VIRTUALIZE!

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AGENDA

- Who we are
- Overview on Cloud Computing
- Do we really need clouds?
- Compute Canada Clouds
  - Access and Use
  - OpenStack
- Demo

WHO WE ARE

- RCS Team
  - Manage advanced research computing (ARC) at UVic
- WestGrid
  - Regional organization for ARC
- Compute Canada Federation
  - National organization for ARC
  - The east and the west clouds

All work together to manage, maintain and support many resources and services as well as to offer experts in different ARC areas

THEORY

Embrace the clouds ☺

OVERVIEW ON CLOUD COMPUTING SIMPLE DEFINITION …

Cloud computing is a utility computing paradigm for delivering services over the Internet

OVERVIEW ON CLOUD COMPUTING ADVANCED DEFINITIONS …

Ian Forster:

"*A pool of abstracted, highly scalable, and managed compute infrastructure capable of hosting end-customer applications and billed by consumption.*"

OVERVIEW ON CLOUD COMPUTING ADVANCED DEFINITIONS …

Redhat:

"*Clouds are pools of virtual resources, storage, applications, and services that are managed by software so the resources can be accessed on demand.*"

CLOUD COMPUTING ADVANCED DEFINITIONS …

NIST (National Institute for Standards and Technology)

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model is composed of five essential characteristics, three service models, and four deployment models …"

CHARACTERISTICS

- On-demand self-service
  - Provision and reconfigure computing capabilities as needed and automatically
- Broad network access - ubiquity
  - Access the computing capabilities from anywhere, especially over the net (present from everywhere)
- Resource pooling
  - Ability to share, assign and reassign physical and virtual resources while satisfying consumer demands
- Rapid Elasticity
  - Capabilities can be expanded or released automatically
  - Scale up or down seamlessly, limitlessly, and in responsive user demands.
- *Measured service*
  - Utility-like offering to monitor, control and report the usage of the capabilities.
  - Pay as you go and as you use

SERVICE MODELS

SaaS

- Use the applications offered by the provider
- *Google docs, different email providers, Zoho, icloud, salesforce.com,* ***Compute Canada CVMFS software stack***

PaaS

- Design, develop and deploy applications using tools, libraries and programming languages supported by the provider
- *Google App Engine, Azure service platform, force.com, openshift, Heroku –* ***Compute Canada-supported Jupyterhubs***

IaaS

- Provision computing resources to deploy arbitrary OSs and applications
- *EC2, S3, GoGrid, 3 tera,* ***Compute Canada clouds***

DEPLOYMENT MODELS

Public	• Open to the public on the internet and resource are pooled amongst the customers • AWS, Google, Microsoft, etc.
Private	• Restricted to a single organization and the resources are dedicated to the users within the organization.
Community	• Shared between a group of organizations from the same community
Hybrid	• Combines public with the other two forms of deployments

TOWARDS PRACTICAL CLOUDS

Clouds are real ☺

DO WE REALLY NEED CLOUDS?

- Not all research computational workloads fit in the HPC realm
  - Where to host our research-related websites
  - What about our scientific gateways
  - What about license restricted software
  - What about running windows programs/software
  - What about deploying specific OS and changing the kernel
  - What about increasing the turn around of my processing
    - Urgent deadlines
    - Interactive use
  - What about Bigdata
- Complete isolation from other jobs/tasks/processes
- Enjoy managing your own resources
- Create special environment with specific requirements
  - Create a cluster with specific resource manager
  - Create very old environment that a grad created 10 years ago

COMPUTE CANADA CLOUDS

- We have a few clouds
  - West cloud (arbutus) hosted at UVic :
    - ~20K cores
    - 5 PB
  - East cloud at the Université de Sherbrooke
  - Each supercomputer has dedicated nodes for the cloud

ACCESSING COMPUTE CANADA CLOUDS

- Have a Compute Canada account by filling the form
  - https://ccdb.computecanada.ca/
- PI fills a RAS form
  - Persistent: 1 year, renewable
  - Compute: 1 year, 1 month, renewable
- Once approved:
  - A tenant with the requested resources is created
  - Users can be added to the tenant as requested by the PI
  - Tenant members have access to the dashboard from which they can manage their virtual resources

AMOUNT OF RESOURCES

Attributes	**Compute Cloud**	**Persistent Cloud**
Who can request	PIs only	PIs only
VCPUs (see VM flavours)	80	10
Instances	20	5
Volumes	2	5
Volume snapshots	2	5
RAM (GB)	300	45
Floating IP	2	2
Persistent storage (GB)	10000	
Default duration	1 year, with 1 month wall-time	1 year (renewable)\
Default renewal	April	April

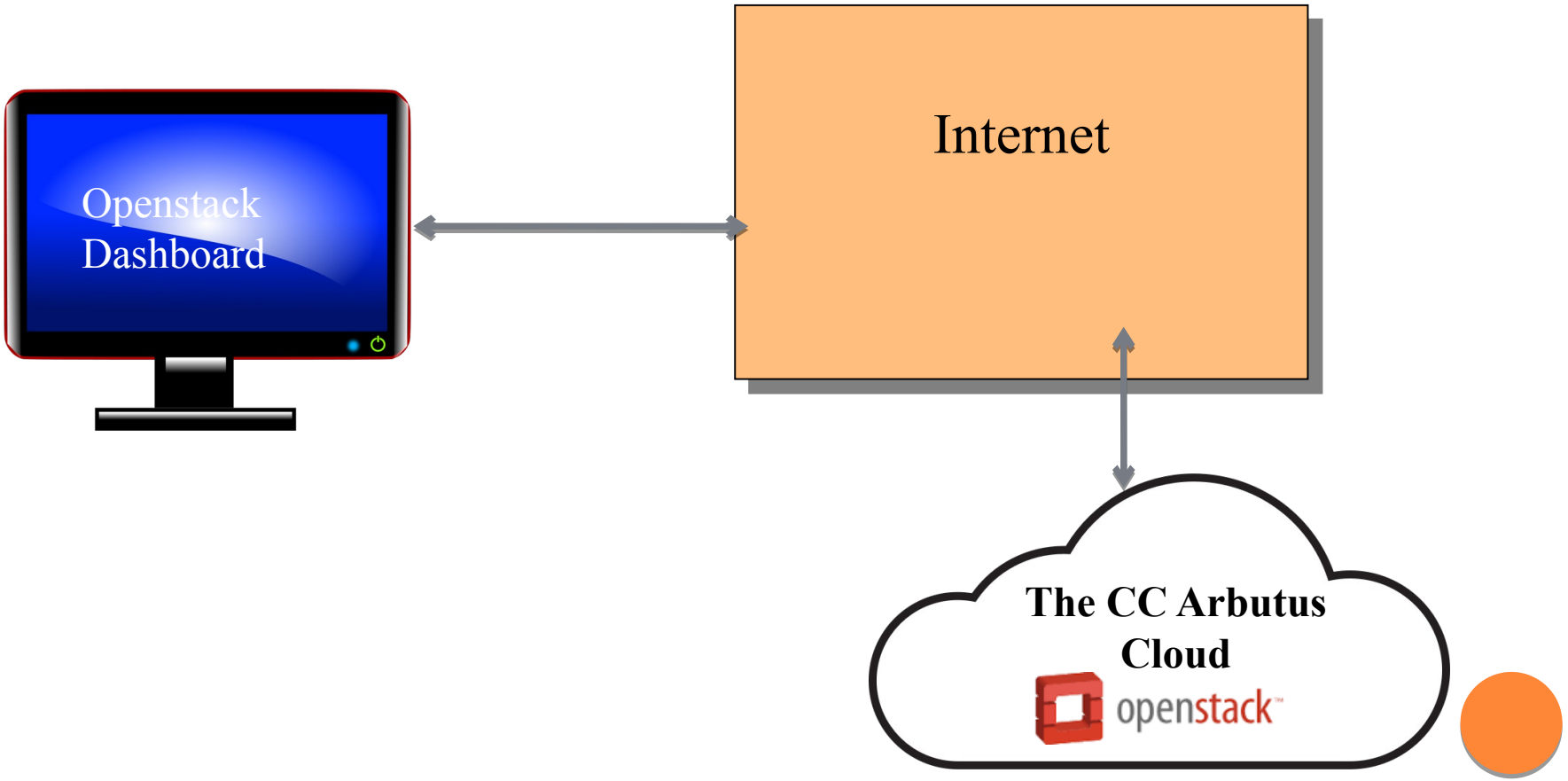
USES CASES

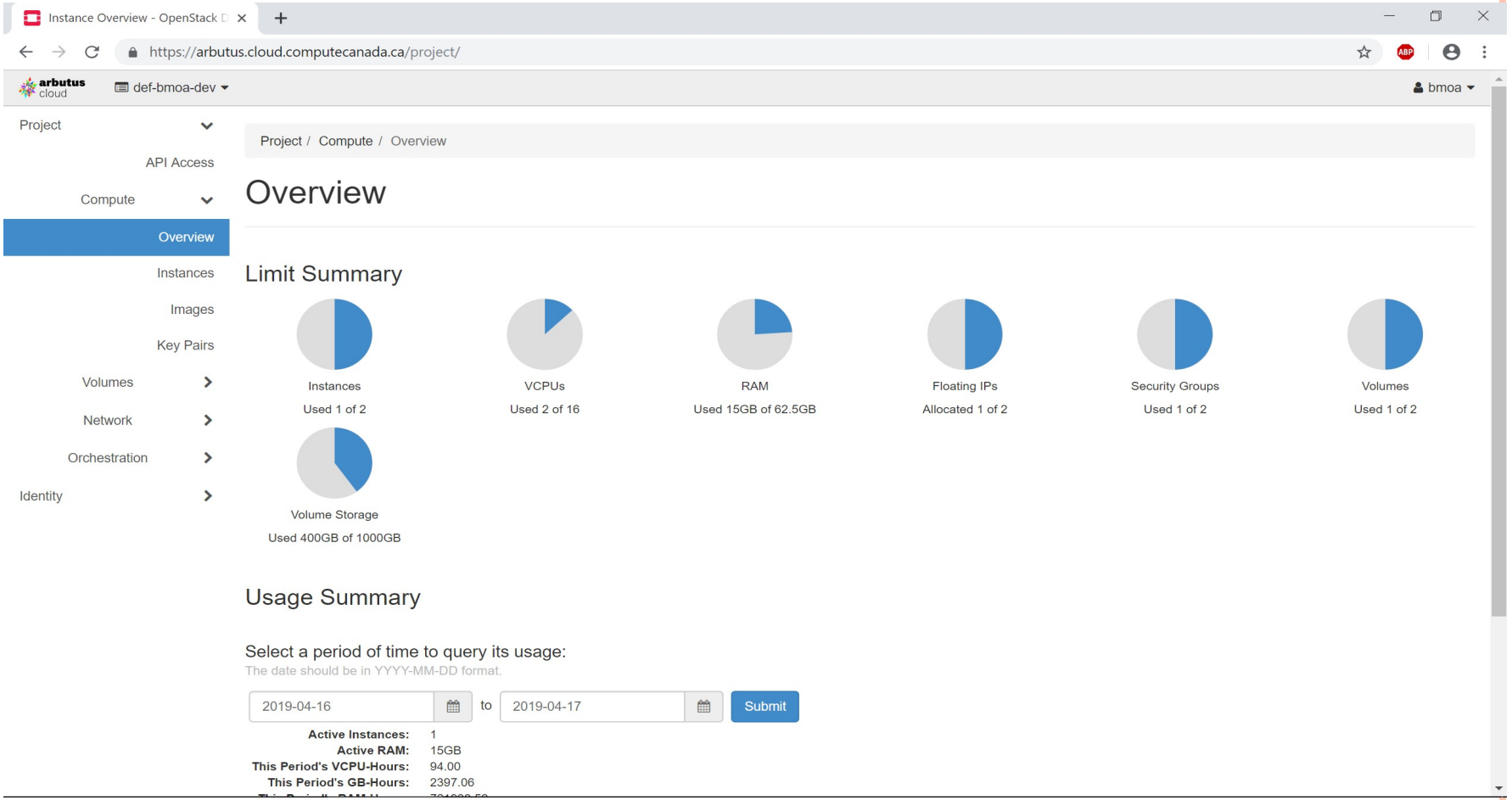
- Persistent
  - Deploy web servers
  - Deploy scientific gateways
    - Jupyterhubs
    - Hubzero
- Compute
  - Urgent and bursty computational needs
  - Match the increase of computational demands with the increase number of users
    - Jupyter notebooks/Dockers
  - User managed serial clusters
  - Contributed clusters

CLOUD STACKS

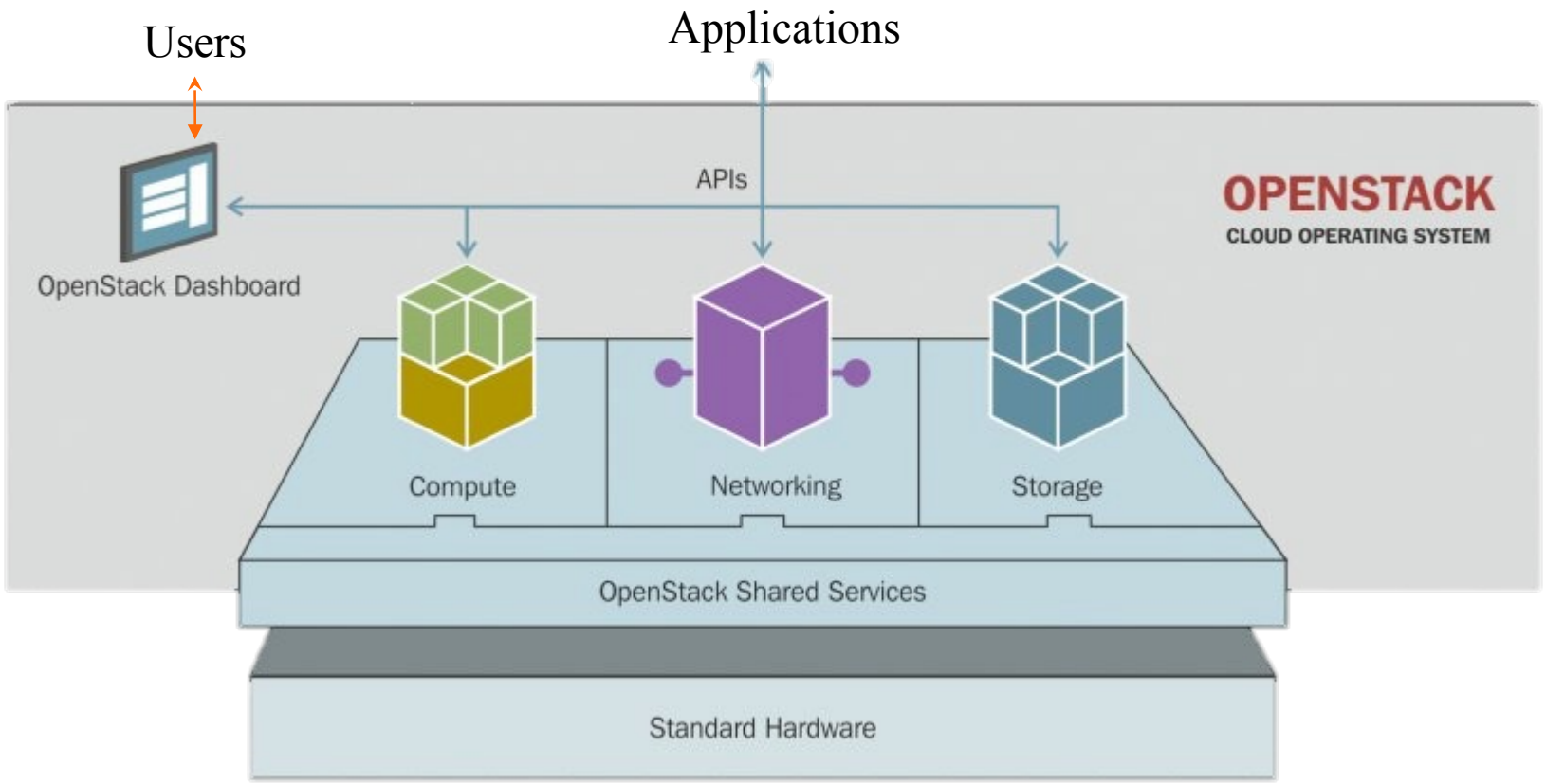
- **Openstack**
- Apache cloudstack
- OpenNebula
- AWS (EC2 and S3)
- Eucalyptus
- Nimbus

OPENSTACK HORIZON - DASHBOARD



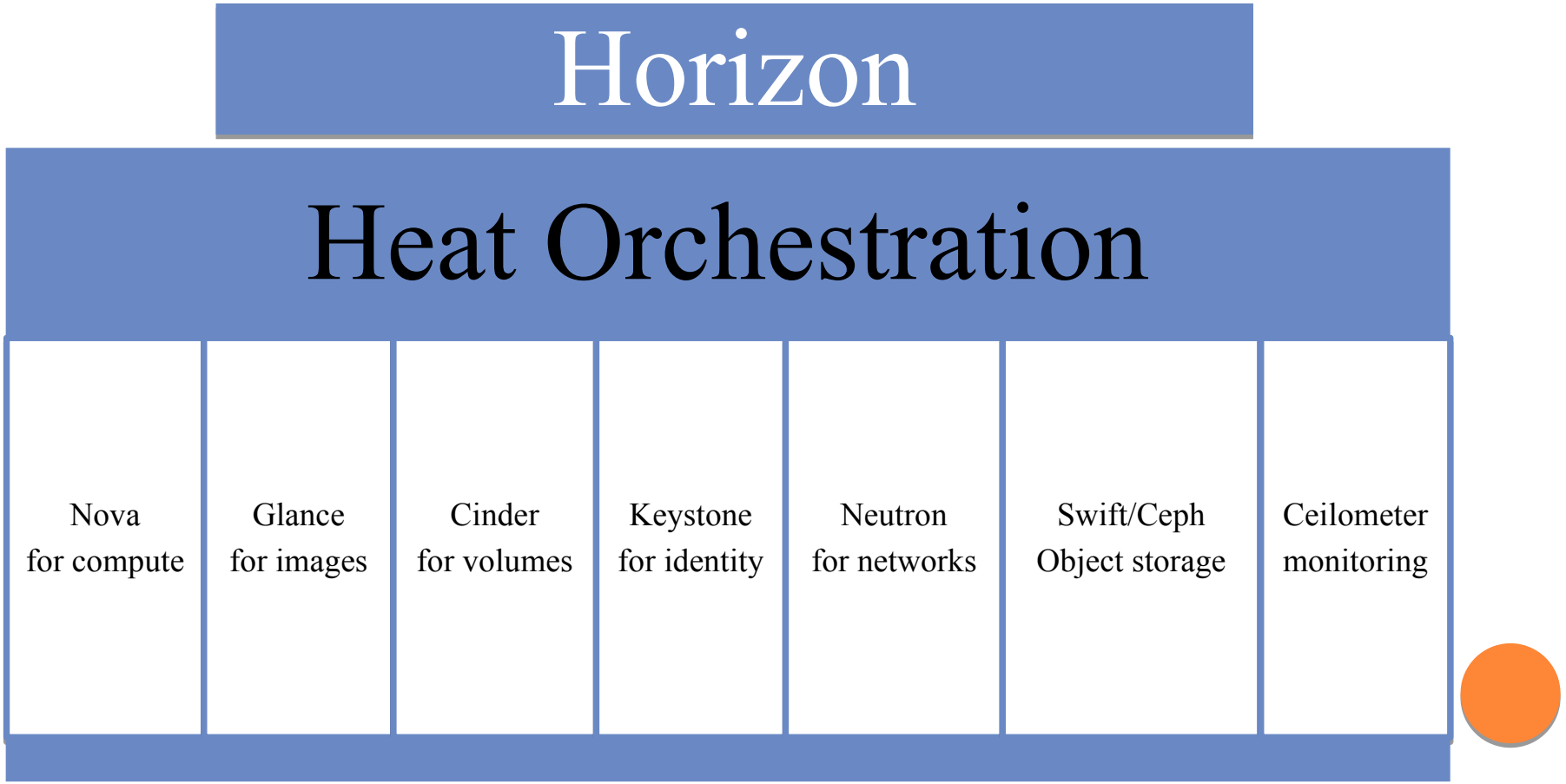

Instance Overview - OpenStack
https://arbutus.cloud.computecanada.ca/project/
arbutus cloud
def-bmoa-dev
bmoa
Project
API Access
Compute
Overview
Instances
Images
Key Pairs
Volumes
Network
Orchestration
Identity
Project / Compute / Overview
Overview
Limit Summary
Instances
Used 1 of 2
VCPUs
Used 2 of 16
RAM
Used 15GB of 62.5GB
Floating IPs
Allocated 1 of 2
Security Groups
Used 1 of 2
Volumes
Used 1 of 2
Volume Storage
Used 400GB of 1000GB
Usage Summary
Select a period of time to query its usage:
The date should be in YYYY-MM-DD format.
2019-04-16
to
2019-04-17
Submit
Active Instances: 1
Active RAM: 15GB
This Period's VCPU-Hours: 94.00
This Period's GB-Hours: 2397.06

OPENSTACK BIRD VIEW

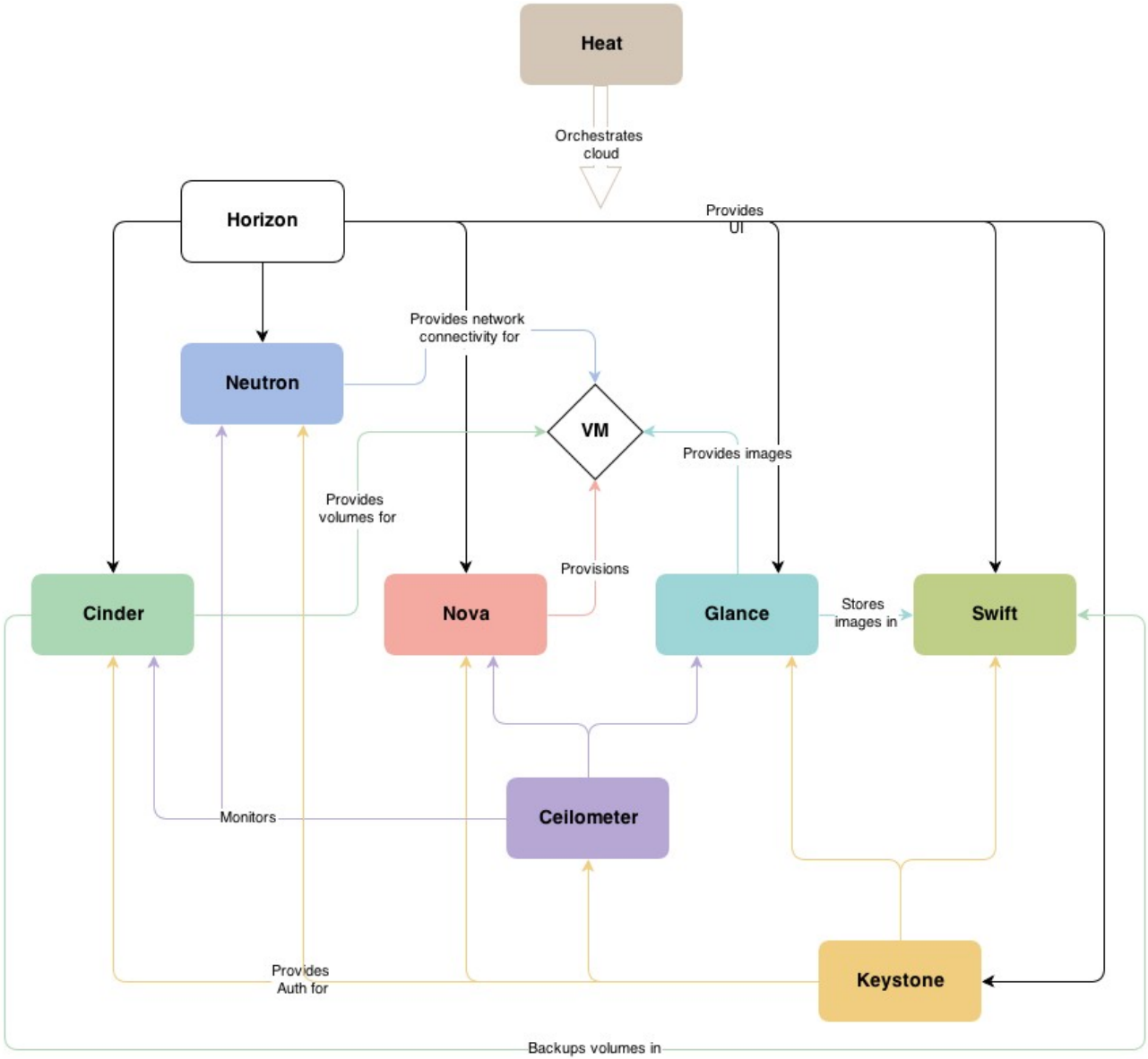


Based on https://cloudarchitectmusings.com

INSIDE OPENSTACK

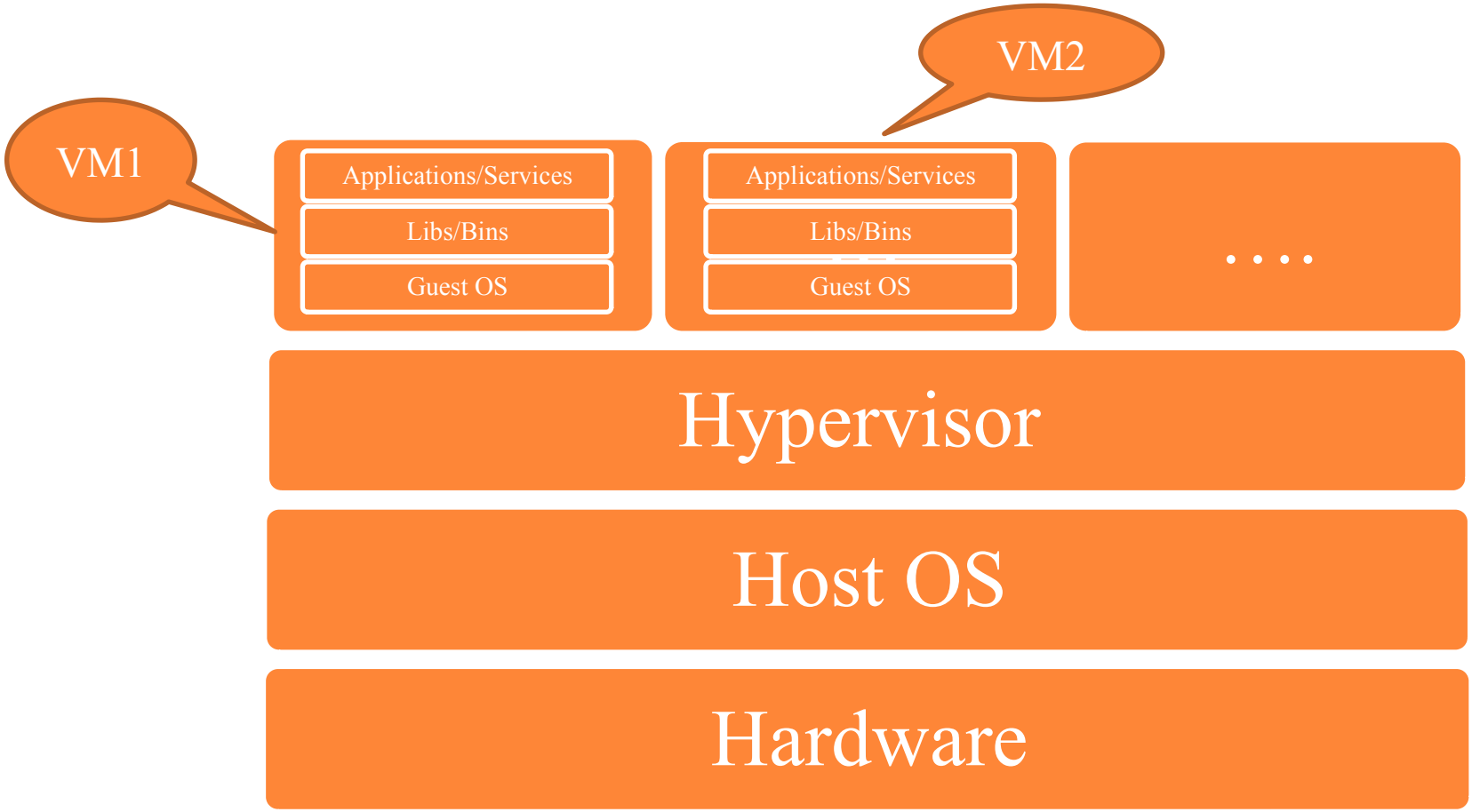


INSIDE OPENSTACK

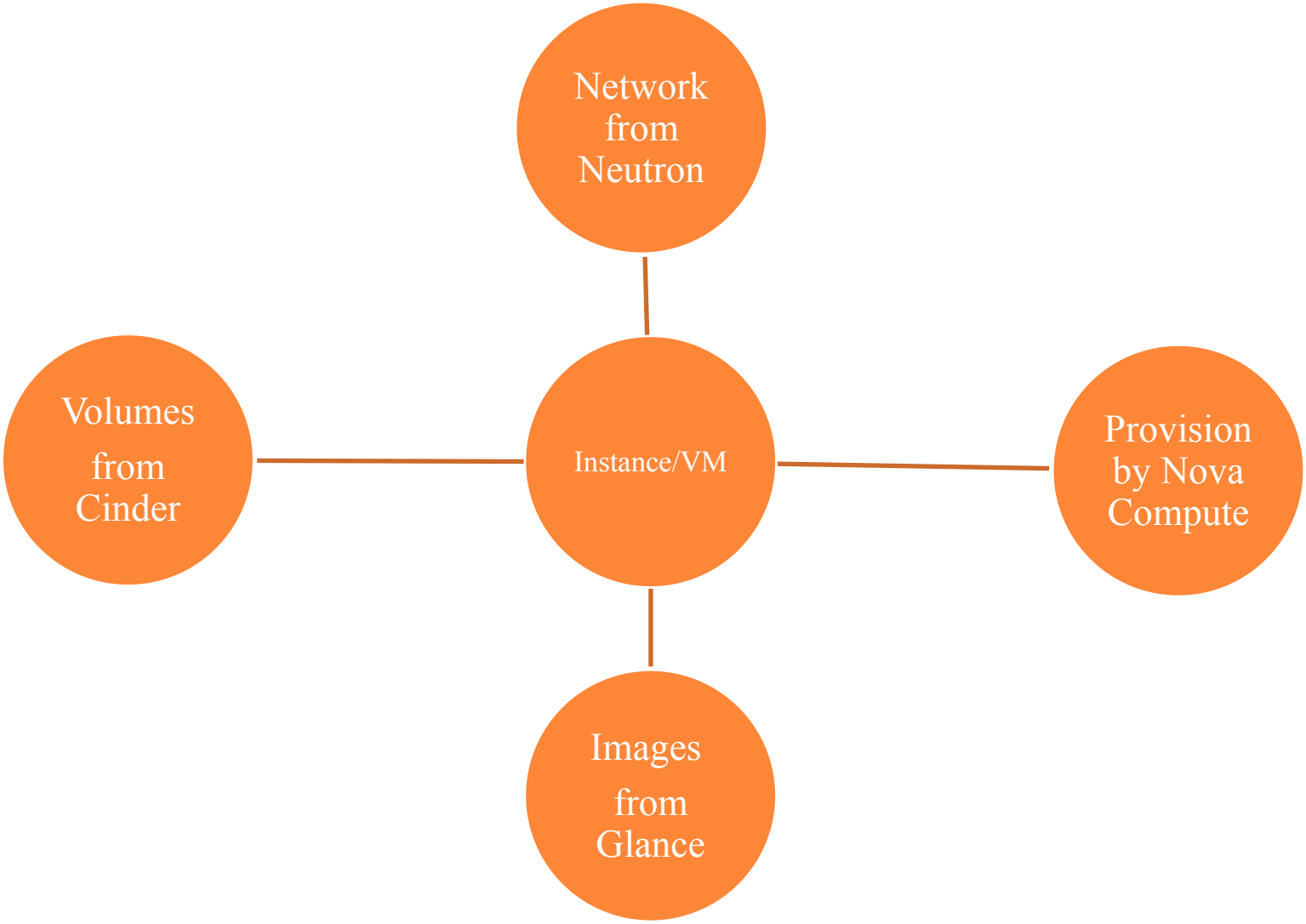


From docs.openstack.org

NOVA COMPUTE NODE



VIRTUAL MACHINE MAIN COMPONENTS



VIRTUAL MACHINE MAIN COMPONENTS

- Volumes
  - Disk-like storage to be attached to/detached from VMs.
  - Can be persistent or ephemeral
    - Persistent: changes are saved
    - Ephemeral: changes are discarded once VM is deleted
- Images
  - Blueprint for a specific operating system that you can use to create and rebuild a server
  - Think of ISO and bootable disk/live CD
- Floating IP
  - IP address that you can associate/disassociate to an instance
  - It allows you to interact with the instance from the outside
- Security groups
  - Specifies the network security settings to applied on instances
  - Look at this as an external firewall
- Flavors
  - The specs of the instance to start: how many cores, how much memory, and ephemeral disk
  - Similar to the specs you provide when buying a machine
- Key Pair
  - Allows you to create, import, and/or use the ssh keys to use for login to an instance
- Snapshot
  - Allows you to create a point-in-time copy of a volume or image

VIRTUAL MACHINE DEPLOYMENT CYCLE

- Prepare the image
- Prepare the volumes
  - Bootable volume from image
  - External volumes to attach to the machine
- Launch the image
- Specify the flavor
  - Compute: intensive CPU workload; CPUs are not oversubscribed
  - Persistent: website-like workload; CPUs are very oversubscribed; enough redundancy to keep the system running 24/7
- Attach the volumes
- Specify the floating IP
- Specify the network security settings
- Login into the machine
- Do the admin tasks
  - Update to the latest
- Take snapshots
- Soft/hard reboot
- Shutdown
- Terminate

HOW TO DEPLOY SERVICES ON OPENSTACK

- GUI – Dashboard
  - Specify the requirements and launch the VM from the GUI
  - Log into the machine
  - Follow the usual admin tasks to deploy your services
- CLI – OpenStack client
  - Install openstack client on the machine
  - Get and source the RC file
  - Specify the requirements and launch via command line
  - Log into to the machine
  - Follow the usual admin tasks to deploy your services

Both are tedious for large deployments

- GUI and/or CLI with cloud-init
  - **Automation of the admin tasks - configuration**
- GUI and/or CLI with heat or any other orchestration tool
  - **Automation and the orchestration of many resources – configuration and orchestration**

The configuration management or/and deployment automation tools such as Ansible, Chef, Fabric, Puppet, SaltStack, Terraform can be used with the above

HANDS-ON CHALLENGES

Fly above the cloud ☺

CHALLENGE 1
EMBRACE THE DASHBOARD

- Login into https://arbutus.computecanada.ca
  - Use your specific wgtrainingXX userID and the password provided during the session
- Click on the tabs and associate the name to the content
  - Compute
  - Volume
  - Network
  - Orchestration
  - Identity
  - API Access
- Setup ssh key pair

CHALLENGE 2
THE BEAUTY OF THE CLOUD

- Prepare a bootable volume of 50 GB with Ubuntu 18.04 as image
- Launch the instance
  - Choose a name – use your name or userID to name your instance
  - Choose the volume you create
  - Specify the flavor c4-15gb-83
  - Use your public ssh key or create a new ssh pair and use that
  - Click ‘launch instance’
- Check the instance by clicking on it, and see console and logs
- Assign a floating IP to it
- Check the network security settings
- If you want, you can create a small volume and attach it to your machine
- ssh to the machine and install the latest updates
- Play with the machine
- You can do many admin tasks on the machine from the dashboard
  - Create a snapshot for it but we will not do it
  - Soft or hard reboot it
  - Shut it down
  - Delete it

CHALLENGE 3: ATTACHING A VOLUME ENJOY THE SYSTEM ADMIN TASKS

- Create a small volume - 10 GBs from the Volumes tab
- Attach the volume to your running instance
- Go the machine – via ssh
- Check whether you see the device using
  - sudo fdisk -l
  - Look in /dev/vd*
- Partition the disk
  - sudo fdisk /dev/vdc
- Create ext4 file system
  - sudo mkfs.ext4 /dev/vdc1
- Make a directory for mounting the device
  - sudo mkdir /data
- Mount it
  - sudo mount /dev/vdc1 /data
- Check it
  - df –hT
- Make directory for ubuntu user
  - sudo mkdir /data/ubuntu
  - sudo chown ubuntu.ubuntu -R /data/ubuntu
  - ln -sf /data/ubuntu data

CHANGE 4: RUNNING SERVICES TOWARDS DOCKERS

- Login into your instace
- Install docker
  - sudo apt update
  - sudo apt install docker.io
- Add user to docker group
  - sudo usermod -aG docker Ubuntu
- Logout and login again
- Start docker services and enable its startup at boot
  - sudo systemctl start docker
  - sudo systemctl enable docker
- Check that docker is running
  - docker info or docker --version

CHANGE 5: CLI TOWARDS MEDIUM DEPLOYMENTS

- Install openstack client
  - sudo apt install python
  - sudo apt install
  - sudo apt install python-dev python-pip
  - sudo pip install python-openstackclient
- Download OpenStack RC v3 from API Access
- Source it
- Use openstack command to do the following:
  - List instances
  - List volumes
  - List images
  - Show details of your instance
- Can you reboot the instance from CLI?

QUIZ AND CHAT

QUESTIONS

- List the OpenStack services and what they are for?
- Why should we use clouds?
- What's cloud computing?
- What cloud service model OpenStack offers?
- What's the different between Compute and persistent flavors?
- What's the difference between persistent and ephemeral volumes?
- What's the process to use CLI in OpenStack?
- Give some examples for workloads for which you should use the cloud?

RESOURCES

- https://docs.openstack.org
- https://docs.computecanada.ca/wiki/Cloud
- https://docs.computecanada.ca/wiki/Automating_VM_creation
- https://www.redhat.com/en/topics/cloud