QARNOT

How to use the Qarnot's computing platform

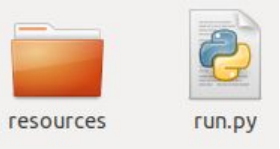
What is Qarnot?

Qarnot is a green cloud computing platform in which you can load your input files from your personal computer and get the output files once the calculation is done on the platform.

Run a computation on the platform

Here is a description of the procedure to run computations on the platform.

1. Log in to the Qarnot account created for the FreeFem Days.
2. Create on your personal computer a folder with your input files and the run.py file as depicted hereafter :



Inside the folder "resources" are your input files and the run.py file will be described in the "Examples" section

3. Download, install and launch your virtual environment in the same folder as your case study. Check the python version you are using by typing in the terminal : "python --version" and follow those instructions depending on the installed version :

Python 2	Python 3

$ apt-get install python-virtualenv
$ easy install virtualenv
$ pip install virtualenv
	$ apt-get install python3-venv
	$pip3 install virtualenv

Now virtual environment is installed	
$ virtualenv venv	$ python3 -m venv venv
Now virtual environment is created, the next steps are to activate it and install the qarnot library used in the run.py file	
$. venv/bin/activate $ pip install qarnot	$. venv/bin/activate $ pip install qarnot

Here "(venv)" should be written on the left of each line on your command prompt.

If you don't have python already installed on your computer you can proceed as follow for Windows or MACs :

- Windows : https://www.python.org/downloads/windows/
- macs : https://www.python.org/downloads/mac-osx/

Once installed, you can go back to the table and follow the instructions to run your virtual environment.

4. Execute the run.py by first making it executable with the command "chmod +x run.py" and the command "./run.py" that will launch the calculation.

If you don't want to run a run.py script but prefer to interactively launch a computation, you can do it with ipython or ipython3.

To install it you need to make sure that python is installed on your computer. Then, install pip if it is not already installed on your computer with the following command :

- sudo apt-get install python-pip -y

To finish, install ipython with this command :

- pip install ipython

Hereafter are some good practices to follow when running tasks, and examples of run.py files to run a calculation. Each line can also be typed in ipython.

Good practices

To avoid confusions between all the cases that will be launched and to clearly identify your task, we recommend the following points :

- Give to your task a name to clearly identify it (e.g. “Name+small description”)

```
task = conn.create_task('Name + small description', 'docker-batch', 1)
```

- Same for your output bucket :

```
task = conn.create_task('Name + small description', 'docker-batch', 3)
```

Examples

1. Hello World - 1

This first example will display ‘hello world’ on your command line and on the STDOUT (STDard OUTput).

```
import qarnot
```

Here you import the Qarnot Python SDK

```
conn = qarnot.connection.Connection(client_token="xx_mytoken_xx")
```

This line creates a connexion to Qarnot computing, don’t forget to replace xx_mytoken_xx by your own API token available on your account.

```
task = conn.create_task('helloworld', 'docker-batch', 1)
```

Here the **task** is created, it is named “helloworld”, uses the “docker-batch” **profile** and is running on 1 **instance**.

```
task.constants['DOCKER_CMD'] = 'echo hello world!'
```

Assign the docker application constant DOCKER_CMD

```
task.run()
```

Submit the task

```
print(task.stdout())
```

Print the STDOUT on your terminal

Result : 0> hello world!

2. Hello World -2

This detailed run.py file is quite similar as the one above but this time several **instances** will be used, 4 in this case. It means that 4 **chunks** will be running on 4 **nodes**. The result is 'hello world from node ...' with '...' the number of the node that ran the code. It will be displayed in the command prompt and the platform STDOUT.

```
import qarnot
```

Here you import the Qarnot Python SDK

```
conn = qarnot.connection.Connection(client_token="xx_mytoken_xx")
```

This line creates a connexion to Qarnot computing, don't forget to replace xx_mytoken_xx by your own API token available on your account.

```
task = conn.create_task('helloworld', 'docker-batch', 4)
```

Here the **task** is created, it is named "helloworld", uses the "docker-batch" **profile** and is running on 4 **instances**.

```
task.constants['DOCKER_CMD'] = 'echo hello world from node ${INSTANCE_ID}!'
```

Assign the docker application constant DOCKER_CMD

```
task.run()
```

Submit the task

```
print(task.stdout())
```

Print the STDOUT on your terminal

Result :

1> hello world from node 1!
3> hello world from node 3!
0> hello world from node 0!
2> hello world from node 2!

3. Fibonacci numbers

In this example we will run the Fibonacci numbers on several instances as we did in the previous example. Here, the difference is that the Fibonacci code will be separated from the run.py file and placed in an **input bucket**. The idea is that the run.py file calls the Fibonacci code placed in this input bucket.

```
import qarnot
```

Here you import the Qarnot Python SDK

```
conn = qarnot.connection.Connection(client_token="xx_mytoken_xx")
```

This line creates a connexion to Qarnot computing, don't forget to replace xx_mytoken_xx by your own API token available on your account.

```
bucket = conn.create_bucket("Fibonacci_code")
```

This line will create a bucket and call it "Fibonacci_code"

```
bucket.sync_directory("resources")
```

This line will synchronize the input bucket to the local directory called "resources"

```
task = conn.create_task('run_Fibo', 'python', 3)
```

Here the task is created, it is called 'run_Fibo' uses the profile 'python' in which the python program is already installed and will be running on 3 instances.

```
task.resources = [ bucket ]
```

This line makes the link between the resources used by the task and the bucket defined previously.

```
task.constants['PYTHON_SCRIPT'] = 'Fibonacci.py 1,21,32 ${INSTANCE_ID}'
```

Here the 'Fibonacci.py' code loaded in the input bucket called 'Fibonacci_code' will be run. '1,21,32' are the first numbers of the Fibonacci numbers. On node with INSTANCE_ID=0 will be calculated the Fibonacci numbers beginning with 1, on node INSTANCE_ID=1 will be calculated the Fibonacci numbers beginning with 21 and on node INSTANCE_ID=2 will be calculated the Fibonacci numbers beginning with 32. Make sure to get the same number of instances as the numbers to begin Fibonacci (for example, 3 instances are set and 3 numbers to start Fibonacci numbers (1, 21 and 32))

```
task.run()
```

Submit the task

```
print(task.stdout())
```

Print the STDOUT on your terminal

Results :

2> On node 2 the 10 firsts Fibonacci numbers beginning with 32 are : [32, 63, 95, 158, 253, 411, 664, 1075, 1739, 2814]

1> On node 1 the 10 firsts Fibonacci numbers beginning with 21 are : [21, 41, 62, 103, 165, 268, 433, 701, 1134, 1835]

0> On node 0 the 10 firsts Fibonacci numbers beginning with 1 are : [1, 1, 2, 3, 5, 8, 13, 21, 34, 55]

4. Text analysis

The aim of the example is to count the number of lines, words and characters in a text file. 3 instances will be running, the first numbered “0” will count the number of lines, the second numbered “1” will count the number of words and the third one numbered “2” will count the number of characters.

```
import qarnot
```

Here you import the Qarnot Python SDK

```
conn = qarnot.connection.Connection(client_token="xx_mytoken_xx")
```

This line creates a connexion to Qarnot computing, don’t forget to replace xx_mytoken_xx by your own API token available on your account.

```
input_bucket = conn.create_bucket('demo_text_input_bucket')
```

This line will create a bucket and call it “demo_text_input_bucket”

```
input_bucket.add_file('script')
```

This line will add the file ‘script’ to the bucket called ‘input_bucket’, this script is in the same folder as the run.py, in opposition to the 3rd example where the script “Fibonacci.py” is in another folder.

```
input_bucket.add_file('text.txt')
```

Same as above for the ‘text.txt’ file

```
output_bucket = conn.create_bucket('demo_text_output_bucket')
```

This line create the output bucket and call it 'demo_text_output_bucket'

```
task = conn.create_task('text_analysis', 'docker-batch', 3)
```

Here the task is created, named ‘text_analysis’, running on the profile ‘docker-batch’ with 3 instances.

```
task.resources.append(input_bucket)
```

This line add the input bucket to the resources used in the task.

```
task.results = output_bucket
```

This line add the results in the output bucket defined earlier

```
task.constants['DOCKER_CMD'] = './script'
```

This command run the script called “script”

```
task.run()
```

Submit the task

```
print(task.stdout())
```

Print the STDOUT on your terminal

Results :
1> Node 1: nb words = 110
0> Node 0: nb lines = 5
2> Node 2: nb characters = 752

5. FreeFem++

```
#!/usr/bin/env python3
```

This line set the language that will read the run.py file

```
import qarnot
```

Here you import the Qarnot Python SDK

```
conn = qarnot.connection.Connection(client_token="xx_mytoken_xx")
```

This line creates a connexion to Qarnot computing, don't forget to replace xx_mytoken_xx by your own API token available on your account.

```
input_bucket = conn.create_bucket('freefem_input')
```

This line will create a bucket and call it "freefem_input"

```
input_bucket.sync_directory("freefem_resources")
```

This line adds the contents of your local directory "freefem_resources" to the bucket you've created on the previous line.

```
output_bucket = conn.create_bucket("freefem-output")
```

Here you've created the **output bucket**. This storage unit will be filled with the **outputs** of your calculation once the calculation is done

```
task = conn.create_task("freefem", "docker-batch", 1)
```

The task is created.

```
task.resources.append(input_bucket)
```

This line adds the input bucket to the resources used by the task.

```
task.results = output_bucket
```

The results of the computation will be stored in the output bucket

```
task.constants["DOCKER_HOST"] = "localhost"
task.constants["DOCKER_REPO"] = "qarnotlab/freefem"
task.constants["DOCKER_TAG"] = "latest"
```

Those three lines define constants that will be used for the calculation. Here DOCKER_HOST is for the host name inside the container, DOCKER_REPO for the

repository where will be downloaded the docker images, and DOCKER_TAG for the version of the image to be downloaded.

```
task.constants["DOCKER_CMD"] = "/usr/freefem/bin/ff-mpirun -n 4 ./navierstokes.edp"
```

This line is the command you ask the image to run. In this case, you call the function “ff-mpirun” to run FreeFem++ on 4 cores defined by “-n 4” and the input file is called “navierstokes.edp”.

```
task.run()
```

Submit the task.

NB. If you want to produce a *.ffglut file to improve the visualization, just make the following change :

```
task.constants["DOCKER_CMD"] = "/usr/freefem/bin/ff-mpirun -n 4 ./navierstokes.edp"
```

to :

```
task.constants["DOCKER_CMD"] = "/usr/freefem/bin/ff-mpirun -n 4 ./navierstokes.edp -fglut output.ffglut"
```

Then, to visualize it:

- if you have freefem on your laptop, type :

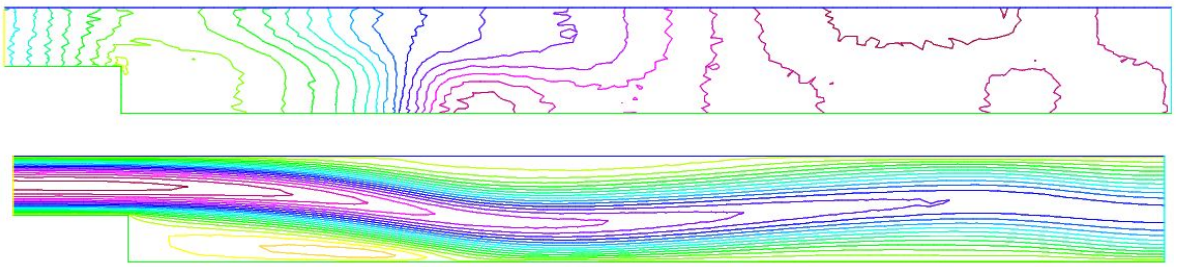
```
ffglut output.ffglut
```

- if you don’t have freefem installed:

```
docker pull pierrestraebler/freefem
```

```
docker run -e DISPLAY -v $HOME/.Xauthority:/root/.Xauthority -v "$PWD":/data pierrestraebler/freefem ffglut /data/output.ffglut
```

Results :



Glossary

- Task : A fragmentable batch computation that contains all the necessary informations to run a simulation on Qarnot's computing platform. It is mounted as follow :
    - task = conn.create_task('**Task_name**', '**profile**', **nb_Instances**)
    - With '**Task_name**' the name you give to your task to quickly identify it on the platform, '**profile**' the profile you want to use to run your simulation and **nb_Instances** the number of nodes that will run your simulation.

- Instance : Number of nodes running in the meantime for one task

- Node : A computer that contains several physical cores (4, 8, 16 or 32)

- Chunk : A portion of a task that will run on a single node. If you chose nb_Instance to 3, 3 chunks will be running independently, each one on one node.

- Profile : It describes the execution environment that will be loaded on every node involved in the task.
    - The two main profiles are *docker-batch* and *docker-network*. On *docker-batch* an insulated docker image is running and on *docker-network* a docker image is running with access to the internet.
    - Some profiles already contains applications like *python* or *blender* where each node run an optimized python or blender container.

- Bucket : A storage unit for input or output data. It is created as follow :
    - Creation of the input bucket :
      bucket = conn.create_bucket("**Input_bucket_name**")
      Which is linked to you local directory called "benchmark :
      bucket.sync_directory("**benchmark**")
      And loaded as the resources needed to run your case :
      task.resources = [**bucket**]
    - Creation of the output bucket :
      task.results = conn.create_bucket("**Output_bucket_name**")