Computing solutions at EP-NU

How computing infrastructure evolved at CERN?



Cloud computing

Cloud computing is the delivery of on-demand computer system resources, as data storage or computing power, without direct active management by the user.



Computing possibilities at CERN

Focused on EP-NU resources for high intensive computing.

Computing resources

GPU resources on OpenStack

Clusters in the CERN cloud container service have built-in support to detect and configure NVIDIA GPUs.

EP-NU Techlab

Physical server with 4 NVIDIA GPUs

Kubeflow (Kubernetes)

Is designed to make running Machine Learning workflows on Kubernetes clusters simpler and more coordinated



CERN Virtualization

OpenStack allows users to create on-demand Virtual Machines on the CERN cloud infrastructure.



1. CERN OpenStack

EP-NU Stack: https://openstack.cern.ch/project/ openstack.

openstack.

OpenStack allow us to create Virtual Machines (VM) ondemand using one of the CERN operative system images or your own image.



openstack.

OpenStack allow us to create Virtual Machines (VM) ondemand using one of the CERN operative system images or your own image.

🖸 openstack	■ EP-	NU Stack 🝷											Tools -
Project	Proj	ect / Compute	e / Instances										
API Access													
Compute	In	Instances											
Overview													
Instances	INS			ANCE ID = - FILTER			▲ LAUNCH INSTANCE			DELETE INSTANCES MORE A		S MORE ACTIONS -	
Images	Displ	aying 4 items											
Key Pairs		Instance Name	Image Name	IP Address	Flavor	Key Pair	Status		Availability Zone	Task	Power State	Time since	Actions
Volumes												created	
Container Infra		epnu-test-0 1	epnu-default-c entos7	188.184.99.153 2001:1458:d00:3a::100:438	m2.small	mjrodrig- Mac	Active	÷	cern- geneva-b	None	Running	6 days, 14 hours	CREATE SNAPSHOT +
Orchestration		epnu-radi		188.184.97.202 2001:1458:d00:39::100:4a3	m2.medium	mjrodrig- Mac	Active	ô	cern- geneva-a	None	Running	6 days, 20 hours	CREATE SNAPSHOT *
Share		epnu-gpu01	-	188.184.195.175 2001:1458:301:72::100:3ad	g112.xlarge	mjrodrig- Mac	Active	ô	none	None	Running	1 week, 2 days	CREATE SNAPSHOT +
Identity		EPNU-OS-Wi nVM	-	188.185.112.246 2001:1458:d00:a::100:f0	m2.large	-	Active	ô	cern- geneva-a	None	Running	2 months, 3 weeks	CREATE SNAPSHOT *
Workflow	Displ	aying 4 items											

openstack.

OpenStack allow us to create Virtual Machines (VM) ondemand using one of the CERN operative system images or your own image.

aunch Instance		×
Details	Please provide the initial hostname for the instance, the availability zone where the instance count. Increase the Count to create multiple instances with the sa	e it will be deployed, and or the settings.
Source *	Instance Name *	Total Instances
_ •	my-test-vm	(30 Max)
Flavor	Description	17%
Key Pair	This is a test VM on OpenStack	
Configuration	Availability Zone	4 Current Usage 1 Added
	Any Availability Zone	25 Remaining
Metadata	Count *	
	1	
× CANCEL	← BACK NEXT →	▲ LAUNCH INSTANCE

OpenStack allow us to create Virtual Machines (VM) ondemand using one of the CERN operative system images or your own image.

Tutorial: https://clouddocs.web.cern.ch/index.html

> **EP-NU** custom image with some common tools included

Launch Instance								×
Details	Instance source is f instance (image sn persistent storage l	the template used to create a apshot), a volume or a volum oy creating a new volume.	n instan e snapsl	ce. You car not (if enab	n use an ima Iled). You ca	age, a sna an also ch	pshot of an oose to use	?
Source	Select Boot Source			Create Ne	ew Volume			
Flavor *	Image		•	YES	NO			
Key Pair	Allocated							
	Name	Updated	Size	Тур	е	Visibility	/	
Configuration		Select an item	from Av	ailable iter	ns below			
Metadata	~ Availabl	e 📧					Selec	ct one
	۹ Click her	e for filters.						×
	Name		Updat	ed	Size	Туре	Visibility	
	> CC7 TEST - x8	6_64 [2020-10-14]	10/14 PM	/20 7:39	4.00 GB	raw	Public	^
	> C8 TEST - x86_	.64 [2020-10-14]	10/14 PM	/20 7:39	4.00 GB	raw	Public	*
	• epnu-default-c	entos7	10/12 PM	/20 6:31	0 bytes	qcow2	Private	*
	> epnu-gpu defa	ult	10/12, PM	/20 5:59	0 bytes	qcow2	Private	^
	> CC7 - x86_64 [2020-10-01]	10/1/2 PM	20 12:11	4.00 GB	raw	Public	^
	> C8 - x86_64 [2	020-10-01]	10/1/2 PM	20 12:12	4.00 GB	raw	Public	^
	CernVM 4 - Bo 4-09]	otloader v2020.04-1 [2020-0	4/14/2 PM	20 2:07	24.06 MB	raw	Public	•
	CernVM 3 - Bo	otloader v2020-04-1 [2020-	4/14/2 PM	20 2:08	24.06 MB	raw	Public	^

OpenStack allow us to create Virtual Machines (VM) ondemand using one of the CERN operative system images or your own image.

Tutorial: https://clouddocs.web.cern.ch/index.html

Launch Instance								×
Details	Flavors manage	the sizing f	or the comp	ute, memory :	and storage cap	acity of the instance.		?
Source	Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public	0
Flavor			Select	t an item fron	n Available items	below		
Key Pair	✓ Availa	ble 🕢					Selec	ct one
Configuration	۹ Click I	Click here for filters.						
Metadata	Name	VCPUS	RAM	Total Disk	Root Disk	Ephemeral Disk	Public	
	> m2.large	4	7.32 GB	40 GB	40 GB	0 GB	Yes	^
	> m2.small	1	1.83 GB	10 GB	10 GB	0 GB	Yes	\uparrow
	m2.mediu m	2	3.66 GB	20 GB	20 GB	0 GB	Yes	1
	g112.xlarg e	4	15.63 GB	80 GB	80 GB	0 GB	No	\uparrow

openstack.

openstack.

OpenStack allow us to create Virtual Machines (VM) ondemand using one of the CERN operative system images or your own image.

Launch Instance			×
Details	A key pair allows you to S a key pair, or generate a n	SH into your newly created instance. You may select an exis new key pair.	ting key pair, import 🥐
Source	+ CREATE KEY PAIR	1 IMPORT KEY PAIR	
Flavor	Allocated		
Key Pair	Name	Fingerprint	
Configuration	> mjrodrig-Mac	64:92:cb:75:4d:f6:56:88:95:e4:34:ba	4
Metadata	Displaying 1 item		
included	✓ Available		Select one
	۹ Click here for	filters.	×
	Displaying 5 items		

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Tutorial: https://clouddocs.web.cern.ch/index.html

openstack.

Launch Instance



× CANCEL

This step allows you to add Metadata items to your instance

You can specify resource metadata by moving items from the left column to the right column. In the left column there are metadata definitions from the Glance Metadata Catalog. Use the "Custom" option to add metadata with the key of your choice.

X

(?

Available Metadata Existing Metadata landb-mainuser mjrodrig ✓ LanDB landb-responsible mirodrig LanDB Alias + LanDB Description + LanDB Internet Connectivity + LanDB IPv6 Ready LanDB OS + LanDB OS Version + LanDB Main User (landb-mainuser) Primary user of the virtual machine **4** LAUNCH INSTANCE ← BACK NEXT →

2. GPU services on OpenStack

EP-NU Stack: https://openstack.cern.ch/project/ openstack. **INVIDIA**.



188.184.195.175

2001:1458:301:72::100:3ad

g112.xlarge

We have been granted with **ONE** GPU instance on OpenStack

 Access is granted by e-group:
 epnu-comp

 Self-subscription policy Use virtual environments for python developments

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	ulu			IIIIEIIL.
	9			

Access through ssh

epnu-gpu01



We have been granted with **ONE** GPU instance on OpenStack

- Reserved to the most exotic computing tasks
- Shared resource.
 Pay attention to others' work!

u-gpu01 -	188.184.195.175 2001:1458:301:72::100:3ad	g112.xla
mjrodrig@epnu-gpu01 ~]\$ nvidia-smi		
Non Oct 19 11:01:52 2020	: 455.23.05 CUDA Version: 1	+ l1.1
GPU Name Persistence-MI Bus-Id Fan Temp Perf Pwr:Usage/Capl I	Disp.A Volatile Unco Memory-Usage GPU-Util Con 	orr. ECC npute M. MIG M.
0 Tesla T4 Off 000000 N/A 64C P0 31W / 70W 0 	00:00:05.0 Off MiB / 15109MiB 4% 	0 Default N/A
Processes: GPU GI CI PID Type Pro ID ID	cess name GPL Uso	J Memory age
No running processes found		

3. Kubeflow

CERN Machine Learning platform: https://ml.cern.ch*

Kubeflow

*The service is still in an experimental stage.

Kubeflow



Kubeflow is a machine learning framework that easy the common machine learning workflow in a kubernetes environment.

í Kubeflow	mjrodrig-personal (owner) ▼							
Home	Dashboard Activity							
Pipelines	Quick shortcuts	Recent Notebooks	Documentation					
Notebook Servers	Upload a pipeline Pipelines	No Notebooks in namespace mjrodrig-personal	Getting Started with Kubeflow Get your machine-learning workflow up and running on Kubeflow	Z				
	View all pipeline runs Pipelines	Recent Pipelines	MiniKF A fast and easy way to deploy Kubeflow locally	Z				
Artifact Store	Create a new Notebook server Notebook Servers	Error retrieving Pipelines	Microk8s for Kubeflow Quickly get Kubeflow running locally on native	Ø				
Manage Contributors	4 View Katib Studies Katib	Recent Pipeline Runs	Minikube for Kubeflow Quickly get Kubeflow running locally	ß				
GitHub ¹²								

More details on Dejan's talk: https://indico.cern.ch/event/961276

Kubeflow



Advance features:

- Various Frameworks
 - Tensorflow, PyTorch, MPI
- Jupyter Notebooks
- Machine Learning Pipelines
- Katib Hyper-parameter
 Optimization
- KALE Notebooks to
 Pipelines or Katib
- Fairing High level API



Kubeflow documentation: https://www.kubeflow.org/docs/about/kubeflow/

Live demo: https://ml.cern.ch

4. EP-NU techlab server

EP-NU Techlab server

The server was hosted at CERN Computing center. The server is working however it reached its end of life (in terms of warranty).

We **will** place it in a rack borrowed from EP-DT-DI



