



OpenStack Labs

Lab 07: Managing an OpenStack Instance

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About This Document

- This document was developed by a team at the University of Tennessee at Chattanooga led by Dr. Mengjun Xie (mengjun-xie@utc.edu).
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Introduction

Up to this point, whenever you have launched an instance, its resources and running state have remained mostly constant. However, OpenStack instances are quite flexible, even after being launched. In this lab, you will launch an instance and perform several management operations while it is running.

Objectives

- Create a snapshot of an instance.
- Manage the running and power state of an instance.
- Shelving and Rescuing an instance.

Lab Settings

The information in the table below will be needed in order to complete the lab. The task sections below provide details on the use of this information.

Virtual Machine	IP Address	Account	Password
workstation	ens3: 192.168.1.21 ens4: 172.25.250.21	ubuntu	ubuntu
devstack	ens3: 192.168.20 ens4: 172.25.250.20	ubuntu	ubuntu

1 Creating a Snapshot with the Horizon Dashboard

In this task, you will launch an instance, modify its configuration, and make a snapshot of it for later use. Taking a snapshot of an image captures its state and data on disk. An OpenStack snapshot can be used as an image to launch other instances. Snapshots are useful tools in many situations. One is to aid in the backup of instance or as a precaution before a major change so that the image is easily recoverable. Another use of snapshots is to build off an existing image to create a better template for new instances. For instance, consider the case where you want to launch multiple customized FTP servers. Instead of launching each one from a basic Ubuntu image and modifying their configurations individually, you might set up one instance completely and take a snapshot. That snapshot could then be used as a template for the other instances to save time and prevent mistakes.

- 1.1. Log into the **workstation** machine as the **ubuntu** user with password **ubuntu**.

```
Ubuntu 18.04.6 LTS workstation tty1

workstation login: ubuntu
Password:
```

- 1.2. Launch the graphical user interface.

```
ubuntu@workstation:~$ startx

Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 4.15.0-213-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

 System information as of Fri Jun  7 21:01:55 UTC 2024

 System load:  0.6           Processes:      197
 Usage of /:   7.9% of 116.12GB  Users logged in:  0
 Memory usage: 13%
 Swap usage:   0%           IP address for ens3: 192.168.1.21
                           IP address for ens4: 172.25.250.21

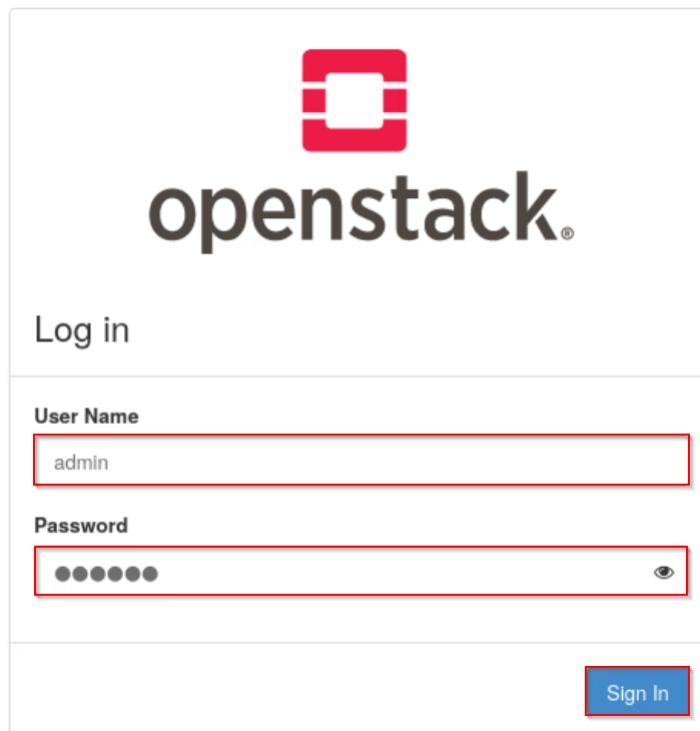
 Expanded Security Maintenance for Infrastructure is not enabled.

 2 updates can be applied immediately.
 To see these additional updates run: apt list --upgradable

 146 additional security updates can be applied with ESM Infra.
 Learn more about enabling ESM Infra service for Ubuntu 18.04 at
 https://ubuntu.com/18-04

ubuntu@workstation:~$ startx_
```

- 1.3. Open the web browser and navigate to **192.168.1.20**. Log into the dashboard as **admin** with the password **secret**.



- 1.4. Ensure the **demo** project is selected. Navigate to **Project > Compute > Instances**, and click **Launch Instance**.

The screenshot shows the OpenStack Horizon Instances page. The navigation bar at the top shows the project is set to "demo". The left sidebar has "Compute" selected under "Project". The main content area is titled "Instances". A table is displayed with the following columns: Instance Name, Image Name, IP Address, Flavor, Key Pair, Status, Availability Zone, Task, Power State, Age, and Actions. A "Launch Instance" button is located in the top right corner of the table's header row. The table currently displays the message "No items to display."

1.5. In the *Details* tab, enter **instance1** in the *Instance Name* field and click **Next**.

Launch Instance

Details

Please provide the initial hostname for the instance, the availability zone where it will be deployed, and the instance count. Increase the Count to create multiple instances with the same settings.

<p>Source *</p> <p>Flavor *</p> <p>Network Ports</p> <p>Security Groups</p> <p>Key Pair</p> <p>Configuration</p> <p>Server Groups</p> <p>Scheduler Hints</p> <p>Metadata</p>	<p>Project Name demo</p> <p>Instance Name * instance1</p> <p>Description </p> <p>Availability Zone nova</p> <p>Count * 1</p>	<p>Total Instances (10 Max)</p> <div style="text-align: center;">  10% </div> <p>0 Current Usage 1 Added 9 Remaining</p>
--	---	--

< Back Next > Launch Instance

- 1.6.** In the *Source* tab, make sure **Image** is selected in the *Select Boot Source* dropdown and select **No** under *Create New Volume*. Select the **ubuntu** image by clicking the **↑** symbol in the same row. Click **Next**.

Launch Instance

Details

Source *

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: **No** (highlighted with a red box)

Flavor *

Networks *

Allocated

Displaying 0 Items

Network Ports

Security Groups

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

Key Pair

Configuration

Server Groups

Available (2) (highlighted with a red box)

Select one

Scheduler Hints

Metadata

Displaying 2 Items

Name	Updated	Size	Format	Visibility	
cirros-0.6.2-x86_64-disk	2/9/24 7:59 PM	20.44 MB	QCOW2	Public	↑ (highlighted with a red box)
ubuntu	2/9/24 9:32 PM	647.50 MB	QCOW2	Shared	↑ (highlighted with a red box)

Displaying 2 Items

Cancel

Back

Next > (highlighted with a red box)

Launch Instance

Stop

Before proceeding to the next step, confirm that **ubuntu** appears underneath the *Allocated* section.

- 1.7. In the *Flavor* tab, click the ↑ symbol in the same row as **m1.small**. Click **Next**.

Launch Instance

Details

Allocated

Flavors manage the sizing for the compute, memory and storage capacity of the instance.

Flavor *

Networks *

Network Ports

Security Groups

Key Pair

Configuration

Server Groups

Scheduler Hints

Metadata

Available (12)

Select one

Q Click here for filters or full text search.

Name	VCPUs	RAM	Total Disk	Root Disk	Ephemeral Disk	Public	Action
m1.nano	1	128 MB	1 GB	1 GB	0 GB	Yes	↑
m1.micro	1	192 MB	1 GB	1 GB	0 GB	Yes	↑
citros256	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

Cancel Back Next > Launch Instance

Stop

Before proceeding to the next step, confirm that **m1.small** appears underneath the *Allocated* section.

- 1.8.** In the *Networks* tab, click the ↑ symbol in the same row as **shared**. Click **Launch Instance**.

Launch Instance

Details Networks provide the communication channels for Instances in the cloud. You can select ports instead of networks or a mix of both. [?](#)

Source **Allocated** Displaying 0 items

Flavor

Networks *

Network Ports Displaying 0 items

Security Groups **Available** 2 Select one or more

Key Pair Click here for filters or full text search. [X](#)

Configuration Displaying 2 items

Server Groups

Network	Subnets Associated	Shared	Admin State	Status
shared	shared-subnet	Yes	Up	Active ↑
private	IPv6-private-subnet private-subnet	No	Up	Active ↑

Scheduler Hints

Metadata Displaying 2 items

Cancel [X](#) Back Next [Launch Instance](#)

Stop

Before proceeding to the next step, confirm that **shared** appears underneath the *Allocated* section.

- 1.9.** Access the instance's console by clicking on **instance1** under the *Instance Name* column. Then, navigate to the *Console* tab if you are not directed there automatically. Click the **Click here to show only the console** link.

openstack. demo admin

Project API Access Compute **instance1** Create Snapshot

Overview Instances Images Key Pairs Server Groups

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.

1.10. Log into the instance as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance1 tty1

instance1 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Jul 16 16:57:24 UTC 2024

 System load:  0.66943359375   Processes:          83
 Usage of /:   7.4% of 19.20GB  Users logged in:    0
 Memory usage: 8%              IPv4 address for ens3: 192.168.233.13
 Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance1:~# _
```

Note

It may take several minutes for the instance to fully boot up and present a login prompt.

- 1.11.** Now, we will make a change to the instance and create a snapshot. Create the **/root/hello.txt** file with the contents **Hello, world!**.

```
root@instance1:~# echo 'Hello, world!' > /root/hello.txt
```

```
root@instance1:~# echo 'Hello, world!' > /root/hello.txt
root@instance1:~#
```

- 1.12.** Now, navigate back to **Project > Compute > Instances**. Before creating a snapshot, click the dropdown next to **Create Snapshot** in the same row as **instance1**, then click **Shut Off Instance**. This will prevent any inconsistencies in the resulting snapshot.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance1	ubuntu	192.168.233.99	m1.small	-	Active	nova	None	Running	13 minutes	Create Snapshot

Tip

A “live snapshot” is a snapshot of a running instance, which may only include a snapshot of the disk, while some OS state may be lost.

Note

Stopping instances and otherwise changing their running states will be explored further later in this lab.

1.13. When the *Status* column shows that **instance1** is **Shutoff**, click **Create Snapshot**.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance1	ubuntu	192.168.233.99	m1.small	-	Shutoff	nova	None	Shut Down	15 minutes	Start Instance

1.14. In the **Create Snapshot** dialog, enter **instance1-snapshot** in the *Snapshot Name* field. Click **Create Snapshot**.

Snapshot Name *

Description:

A snapshot is an image which preserves the disk state of a running instance.

Create Snapshot

Stop

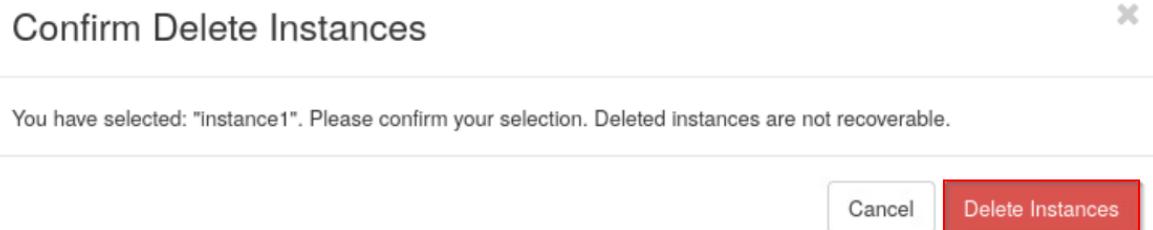
When you create the snapshot, you will be redirected to **Projects > Compute > Images**. Wait until **instance1-snapshot** is **Active** before proceeding.

- 1.15.** Navigate back to the **Instances** page. The instance is no longer needed, so select the checkbox next to **instance1** and click **Delete Instances**.

The screenshot shows the OpenStack Horizon interface under the 'Compute' tab. The 'Instances' sub-tab is selected and highlighted with a red box. On the right, a table displays one instance named 'instance1'. The 'Delete Instances' button at the bottom right of the table is also highlighted with a red box.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance1	ubuntu	192.168.233.99	m1.small	-	Shutoff	nova	None	Shut Down	19 minutes	<button>Start Instance</button>

- 1.16.** In the **Confirm Delete Instances** dialog, click **Delete Instances**.



- 1.17.** To verify that the snapshot works correctly, use the snapshot to launch another instance named **instance1**. Follow the same steps that were used to create **instance1**. However, in the *Source* tab of the **Launch Instance** dialog, select **Image Snapshot** under *Boot Source* click the ↑ symbol next to **instance1-snapshot**.

Launch Instance

Details	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.				
Source *	Select Boot Source <input type="button" value="Instance Snapshot"/> <input type="button" value="Create New Volume"/> <input checked="" type="radio"/> Yes <input type="radio"/> No				
Flavor *					
Networks *	Allocated Network Ports Displaying 0 items				
Security Groups	Name	Updated	Size	Format	Visibility
	Select an item from Available items below				
Key Pair	Displaying 0 items				
Configuration					
Server Groups	Available 1 Select one <input type="text"/> Click here for filters or full text search.				
Scheduler Hints	Displaying 0 items				
Metadata	Name	Updated	Size	Format	Visibility
	instance1-snapshot	7/10/24 2:21 PM	1.53 GB	QCOW2	Private
	Displaying 1 item				
	<input type="button" value="Cancel"/> <input type="button" value="Next >"/> <input type="button" value="Launch Instance"/>				

Tip

The snapshot will also appear on the **Project > Compute > Images** page. It should say **Snapshot** in the *Type* column. For an alternative method of launching an image with the snapshot, navigate to this page, click **Launch** in the same row as the snapshot, and enter the required information in the following dialog. The snapshot can also be deleted from here.

- 1.18. Open the instance's console and log in with the username **root** and password **secret**.

```
Ubuntu 22.04.3 LTS instance1 tty1

instance1 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Jul 16 16:57:24 UTC 2024

 System load:  0.66943359375   Processes:          83
 Usage of /:   7.4% of 19.20GB  Users logged in:    0
 Memory usage: 8%
 Swap usage:   0%               IPv4 address for ens3: 192.168.233.13

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance1:~# _
```

- 1.19. Check that the file created in the previous instance also exists on this instance.

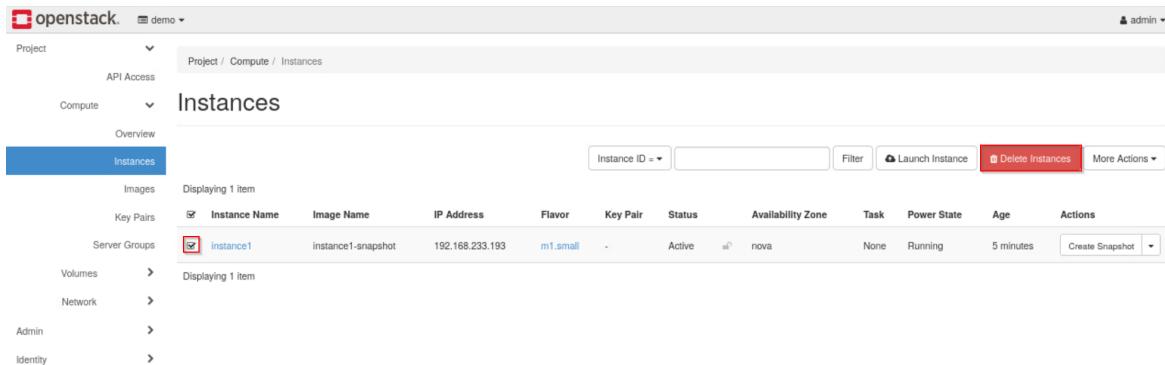
```
root@instance1:~# cat /root/hello.txt
```

```
root@instance1:~# cat /root/hello.txt
Hello, world!
root@instance1:~# _
```

Note

It may take several minutes for the instance to fully boot up and present a login prompt.

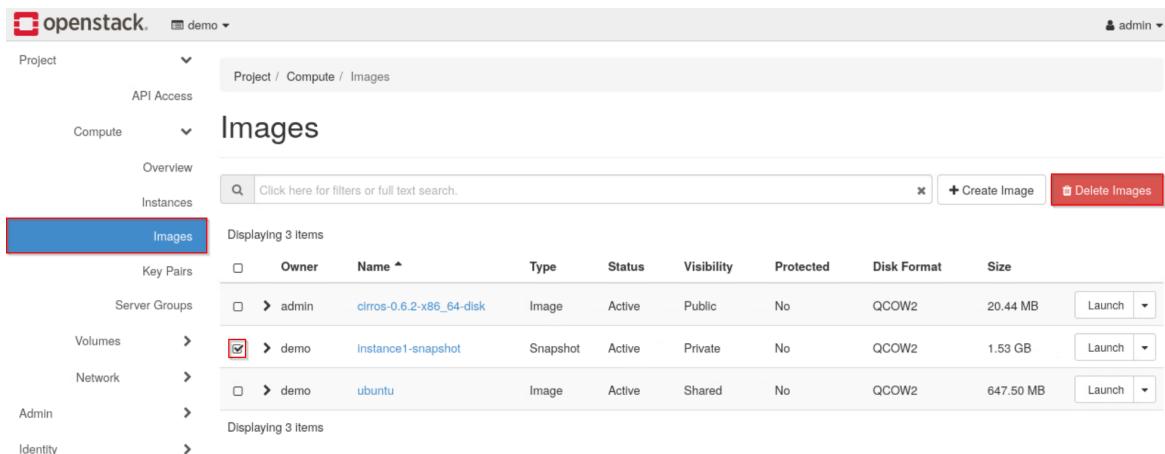
- 1.20.** Exit the instance's console, navigate back to **Project > Compute > Instances**, and delete the instance.



The screenshot shows the OpenStack Horizon dashboard under the 'Compute' tab. The 'Instances' sub-tab is selected. A single instance, 'instance1', is listed in the table. The 'Actions' column for this instance contains a red-bordered 'Delete Instances' button.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance1	instance1-snapshot	192.168.233.193	m1.small	-	Active	nova	None	Running	5 minutes	<button>Create Snapshot</button>

- 1.21.** You will create another snapshot with the *OpenStack Unified CLI* in the next task, so **instance1-snapshot** can safely be deleted. Navigate to **Project > Compute > Images**, select **instance1-snapshot**, and click **Delete Images**.



The screenshot shows the OpenStack Horizon dashboard under the 'Compute' tab. The 'Images' sub-tab is selected. A table lists three items, with 'instance1-snapshot' selected. The 'Actions' column for this item contains a red-bordered 'Delete Images' button.

Owner	Name	Type	Status	Visibility	Protected	Disk Format	Size	Action
admin	cirros-0.6.2-x86_64-disk	Image	Active	Public	No	QCOW2	20.44 MB	<button>Launch</button>
demo	instance1-snapshot	Snapshot	Active	Private	No	QCOW2	1.53 GB	<button>Launch</button>
demo	ubuntu	Image	Active	Shared	No	QCOW2	647.50 MB	<button>Launch</button>

- 1.22.** In the **Confirm Delete Image** dialog, click **Delete Image**.

Confirm Delete Image

You have selected "instance1-snapshot". Deleted image is not recoverable.

Cancel **Delete Image**

- 1.23.** Log out of the dashboard, close the browser window, and continue to the next task.

2 Creating a Snapshot with the OpenStack Unified CLI

In this task, you will repeat the steps from the previous task in the *OpenStack Unified CLI*.

- 2.1. Open a terminal window and source the keystone credentials for the **admin** user.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.2. List the current instances. The list should be empty.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.3. Now, we will create the same snapshot as before from the command line. Launch an instance. Use the **ubuntu** image, the **m1.small** flavor, and the **shared** network.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --network shared \
instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --network shared \
> instance2
+-----+
| Field | Value |
+-----+
| OS-DCF:diskConfig | MANUAL
| OS-EXT-AZ:availability_zone | None
| OS-EXT-SRV-ATTR:host | None
| OS-EXT-SRV-ATTR:hypervisor_hostname | None
| OS-EXT-SRV-ATTR:instance_name | None
| OS-EXT-STS:power_state | NOSTATE
| OS-EXT-STS:task_state | scheduling
| OS-EXT-STS:vm_state | building
| OS-SRV-USG:launched_at | None
| OS-SRV-USG:terminated_at | None
| accessIPv4 | None
| accessIPv6 | None
| addresses | None
| adminPass | wT4XJkc666NH
| config_drive | None
| created | 2025-07-09T20:25:08Z
| flavor | m1.small (2)
| hostId | None
| id | cd56a55b-f5a2-4b23-9dba-e8cc14820d56
| image | ubuntu (329d361e-f6dc-4b72-b200-3de0ec230e65)
| key_name | None
| name | instance2
| progress | 0
| project_id | 39e851b14f864573aad60582c35e40dc
| properties | None
| security_groups | name='default'
| status | BUILD
| updated | 2025-07-09T20:25:08Z
| user_id | 14f5376f00c04e90b7103dd8d4263040
| volumes_attached | None
+-----+
[ubuntu@workstation (keystone-admin)]:~$
```

2.4. List the instances again to ensure it was created correctly.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
+-----+-----+-----+-----+-----+
| ID      | Name     | Status  | Networks       | Image   | Flavor  |
+-----+-----+-----+-----+-----+
| cd56a55b- | instance2 | ACTIVE | shared=192.168.2 | ubuntu | m1.small |
| f5a2-4b23-9dba- |           |         | 33.164          |         |          |
| e8cc14820d56  |           |         |                 |         |          |
+-----+-----+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

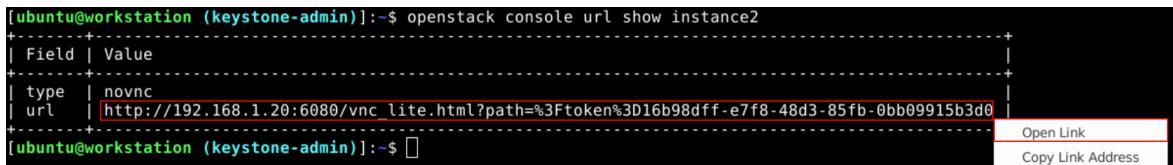
Tip

When typing the command, make sure there is a space between **list** and the \ character, and press **Enter** to get the > and continue typing the rest of the command.

2.5. Show the URL to the console of the instance. Right-click the URL and click **Open Link**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack console url show instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack console url show instance2
+-----+
| Field | Value
+-----+
| type  | novnc
| url   | http://192.168.1.20:6080/vnc_lite.html?path=%3Ftoken%3D16b98dff-e7f8-48d3-85fb-0bb09915b3d0
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```



2.6. Log in to **instance2** as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance2 tty1

instance2 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Thu Jul 11 16:27:13 UTC 2024

 System load:  0.552734375      Processes:           82
 Usage of /:   7.4% of 19.20GB   Users logged in:    0
 Memory usage: 8%
 Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance2:~# _
```

Note

It may take several minutes for the instance to fully boot up and present a login prompt.

2.7. Create the **/root/hello.txt** file with the contents **Hello, world!**.

```
root@instance2:~# echo 'Hello, world!' > /root/hello.txt
```

```
root@instance2:~# echo 'Hello, world!' > /root/hello.txt
root@instance2:~# _
```

- 2.8. Close the browser window and return focus to the terminal window. Stop the instance before making a snapshot.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server stop instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server stop instance2  
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.9. List the current images. The list should have two items.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list  
+-----+-----+-----+  
| ID | Name | Status |  
+-----+-----+-----+  
| dfc5286d-bdb7-4338-8e4b-087422b21e68 | cirros-0.6.2-x86_64-disk | active |  
| 329d361e-f6dc-4b72-b200-3de0ec230e65 | ubuntu | active |  
+-----+-----+-----+  
[ubuntu@workstation (keystone-admin)]:~$ █
```

2.10. Make a snapshot of the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server image create \
> --name instance2-snapshot \
> instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server image create \
> --name instance2-snapshot \
> instance2
+-----+
| Field      | Value
+-----+
| checksum    | None
| container_format | None
| created_at  | 2025-07-09T20:36:58Z
| disk_format | None
| file        | /v2/images/866180b6-47aa-4d72-be6e-2608768ba4c1/file
| id          | 866180b6-47aa-4d72-be6e-2608768ba4c1
| min_disk    | 20
| min_ram    | 0
| name        | instance2-snapshot
| owner       | 39e851b14f864573aad60582c35e40dc
| properties  | base_image_ref='329d361e-f6dc-4b72-b200-3de0ec230e65',
|               | boot_roles='member,reader,manager,admin',
|               | hw_cdrom_bus='ide', hw_disk_bus='virtio',
|               | hw_machine_type='pc', hw_video_model='virtio',
|               | hw_vif_model='virtio', image_type='snapshot',
|               | instance_uuid='cd56a55b-f5a2-4b23-9dba-e8cc14820d56',
|               | os_hash_algo='None', os_hash_value='None',
|               | os_hidden='False', owner_project_name='demo',
|               | owner_user_name='admin',
|               | user_id='14f5376f00c04e90b7103dd8d4263040'
| protected   | False
| schema     | /v2/schemas/image
| size        | None
| status      | queued
| tags        |
| updated_at  | 2025-07-09T20:36:58Z
| virtual_size| None
| visibility  | private
+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

2.11. List the current images again to ensure the snapshot was created properly.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
+-----+
| ID            | Name           | Status |
+-----+
| dfc5286d-bdb7-4338-8e4b-087422b21e68 | cirros-0.6.2-x86_64-disk | active |
| 8ecabdd4-bf66-49ee-b9c1-66496ccac8a2 | instance2-snapshot    | active |
| 329d361e-f6dc-4b72-b200-3de0ec230e65 | ubuntu           | active |
+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

- 2.12. To verify the correctness of the snapshot, first delete the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server delete instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server delete instance2  
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.13. Confirm the deletion of the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list  
[ubuntu@workstation (keystone-admin)]:~$ █
```

2.14. Now, recreate the instance, using **instance2-snapshot** as the image.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image instance2-snapshot \
> --flavor m1.small \
> --network shared \
instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image instance2-snapshot \
> --flavor m1.small \
> --network shared \
> instance2
+-----+-----+
| Field | Value |
+-----+-----+
| OS-DCF:diskConfig | MANUAL
| OS-EXT-AZ:availability_zone |
| OS-EXT-SRV-ATTR:host | None
| OS-EXT-SRV-ATTR:hypervisor_hostname | None
| OS-EXT-SRV-ATTR:instance_name |
| OS-EXT-STS:power_state | NOSTATE
| OS-EXT-STS:task_state | scheduling
| OS-EXT-STS:vm_state | building
| OS-SRV-USG:launched_at | None
| OS-SRV-USG:terminated_at | None
| accessIPv4 |
| accessIPv6 |
| addresses | t7cMgU7wboCJ
| adminPass |
| config_drive |
| created | 2025-07-09T20:38:28Z
| flavor | m1.small (2)
| hostId |
| id | 38edd8fd-c2ce-4286-9611-006c2d603501
| image | instance2-snapshot (866180b6-47aa-4d72
| -be6e-2608768ba4c1)
| key_name | None
| name | instance2
| progress | 0
| project_id | 39e851b14f864573aad60582c35e40dc
| properties |
| security_groups | name='default'
| status | BUILD
| updated | 2025-07-09T20:38:28Z
| user_id | 14f5376f00c04e90b7103dd8d4263040
| volumes_attached |
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$
```

- 2.15. Using the same steps as before, log in to the instance's console as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance2 tty1

instance2 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Thu Jul 11 16:27:13 UTC 2024

 System load:  0.552734375      Processes:           82
 Usage of /:   7.4% of 19.20GB   Users logged in:    0
 Memory usage: 8%                  IPv4 address for ens3: 192.168.233.122
 Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance2:~# _
```

Note

It may take several minutes for the instance to fully boot up and present a login prompt.

- 2.16. Verify that the **/root/hello.txt** file exists.

```
root@instance2:~# cat /root/hello.txt
```

```
root@instance2:~# cat /root/hello.txt
Hello, world!
root@instance2:~# _
```

- 2.17. Close the browser window, and delete the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server delete instance2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server delete instance2
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.18. Delete the **instance2-snapshot** image.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image delete \
> instance2-snapshot
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image delete \
> instance2-snapshot
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.19. Leave the terminal window open, and continue to the next task.

3 Managing the Running State of an Instance with the Horizon Dashboard

OpenStack allows for managing the running and power state of instances in a variety of ways, and each method is useful in different situations. In this task, you will manage the running and power state of an instance by starting, stopping, pausing, suspending, resuming, and rebooting the instance with the *Horizon Dashboard*.

- 3.1. If a terminal window is not already open, open one and source the keystone credentials for the **admin** user.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

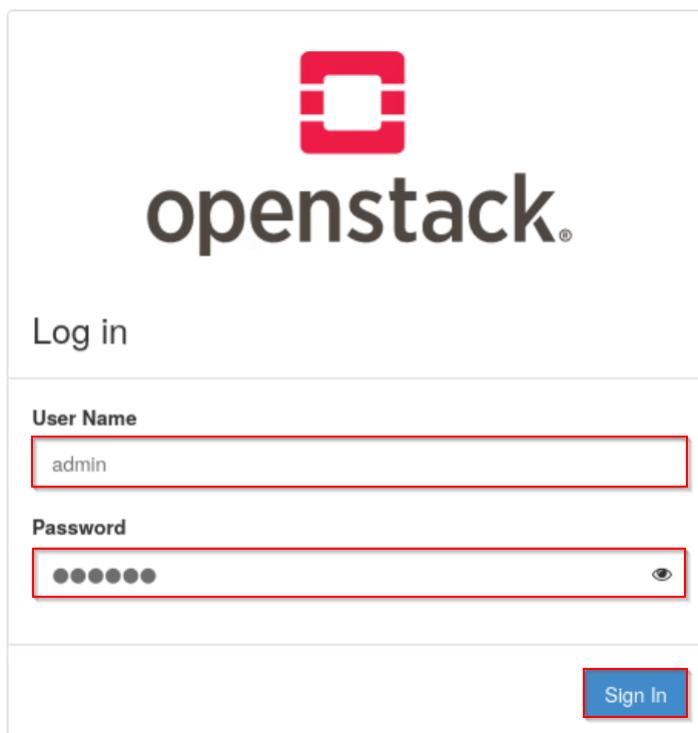
```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.2.** Create an instance named **instance3**. Use the **ubuntu** image and the **m1.small** flavor, and connect the instance to the **shared** network.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --network shared \
instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --network shared \
> instance3
+-----+
| Field | Value |
+-----+
| OS-DCF:diskConfig | MANUAL
| OS-EXT-AZ:availability_zone | None
| OS-EXT-SRV-ATTR:host | None
| OS-EXT-SRV-ATTR:hypervisor_hostname | None
| OS-EXT-SRV-ATTR:instance_name | instance3
| OS-EXT-STS:power_state | NOSTATE
| OS-EXT-STS:task_state | scheduling
| OS-EXT-STS:vm_state | building
| OS-SRV-USG:launched_at | None
| OS-SRV-USG:terminated_at | None
| accessIPv4 | None
| accessIPv6 | None
| addresses | None
| adminPass | y3mrb79gbWSq
| config_drive | None
| created | 2025-07-09T23:21:48Z
| flavor | m1.small (2)
| hostId | None
| id | 61a2423-0bf9-46e4-b196-3039415b2e3e
| image | ubuntu (329d361e-f6dc-4b72-b200-3de0ec230e65)
| key_name | None
| name | instance3
| progress | 0
| project_id | 39e851b14f864573aad60582c35e40dc
| properties | None
| security_groups | name='default'
| status | BUILD
| updated | 2025-07-09T23:21:48Z
| user_id | 14f5376f00c04e90b7103dd8d4263040
| volumes_attached | None
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.3.** Close the terminal window. Open a browser window, and navigate to **192.168.1.20**. Log in as **admin** with the password **secret**.



- 3.4.** Navigate to **Project > Compute > Instances**. Open the **instance3** link in a new tab.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance3	ubuntu	192.168.233.23	m1.small	-	Active	nova	None	Running	0 minutes	Create Snapshot

- 3.5.** Navigate to the **Console** tab, and click the **Click here to show only console** link.

3.6. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

Note

It may take several minutes for the instance to fully boot up and present a login prompt.

- 3.7.** Pausing an instance is one way to manage the running state of an OpenStack instance. When an instance is paused, its operation is frozen, and its state and memory are preserved in the RAM of the underlying compute node. Pausing an instance does not release its resources. When the instance is resumed, it will pick up any processes where they left off. To view the effects of pausing an instance, first start continuously pinging the DHCP server.

```
root@instance3:~# ping 192.168.233.2
```

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=13.9 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.07 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.50 ms
```

Tip

Pausing an instance is useful when the operation of an instance needs to be interrupted while its state should be kept intact. For example, an instance might be paused while making changes to the underlying infrastructure to prevent disrupting processes and requiring applications or the instance to be restarted. Pausing an instance is similar to putting a computer in sleep mode.

- 3.8.** To pause the instance, navigate to **Project > Compute > Instances**, click the dropdown next to **Create Snapshot** in the same row as **instance3**, scroll down if necessary, and click **Pause Instance**.

The screenshot shows the OpenStack Horizon dashboard under the 'Compute' tab. On the left, there's a sidebar with 'Project' and 'Compute' dropdowns, and sections for 'Overview', 'Instances', 'Images', 'Key Pairs', 'Server Groups', 'Volumes', 'Network', 'Admin', and 'Identity'. The 'Instances' section is active, displaying a table with one item: 'Instance3' (ubuntu, 192.168.233.23, m1.small, nova). Below the table, a 'More Actions' dropdown is open, listing options like 'Associate Floating IP', 'Attach Interface', 'Detach Interface', 'Edit Instance', 'Attach Volume', 'Detach Volume', 'Update Metadata', 'Edit Security Groups', 'Edit Port Security Groups', 'Console', 'View Log', 'Rescue Instance', 'Pause Instance' (which is highlighted with a red box), and 'Suspend Instance'.

Stop

Wait until the instance's status becomes **Paused**.

- 3.9.** Now, view the console again to see that it is frozen and no more ping replies are appearing.

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=1.61 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.62 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.19 ms
64 bytes from 192.168.233.2: icmp_seq=4 ttl=64 time=1.52 ms
64 bytes from 192.168.233.2: icmp_seq=5 ttl=64 time=0.623 ms
64 bytes from 192.168.233.2: icmp_seq=6 ttl=64 time=1.51 ms
64 bytes from 192.168.233.2: icmp_seq=7 ttl=64 time=1.72 ms
-
```

- 3.10.** Navigate back to the **Instances** page. Click the dropdown next to **Create Snapshot** in the same row as **instance2** and click **Resume Instance**.

The screenshot shows the OpenStack Horizon dashboard under the 'Compute' tab. In the 'Instances' section, there is one item listed: 'Instance3' (ubuntu, IP 192.168.233.23, m1.small flavor, Paused status). A context menu is open over this instance, with the 'Resume Instance' option highlighted. Other options in the menu include Associate Floating IP, Edit Instance, Update Metadata, Edit Port Security Groups, Resum Instance (highlighted), Shelve Instance, Lock Instance, and Delete Instance.

	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
<input type="checkbox"/>	Instance3	ubuntu	192.168.233.23	m1.small	-	Paused	nova	None	Paused	8 minutes	Create Snapshot <input type="button" value="▼"/>

Stop

Wait until the instance's status becomes **Active**.

- 3.11. View the console again to see that the ping replies have resumed. Press **Ctrl+C** to stop the **ping** command.

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=1.22 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=1.91 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.16 ms
64 bytes from 192.168.233.2: icmp_seq=4 ttl=64 time=1.15 ms
64 bytes from 192.168.233.2: icmp_seq=5 ttl=64 time=1.12 ms
64 bytes from 192.168.233.2: icmp_seq=6 ttl=64 time=1.73 ms
64 bytes from 192.168.233.2: icmp_seq=7 ttl=64 time=1.19 ms
64 bytes from 192.168.233.2: icmp_seq=8 ttl=64 time=1.61 ms
64 bytes from 192.168.233.2: icmp_seq=9 ttl=64 time=0.696 ms
64 bytes from 192.168.233.2: icmp_seq=10 ttl=64 time=1.13 ms
64 bytes from 192.168.233.2: icmp_seq=11 ttl=64 time=1.75 ms
^C
--- 192.168.233.2 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10025ms
rtt min/avg/max/mdev = 0.696/1.332/1.906/0.348 ms
root@instance3:~# _
```

- 3.12. Suspending an instance is similar to pausing an instance. The main difference is that the instance's state is written to a persistent disk of the underlying compute node rather than memory. This means the state can be preserved even if the compute node loses power during the suspension. Suspending an instance does not release its resources. When the instance is resumed, it will pick up any processes where they left off. To view the effects of suspending an instance, perform the same experiment as before. Focus on the tab with the instance's console and continuously ping the DHCP server.

```
root@instance3:~# ping 192.168.233.2
```

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=13.9 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.07 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.50 ms
-
```

Tip

Suspending an instance is useful in similar situations as pausing. However, suspending an image allows the compute node to be rebooted or migrated without disrupting the processes of the instance and requiring applications or the instance to be restarted. Suspending an instance is similar to putting a computer in hibernation mode.

- 3.13.** To suspend the instance, navigate back to **Project > Compute > Instances**, click the dropdown next to **Create Snapshot**, scroll down if necessary, and click **Suspend Instance**.

The screenshot shows the OpenStack Horizon dashboard under the 'Compute' tab. The 'Instances' sub-tab is selected. A single instance, 'instance3', is listed in the table. A context menu is open over this instance, with the 'Suspend Instance' option highlighted. Other options in the menu include: Associate Floating IP, Attach Interface, Detach Interface, Edit Instance, Attach Volume, Detach Volume, Update Metadata, Edit Security Groups, Edit Port Security Groups, Console, View Log, Rescue Instance, Pause Instance, Suspend Instance, and Shelve Instance.

Stop

Wait until the instance's status becomes **Suspended**.

- 3.14.** View the console again to see that the connection has been ended. When the instance is resumed, a new connection will be created, and this tab will still be unresponsive. Close the tab containing the instance console.



- 3.15.** Navigate back to the **Instances** page. Click the dropdown next to **Create Snapshot** in the same row as **instance3** and click **Resume Instance**.

The screenshot shows the OpenStack Horizon interface under the 'Compute' tab. In the 'Instances' section, there is one item listed: 'Instance3' (ubuntu, 192.168.233.23, m1.small, Suspended, nova, None, Shut Down, 15 minutes). A context menu is open over this instance, with the 'Resume Instance' option highlighted.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
Instance3	ubuntu	192.168.233.23	m1.small	-	Suspended	nova	None	Shut Down	15 minutes	Create Snapshot

Stop

Wait until the instance's status becomes **Active**.

- 3.16.** Click **instance3** and select the **Console** tab to see that the ping replies have resumed. Press **Ctrl+C** to stop the **ping** process.

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=1.22 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=1.91 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.16 ms
64 bytes from 192.168.233.2: icmp_seq=4 ttl=64 time=1.15 ms
64 bytes from 192.168.233.2: icmp_seq=5 ttl=64 time=1.12 ms
64 bytes from 192.168.233.2: icmp_seq=6 ttl=64 time=1.73 ms
64 bytes from 192.168.233.2: icmp_seq=7 ttl=64 time=1.19 ms
64 bytes from 192.168.233.2: icmp_seq=8 ttl=64 time=1.61 ms
64 bytes from 192.168.233.2: icmp_seq=9 ttl=64 time=0.696 ms
64 bytes from 192.168.233.2: icmp_seq=10 ttl=64 time=1.13 ms
64 bytes from 192.168.233.2: icmp_seq=11 ttl=64 time=1.75 ms
^C
--- 192.168.233.2 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10025ms
rtt min/avg/max/mdev = 0.696/1.332/1.906/0.348 ms
root@instance3:~# _
```

- 3.17.** Shutting off or stopping an instance turns off the instance. The instance state and any data stored in the instance's RAM will be lost. Stopping an instance does not release its resources. To stop an instance, navigate to the **Instances** page. Click the dropdown next to **Create Snapshot** in the same row as **instance3**, scroll down if necessary, and click **Shut Off Instance**.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance3	ubuntu	192.168.233.23	m1.small	-	Active	nova	None	Running	19 minutes	Create Snapshot

Stop

Wait until the instance's status becomes **Shutoff**.

- 3.18.** In the **Confirm Shut Off Instance** dialog, click **Shut Off Instance**.

Confirm Shut Off Instance

Cancel **Shut Off Instance**

- 3.19.** When the power state of the instance indicates that it is shut off, the **Create Snapshot** button will become **Start Instance**. Click this button to turn the instance back on.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance3	ubuntu	192.168.233.23	m1.small	-	Shutoff	nova	None	Shut Down	22 minutes	Start Instance

Stop

Wait until the instance's status becomes **Active**.

Tip

In addition to shutting off an instance, an instance can also be soft or hard rebooted, or turned off and back on. A soft reboot allows the instance to perform a graceful shutdown, while hard rebooting an instance is analogous to pulling the power cord from a computer.

- 3.20.** Close the browser window, and continue to the next task.

4 Managing the Running State of an Instance with the OpenStack Unified CLI

In this task, you will repeat the steps from the previous task in the *OpenStack Unified CLI*.

- Open a terminal window, and source the keystone credentials for the **admin** user.

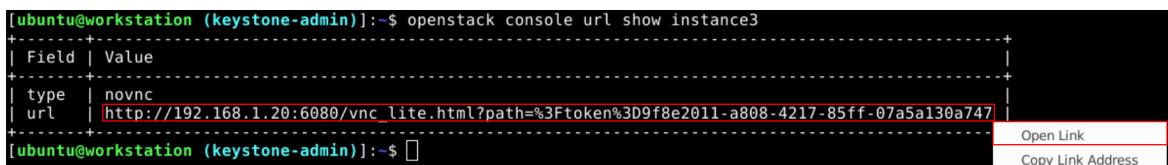
```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- Maximize the terminal window. Show the URL to the console of the instance. Right-click the URL and click **Open Link**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack console url show instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack console url show instance3
+-----+
| Field | Value
+-----+
| type  | novnc
| url   | http://192.168.1.20:6080/vnc_lite.html?path=%3Ftoken%3D9f8e2011-a808-4217-85ff-07a5a130a747
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```



Tip

If the URL is split over multiple lines, you will not be able to follow the link.

4.3. Log in to **instance3** as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

4.4. Continuously ping the DHCP server to see the effects of pausing an instance.

```
root@instance3:~# ping 192.168.233.2
```

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=13.9 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.07 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.50 ms
-
```

- 4.5. Focus back on the terminal window and pause the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server pause instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server pause instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.6. Now, view the browser window again to see that the instance is frozen and no more ping replies are appearing.

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=1.61 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.62 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.19 ms
64 bytes from 192.168.233.2: icmp_seq=4 ttl=64 time=1.52 ms
64 bytes from 192.168.233.2: icmp_seq=5 ttl=64 time=0.623 ms
64 bytes from 192.168.233.2: icmp_seq=6 ttl=64 time=1.51 ms
64 bytes from 192.168.233.2: icmp_seq=7 ttl=64 time=1.72 ms
-
```

- 4.7. Focus back on the terminal window and resume the instance

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server unpause instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server unpause instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.8. View the browser window again to see that more ping replies are coming in. Press **Ctrl+C** to stop the **ping** process.

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=1.22 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=1.91 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.16 ms
64 bytes from 192.168.233.2: icmp_seq=4 ttl=64 time=1.15 ms
64 bytes from 192.168.233.2: icmp_seq=5 ttl=64 time=1.12 ms
64 bytes from 192.168.233.2: icmp_seq=6 ttl=64 time=1.73 ms
64 bytes from 192.168.233.2: icmp_seq=7 ttl=64 time=1.19 ms
64 bytes from 192.168.233.2: icmp_seq=8 ttl=64 time=1.61 ms
64 bytes from 192.168.233.2: icmp_seq=9 ttl=64 time=0.696 ms
64 bytes from 192.168.233.2: icmp_seq=10 ttl=64 time=1.13 ms
64 bytes from 192.168.233.2: icmp_seq=11 ttl=64 time=1.75 ms
^C
--- 192.168.233.2 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10025ms
rtt min/avg/max/mdev = 0.696/1.332/1.906/0.348 ms
root@instance3:~# _
```

- 4.9. Start the **ping** process again to view the effects of suspending an instance.

```
root@instance3:~# ping 192.168.233.2
```

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=13.9 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.07 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.50 ms
-
```

- 4.10. Focus back on the terminal window and suspend the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server suspend instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server suspend instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.11. View the console again to see that the connection has been ended. When the instance is resumed, a new connection will be created, and this tab will still be unresponsive. Close the browser window.



- 4.12. Focus back on the terminal window and resume the instance.

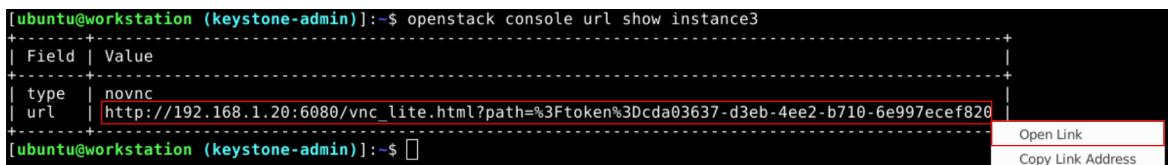
```
[ubuntu@workstation (keystone-admin)]:~$ openstack server resume instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server resume instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.13. Show the URL to the console of the instance. Right-click the URL and click **Open Link**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack console url show instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack console url show instance3
+-----+
| Field | Value
+-----+
| type  | novnc
| url   | http://192.168.1.20:6080/vnc_lite.html?path=%3Ftoken%3Dcda03637-d3eb-4ee2-b710-6e997ecef820
+-----+
[ubuntu@workstation (keystone-admin)]:~$
```



- 4.14. Log in to **instance3** as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 4.15.** Note that more ping replies are now coming in. Press **Ctrl+C** to stop the **ping** command, and close the browser window.

```
root@instance3:~# ping 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=1.22 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=1.91 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=1.16 ms
64 bytes from 192.168.233.2: icmp_seq=4 ttl=64 time=1.15 ms
64 bytes from 192.168.233.2: icmp_seq=5 ttl=64 time=1.12 ms
64 bytes from 192.168.233.2: icmp_seq=6 ttl=64 time=1.73 ms
64 bytes from 192.168.233.2: icmp_seq=7 ttl=64 time=1.19 ms
64 bytes from 192.168.233.2: icmp_seq=8 ttl=64 time=1.61 ms
64 bytes from 192.168.233.2: icmp_seq=9 ttl=64 time=0.696 ms
64 bytes from 192.168.233.2: icmp_seq=10 ttl=64 time=1.13 ms
64 bytes from 192.168.233.2: icmp_seq=11 ttl=64 time=1.75 ms
^C
--- 192.168.233.2 ping statistics ---
11 packets transmitted, 11 received, 0% packet loss, time 10025ms
rtt min/avg/max/mdev = 0.696/1.332/1.906/0.348 ms
root@instance3:~# _
```

- 4.16.** Focus back on the terminal window and confirm that **instance3** is listed as **ACTIVE**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

ID	Name	Status	Networks	Image	Flavor
6ela2423-0bf9-46 e4-b196-3039415b 2e3e	instance3	ACTIVE	shared=192.168.2 33.23	ubuntu	m1.small

- 4.17.** Stop the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server stop instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server stop instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.18.** Verify that the status of **instance3** is **SHUTOFF**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

ID	Name	Status	Networks	Image	Flavor
6e1a2423-0bf9-4	instance3	SHUTOFF	shared=192.168.2	ubuntu	m1.small
6e4-b196-303941			33.23		
5b2e3e					

- 4.19.** Power the instance back on.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server start instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server start instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.20.** Verify that the status of **instance3** is **ACTIVE**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

ID	Name	Status	Networks	Image	Flavor
6e1a2423-0bf9-46	instance3	ACTIVE	shared=192.168.2	ubuntu	m1.small
e4-b196-3039415b			33.23		
2e3e					

- 4.21.** Close the terminal window, and continue to the next task.

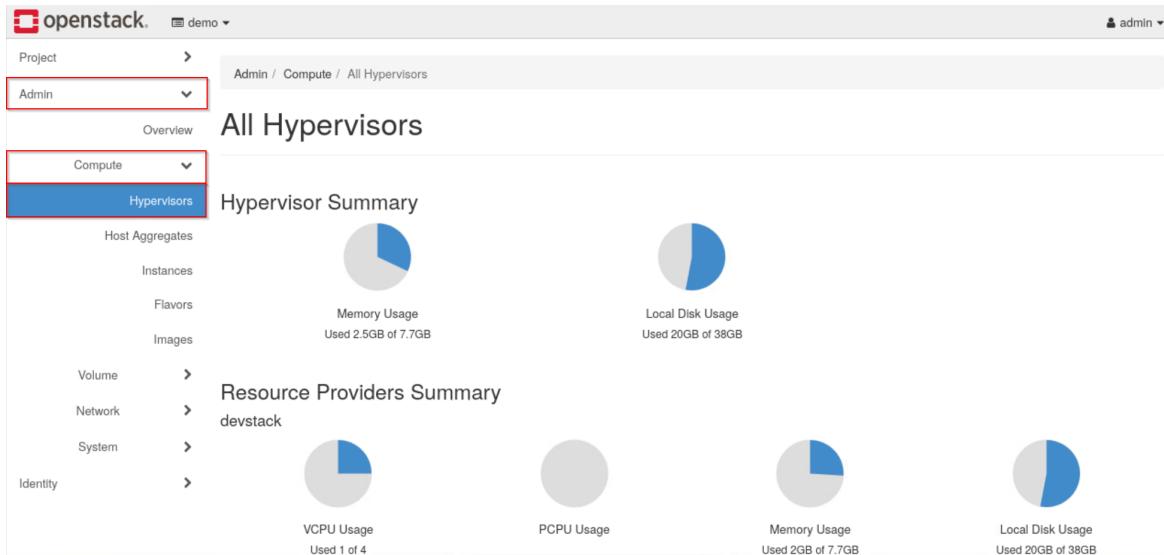
5 Shelving an Instance with the Horizon Dashboard

Sometimes, you may want to free up the resources of an instance when it is not needed, while keeping its data and work intact for future use. This can be accomplished by shelving and later unshelving the instance. Shelving an instance removes it from the hypervisor—the physical machine that hosts the OpenStack environment and instances. In these labs, the hypervisor is the **devstack** machine. When an instance is shelved, it is shut down, and its compute resources (VCpus and RAM) are freed, which means processes in memory are lost. However, its non-ephemeral disk contents are preserved. Shelving differs from simply shutting down an instance because shutting down an instance does not release the instance's allocated resources on the hypervisor.

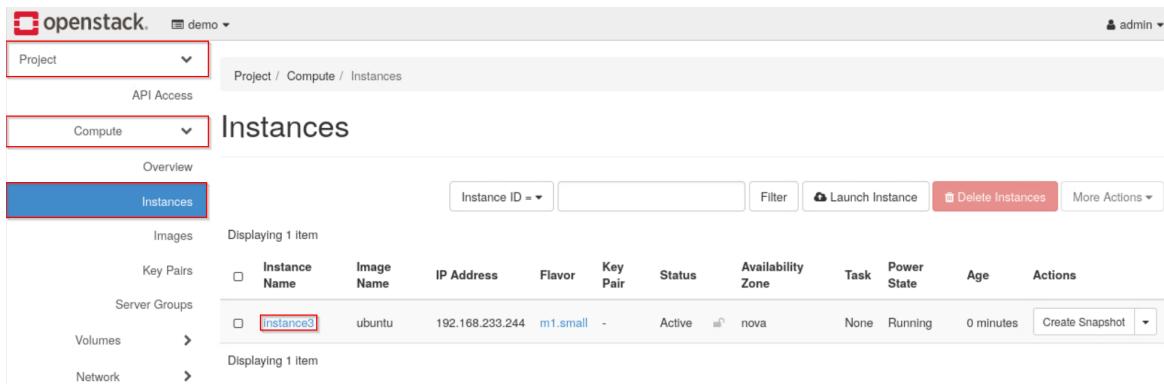
- 5.1. Open a browser window, and navigate to **192.168.1.20**. Log in as **admin** with the password **secret**.

The screenshot shows the OpenStack Horizon login interface. At the top center is the OpenStack logo, which consists of a red square icon with white lines forming a stylized 'O' shape, followed by the word "openstack." in a lowercase sans-serif font. Below the logo is the word "Log in". Underneath, there are two input fields: "User Name" containing "admin" and "Password" containing five black dots. To the right of the password field is a small eye icon for password visibility. At the bottom right of the form is a blue rectangular button labeled "Sign In".

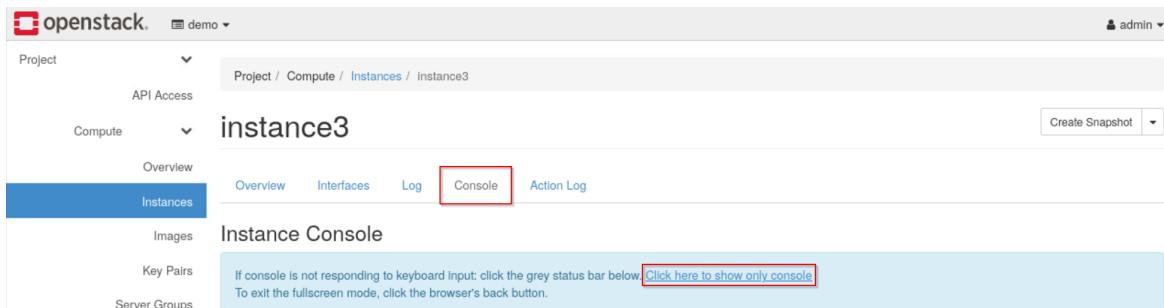
- 5.2.** First, navigate to the **Admin > Compute > Hypervisors** tab, and look at the *Resource Providers Summary* section to view the resources from **devstack** currently being used by **instance3**. This summary should show the 1 VCPU, 2 GB of Memory Usage, and 20 GB of Local Disk Usage.



- 5.3.** Navigate to **Project > Compute > Instances**. Middle-click **instance3** (click with the mouse wheel), or right-click it, and select **Open Link in New tab**.



- 5.4.** Navigate to the **Console** tab, and click the **Click here to show only console** link.



5.5. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

5.6. First, create a text file in the **/root** directory to show that the file system persists after shelving and unshelving an instance.

```
root@instance3:~# echo "hello" > /root/hello.txt
```

```
root@instance3:~# echo "hello" > /root/hello.txt
root@instance3:~# _
```

- 5.7. Next, you will run a process in the background and a process in the foreground to show that the full running state of the instance is not saved after it is shelved. First, have the instance ping itself in the background every 10 seconds, and save the output to **/tmp/ping.txt**. Since this is a temporary file stored in RAM, it should not be accessible after the instance is shelved and unshelved.

```
root@instance3:~# ping -i 10 127.0.0.1 > /tmp/ping.txt &
```

```
root@instance3:~# ping -i 10 127.0.0.1 > /tmp/ping.txt &
[1] 979
root@instance3:~#
```

Note

When the **&** symbol is appended to a command, it is run in the background, which prevents the command's output from being printed to the terminal and returns control of the terminal to the user.

- 5.8. View the beginning of the **/tmp/ping.txt** to confirm that it is being written to.

```
root@instance3:~# head /tmp/ping.txt
```

```
root@instance3:~# head /tmp/ping.txt
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=1.60 ms
root@instance3:~#
```

- 5.9.** Now, run **top** as a foreground process. We are not interested in its output. Instead, we just want to confirm that this process will no longer be running once the instance is shelved and unshelved.

```
root@instance3:~# top
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
981	root	20	0	10940	3536	3016	R	33.3	0.2	0:00.28	top
1	root	20	0	106104	11400	6212	S	0.0	0.6	0:17.39	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.02	kthreadd
3	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_gp
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_par_gp
5	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	slub_flushq
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	netns
8	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker/u:0H-events_highpri
9	root	20	0	0	0	0	I	0.0	0.0	0:08.89	kworker/u2:0-events_power_efficient
10	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	mm_percpu_wq
11	root	20	0	0	0	0	S	0.0	0.0	0:00.00	rcu_tasks_rude...
12	root	20	0	0	0	0	S	0.0	0.0	0:00.00	rcu_tasks_trace
13	root	20	0	0	0	0	S	0.0	0.0	0:00.50	ksoftirqd/0
14	root	20	0	0	0	0	I	0.0	0.0	0:04.09	rcu_sched
15	root	r1	0	0	0	0	S	0.0	0.0	0:00.18	migration/0
16	root	-51	0	0	0	0	S	0.0	0.0	0:00.00	idle_Inject/0
17	root	20	0	0	0	0	I	0.0	0.0	0:10.23	kworker/u:1-events
18	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cpuhp/0
19	root	20	0	0	0	0	S	0.0	0.0	0:00.02	Kdevtmpfs
20	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	inet_frag_wq
21	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kauditd
22	root	20	0	0	0	0	S	0.0	0.0	0:00.00	khungtaskd
23	root	20	0	0	0	0	S	0.0	0.0	0:00.00	oom_reaper
24	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	writeback
25	root	20	0	0	0	0	S	0.0	0.0	0:00.82	Kcompactd0
26	root	25	5	0	0	0	S	0.0	0.0	0:00.00	ksmd
27	root	39	19	0	0	0	S	0.0	0.0	0:00.00	khugepaged
73	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kinegrityd
74	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kblockd
75	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	bikcg_punt_bio
76	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	tpm_dev_wq
77	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	ata_sff
78	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	md
79	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	edac-poller
80	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	devfreq_wq
81	root	-51	0	0	0	0	S	0.0	0.0	0:00.00	watchdogd
83	root	0	-20	0	0	0	I	0.0	0.0	0:00.57	kworker/u:1H-kblockd
85	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kswapd0
86	root	20	0	0	0	0	S	0.0	0.0	0:00.00	cryptifs-kthrea
88	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kthrotld
89	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	acpi_thermal_pm

Tip

If you leave the console window open, the page can be refreshed once the instance is unshelved to resume the session.

- 5.10.** Navigate to **Project > Compute > Instances**. Click the dropdown next to **Create Snapshot** in the same row as **instance1**, scroll down if necessary, and click **Shelve Instance**.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance3	ubuntu	192.168.233.244	m1.small	-	Active	nova	None	Running	10 minutes	Create Snapshot

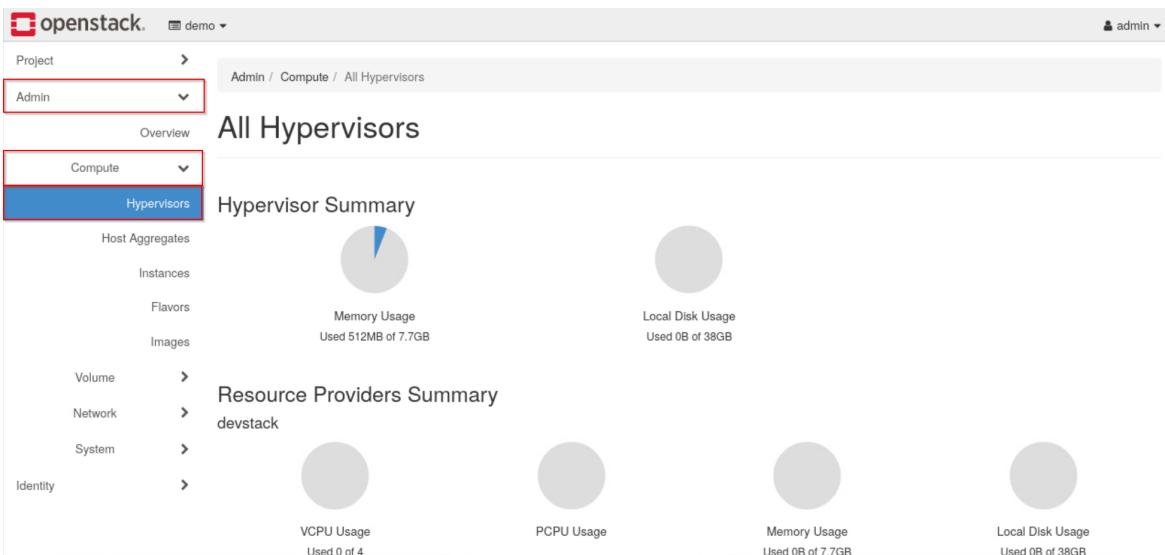
Stop

Wait until the instance's status is **Shelved Offloaded**.

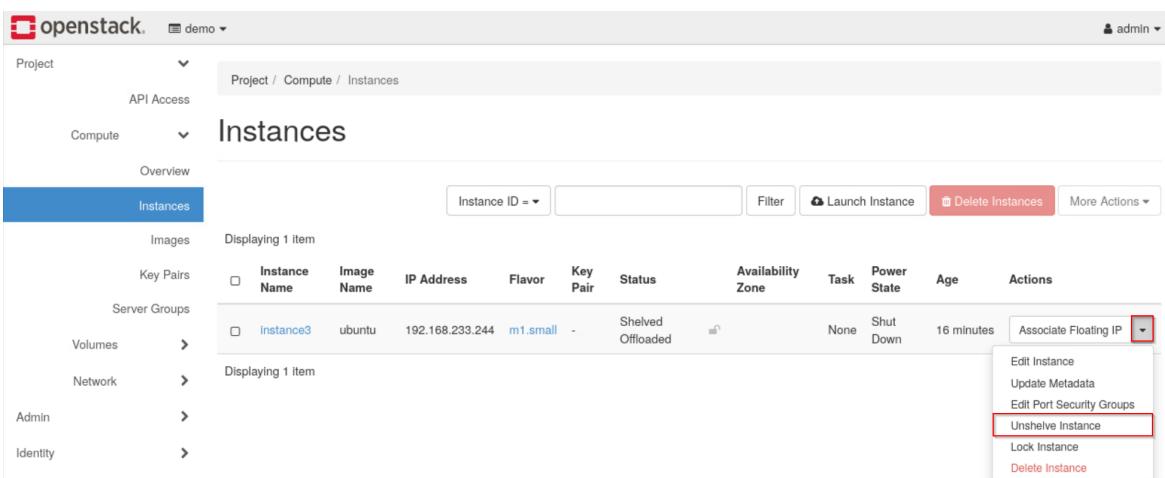
- 5.11.** When an instance is shelved, it is stored as a snapshot. Navigate to the **Images** tab and notice the new **instance3-shelved** snapshot that was just created.

Owner	Name	Type	Status	Visibility	Protected	Disk Format	Size
admin	cirros-0.6.2-x86_64-disk	Image	Active	Public	No	QCOW2	20.44 MB
demo	instance3-shelved	Snapshot	Active	Private	No	QCOW2	1.52 GB
demo	ubuntu	Image	Active	Shared	No	QCOW2	647.50 MB

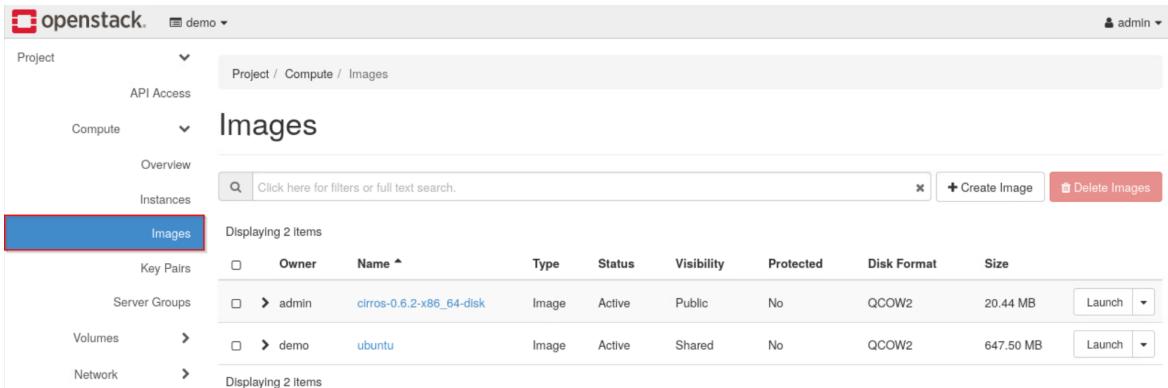
- 5.12.** Navigate to **Admin > Compute > Hypervisors**, and note that the *Resource Providers Summary* shows that all the physical resources have been freed up.



- 5.13.** Now, we will unshelve the instance and observe the effects. Navigate back to **Project > Compute > Instances**. Click the dropdown next to **Create Snapshot** in the same row as **instance1**, and click **Unshelve Instance**.



- 5.14.** The snapshot created to preserve an instance while it is shelved is temporary, and it is deleted once the instance is unshelved. To confirm this, navigate back to **Project > Compute > Images**, and notice that the **instance3-shelved** snapshot has been deleted since **instance3** was unshelved.



	Owner	Name ^	Type	Status	Visibility	Protected	Disk Format	Size
<input type="checkbox"/>	admin	cirros-0.6.2-x86_64-disk	Image	Active	Public	No	QCOW2	20.44 MB
<input type="checkbox"/>	demo	ubuntu	Image	Active	Shared	No	QCOW2	647.50 MB

- 5.15. Navigate back to the console window, and refresh it if necessary. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 5.16. Next, we will see whether any of the processes left running before shelving the instance are still running. First, note that the output from **top** is no longer showing. To ensure that the process is no longer running, use the **ps aux** command and search for the string **top**. There should be only one result, which is the **grep** process you started to search for **top**. The lack of other results verifies that the process was terminated.

```
root@instance3:~# ps aux | grep top
```

```
root@instance3:~# ps aux | grep top
root      911 10.0  0.1  7008  2200 pts/1    S+   17:57   0:00 grep --color=auto top
root@instance3:~# _
```

Note

The command **ps aux** lists details about currently running processes. Piping this command to **grep** allows us to search for a process by name.

- 5.17.** Do the same test for the **ping** process that was running in the background.

```
root@instance3:~# ps aux | grep ping
```

```
root@instance3:~# ps aux | grep ping
root      920  0.0  0.1    7008  2080  ttys000  S+    17:57   0:00 grep --color=auto ping
root@instance3:~#
```

- 5.18.** Try to view the contents of the **/tmp/ping.txt** file which the **ping** process was writing to. There should be no such file since it was a temporary file being stored in RAM.

```
root@instance3:~# cat /tmp/ping.txt
```

```
root@instance3:~# cat /tmp/ping.txt
cat: /tmp/ping.txt: No such file or directory
root@instance3:~# _
```

- 5.19.** Now try to view the contents of the **/root/hello.txt** file you created before you shelved the instance. It should still exist.

```
root@instance3:~# cat /root/hello.txt
```

```
root@instance3:~# cat /root/hello.txt
hello
root@instance3:~#
```

- 5.20.** Leave the browser window and instance console open, and continue to the next task.

6 Shelving an Instance with the OpenStack Unified CLI

In this task, you will repeat the steps from the previous task in the *OpenStack Unified CLI*.

- If a terminal window is not already open, open one and source the keystone credentials for the **admin** user.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- First, list the resources currently being used by the instance. The output should show the 1 VCPUs, 2 GB of memory usage, and 20 GB of disk.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack hypervisor stats show
```

Field	Value
count	1
current_workload	0
disk_available_least	-6
free_disk_gb	18
free_ram_mb	5342
local_gb	38
local_gb_used	20
memory_mb	7902
memory_mb_used	2560
running_vms	1
vcpus	4
vcpus_used	1

```
[ubuntu@workstation (keystone-admin)]:~$ █
```

- Navigate back to the console window. If necessary, log in as **root** with the password **secret**.
- Create a text file in the **/root** directory to show that the file system persists after shelving and unshelving an instance.

```
root@instance3:~# echo "hello" > /root/hello2.txt
```

```
root@instance3:~# echo "hello" > /root/hello2.txt
root@instance3:~#
```

- 6.5.** Next, you will start a background and foreground process to show that the instance's running state is not preserved after being shelved and unshelved. First, have the instance ping itself every 10 seconds and write the results to **/tmp/ping.txt**.

```
root@instance3:~# ping -i 10 127.0.0.1 > /tmp/ping.txt &
```

```
root@instance3:~# ping -i 10 127.0.0.1 > /tmp/ping.txt &
[2] 960
root@instance3:~# _
```

- 6.6.** Then, run **top** as a foreground process.

```
root@instance3:~# top
```

```
top - 17:47:58 up 27 min,  1 user,  load average: 0.09, 0.10, 0.22
Tasks: 83 total,   1 running,  82 sleeping,   0 stopped,   0 zombie
%Cpu(s): 12.5 us, 40.6 sy,  0.0 ni, 46.9 id,  0.0 wa,  0.0 hi,  0.0 sl,  0.0 st
MiB Mem : 1964.0 total, 1542.6 free, 149.4 used,   272.0 buff/cache
MiB Swap:  0.0 total,  0.0 free,  0.0 used. 1660.5 avail Mem

PID USER      PR  NI    VIRT    RES    SHR S %CPU %MEM     TIME+ COMMAND
 981 root      20   0 10940  3536  3016 R 33.3  0.2  0:00.28 top
  1 root      20   0 166104 11498  8212 S  0.0  0.6  0:17.39 systemd
  2 root      20   0      0      0      0 S  0.0  0.0  0:00.02 kthreadd
  3 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 rcu_gp
  4 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 rcu_par_gp
  5 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 stub_flushq
  6 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 netns
  8 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 kworker/u:0H-events_highpri
  9 root      20   0      0      0      0 I  0.0  0.0  0:08.99 kworker/u2:0-events_power_efficient
 10 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 mm_percpu_wq
 11 root      20   0      0      0      0 S  0.0  0.0  0:00.00 rcu_tasks_rude_
 12 root      20   0      0      0      0 S  0.0  0.0  0:00.00 rcu_tasks_trace
 13 root      20   0      0      0      0 S  0.0  0.0  0:00.50 ksoftirqd/0
 14 root      20   0      0      0      0 I  0.0  0.0  0:04.09 rcu_sched
 15 root      rt  0      0      0      0 S  0.0  0.0  0:00.18 migration/0
 16 root     -51   0      0      0      0 S  0.0  0.0  0:00.00 idle_inject/0
 17 root      20   0      0      0      0 I  0.0  0.0  0:10.23 kworker/u:1-events
 18 root      20   0      0      0      0 S  0.0  0.0  0:00.00 cpuhp/0
 19 root      20   0      0      0      0 S  0.0  0.0  0:00.02 kdevtmpfs
 20 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 inst_frag_wq
 21 root      20   0      0      0      0 S  0.0  0.0  0:00.00 kauditd
 22 root      20   0      0      0      0 S  0.0  0.0  0:00.00 khungtaskd
 23 root      20   0      0      0      0 S  0.0  0.0  0:00.00 oom_reaper
 24 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 writeback
 25 root      20   0      0      0      0 S  0.0  0.0  0:00.82 kcompactd0
 26 root      25   5      0      0      0 S  0.0  0.0  0:00.00 ksmd
 27 root     39  19      0      0      0 S  0.0  0.0  0:00.00 khugepaged
 73 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 kintegrityd
 74 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 kblockd
 75 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 blkcg_punt_bio
 76 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 tpm_dev_wq
 77 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 ata_sff
 78 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 md
 79 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 edac_poller
 80 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 devfreq_wq
 81 root     -51   0      0      0      0 S  0.0  0.0  0:00.00 watchdogd
 83 root      0 -20      0      0      0 I  0.0  0.0  0:00.57 kworker/u:1H-kblockd
 85 root      20   0      0      0      0 S  0.0  0.0  0:00.00 ksmpd0
 86 root      20   0      0      0      0 S  0.0  0.0  0:00.00 encryptfs-kthrea
 88 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 kthrotld
 89 root      0 -20      0      0      0 I  0.0  0.0  0:00.00 acpi_thermal_pm
```

- 6.7.** Return to the OpenStack terminal, and shelve the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server shelve instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server shelve instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

6.8. Verify that the instance is shelved and offloaded.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list \
> -c Name \
> -c Status
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list \
> -c Name \
> -c Status
+-----+-----+
| Name      | Status        |
+-----+-----+
| instance3 | SHELVED_OFFLOADED |
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

6.9. Verify that the resources for **instance3** have been freed up by noting the amounts for VCPUs, RAM, and disk have gone to zero.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack hypervisor stats show
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack hypervisor stats show
+-----+-----+
| Field          | Value |
+-----+-----+
| count          | 1     |
| current_workload | 0     |
| disk_available_least | 11   |
| free_disk_gb    | 38   |
| free_ram_mb     | 7390 |
| local_gb         | 38   |
| local_gb_used    | 0     |
| memory_mb        | 7902 |
| memory_mb_used    | 512  |
| running_vms      | 0     |
| vcpus           | 4     |
| vcpus_used       | 0     |
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.10. List the available images to verify that a snapshot was taken of **instance3** when it was shelved.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
+-----+-----+-----+
| ID      | Name          | Status |
+-----+-----+-----+
| dfc5286d-bdb7-4338-8e4b-087422b21e68 | cirros-0.6.2-x86_64-disk | active |
| c719fc3a-f7e0-4cc0-b2f5-365c3ce729eb | instance3-shelved     | active |
| 329d361e-f6dc-4b72-b200-3de0ec230e65 | ubuntu                 | active |
+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.11. Unshelve the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server unshelve instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server unshelve instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.12. List the available images again to verify that **instance3-shelved** was deleted when the instance was unshelved.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack image list
+-----+-----+-----+
| ID      | Name          | Status |
+-----+-----+-----+
| dfc5286d-bdb7-4338-8e4b-087422b21e68 | cirros-0.6.2-x86_64-disk | active |
| 329d361e-f6dc-4b72-b200-3de0ec230e65 | ubuntu                 | active |
+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.13. Open the instance's console window, and refresh the page if necessary. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

Tip

If the console remains disconnected, close the window and reopen it.

- 6.14. Now, you will verify that the processes running before the instance was shelved have been terminated. There should be only one result, which is the **grep** command used to search for the process. First, search for the **top** process.

```
root@instance3:~# ps aux | grep top
```

```
root@instance3:~# ps aux | grep top
root      958  0.0  0.1  7008  2172  ttys000  S+   19:06   0:00 grep --color=auto top
root@instance3:~#
```

- 6.15. Next, search for the **ping** process.

```
root@instance3:~# ps aux | grep ping
```

```
root@instance3:~# ps aux | grep ping
root      961  6.0  0.1  7008  2108  ttys1     S+   19:06   0:00 grep --color=auto ping
root@instance3:~#
```

- 6.16. Now, verify that the file written to by the **ping** process, which was a temporary file stored in RAM, no longer exists.

```
root@instance3:~# cat /tmp/ping.txt
```

```
root@instance3:~# cat /tmp/ping.txt
cat: /tmp/ping.txt: No such file or directory
root@instance3:~# _
```

- 6.17. Finally, verify that the text file you stored on disk still exists.

```
root@instance3:~# cat /root/hello2.txt
```

```
root@instance3:~# cat /root/hello2.txt
hello
root@instance3:~# _
```

- 6.18. Close the browser and terminal windows, and continue to the next task.

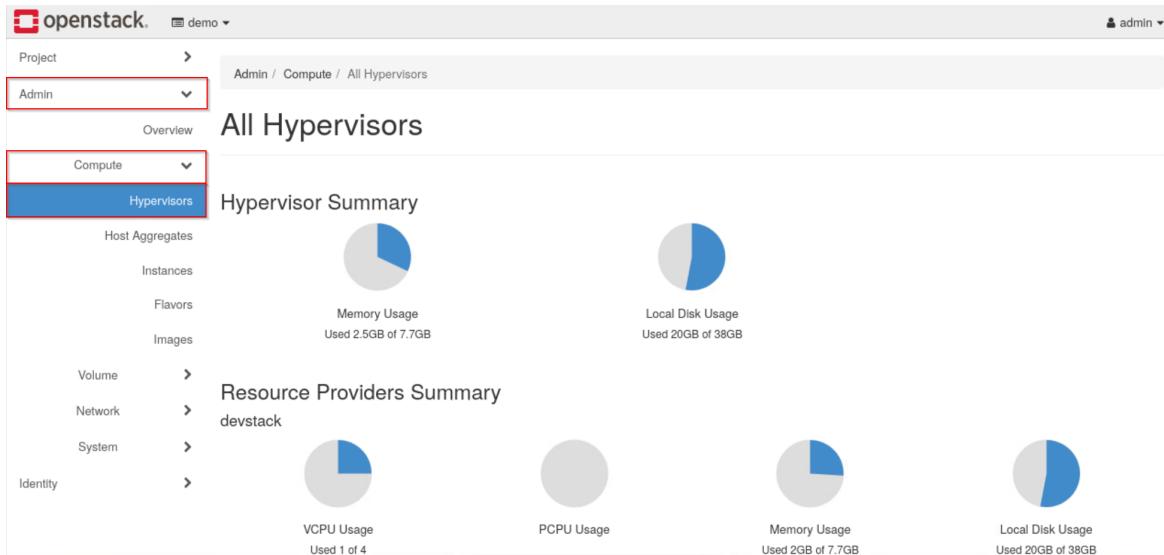
7 Rescuing an Instance with the Horizon Dashboard

Instances can sometimes experience catastrophic failures due to misconfiguration, the loss or corruption of important files, or other failures that make them unbootable or unreachable. The risk of data loss is one reason why making regular backups is essential. In some cases, an instance can be rescued and repaired. When an instance is rescued in OpenStack, it is launched in a minimal environment with a snapshot of its root disk attached as a secondary disk. This allows you to recover data (if possible) and attempt to put the instance back into a working state. However, rescuing an instance does not recover data that has already been deleted.

- 7.1. Open a browser window, and navigate to **192.168.1.20**. Log in as **admin** with the password **secret**.

The screenshot shows the OpenStack Horizon login interface. At the top center is the OpenStack logo, which consists of a red square divided into four quadrants. Below the logo, the word "openstack" is written in a large, lowercase, sans-serif font, with a registered trademark symbol (®) at the end. Underneath this, the word "Log in" is centered. The main form area contains two input fields: "User Name" with the value "admin" and "Password" with six dots. To the right of the password field is a small eye icon for password visibility. At the bottom right of the form is a blue "Sign In" button.

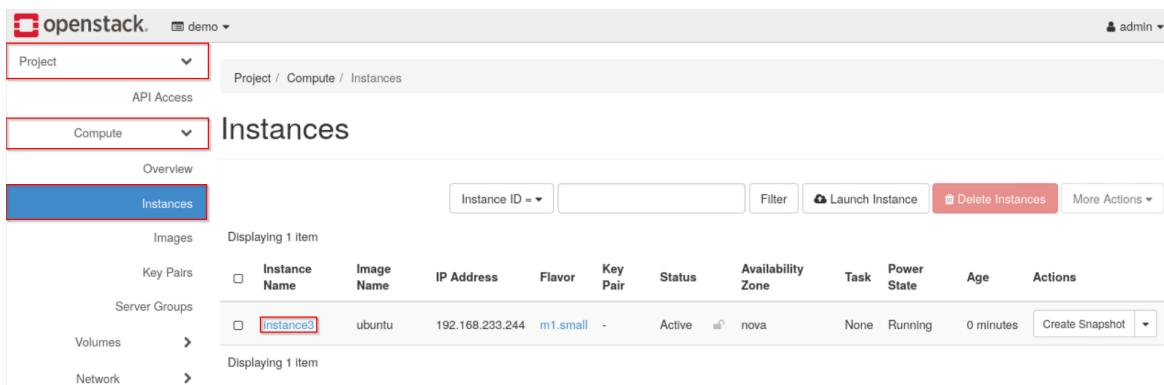
- 7.2.** First, navigate to the **Admin > Compute > Hypervisors** tab, and look at the *Resource Providers Summary* section to view the resources from **devstack** currently being used by **instance3**. This summary should show the 1 VCPU, 2 GB of Memory Usage, and 20 GB of Local Disk Usage.



Tip

Do not be confused by the **Project > Compute > Overview** page. This page does not show current physical resource usage, but quota usage. Even shelved resources count against a project's quota, so they will still appear on this page.

- 7.3.** Navigate to **Project > Compute > Instances**. Middle-click **instance3** (click with the mouse wheel), or right-click it, and select **Open Link in New tab**.



7.4. Navigate to the **Console** tab, and click the **Click here to show only console** link.

The screenshot shows the OpenStack Horizon dashboard. The URL is `openstack.demolab.nexus.com`. The user is logged in as 'admin'. The navigation bar shows 'Project / Compute / Instances / instance3'. On the left, there's a sidebar with 'Compute' selected, showing 'Instances' (which is highlighted in blue), 'Overview', 'Images', 'Key Pairs', and 'Server Groups'. The main content area is titled 'instance3'. It has tabs for 'Overview', 'Interfaces', 'Log', 'Console' (which is highlighted with a red border), and 'Action Log'. Below these tabs, it says 'Instance Console'. A tooltip message reads: '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.' The 'Console' link in the tooltip is also highlighted with a red box.

7.5. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 7.6. First, to understand the effects of rescuing an instance, list the instance's block devices, including disks. In the output, **vda** is the primary disk, and **vda1** is the root partition.

```
root@instance3:~# lsblk
```

```
root@instance3:~# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0    7:0    0 63.9M  1 loop /snap/core20/2105
loop1    7:1    0 114.4M  1 loop /snap/1xd/26741
loop2    7:2    0 40.4M  1 loop /snap/snapd/20671
vda     252:0   0 20G  0 disk 
└─vda1   252:1   0 19.9G 0 part /
  ├─vda14 252:14  0 4M  0 part
  └─vda15 252:15  0 106M 0 part /boot/efi
root@instance3:~#
```

Tip

Consider rescuing an instance if it repeatedly fails to boot, if it cannot be accessed over SSH, or if it has a file system corruption or misconfiguration. It may also be useful in certain cases to investigate an instance after a security event without directly logging in to the compromised environment.

- 7.7. To rescue the instance, we first need to break it. An easy way to do this is to delete the **/boot** directory, which contains the kernel's bootloader. If files in this directory are deleted, the instance should fail to boot. However, because this lab assumes that the instance will not have Internet connection, we should first make a backup copy of the directory so that we can restore it later. In an environment with an Internet connection, we would instead repair the directory with the **apt** package manager.

```
root@instance3:~# cp -a /boot/. /root/boot_bkp
```

```
root@instance3:~# cp -a /boot/. /root/boot_bkp
root@instance3:~# _
```

Note

The **cp** command copies files and directories. The **-a** option copies all files in a directory recursively, and it maintains their file permissions and metadata. Appending **./** to **/boot** specifies that the files should be stored in **/root/boot_bkp** instead of **/root/boot_bkp/boot**.

7.8. Verify that the contents of both directories are the same.

```
root@instance3:~# ls /boot
root@instance3:~# ls /root/boot_bkp
```

```
root@instance3:~# ls /boot
System.map-5.15.0-92-generic  efi  initrd.img          initrd.img.old  vmlinuz-5.15.0-92-generic
config-5.15.0-92-generic     grub  initrd.img-5.15.0-92-generic  vmlinuz        vmlinuz.old
root@instance3:~# ls /root/boot_bkp
System.map-5.15.0-92-generic  efi  initrd.img          initrd.img.old  vmlinuz-5.15.0-92-generic
config-5.15.0-92-generic     grub  initrd.img-5.15.0-92-generic  vmlinuz        vmlinuz.old
root@instance3:~# _
```

7.9. Delete the **/boot** directory.

```
root@instance3:~# rm -rf /boot
```

```
root@instance3:~# rm -rf /boot
rm: cannot remove '/boot/efi': Device or resource busy
root@instance3:~# _
```

Note

The **/boot/efi** directory will not be deleted because it is in use. This is the boot partition (**vda15**) listed in the output of **lsblk**. However, we have still done enough damage to the system that it will be unable to boot.

Note

The **rm** command deletes files and directories. The **-r** option specifies that all files in the directory and any subdirectories should be deleted, and the **-f** option specifies to not ask permission before deleting.

7.10. List the files in the **/boot** directory again to make sure everything but **/boot/efi** was deleted.

```
root@instance3:~# ls /boot
```

```
root@instance3:~# ls /boot
efi
root@instance3:~#
```

- 7.11.** Close the console and return to the **Project > Compute > Instances** page. Click the dropdown next to **Create Snapshot** in the same row as **instance3**, scroll down if necessary, and click **Hard Reboot**.

The screenshot shows the OpenStack Horizon dashboard under the 'Compute' project. The 'Instances' tab is selected. A single instance, 'instance3', is listed with the following details:

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance3	ubuntu	192.168.233.244	m1.small	-	Active	nova	None	Running	10 minutes	Create Snapshot

A context menu is open over the 'Create Snapshot' link, listing various actions for the instance. The 'Hard Reboot Instance' option is highlighted with a red box.

- 7.12.** In the **Confirm Hard Reboot Instance** pop-up, click **Hard Reboot Instance**.

Confirm Hard Reboot Instance

You have selected: "instance3". Please confirm your selection. Restarted instances will lose any data not saved in persistent storage.

[Cancel](#) [Hard Reboot Instance](#)

- 7.13.** The instance should fail to boot due to the missing file. The instance will still be listed as **Active** by OpenStack. However, if you open a new console window, it should indicate that it is booting into GRUB rescue mode (which is separate from OpenStack's rescue mode).

```
SeaBIOS (version 1.15.0-1)
Machine UUID 8a0a6a59-a059-454d-b1fd-f004e5399797

iPXE (https://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+7FF8B340+7FECB340 CA00

Booting from Hard Disk...
error: file '/boot/grub/i386-pc/normal.mod' not found.
Entering rescue mode...
grub rescue> _
```

- 7.14.** On the **Project > Compute > Instances** page, click the dropdown again, and click **Rescue Instance**.

The screenshot shows the OpenStack Horizon dashboard under the 'Compute' section. The 'Instances' tab is selected. A single instance, 'Instance3', is listed with details: Image Name 'ubuntu', IP Address '192.168.233.244', Flavor 'm1.small', Key Pair '-', Status 'Active', Availability Zone 'nova', Task 'None', Power State 'Running', and Age '15 minutes'. To the right of the instance table, a context menu is open, listing various actions like 'Associate Floating IP', 'Attach Interface', etc. The 'Rescue Instance' option is highlighted with a red box.

- 7.15.** In the **Rescue Instance** pop-up, click **Confirm**.

The screenshot shows the 'Rescue Instance' dialog box. It has two main sections: 'Select Image *' containing a dropdown menu with 'ubuntu (647.5 MB)' selected, and 'Password' with a text input field and an eye icon. To the right, there is a 'Description:' section with explanatory text about rescue mode and its purpose. At the bottom right are 'Cancel' and 'Confirm' buttons, with 'Confirm' being highlighted by a red box.

- 7.16. Open a new console window for the instance. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 7.17. List the block devices again to see that there is now a **vdb** device. This is where the original root disk of **instance3** was placed when it was rescued.

```
root@instance3:~# lsblk
```

```
root@instance3:~# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0    7:0    0 63.9M  1 loop /snap/core20/2105
loop1    7:1    0 114.4M 1 loop /snap/1xd/26741
loop2    7:2    0 40.4M  1 loop /snap/snapd/20671
vda     252:0   0  2.2G  0 disk 
└─vda1   252:1   0  2.1G  0 part 
  ├─vda14  252:14  0     4M  0 part 
  └─vda15  252:15  0 106M  0 part 
vdb     252:16  0   20G  0 disk 
└─vdb1   252:17  0 19.9G  0 part /
  ├─vdb14  252:30  0     4M  0 part 
  └─vdb15  252:31  0 106M  0 part /boot/efi
root@instance3:~#
```

Note

Notice that the **vdb1** partition is about 20 GB, which closely matches the value specified in the **m1.small** flavor given to the instance. This further confirms that this device is a copy of the original instance's.

- 7.18. Now, we will repair the instance by restoring the bootloader. First, make a new directory called **/mnt/root**, and mount the **vdb1** partition to it.

```
root@instance3:~# mkdir /mnt/root
root@instance3:~# mount /dev/vdb1 /mnt/root
```

```
root@instance3:~# mkdir /mnt/root
root@instance3:~# mount /dev/vdb1 /mnt/root
root@instance3:~# _
```

- 7.19.** To more easily interact with the environment, change the root directory to **/mnt/root** so that the directory will be treated as **/**.

```
root@instance3:~# chroot /mnt/root
```

```
root@instance3:~# chroot /mnt/root
root@instance3:/# _
```

- 7.20.** Finally, we can repair the instance. Copy the files in the **/root/boot_bkp** directory into the **/boot** directory. Make sure to use **./** to copy only the files inside and not the **boot_bkp** directory itself.

```
root@instance3:/# cp -a /root/boot_bkp/. /boot
```

```
root@instance3:/# cp -a /root/boot_bkp/. /boot
root@instance3:/# _
```

- 7.21.** List the contents of **/boot** to confirm that everything was copied correctly. Close the console tab.

```
root@instance3:/# ls /boot
```

```
root@instance3:/# ls /boot
System.map-5.15.0-92-generic  efi  initrd.img  initrd.img.old  vmlinuz-5.15.0-92-generic
config-5.15.0-92-generic     grub  initrd.img-5.15.0-92-generic  vmlinuz      vmlinuz.old
root@instance3:/# _
```

- 7.22.** Now that we have repaired the missing file in the instance, it can be unrescued. Return to the **Project > Compute > Instances** page. Click the dropdown next to **Create Snapshot** in the same row as **instance3**, and click **Unrescue Instance**.

The screenshot shows the OpenStack Horizon dashboard under the 'Compute' section. The 'Instances' tab is selected. A table lists one instance: 'instance3' (ubuntu, m1.small flavor, IP 192.168.233.244). In the 'Actions' column for this instance, a dropdown menu is open, showing options like 'Associate Floating IP', 'Edit Instance', 'Update Metadata', 'Edit Port Security Groups', 'Unrescue Instance' (which is highlighted with a red box), 'Lock Instance', 'Shut Off Instance', and 'Delete Instance'.

- 7.23. Navigate back to the console window. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

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The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 7.24. List the disk partitions one more time to confirm that there is only one main partition, **vda**.

```
root@instance3:~# lsblk
```

```
root@instance3:~# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0    7:0    0 114.4M  1 loop /snap/lxd/26741
loop1    7:1    0  40.4M  1 loop /snap/snapd/20671
loop2    7:2    0  63.9M  1 loop /snap/core20/2105
vda     252:0    0   20G  0 disk 
└─vda1   252:1    0  19.9G  0 part /
  ├─vda14 252:14   0      4M  0 part
  └─vda15 252:15   0   106M  0 part /boot/efi
root@instance3:~# _
```

- 7.25. Finally, to ensure that the existing data from the instance was preserved, view the contents of the **/root/hello.txt** file that was created earlier in the lab.

```
root@instance3:~# cat /root/hello.txt
```

```
root@instance3:~# cat /root/hello.txt
hello
root@instance3:~# _
```

- 7.26. Leave the browser, and continue to the next task.

8 Rescuing an Instance with the OpenStack Unified CLI

In this task, you will repeat the steps from the previous task in the *OpenStack Unified CLI*.

- 8.1. If it is not already open, open the console window of **instance3**, and log in as **root** with the password **secret**. First, list the block devices on the instance.

```
root@instance3:~# lsblk
```

```
root@instance3:~# lsblk
NAME   MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
loop0    7:0    0 63.9M  1 loop /snap/core20/2105
loop1    7:1    0 114.4M  1 loop /snap/lxd/26741
loop2    7:2    0 40.4M  1 loop /snap/snapd/20671
vda     252:0   0   20G  0 disk 
└─vda1   252:1   0 19.9G  0 part /
  ├─vda14 252:14  0     4M  0 part
  └─vda15 252:15  0 106M  0 part /boot/efi
root@instance3:~#
```

- 8.2. The **/boot** and **root/boot_bkp** directories should still be intact. List their contents to make sure they exist and match.

```
root@instance3:~# ls /boot
root@instance3:~# ls /root/boot_bkp
```

```
root@instance3:~# ls /boot
System.map-5.15.0-92-generic  efi  initrd.img          initrd.img.old  vmlinuz-5.15.0-92-generic
config-5.15.0-92-generic     grub  initrd.img-5.15.0-92-generic  vmlinuz        vmlinuz.old
root@instance3:~# ls /root/boot_bkp
System.map-5.15.0-92-generic  efi  initrd.img          initrd.img.old  vmlinuz-5.15.0-92-generic
config-5.15.0-92-generic     grub  initrd.img-5.15.0-92-generic  vmlinuz        vmlinuz.old
root@instance3:~# _
```

- 8.3. Delete the **/boot** directory to prevent the instance from being able to successfully boot. The **/boot/efi** directory should fail to delete.

```
root@instance3:~# rm -rf /boot
```

```
root@instance3:~# rm -rf /boot
rm: cannot remove '/boot/efi': Device or resource busy
root@instance3:~# _
```

- 8.4. List the contents of the **/boot** directory to verify that everything but **/boot/efi** was deleted.

```
root@instance3:~# ls /boot
```

```
root@instance3:~# ls /boot
efi
```

```
root@instance3:~#
```

- 8.5. If a terminal window is not already open, open one and source the keystone credentials for the **admin** user.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 8.6. Reboot **instance3**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server reboot instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server reboot instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 8.7. Open the instance console, which should have booted into GRUB rescue mode.

```
SeaBIOS (version 1.15.0-1)
Machine UUID 8a0a6a59-a059-454d-b1fd-f004e5399797

iPXE (https://ipxe.org) 00:03.0 CA00 PCI2.10 PnP PMM+7FF8B340+7FECB340 CA00

Booting from Hard Disk...
error: file '/boot/grub/i386-pc/normal.mod' not found.
Entering rescue mode...
grub rescue> _
```

- 8.8. Return to the OpenStack terminal, and rescue the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server rescue instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server rescue instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

8.9. Open the instance console. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 8.10. List the block devices, which should now include **vda** and **vdb**.

```
root@instance3:~# lsblk
```

```
root@instance3:~# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0    7:0    0 63.9M  1 loop /snap/core20/2105
loop1    7:1    0 114.4M  1 loop /snap/1xd/26741
loop2    7:2    0 40.4M  1 loop /snap/snapd/20671
vda     252:0    0  2.2G  0 disk
└─vda1   252:1    0  2.1G  0 part
  ├─vda14  252:14   0     4M  0 part
  ├─vda15  252:15   0 106M  0 part
vdb     252:16   0   20G  0 disk
└─vdb1   252:17   0 19.9G  0 part /
  ├─vdb14  252:30   0     4M  0 part
  └─vdb15  252:31   0 106M  0 part /boot/efi
root@instance3:~#
```

- 8.11. Create the **/mnt/root** directory, and mount the **vdb1** partition to it.

```
root@instance3:~# mkdir /mnt/root
root@instance3:~# mount /dev/vdb1 /mnt/root
```

```
root@instance3:~# mkdir /mnt/root
root@instance3:~# mount /dev/vdb1 /mnt/root
root@instance3:~# _
```

- 8.12. Change the root directory to **/mnt/root**.

```
root@instance3:~# chroot /mnt/root
```

```
root@instance3:~# chroot /mnt/root
root@instance3:/# _
```

- 8.13. Copy the backup of the bootloader into the **/boot** directory, making sure to copy only the files and not the **boot_bkp** directory itself.

```
root@instance3:/# cp -a /root/boot_bkp/. /boot
```

```
root@instance3:/# cp -a /root/boot_bkp/. /boot
root@instance3:/# _
```

- 8.14. List the contents of **/boot** to confirm that everything was copied correctly. Close the console tab.

```
root@instance3:/# ls /boot
```

```
root@instance3:/# ls /boot
System.map-5.15.0-92-generic  efi    initrd.img           initrd.img.old  vmlinuz-5.15.0-92-generic
config-5.15.0-92-generic     grub   initrd.img-5.15.0-92-generic  vmlinuz      vmlinuz.old
root@instance3:/# _
```

- 8.15. Return to the OpenStack terminal, and unrescue the instance.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server unrescue instance3
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server unrescue instance3
[ubuntu@workstation (keystone-admin)]:~$ █
```

8.16. Open the instance console. Log in as **root** with the password **secret**.

```
Ubuntu 22.04.3 LTS instance3 tty1

instance3 login: root
Password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

System information disabled due to load higher than 1.0

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

root@instance3:~#
```

- 8.17. List the block devices again to confirm that **vdb** is no longer present.

```
root@instance3:~# lsblk
```

```
root@instance3:~# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINTS
loop0    7:0    0 114.4M  1 loop /snap/1xd/26741
loop1    7:1    0  40.4M  1 loop /snap/snapd/20671
loop2    7:2    0  63.9M  1 loop /snap/core20/2105
vda     252:0    0   20G  0 disk
└─vda1   252:1    0  19.9G  0 part /
  ├─vda14 252:14   0      4M  0 part
  └─vda15 252:15   0   106M  0 part /boot/efi
root@instance3:~# _
```

- 8.18. List the contents of the **/root/hello2.txt** file to verify that it was preserved through the rescuing process.

```
root@instance3:~# cat /root/hello2.txt
```

```
root@instance3:~# cat /root/hello.txt
hello
root@instance3:~# _
```

- 8.19. The lab is now complete.