INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Cloud Computing

Google Cloud Engine & Docker

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Institut National des Sciences Appliquées

Introduction

Data Science tools

Tools you know

- Programming : Python. 
- Libraries : Numpy, Pandas, Scikit Learn, Keras, Tensorflow ...
- Development : Jupyter. 

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  - To use more computation power.

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- Cloud services : **Google Cloud**, AWS, Azure.
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- Docker.
  - To use application easy to replicate and sustainable.

Table of contents

Script Python

Why using script?

Jupyter limits :

- it's an exploration tool
  - but cloud machine are accounted on an hourly base.
- Non-linear workflow.
  - Easy to write messy code.
- Not designed to handle large-scale experiment.
- Not designed for production.
  - Can't be run from terminal, no test procedure.

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$\Longrightarrow$ Exploration work : *Jupyter*.

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$\Longrightarrow$ Exploration work : *Jupyter*.

$\Longrightarrow$ Large-scale/production work : Write *Script* !

Script execution

File *script.py*

```
a = 5
b = 3
c = a + b
print("The answer is %d" %c)
```

Terminal

```
bguillou $> python script.py
bguillou $> The answer is 8
```

Librairie *Argparse*

File *script.py*

```python
import argparse

parser = argparse.ArgumentParser()
parser.add_argument('--a', type=int, default=5)
parser.add_argument('--b', type=int, default=3)

args = parser.parse_args()

c= args.a + args.b
print("The answer is %d" %c)
```

Terminal

```
bguillou $> python script.py
bguillou $> The answer is 8
bguillou $> python script.py --a 4
bguillou $> The answer is 7
bguillou $> python script.py --a 4 --b 2
bguillou $> The answer is 7
```

Librairie *pickle*

File *learning.py*

```
import pickle
...
results = {"learning_time" : lt, "accuracy" : acc}
pickle.dump(results, open("/User/bguillouet/data/results.pkl,"wb"))
```

File *explore_results.py*

```
import pickle
results = pickle.load(open("/User/bguillouet/data/results.pkl,"rb"))
print(results)
```

Terminal

```
bguillou $> ls data/
bguillou $>
bguillou $> python learning.py
bguillou $> ls data/
bguillou $> results.pkl
bguillou $> python explore_results.py
bguillou $> {"learning_time" : lt, "accuracy" : acc}
```

Librairie *hashlib*

python *script.py*

```
import argparse
import hashlib
import pickle

parser = argparse.ArgumentParser()
parser.add_argument('--a', type=int, default=5)
parser.add_argument('--b', type=int, default=3)
parser.add_argument('--type_op', type =str, default="addition")

args = parser.parse_args()

if args.type_op == "addition":
    c= args.a + args.b
else:
    c= args.a * args.b

results = var(args)
print("Argument dictionary: "+ str(results))
results.update({"results" : c})
print("Argument dictionary with score: "+ str(results))


args_str = "_".join([k + ":" + str(v) for k, v in sorted(results.items(), key=lambda x : x[0])])
print("Argument string: "+ args_str)

id_str = hashlib.md5(args_str.encode("utf8")).hexdigest()
print(id_str)

result_file = "/User/bguillouet/data/" + id_str + ".pkl"

pickle.dump(results, open(results_file, "wb"))
```

Librairie *hashlib*

```
bguillou $> python script.py
bguillou $> {"a":5, "b":3, "type_op":"addition"}
bguillou $> {"a":5, "b":3, "type_op":"addition", "results":8}
bguillou $> a:5_b:3_type_op:addition_results:8
bguillou $> aZezEzj7jhZ8793DeefdjZ9
bguillou $> ls data/
bguillou $> aZezEzj7jhZ8793DeefdjZ9.pkl
```

Google Cloud

Google Cloud

Suite of cloud computing services with more than 90 products.

- Power computation , Database, AI, Networking, Security *etc*..

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Why not IA tools ?

- *AutoML* or *ML Engine* are tools that provide solution for non-expert.

Google CLoud

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What do I need to know you use Google CLoud Engine ?

- Basic knowledge of Google cloud interface.
- Basic use of terminal command (no graphic interface).
- *gcloud SDK*.

Gcloud - Command

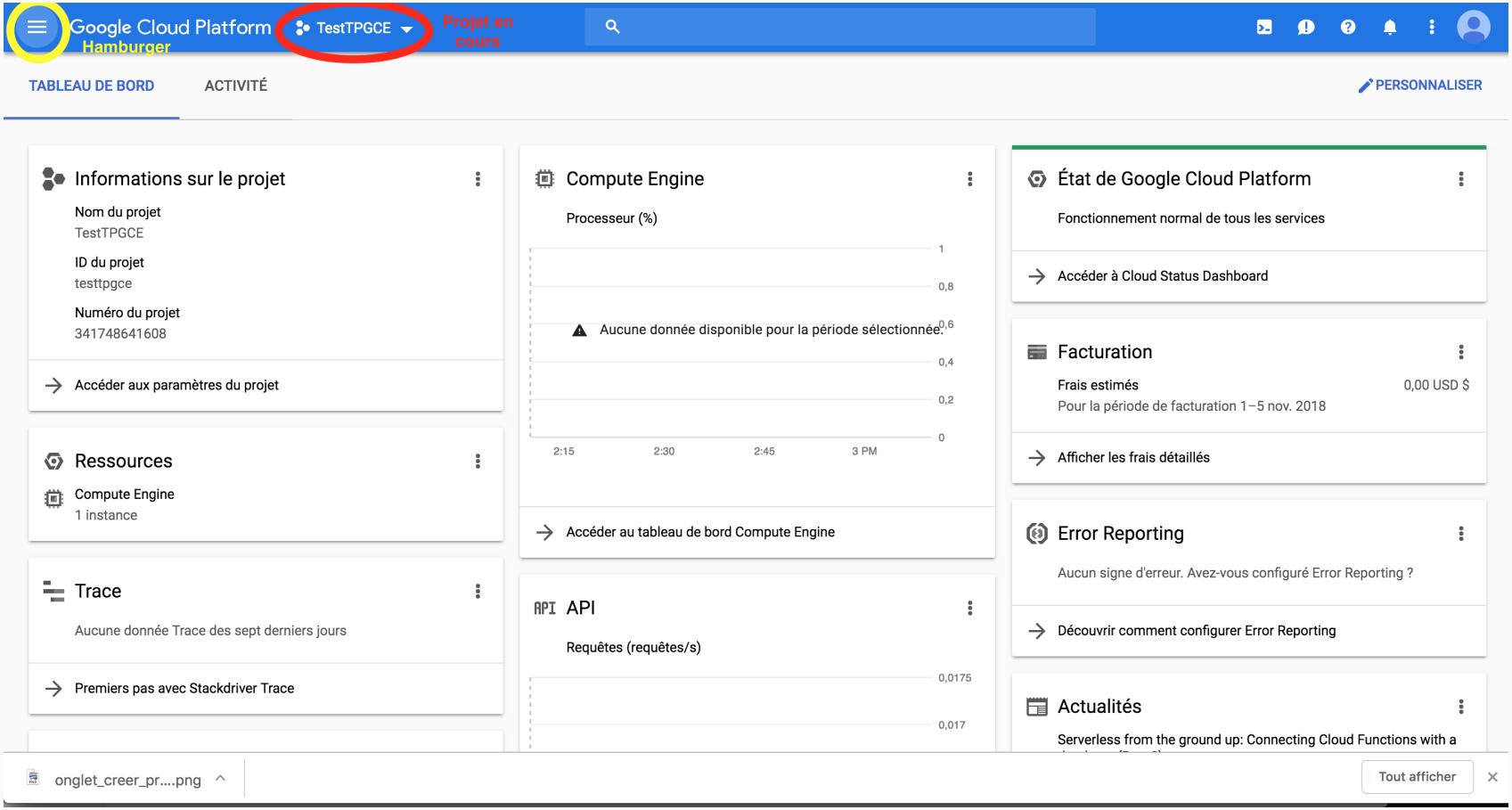
Command line tool which allow to manage VM instance.

- *gcloud init*. To be used at first utilization.
- *gcloud compute instances start/stop/delete instance_name*. To start/stop/remove instance.
- *gcloud compute scp --recurse CopyFrom CopyTo*
  - *--recurse* (optional) : To be used if directory is copied.
  - *CopyFrom* : Location of the file or directory to be copied.
  - *CopyTo* : Location of the directory were the file or directory will be copied.
  - *Syntax :* [[[USER@]INSTANCE :]DIR] . To send file on the instance.

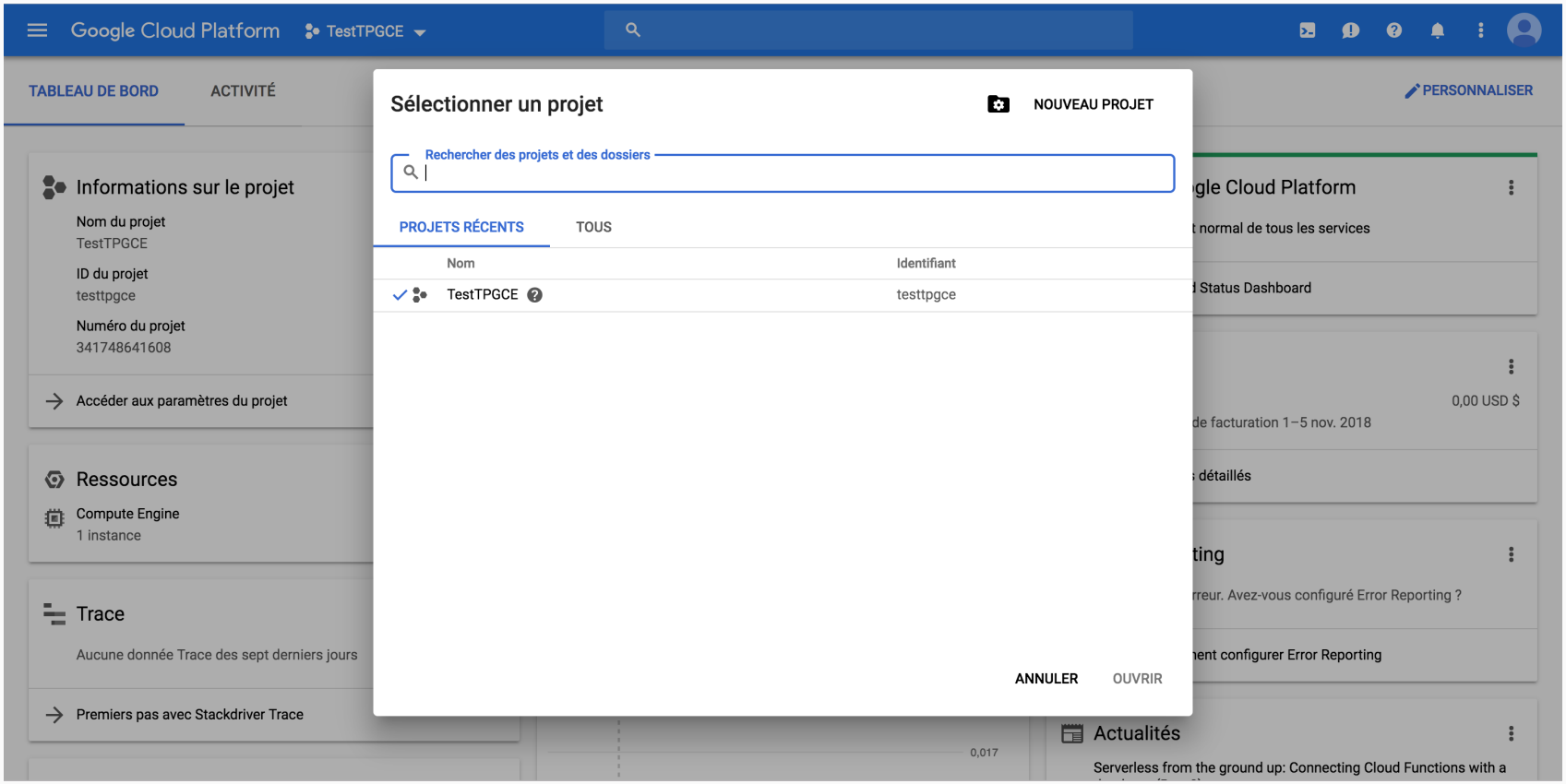
Gcloud - Command

- *gcloud compute ssh --ssh-key-file LocationOfSShKey --zone europe-west1-b*. To set ssh-connection to the instance.
- *gcloud compute ssh --command 'COMMAND'*. To execute command on the instance.
  - *gcloud compute ssh --command 'mkdir data'*
  - *gcloud compute ssh --command 'python learning.py'*

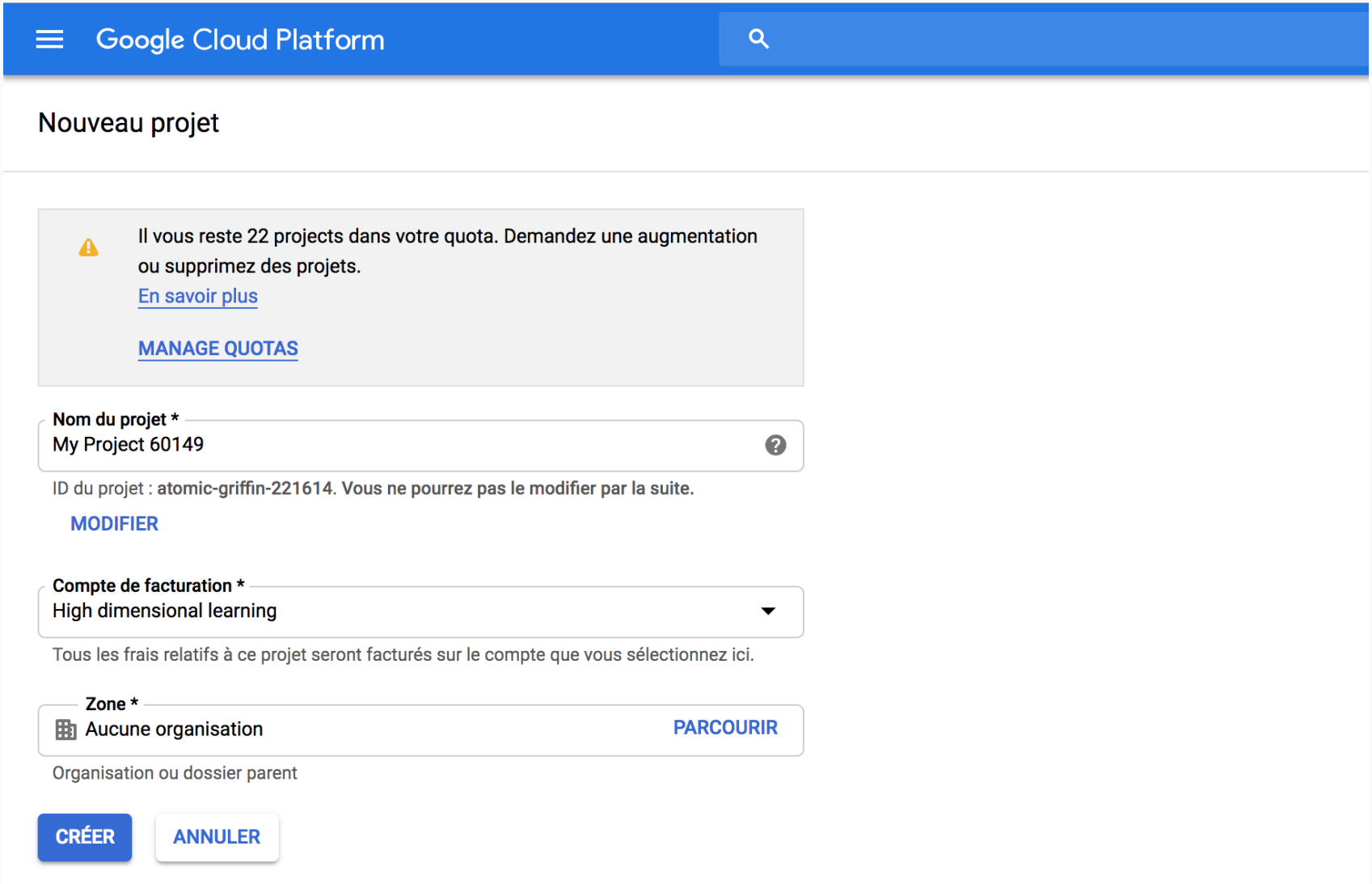
GCE : Accueil


Google Cloud Platform
Hamburger
TestTPGCE
Projet en cours
TABLEAU DE BORD
ACTIVITÉ
PERSONNALISER
Informations sur le projet
Nom du projet
TestTPGCE
ID du projet
testtpgce
Numéro du projet
341748641608
Accéder aux paramètres du projet
Ressources
Compute Engine
1 instance
Trace
Aucune donnée Trace des sept derniers jours
Premiers pas avec Stackdriver Trace
Compute Engine
Processeur (%)
1
0,8
0,6
0,4
0,2
0
Aucune donnée disponible pour la période sélectionnée.
2:15
2:30
2:45
3 PM
Accéder au tableau de bord Compute Engine
API
API
Requêtes (requêtes/s)
0,0175
0,017
État de Google Cloud Platform
Fonctionnement normal de tous les services
Accéder à Cloud Status Dashboard
Facturation
Frais estimés
0,00 USD $
Pour la période de facturation 1–5 nov. 2018
Afficher les frais détaillés
Error Reporting
Aucun signe d'erreur. Avez-vous configuré Error Reporting ?
Découvrir comment configurer Error Reporting
Actualités
Serverless from the ground up: Connecting Cloud Functions with a
onglet_creer_pr....png
Tout afficher

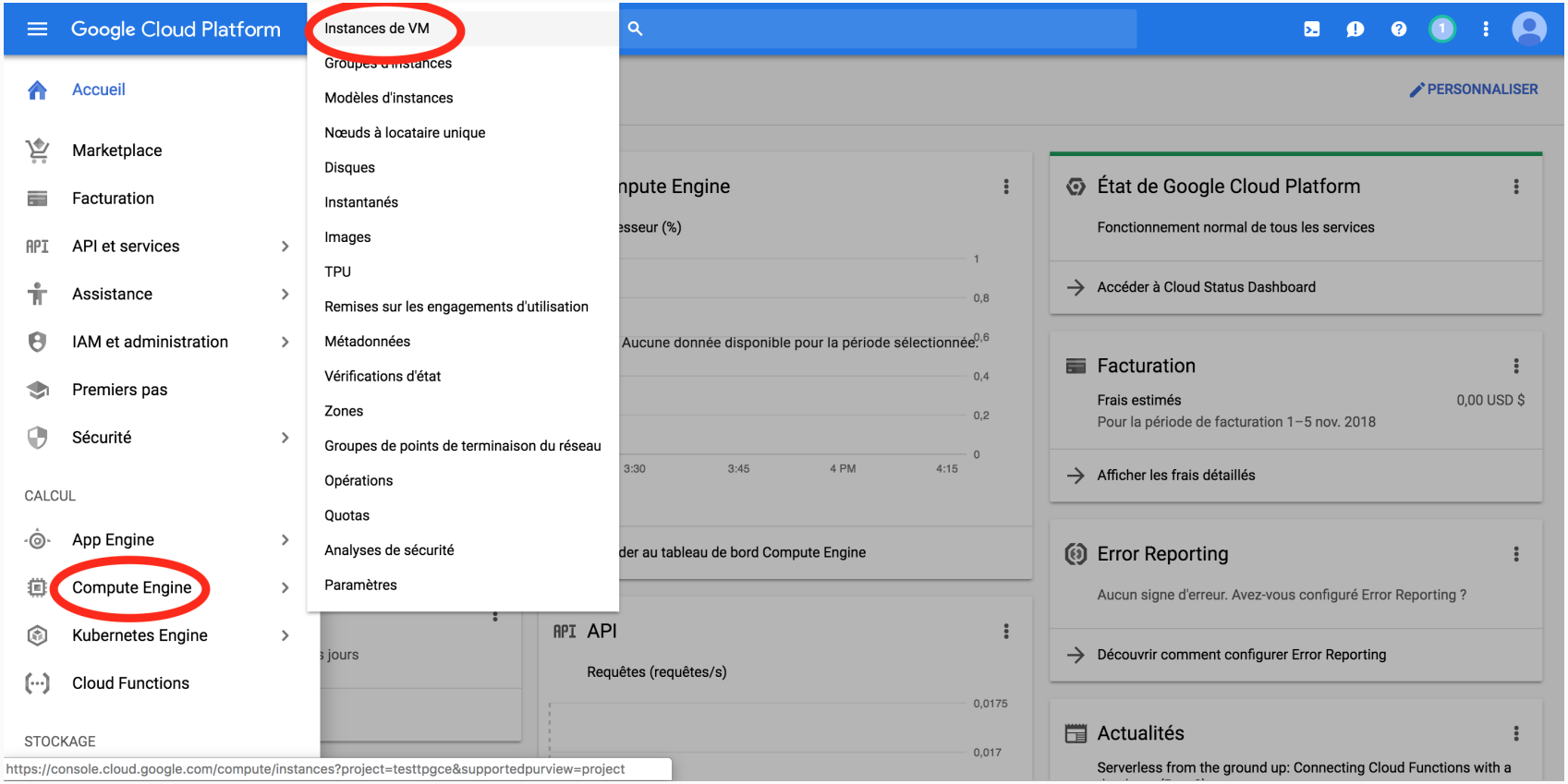
GCE : Sélection Projet



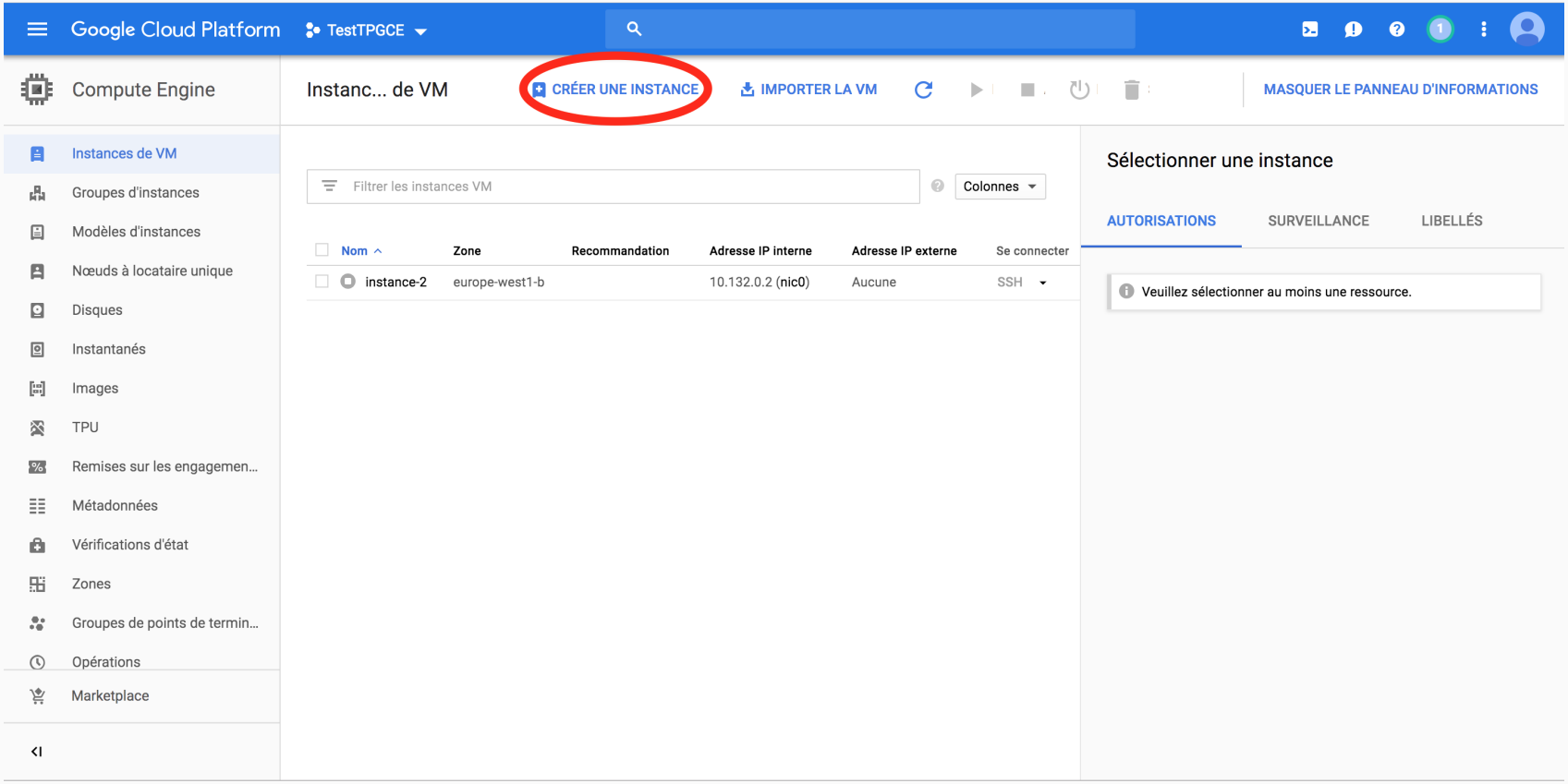
GCE : Nouveau Projet



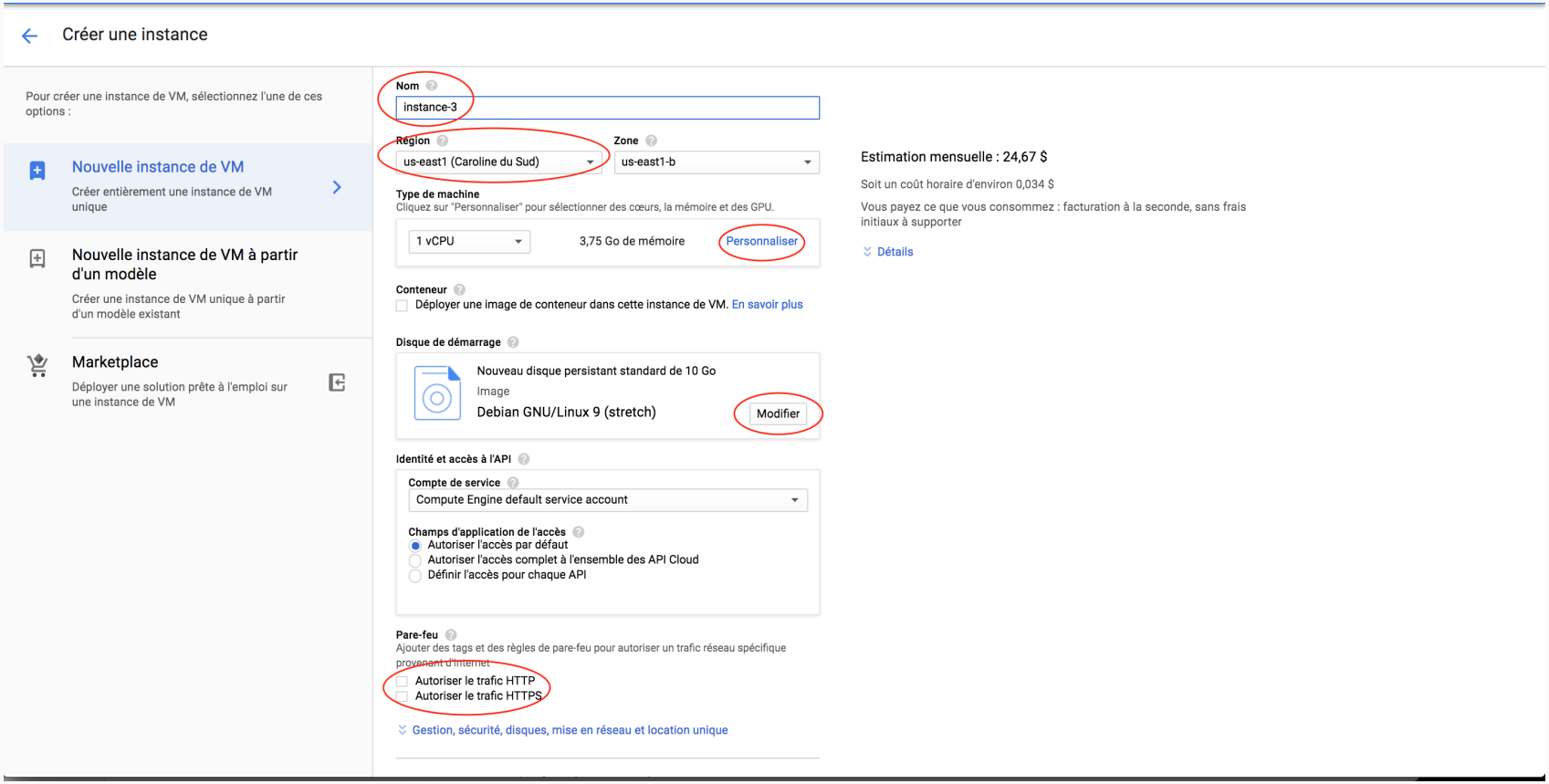
GCE : Menu Principal (Hamburger)



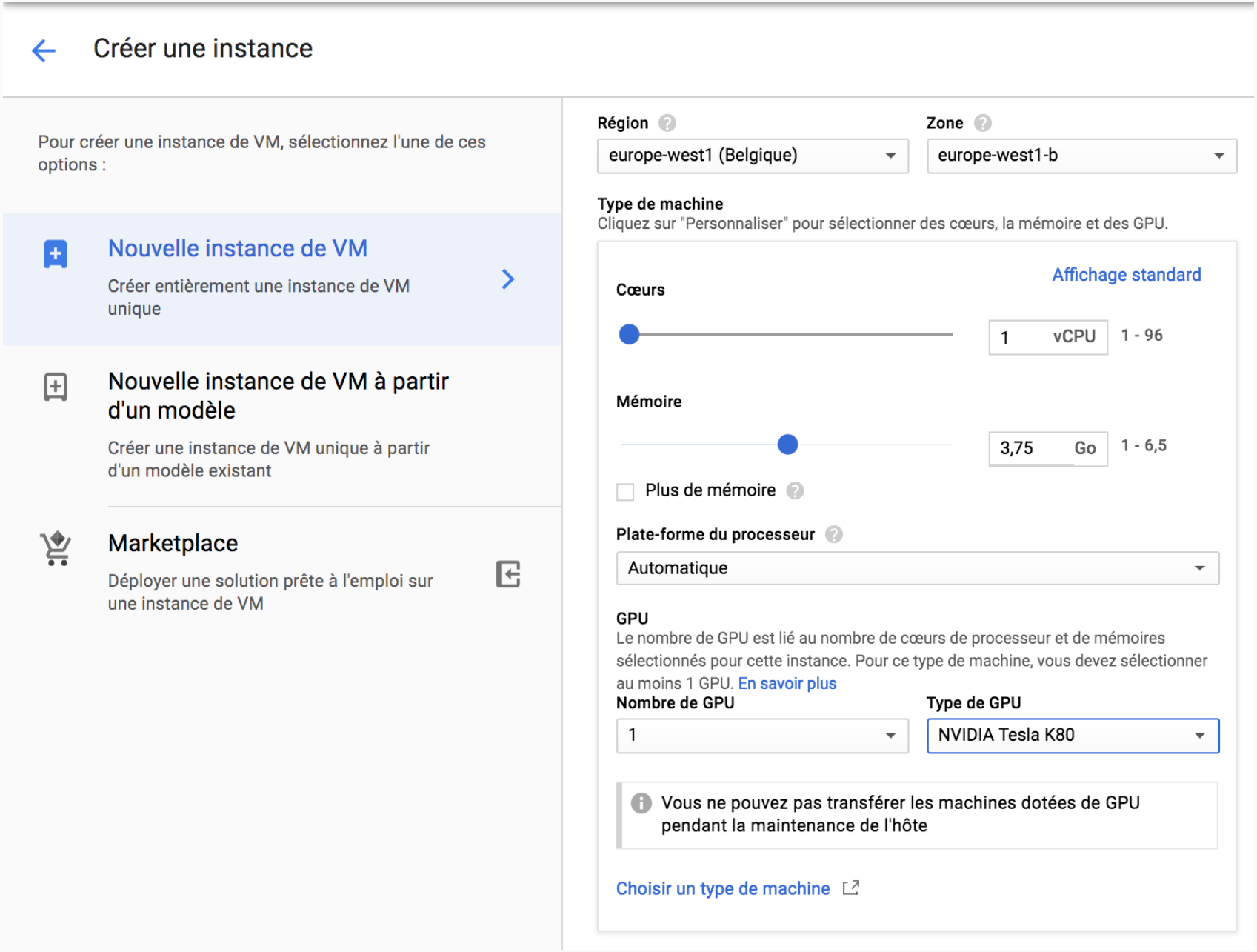
GCE : Instance VM



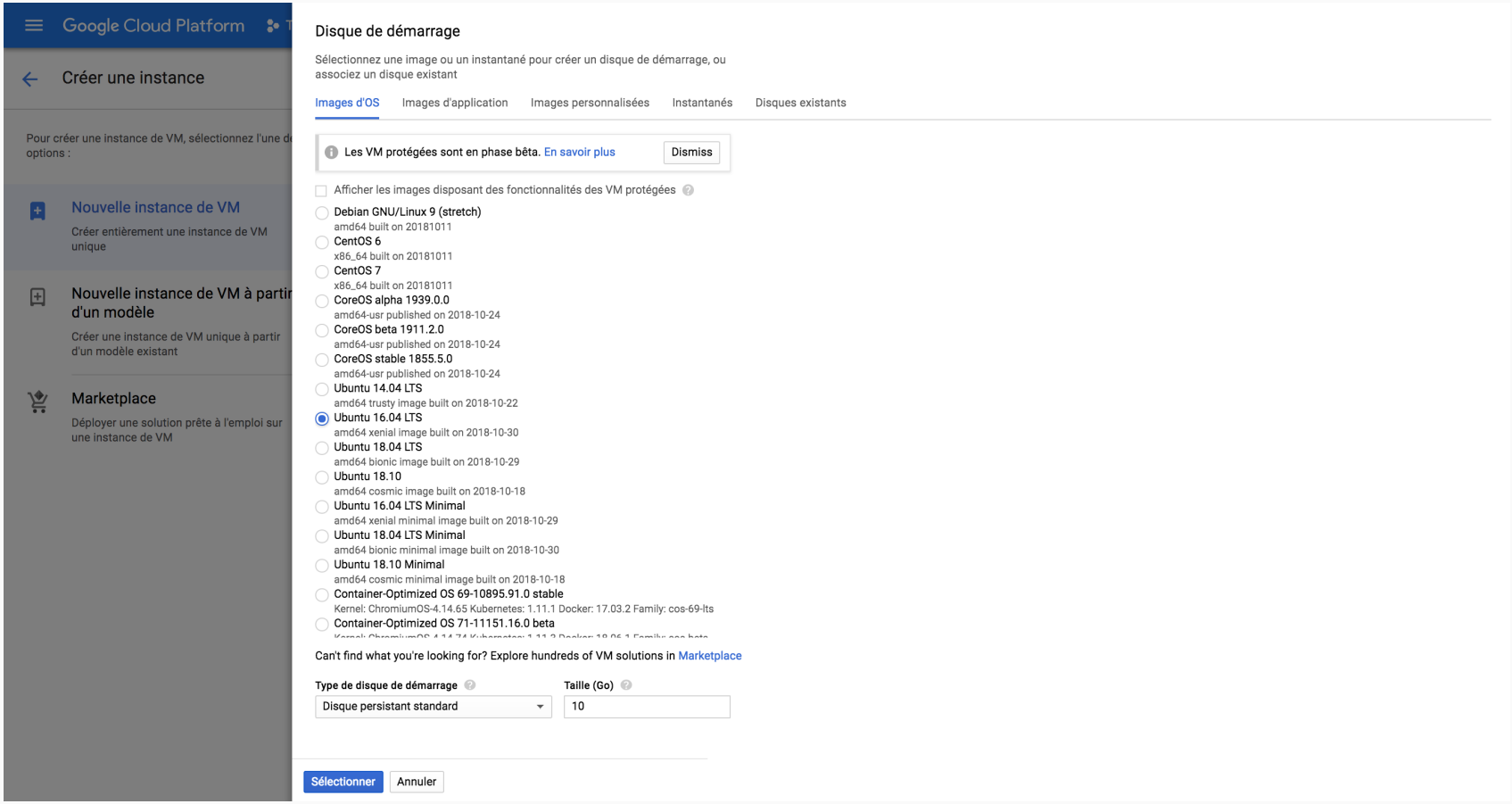
GCE : Créer une Instance VM



GCE : Type de machine



GCE : Disque démarrage



Install framework

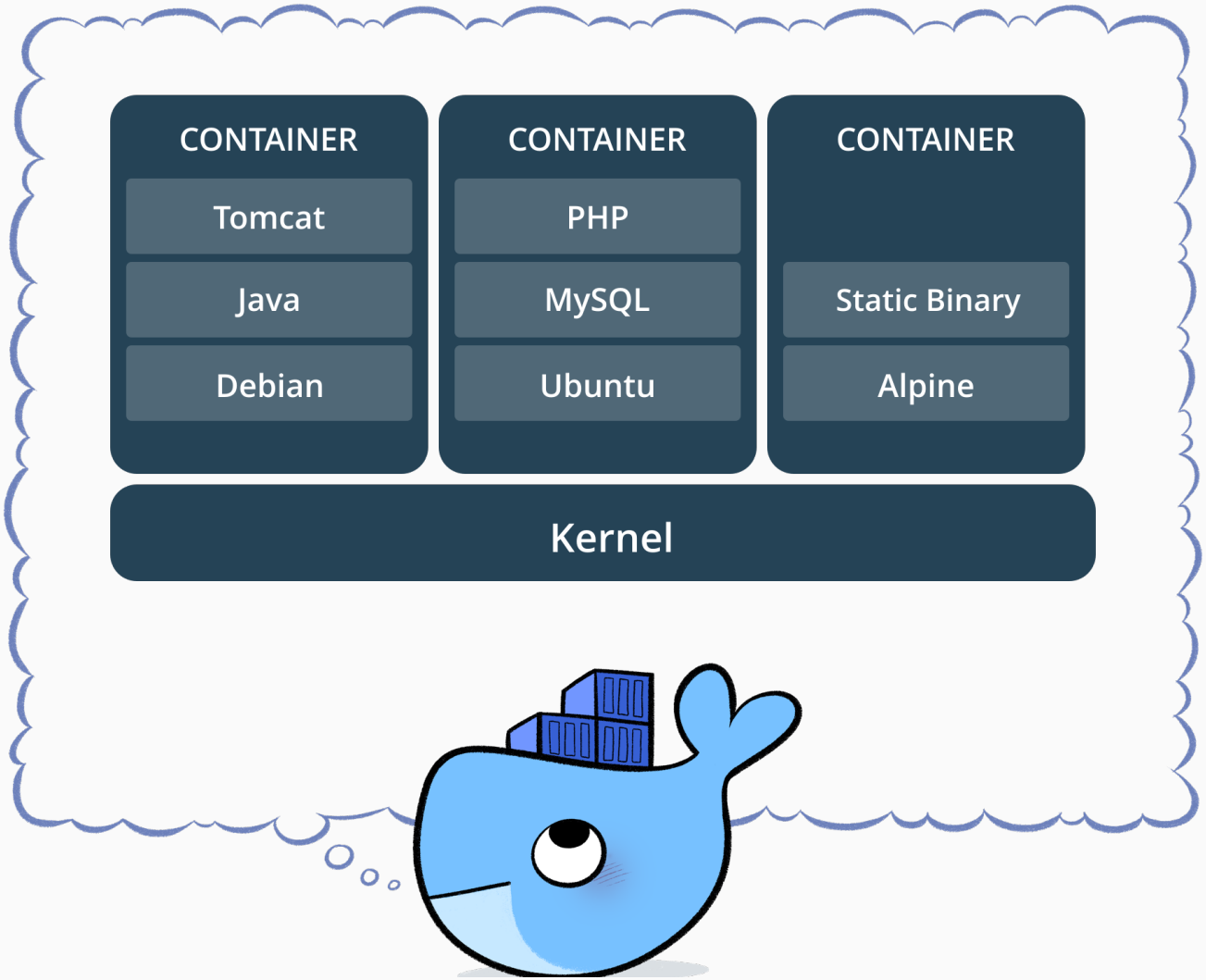
- Python
- Cuda
- Docker
- Nvidia-docker

bash_script for installation in *utils/bash_utils_on_gpu*.

Docker

What is Docker?

Docker enable to build Virtual machines which are easy to re-create on different compute environment.



Why should I use docker AS A DATA SCIENTIST ?

- **Reproducibility** : wrapping all you environment in a Docker container ensure the possibility to recreate your environment and makes your work more accessible.
- **Portability of your compute environment** To move your code and your model easily on machine with more computational power.
- **Enlarge your possibility** : being comfortable with Docker can allow you to use various solution available with docker.

Docker terminology

- **Image** : Its like a turned-off VM which contains the tool you want. Ex : Ubuntu + TensorFlow with Nvidia Drivers and a running Jupyter Server.
- **Container** : Is an instantiation of an image. You can have multiple copies of the same image running.
- **Dockerfile** : Recipe for creating an Image.
- **DockerHub / Image Registry** : Place where people/organization can post public (or private) docker images to facilitate collaboration and sharing.

What we'll do in this TP

- Write a *Dockerfile* which is based on the official *Tensorflow Dockerfile* available on *DockerHub*.
- Use the *Dockerfile* to build a *image*.
- Launch *container* with different option from the build *image*

Dockerfile

Dockerfile of the image we'll build :

```
FROM tensorflow/tensorflow:latest-devel-gpu-py3
RUN apt-get update && apt-get install -y
python-opencv python-tk vim
RUN pip install h5py keras pytest scikit-image
seaborn tqdm  gensim
```

- **FROM** : Specifies the base image you want to build on top of. Docker will look in your local environment for the image you called and if it cannot find it locally it will search it in *DockerHub*.
- **RUN** : Is followed by normal commands that would be directly run on terminal to install librairies or framework.

Build Image

Run the BUILD command in order to build your **IMAGE**.

```
nvidia-docker build -t ImageName -f /Docker/Dockerfile /Docker/
```

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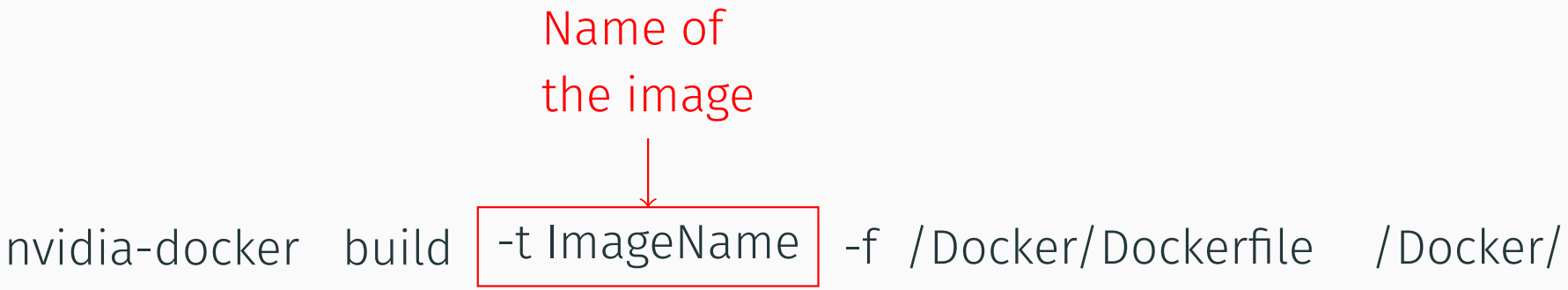

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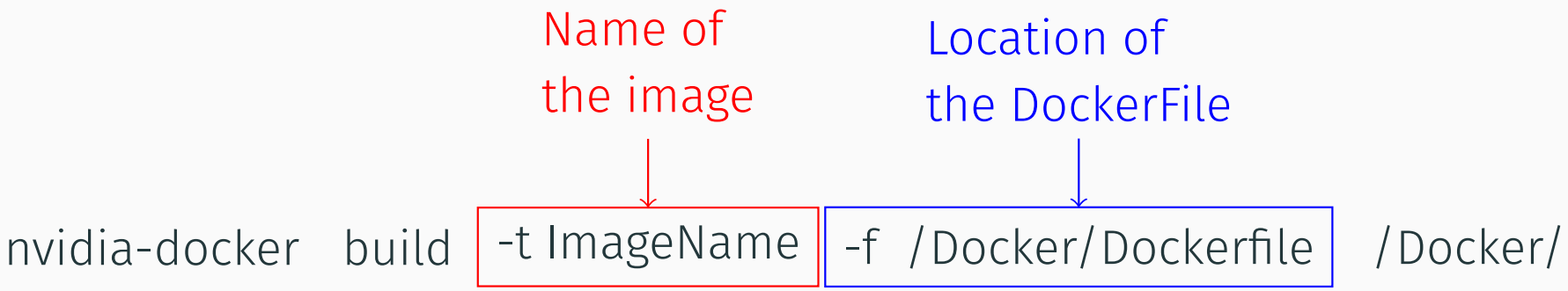

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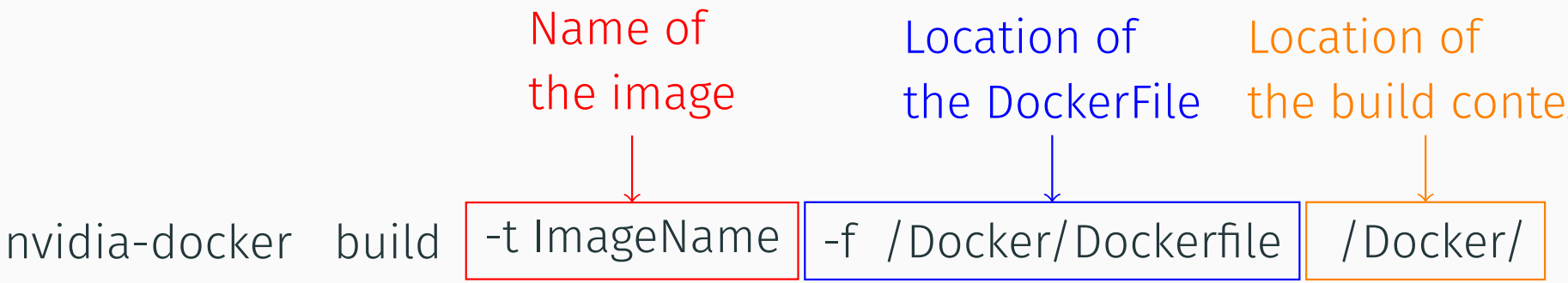

The buid context is the location of the folder to which the **ADD** statement will reference. This means that all external files require by the *Dockerfile* will be located here.

Run Container

Run the RUN command in order to run your **CONTAINER**.

```
nvidia-docker run -it -name ContainerName
    -v ~/CatsVsDogs/ :/root/CatsVsDogs ImageName
```

Run Container

Run the RUN command in order to run your **CONTAINER**.

Mode in which
the container
wil be launched

```
nvidia-docker run -it -name ContainerName
    -v ~/CatsVsDogs/ :/root/CatsVsDogs ImageName
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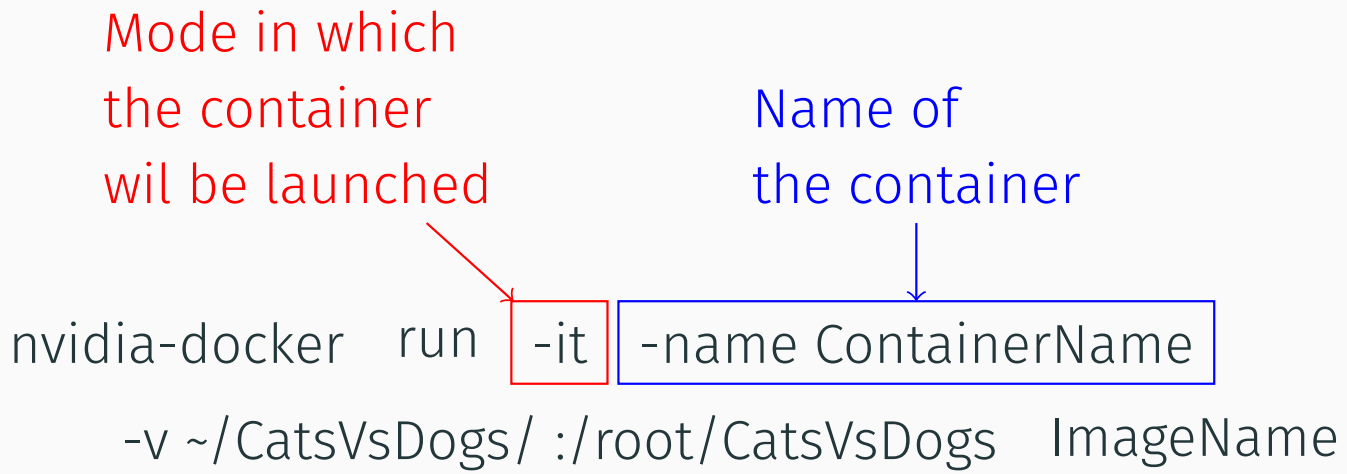
Mode of the container could be :

- -it : interactive mode,
- -dt : detached mode.

Run Container

Run the RUN command in order to run your **CONTAINER**.



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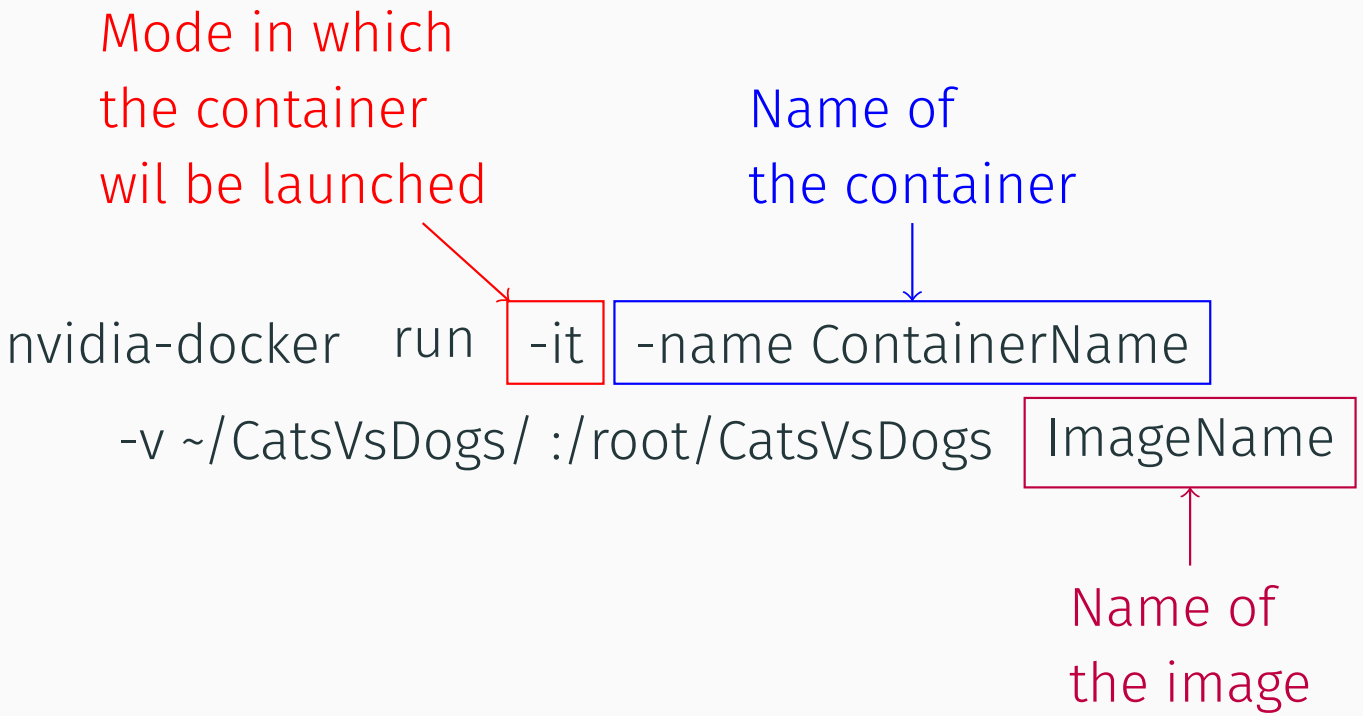

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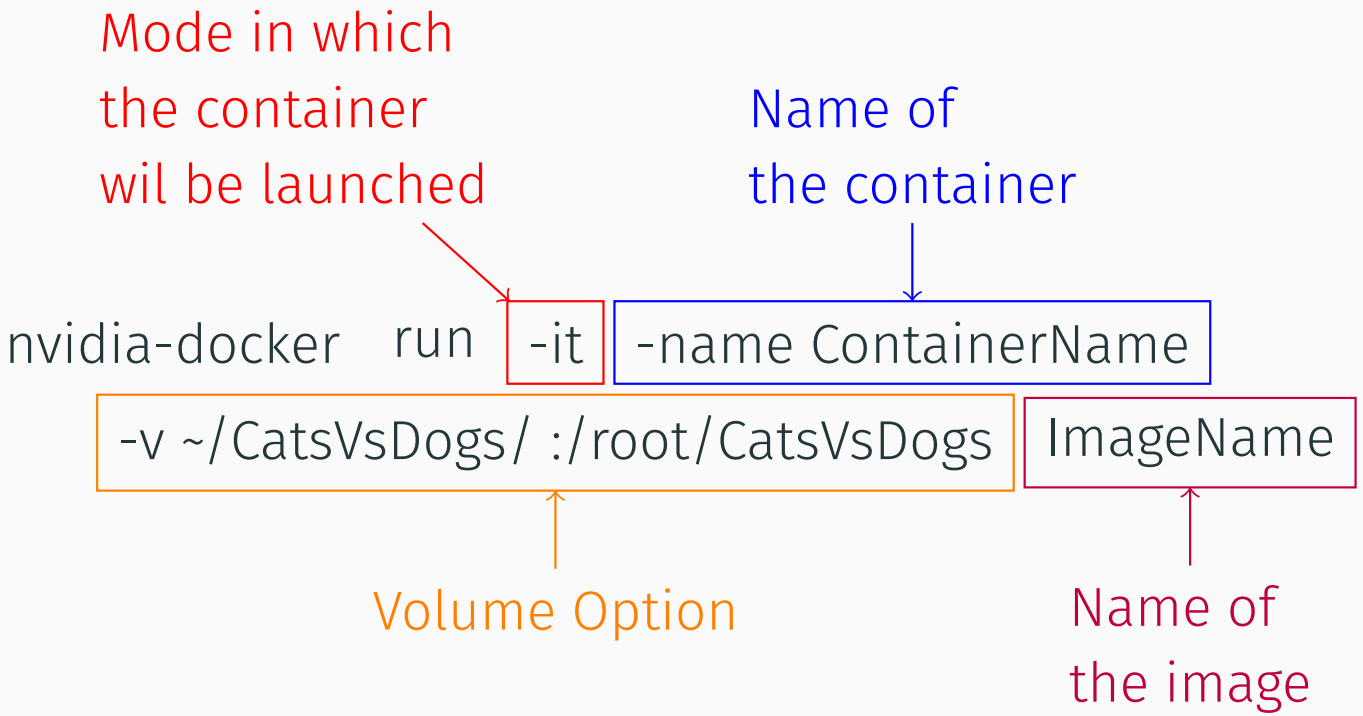

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Mounted Volume

The *-v* option allow you to use some date you have in yout machine within a container.

```
-v  ~/CatsVsDogs/ :/root/CatsVsDogs
```

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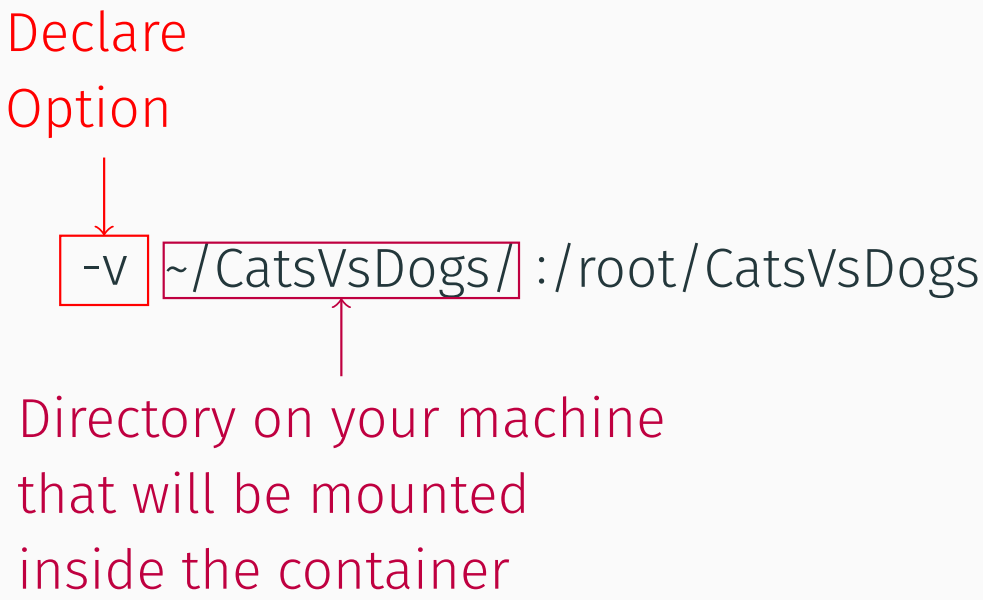

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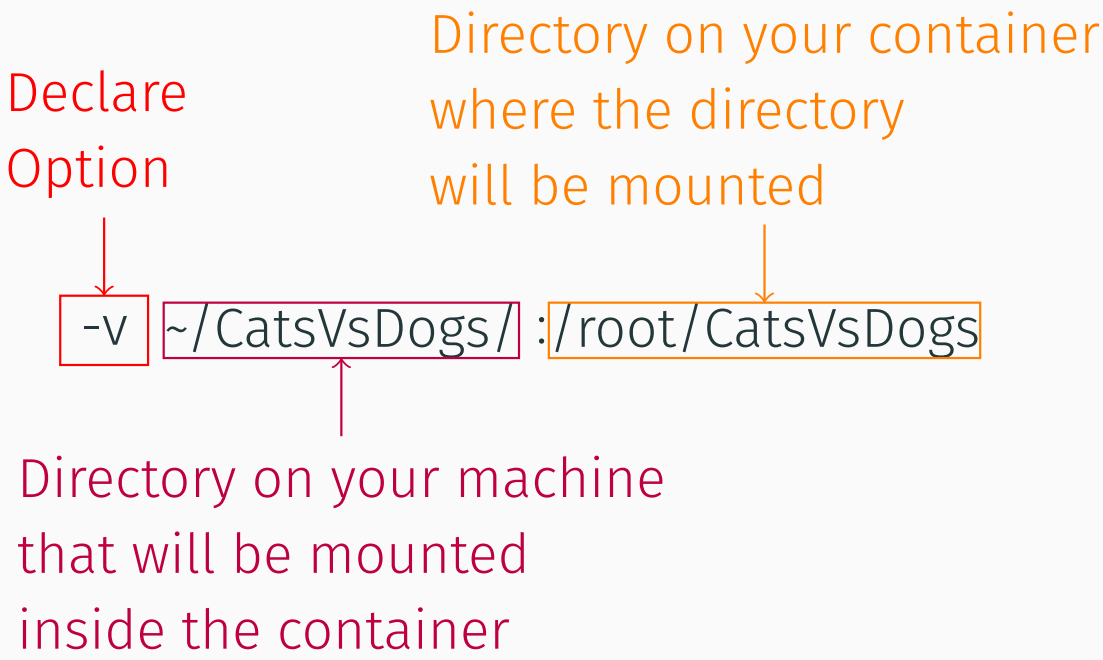

Util Command

- sudo nvidia-docker image ls -a
- sudo nvidia-docker container ls -a
- sudo nvidia-docker start/stop/rm container_name -a
- sudo nvidia-docker exec container_name 'Command to execute in container' -a

Nuage Magix

Pipeline in practice

1. Write script in your *local* machine.
2. Turn you *instance on*.
3. Build environment(if first used).
4. Send latest version of your code to the instance.
5. Send data to the instance.

7. Run the script on the instance.
8. Copy the results you want to analyze from the instance to your local machine.

10. Turn your instance off.

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1. Write script in your *local* machine.
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6. Run container.
7. Run the script on the instance.
8. Copy the results you want to analyze from the instance to your local machine.
9. Stop and remove container.
10. Turn your instance off.

Pipeline - Command

1. Write script in your *local* machine.
2. *gcloud compute instances start ..*
3. *gcloud compute ssh --command 'mkdir data'*
4. *gcloud compute scp script.py bguillou@instance-gpu :/home/*
5. *gcloud compute scp --recurse data bguillou@instance-gpu :/home/*

7. *gcloud compute ssh --command 'python script.py –a 3'*
8. *gcloud compute scp --recurse bguillou@instance-gpu :/home/results/ /home/*

10. *gcloud compute instances stop ..*

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Too many possibility to make a mistake.

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7. *gcloud compute ssh --command 'python script.py –a 3'*
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10. *gcloud compute instances stop ..*

Too many possibility to make a mistake.

$\Longrightarrow$ NuageMagix

NuageMagix

NuageMagix is a small tools compose of 3 *python script* and a *.yml* file :

- **conf.yml** : This file works like a dictionary which contains global variable such as location of directory.
- **instances.py** : This script define a Python class *InstanceManager* which encapsule calls to *gcloud*. For exemple *list()* function of this class call this command in terminal :

```
gcloud compute instances list
```

- **project.py** This script define a Python class *ProjectManager* which contains specific function to manage your project.
  For example, the *update_data(self, zip_file)* function allow to send a *zip_file* from your *data* directory from your local machine to the *data* directory on your instance.
- **main.py** This python script which contains all the command to execute your pipeline.

Other possibilities

- Use Jupyter on the instance (via ssh connection)
- Google Colab
- Image Gcloud

Reference

https ://towardsdatascience.com/how-docker-can-help-you-become-a-more-effective-data-scientist-7fc048ef91d5

Références