Qiskit Demo Day: Qat Computer

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Voice : Neural network cloned voice of Michaël Rollin

Problem ?

- Local Qiskit env and its dependencies complicate to maintained
- Python virtualenv & Conda env, useful but not ideal in the long run
- Making a paper or demo project work for long time is complicated

Solution → Qat Computer !

The Qat Computer is first of all a Qiskit base docker image designed for any of my quantum platform. Like my Jupyter Lab, or my quantum games.

Secondary it’s also a container service designed for batchs or services executions.

Last (but not least), it contained a Go binary designed to run python project and checking the status of the Qiskit env inside.

Container base

- Allow build and run faster
- Same base for any project
- Automatic update
- Base on last Ubuntu LTS (22.04)

Examples :

- Base for Jupyter quantum lab
- Base for quantum game
- Base for apps/API

How to use it

- Just call the main image in your Dockerfile and add your project around

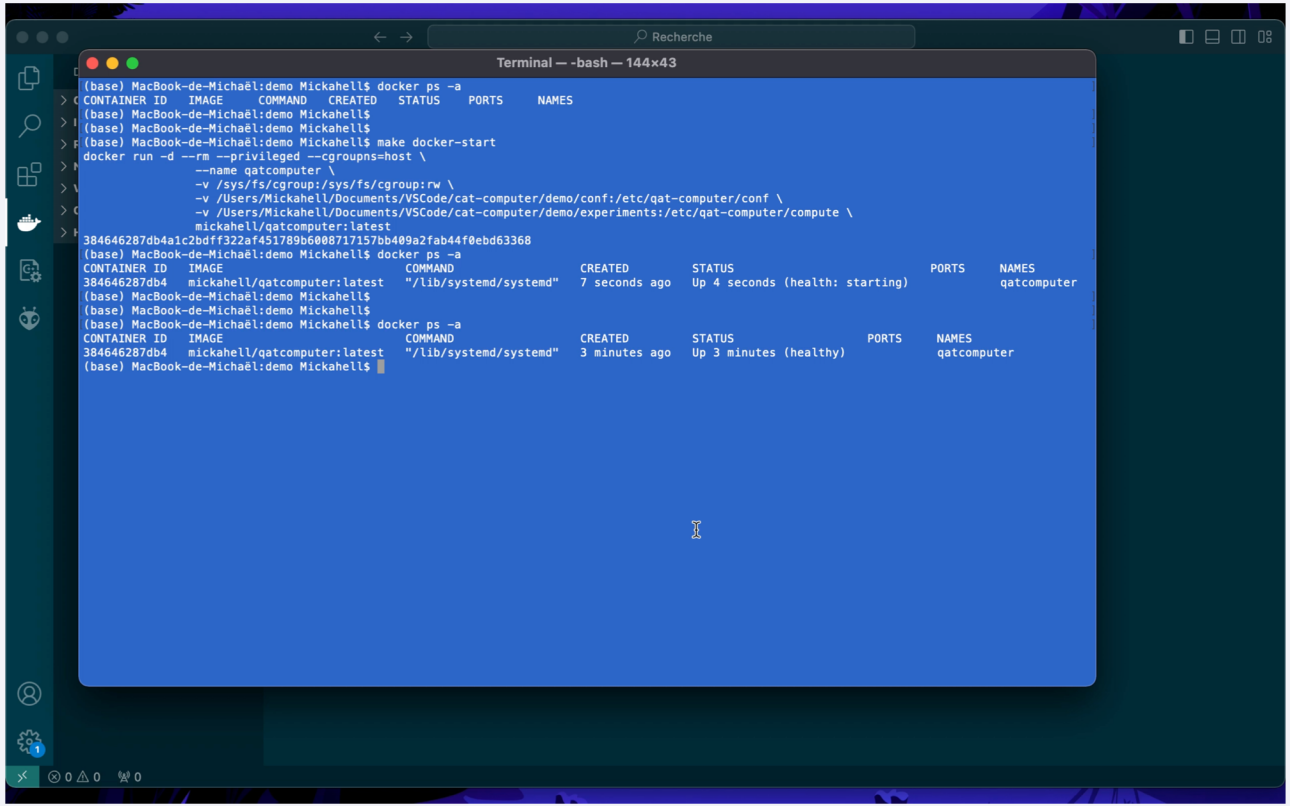
2 versions available :

- Classical version with Qiskit minimal setup
- Full version with every Qiskit sub-libraries

```
FROM mickahell/qatcomputer-full:latest

# Var for labels
ARG GITHUB_ACTOR
ARG GITHUB_REPOSITORY
ARG GITHUB_REF

ARG DEBIAN_FRONTEND=noninteractive
ENV TZ=Europe/Paris

LABEL org.opencontainers.image.title="Quantum Lab" \
      org.opencontainers.image.authors=${GITHUB_ACTOR} \
      org.opencontainers.image.vendor=${GITHUB_REPOSITORY} \
      org.opencontainers.image.source="https://github.com/mickahell/quantum_lab" \
      org.opencontainers.image.url="https://github.com/mickahell/quantum_lab/tags" \
      org.opencontainers.image.description="Docker image for quantum algorythm" \
      org.opencontainers.image.documentation="https://github.com/mickahell/quantum_lab/blob/main/README.md" \
      org.opencontainers.image.os="Ubuntu Focal" \
      org.opencontainers.image.version=${GITHUB_REF}

# OS requirements
RUN apt-get update -yq \
&& apt-get install -yq \
      python3-tk \
      graphviz \
      git \
&& apt-get dist-upgrade -yq \
&& apt-get clean -yq

# Add script & data
ADD build/* /opt/quantum_lab/build/
ADD data/ /opt/quantum_lab/data/
ADD start_jupyter.sh /opt/quantum_lab/

# General & env requirements
RUN pip install --upgrade pip setuptools
RUN pip install -r /opt/quantum_lab/build/requirements.txt

WORKDIR /opt/quantum_lab/data
VOLUME /opt/quantum_lab/data/share

EXPOSE 8888

CMD /bin/bash
```

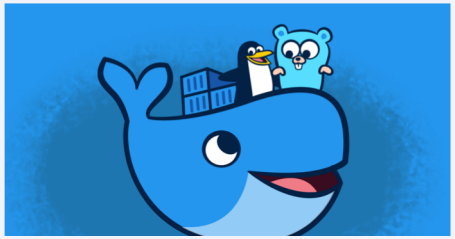
Initctl emulation

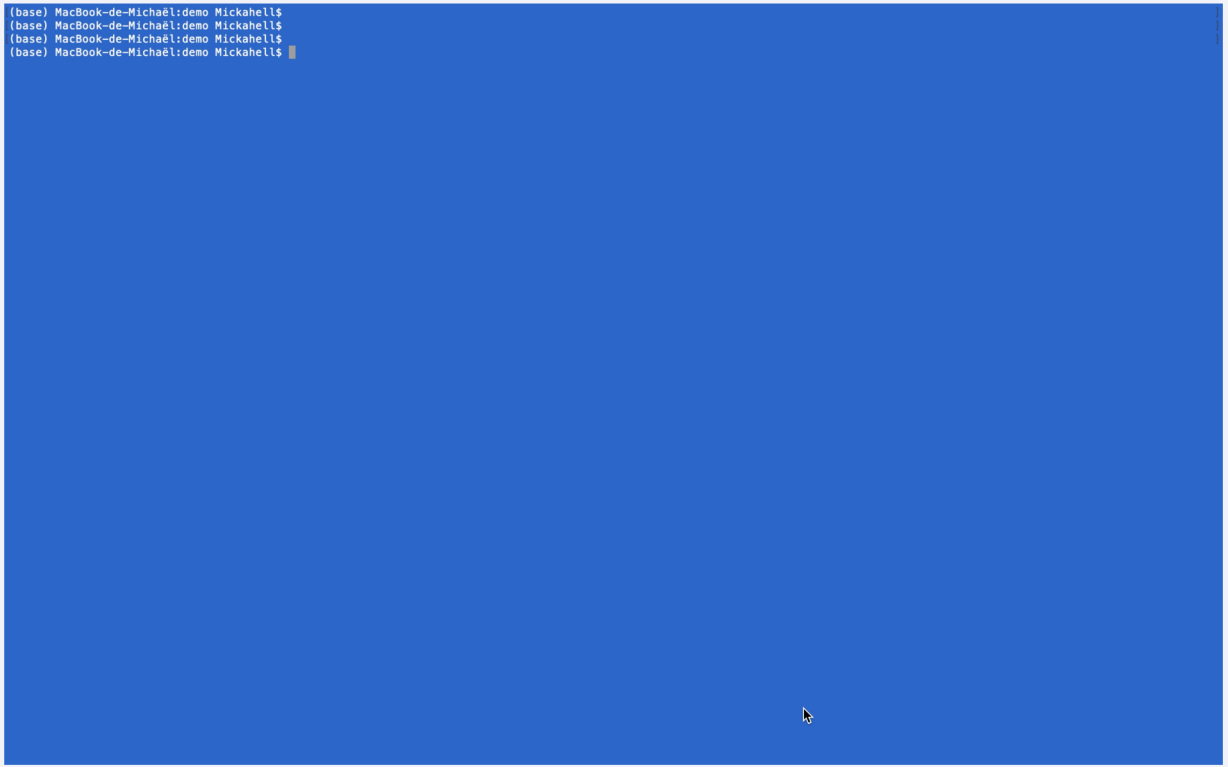
- Container as a service
- Allows usage in GitHub Action
- Allows usage in testing mode with VSCode (or any ide compatible with container)
- Qiskit cluster service (Quantumbernetes from K8S → Q13S ?)



Go API

- Allow to run your quantum app as a batch/web/service/... container
- Allows usage in GitHub Action
- Give the status of the Qiskit env inside



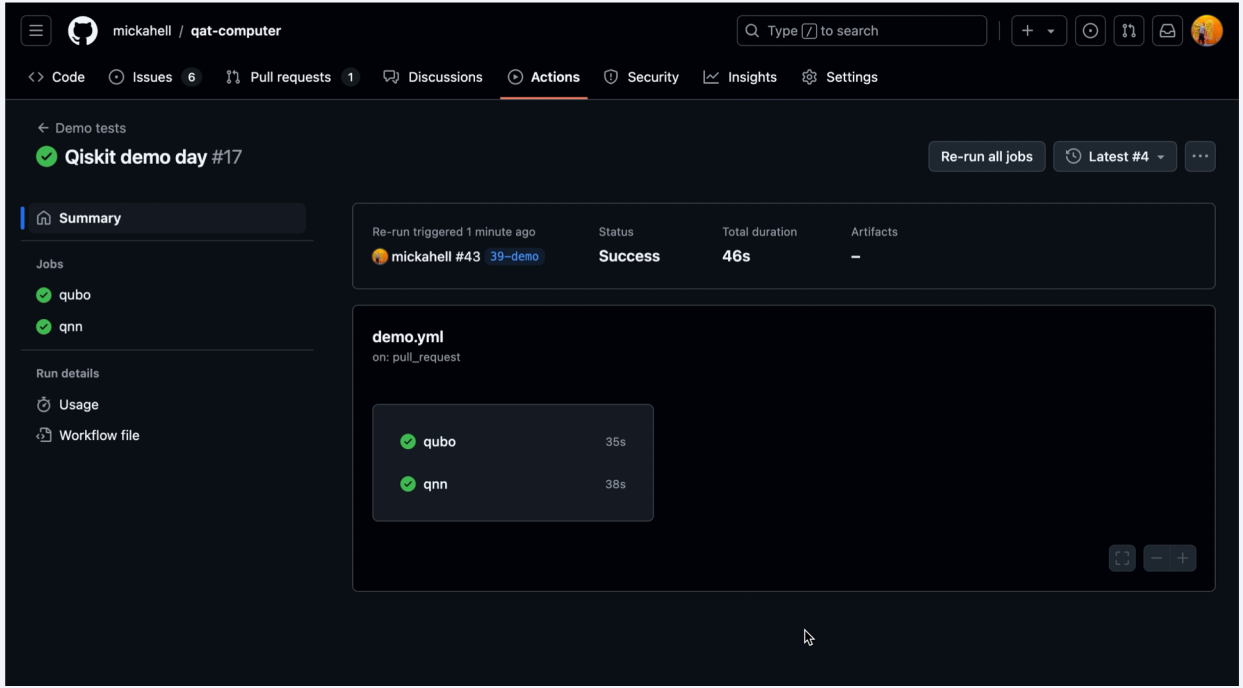


Example : Quadratic Program

Qiskit

Demo with QUBO project :

- Run QAOA
- Run Grover

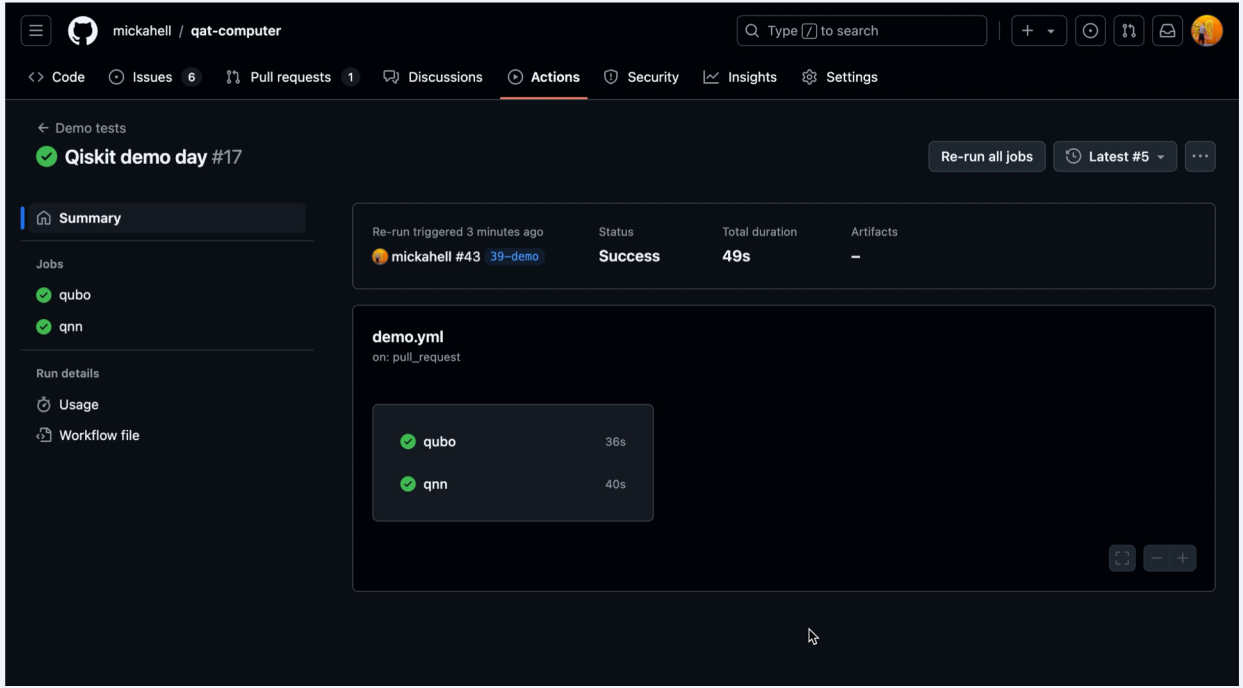


Example : Quantum Neural Network

Qiskit

Demo with QNN project :

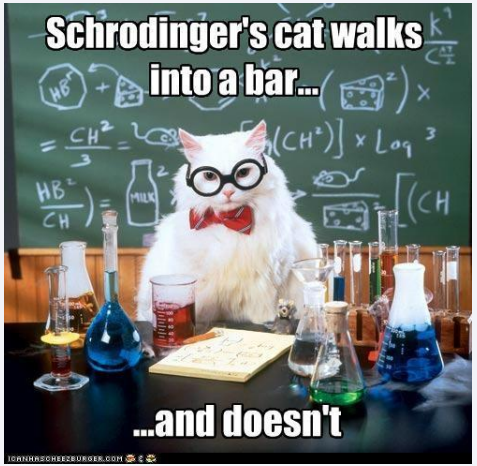
- Trained your model
- Generated your data



Notable info

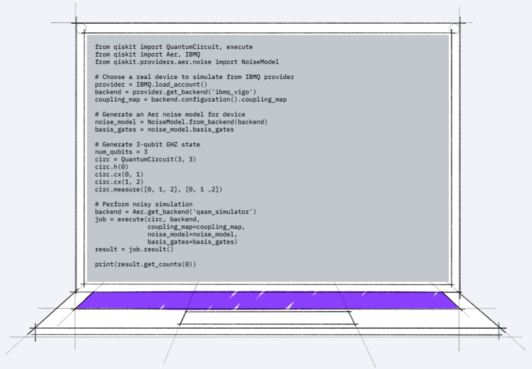
- The Quantum Lab base on this image was use during :
  - Last Qiskit challenge by ~ 150 participants (a specialized version was builded for)
  - Last Qiskit Global Summer School ~ 100 participants

No Qat was dead/alive during the testing of this project.



Next step

- Schedule build synchronized with Qiskit releases
- Unit tests endpoint for the Go API
- Be use as full Qiskit serverless infrastructure in DinD (link with the official Qiskit Serverless project)
- Cool logo
- Some easter eggs



Thanks for your attention !

Michaël & his clone

All the code is available in the GitHub repository as well as the code of the demo.

https://github.com/mickahell/qat-computer