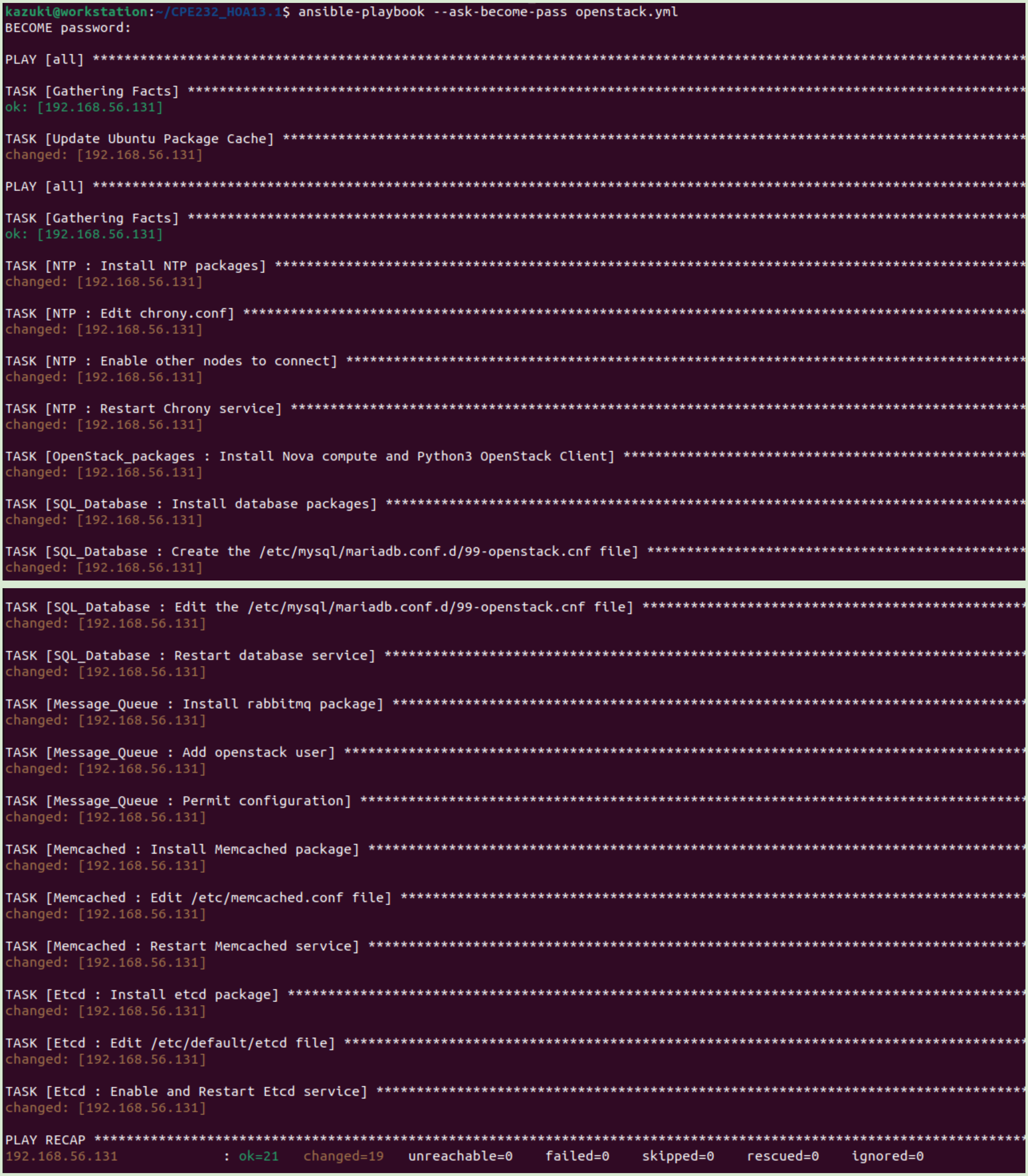
```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano /home/kazuki/CPE232_HOA13.1/roles/Etcd/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat /home/kazuki/CPE232_HOA13.1/roles/Etcd/tasks/main.yml

- name: Install etcd package
  apt:
    name: etcd
    state: present

- name: Edit /etc/default/etcd file
  lineinfile:
    path: /etc/default/etcd
    regexp: 'ETCD_INITIAL_CLUSTER, ETCD_INITIAL_ADVERTISE_PEER_URLS, ETCD_ADVERTISE_CLIENT_URLS, ETCD_LISTEN_CLIENT_URLS'
    line: 'ETCD_INITIAL_CLUSTER=\"controller=http://10.0.0.11:2380\" ETCD_INITIAL_ADVERTISE_PEER_URLS=\"http://10.0.0.11:2380\" ETCD_
ADVERTISE_CLIENT_URLS=\"http://10.0.0.11:2379\" '

- name: Enable and Restart Etcd service
  systemd:
    name: etcd
    enabled: yes
    state: restarted
```

Lastly, for the Etcd. I created an installation task, then edited the file by replacing the current line present in the file and added the new given code.



```
kazuki@workstation:~/CPE232_HOA13.1$ sudo nano openstack.yml
kazuki@workstation:~/CPE232_HOA13.1$ cat openstack.yml
---
- hosts: all
  become: true
  tasks:

  - name: Update Ubuntu Package Cache
    apt:
      update_cache: yes
      state: present

- hosts: all
  become: true
  roles:
    - NTP
    - OpenStack_packages
    - SQL_Database
    - Message_Queue
    - Memcached
    - Etcd
```

This is my main playbook where I added a task that updates the target host then the roles.

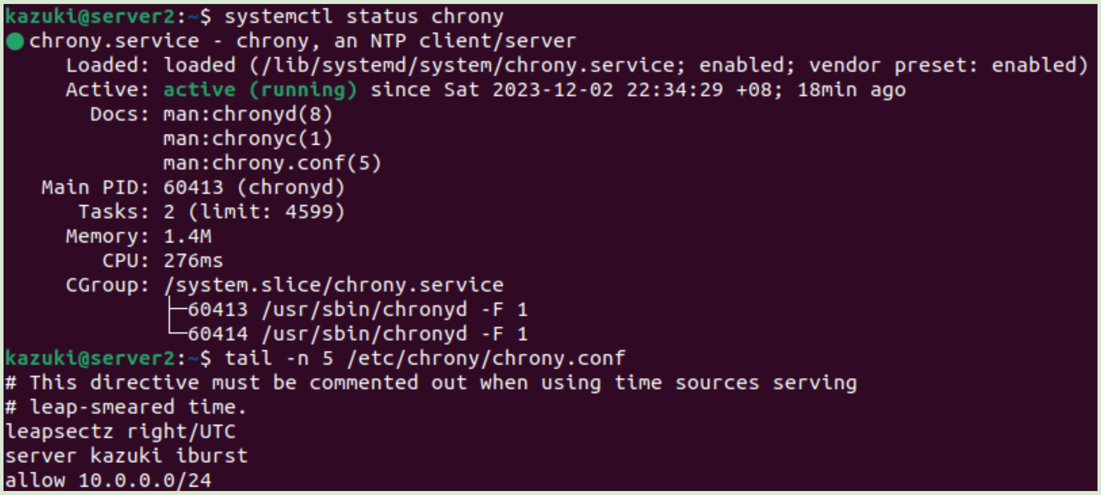


```
kazuki@workstation:~/CPE232_HOA13.1$ ansible-playbook --ask-become-pass openstack.yml
BECOME password:

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

TASK [Gathering Facts] *********************************************************************************************************
ok: [192.168.56.131]

TASK [Update Ubuntu Package Cache] *********************************************************************************************
changed: [192.168.56.131]

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

TASK [Gathering Facts] *********************************************************************************************************
ok: [192.168.56.131]

TASK [NTP : Install NTP packages] **********************************************************************************************
changed: [192.168.56.131]

TASK [NTP : Edit chrony.conf] **************************************************************************************************
changed: [192.168.56.131]

TASK [NTP : Enable other nodes to connect] *************************************************************************************
changed: [192.168.56.131]

TASK [NTP : Restart Chrony service] ********************************************************************************************
changed: [192.168.56.131]

TASK [OpenStack_packages : Install Nova compute and Python3 OpenStack Client] *************************************************
changed: [192.168.56.131]

TASK [SQL_Database : Install database packages] ********************************************************************************
changed: [192.168.56.131]

TASK [SQL_Database : Create the /etc/mysql/mariadb.conf.d/99-openstack.cnf file] ***********************************************
changed: [192.168.56.131]
```

```
TASK [SQL_Database : Edit the /etc/mysql/mariadb.conf.d/99-openstack.cnf file] *************************************************
changed: [192.168.56.131]

TASK [SQL_Database : Restart database service] *********************************************************************************
changed: [192.168.56.131]

TASK [Message_Queue : Install rabbitmq package] ********************************************************************************
changed: [192.168.56.131]

TASK [Message_Queue : Add openstack user] **************************************************************************************
changed: [192.168.56.131]

TASK [Message_Queue : Permit configuration] ************************************************************************************
changed: [192.168.56.131]

TASK [Memcached : Install Memcached package] ***********************************************************************************
changed: [192.168.56.131]

TASK [Memcached : Edit /etc/memcached.conf file] *******************************************************************************
changed: [192.168.56.131]

TASK [Memcached : Restart Memcached service] ***********************************************************************************
changed: [192.168.56.131]

TASK [Etcd : Install etcd package] *********************************************************************************************
changed: [192.168.56.131]

TASK [Etcd : Edit /etc/default/etcd file] **************************************************************************************
changed: [192.168.56.131]

TASK [Etcd : Enable and Restart Etcd service] **********************************************************************************
changed: [192.168.56.131]

PLAY RECAP *********************************************************************************************************************
192.168.56.131             : ok=21   changed=19   unreachable=0    failed=0    skipped=0    rescued=0    ignored=0
```

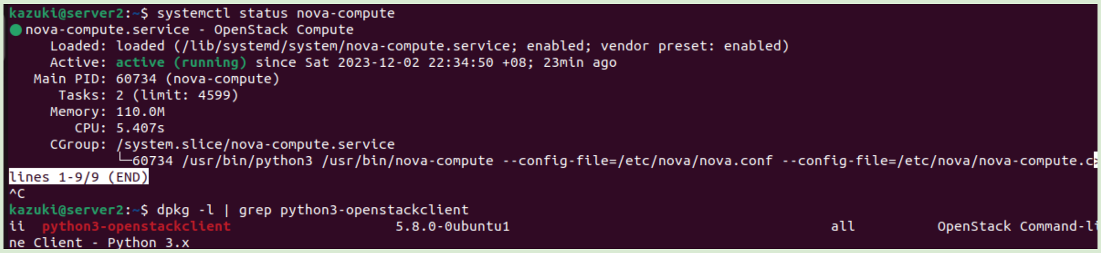
This is the output of my main playbook. As we can see, there is no error, unreachable, failed, skipped, rescued, and ignored. Meaning the playbook was successfully executed. Below are the proofs that my main playbook was successfully executed.

NTP PROOF:



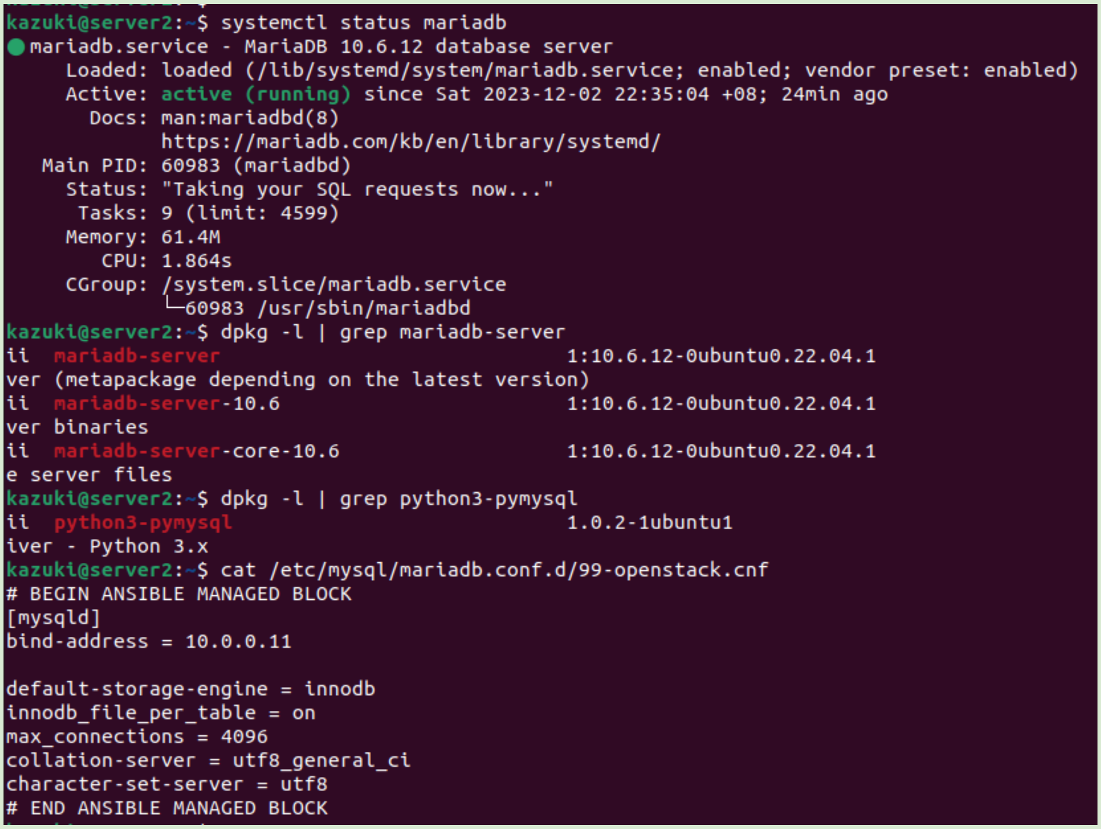
```
kazuki@server2:~$ systemctl status chrony
● chrony.service - chrony, an NTP client/server
     Loaded: loaded (/lib/systemd/system/chrony.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2023-12-02 22:34:29 +08; 18min ago
       Docs: man:chronyd(8)
             man:chronyc(1)
             man:chrony.conf(5)
   Main PID: 60413 (chronyd)
      Tasks: 2 (limit: 4599)
     Memory: 1.4M
        CPU: 276ms
     CGroup: /system.slice/chrony.service
             ├─60413 /usr/sbin/chronyd -F 1
             └─60414 /usr/sbin/chronyd -F 1
kazuki@server2:~$ tail -n 5 /etc/chrony/chrony.conf
# This directive must be commented out when using time sources serving
# leap-smeared time.
leapsectz right/UTC
server kazuki iburst
allow 10.0.0.0/24
```

OPENSTACK PACKAGES PROOF:



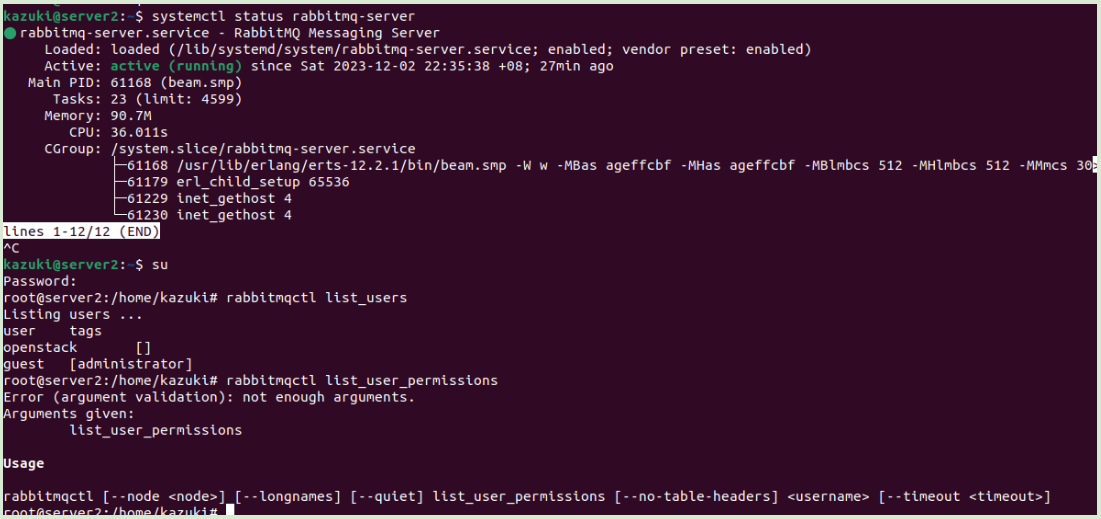
```
kazuki@server2:~$ systemctl status nova-compute
● nova-compute.service - OpenStack Compute
     Loaded: loaded (/lib/systemd/system/nova-compute.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2023-12-02 22:34:50 +08; 23min ago
   Main PID: 60734 (nova-compute)
      Tasks: 2 (limit: 4599)
     Memory: 110.0M
        CPU: 5.407s
     CGroup: /system.slice/nova-compute.service
             └─60734 /usr/bin/python3 /usr/bin/nova-compute --config-file=/etc/nova/nova.conf --config-file=/etc/nova/nova-compute.c>
lines 1-9/9 (END)
^C
kazuki@server2:~$ dpkg -l | grep python3-openstackclient
ii  python3-openstackclient                    5.8.0-0ubuntu1                                  all          OpenStack Command-li
ne Client - Python 3.x
```

SQL DATABASE PROOF:



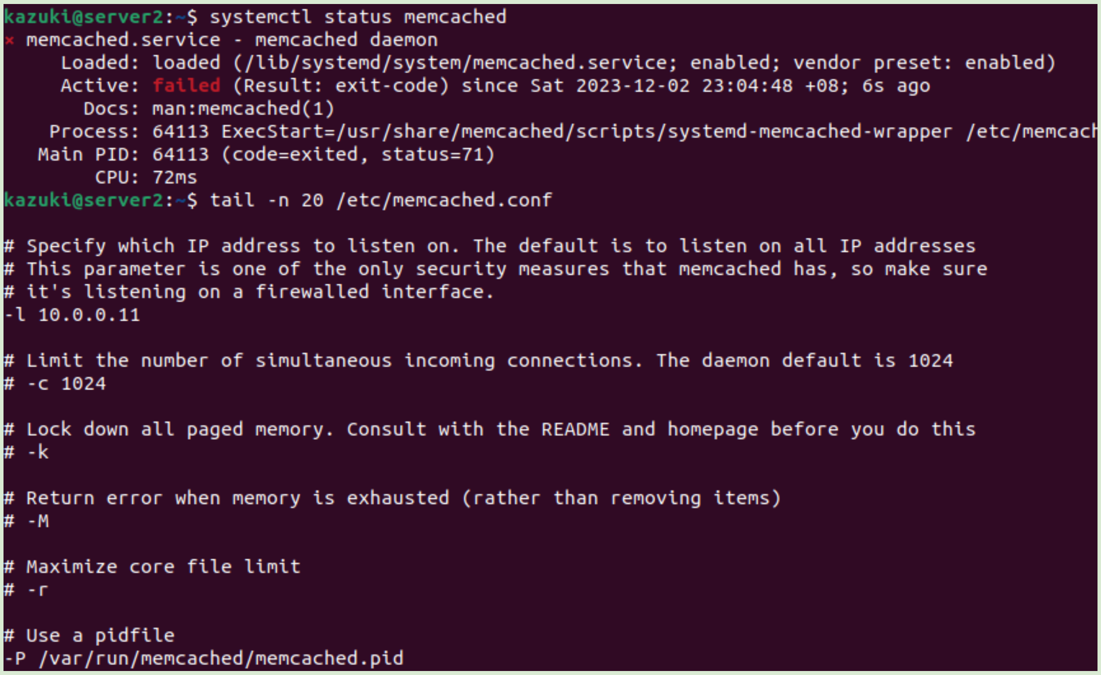
```
kazuki@server2:~$ systemctl status mariadb
● mariadb.service - MariaDB 10.6.12 database server
     Loaded: loaded (/lib/systemd/system/mariadb.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2023-12-02 22:35:04 +08; 24min ago
       Docs: man:mariadbd(8)
             https://mariadb.com/kb/en/library/systemd/
   Main PID: 60983 (mariadbd)
     Status: "Taking your SQL requests now..."
      Tasks: 9 (limit: 4599)
     Memory: 61.4M
        CPU: 1.864s
     CGroup: /system.slice/mariadb.service
             └─60983 /usr/sbin/mariadbd
kazuki@server2:~$ dpkg -l | grep mariadb-server
ii  mariadb-server                     1:10.6.12-0ubuntu0.22.04.1
ver (metapackage depending on the latest version)
ii  mariadb-server-10.6                1:10.6.12-0ubuntu0.22.04.1
ver binaries
ii  mariadb-server-core-10.6           1:10.6.12-0ubuntu0.22.04.1
e server files
kazuki@server2:~$ dpkg -l | grep python3-pymysql
ii  python3-pymysql                    1.0.2-1ubuntu1
iver - Python 3.x
kazuki@server2:~$ cat /etc/mysql/mariadb.conf.d/99-openstack.cnf
# BEGIN ANSIBLE MANAGED BLOCK
[mysqld]
bind-address = 10.0.0.11

default-storage-engine = innodb
innodb_file_per_table = on
max_connections = 4096
collation-server = utf8_general_ci
character-set-server = utf8
# END ANSIBLE MANAGED BLOCK
```

MESSAGE QUEUE PROOF:



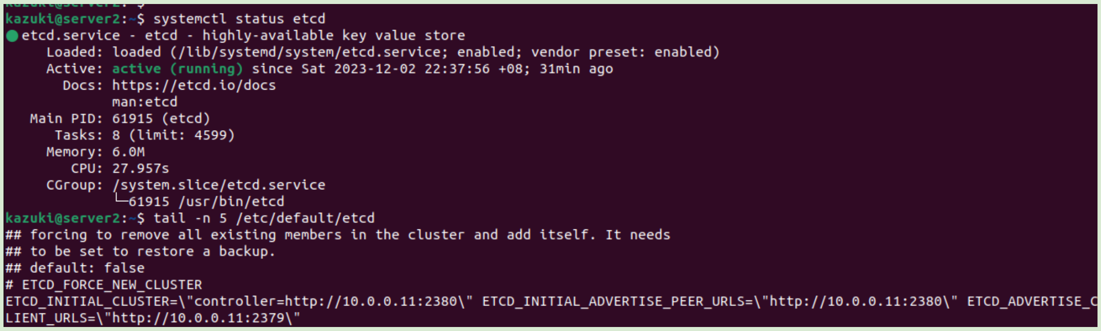
```
kazuki@server2:~$ systemctl status rabbitmq-server
● rabbitmq-server.service - RabbitMQ Messaging Server
     Loaded: loaded (/lib/systemd/system/rabbitmq-server.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2023-12-02 22:35:38 +08; 27min ago
   Main PID: 61168 (beam.smp)
      Tasks: 23 (limit: 4599)
     Memory: 90.7M
        CPU: 36.011s
     CGroup: /system.slice/rabbitmq-server.service
             ├─61168 /usr/lib/erlang/erts-12.2.1/bin/beam.smp -W w -MBas ageffcbf -MHas ageffcbf -MBlmbcs 512 -MHlmbcs 512 -MMmcs 30>
             ├─61179 erl_child_setup 65536
             ├─61229 inet_gethost 4
             └─61230 inet_gethost 4
lines 1-12/12 (END)
^C
kazuki@server2:~$ su
Password:
root@server2:/home/kazuki# rabbitmqctl list_users
Listing users ...
user    tags
openstack       []
guest   [administrator]
root@server2:/home/kazuki# rabbitmqctl list_user_permissions
Error (argument validation): not enough arguments.
Arguments given:
        list_user_permissions

Usage

rabbitmqctl [--node <node>] [--longnames] [--quiet] list_user_permissions [--no-table-headers] <username> [--timeout <timeout>]
root@server2:/home/kazuki#
```

MEMCACHED PROOF:

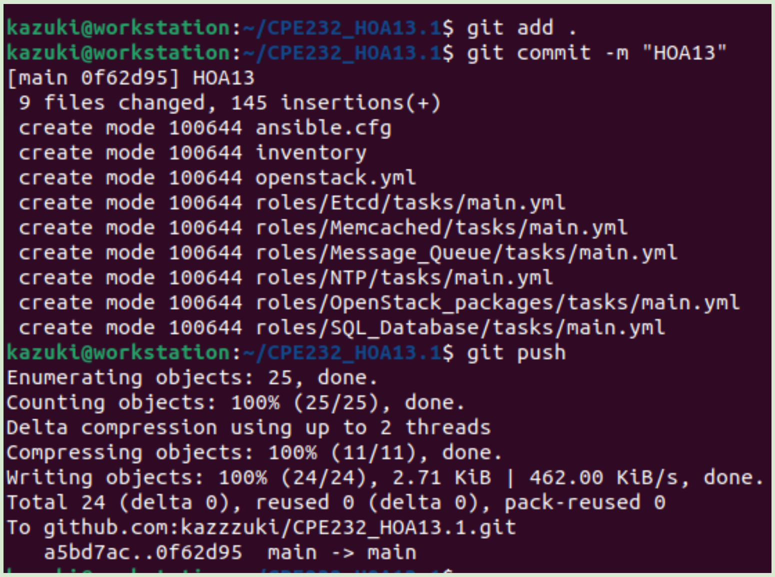


```
kazuki@server2:~$ systemctl status memcached
× memcached.service - memcached daemon
     Loaded: loaded (/lib/systemd/system/memcached.service; enabled; vendor preset: enabled)
     Active: failed (Result: exit-code) since Sat 2023-12-02 23:04:48 +08; 6s ago
       Docs: man:memcached(1)
    Process: 64113 ExecStart=/usr/share/memcached/scripts/systemd-memcached-wrapper /etc/memcach
   Main PID: 64113 (code=exited, status=71)
        CPU: 72ms
kazuki@server2:~$ tail -n 20 /etc/memcached.conf

# Specify which IP address to listen on. The default is to listen on all IP addresses
# This parameter is one of the only security measures that memcached has, so make sure
# it's listening on a firewalled interface.
-l 10.0.0.11

# Limit the number of simultaneous incoming connections. The daemon default is 1024
# -c 1024

# Lock down all paged memory. Consult with the README and homepage before you do this
# -k

# Return error when memory is exhausted (rather than removing items)
# -M

# Maximize core file limit
# -r

# Use a pidfile
-P /var/run/memcached/memcached.pid
```

ETCD PROOF:



```
kazuki@server2:~$ systemctl status etcd
● etcd.service - etcd - highly-available key value store
     Loaded: loaded (/lib/systemd/system/etcd.service; enabled; vendor preset: enabled)
     Active: active (running) since Sat 2023-12-02 22:37:56 +08; 31min ago
       Docs: https://etcd.io/docs
             man:etcd
   Main PID: 61915 (etcd)
      Tasks: 8 (limit: 4599)
     Memory: 6.0M
        CPU: 27.957s
     CGroup: /system.slice/etcd.service
             └─61915 /usr/bin/etcd
kazuki@server2:~$ tail -n 5 /etc/default/etcd
## forcing to remove all existing members in the cluster and add itself. It needs
## to be set to restore a backup.
## default: false
# ETCD_FORCE_NEW_CLUSTER
ETCD_INITIAL_CLUSTER=\"controller=http://10.0.0.11:2380\" ETCD_INITIAL_ADVERTISE_PEER_URLS=\"http://10.0.0.11:2380\" ETCD_ADVERTISE_C
LIENT_URLS=\"http://10.0.0.11:2379\"
```



```
kazuki@workstation:~/CPE232_HOA13.1$ git add .
kazuki@workstation:~/CPE232_HOA13.1$ git commit -m "HOA13"
[main 0f62d95] HOA13
 9 files changed, 145 insertions(+)
 create mode 100644 ansible.cfg
 create mode 100644 inventory
 create mode 100644 openstack.yml
 create mode 100644 roles/Etcd/tasks/main.yml
 create mode 100644 roles/Memcached/tasks/main.yml
 create mode 100644 roles/Message_Queue/tasks/main.yml
 create mode 100644 roles/NTP/tasks/main.yml
 create mode 100644 roles/OpenStack_packages/tasks/main.yml
 create mode 100644 roles/SQL_Database/tasks/main.yml
kazuki@workstation:~/CPE232_HOA13.1$ git push
Enumerating objects: 25, done.
Counting objects: 100% (25/25), done.
Delta compression using up to 2 threads
Compressing objects: 100% (11/11), done.
Writing objects: 100% (24/24), 2.71 KiB | 462.00 KiB/s, done.
Total 24 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:kazzzuki/CPE232_HOA13.1.git
   a5bd7ac..0f62d95  main -> main
```

I used the command “git add .” to add all the created files to my github repository then commit it using the “git commit” command and then lastly push it using the “git push” command.

GITHUB REPOSITORY LINK: https://github.com/kazzzuki/CPE232_HOA13.1

Reflections:

Answer the following:

1. What are the benefits of implementing OpenStack?
   - The benefits of implementing OpenStack are it is flexible, scalable, adaptable, and cost efficient in managing infrastructures. It allows us to create and manage clouds for better and easy deployment and automation of virtualized resources. For example, there is a company that has multiple development groups that are working on different projects. These groups/teams for sure need their own environment for testing and deployment. So, instead of doing it or giving each group/team a separate server they can use OpenStack. OpenStack also promotes collaboration and agility in adapting to the needs of each team.

Conclusions:

In conclusion, just like I said in the reflection part, the implementation of OpenStack provides important benefits such as flexibility, scalability, adaptability, and cost efficiency in infrastructure management. In doing this activity, I already encountered some little errors like service syntax in restarting service is not working so I added a additional commands/codes in my ansible.cfg like host_key_checking=False, deprecation_warnings=False, remote_user=kazuki, and private_key_file=~/.ssh/. This code helped me in troubleshooting that error. Lastly, I was introduced to the new syntax like “lineinfile” and “blockinfile”. Based on my research, they are modules in Ansible that is a powerful open-source automation tool. They can be used to add, replace, modify, or even remove a specific line on the target host’s file.