



University of Zurich^{UZH}

High Performance Computing | Lecture 9

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Cloud
Computing



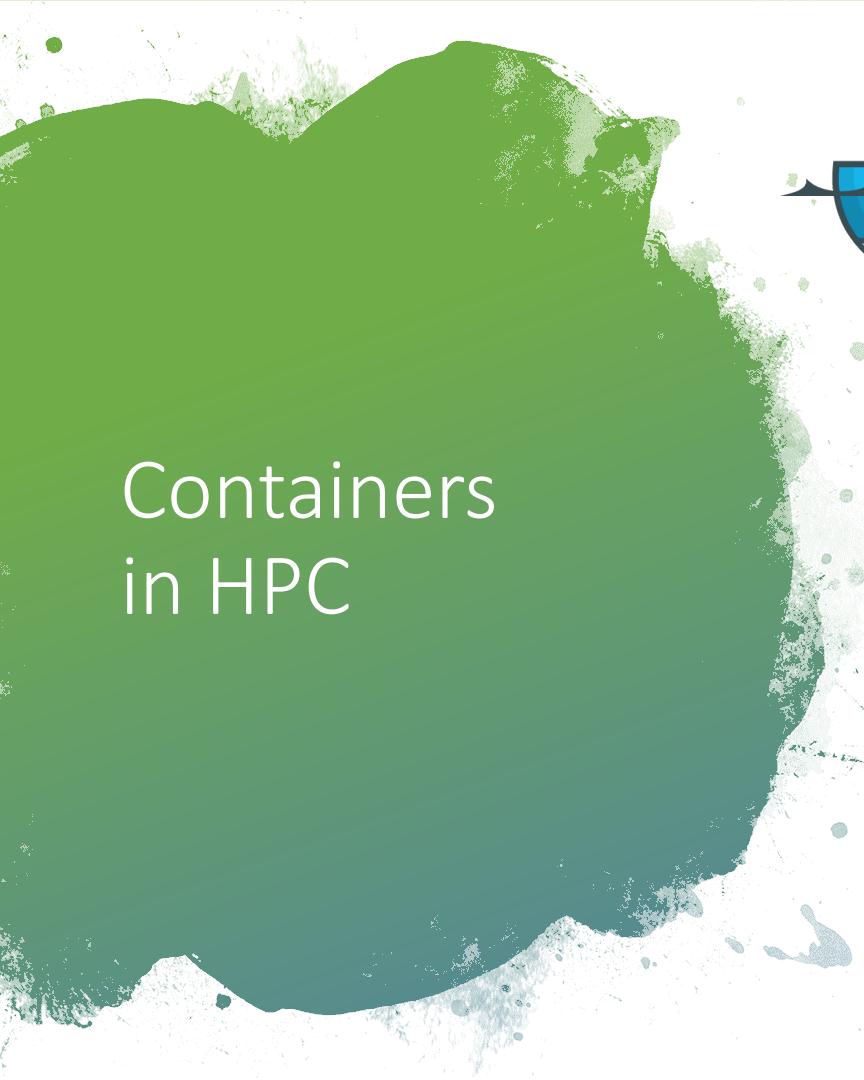
Google Cloud



openstack®



High Performance Computing



Containers
in HPC



Singularity



SHIFTER



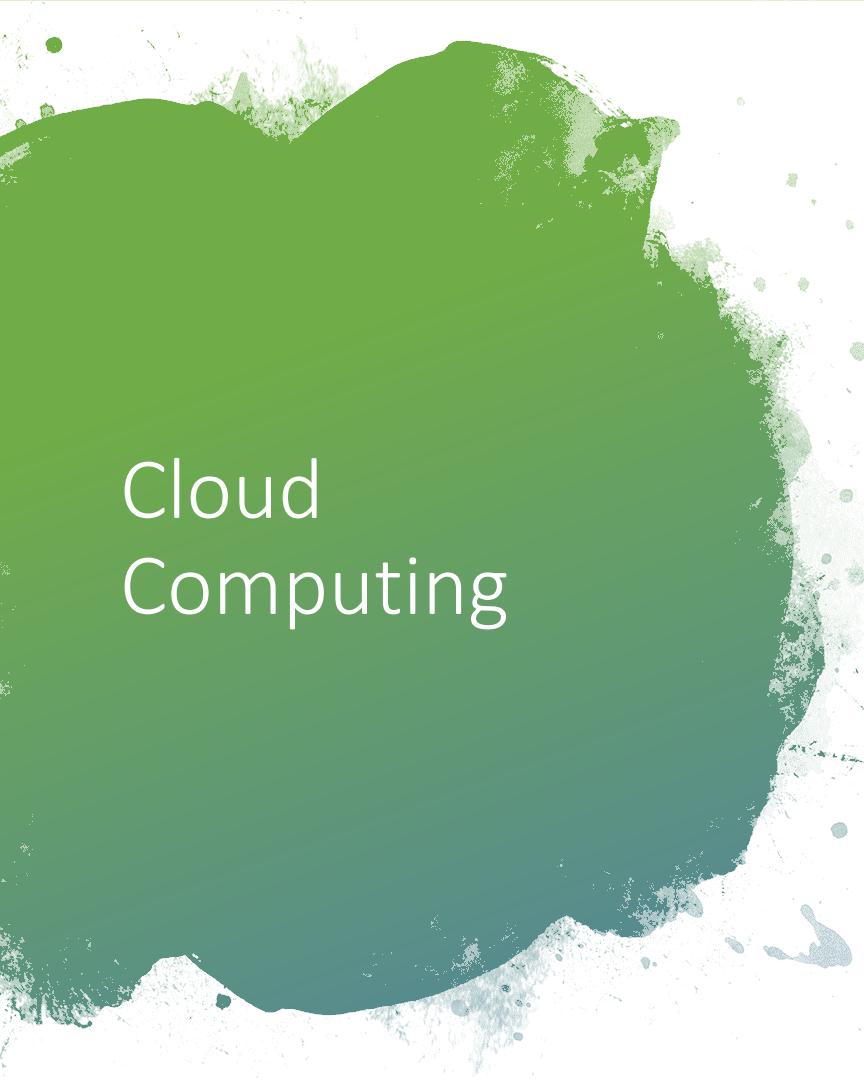
Anything as a Service (XaaS)

Infrastructure as a Service (IaaS)

- Data Centres (cooled rooms) are expensive to build and operate
- There is economy of scale
- Data centres can be large and remote
- Servers are “Virtualized”

Containers as a Service (Caas)

- The same principle, but for containers
- What is a container? More later.



Cloud
Computing



Google Cloud



openstack®



High Performance Computing



Cloud
Computing

openstack®



aws

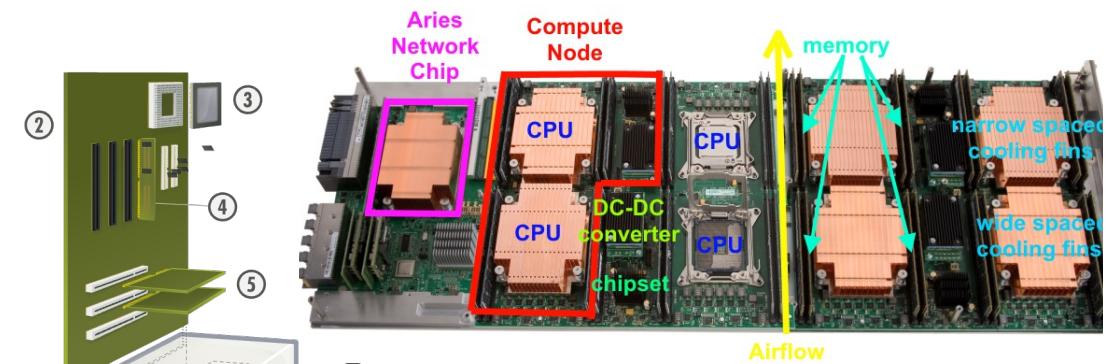


Google Cloud



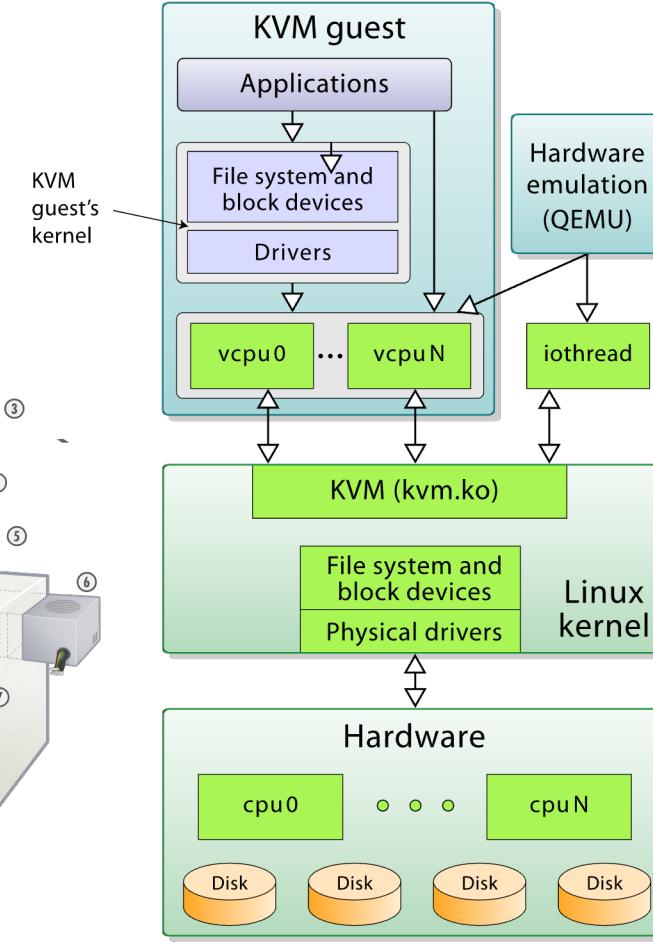
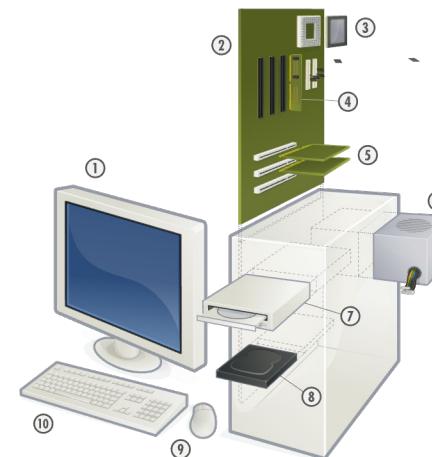
Azure

High Performance Computing



Hardware Components

What is a Virtual Machine (VM)





Login

uZH Login - ScienceCloud Dashboard +

← → ⌛ ⌂ ⌄ https://cloud.s3it.uzh.ch/auth/login/?next=/ ... ⌁ ⌂ ⌃ ⌅ ⌆



ScienceCloud

Log in

User Name

Password

By logging into ScienceCloud you accept the following [usage policies](#)

Connect

High Performance Computing



UZH Instance Overview - ScienceCloud

esc401.ics.mnf.uzh.ch

dpotte

Project COMPUTE Overview Instances Volumes Images Access & Security NETWORK OBJECT STORE Identity

Overview

Limit Summary

Resource	Total Limit	Used	Status
Instances	20	0	Used 0 of 20
VCPUs	320	0	Used 0 of 320
RAM	1,310,720	0	Used 0 of 1,310,720
Floating IPs	10	0	Used 0 of 0
Security Groups	10	1	Used 1 of 10
Volumes	10	0	Used 0 of 10
Volume Storage	1,000	0	Used 0 of 1,000

Usage Summary

Select a period of time to query its usage:

From: To: Submit The date should be in YYYY-mm-dd format.

Active Instances: 0 Active RAM: 0Bytes This Period's VCPU-Hours: 0.16 This Period's GB-Hours: 4.03 This Period's RAM-Hours: 644.44

Usage

Download CSV Summary Download Juju Environment File

Instance Name	VCPUs	Disk	RAM	Time since created
No items to display.				



UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ dpotte

ScienceCloud esc401.ics.mnf.uzh

Project COMPUTE Instances Volumes Images Access & Security NETWORK OBJECT STORE Identity

Instances

Instance Name = Filter Launch Instance

Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
No items to display.										

Instances



Instance Name

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ esc401.ics.mnf.uzh Project COMPUTE NETWORKS OBJECT ST... Identity

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 * dpotte_test

Availability Zone nova

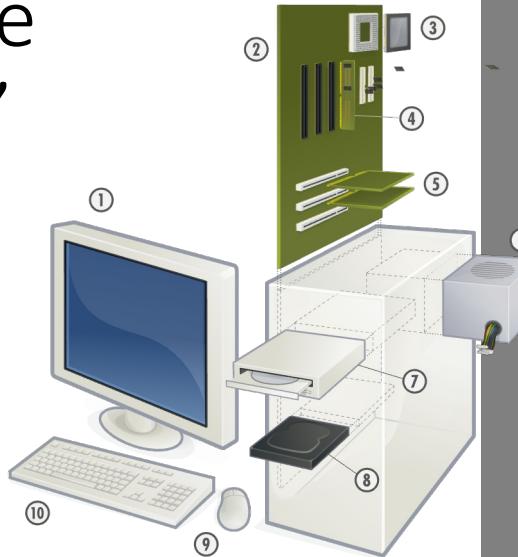
Count * 1

Total Instances (20 Max) 5%
0 Current Usage
1 Added
19 Remaining

Cancel Back Next Launch Instance



Source “Disk”



UZH Instances - ScienceCloud Dash X + https://cloud.s3it.uzh.ch/project/instances/ dpote

ScienceCloud esc401.ics.mnf.uzh Project COMPUTE NETWORK OBJECTS Identity

Launch Instance

Details

Source *

Flavor *

Networks

Network Ports

Security Groups

Key Pair

Configuration

Metadata

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

Select Boot Source Create New Volume

Image Yes No

Select a source from those listed below.

Available 23 Select one

ubuntu

Name	Updated	Size	Type	Visibility	Action
***CUDA 10.2 on Ubuntu 18.04 (2020-03-27)	3/31/20 1:57 AM	100.00 GB	RAW	Public	[+]
***Matlab-R2019b Ubuntu 18.04 (2019-09-30)	4/1/20 2:27 PM	100.00 GB	RAW	Public	[+]
***Ubuntu 16.04 (2020-03-27)	3/31/20 1:05 AM	100.00 GB	RAW	Public	[+]
***Ubuntu 18.04 (2020-03-27)	3/31/20 1:05 AM	100.00 GB	RAW	Public	[+]
CUDA 10.1 on Ubuntu 18.04 (2019-12-06)	3/31/20 1:04 AM	100.00 GB	RAW	Public	[+]
Mathematica 11 - ubuntu 16.04 x86_64 - (2016-08-18)	5/22/17 9:23 AM	100.00 GB	RAW	Public	[+]
Matlab-R2016b - ubuntu 16.04.1 (2016-11-02)	5/22/17 9:23 AM	100.00 GB	RAW	Public	[+]
Matlab-R2019a Ubuntu 18.04 (2019-07-24)	7/25/19 2:47 PM	100.00 GB	RAW	Public	[+]



Source “Ubuntu”

UZH Instances - ScienceCloud Dash X + https://cloud.s3it.uzh.ch/project/instances/ ... dpotte v

ScienceCloud esc401.ics.mnf.uzh Project COMPUTE NETWORKS OBJECT ST... Identity

Launch Instance

Details Source

Flavor * Networks Network Ports Security Groups Key Pair Configuration Metadata

Select Boot Source Create New Volume

Image Yes No

Allocated

Name	Updated	Size	Type	Visibility	-
> ***Ubuntu 18.04 (2020-03-27)	3/31/20 1 0:51 AM	100.00 G B	RAW	Public	[]

Available 22 Select one

ubuntu

Name ^	Updated	Size	Type	Visibility	+
> ***CUDA 10.2 on Ubuntu 18.04 (2020-03-27)	3/31/20 1 1:57 AM	100.00 G B	RAW	Public	[+]
> ***Matlab-R2019b Ubuntu 18.04 (2019-09-30)	4/1/20 2:27 PM	100.00 G B	RAW	Public	[+]
> ***Ubuntu 16.04 (2020-03-27)	3/31/20 1 0:51 AM	100.00 G B	RAW	Public	[+]
> CUDA 10.1 on Ubuntu 18.04 (2019-12-06)	3/31/20 1 0:44 AM	100.00 G B	RAW	Public	[+]
> Mathematica 11 - ubuntu 16.04 x86_64 - (2016-08-18)	5/22/17 9:23 AM	100.00 G B	RAW	Public	[+]
> Matlab-R2016b - ubuntu 16.04.1 (2016-11-02)	5/22/17 9:23 AM	100.00 G B	RAW	Public	[+]
> Matlab-R2019a Ubuntu 18.04 (2019-07-24)	7/25/19 2:47 PM	100.00 G B	RAW	Public	[+]
> Ubuntu 16.04 (2019-12-06)	3/31/20 1 0:44 AM	100.00 G B	RAW	Public	[+]



Flavor “Hardware”



UZH Instances - ScienceCloud Dash X + https://cloud.s3it.uzh.ch/project/instances/ dpote

ScienceCloud esc401.ics.mnf.uzh Project COMPUTE NETWORK OBJECTS Identity

Launch Instance

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

Source

Allocated

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

Available 25 Select one

Name	VCPUS	RAM	Total Disk	Public
1cpu-4ram-hpcv3	1	3.91 GB	100 GB	Yes
2cpu-8ram-hpcv3	2	7.81 GB	100 GB	Yes
4cpu-16ram-hpcv3	4	15.63 GB	100 GB	Yes
8cpu-32ram-hpcv3-gpuT4	8	31.25 GB	100 GB	Yes
8cpu-32ram-hpcv3	8	31.25 GB	100 GB	Yes
16cpu-64ram-hpcv3	16	62.5 GB	100 GB	Yes
16cpu-64ram-hpcv3-gpuT4	16	62.5 GB	100 GB	Yes
32cpu-128ram-hpcv3-gpuT4	32	122.07 GB	100 GB	Yes
32cpu-128ram-hpcv3	32	125 GB	100 GB	Yes

Cancel Back Next Launch Instance



Flavor
8 cores
32 GB RAM

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/

ScienceCloud esc401.ics.mnf.uzh

Project COMPUTE NETWORKS OBJECT STORE Identity

Launch Instance

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

Source

Allocated

Name	VCPUS	RAM	Total Disk	Public
8cpu-32ram-hpcv3	8	31.25 GB	100 GB	Yes

Available 24 Select one

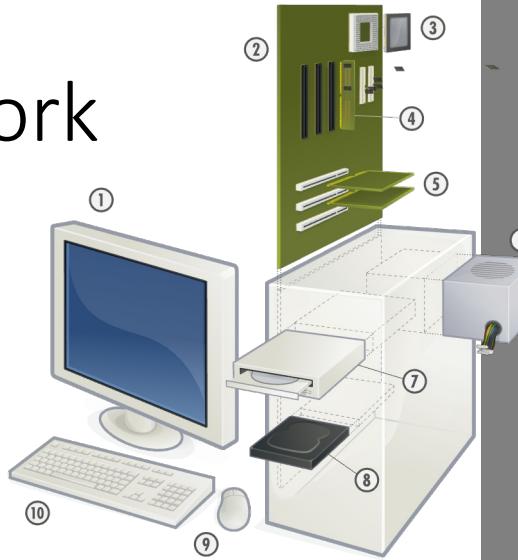
hpcv3

Name	VCPUS	RAM	Total Disk	Public
1cpu-4ram-hpcv3	1	3.91 GB	100 GB	Yes
2cpu-8ram-hpcv3	2	7.81 GB	100 GB	Yes
4cpu-16ram-hpcv3	4	15.63 GB	100 GB	Yes
8cpu-32ram-hpcv3-gpuT4	8	31.25 GB	100 GB	Yes
16cpu-64ram-hpcv3	16	62.5 GB	100 GB	Yes
16cpu-64ram-hpcv3-gpuT4	16	62.5 GB	100 GB	Yes
32cpu-128ram-hpcv3-gpuT4	32	122.07 GB	100 GB	Yes
32cpu-128ram-hpcv3	32	125 GB	100 GB	Yes

* Cancel < Back Next > Launch Instance



Network



UZH Instances - ScienceCloud Dash X + https://cloud.s3it.uzh.ch/project/instances/ dpote

ScienceCloud esc401.ics.mnf.uzh Project COMPUTE NETWORKS OBJECT STORE Identity

Launch Instance

Launch Instance Actions

Allocated 1 Select networks from those listed below.

Network	Shared	Admin State	Status
1 uzh-only	Yes	Up	Active

Available 0 Select at least one network.

Network	Shared	Admin State	Status
No available items			

Cancel Back Next Launch Instance



Key Pair

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/

ScienceCloud esc401.ics.mnf.uzh

Project COMPUTE NETWORK OBJECT STORE Identity

Launch Instance

Details 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.

Source + Create Key Pair Import Key Pair

Flavor

Allocated Networks

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

Network Ports

Security Groups

Key Pair Available 2 Select one

Configuration

Metadata

Name Fingerprint

dpotter normal access 8e:3d:16:00:9b:2e:d6:c5:bf:a0:1c:7b:85:86:db:f1 +

dpotter secure access 16:62:c8:f9:44:3a:37:f3:22:2b:91:92:4d:08:22:fb +

Cancel Back Next Launch Instance

Launch Instance Actions



Key Pair

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ esc401.ics.mnf.uzh Project COMPUTE NETWORKS OBJECT STORE Identity

Launch Instance

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.

Details

Source

Flavor

Allocated

Name

dpotter normal access

Available 1 Select one

Key Pair

Configuration

Metadata

Name **Fingerprint**

dpotter secure access 16:62:c8:f9:44:3a:37:f3:22:2b:91:92:4d:08:22:fb

Cancel **Back** **Next >** **Launch Instance**

Launch Instance Actions



Import Key

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ esc401.ics.mnf.uzh Project COMPUTE Instances Actions

Import Key Pair

Key Pairs are how you login to your instance after it is launched. Choose a key pair name you will recognize and paste your SSH public key into the space provided.

Key Pair Name *

my ssh key

Public Key *

ssh-rsa
AAAAAB3NzaC1yc2EAAAQABAAQDXg8Y1vXAMkYpQM09lOXDI5tD001i1zo8u4rZgQJSNT07X6h2dCp/em
iS2rLhBM33Auaw2vW+AmRoBUJZelQvcFewdRYpBmd2B7M4eko3WitElc7bYuQAhsBU2WGpYad8h4Jne
/zsAA4HQupVXuRjsHGvxR
//IQOgK0privnCbiMyuYeHMdKFJsNHGWkQWj2KeCzAsJyzoYnFKj8K9ZL93l+RHtBHGHq4kslvp9O2j9unY5c63lqYb
qfWDc2uLHgX54ggk210lHpvM20m2B8uQdEYsveOqy0kAB05y1gvUdzFXcvqpVDViLQRwsPCOSZjnbumuY0RV3l3kc
grmpb3 username@machinename

Cancel Import Key Pair



Import Key

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ esc401.ics.mnf.uzh Project COMPUTE NETWORKS OBJECT ST... Identity

Launch Instance

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.

Details * Source * Flavor *

+ Create Key Pair Import Key Pair

Allocated

Name my ssh key

Available 2 Select one

Filter

Name	Fingerprint
dpotter normal access	8e:3d:16:00:9b:2e:d6:c5:bf:a0:1c:7b:85:86:db:f1
dpotter secure access	16:62:c8:f9:44:3a:37:f3:22:2b:91:92:4d:08:22:fb

Cancel Back Next Launch Instance

The screenshot shows a web-based cloud management interface for the ScienceCloud service at the University of Zurich. The main navigation bar includes links for 'Project', 'Compute' (selected), 'Networks', 'Object Storage', 'Identity', and 'Actions'. A sub-menu for 'Identity' is open, showing options like 'Key Pair' (selected), 'Configuration', and 'Metadata'. A modal window titled 'Launch Instance' is displayed, prompting the user to select a key pair for SSH access. It lists two available key pairs: 'dpotter normal access' and 'dpotter secure access', each with its corresponding SHA-256 fingerprint. Buttons for creating a new key pair or importing an existing one are also present.



UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/

esc401.ics.mnf.uzh ▾ dpotte

Project ▾

COMPUTE ▾

Instances

Overview

Volumes

Images

Access & Security

NETWORK >

OBJECT STORE >

Identity >

Instances

Instance Name = Filter Launch Instance

Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since creation	
dpotte_test	***Ubuntu 18.04 (2020-03-27)	172.23.22.125	8cpu-32ram-hpcv3	dpotte	normal access	Build	nova	Spawning	No State	0 min

Displaying 1 item

Launching Instance



UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/

esc401.ics.mnf.uzh Project COMPUTE Instances Overview Volumes Images

Access & Security NETWORK OBJECT STORE Identity

Instances

Instance Name = Filter Launch Instance Delete !

Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since create
dpotte_test	***Ubuntu 18.04 (2020-03-27)	172.23.22.125	8cpu-32ram-hpcv3	dpotter normal access	Active	nova	None	Running	0 min

Displaying 1 item

Launch Instance



Launch Instance

UZH Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ esc401.ics.mnf.uzh dpotte

ScienceCloud

Instances

Instance Name = Filter Launch Instance Delete Instances More Actions

Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
dpotte_test	***Ubuntu 18.04 (2020-03-27)	172.23.22.125	8cpu-32ram-hpcv3	dpotter	normal access	Active	nova	None	Running 0 minutes	Create Snapshot

Displaying 1 item

Associate Floating IP
Attach Interface
Detach Interface
Edit Instance
Update Metadata
Edit Security Groups
Console
View Log
Pause Instance
Suspend Instance
Shelve Instance
Resize Instance
Lock Instance
Unlock Instance
Soft Reboot Instance
Hard Reboot Instance
Shut Off Instance
Rebuild Instance
Delete Instance



Login!

(VPN needed)

```
dhcp-94-183:~$ ssh ubuntu@172.23.22.125
The authenticity of host '172.23.22.125 (172.23.22.125)' can't be established.
EDSA key fingerprint is SHA256:j6Cszsmbf9VfgDXXhr+p4YInyGoZeljq/pPm6LL0Rxo.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '172.23.22.125' (EDSA) to the list of known hosts.
Warning: No xauth data; using fake authentication data for X11 forwarding.
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 4.15.0-91-generic x86_64)

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

System information as of Thu Apr 16 14:12:54 UTC 2020

System load: 0.0          Processes:      149
Usage of /: 1.2% of 96.75GB  Users logged in:  0
Memory usage: 0%           IP address for ens3: 172.23.22.125
Swap usage:  0%

* Kubernetes 1.18 GA is now available! See https://microk8s.io for docs or
install it with:

    sudo snap install microk8s --channel=1.18 --classic

* Multipass 1.1 adds proxy support for developers behind enterprise
firewalls. Rapid prototyping for cloud operations just got easier.

https://multipass.run/

0 packages can be updated.
0 updates are security updates.
```

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.

```
Last login: Fri Mar 27 15:39:56 2020 from 172.23.255.1
/usr/bin/xauth:  file /home/ubuntu/.Xauthority does not exist
ubuntu@dpotte-test:~$
```



VPN Instructions

UZH - Knowhow Datenbank - E +

Universität Zürich » ZI Home » Support » Netzwerk » Externer Zugang zum Netz (VPN)

Home | Kontakt | Sitemap | Google Suche

Universität
Zürich^{UZH}

Zentrale Informatik – Support

▲ ZI Home

Audio/Video-Infrastruktur

Beratung, Support, Schulung

E-Mail und Kollaboration

eLearning und Prüfungsunterstützung

Geschäftsapplikationen

Identität und Zugang

IT Arbeitsplatz

Kommunikation und Telefonie

Netzwerk

Externer Zugang zum Netz (VPN)

Mobilgeräte

Kabel-Verbindung (LAN)

Drahtlos-Verbindung (WLAN)

eduroam

Richtlinien, Anweisungen, Vorschriften

Visuelle Gestaltung und Video & Multimedia

Web- und Applikations-Hosting

Externer Zugang zum Netz (VPN)

Authentifizierung ist nicht gleich Verschlüsselung. An öffentlichen Netzwerken authentifizieren Sie sich zwar mit einem Passwort, der Datenverkehr verbleibt jedoch unverschlüsselt. Mittels einer "UZH Virtual Private Network (VPN)-Verbindung" werden öffentliche Verbindungen verschlüsselt, sodass UZH-Angehörige, außerhalb der UZH-Gebäude, sicheren Zugriff auf das UZH-Netz haben, gerade so, als sässen sie mittendrin, gerade so, als würden sie sich direkt mit dem UZH-Netzwerk verbinden.

Für eine VPN-Verbindungsherstellung benötigen Sie keine zusätzliche Software, sondern lediglich eine bestehende Internet-Verbindung, sowie zusätzlich, wie nachfolgend schrittweise beschrieben, eine mit UZH-spezifischen (Verschlüsselungs-)Parametern konfigurierte aktive Netzwerk-Verbindung. Alternativ zur manuellen VPN-Konfiguration, stellt Ihnen die Zentrale Informatik hier ein Setup-Programm zur automatisierten VPN-Konfiguration unter Windows (Versionen 7 / 8 / 10) zur Verfügung.

show all

Windows - Automatische VPN-Konfiguration

1.) Konfigurationsdatei herunterladen

2.) Konfigurationsdatei ausführen

3.) VPN-Verbindung aufrufen

4.) VPN-Verbindung herstellen

... VPN-Verbindung entfernen

Windows - VPN-Konfiguration

1.) "Netzwerk- und Freigabecenter" in der Systemsteuerung aufrufen

2.) "Neue Verbindung oder neues Netzwerk einrichten" auswählen

3.) "Verbindung mit dem Arbeitsplatz herstellen" auswählen

4.) "Die Internetverbindung (VPN) verwenden" auswählen

5.) Internetadresse (Server) und Namen angeben

6.) Benutzerdaten angeben und Assistenten schliessen

7.) (Verbindungs-) Eigenschaften aufrufen

8.) VPN-Typ & Authentifizierung festlegen

9.) Erweiterte Eigenschaften angeben (Gruppenschlüssel)

10.) VPN-Verbindung aufrufen

11.) VPN-Verbindung herstellen

Mac OS X - VPN-Konfiguration

1.) Systemeinstellungen aufrufen

2.) Netzwerkeinstellungen öffnen

3.) Neue Verbindung erstellen



cowsay

```
ubuntu@dpotte-test:~$ cowsay
Command 'cowsay' not found, but can be installed with:
sudo apt install cowsay

ubuntu@dpotte-test:~$ sudo apt update -q
Hit:1 http://nova.clouds.archive.ubuntu.com/ubuntu bionic InRelease
Hit:2 http://nova.clouds.archive.ubuntu.com/ubuntu bionic-updates InRelease
Hit:3 http://nova.clouds.archive.ubuntu.com/ubuntu bionic-backports InRelease
Hit:4 http://security.ubuntu.com/ubuntu bionic-security InRelease
Reading package lists...
Building dependency tree...
Reading state information...
14 packages can be upgraded. Run 'apt list --upgradable' to see them.
ubuntu@dpotte-test:~$ sudo apt install -q cowsay
Reading package lists...
Building dependency tree...
Reading state information...
The following package was automatically installed and is no longer required:
  grub-pc-bin
Use 'sudo apt autoremove' to remove it.
Suggested packages:
  filters cowsay-off
The following NEW packages will be installed:
  cowsay
0 upgraded, 1 newly installed, 0 to remove and 14 not upgraded.
Need to get 17.7 kB of archives.
After this operation, 89.1 kB of additional disk space will be used.
Get:1 http://nova.clouds.archive.ubuntu.com/ubuntu bionic/universe amd64 cowsay all 3.03+dfsg2-4 [17.7 kB]
Fetched 17.7 kB in 0s (115 kB/s)
Selecting previously unselected package cowsay.
(Reading database ... 62219 files and directories currently installed.)
Preparing to unpack .../cowsay_3.03+dfsg2-4_all.deb ...
Unpacking cowsay (3.03+dfsg2-4) ...
Setting up cowsay (3.03+dfsg2-4) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
ubuntu@dpotte-test:~$ cowsay "Moo"
< Moo >
-----
 \  ^__^
  \  (oo)\_____
   (__)\       )\/\
    ||----w |
     ||     ||
```



gcc

```
ubuntu@dpotte-test:~$ gcc
Command 'gcc' not found, but can be installed with:
sudo apt install gcc

ubuntu@dpotte-test:~$ sudo apt install -q gcc cmake make
Reading package lists...
Building dependency tree...
Reading state information...
The following package was automatically installed and is no longer required:
  grub-pc-bin
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  Preparing to unpack .../26-gcc_7.5.0-3ubuntu1~18.04_amd64.deb ...
  Unpacking gcc-7 (7.5.0-3ubuntu1~18.04) ...
  Selecting previously unselected package gcc.
  Preparing to unpack .../27-gcc_4%3a7.4.0-1ubuntu2.3_amd64.deb ...
  Unpacking gcc (4:7.4.0-1ubuntu2.3) ...
  Selecting previously unselected package libc-dev-bin.
  Preparing to unpack .../28-libc-dev-bin_2.27-3ubuntu1_amd64.deb ...
  Unpacking libc-dev-bin (2.27-3ubuntu1) ...
  Selecting previously unselected package linux-libc-dev:amd64.
  Preparing to unpack .../29-linux-libc-dev_4.15.0-96.97_amd64.deb ...
  Unpacking linux-libc-dev:amd64 (4.15.0-96.97) ...
  Selecting previously unselected package libc6-dev:amd64.
  Preparing to unpack .../30-libc6-dev_2.27-3ubuntu1_amd64.deb ...
  Unpacking libc6-dev:amd64 (2.27-3ubuntu1) ...
  Selecting previously unselected package make.
  Preparing to unpack .../31-make_4.1-9.1ubuntu1_amd64.deb ...
  Unpacking make (4.1-9.1ubuntu1) ...
  Selecting previously unselected package manpages-dev.
  Preparing to unpack .../32-manpages-dev_4.15-1_all.deb ...
  Unpacking manpages-dev (4.15-1) ...
  Setting up libquadmath0:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up libgomp1:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up libatomic1:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up libcc1-0:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up make (4.1-9.1ubuntu1) ...
  Setting up libarchive13:amd64 (3.2.2-3.1ubuntu0.6) ...
  Setting up libtsan0:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up linux-libc-dev:amd64 (4.15.0-96.97) ...
  Setting up cmake-data (3.10.2-1ubuntu2.18.04.1) ...
  Setting up librhash0:amd64 (1.3.6-2) ...
  Setting up liblsan0:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up gcc-7-base:amd64 (7.5.0-3ubuntu1~18.04) ...
  Setting up binutils-common:amd64 (2.30-21ubuntu1~18.04.2) ...
  Setting up libmpx2:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up libmpc3:amd64 (1.1.0-1) ...
  Setting up libc-dev-bin (2.27-3ubuntu1) ...
  Setting up manpages-dev (4.15-1) ...
  Setting up libc6-dev:amd64 (2.27-3ubuntu1) ...
  Setting up libitm1:amd64 (8.4.0-1ubuntu1~18.04) ...
  Setting up libisl19:amd64 (0.19-1) ...
  Setting up libjsoncpp1:amd64 (1.7.4-3) ...
  Setting up libasan4:amd64 (7.5.0-3ubuntu1~18.04) ...
  Setting up libbinutils:amd64 (2.30-21ubuntu1~18.04.2) ...
  Setting up libcilkkrts5:amd64 (7.5.0-3ubuntu1~18.04) ...
```



gcc

```
ubuntu@dpotte-test:~
```

Unpacking gcc-7 (7.5.0-3ubuntu1~18.04) ...
Selecting previously unselected package gcc.
Preparing to unpack .../27-gcc_4%3d7.4.0-1ubuntu2.3_amd64.deb ...
Unpacking gcc (4:7.4.0-1ubuntu2.3) ...
Selecting previously unselected package libc-dev-bin.
Preparing to unpack .../28-libc-dev-bin_2.27-3ubuntu1_amd64.deb ...
Unpacking libc-dev-bin (2.27-3ubuntu1) ...
Selecting previously unselected package linux-libc-dev:amd64.
Preparing to unpack .../29-linux-libc-dev_4.15.0-96.97_amd64.deb ...
Unpacking linux-libc-dev:amd64 (4.15.0-96.97) ...
Selecting previously unselected package libc6-dev:amd64.
Preparing to unpack .../30-libc6-dev_2.27-3ubuntu1_amd64.deb ...
Unpacking libc6-dev:amd64 (2.27-3ubuntu1) ...
Selecting previously unselected package make.
Preparing to unpack .../31-make_4.1-9.1ubuntu1_amd64.deb ...
Unpacking make (4.1-9.1ubuntu1) ...
Selecting previously unselected package manpages-dev.
Preparing to unpack .../32-manpages-dev_4.15-1_all.deb ...
Unpacking manpages-dev (4.15-1) ...
Setting up libquadmath0:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up libomp1:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up libatomic1:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up libcc1-0:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up make (4.1-9.1ubuntu1) ...
Setting up libarchive13:amd64 (3.2.2-3.1ubuntu0.6) ...
Setting up libtsan0:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up linux-libc-dev:amd64 (4.15.0-96.97) ...
Setting up cmake-data (3.10.2-1ubuntu2.18.04.1) ...
Setting up librhash0:amd64 (1.3.6-2) ...
Setting up liblsan0:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up gcc-7-base:amd64 (7.5.0-3ubuntu1~18.04) ...
Setting up binutils-common:amd64 (2.30-21ubuntu1~18.04.2) ...
Setting up libmpx2:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up libmpc3:amd64 (1.1.0-1) ...
Setting up libc-dev-bin (2.27-3ubuntu1) ...
Setting up manpages-dev (4.15-1) ...
Setting up libc6-dev:amd64 (2.27-3ubuntu1) ...
Setting up libitm1:amd64 (8.4.0-1ubuntu1~18.04) ...
Setting up libisl19:amd64 (0.19-1) ...
Setting up libjsoncpp1:amd64 (1.7.4-3) ...
Setting up libasan4:amd64 (7.5.0-3ubuntu1~18.04) ...
Setting up libbinutils:amd64 (2.30-21ubuntu1~18.04.2) ...
Setting up libcilkrt5:amd64 (7.5.0-3ubuntu1~18.04) ...
Setting up libubsan0:amd64 (7.5.0-3ubuntu1~18.04) ...
Setting up libgcc-7-dev:amd64 (7.5.0-3ubuntu1~18.04) ...
Setting up cpp-7 (7.5.0-3ubuntu1~18.04) ...
Setting up cmake (3.10.2-1ubuntu2.18.04.1) ...
Setting up binutils-x86-64-linux-gnu (2.30-21ubuntu1~18.04.2) ...
Setting up cpp (4:7.4.0-1ubuntu2.3) ...
Setting up binutils (2.30-21ubuntu1~18.04.2) ...
Setting up gcc-7 (7.5.0-3ubuntu1~18.04) ...
Setting up gcc (4:7.4.0-1ubuntu2.3) ...
Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
Processing triggers for libc-bin (2.27-3ubuntu1) ...
ubuntu@dpotte-test:~\$ gcc
gcc: fatal error: no input files
compilation terminated.
ubuntu@dpotte-test:~\$



Instances - ScienceCloud Dash X +

Instances

Instance Name = Filter Launch Instance Delete Instances More Actions ▾

<input type="checkbox"/> Instance Name	Image Name	IP Address	Size	Key Pair	Status	Availability Zone	Task	Power State	Time since created	Actions
<input type="checkbox"/> dpotte_test	***Ubuntu 18.04 (2020-03-27)	172.23.22.137	8cpu-32ram-hpcv3	dpotter normal access	Active	nova	None	Running	10 minutes	<button>Create Snapshot</button> ▾

Displaying 1 item

Snapshot



Instances - ScienceCloud Dash X +

https://cloud.s3it.uzh.ch/project/instances/ esc401.ics.mnf.uzh.dpotte

ScienceCloud Instances More Actions ▾

Create Snapshot

Snapshot Name * cowsay_with_gcc

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

Cancel Create Snapshot

Displaying 1 item

The screenshot shows a web browser window for the ScienceCloud Instances dashboard. A modal dialog box is open in the center, titled 'Create Snapshot'. It contains a field labeled 'Snapshot Name *' with the value 'cowsay_with_gcc'. To the right of the input field is a section titled 'Description:' with the text: 'A snapshot is an image which preserves the disk state of a running instance.' At the bottom of the modal are two buttons: 'Cancel' and 'Create Snapshot'. In the background, the main dashboard shows a table with one item, 'esc401.ics.mnf.uzh.dpotte', listed under 'Instances'. The table includes columns for 'Instance Name' and 'Access'. The URL in the browser's address bar is 'https://cloud.s3it.uzh.ch/project/instances/'. The overall theme is dark grey with light blue highlights for interactive elements.

Snapshot



Images - ScienceCloud Dashboard

https://cloud.s3it.uzh.ch/project/images/

esc401.ics.mnf.uzh

Project COMPUTE Images

Overview Instances Volumes Images Access & Security NETWORK OBJECT STORE Identity

Project (1) Shared with Me (0) Public (26) + Create Image Delete Images

<input type="checkbox"/>	Image Name	Type	Status	Public	Protected	Format	Size	Actions
<input type="checkbox"/>	cowsay_with_gcc	Snapshot	Queued	No	No		0 bytes	<button>Delete Image</button>

Displaying 1 item

Snapshot



Images - ScienceCloud Dashboard

https://cloud.s3it.uzh.ch/project/images/

esc401.ics.mnf.uzh

Project COMPUTE Images Overview Instances Volumes

Access & Security NETWORK OBJECT STORE Identity

Project (1) Shared with Me (0) Public (26) + Create Image Delete Images

<input type="checkbox"/>	Image Name	Type	Status	Public	Protected	Format	Size	Actions
<input type="checkbox"/>	cowsay_with_gcc	Snapshot	Active	No	No	Raw	100.0 GB	Launch ▾

Displaying 1 item

Snapshot



Snapshot

Images - ScienceCloud Dashbo X + https://cloud.s3it.uzh.ch/project/images/ esc401.ics.mnf.uzh.ch Project COMPUTER NETWORKS OBJECT ST Identity

Launch Instance

Details

Source *

Flavor *

Networks

Network Ports

Security Groups

Key Pair

Configuration

Metadata

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

Select Boot Source

Instance Snapshot

Select Allocated

Name	Updated	Size	Type	Visibility
Select a source from those listed below.				

Available 4 Select one

Click here for filters.

Name	Updated	Size	Type	Visibility
cowsay_with_gcc	4/17/20 1 0:32 AM	100.00 G B	RAW	Private
Matlab-R2017b - ubuntu 16.04.3 (2017-10-06)	4/1/20 9:0 1 AM	100.00 G B	RAW	Public
Matlab-R2018a update 4 - ubuntu 16.04.4 (2018-08-03)	4/1/20 9:0 1 AM	100.00 G B	RAW	Public
Matlab-R2018b Ubuntu 18.04 (04.02.2019_21:32:11)	4/1/20 9:0 1 AM	100.00 G B	RAW	Public

* Cancel < Back Next > Launch Instance



Snapshot

Images - ScienceCloud Dashboard

https://cloud.s3it.uzh.ch/project/images/

esc401.ics.mnf.uzh

Launch Instance

Details

Source

Flavor *

Networks

Network Ports

Security Groups

Key Pair

Configuration

Metadata

Select Boot Source

Instance Snapshot

Allocated

Name	Updated	Size	Type	Visibility
cowsay_with_gcc	4/17/2017 0:32 AM	100.00 GB	RAW	Private

Available (3) Select one

Click here for filters.

Name	Updated	Size	Type	Visibility
Matlab-R2017b - ubuntu 16.04.3 (2017-10-06)	4/1/2017 9:01 AM	100.00 GB	RAW	Public
Matlab-R2018a update 4 - ubuntu 16.04.4 (2018-08-03)	4/1/2017 9:01 AM	100.00 GB	RAW	Public
Matlab-R2018b Ubuntu 18.04 (04.02.2019_21:32:11)	4/1/2017 9:01 AM	100.00 GB	RAW	Public

Cancel Back Next Launch Instance

Command Line

The screenshot shows the ScienceCloud web interface. The top navigation bar includes a logo, project dropdown (esc401.ics.mnf.uzh), user info (dpot), and a search bar (cloud.s3it.uzh.ch). The left sidebar has sections for Project, COMPUTE (selected), NETWORK, OBJECT STORE, and Identity. The main content area is titled "Access & Security" and displays "Service Endpoint" details for various services. The "API Access" tab is selected. A note at the bottom says "Displaying 8 items".

Service	Service Endpoint
Identity	https://cloud.s3it.uzh.ch:5000/v2.0
Volume	https://cloud.s3it.uzh.ch:8776/v2/3bf33d6aaddeb4b40a174576cbc30783f
Image	https://cloud.s3it.uzh.ch:9292
Volumev2	https://cloud.s3it.uzh.ch:8776/v2/3bf33d6aaddeb4b40a174576cbc30783f
Compute	https://cloud.s3it.uzh.ch:8774/v2.1/3bf33d6aaddeb4b40a174576cbc30783f
Network	https://cloud.s3it.uzh.ch:9696
Object Store	https://cloud.s3it.uzh.ch:8080/v1/AUTH_3bf33d6aaddeb4b40a174576cbc30783f
Metering	http://10.129.20.6:8777

- Access & Security Tab
- Download Openstack RC File v3 (version 3)



Using

```
#!/usr/bin/env bash

# To use an OpenStack cloud you need to authenticate against the Identity
# service named keystone, which returns a **Token** and **Service Catalog**.
# The catalog contains the endpoints for all services the user/tenant has
# access to - such as Compute, Image Service, Identity, Object Storage, Block
# Storage, and Networking (code-named nova, glance, keystone, swift,
# cinder, and neutron).
#
# *NOTE*: Using the 3 *Identity API* does not necessarily mean any other
# OpenStack API is version 3. For example, your cloud provider may implement
# Image API v1.1, Block Storage API v2, and Compute API v2.0. OS_AUTH_URL is
# only for the Identity API served through keystone.
export OS_AUTH_URL=https://cloud.s3it.uzh.ch:5000/v3

# With the addition of Keystone we have standardized on the term **project**
# as the entity that owns the resources.
export OS_PROJECT_ID=3bf33d6aadeb4b40ai74576cbc30783f
export OS_PROJECT_NAME="esc401.ics.mnf.uzh"
export OS_USER_DOMAIN_NAME="Default"
if [ -z "$OS_USER_DOMAIN_NAME" ]; then unset OS_USER_DOMAIN_NAME; fi

# unset v2.0 items in case set
unset OS_TENANT_ID
unset OS_TENANT_NAME

# In addition to the owning entity (tenant), OpenStack stores the entity
# performing the action as the **user**.
export OS_USERNAME="dpotter"

# With Keystone you pass the keystone password.
echo "Please enter your OpenStack Password: "
read -s OS_PASSWORD_INPUT
export OS_PASSWORD=$OS_PASSWORD_INPUT

# If your configuration has multiple regions, we set that information here.
# OS_REGION_NAME is optional and only valid in certain environments.
export OS_REGION_NAME="RegionOne"
# Don't leave a Blank variable, unset it if it was empty
if [ -z "$OS_REGION_NAME" ]; then unset OS_REGION_NAME; fi

export OS_INTERFACE=public
export OS_IDENTITY_API_VERSION=3
```

```
douglass-macbook-pro:~$ source Downloads/esc401.ics.mnf.uzh-openrc.sh
Please enter your OpenStack Password:

douglass-macbook-pro:~$ openstack flavor list -c ID -c Name
+-----+-----+
| ID | Name |
+-----+-----+
| b31d0cd7-96bd-4df7-ade5-4824754a4820 | 8cpu-32ram-hpcv3 |
...
+-----+-----+
douglass-macbook-pro:Cloud$ openstack image list -c ID -c Name | grep 20.04
| 8b658463-195e-42d1-a718-becc647c5c1d | ***CUDA latest on Ubuntu 20.04 (2021-03-19) |
| 294ca836-5cf7-465c-8483-07e7e947f5eb | ***Ubuntu 20.04 (2021-03-19) |
| b14e8803-e840-4a3b-bfa3-c3523c86c6fa | Ubuntu 20.04 (2020-11-18) |
```



Scripts

```
$ cat make.sh
```

```
#!/bin/bash

NAME=dpotte_test

openstack server create --wait \
    --flavor b31d0cd7-96bd-4df7-ade5-4824754a4820 \
    --image 294ca836-5cf7-465c-8483-07e7e947f5eb \
    --key-name 'dpotter secure access' \
    --security-group default \
    --user-data user.sh \
$NAME
```

```
$ cat user.sh
```

```
#!/bin/bash

sudo apt update -q
sudo apt-get install -y \
    cowsay gcc cmake make
```



Create a server

```
douglass-macbook-pro:Cloud$ openstack server list
```

```
douglass-macbook-pro:Cloud$ ./make.sh
```

Field	Value
OS-DCF:diskConfig	MANUAL
OS-EXT-AZ:availability_zone	nova
OS-EXT-STS:power_state	Running
OS-EXT-STS:task_state	None
OS-EXT-STS:vm_state	active
OS-SRV-USG:launched_at	2021-04-28T06:37:58.000000
OS-SRV-USG:terminated_at	None
accessIPv4	
accessIPv6	
addresses	uzh-only=172.23.8.51
adminPass	C3zwcC494Lnf
config_drive	
created	2021-04-28T06:37:48Z
flavor	8cpu-32ram-hpcv3 (b31d0cd7-96bd-4df7-adef-4824754a4820)
hostId	3a4e0311e94a485acdfe84c6519cb8547aea48137ccb59106782a54
id	b2c1ec9d-17de-4574-9e4b-ff65a54e7165
image	***Ubuntu 20.04 (2021-03-19) (294ca836-5cf7-465c-8483-07e7e947f5eb)
key_name	dpotter_secure_access
name	dpotte_test
progress	0
project_id	3bf33d6aadeb4b40a174576cbc30783f
properties	
security_groups	name='default'
status	ACTIVE
updated	2021-04-28T06:37:59Z
user_id	dpotte
volumes_attached	

```
douglass-macbook-pro:Cloud$ openstack server list
```

ID	Name	Status	Networks	Image	Flavor
b2c1ec9d-17de-4574-9e4b-ff65a54e7165	dpotte_test	ACTIVE	uzh-only=172.23.8.51	***Ubuntu 20.04 (2021-03-19)	8cpu-32ram-hpcv3



Logging In

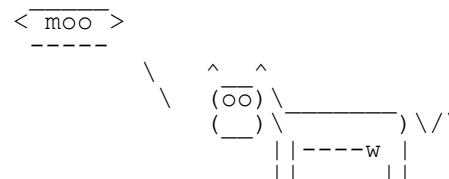
```
douglass-macbook-pro:Cloud$ ssh ubuntu@172.23.8.51
ssh: connect to host 172.23.8.51 port 22: Connection refused
douglass-macbook-pro:Cloud$ ssh ubuntu@172.23.8.51
The authenticity of host '172.23.8.51 (172.23.8.51)' can't be established.
ECDSA key fingerprint is SHA256:6VVoE6elUj2ArV2M/CEilovDT9/J7FtSPgJQMBy2TYk.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '172.23.8.51' (ECDSA) to the list of known hosts.
Welcome to Ubuntu 20.04.2 LTS (GNU/Linux 5.4.0-67-generic x86_64)

...
Last login: Fri Mar 19 13:52:57 2021 from 172.23.255.1
ubuntu@dpotte-test:~$ cowsay "moo"
```

Command 'cowsay' not found, but can be installed with:

```
sudo apt install cowsay
```

```
ubuntu@dpotte-test:~$ cowsay "moo"
```





Cleaning up

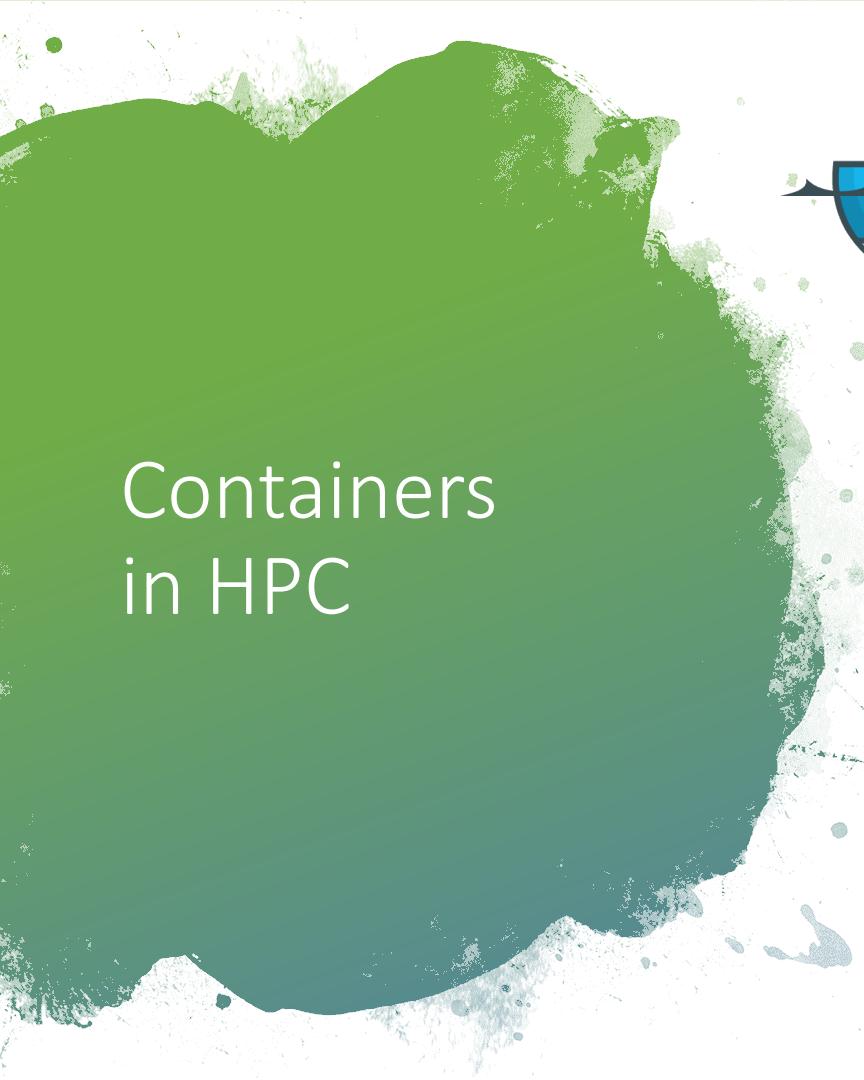
```
douglass-macbook-pro:Cloud$ openstack server list
+-----+-----+-----+-----+-----+
| ID      | Name     | Status  | Networks | Image           | Flavor |
+-----+-----+-----+-----+-----+
| b2c1ec9d-17de-4574-9e4b-ff65a54e7165 | dpotte_test | ACTIVE | uzh-only=172.23.8.51 | ***Ubuntu 20.04 (2021-03-19) | 8cpu-32ram-hpcv3 |
+-----+-----+-----+-----+-----+
douglass-macbook-pro:Cloud$ openstack server delete dpotte_test
douglass-macbook-pro:Cloud$ openstack server list
+-----+-----+-----+-----+-----+
| ID      | Name     | Status  | Networks | Image           | Flavor |
+-----+-----+-----+-----+-----+
| b2c1ec9d-17de-4574-9e4b-ff65a54e7165 | dpotte_test | ACTIVE | uzh-only=172.23.8.51 | ***Ubuntu 20.04 (2021-03-19) | 8cpu-32ram-hpcv3 |
+-----+-----+-----+-----+-----+
douglass-macbook-pro:Cloud$ openstack server list
douglass-macbook-pro:Cloud$
```

Summary

- Create an instance with the right “hardware”
- Log into our new instance (“Server”)
`ssh ubuntu@172.23.x.x`
- Update package catalogue:
`sudo apt update`
- Install package(s):
`sudo apt install cowsay`
`sudo apt install gcc cmake`
- Create a snapshot if needed
- Can be automated in BASH or Python

Omitted

- Attaching additional storage (“Volumes”)
 - Image changes disappear when instance deleted
 - Unless a snapshot is taken
 - Image is rather small – 100 GB maximum
- Using the API (in for example Python)
 - You can use Python instead of the web interface
 - Allows multiple instances to be launched
- Orchestration
 - Create a pipeline and execute it
 - Analogous to queue systems



Containers
in HPC

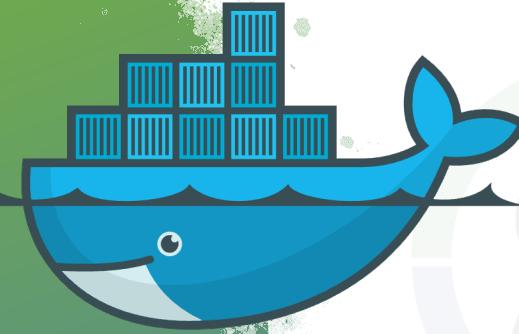


Singularity



SHIFTER

Containers
in HPC



docker

SHIFTER

Singularity

Why Containers?

- We need a custom environment like a VM
 - Example: want to run an Ubuntu code on Piz Daint
- Software setup is difficult
 - Requires a specific operating system (e.g., Redhat)
 - Requires specific versions of libraries
 - Compilation process is difficult and time consuming
 - Binary only distribution with dependencies
- Solutions
 - Provide a VM image
 - Provide a container
- Containers are lightweight



CSCS User Portal



TOOLS

Containers

Sarus

Shifter

Singularity

Continuous integration

High Throughput Scheduler

Interactive Supercomputing

Julia

Python

JupyterLab

OpenStack

USEFUL LINKS

[Account and Resources Tool](#)

[CSCS Website](#)

[Events](#)

[Tutorials](#)

[Production Repository](#)

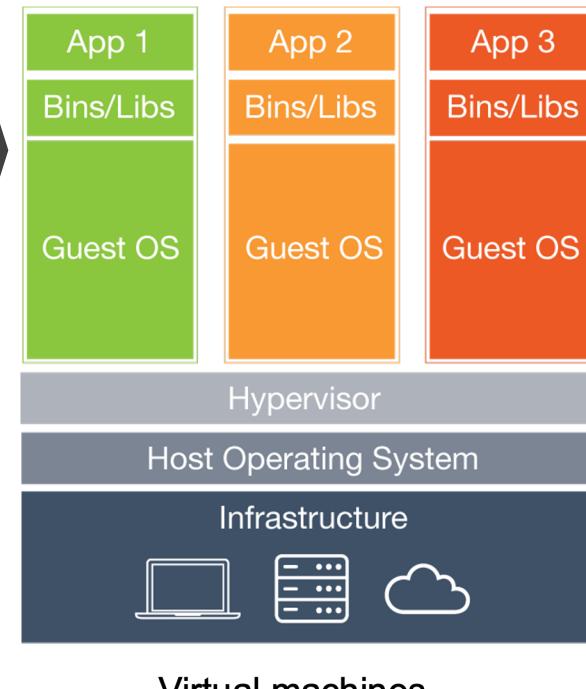
Sarus

Sarus is a software to run Linux containers on High Performance Computing environments. Its development has been driven by the specific requirements of HPC systems, while leveraging open standards and technologies to encourage vendor and community involvement.

CSCS



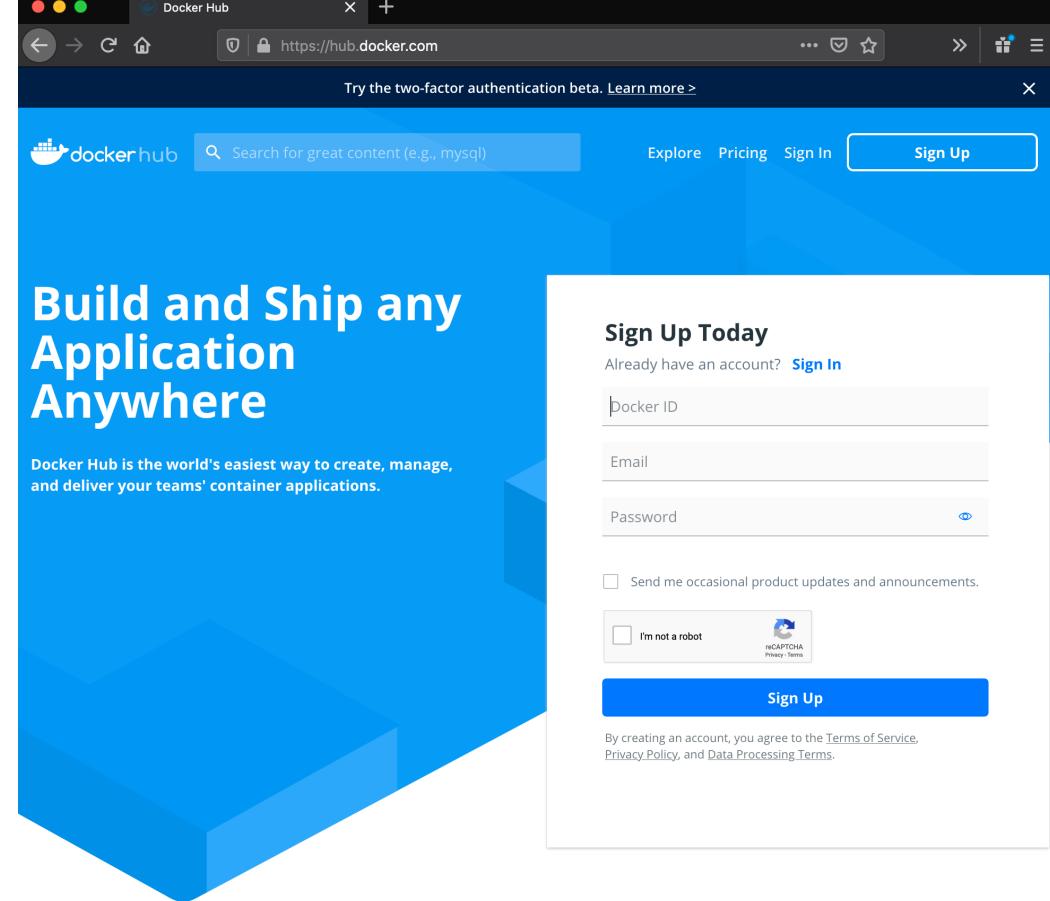
Container vs. Virtual Machine





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Docker Hub



The screenshot shows the Docker Hub homepage. At the top, there's a banner with the text "Try the two-factor authentication beta. [Learn more >](#)". Below the banner, the Docker Hub logo is on the left, followed by a search bar containing "Search for great content (e.g., mysql)". To the right of the search bar are links for "Explore", "Pricing", "Sign In", and a prominent "Sign Up" button. The main visual features a large blue 3D block graphic. Centered on the block is the text "Build and Ship any Application Anywhere". Below this, a subtext reads "Docker Hub is the world's easiest way to create, manage, and deliver your teams' container applications." To the right of the main content area is a white sign-up form titled "Sign Up Today". It includes fields for "Docker ID", "Email", "Password", and a checkbox for "Send me occasional product updates and announcements". There's also a reCAPTCHA field with the text "I'm not a robot" and a "Sign Up" button at the bottom. A small note at the bottom of the form states: "By creating an account, you agree to the [Terms of Service](#), [Privacy Policy](#), and [Data Processing Terms](#)".

Docker Hub is the world's largest library and community for container images



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Search

Docker Hub

Try the two-factor authentication beta. [Learn more >](#)

docker hub

cowsay-test

Community (15)

demon1024/cowsay-test

matsen/cowsay-test

matsen/cowsay-test-build

shanjingheng/cowsay-test

Show all 15 hits in Community

**Build a
Application
Anywhere**

Docker Hub is the world's easiest way to create, manage, and deliver your teams' container applications.

Sign Up Today

Already have an account? [Sign In](#)

Docker ID

Email

Password

Send me occasional product updates and announcements.

I'm not a robot

reCAPTCHA

Privacy · Terms

Sign Up

By creating an account, you agree to the [Terms of Service](#), [Privacy Policy](#), and [Data Processing Terms](#).

Docker Hub is the world's largest library and community for container images



matsen/ cowsay-test

matsen/cowsay-test - Docker X

Try the two-factor authentication beta. Learn more >

dockerhub cowsay-test Explore Pricing Sign In Sign Up

Explore matsen/cowsay-test

 matsen/cowsay-test ☆ Pulls 119

By matsen • Updated 2 years ago

Test cowsay

Container

Overview Tags Dockerfile Builds

Cowsay

docker build passing

About

This project has an ASCII cow saying "Hello world." To learn more, see Billey, S. C., Konvalinka, M., & Matsen, F. A., IV. (2017). *On the enumeration of tanglegrams and tangled chains*. Journal of Combinatorial Theory. Series A, 146, 239–263.

Dependencies

- Cowsay

A complete "from scratch" installation is documented as the Dockerfile in this

Docker Pull Command

```
docker pull matsen/cowsay-test
```

Owner

 matsen

Source Repository

 Github matsen/cowsay-test



The screenshot shows a web browser window with the URL <https://hub.docker.com/r/matsen/cowsay-test/dockerfile>. The page is titled "matsen/cowsay-test Dockerfile". At the top, there's a navigation bar with "Explore", "Pricing", "Sign In", and "Sign Up" buttons. Below the navigation, a search bar shows "cowsay-test". The main content area displays the Dockerfile content:

```
FROM ubuntu:trusty

RUN apt-get update -q && \
    apt-get install -y -q --no-install-recommends \
    cowsay

RUN ln -s /usr/games/cowsay /usr/bin

COPY . /test-cowsay
WORKDIR /test-cowsay
CMD ./test.sh
```

On the right side, there's a "Source Repository" section linking to [Github matsen/cowsay-test](#). The Dockerfile tab is currently selected.

Dockerfile



Ubuntu

ubuntu - Docker Hub

Try the two-factor authentication beta. [Learn more >](#)

dockerhub Explore Pricing Sign In Sign Up

Explore → ubuntu



ubuntu ☆
[Docker Official Images](#)
Ubuntu is a Debian-based Linux operating system based on free software.
 1B+

Container Linux IBM Z PowerPC 64 LE x86-64 386 ARM 64 ARM

Base Images Operating Systems Official Image

Description

Reviews

Tags

Supported tags and respective Dockerfile links

- [18.04](#), [bionic-20200311](#), [bionic](#), [latest](#)
- [19.10](#), [eoan-20200313](#), [eoan](#), [rolling](#)
- [20.04](#), [focal-20200319](#), [focal](#), [devel](#)
- [14.04](#), [trusty-20191217](#), [trusty](#)
- [16.04](#), [xenial-20200212](#), [xenial](#)



The screenshot shows a web browser window with the URL <https://hub.docker.com/r/matsen/cowsay-test/dockerfile>. The page is titled "matsen/cowsay-test Dockerfile". At the top right, there are links for "Explore", "Pricing", "Sign In", and "Sign Up". Below that, a search bar contains the text "cowsay-test". A blue header bar at the top of the page has the "dockerhub" logo and the text "Try the two-factor authentication beta. Learn more >". The main content area displays the Dockerfile content:

```
FROM ubuntu:trusty

RUN apt-get update -q && \
    apt-get install -y -q --no-install-recommends \
    cowsay

RUN ln -s /usr/games/cowsay /usr/bin

COPY . /test-cowsay
WORKDIR /test-cowsay
CMD ./test.sh
```

On the right side of the page, there is a "Source Repository" section with a GitHub icon and the link "matsen/cowsay-test".

Dockerfile



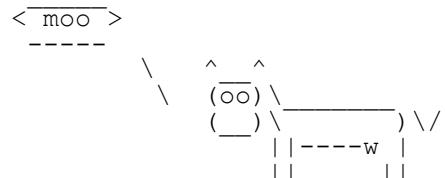
Command line

```
root@81f14d0154d1:/test-cowsay
>doogs-macbook-pro:~$ docker image pull matsen/cowsay-test
Using default tag: latest
latest: Pulling from matsen/cowsay-test
c2c80a08aa8c: Pull complete
6ace04d7a4e2: Pull complete
f03114bcfb25: Pull complete
99df43987812: Pull complete
9c646cd4d155: Pull complete
033d410e2c1e: Pull complete
a33cabbb3e718: Pull complete
43fc1761798: Pull complete
Digest: sha256:957773822d7d42e0ceeedcc9761b0cc58783c31904ddd18ff7c4589ed733e7db
Status: Downloaded newer image for matsen/cowsay-test:latest
docker.io/matsen/cowsay-test:latest
>doogs-macbook-pro:~$ docker images matsen/cowsay-test
REPOSITORY          TAG           IMAGE ID            CREATED         SIZE
matsen/cowsay-test  latest        2a52ce4f67e4      24 months ago   245MB
>doogs-macbook-pro:~$ docker run matsen/cowsay-test
-----
< Hello world. >
-----
\  ^__^
 \  (oo)\_____
   (__)\       )\/\
     ||----w |
     ||     ||
>doogs-macbook-pro:~$ docker run matsen/cowsay-test cowsay "Moo"
-----
< Moo >
-----
\  ^__^
 \  (oo)\_____
   (__)\       )\/\
     ||----w |
     ||     ||
>doogs-macbook-pro:~$ docker run -it matsen/cowsay-test /bin/bash
root@81f14d0154d1:/test-cowsay# ls
Dockerfile README.md docker.test.yml test.sh
root@81f14d0154d1:/test-cowsay# cat test.sh
cowsay "Hello world."
root@81f14d0154d1:/test-cowsay# ls /
bin boot dev etc home lib lib64 media mnt opt proc root run sbin srv sys test-cowsay tmp usr var
root@81f14d0154d1:/test-cowsay#
```



Let's do it ourselves

```
douglass-macbook-pro:~$ docker pull ubuntu:20.04
20.04: Pulling from library/ubuntu
345e3491a907: Pull complete
57671312ef6f: Pull complete
5e9250ddb7d0: Pull complete
Digest: sha256:cf31af331f38d1d7158470e095b132acd126a7180a54f263d386da88eb681d93
Status: Downloaded newer image for ubuntu:20.04
docker.io/library/ubuntu:20.04
douglass-macbook-pro:~$ docker images
REPOSITORY                      TAG      IMAGE ID      CREATED     SIZE
ubuntu                          20.04   7e0aa2d69a15  4 days ago  72.7MB
douglass-macbook-pro:~$ docker run -it ubuntu:20.04 /bin/bash
root@d28664f23d4d:/# ps -ef
UID      PID  PPID  C STIME TTY          TIME CMD
root      1      0  0 07:23 pts/0    00:00:00 /bin/bash
root      9      1  0 07:24 pts/0    00:00:00 ps -ef
root@d28664f23d4d:/# apt-get update -q
...
root@d28664f23d4d:/# apt-get install -q cowsay
...
root@d28664f23d4d:/# /usr/games/cowsay "moo"
```





Containers are “Ephemeral”

```
root@d28664f23d4d:/# exit
exit
douglass-macbook-pro:~$ docker run -it ubuntu:20.04 /bin/bash
root@e2c4cf63253c:/# /usr/games/cowsay "moo"
bash: /usr/games/cowsay: No such file or directory
root@e2c4cf63253c:/# exit
exit
douglass-macbook-pro:~$ docker ps
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
douglass-macbook-pro:~$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
e2c4cf63253c ubuntu:20.04 "/bin/bash" 22 seconds ago Exited (127) 6 seconds ago funny_gates
d28664f23d4d ubuntu:20.04 "/bin/bash" 5 minutes ago Exited (0) 24 seconds ago nice_meninsky
douglass-macbook-pro:~$ docker rm e2c4cf63253c
e2c4cf63253c
douglass-macbook-pro:~$ docker rm nice_meninsky
nice_meninsky
douglass-macbook-pro:~$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
```



Accessing host files

```
douglass-macbook-pro:~$ pwd
/Users/dpotter
douglass-macbook-pro:~$ docker run -it --rm ubuntu:20.04 /bin/bash
root@0053aa324313:/# ls /Users/dpotter
ls: cannot access '/Users/dpotter': No such file or directory
root@e83251495392:/# ls /home/
root@e83251495392:/# exit
douglass-macbook-pro:~$ docker ps -a
CONTAINER ID        IMAGE           COMMAND       CREATED      STATUS      PORTS      NAMES
douglass-macbook-pro:~$ docker run -it --rm --mount type=bind,source=/Users/dpotter,target=/home
ubuntu:20.04 /bin/bash
root@ef3698e747bd:/# ls /home/
5tB4LJZv.json Pictures ...
root@ef3698e747bd:/# exit
```



CSCS (Sarus)

```
dpotter@daint102:~> module load sarus
dpotter@daint102:~> sarus pull matsen/cowsay-test
# image           : index.docker.io/matsen/cowsay-test:latest
# cache directory : "/scratch/sn3000/dpotter/.sarus/cache"
# temp directory  : "/tmp"
# images directory: "/scratch/sn3000/dpotter/.sarus/images"
> save image layers ...
> pulling        : sha256:9c646cd4d1557832b81ce6956a18f791bdcce470290be8b23f153811a0d372f
> pulling        : sha256:c2c80a08aa8cdf0629269bab360b225d96a511b4c4ccb5f9c1d2abe01ff23d6f
> pulling        : sha256:99df439878124298f9d5577c286e59d7f012baedb7cf8d69d104f5d87d727c28
> pulling        : sha256:f03114bcfb255c8eaaf7fe3bbe409e7070993ee96152b9a04a7b6db0c3da5130
> pulling        : sha256:43fcfb1761798a04a3cd0d71f8ba069c398f36ccab6c13630ec7df989ae37ed9
> pulling        : sha256:6ace04d7a4d232362e4578bc07a21157fcfd3203d0e26a3d1dfcb2b918db6
> completed     : sha256:9c646cd4d1557832b81ce6956a18f791bdcce470290be8b23f153811a0d372f
> pulling        : sha256:033d410e21e50d15d2a2ee59649347f0896769c35adc1ac5c4d6688c474ea5b
> completed     : sha256:f03114bcfb255c8eaaf7fe3bbe409e7070993ee96152b9a04a7b6db0c3da5130
> completed     : sha256:99df439878124298f9d5577c286e59d7f012baedb7cf8d69d104f5d87d727c28
> completed     : sha256:43fcfb1761798a04a3cd0d71f8ba069c398f36ccab6c13630ec7df989ae37ed9
> pulling        : sha256:a33cab3e7188dee4fd0825d8afdb2faa9d3c0e8f16c57229448b277498b06b8
> completed     : sha256:6ace04d7a4d232362e4578bc07a21157fcfd3203d0e26a3d1dfcb2b918db6
> completed     : sha256:a33cab3e7188dee4fd0825d8afdb2faa9d3c0e8f16c57229448b277498b06b8
> completed     : sha256:033d410e21e50d15d2a2ee59649347f0896769c35adc1ac5c4d6688c474ea5b
> completed     : sha256:c2c80a08aa8cdf0629269bab360b225d96a511b4c4ccb5f9c1d2abe01ff23d6f
> expanding image layers ...
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:c2c80a08aa8cdf0629269bab360b225d96a511b4c4ccb5f9c1d2abe01ff23d6f.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:6ace04d7a4d232362e4578bc07a21157fcfd3203d0e26a3d1dfcb2b918db6.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:f03114bcfb255c8eaaf7fe3bbe409e7070993ee96152b9a04a7b6db0c3da5130.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:99df439878124298f9d5577c286e59d7f012baedb7cf8d69d104f5d87d727c28.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:9c646cd4d1557832b81ce6956a18f791bdcce470290be8b23f153811a0d372f.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:033d410e21e50d15d2a2ee59649347f0896769c35adc1ac5c4d6688c474ea5b.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:a33cab3e7188dee4fd0825d8afdb2faa9d3c0e8f16c57229448b277498b06b8.tar"
> extracting    : "/scratch/sn3000/dpotter/.sarus/cache/sha256:43fcfb1761798a04a3cd0d71f8ba069c398f36ccab6c13630ec7df989ae37ed9.tar"
> make squashfs image: "/scratch/sn3000/dpotter/.sarus/images/index.docker.io/matsen/cowsay-test/latest.squashfs"
dpotter@daint102:~> sarus run matsen/cowsay-test
Detected glibc 2.19 (< 2.26) in the container. Replacing it with glibc 2.26 from the host. Please consider upgrading the container image to a distribution with glibc >= 2.26.

< Hello world. >
-----
 \ ^__^
  \  (oo)\_____
   (__)\       )\/\
    ||----w |
    ||     ||
```

Omitted

- Details of building a Docker image
 - There are various tricks to optimize
 - Image layers for example
 - Multi-stage builds to reduce the size
 - You only need gcc to compile, not to run
- Orchestration
 - Create a pipeline and execute it
 - Kubernetes is one such system