

OpenStack Cloud Security

Lab 1

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Introduction to OpenStack

Learning Objectives

By the end of this lab, students will be able to:

- Understand what OpenStack is and its core components
- Identify the key services that make up an OpenStack cloud
- Navigate the OpenStack architecture and understand service relationships
- Access and use the OpenStack Horizon dashboard
- Create and manage basic cloud resources

Prerequisites

- Basic Linux command-line knowledge
 - Understanding of virtualization concepts
 - Access to a virtual machine or physical server with:
 - Ubuntu 22.04 LTS or later (recommended)
 - Minimum 8GB RAM, 40GB disk space
 - Network connectivity
 - DevStack Preinstalled ([Install Here](#))
-




Part 1: What is OpenStack?

OpenStack is an open-source cloud computing platform that provides Infrastructure as a Service (IaaS). It enables organizations to create and manage large networks of virtual machines and other resources through a web-based dashboard, command-line tools, or REST APIs.

Key Characteristics

- **Open Source:** Free and community-driven
- **Modular Architecture:** Composed of multiple interconnected services
- **Scalable:** Can manage thousands of compute nodes
- **Multi-tenant:** Supports multiple users and projects
- **API-driven:** Everything can be automated through APIs

OpenStack VS the Competition:

			
License Model	Open Source	pay as you go	licensing / subscription
Control	Full control	Limited. Aws managed	Strong control but limited to VMWare tools
Scalability	Very High, proven at hyperscale	Virtually unlimited	Good but high cost for enterprise scale
Flexibility	Highly modular using only the modules you need	Great but locked to AWS ecosystem	VMWare Ecosystem Only (NSX, vSAN)

OpenStack vs. Traditional IT

Traditional IT	OpenStack Cloud
Manual provisioning	Self-service provisioning
Fixed capacity	Elastic scaling
Hardware-specific	Hardware-agnostic
Siloed resources	Pooled resources
Manual management	Automated management

Part 2: OpenStack Architecture

- **Controller Node** – Runs central services (Keystone, Glance, Horizon, DB, MQ).
 - **Compute Node** – Hosts VM workloads.
 - **Storage Node** – Provides block/object storage.
 - **Networking Node** – Handles routing, VLANs, DHCP, NAT.
-

Part 3: Core OpenStack Services

OpenStack consists of several core services, each with a specific role:

Compute (Nova)

- **Purpose:** Manages virtual machine instances
- **Function:** Provisions, schedules, and manages VM lifecycle
- **Analogy:** The "brain" that decides where and how to run your applications

Networking (Neutron)

- **Purpose:** Provides network connectivity services
- **Function:** Creates virtual networks, subnets, routers, and security groups
- **Analogy:** The "highway system" connecting your resources

Storage Services

Block Storage (Cinder)

- **Purpose:** Provides persistent block storage volumes
- **Function:** Creates, attaches, and manages storage volumes for VMs
- **Analogy:** External hard drives that can be attached to any computer

Object Storage (Swift)

- **Purpose:** Stores and retrieves unstructured data objects
- **Function:** Handles files, images, backups through REST API

- **Analogy:** A massive filing cabinet accessible from anywhere

Image Service (Glance)

- **Purpose:** Manages virtual machine images
- **Function:** Stores, discovers, and retrieves VM templates
- **Analogy:** A library of operating system templates

Identity (Keystone)

- **Purpose:** Authentication and authorization service
- **Function:** Manages users, projects, roles, and service catalog
- **Analogy:** The "security guard" that controls access to everything

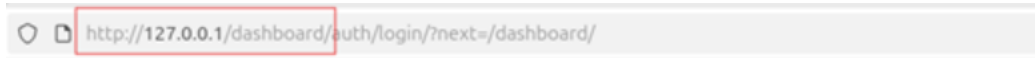
Dashboard (Horizon)

- **Purpose:** Web-based management interface
- **Function:** Provides graphical access to OpenStack services
- **Analogy:** The "control panel" for your cloud

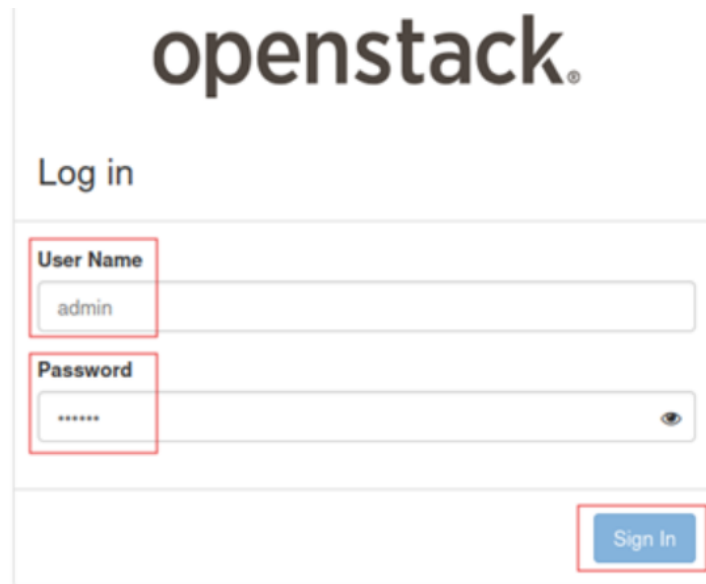
Part 4: Hands-On OpenStack Introduction Lab

Section 1: Dashboard Overview

1. With DevStack installed on your computer, open your web browser and navigate to <http://127.0.0.1/dashboard/> to see the dashboard login for OpenStack.

A screenshot of the OpenStack dashboard login page. At the top is the OpenStack logo, which consists of a red square with a white 'O' inside, followed by the text 'openstack.' in a dark grey font. Below the logo is the text 'Log in'. Underneath is a 'User Name' label followed by a text input field. Below that is a 'Password' label followed by a password input field with a toggle icon on the right. At the bottom right of the form is a blue button with the text 'Sign In'.

2. Login with the username: 'admin' and password that is in the '/opt/stack/devstack/local.conf' file. Then click 'Sign In'



The image shows the OpenStack login interface. At the top is the 'openstack.' logo. Below it is the text 'Log in'. There are two input fields: 'User Name' with the value 'admin' and 'Password' with masked characters '*****'. A 'Sign In' button is located at the bottom right. Red boxes highlight the 'User Name' label and input, the 'Password' label and input, and the 'Sign In' button.

openstack.

Log in

User Name
admin

Password

Sign In

3. You should see the Overview screen for the Compute section. On this page, an overview of the entire cloud network can be found that gives you information about the Compute, Volume, and Network sections of your cloud network.

Project

API Access

Compute

Overview

Instances

Images

Key Pairs

Server Groups

Volumes

Network

Admin

Identity

Project / Compute / Overview

Overview

Limit Summary

Compute



Instances
Used 0 of 10



vCPUs
Used 0 of 20



RAM
Used 0B of 50GB

Volume



Volumes
Used 0 of 10



Volume Snapshots
Used 0 of 10



Volume Storage
Used 0B of 1000GB

Network



Floating IPs
Allocated 1 of 50

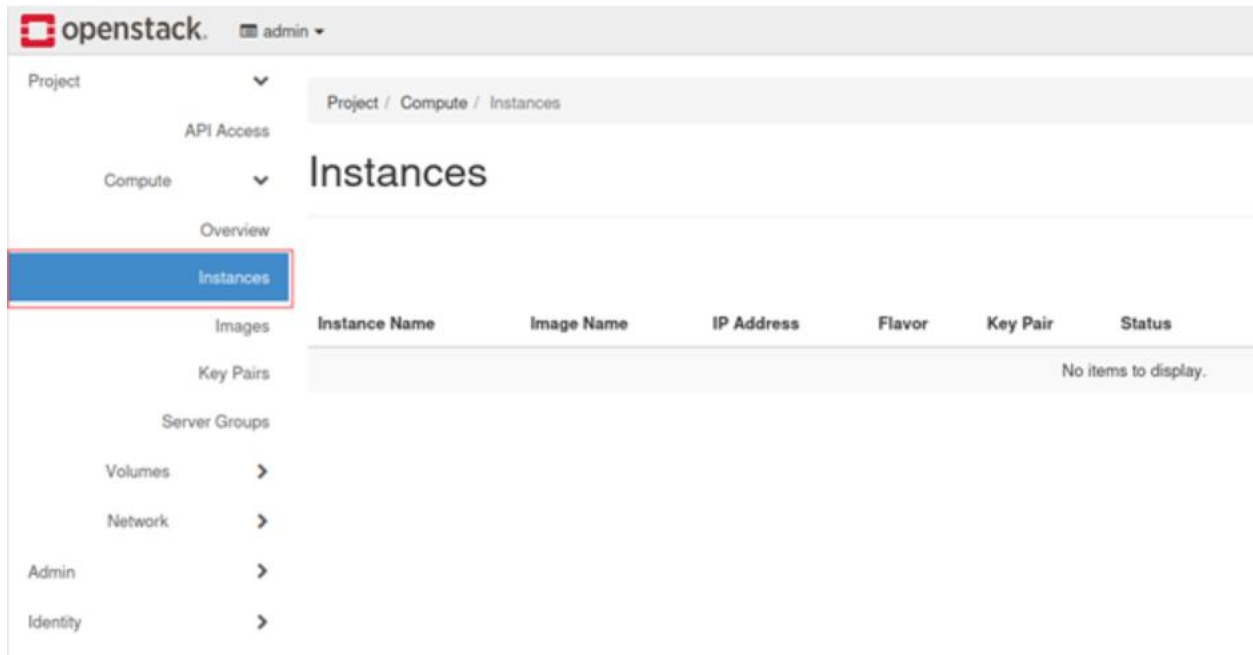


Security Groups
Used 2 of 10

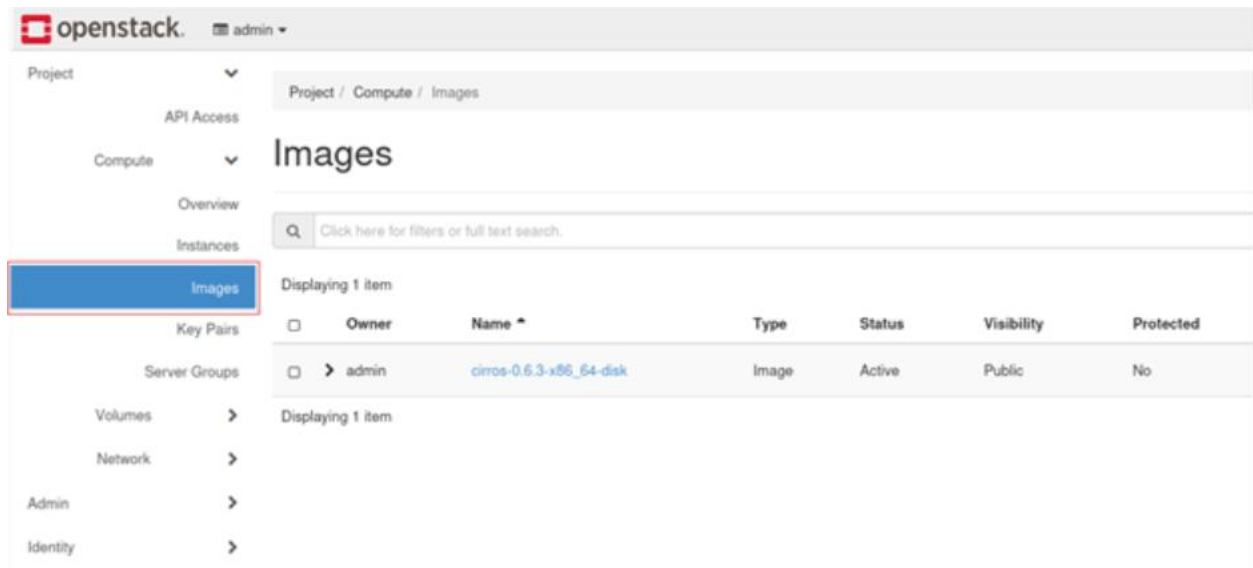


Security Group Rules
Used 7 of 100

- Click on 'Instances' below the highlighted Overview section. This screen shows all instances that are set up to run on OpenStack. Right now, there should be no instances running on your virtual machine. This screen will later allow you to create, monitor, and manage your VMs.



- Next, click on 'Images' below the Instances section. Here you will find all the virtual machine images that can be set up to run on your version of OpenStack. Cirros is the default image installed with DevStack.



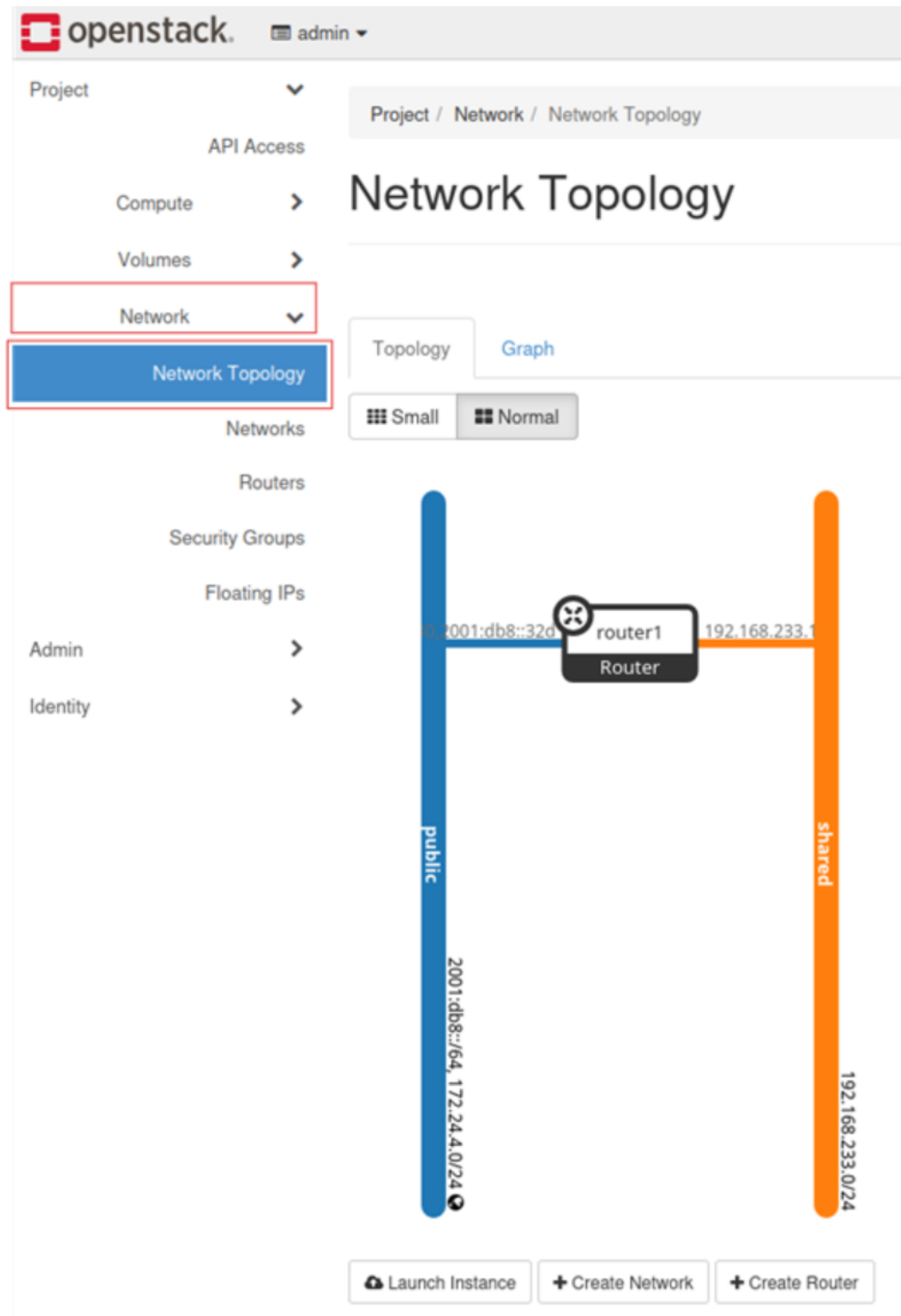
- Skip further down and click on the 'Volumes' drop-down and then 'Volumes' again. Volumes in OpenStack are like virtual hard drives you can attach to instances, providing persistent storage for your VMs.

Volumes

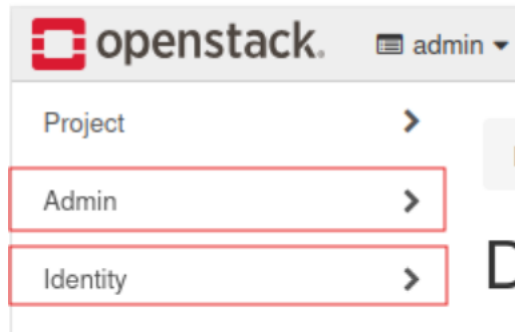
Filter

Name	Description	Size	Status	Group	Type	Attached To	Availability Zone
No items to display.							

- Click on the 'Network' drop-down and then click on 'Network Topology'. Virtual networks can be set up on OpenStack that connect instances with one another and to external networks. This page shows a visual map of your virtual networks. As an example, in the picture below, a router is set up that connects the shared subnet to the public external network.

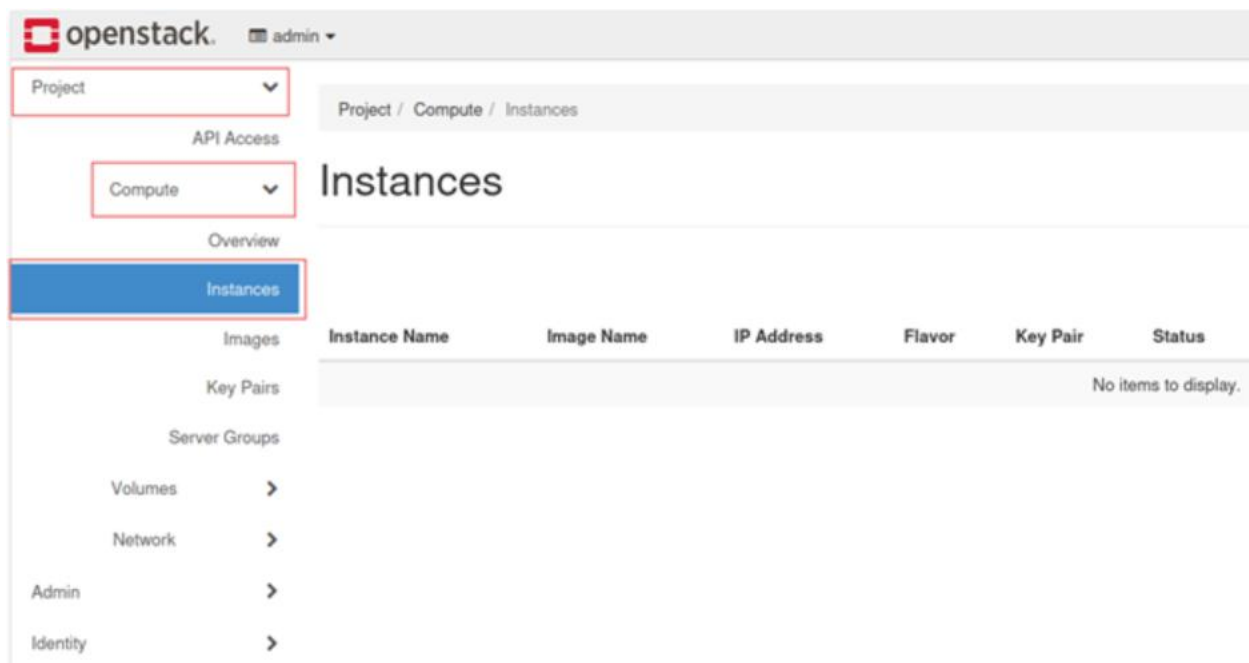


8. Below the Project drop-down there are two sections labeled 'Admin' and 'Identity'. These sections provide many useful tools for administrators to control their OpenStack deployment. However, these sections are out of scope for the current lab. This concludes section 1 of the hand-on lab.

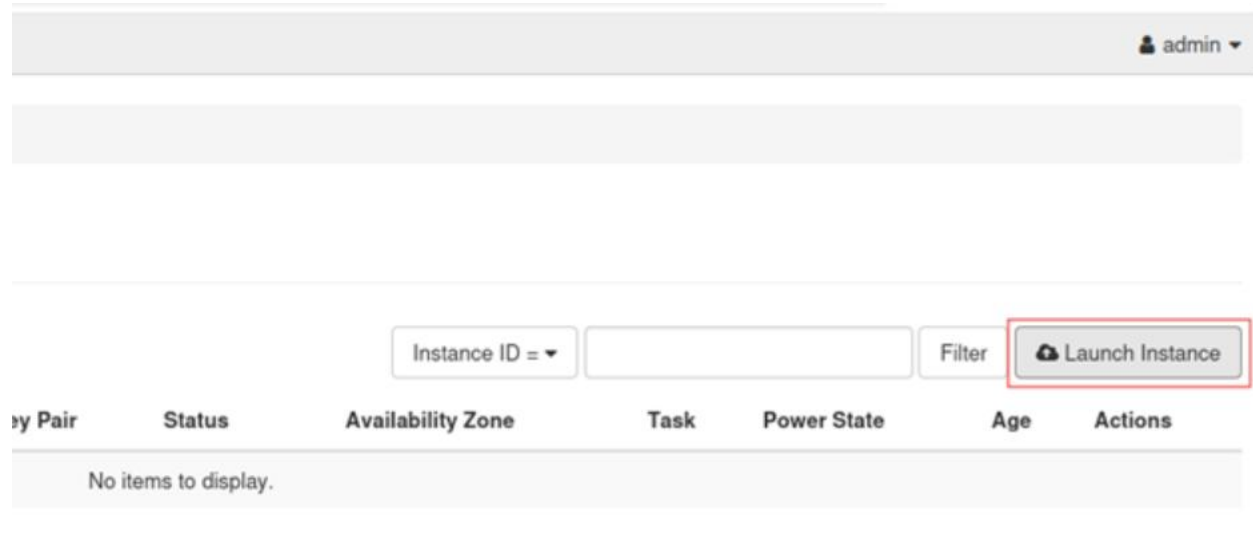


Section 2: Setting Up Your First Virtual Machine Instance

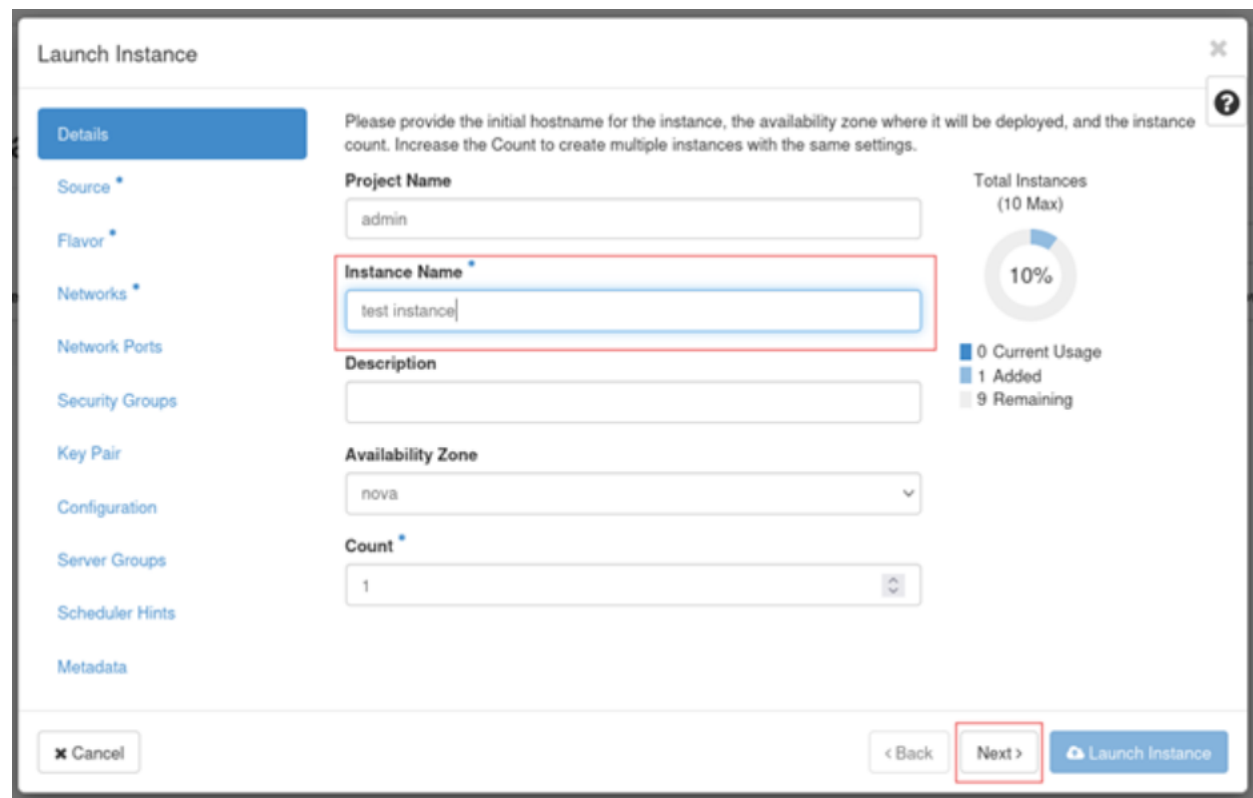
9. Navigate to the 'Project > Compute > Instances' page in your OpenStack Dashboard. You should see 'No items to display.' under Status.



10. Click the 'Launch Instance' button on the right side of the dashboard. This will open up a menu that allows you to configure a new instance.



11. You should see the screen below open up in your dashboard. Type a name into the 'Instance Name' text box and click 'Next'.



12. On the Source screen, click on the up arrow to the right of the cirros image. This will add it to the section titled 'Allocated'. If you wanted to use a previously created volume, you could change the 'Create New Volume' setting. You can also set up the volume to delete when the instance is deleted by changing the 'Delete Volume on Instance Delete' setting. However, for this lab, continue with the default settings by clicking 'Next' at the bottom right corner.

Launch Instance

Details

Source

Flavor

Networks

Network Ports

Security Groups

Key Pair

Configuration

Server Groups

Scheduler Hints

Metadata

Instance source is the template used to create an instance. You can use an image, a snapshot of an instance (image snapshot), a volume or a volume snapshot (if enabled). You can also choose to use persistent storage by creating a new volume.

Select Boot Source

Image

Create New Volume

Yes

No

Volume Size (GB)

1

Delete Volume on Instance Delete

Yes

No

Volume Type

lvmdriver-1

Allocated

Displaying 0 items

Name	Updated	Size	Format	Visibility
Select an item from Available items below				

Displaying 0 items

Available

1

Select one

Click here for filters or full text search.

Displaying 1 item

Name	Updated	Size	Format	Visibility
> cirros-0.6.3-x86_64-disk	9/15/25 1:02 AM	20.69 MB	QCOW2	Public

Displaying 1 item

Cancel

< Back

Next >

Launch Instance

13. Next, you will see a long list of Flavors. These allow you to allocate virtual CPUs, RAM, and disk space for your instance. Click the arrow to the right of the 'm1.tiny' flavor to select it. Then click 'Next' at the bottom right.

[Security Groups](#)
[Key Pair](#)
[Configuration](#)
[Server Groups](#)
[Scheduler Hints](#)
[Metadata](#)

▼ Available 12

Select one

Q Click here for filters or full text search. X

Displaying 12 items

Name	vCPUs	RAM	Total Disk	Root Disk	Ephemeral Disk	Public	
➤ m1.nano	1	192 MB	1 GB	1 GB	0 GB	Yes	⬆
➤ m1.micro	1	256 MB	1 GB	1 GB	0 GB	Yes	⬆
➤ cirros256	1	256 MB	1 GB	1 GB	0 GB	Yes	⬆
➤ m1.tiny	1	512 MB	1 GB	1 GB	0 GB	Yes	⬆
➤ ds512M	1	512 MB	5 GB	5 GB	0 GB	Yes	⬆
➤ ds1G	1	1 GB	10 GB	10 GB	0 GB	Yes	⬆
➤ m1.small	1	2 GB	20 GB	20 GB	0 GB	Yes	⬆
➤ ds2G	2	2 GB	10 GB	10 GB	0 GB	Yes	⬆
➤ m1.medium	2	4 GB	40 GB	40 GB	0 GB	Yes	⬆
➤ ds4G	4	4 GB	20 GB	20 GB	0 GB	Yes	⬆
➤ m1.large	4	8 GB	80 GB	80 GB	0 GB	Yes	⬆
➤ m1.xlarge	8	16 GB	160 GB	160 GB	0 GB	Yes	⬆

Displaying 12 items

X Cancel

< Back

Next >

Launch Instance

14. In the Network menu, click the up arrow to the right of the 'shared' network. This will put your VM instance in a private shared subnet on your cloud network. The public network can be used with other settings to allow your instance to connect to the internet. For now, continue with the 'shared' network selected and click the 'Launch Instance' button.

The screenshot shows the 'Launch Instance' dialog box with the 'Networks' tab selected. The 'Available' section shows two networks: 'shared' and 'public'. The 'shared' network is selected, and the 'Launch Instance' button is highlighted.

Launch Instance

Details
Source
Flavor
Networks
Network Ports
Security Groups
Key Pair
Configuration
Server Groups
Scheduler Hints
Metadata

Networks provide the communication channels for instances in the cloud. You can select ports instead of networks or a mix of both.

▼ Allocated
Displaying 0 items

Network	Subnets Associated	Shared	Admin State	Status
Select one or more networks from the available networks below.				

Displaying 0 items

▼ Available 2
Select one or more

Click here for filters or full text search.

Displaying 2 items

Network	Subnets Associated	Shared	Admin State	Status	
> shared	shared-subnet	No	Up	Active	⬆
> public	ipv6-public-subnet public-subnet	No	Up	Active	⬆

Displaying 2 items

Cancel < Back Next > Launch Instance

15. You should see your instance starting up on the Instances page. Wait until it says None under the Task menu and Running is listed under the Power State section. Now click the name of your instance under 'Instance Name'.

Instances

The screenshot shows the 'Instances' page with a table of instances. The first instance is named 'test 1' and is in the 'Building' state.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
test 1	-	-	m1.tiny	-	Build	us-east-1c	Networking	No State	0 minutes	Associate Floating IP

16. Here you will see information about the instance you created. To access your virtual machine instance, click 'Console' to the right of the Overview section.

test 1

Overview

Interfaces

Log

Console

Action Log

Name	test 1
ID	4715831e-8869-424c-8f60-14f01ebee08
Description	-
Project ID	262375dcfe024207911ef954eb472d88
Status	Active
Locked	False
Availability Zone	nova
Created	Sept. 20, 2025, 5:35 p.m.
Age	5 minutes
Host	ubuntu
Instance Name	instance-00000004
Reservation ID	r-esa1zd74
Launch Index	-
Hostname	test-1
Kernel ID	-
Ramdisk ID	-
Device Name	/dev/vda
User Data	-

17. When you scroll down, you will see the console for your virtual machine. You can login with the default user and password listed in the console window.

[Overview](#) [Interfaces](#) [Log](#) [Console](#) [Action Log](#)

Instance Console

If console is not responding to keyboard input: click the grey status bar below. [Click here to show only console](#)
To exit the fullscreen mode, click the browser's back button.

Connected to QEMU (instance-00000004)

```
[ 9.845570] evm: security.SMACK64
[ 9.845924] evm: security.SMACK64EXEC
[ 9.846244] evm: security.SMACK64TRANSMUTE
[ 9.846652] evm: security.SMACK64MMAP
[ 9.847007] evm: security.apparmor
[ 9.847610] evm: security.ina
[ 9.847908] evm: security.capability
[ 9.848303] evm: HMAC attrs: 0x1
[ 9.856261] PM: Magic number: 9:458:694
[ 9.865697] RAS: Correctable Errors collector initialized.
[ 9.869528] clk: Disabling unused clocks
[ 9.901233] Freeing unused decrypted memory: 2036K
[ 10.065009] Freeing unused kernel image (initmem) memory: 3368K
[ 10.066756] Write protecting the kernel read-only data: 30720k
[ 10.073574] Freeing unused kernel image (text/rodata gap) memory: 2036K
[ 10.079140] Freeing unused kernel image (rodata/data gap) memory: 1328K
[ 10.536743] x86/mm: Checked W*X mappings: passed, no W*X pages found.
[ 10.539630] x86/mm: Checking user space page tables
[ 10.971136] x86/mm: Checked W*X mappings: passed, no W*X pages found.
[ 10.982868] Run /init as init process

further output written to /dev/ttyS0
[ 13.281592] virtio_blk virtio2: [vda] 2097152 512-byte logical blocks (1.07 G
B/1.00 GiB)
[ 13.729796] virtio_gpu virtio0: [drm] drm_plane_enable_fb_damage_clips() not called
[ 13.806798] random: crng init done

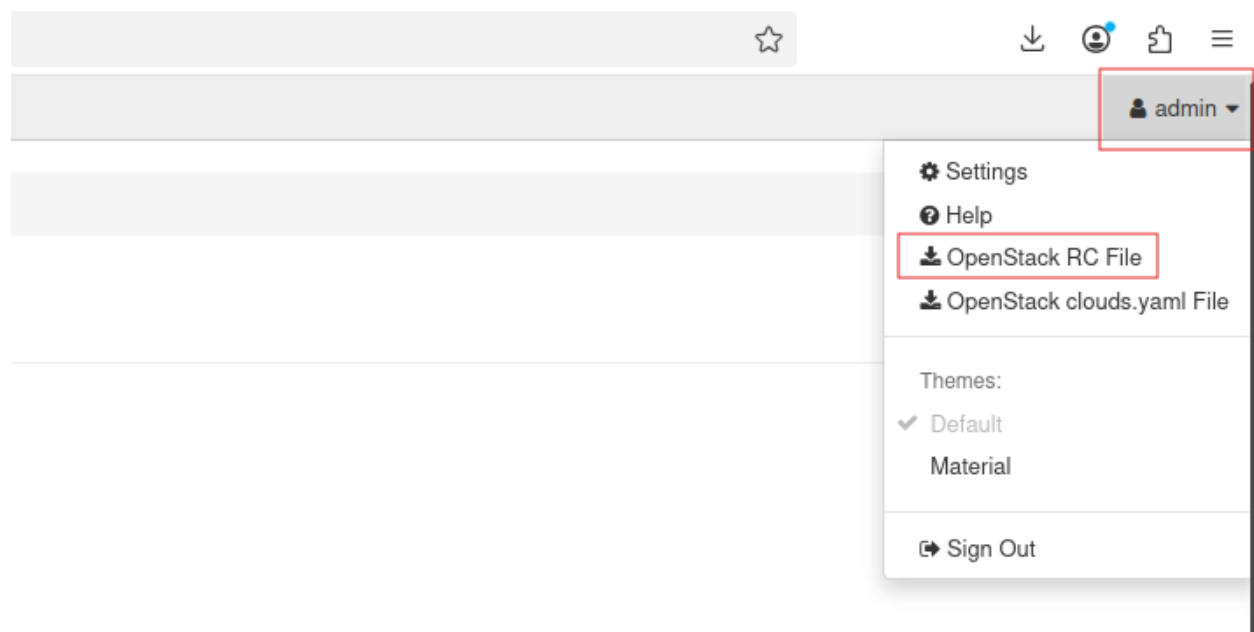
login as 'cirros' user. default password: 'gocubsgo'. use 'sudo' for root.
test-1 login:
```

18. Congratulations! You have now created and logged into a simple virtual machine instance on your OpenStack deployment. Once you login, you can try some simple Linux commands, such as `cd`, `ls`, or `echo`. This concludes Section 2 of the hands-on lab.

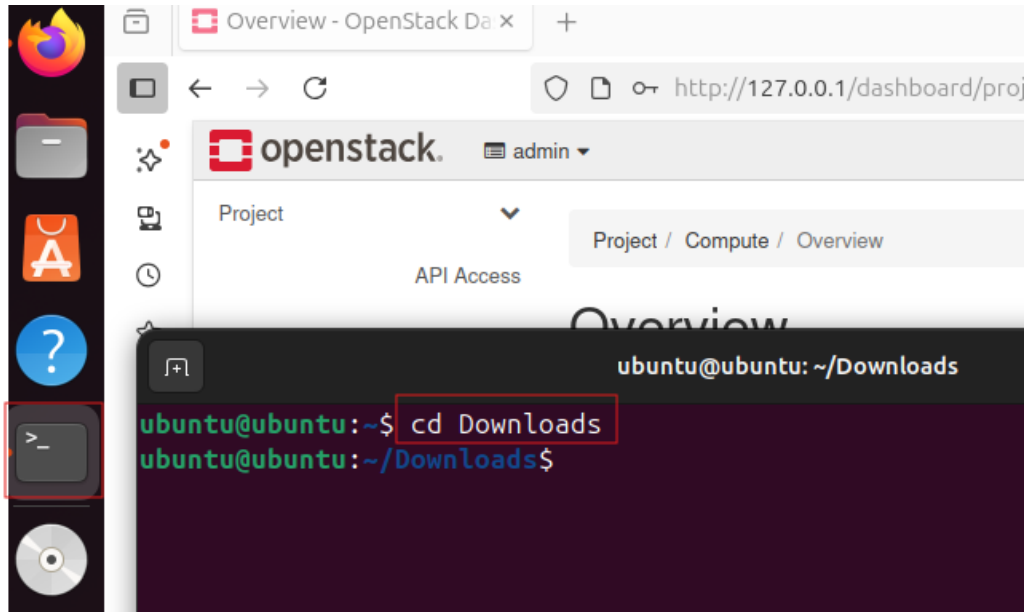
```
login as 'cirros' user. default password: 'gocubsgo'. use 'sudo' for root.
test-1 login: cirros
Password:
$ echo 'hello'
hello
$ ls
$ cd ..
$ ls
$ ls
cirros
$ cd ..
$ ls
bin      dev      hone     initrd.img  lib64      lost+found  mnt      opt      root
boot     etc      init     lib         linuxrc    media       old-root  proc     run
$ _
```

Section 3: Setting Up OpenStack CLI

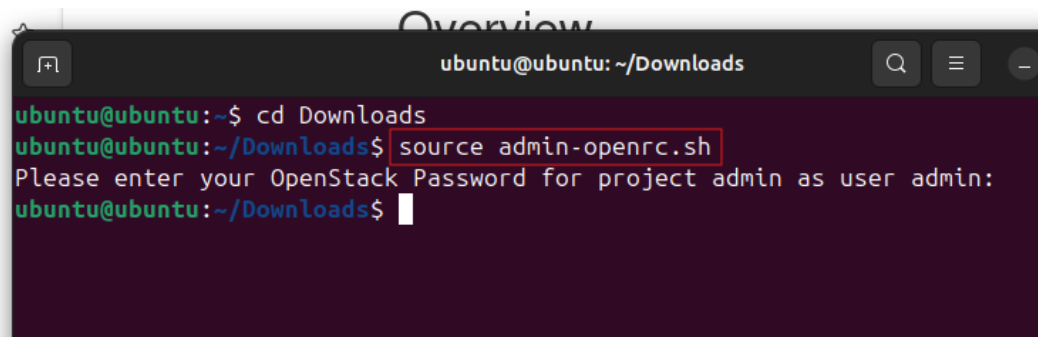
1. From the dashboard, click the admin drop-down on the top-right corner of the screen. Then click 'OpenStack RC File' to download the shell script.



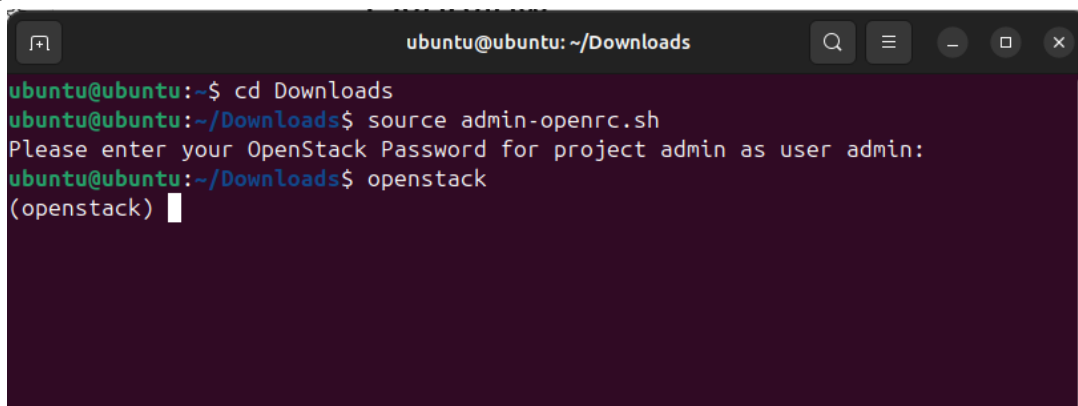
2. Open a terminal window, type 'cd Downloads', and press Enter to change to the directory where the downloaded admin-openrc.sh file is located.



3. In the terminal, type 'source admin-openrc.sh' from the Downloads directory and press Enter. When prompted, type your OpenStack admin password and press Enter.



4. You should be returned back to the shell prompt. Next, type 'openstack' and press Enter. This will open a new prompt with the text '(openstack)'. You can now enter OpenStack commands in the terminal window.



5. In the (openstack) prompt, type 'service list' and press Enter to see a list of all running OpenStack services.

```
(openstack) service list
```

ID	Name	Type
3b26b0a0fdf74fdaa07fa51978d027ba	cinder	block-storage
3d795027dcc648d4861214211ea85594	glance	image
55f8b99073084b4dab0016a5998d6289	neutron	network
b40afb4df4a44060bd23c55464d8b084	nova_legacy	compute_legacy
c66f3e50c0bf40828a8059c39417bd6f	nova	compute
d75ad13f19d34f99b3589aea8d80ba99	placement	placement
e3886521e1d141189152417c5a8a7264	keystone	identity

```
(openstack) 
```

6. Other interesting CLI commands can be found in the official OpenStack documentation. [Click this link](#) to see a quick cheat sheet with some useful commands to experiment with. This concludes Section 3 of the hands-on lab.

Part 5: References

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