



Clearing the Fog! Getting Started on Cumulus: a Near to the Ground On Campus Cloud Solution

Getting Started on CUMulus

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Slides and tutorial:

https://github.com/ResearchComputing/CUMulus_tutorials

Survey at: <http://tinyurl.com/curc-survey18>

Learning Objectives

- [Logging into CUMulus via Horizon](#) (the CUMulus web portal)
- [Creating your instance](#) (i.e. virtual machine)
- [Logging into your instance](#) via ssh

Outline

- What is CUMulus?
- CUMulus Access
 - Access to CUMulus and the allocation process
 - Logging into Horizon (CUMulus web portal)
 - Creation of an instance
 - Logging into your instance
- Demo workflow one might use on CUMulus:
 - Web App & Database
 - CUMulus + CURC HPC Integration

What is CUmulus?

- CUmulus is CU Research Computing's free-to-use on-premise cloud service.
- Supports cases not well-suited for HPC such as
 - research-oriented web servers
 - databases
 - long-running services
- Provides users with persistent or ongoing availability by allocating them a logically isolated section of the cloud.

What is CUMulus?

- You get your own virtual “world” for experimentation - an environment that can be easily created/deleted.
 - Install Software
 - Administer your instance (you’re in control!)
 - Run applications and jobs
 - Interface w/ other CURC services: Blanca, Alpine, PetaLibrary
- You can request specific resources (CPU, storage, memory) and can set up persistent storage.

CUmulus Access

CUmulus Access and Allocation

Users will submit a proposal for your use case (email rc-help@colorado.edu):

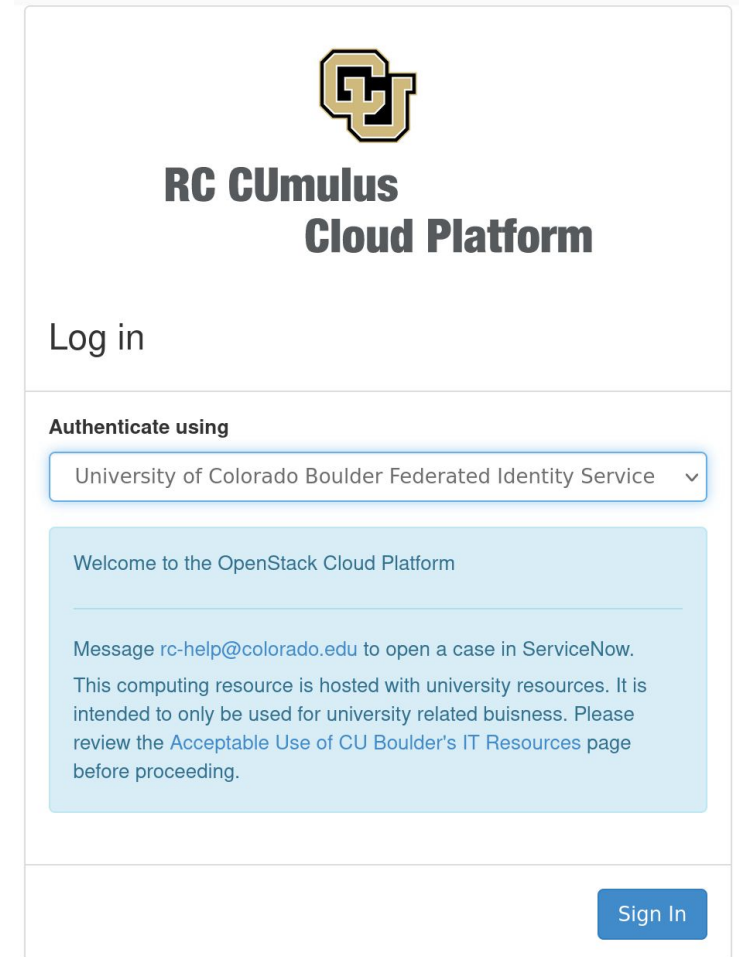
- Describe your CUmulus workflow
- Describe why your workflow is appropriate for CUmulus
- Estimate the resources you require:
 - operating system, CPU cores, disk space, memory

This is an iterative process where we work with you to make sure the request for resources fits your (and our) needs.

- Learn more about the allocation request process at <https://www.colorado.edu/rc/userservices/allocations>

Log in to Horizon

- Horizon is the CUMulus web portal
 - cumulus.rc.colorado.edu/
- Let's take a brief tour of Horizon
- Log in with your institution's credentials:



The screenshot shows the login interface for the RC CUMulus Cloud Platform. At the top is the CU Boulder logo and the text "RC CUMulus Cloud Platform". Below this is a "Log in" section. Under the heading "Authenticate using", there is a dropdown menu currently showing "University of Colorado Boulder Federated Identity Service". Below the dropdown is a light blue box containing a welcome message and a disclaimer. At the bottom right of the page is a blue "Sign In" button.

**RC CUMulus
Cloud Platform**

Log in

Authenticate using

University of Colorado Boulder Federated Identity Service ▾

Welcome to the OpenStack Cloud Platform

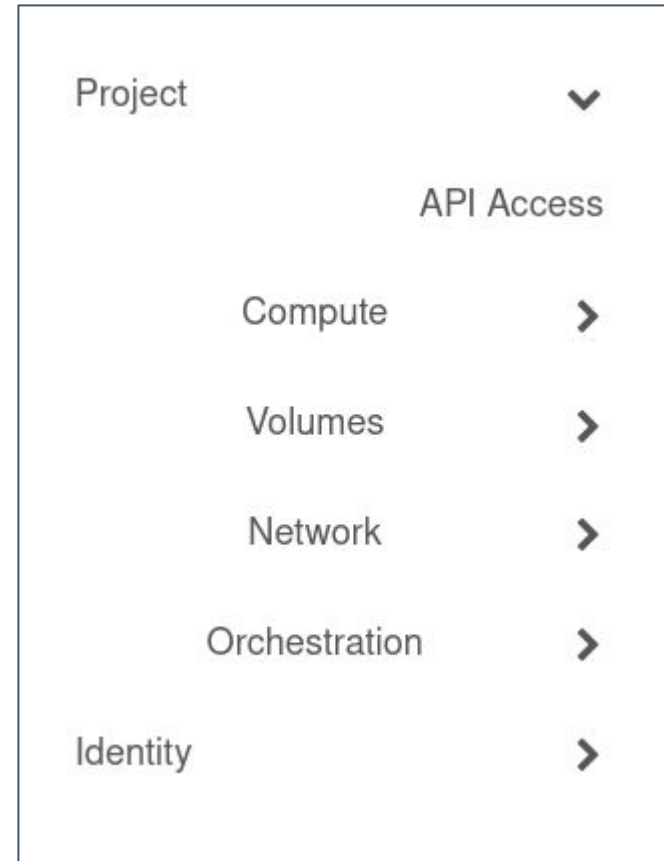
Message rc-help@colorado.edu to open a case in ServiceNow.

This computing resource is hosted with university resources. It is intended to only be used for university related business. Please review the [Acceptable Use of CU Boulder's IT Resources](#) page before proceeding.

Sign In

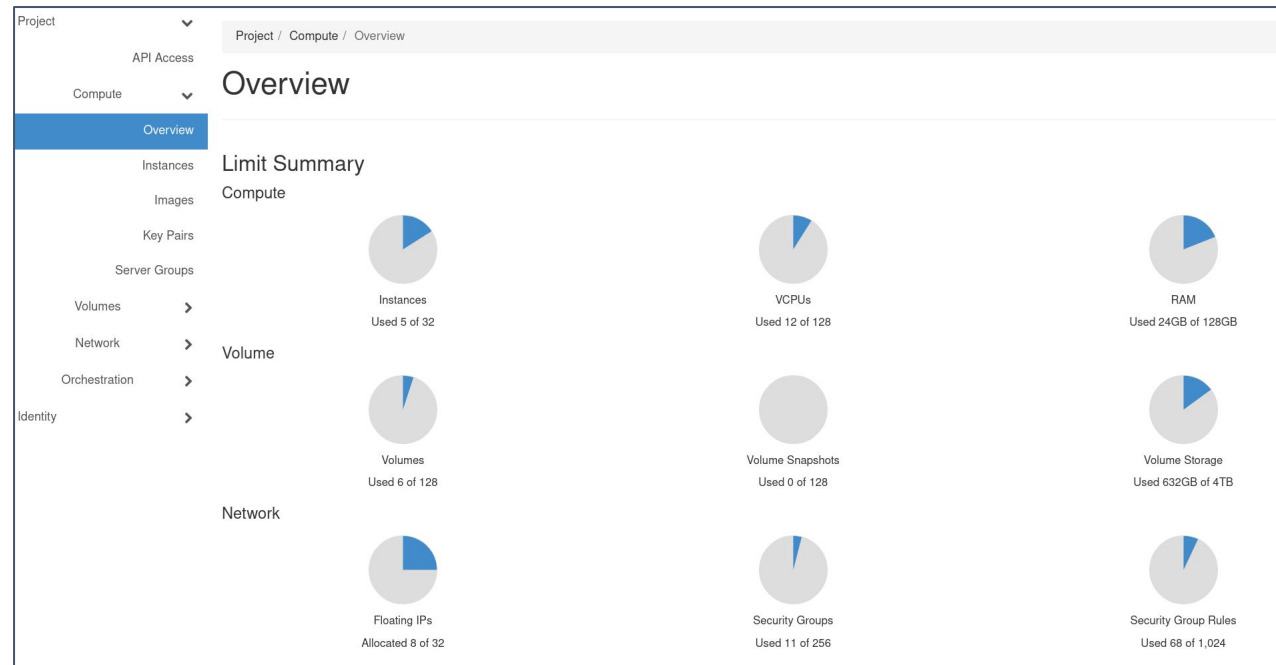
Navigate Horizon

- Choose your project (top left)
 - Generally users only have 1 project
- 4 main sections
 - Compute
 - Volumes
 - Networks
 - Orchestration



Navigate Horizon: Overview

- Land on the Overview page under “Compute”
 - quick summary of your project



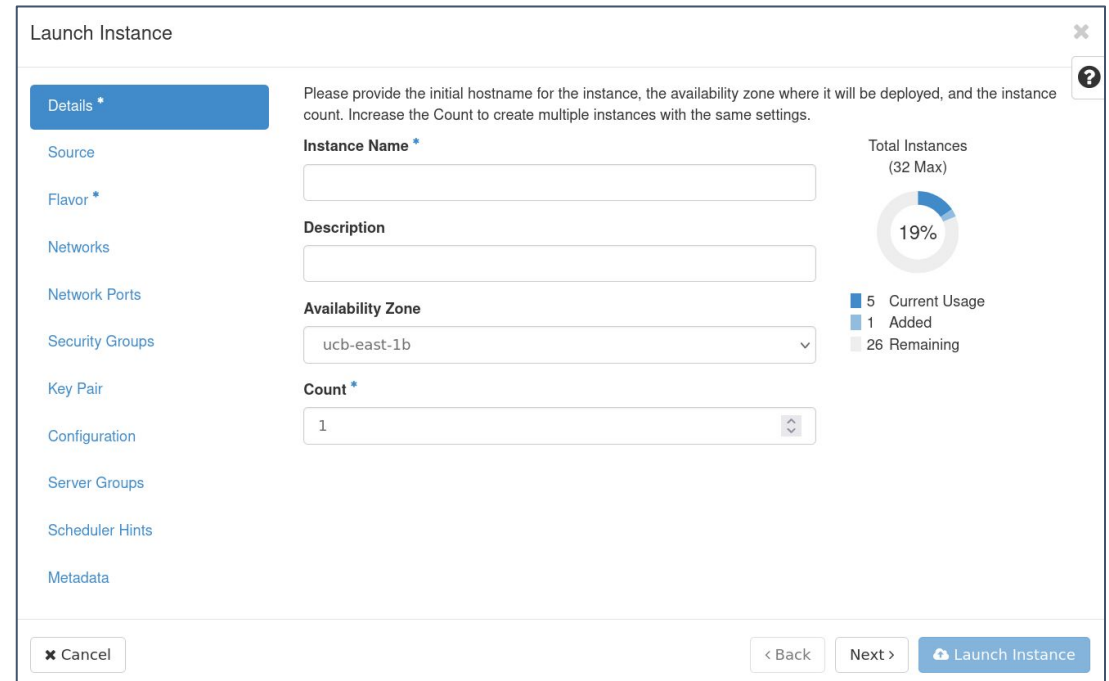
Navigate Horizon: Instances

- Navigate to:
 - Project->Compute->Instances
- Instances are virtual machines that run inside the cloud, more simply: an instance is just a digital version of a physical computer.
 - Instances can perform almost all of the same functions as a computer, including running applications and operating systems.

Instance Creation

Let's create a simple instance together

- From the instances page click on “Launch Instance”
- The Instance Creation Launcher will pop up giving us options to create our virtual machine:



The screenshot shows the 'Launch Instance' dialog box with a sidebar on the left containing links: Details (selected), Source, Flavor, Networks, Network Ports, Security Groups, Key Pair, Configuration, Server Groups, Scheduler Hints, and Metadata. The main area contains the following fields and information:

- Instructions:** 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.
- Instance Name:** A text input field.
- Description:** A text input field.
- Availability Zone:** A dropdown menu currently showing 'ucb-east-1b'.
- Count:** A dropdown menu currently showing '1'.
- Usage Summary:** A circular progress indicator showing 19% usage. A legend indicates: 5 Current Usage (blue), 1 Added (light blue), and 26 Remaining (grey). The total capacity is 32.

At the bottom, there are three buttons: 'Cancel', '< Back', and 'Next >', followed by a large blue 'Launch Instance' button.

Details

- Fill out Instance details, including a name and description
 - availability zone and count can be left as defaults

The screenshot shows a 'Launch Instance' dialog box with a sidebar on the left containing links to 'Details', 'Source', 'Flavor', 'Networks', 'Network Ports', 'Security Groups', 'Key Pair', 'Configuration', 'Server Groups', 'Scheduler Hints', and 'Metadata'. The 'Details' tab is selected. The main area contains a text box for 'Instance Name', a text box for 'Description', a dropdown menu for 'Availability Zone' (set to 'ucb-east-1b'), and a dropdown menu for 'Count' (set to '1'). A message at the top right says: '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.' On the right side, there is a circular progress indicator showing '19%' usage, with a legend indicating '5 Current Usage', '1 Added', and '26 Remaining'. At the bottom, there are buttons for 'Cancel', '< Back', 'Next >', and 'Launch Instance'.

Launch Instance

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.

Instance Name *

Description

Availability Zone

ucb-east-1b

Count *

1

Total Instances (32 Max)

19%

5 Current Usage
1 Added
26 Remaining

✕ Cancel < Back Next > Launch Instance

Source

- You can choose an operating system from the images CURC provides
- Choose to have your storage volume deleted on Instance Deletion
 - If you select “no” be aware of “zombie” volumes that will stay around when the instance is deleted

Launch Instance

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

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

Select Boot Source
Image

Create New Volume
Yes No

Volume Size (GB) *
1

Delete Volume on Instance Delete
Yes No

Allocated
Displaying 0 items

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

Displaying 0 items

▼ Available 9 Select one

Click here for filters or full text search.

Displaying 9 items

Name	Updated	Size	Type	Visibility
> CentOS 7	6/3/21 6:54 AM	847.81 MB	QCOW2	Public
> CentOS 8	9/20/21 9:22 PM	1.19 GB	QCOW2	Private

Flavor

- Choose from a list of pre-selected resources:
 - A flavor defines the compute, memory, and storage capacity of our instance.

Launch Instance

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

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

Allocated

Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public
Select an item from Available items below						

▼ Available 8 Select one

Q Click here for filters or full text search. X

Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public	
> m5.nano	2	512 MB	0 GB	0 GB	0 GB	No	↑
> m5.micro	2	1 GB	0 GB	0 GB	0 GB	No	↑
> m5.small	2	2 GB	0 GB	0 GB	0 GB	No	↑
> m5.medium	2	4 GB	0 GB	0 GB	0 GB	No	↑
> c5.xlarge	4	8 GB	0 GB	0 GB	0 GB	No	↑

Networks & Network Ports

- Select a project network, which determines routability of either a public/internet or campus/internal floating IP.
 - We'll choose an external network
- Ports provide extra communication channels to your instances.
- You can select ports instead of networks or a mix of both.

Launch Instance

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

Networks provide the communication channels for instances in the cloud.

▼ Allocated 1 Select networks from those listed below.

	Network	Subnets Associated	Shared	Admin State	Status
1	projectnet2021-private	projectnet2021-private-subnet	No	Up	Active

▼ Available 0 Select at least one network

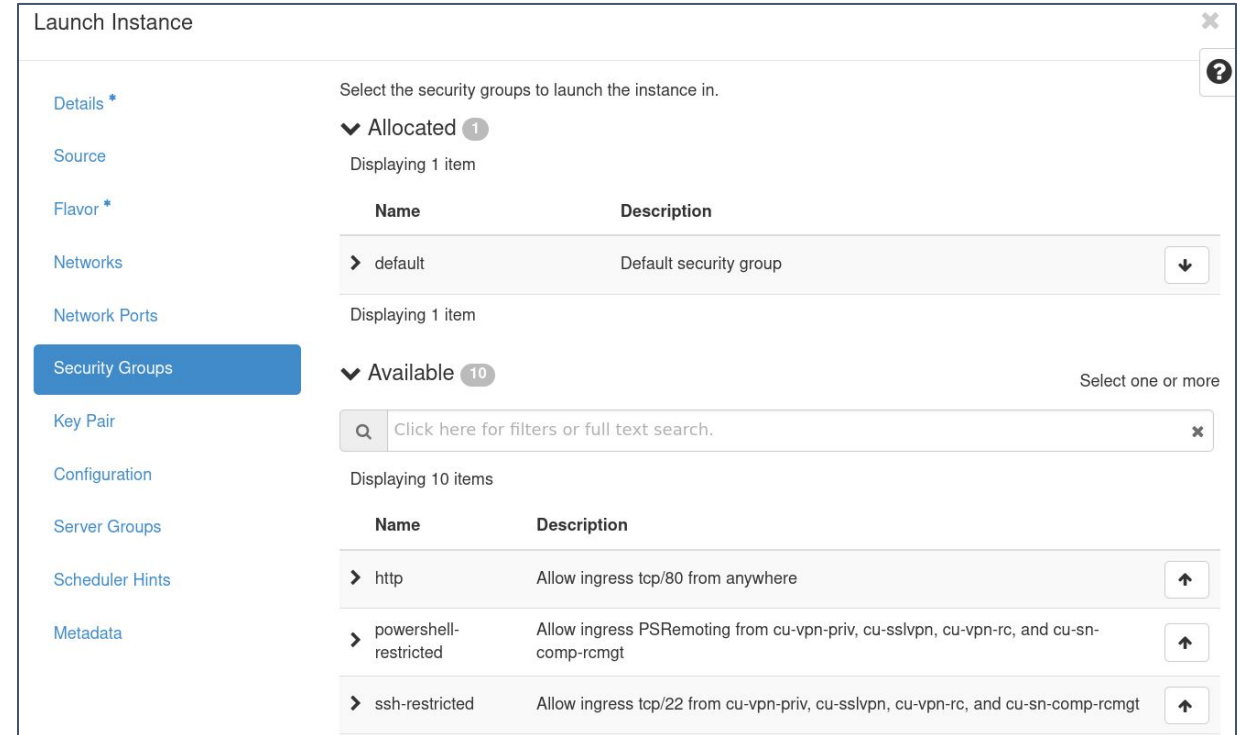
Click here for filters or full text search.

Network	Subnets Associated	Shared	Admin State	Status
No available items				

Cancel < Back Next > Launch Instance

Security Groups

- Security Groups act as a virtual firewall for your instance to control inbound and outbound traffic.
- We'll pick ssh-restricted, http, and https for our demo



Launch Instance

Select the security groups to launch the instance in.

▼ Allocated ¹

Displaying 1 item

Name	Description
> default	Default security group

Displaying 1 item

▼ Available ¹⁰ Select one or more

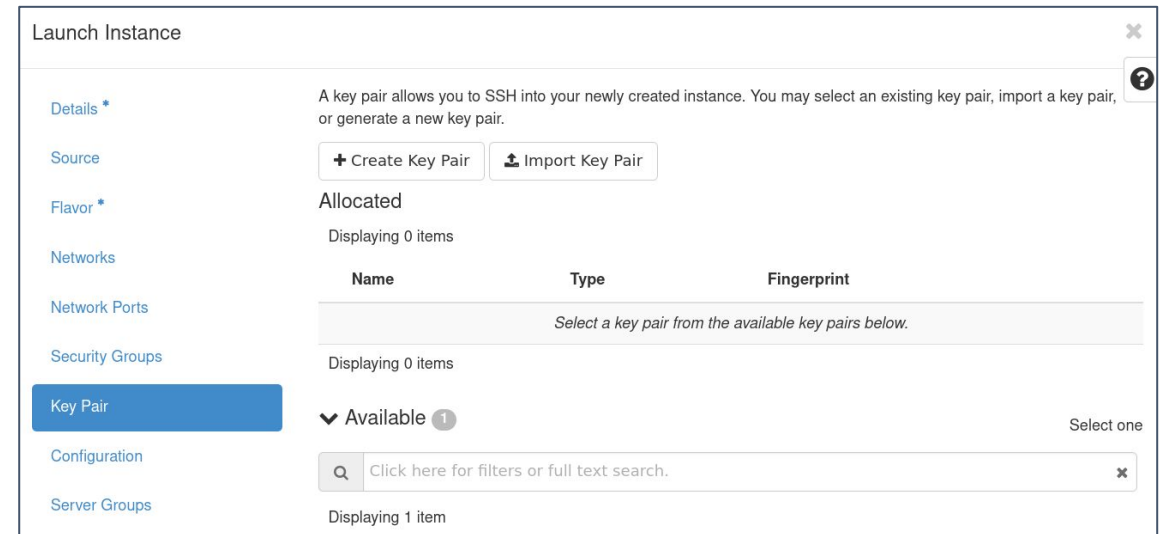
Click here for filters or full text search.

Displaying 10 items

Name	Description
> http	Allow ingress tcp/80 from anywhere
> powershell-restricted	Allow ingress PSRemoting from cu-vpn-priv, cu-sslvpn, cu-vpn-rc, and cu-sn-comp-rcmgt
> ssh-restricted	Allow ingress tcp/22 from cu-vpn-priv, cu-sslvpn, cu-vpn-rc, and cu-sn-comp-rcmgt

Key Pairs

- A key pair allows you to SSH into your new instance.
 - You may select an existing key pair, import a key pair, or generate a new key pair.
-
- I find it easiest to create a keypair on my local machine and import it
 - <https://www.ssh.com/academy/ssh/public-key-authentication>



The screenshot shows the 'Launch Instance' console in AWS. The 'Key Pair' tab is selected in the left-hand navigation menu. The main content area displays instructions on how to use a key pair for SSH access. It provides two buttons: '+ Create Key Pair' and '+ Import Key Pair'. Below these, there are sections for 'Allocated' (displaying 0 items) and 'Available' (displaying 1 item). The 'Available' section includes a search bar and a dropdown menu to select a key pair. The 'Key Pair' tab is highlighted in blue in the left sidebar.

Launch Instance

Details *
Source
Flavor *
Networks
Network Ports
Security Groups
Key Pair
Configuration
Server Groups

A key pair allows you to SSH into your newly created instance. You may select an existing key pair, import a key pair, or generate a new key pair.

+ Create Key Pair + Import Key Pair

Allocated
Displaying 0 items

Name	Type	Fingerprint
Select a key pair from the available key pairs below.		

Displaying 0 items

▼ Available 1 Select one

Click here for filters or full text search.

Displaying 1 item

Key Pairs: An aside

- SSH keys are an access credential that is used in the SSH protocol and they are foundational to modern Infrastructure-as-a-Service platforms.
- They can be tricky to set up for new users however, so we'll go over a simple example here. From your terminal in a local machine use the ssh-keygen command to create a new ssh keypair:

```
$ ssh-keygen -t ed25519
```

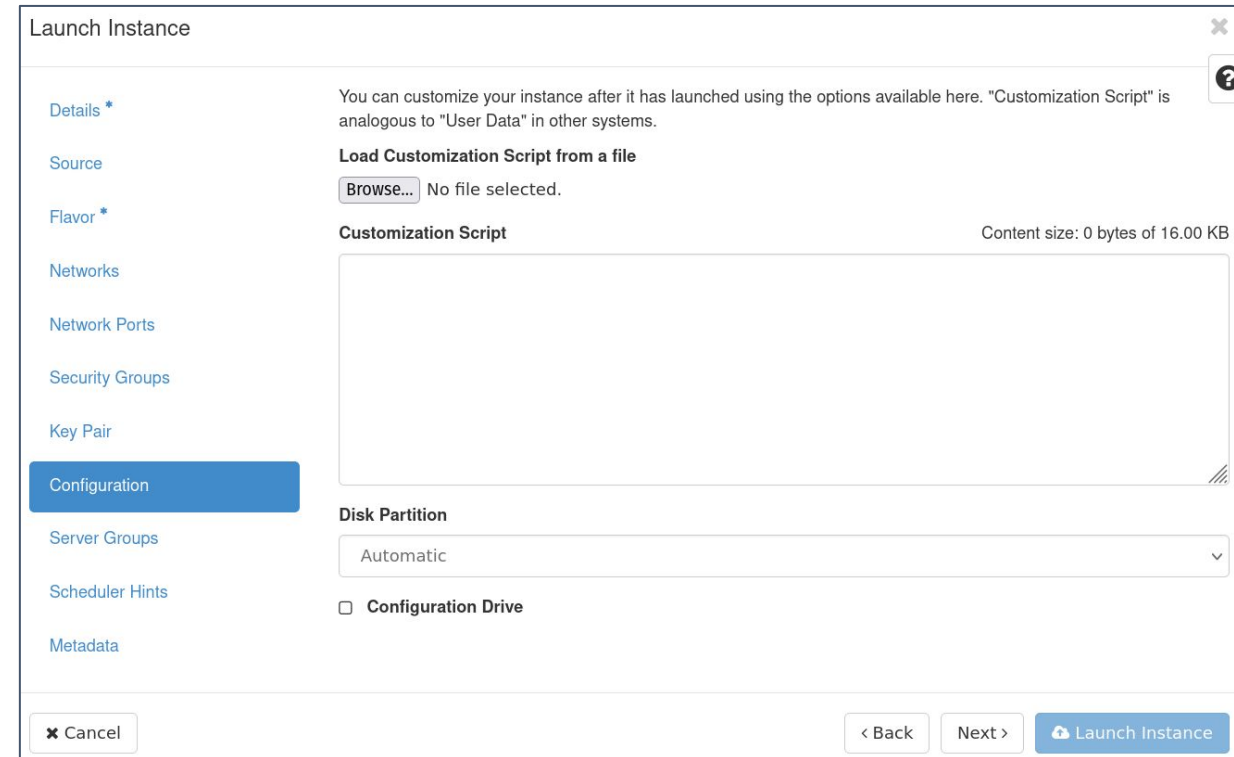
```
Generating public/private ed25519 key pair.
```

```
Enter file in which to save the key (/home/username/.ssh/id_ed25519):
```

- Our new keypairs have been created at `/home/username/.ssh/` and are called `id_ed25519` and `id_ed25519.pub`. The public key (.pub) can be transferred to other remote servers (*this is the key we will import to our CUmulus instance*) but the private key (no suffix) should *never* leave the host machine.

Config, Server Group, Scheduler Hints, and Metadata

- We'll leave these as defaults as they are extra configuration we can provide our instances, but not necessary



The screenshot shows the 'Launch Instance' dialog box with a sidebar on the left containing the following links: Details *, Source, Flavor *, Networks, Network Ports, Security Groups, Key Pair, Configuration (highlighted in blue), Server Groups, Scheduler Hints, and Metadata. The main content area has a title bar 'Launch Instance' with a close button. Below the title bar is a text box explaining customization options. The 'Load Customization Script from a file' section includes a 'Browse...' button and the text 'No file selected.'. The 'Customization Script' section shows a large text area and 'Content size: 0 bytes of 16.00 KB'. The 'Disk Partition' section has a dropdown menu set to 'Automatic'. Below that is a checkbox for 'Configuration Drive' which is unchecked. At the bottom are three buttons: 'Cancel', '< Back', and 'Next >', followed by a blue 'Launch Instance' button.

Launch Instance

You can customize your instance after it has launched using the options available here. "Customization Script" is analogous to "User Data" in other systems.

Load Customization Script from a file

No file selected.

Customization Script Content size: 0 bytes of 16.00 KB

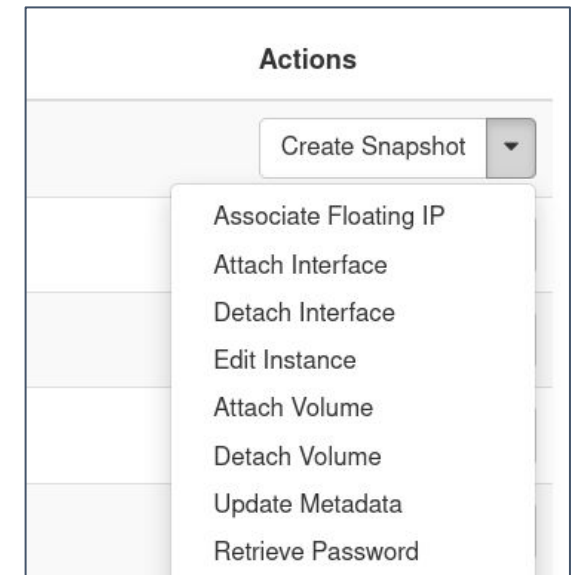
Disk Partition

Automatic

☐ Configuration Drive

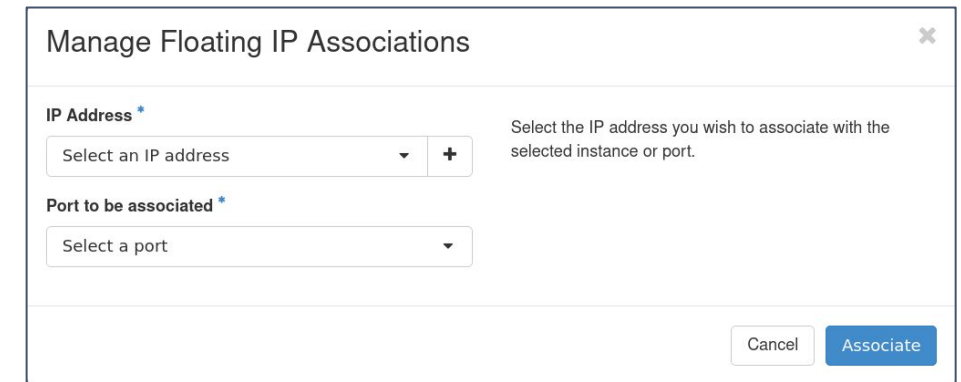
Launch Instance and Associate IP

- Launch instance and wait for it to be set up
- We can then associate a Floating IP which will allow us to access the instance from outside of the CU network
 - On the right hand side of the newly created instance choose “Associate Floating IP” under the “actions” dropdown



Associate IP

- Select from available IP addresses
 - If needed you can add a floating IP, but be aware there are limited numbers of floating IPs
- Select port to be associated
 - This should be pre-populated with the internal IP of your new instance



The screenshot shows a dialog box titled "Manage Floating IP Associations" with a close button (X) in the top right corner. Inside the dialog, there are two main sections. The first section is labeled "IP Address" with a blue asterisk. It contains a dropdown menu with the text "Select an IP address" and a plus sign button to the right. To the right of this dropdown is a text label: "Select the IP address you wish to associate with the selected instance or port." The second section is labeled "Port to be associated" with a blue asterisk. It contains a dropdown menu with the text "Select a port". At the bottom right of the dialog, there are two buttons: "Cancel" and "Associate".

Logging into your Instance

Logging In

- You must be on CU VPN to connect via ssh (CURC restriction)
- Open up an ssh connection providing the identity (key) file:
 - `$ ssh -i ~/.ssh/<private key> <hostname>@<external floating IP>`
- For an ubuntu instance this may look something like:
 - `$ ssh -i ~/.ssh/testkey ubuntu@123.456.789.123`

Logged In

- Congratulations! You are now logged into your instance
- You can now:
 - Install Software
 - Administer your instance
 - Run applications and jobs

Demo

Demo workflow: Twitter API with DB

- There are a (nearly) *infinite* number of workflows you could run on your CUMulus instance*

**As long as the workflow is related to research, personal projects are not permitted.*

- We'll demo a *potential* workflow: a web application which allows users to query using the Twitter API and store this data persistently to a mysql database.
- This demo showcases a few important features of CUMulus not possible on HPC:
 - A persistent workflow not limited by wall clock times
 - User administration of compute resources (using root privileges for applications such as Docker)
 - Routable floating IPs available on the Public Internet

Thank you!

- Survey: <http://tinyurl.com/curc-survey18>
- Contact information: rc-help@Colorado.edu