Department of Computer Science and Engineering

Cloud Architecture

Lab4A: OpenStack Implementation

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Objective:

1. Establish a Stable and Scalable Cloud Infrastructure: deploy OpenStack on Ubuntu servers, creating a robust cloud infrastructure capable of handling diverse workloads
2. Optimize Resource Utilization and Efficiency

Outcomes: After successful completion of the lab, students should be able to:

[1] Deploy OpenStack on Ubuntu servers

[2] Create a robust cloud infrastructure capable of handling diverse workloads

[3] Utilize OpenStack's orchestration capabilities to automate the provisioning and management of virtual instances, reducing manual intervention and streamlining operations.

[4] Implement monitoring and analytics tools (e.g., Ceilometer) to gather insights into resource utilization, enabling proactive capacity planning and optimization.

System Requirements:

The following minimum prerequisites are required for OpenStack:

1. A fresh Ubuntu 22.04 installation
2. User with sudo privileges
3. 8 GB RAM
4. Hard disk capacity of 10 GB
5. Internet connection

OpenStack

OpenStack is an open-source software platform for cloud computing, primarily used for building and managing public and private clouds. It provides a set of tools for managing compute, storage, and networking resources in a data center through a dashboard or via the OpenStack API.

Originally launched in 2010 as a joint project between Rackspace Hosting and NASA, OpenStack has grown into a large community-driven project with contributions from various organizations and individuals worldwide. Its modular architecture allows users to integrate different components to create a customized cloud infrastructure tailored to their specific needs.

Some key components of OpenStack include:

- Nova (Compute): Manages virtual machines (VMs) and provides computing resources to users.
- Swift (Object Storage): Offers scalable and redundant object storage suitable for storing large amounts of unstructured data.
- Cinder (Block Storage): Provides persistent block storage volumes for use with VMs.-
- Neutron (Networking): Manages network connectivity in the cloud, including virtual networks, routers, and security groups.
- Keystone (Identity): Handles authentication and authorization for all OpenStack services.
- Glance (Image Service): Stores and retrieves VM images used to create new instances.
- Horizon (Dashboard): A web-based dashboard for managing and monitoring OpenStack resources.

OpenStack is used by organizations of all sizes to build private clouds for internal use or public clouds for offering cloud services to customers. Its open-source nature promotes interoperability and avoids vendor lock-in, making it a popular choice for those seeking flexibility and control over their cloud infrastructure.

Steps

Step 1: Update and Upgrade the System

$sudo apt update
$sudo apt upgrade

- Next reboot the system using the command

$sudo reboot

Step 2: Create Stack user and assign sudo privilege

$sudo adduser stack

```
techz@techz:~/my_directory$ sudo adduser stack
Adding user `stack' ...
Adding new group `stack' (1001) ...
Adding new user `stack' (1001) with group `stack' ...
Creating home directory `/home/stack' ...
Copying files from `/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for stack
Enter the new value, or press ENTER for the default
        Full Name []:
        Room Number []:
        Work Phone []:
        Home Phone []:
        Other []:
Is the information correct? [Y/n]
techz@techz:~/my_directory$
```

$echo "stack ALL=(ALL) NOPASSWD: ALL" | sudo tee /etc/sudoers.d/stack

Step 3: Install git and download DevStack

$su - stack

```
stack@techz:~$ clear
stack@techz:~$ su - stack
Password:
```

$git clone https://git.openstack.org/openstack-dev/devstack

```
stack@techz:~$ git clone https://git.openstack.org/openstack-dev/devstack
Cloning into 'devstack'...
warning: redirecting to https://opendev.org/openstack/devstack/
remote: Enumerating objects: 51074, done.
remote: Counting objects: 100% (31021/31021), done.
remote: Compressing objects: 100% (10429/10429), done.
remote: Total 51074 (delta 30265), reused 20592 (delta 20592), pack-reused 20053
Receiving objects: 100% (51074/51074), 9.58 MiB | 2.14 MiB/s, done.
Resolving deltas: 100% (36266/36266), done.
```

Step 4: Create devstack configuration file

- Navigate to the devstack directory

$cd devstack

$cd samples

$cp local.conf ../

$cd..

$nano local.conf

```
# If the ``*_PASSWORD`` variables are not set here you will be prompted to enter
# values for them by ``stack.sh``and they will be added to ``local.conf``.
ADMIN_PASSWORD=toor
DATABASE_PASSWORD=toor
RABBIT_PASSWORD=toor
SERVICE_PASSWORD=toor

# ``HOST_IP`` and ``HOST_IPV6`` should be set manually for best results if
# the NIC configuration of the host is unusual, i.e. ``eth1`` has the default
# route but ``eth0`` is the public interface.  They are auto-detected in
# ``stack.sh`` but often is indeterminate on later runs due to the IP moving
# from an Ethernet interface to a bridge on the host. Setting it here also
# makes it available for ``openrc`` to include when setting ``OS_AUTH_URL``.
# Neither is set by default.
HOST_IP=192.168.0.105
FLOTING_RANGE=192.168.0.224/27
#HOST_IPV6=2001:db8::7
```

Step 5: Install OpenStack with Devstack

- To commence the installation of OpenStack on Ubuntu 22.04, run the script below contained in the DevStack directory.

$./stack.sh
The following features will be installed:

- Horizon — OpenStack Dashboard
- Nova — Compute Service
- Glance — Image Service
- Neutron — Network Service
- Keystone — Identity Service
- Cinder — Block Storage Service
- Placement — Placement API

```
| nova_api   | SELECT    |    52 |
| nova_cell0 | SELECT    |    51 |
| nova_cell1 | SELECT    |    83 |
| nova_cell0 | INSERT    |    11 |
| nova_cell0 | UPDATE    |     4 |
| nova_cell1 | INSERT    |     6 |
| nova_cell1 | UPDATE    |    19 |
| cinder     | SELECT    |    67 |
| cinder     | INSERT    |     5 |
| cinder     | UPDATE    |     3 |
| glance     | INSERT    |    22 |
| placement  | UPDATE    |     3 |
| nova_api   | INSERT    |    20 |
| nova_api   | SAVEPOINT |    10 |
| nova_api   | RELEASE   |    10 |
| glance     | SELECT    |    28 |
| glance     | UPDATE    |     2 |
| cinder     | DELETE    |     1 |
+------------+-----------+-------+



This is your host IP address: 192.168.0.105
This is your host IPv6 address: ::1
Horizon is now available at http://192.168.0.105/dashboard
Keystone is serving at http://192.168.0.105/identity/
The default users are: admin and demo
The password: toor

WARNING:
Configuring uWSGI with a WSGI file is deprecated, use module paths instead
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Services are running under systemd unit files.
For more information see:
https://docs.openstack.org/devstack/latest/systemd.html

DevStack Version: 2024.2
Change: 0ff627286297a3957143577412884dc50ff8a57a Run chown for egg-info only if the directory exists 2024-09-03 08:14:00
OS Version: Ubuntu 24.04 noble

stack@techz:~/devstack$
```
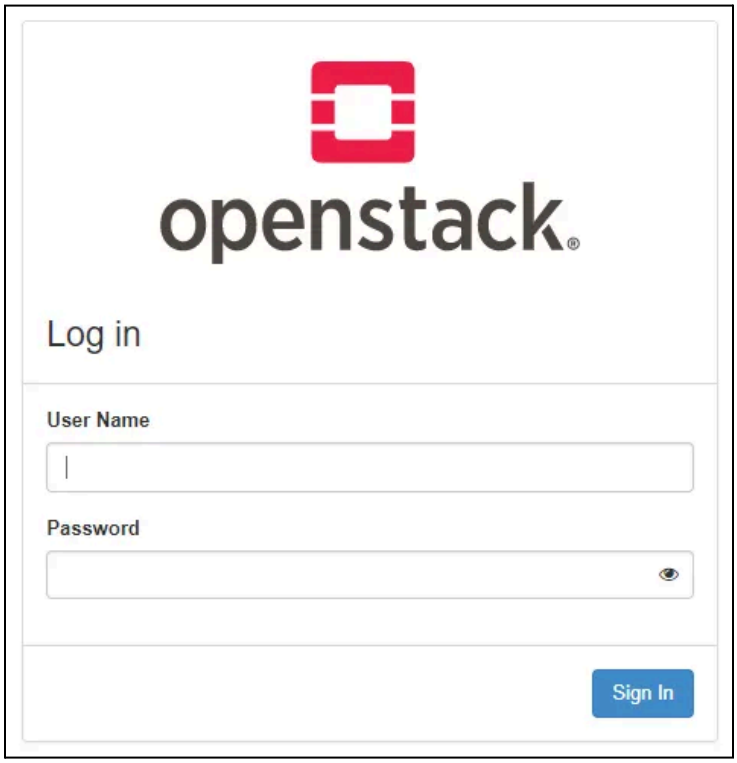
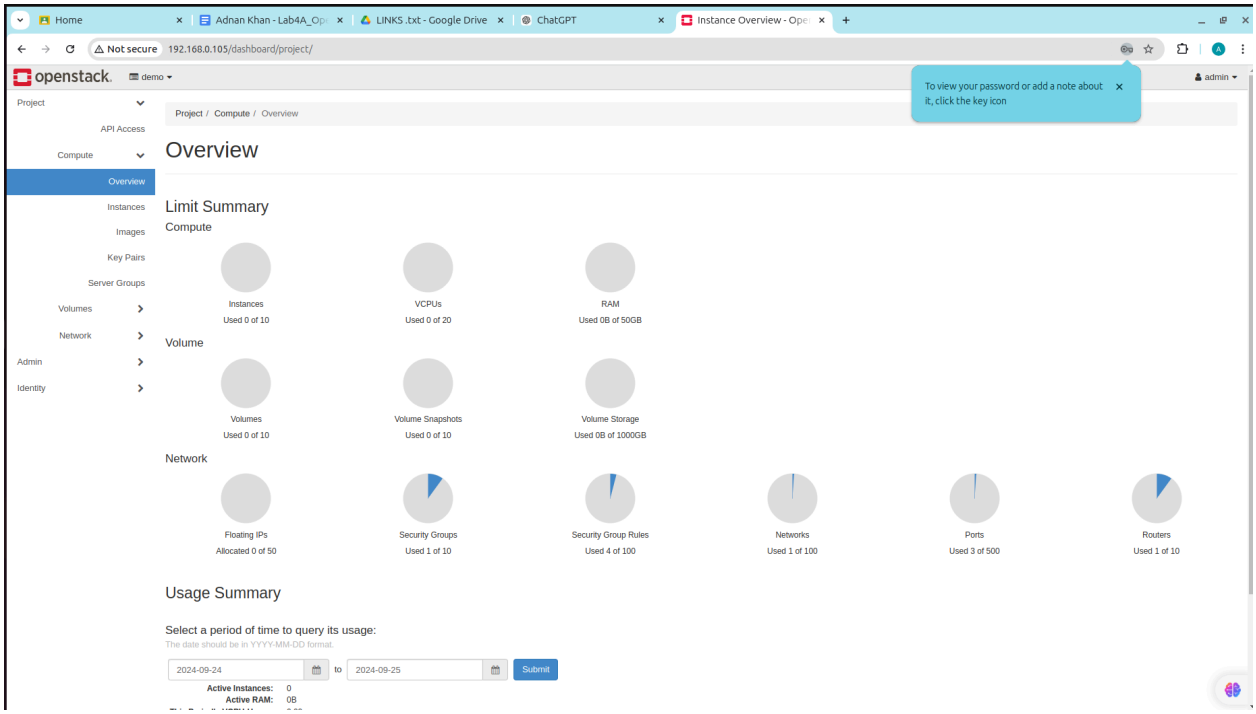

Step 6: Accessing OpenStack on a web browser





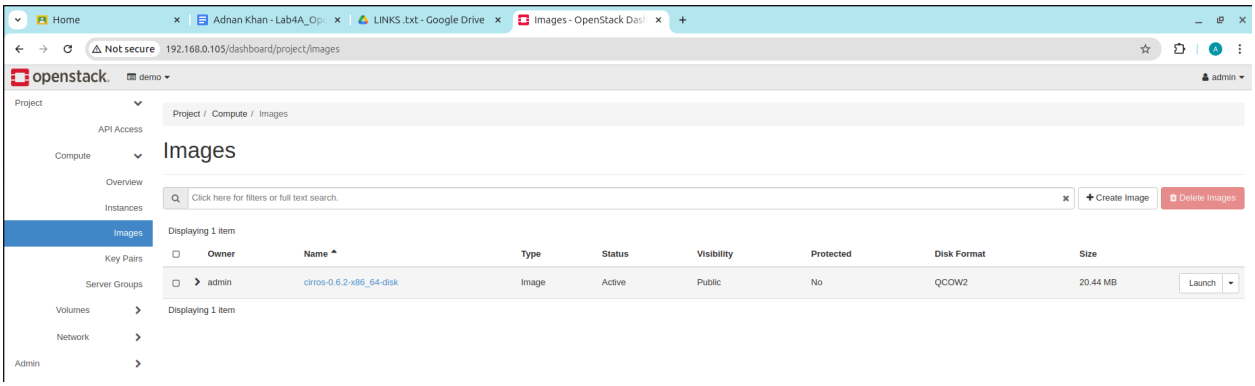

```
stack@techz:~/devstack$ openstack image list
+--------------------------------------+---------------------------+--------+
| ID                                   | Name                      | Status |
+--------------------------------------+---------------------------+--------+
| 660cc50b-9c40-44b8-9aa6-d343006992a7 | cirros-0.6.2-x86_64-disk | active |
+--------------------------------------+---------------------------+--------+
```

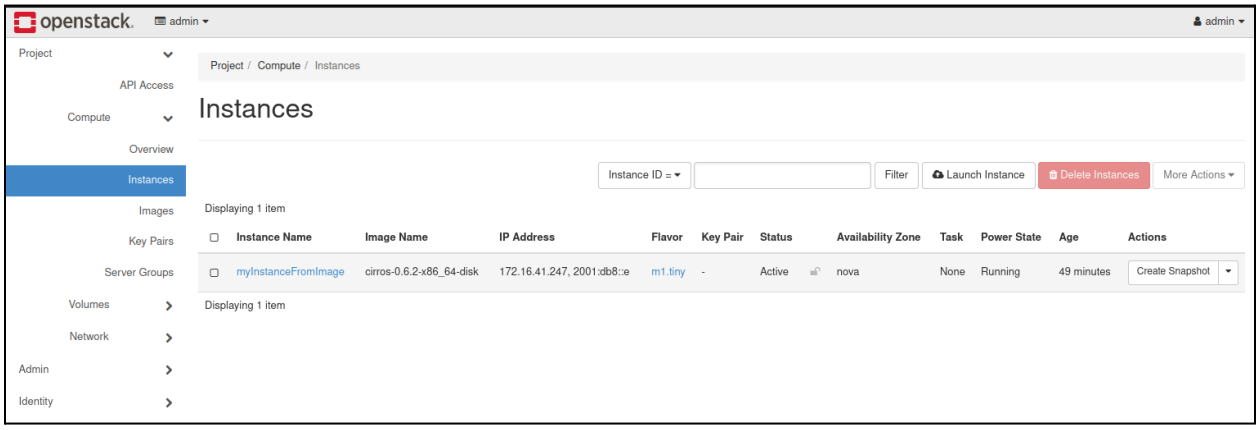
```
stack@techz:~/devstack$ openstack port list
+--------------------------------------+------+-------------------+-----------------------------------------------------+--------+
| ID                                   | Name | MAC Address       | Fixed IP Addresses                                  | Status |
+--------------------------------------+------+-------------------+-----------------------------------------------------+--------+
| 056e2c99-52ff-477b-8c13-d36562473e89 |      | fa:16:3e:56:10:a5 | ip_address='10.0.0.1',                              | ACTIVE |
|                                      |      |                   | subnet_id='a4e4af4b-e26c-4941-a281-02a2db25a960'    |        |
| 2681a15a-4135-4f7a-8b40-4e360d3b012d |      | fa:16:3e:8f:07:60 | ip_address='172.24.4.241',                          | ACTIVE |
|                                      |      |                   | subnet_id='e931ae54-47b1-4f3b-bea5-137995e3fbe5'    |        |
|                                      |      |                   | ip_address='2001:db8::1d7',                         |        |
|                                      |      |                   | subnet_id='f7b87a2d-8d41-4367-97c2-f3739ab54709'    |        |
| 64af0749-f0c5-48b9-9e30-40e283e95223 |      | fa:16:3e:6e:23:63 | ip_address='fd8f:e54e:a26::1',                      | ACTIVE |
|                                      |      |                   | subnet_id='c4a91df3-11fe-41af-baea-e3852cdc06a1'    |        |
| af5e93e0-220e-4be3-abc7-8ded92aa1f98 |      | fa:16:3e:46:eb:74 |                                                     | DOWN   |
| ce1b8b0f-0876-41a8-b219-b5c9cbc9419a |      | fa:16:3e:c0:a1:f0 | ip_address='192.168.233.2',                         | DOWN   |
|                                      |      |                   | subnet_id='c0f66db8-6dac-4232-84ae-bcce07d1aa1b'    |        |
| f2758bc1-5fbd-445e-8ce2-fac4df5ee986 |      | fa:16:3e:b0:f7:67 | ip_address='10.0.0.2',                              | DOWN   |
|                                      |      |                   | subnet_id='a4e4af4b-e26c-4941-a281-02a2db25a960'    |        |
|                                      |      |                   | ip_address='fd8f:e54e:a26:0:f816:3eff:feb0:f767'    |        |
|                                      |      |                   | , subnet_id='c4a91df3-11fe-41af-                    |        |
|                                      |      |                   | baea-e3852cdc06a1'                                  |        |
+--------------------------------------+------+-------------------+-----------------------------------------------------+--------+
stack@techz:~/devstack$ openstack flavor list
```

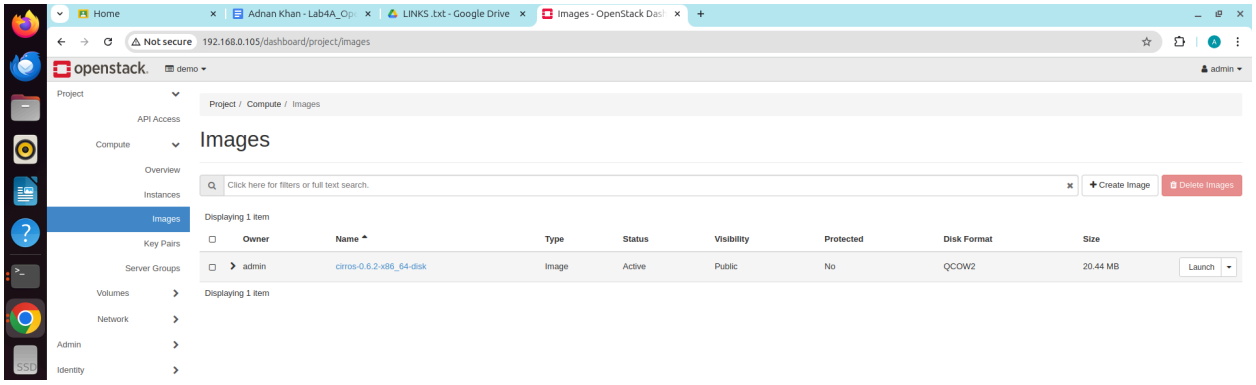
```
stack@techz:~/devstack$ openstack port list
+--------------------------------------+------+-------------------+----------------------------------------------------+--------+
| ID                                   | Name | MAC Address       | Fixed IP Addresses                                 | Status |
+--------------------------------------+------+-------------------+----------------------------------------------------+--------+
| 056e2c99-52ff-477b-8c13-d36562473e89 |      | fa:16:3e:56:10:a5 | ip_address='10.0.0.1',                             | ACTIVE |
|                                      |      |                   | subnet_id='a4e4af4b-e26c-4941-a281-02a2db25a960'   |        |
| 2681a15a-4135-4f7a-8b40-4e360d3b012d |      | fa:16:3e:8f:07:60 | ip_address='172.24.4.241',                         | ACTIVE |
|                                      |      |                   | subnet_id='e931ae54-47b1-4f3b-bea5-137995e3fbe5'   |        |
|                                      |      |                   | ip_address='2001:db8::1d7',                        |        |
|                                      |      |                   | subnet_id='f7b87a2d-8d41-4367-97c2-f3739ab54709'   |        |
| 64af0749-f0c5-48b9-9e30-40e283e95223 |      | fa:16:3e:6e:23:63 | ip_address='fd8f:e54e:a26::1',                     | ACTIVE |
|                                      |      |                   | subnet_id='c4a91df3-11fe-41af-baea-e3852cdc06a1'   |        |
| af5e93e0-220e-4be3-abc7-8ded92aa1f98 |      | fa:16:3e:46:eb:74 |                                                    | DOWN   |
| ce1b8b0f-0876-41a8-b219-b5c9cbc9419a |      | fa:16:3e:c0:a1:f0 | ip_address='192.168.233.2',                        | DOWN   |
|                                      |      |                   | subnet_id='c0f66db8-6dac-4232-84ae-bcce07d1aa1b'   |        |
| f2758bc1-5fbd-445e-8ce2-fac4df5ee986 |      | fa:16:3e:b0:f7:67 | ip_address='10.0.0.2',                             | DOWN   |
|                                      |      |                   | subnet_id='a4e4af4b-e26c-4941-a281-02a2db25a960'   |        |
|                                      |      |                   | ip_address='fd8f:e54e:a26:0:f816:3eff:feb0:f767'   |        |
|                                      |      |                   | , subnet_id='c4a91df3-11fe-41af-                   |        |
|                                      |      |                   | baea-e3852cdc06a1'                                 |        |
+--------------------------------------+------+-------------------+----------------------------------------------------+--------+
stack@techz:~/devstack$ openstack flavor list
```

```
| d4 | ds4G      |  4096 |   20 |         0 |     4 | True      |
+----+-----------+-------+------+-----------+-------+-----------+
stack@techz:~/devstack$ openstack availability zone list
+-------------+-------------+
| Zone Name   | Zone Status |
+-------------+-------------+
| internal    | available   |
| nova        | available   |
| nova        | available   |
+-------------+-------------+
```

```
stack@techz:~/devstack$ openstack server list
+--------------------------------------+-------+--------+---------------------------------+-------------------------+---------+
| ID                                   | Name  | Status | Networks                        | Image                   | Flavor  |
+--------------------------------------+-------+--------+---------------------------------+-------------------------+---------+
| 810a976d-fe25-40d3-b856-49d51bbeae65 | TechZ | ACTIVE | public=172.24.4.75, 2001:db8::2a5 | cirros-0.6.2-x86_64-disk | m1.tiny |
+--------------------------------------+-------+--------+---------------------------------+-------------------------+---------+
stack@techz:~/devstack$ openstack floating ip create public
openstack server add floating ip 810a976d-fe25-40d3-b856-49d51bbeae65 192.168.0.224
+---------------------+--------------------------------------+
| Field               | Value                                |
+---------------------+--------------------------------------+
| created_at          | 2024-09-25T18:35:23Z                 |
| description         |                                      |
| dns_domain          |                                      |
| dns_name            |                                      |
| fixed_ip_address    | None                                 |
| floating_ip_address | 172.24.4.192                         |
| floating_network_id | 1405a5da-31da-4f77-ba04-ed572b29cbce |
| id                  | 984518fb-16cb-4506-8538-7815a432d897 |
| name                | 172.24.4.192                         |
| port_details        | None                                 |
| port_id             | None                                 |
| project_id          | d7432cbd06de41e899a35df634b087df     |
| qos_policy_id       | None                                 |
| revision_number     | 0                                    |
| router_id           | None                                 |
| status              | DOWN                                 |
| subnet_id           | None                                 |
| tags                | []                                   |
| updated_at          | 2024-09-25T18:35:23Z                 |
+---------------------+--------------------------------------+
No FloatingIP found for 192.168.0.224
stack@techz:~/devstack$
```







Conclusion:

In this lab, we successfully deployed OpenStack on Ubuntu 22.04, paving the way for creating a robust and scalable cloud infrastructure capable of handling a variety of workloads. This hands-on experience allowed us to dive into the world of cloud computing, where we set up essential components like Nova, Glance, Neutron, Keystone, and Cinder.

Using DevStack for installation simplified the process, enabling us to quickly provision and configure cloud resources without getting bogged down by complex setups. It was exciting to see how each component plays a vital role in managing compute, storage, and networking resources, all while offering us the flexibility to tailor the cloud environment to specific needs.

We also explored the importance of monitoring tools such as Ceilometer, which help us gain insights into resource utilization. This knowledge empowers us to plan ahead and optimize our resources effectively, ensuring that our cloud infrastructure remains efficient and responsive.

Overall, this lab not only enhanced our technical skills in deploying and managing OpenStack but also highlighted the significance of cloud technologies in today's computing landscape. We are now better equipped to tackle future challenges in cloud architecture and management, and we look forward to applying what we've learned in real-world scenarios.

References:

[1] https://medium.com/@kcoupal/how-to-install-openstack-on-ubuntu-22-04-with-devstack-3336c01ddcfa

[2] https://stackoverflow.com/questions/26583885/openstack-devstack-virtual-machine-installation-error
[3] https://www.youtube.com/watch?v=kQQwdpYphl4
[4] https://access.redhat.com/documentation/en-us/red_hat_openstack_platform/16.1/html-single/creating_and_managing_instances/index